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[54] **LOCATOR SPRING STRUCTURE FOR CONTACT ASSEMBLY OF HIGH VOLTAGE ELECTRICAL CIRCUIT BREAKERS**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**.....**H01h 1/50,** H01h 9/30

[58] **Field of Search**.....200/8 A, 11 G, 11 H, 11 K, 200/11 J, 166 R, 166 E, 166 BE, 166 BF, 166 J, 144 R

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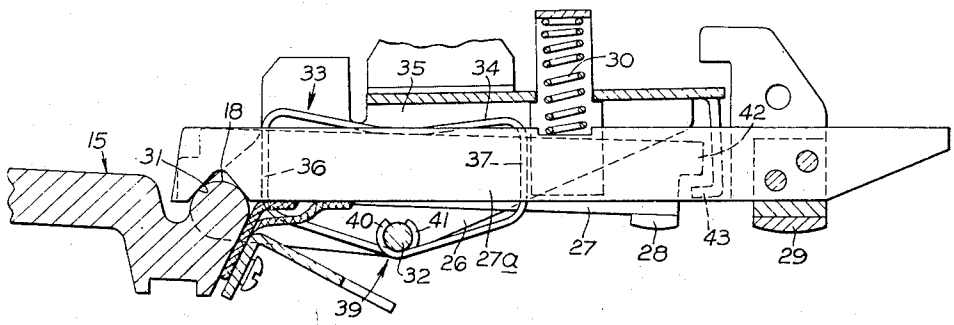
[57] **ABSTRACT**

An electrical circuit breaker or isolator, intended to carry high currents of the order of 100,000 amperes, has for each pole a respective moving contact assembly comprising a plurality of parallel-connected movable contact arms each carrying a respective movable contact, said arms being of strip metal, to reduce manufacturing costs, are disposed side-by-side and substantially parallel in a carrier, each said arm being mounted in the carrier by a respective locator spring shaped to provide a loading portion which engages one longitudinal edge of the arm and a pair of limbs extending across the arm one adjacent each side thereof and which locates on a cross-member, extending transversely of the arms, of the carrier adjacent the other longitudinal edge of the arm, the locator springs serving yieldingly and resiliently to mount the movable contact arms in the carrier and the limbs of the springs effectively locating the arms relative to one another.

6 Claims, 4 Drawing Figures



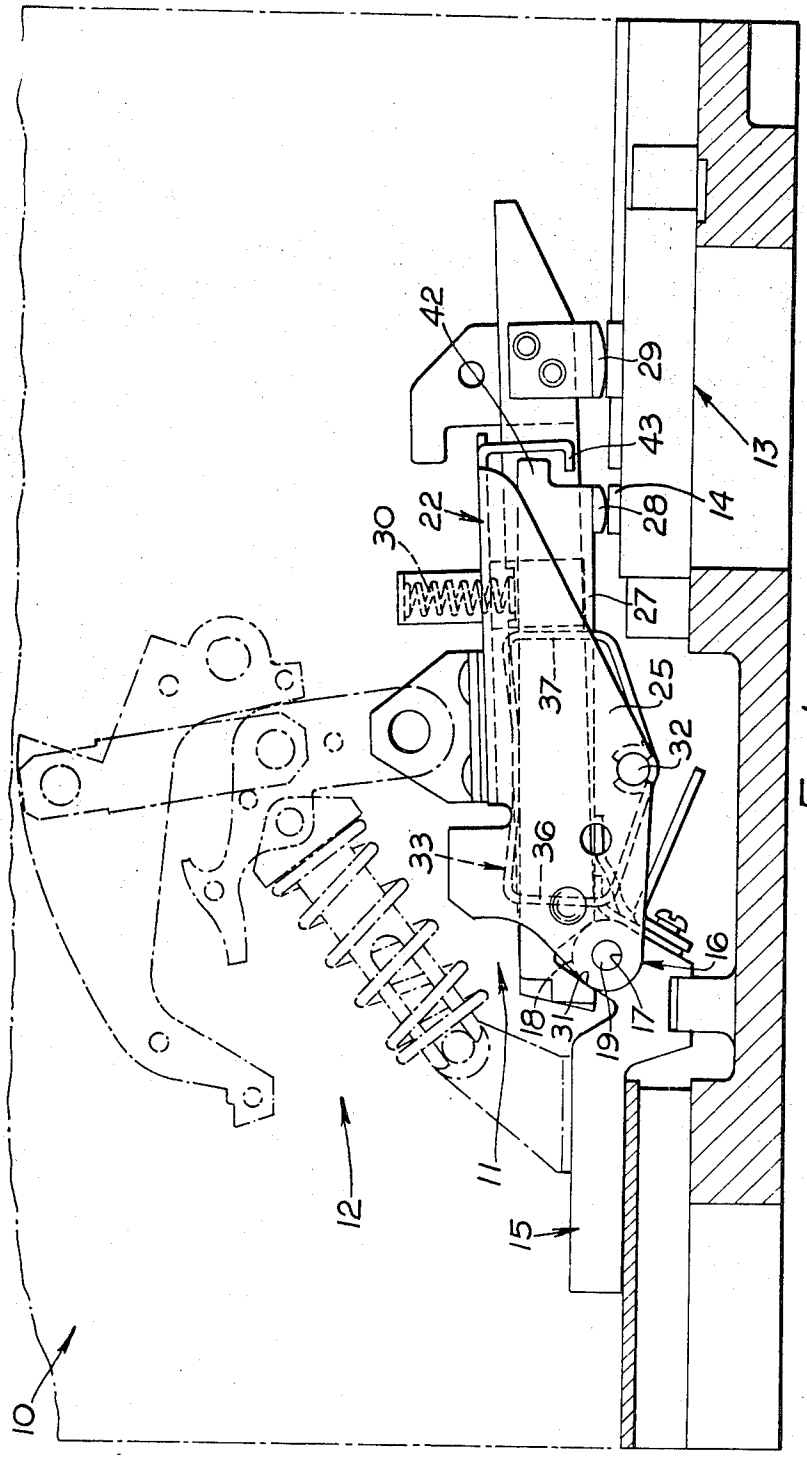


Fig. 1.

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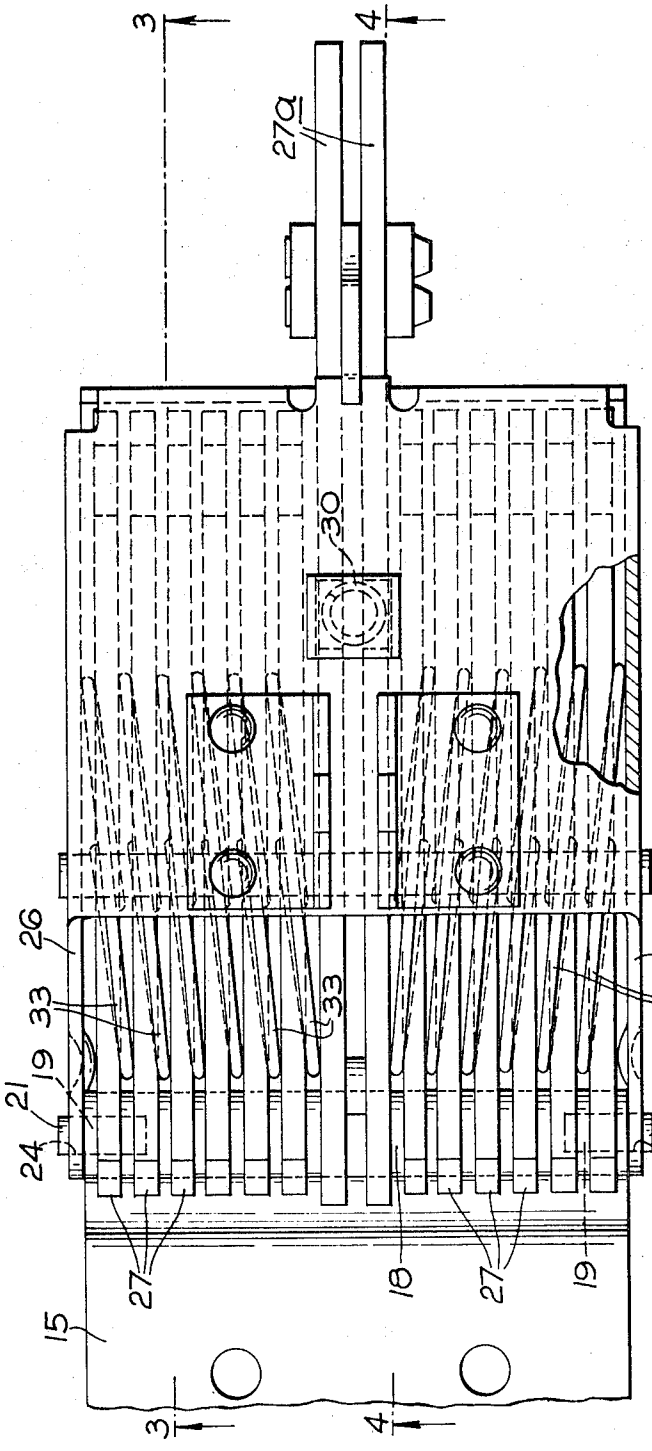

Fig. 2.

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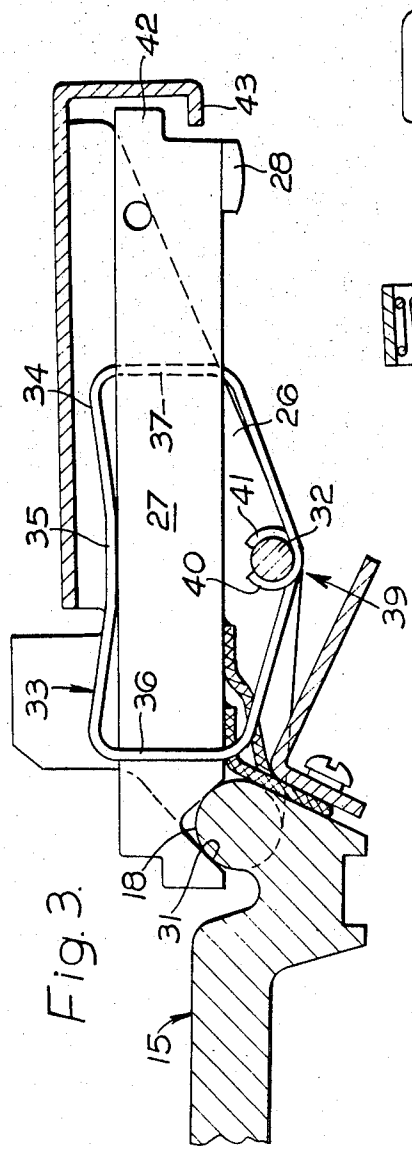

Fig. 3.

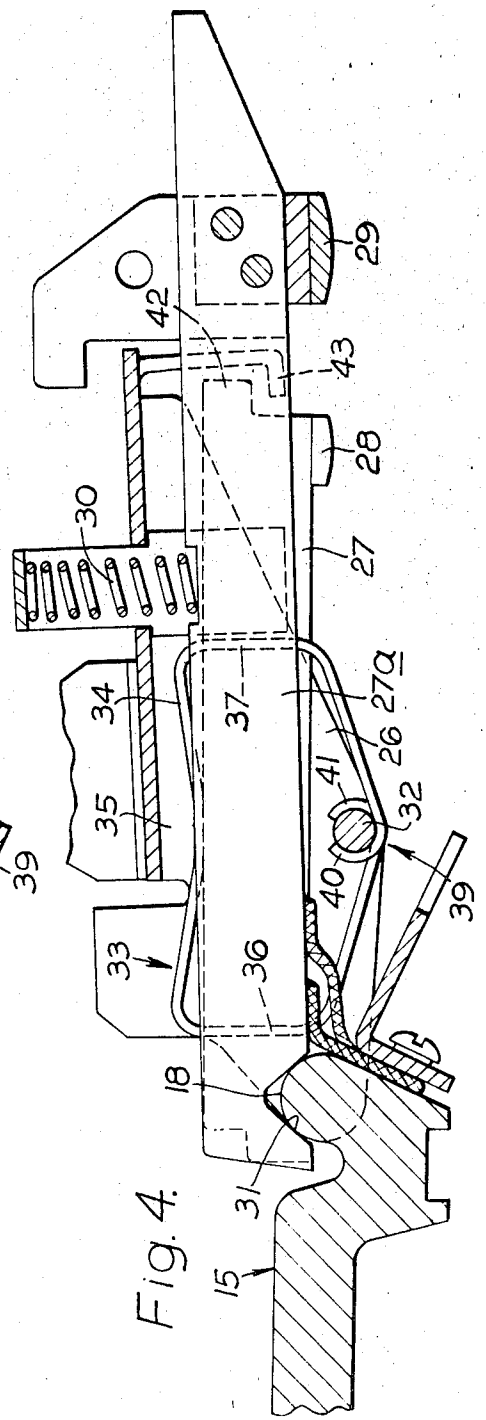

Fig. 4.

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LOCATOR SPRING STRUCTURE FOR CONTACT ASSEMBLY OF HIGH VOLTAGE ELECTRICAL CIRCUIT BREAKERS

This invention concerns electric circuit breakers and isolators and more particularly contact arrangements thereof.

It is well known, in relation to electric circuit breakers, that a so-called "blow-off force" occurs at the abutting contacts, when current is passing therethrough, tending to separate such contacts, and this force is proportional to the square of the current passing. Accordingly, with circuit breakers of large short circuit current capacity, e.g. of the order of one hundred thousand peak amperes, provision has to be made to counteract very substantial blow-off forces to keep the movable contacts properly in engagement with their stationary contacts.

For this reason, as well as others, it is advantageous to provide, for each pole of the circuit breaker, a moving contact assembly comprising a plurality of parallel-connected movable contact arms or fingers each carrying a respective movable contact engageable with a fixed contact, so that the current in each pole is split according to the number of arms. The total blow-off force then arising for any particular current is reduced in inverse proportion to the number of such arms, as compared with the case where only a single contact arm is present, and consequently the actuating mechanism and structure of the circuit breaker needs only to apply a substantially smaller force to retain the movable contacts in their closed position, without blow-off occurring.

In such an assembly, it is usual to load the individual contact arms by means of respective helical compression springs. Such an arrangement has the disadvantage, however, that it restricts the minimum width of movable contact arm which can usefully be employed, and consequently restricts the number of such arms which can be incorporated in a particular assembly of predetermined dimensions. In practice, if one attempts to make use of movable contact arms of width less than five-sixteenths of an inch, one is confronted with the difficult problem of designing corresponding helical springs able to apply adequate force to the respective arms without either the spring rate being too high or the length being too great. Accordingly, in the heretofore proposed constructions, the movable contact arms have usually been thick, to facilitate spring loading thereof, and the number of such arms which have been employed in any specific assembly has been small.

An object of the present invention is to provide a parallel-connected movable contact arrangement of the above-mentioned kind, which is particularly suitable for electric circuit breakers but may also be employed in electrical isolators, wherein relative location of and loading of the arms within a carrier therefore is achieved in a simple and convenient manner which permits the arms to be substantially thinner than has previously been necessary, so that a large number thereof can be employed.

With this object in view, the present invention provides an electric circuit breaker or isolator which has, for the or each pole thereof, a respective moving contact assembly comprising a plurality of parallel-connected movable contact arms each carrying a respective movable contact engageable with a fixed contact, characterized in that the arms are of strip metal, are disposed side-by-side and substantially parallel in a carrier, each the arm being mounted in the carrier by a respective locator spring which is shaped to provide a loading portion which engages one longitudinal edge of the arm and a pair of limbs extending across the arm one adjacent each side thereof and which locates on a cross member, extending transversely of the arms, of the carrier adjacent the other longitudinal edge of the arm.

In such arrangement, the locator springs serve yieldingly and resiliently to mount the movable contact arms in the carrier, and the space between adjacent pairs of the contact arms has one limb of the locator spring of each of the arms extending therethrough, so that these limbs serve effectively to locate the arms relative to one another.

Each locator spring is conveniently substantially rectangular in configuration, with its shorter sides constituting the limbs, one of the longer sides being the loading portion of the spring, and the other longer side incorporating a formation whereby it locates on the cross member.

The formation whereby the spring locates on the cross member may be an eye; and such eye can be formed by oppositely directed hooks provided on the two ends of a single spring-wire length forming the locator spring.

The aforementioned one of the longer sides of the locator spring which provides the loading portion of the spring is conveniently shaped so that only a short central portion engages with the respective edge of the respective contact arm.

Each movable contact arm is conveniently in the form of a metal pressing, the respective movable contact being secured adjacent one end thereof, e.g. by high speed brazing which can be effected without softening the contact arm.

Each such arm may then be formed with a V-shaped notch adjacent its other end whereby it locates onto an arcuate surface provided by a fixed hinge contact block to which the carrier is hingedly connected.

The end of each movable contact arm adjacent which the respective movable contact is provided is conveniently shaped to provide a protrusion beneath which engages a lip of the carrier whereby to limit possible movement of the arms under the loading of their springs.

The invention will be described further, by way of example, with reference to the accompanying drawings which illustrate a preferred embodiment thereof, as applied to an electric circuit breaker, it being understood that the following description is illustrative and not limitative of the scope of the invention.

In the drawings:

FIG. 1 is a cross-section through a preferred embodiment of electric circuit breaker conforming to the invention showing one contact assembly thereof;

FIG. 2 is a plan view of the contact assembly of FIG. 1;

FIG. 3 is a cross-section on the line 3—3 of FIG. 2; and

FIG. 4 is a cross-section on the line 4—4 of FIG. 2.

The preferred embodiment of the circuit breaker conforming to the invention is a three pole breaker and comprises a generally, rectangular casing (indicated generally at **10**) moulded from a suitable electrically insulating plastics material the interior of which is divided by appropriate partitions (not shown) to provide three channels (not shown) each of which accommodates a respective contact assembly **11**. A manual operating mechanism (not shown) of the breaker includes a pivoted lever projecting through a top cover of the casing **10** and connected to the contact assemblies **11** by way of a toggle linkage **12** incorporating a member (not shown) which is supported by a pivoted trip bar (not shown) extending transversely across the three channels. A respective bimetal and electromagnet arrangement (not shown) associated with each contact assembly cooperates with the trip bar to pivot the latter, upon occurrence of a sustained overload (i.e. a sustained passage of current in excess of the rated current of the circuit breaker) or upon occurrence of short circuit conditions (i.e. the passage of a current substantially in excess of the rated current), to release its support and permit collapse of the toggle linkage **12** and thereby trip the breaker.

The contact assemblies **11** in each of the three channels are substantially identical, and therefore it is only necessary to describe one of them in detail.

Such contact assembly **11** comprises, at one end of the channel, a fixed contact block **13** having a fixed contact strip **14** secured to its upper surface so as to extend transversely across the channel. In the other end of the channel is mounted a hinge contact block **15** whose end **16** closest to the fixed contact block **13** has bores **17** at each side thereof each being about three quarters of an inch long and extending transversely of the channel and is shaped on its upper surface to provide a substantially semi-cylindrical upwardly directed bearing surface **18** disposed so that its axis extends transversely of the channel substantially concentrically of the bores **17**.

The bores accommodate respective hingep pins **19** the ends **20**, **21** of which protrude from the hinged contact block **15** and serves pivotally to connect, to said hinge contact block **15**, an inverted-U-sectioned, or inverted-channel-sectioned movable contact arm carrier **22**, with the ends **20**, **21** of the pins **19** engaging into apertures **23**, **24** in respective side walls **25**, **26** of said carrier **22**.

The carrier **22**, which is connected to the toggle linkage **12**, serves to carry a plurality of parallel movable contact arms **27** which, in the closed condition of the breaker illustrated in FIG. **1**, extend from the hinge contact block **15** to just above the fixed contact block **13**, so that movable contacts **28** carried by each of said arms **27** engage with a respective location on the fixed contact strip **14** on the fixed contact block **13**.

There are thirteen of said movable contact arms **27** of which the middle one **27***a* (see FIG. **4**) is longer than the rest, has its own movable arcing contact **29** offset relative to the others, and is spring loaded downwards relative to the carrier **22** by an independent helical spring **30** set into the carrier **22**. Each of the movable contact arms **27** is in the form of a metal pressing, of copper strip, for example of approximately three-sixteenths of an inch in thickness, generally rectangular in configuration, and having the respective movable contact **28** secured to one edge thereof, adjacent to one end, e.g. by high speed brazing. Adjacent to the other end, each such strip has a V-shaped notch **31** cut therein, from the same edge, whereby the arm **27** locates on and makes electrical contact with the bearing surface **18** of the hinged contact block **15**. The fact that the movable contacts **28** can be secured to their respective arms **27** by high speed brazing has the advantage that it can be effected without causing the material of the arm **27** to anneal and become soft. Any softening of the movable contact arms **27** is to be avoided, of course, since impacts of substantial force occur in the operation of the breaker, and this would cause distortion of the arms **27**.

About midway along the length of the carrier **22**, a cross member **32** thereof extends transversely across the carrier **22** between the side walls **25**, **26** thereof at a level below the lower edges of the contact arms **27**, which lower edges are, of course, the edges in which the V-shaped notches **31** are provided and on which the movable contacts **28** are secured. The arms **27** are mounted in the carrier **22** by way of respective locator springs **33** which engage with the upper edges of the respective contact arms **27** and locate on the cross member **32**.

Each locator spring **33** (see FIGS. **3** and **4**) is made from a length of strong spring wire bent to a substantially rectangular configuration. One of the longer sides thereof is a loading portion **34** which is slightly bowed along its length and provides a linear middle section **35** which abuts against a part of the upper edge of the respective contact arm **27**. The two shorter sides of the spring constitute guide limbs **36**, **37** which extend across the respective contact arm **27**, one against each side of the contact arm **27** and join with the other longitudinal side of the spring which is provided with a formation **39** locating the spring **33** on the cross member **32** of the carrier **22**. The formation **39** is provided by the ends of the length of wire, which ends are curved to form oppositely directed hooks **40**, **41** which together form an eye around the cross member **32**.

Each said one end of each contact arm **27** is formed with a protrusion **42** which engages with a lip **43** on the carrier **22** to limit movement of the arm **27** under the influence of its spring **33**.

It will be appreciated that the circuit breaker effectively operates in the same way as prior known comparable constructions of breaker. With the operating handle in the "on" position, the toggle linkage **12** is extended to press the carriers **22** downwards, so that the movable contacts **28** all engage the fixed contact strip **14** and are loaded thereagainst by their respective locator springs **33**.

The moving contact arms **27** in the contact assembly of each pole serve to divide the current passing in said pole, with the consequent advantage of reduced blow-off force (as already discussed herein) so that the force necessary to hold the moving contacts **28** in adequate engagement with the fixed contact strip **14** is substantially less than in the case where each pole has a smaller number of contact arms **27** and respective movable contacts **28**, and the components of the circuit breaker can be of lesser dimensions and strength than in the latter instance.

Upon occurrence of a sustained overload or short circuit (as above explained) the toggle **12** is broken, the arms **27** are displaced away from the fixed contacts **14** to open the circuits through the circuit breaker, and the handle is moved to the "tripped" position.

In the addition of the advantages already discussed and the advantage that the circuit breaker may be constructed with components of lesser dimensions and/or strength, as discussed in the foregoing, the construction of the invention has other advantages. Thus, the arrangement of springs **33** providing for one limb **36, 37** thereof alongside each side of the respective contact arm **27** achieves proper location of the contact arms **27** relative to one another, so that they lie side-by-side in parallel disposition in a very simple and convenient manner which is easy to assemble. Furthermore, the form of the contact arms **27** is such that they can be manufactured readily and relatively inexpensively by simple pressing operations as compared with the expensive castings or extruded sections which have hitherto been conventionally employed for movable contact arms.

It is to be understood that the invention is not confined to the precise details of the foregoing example, and variations may be made to these details without departing from the scope of the invention. Thus, for example, the contact arrangement **11** of the invention can be employed in an electrical isolator, the construction being such as to provide two opposed carriers **22** with their contact arms **27** facing one another to provide therebetween a gap for accommodating a withdrawable conductor leading, for example, to an electrical component, the arrangement being such that relative movement between the contact arms **27** and the conductor is possible for withdrawing the latter to isolate the electrical component.

What we claim is:

1. In an electrical circuit breaker or isolator, the combination of: a carrier, a hinge contact block, a plurality of parallel movable contact arms mounted in the carrier, the carrier having a cross-member extending transversely of and spaced from one side of the contact arms, each contact arm constituting a strip in electrical contact with the contact block adjacent one of its ends, a single loop helical locator spring serving to mount each contact arm in the carrier, the locator spring having its ends engaged with the cross-member of the carrier and extending around the contact arm and having a loading portion extending diagonally across a longitudinal edge of the contact arm and having limbs extending one adjacent each side of the contact arm, the loading portion of the locator spring biassing the arm towards the cross-member and the limbs acting as spacers between adjacent contact arms.

2. In the circuit breaker as claimed in claim **9** wherein each locator spring is substantially rectangular in configuration, with its shorter sides constituting the limbs, one of the longer sides being the loading portion of the spring and the other longer side incorporating a formation whereby it locates on the cross-member.

3. In the circuit breaker as claimed in claim **2**, wherein the formation is an eye formed by oppositely directed hooks provided on the two ends of a single spring-wire length forming the locator spring.

4. In the circuit breaker as claimed in claim **2** wherein the said one longer side of the locator spring is shaped whereby only a short central portion engages with the respective edge of the respective contact arm.

5. In the circuit breaker as claimed in claim **4** wherein each movable contact arm is formed with a V-shaped notch adjacent its other end whereby it locates onto an arcuate surface provided by a fixed hinge contact block to which the carrier is hingedly connected.

6. In the circuit breaker as claimed in claim **1** wherein the said one end of each movable contact arm is shaped to provide a protrusion beneath which engages a lip of the carrier whereby to limit possible movement of the arms under the loading of their spring.

* * * * *