Aug. 8, 1961 A. A. H. SOUCHET 2,995,638

CUT-OFF SWITCH

Filed June 18, 1958

Fig: 1
PRIOR ART

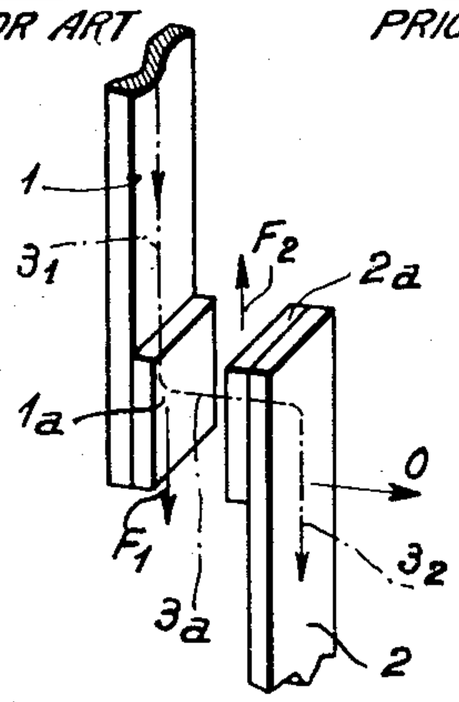


Fig: 2
PRIOR ART

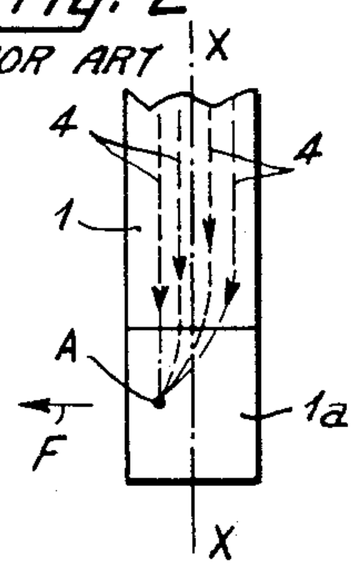


Fig: 3

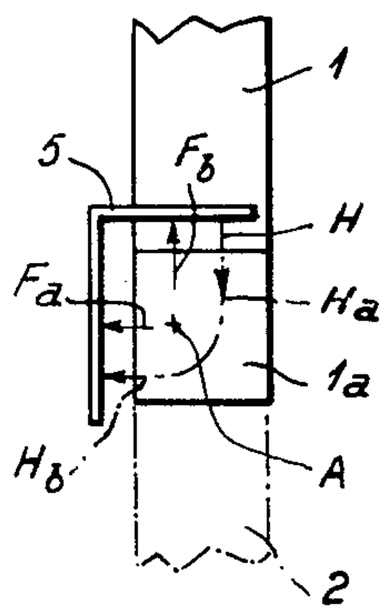


Fig: 5

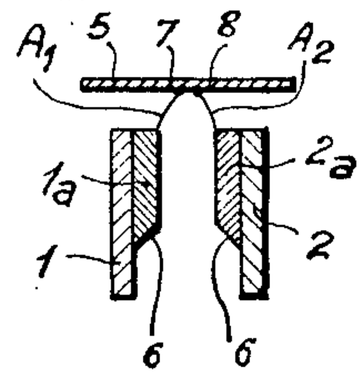


Fig: 5a

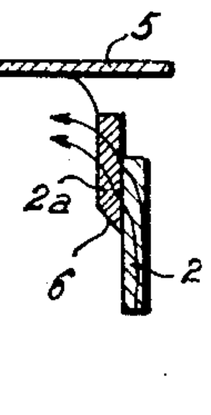


Fig: 4

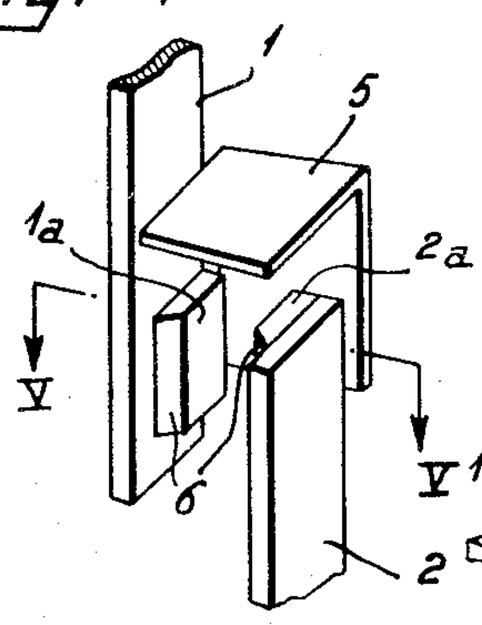


Fig: 6a

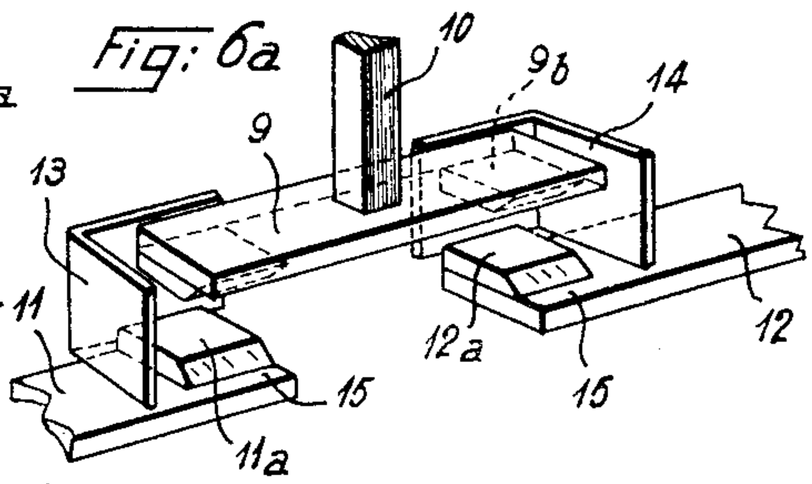
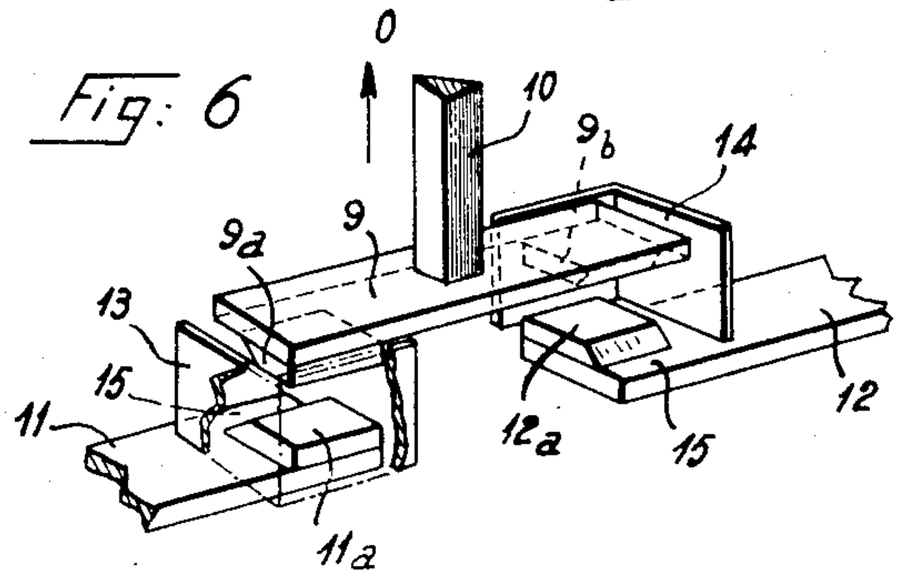


Fig: 6



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CUT-OFF SWITCH

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5 Claims. (Cl. 200—147)

This invention relates to cut-off switch arrangements and its general object is to provide a cut-off switch including improved means for quenching the arc occurring on separation of the switch contacts.

The invention is especially, though not exclusively, applicable to cut-off switch arrangements wherein flat switch contacts are carried in mutually opposed relationship at adjacent ends of two flat strip like conductors extending in generally reverse directions to each other away from said adjacent contact-bearing ends, and wherein the contact making and breaking displacements involve a displacement of one of said conductors towards and away from the other, normally to the plane of the contact elements.

A known arc quenching expedient sometimes used in connection with such cut-off switches involves the provision of metal plate elements disposed symmetrically on opposite sides of said contacts in spaced relation therewith and extending in planes generally normal to the planes of said contacts. The arc-quenching action of such a device relies on the fact that the magnetic field present around the arc cooperates with the magnetic characteristics of the plate to generate a magnetomotive force which tends to shift the arc towards one or the other plate, whereupon the arc is rapidly quenched, mainly due to the cooling effect of the plate.

In practice however such arc quenching devices have not been fully satisfactory since it is found that the arc frequently tends to dwell a relatively long period of time across the contacts of the switch before it finally shifts one way or the other towards one of the plates to be quenched thereby. It has now been found by applicant that this undesirable condition in which the quenching of the arc is delayed, occurs whenever the random points of the contact surfaces at which the arc first initiates, happen to be positioned substantially at equal distances from both side quenching plates, so that the arc is at such times subjected to substantially equal and opposite forces in both directions and as a consequence remains substantially stationary until one or the other force predominates.

The invention is based on the finding just stated and in accordance therewith achieves improved arc quenching action in a cut-off switch by providing a quenching member on only one side of the switch contacts. It will be understood that in such conditions no matter where the arc happens to originate over the entire surfaces of the contact elements, it will be urged by the electromagnetic forces only in the direction of said one side, and will under no circumstances tend to dwell in the central area of the contact surfaces. Greatly improved arc quenching action is thus obtained.

The invention therefore provides a cut-off switch arrangement having a pair of opposed generally flat contact elements movable into and out of engagement with each other in a direction generally normal to the plane of said elements, and a metallic member adjacent to only one side of said contact elements and spaced therefrom, whereby a cut-off arc occurring on disengagement of said elements will tend to shift laterally towards said member to be quenched thereby.

In a preferred construction the member is in the form

of an angularly bent plate having two portions at right angles to each other respectively extending alongside a longitudinal and transverse side edge of both contact elements. According to a further advantageous feature, the contact elements are supported on respective flat strip-like conductors at positions laterally displaced from the longitudinal midline of said conductors towards said metallic quenching member. It is found that the further dissymmetry thus introduced is accompanied by a correspondingly increased dissymmetry in the magnetomotive forces acting on the arc and that the quenching action is thus further accelerated. Furthermore, the longitudinal side of each contact element remote from the metallic quenching member is preferably provided beveled.

The invention further includes within its scope the application of the above specified cut-off switch arrangement to circuit breaker switch devices of the type including a movable bridging conductor member displaceable into and out of contacting cooperation with a pair of spaced contacts. Such devices are advantageous in that the cut-off arc is divided into two smaller arcs of weaker energy content.

Exemplary embodiments of the invention will now be described for purposes of illustration but not of limitation with reference to the accompanying drawings, wherein:

FIG. 1 is a perspective view of a conventional cut-off switch arrangement;

FIG. 2 is a plan view of one contact of the conventional arrangement shown in FIG. 1;

FIG. 3 is a plan view of an arrangement according to the invention in a simple construction form;

FIG. 4 is a perspective view of a cut-off switch arrangement according to the invention in a more elaborate form thereof;

FIG. 5 is a section on line V—V of FIG. 4.

FIG. 5*a* is a similar view relating to a modification;

FIG. 6 is a perspective view illustrating the application of the invention to a bridge type circuit breaker; and

FIG. 6*a* is a similar view of a modified construction.

As shown in FIG. 1, a conventional cut-off switch arrangement of the general type to which this invention relates comprises a pair of parallel flat conductor bars or strips **1** and **2** extending in generally opposite directions and having secured to the adjacent ends of them in facing relationship, the respective rectangular contact lugs **1***a* and **2***a*. The contact lugs are adapted to be pressed against each other for establishing the circuit and separated for breaking the circuit, by displacement of conductor **2** as indicated by the arrow O.

In such an arrangement the current, at an instant of time, can be represented by the chain-line arrows indicated as passing from conductor **1** to conductor **2**. This current path includes three sections: section 3_1 extending through conductor **1**, section **3***a* which is constituted by an arc discharging across the contacts, and a third section 3_2 along conductor **2**.

In this circuit path, the arc section **3***a* is freely movable under the influence of the fields generated by the sections 3_1 and 3_2. The field forces generated by these sections and acting on the arc **3***a* are respectively indicated as F_1 and F_2. The arc itself generates a symmetric field surrounding it, and because of this symmetry this field has no influence upon the path followed by the arc.

In the conventional construction shown in FIG. 1 therefore, there should apparently not be any tendency for the arc to be shifted transversely. However, as shown in FIG. 2, should the arc be struck at a position displaced from the plane X—X which is the plane of symmetry of the contacts, for instance at the position A, the linear current paths indicated as the broken lines **4** in each of the conductors **1** and **2**, are bent in dissymmetrical fashion in

both conductors and it will be seen that this will result in a transverse force F being generated tending to increase further the displacement of the arc away from the X—X plane. The same effect obviously is present to either side of the plane of symmetry.

The invention proposes, in effect, to increase and develop this dissymmetry effect in order to force the arc to reach surrounding metal surfaces of the assembly to be thereby cooled, damped and quenched.

For this purpose as shown in FIG. 3, there is arranged adjacent the contact lugs **1***a* and **2***a* an element of magnetic sheet material **5** bent at right angles so as to comprise two flanges both parallel to the direction of relative displacements of the contacts towards and away from each other, so as to enclose said contacts on two sides thereof, while the remaining two sides are free. With this arrangement, the magnetic field H which surrounds the arc present at the position A is rendered dissymmetrical due to the presence of the flanges of the magnetic element **5**, so that only the field components such as H_a and H_b are effective. The field components generate the magnetomotive forces F_a and F_b which act to displace the arc towards the element **5**. The arc then becomes caught on the surface of the element and is quenched due to strong cooling effect.

As previously indicated, such an action would be facilitated if the arc were to assume dissymmetrical initial position towards the magnetic element **5**. In order to increase this effect of dissymmetry, as shown in FIG. 4, the contacts **1***a* and **2***a* may be arranged dissymmetrically at the ends of the respective conductors **1** and **2**, i.e. displaced towards the element **5**. With this arrangement, the distribution of the lines of current flow across the contacts is such as to provide an initial dissymmetry in the forces at the instant the arc is generated, and thus accelerates the displacement of the arc ends towards the quenching element.

The dissymmetrical effect described can further be emphasized by forming both rectangular contact lugs with bevel side portions **6** over at least that side edge of each contact remote from the element **5**. In practice, it is sufficient if such a bevel is formed on the edge of the contact remote from element **5** and parallel to the direction of the conductors **1** and **2**.

In such conditions, as shown in FIG. 5, the arc originating across the contacts **1***a* and **2***a* as the contacts separate, rapidly progresses towards the edges of the contacts directed towards the element **5**, and breaks down into two smaller arcs A_1 and A_2 between the edge of each contact and the element.

The sharp drop in anode and cathode voltages at the points **7** and **8** at which the arc is engaging the sheet element causes a corresponding drop in the energy of the component arcs. This, together with the increase in length of the arc as it is displaced out of its normal path across the contact, and the cooling action of the element, rapidly damps out the arc and thus increases the cut-off capacity of the switch.

In case of a cut-off switch enclosed within a casing of e.g. plastic material, the angular metallic element will simultaneously serve to protect the wall of the casing and prevent damage of its by the arc.

FIG. 6 illustrates the application of the invention to a bridge contact arrangement in a circuit breaker or similar cut-off switch apparatus. As shown the bridging member **9** is operated through the insulated rod **10** so as to be displaced in the direction indicated by the arrow O to break the circuit, and displaced in the opposite direction to establish connection between the conductors **11** and **12**. The bridging member carries the contact lugs **9***a* and **9***b* at its respective ends, and the conductors **11** and **12** carry the cooperating contact lugs **11***a* and **12***a*. Each cooperating pair of contact lugs **9***a*–**11***a*, and **9***b*–**12***a*, is surrounded on two sides by a related angular metallic element **13** or **14**. Moreover each said cooperating

contact pair is displaced laterally to one side of the related conductors towards the related metal element. That edge of each contact lug directed away from the parallel flange of the related element and parallel to the direction of the conductors is bevelled. Adjacent each bevel edge of each contact lug a free area such as **15** is defined on the related conductor, while the opposite edge of the contact lug extends flush with the adjacent edge of the conductor, or may even project beyond the conductor edge as indicated in FIG. 5*a*.

In the arrangement of FIG. 6 just described, it will be noted that the angular metal elements **13** and **14** are arranged in mutually opposed relation, so that they may be rigidly secured to or form part of opposite casing walls of a common casing enclosing the switch device. Further, the opposed relationship between the elements **13** and **14** results in the bridging member **9** being symmetrical, so that it can be rotated 180° about its vertical axis without impairing the operation of the switch. While this may have its advantages in facilitating the assembly of the device, it will be evident that such construction is not essential and that instead the arrangement shown in FIG. 6*a* may be used, wherein both angular elements **13** and **14** are disposed on the same side of the bridge member, and where consequently the free areas **15** of the conductors would also lie on the same side.

Various other modifications will be apparent to those familiar with the art within the scope of the invention.

What I claim is:

1. A cut-off switch comprising a pair of conductor strips extending endwisely in opposite directions, a pair of generally flat contact lugs on adjacent ends of said strips, with flat contact faces of said lugs in face-to-face relationship, said strips being relatively movable in a direction normal to said contact faces to move said faces into and out of interengagement, and arc-quenching means of metallic magnetic material spaced from said strips and lugs and disposed at only one of opposite sides of said conductor strips; the spacing of said means from any arc formable between said lugs being such as to cause attraction of the arc to said means, free of counter-attraction from the other of the opposite sides of the conductor strips, said conductor strips being of flat material and disposed with adjacent ends thereof in overlapping relation, said arc-quenching means comprising a member of magnetic sheet metal of L-shape in section, the legs of the L extending in planes normal to the planes of said contact faces, one of said legs being at said only one of opposite sides of said conductor strips, and the other of the legs of the L extending transversely of said strips in opposed relation to the end of one of said strips and to said contact lugs.

2. A cut-off switch comprising a pair of conductor strips extending endwisely in opposite directions, a pair of generally flat contact lugs on adjacent ends of said strips, with flat contact faces of said lugs in face-to-face relationship, said strips being relatively movable in a direction normal to said contact faces to move said faces into and out of interengagement, and arc-quenching means of metallic magnetic material spaced from said strips and lugs and disposed at only one of opposite sides of said conductor strips; the spacing of said means from any arc formable between said lugs being such as to cause attraction of the arc to said means, free of counter-attraction from the other of the opposite sides of the conductor strips, said contact lugs being generally rectangular and said arc-quenching means having two flat surfaces in right-angular interrelation, one of said flat surfaces being at said only one of opposite sides of said conductor strips and the other of said flat surfaces extending transversely of said strips adjacent to said contact lugs and to the end of one of said strips.

3. A cut-off switch comprising a pair of coplanar conductor strips extending endwisely in opposite directions, flat, rectangular, first contact elements carried by the near-

est end portions of said strips, a conductive bridging member movable normally to the plane of said strips, second contact elements carried toward opposite ends of said bridging member and arranged to conductively engage said first contact elements upon such movement of the bridging member, and two separate L-shaped arc-quenching members of magnetic metal disposed separately in arc-attracting association with each pair of such conductively engageable contact elements, each of said arc-quenching members having flanges, normal to the plane of said strips and a first of said flanges being adjacent to corresponding sides of said strips and bridging member and a second of said flanges being adjacent to an opposed end of said bridging member.

4. A cut-off switch according to claim 3, said first flanges of the two arc-quenching members both being adjacent to corresponding sides of said strips.

5. A cut-off switch according to claim 3, said first

flanges of the two arc-quenching members being adjacent to the contact element toward opposite ends of the bridging member and to opposite longitudinal sides of said strips.

References Cited in the file of this patent

UNITED STATES PATENTS

2,343,323	Pierce	Mar. 7, 1944
2,356,039	Ellis et al.	Aug. 15, 1944
2,411,892	Peters	Dec. 3, 1946
2,524,287	Ellis	Oct. 3, 1950
2,618,716	Boller et al.	Nov. 18, 1952
2,704,315	Norden	Mar. 15, 1955
2,836,685	Pettit	May 27, 1958

FOREIGN PATENTS

68,768	Switzerland	Apr. 16, 1915