United States Patent

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[72] Inventors George E. Gauthier
Plainville;
Keith W. Klein, Simsbury, Conn.

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[73] Assignee General Electric Company

[54] **ELECTRIC CIRCUIT BREAKER**
10 Claims, 5 Drawing Figs.

[52] U.S. Cl. 200/166
[51] Int. Cl. H01h 1/02
[50] Field of Search ..... 200/166C, 168 (A), 169, 170; 335/23, 35, 46, 196

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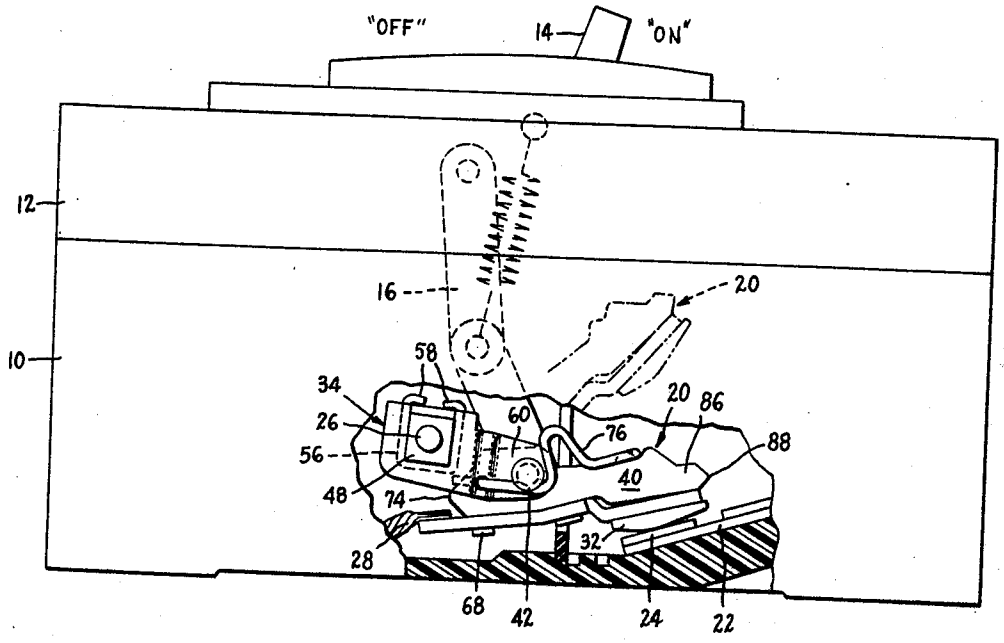
Primary Examiner—H. O. Jones
Attorneys—Robert T. Casey, Robert S. Smith, D. M. Schiller, Frank L. Neuhauser, Oscar B. Waddell and Melvin M. Goldenberg

ABSTRACT: A movable contact-supporting arm comprising a relatively high conductivity low strength flat plate portion disposed with its major planar surface generally at right angles to the direction of movement of the contact arm and a relatively low conductivity high strength backing plate having its major planar surface disposed generally parallel to the direction of movement of said contact arm to form a generally T-shaped cross-sectional configuration, and a contact member mounted on the front surface of the high conductivity plate portion by suitable means, such as by welding.



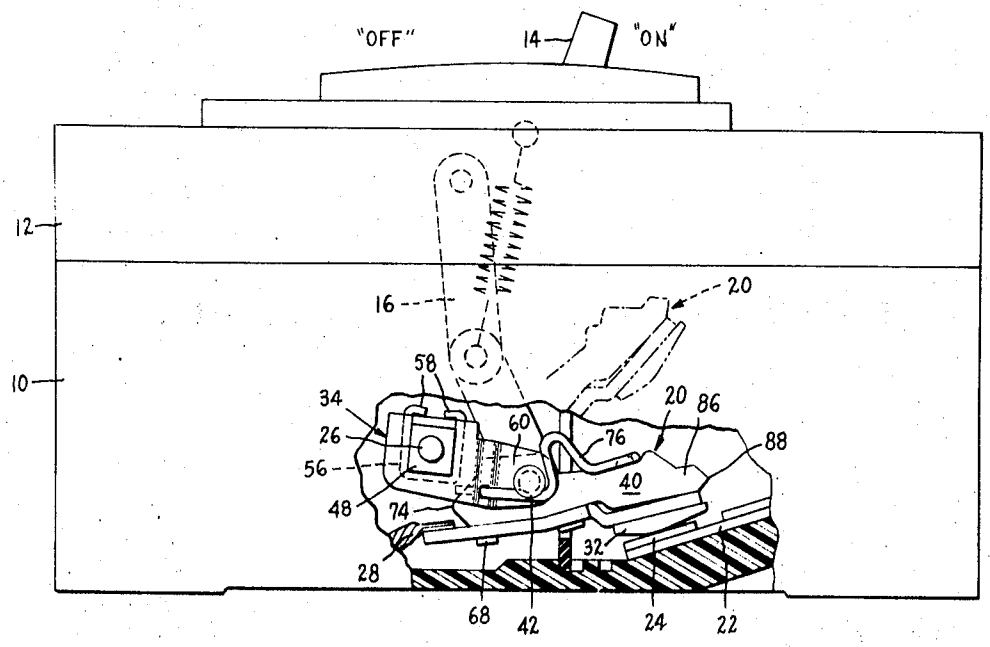


FIG. 1

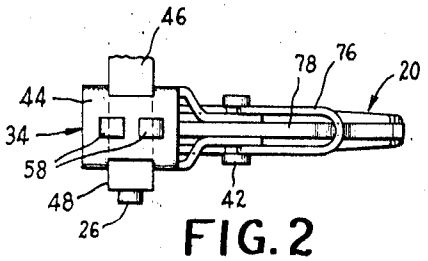


FIG. 2

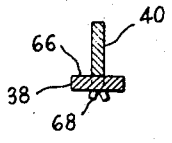


FIG. 4

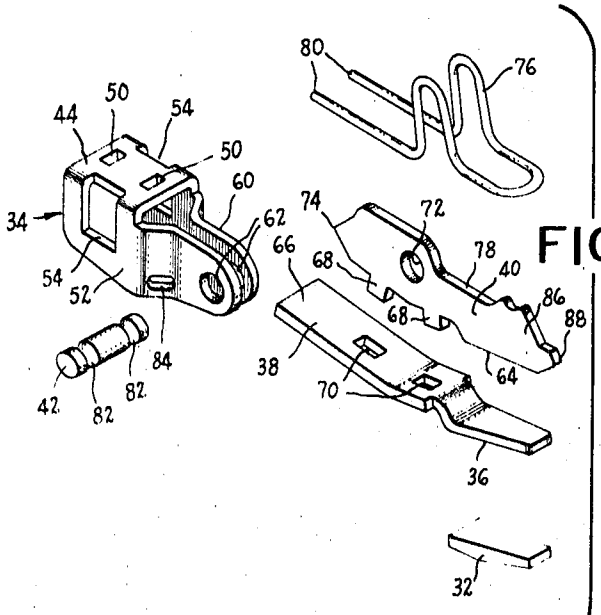


FIG. 3

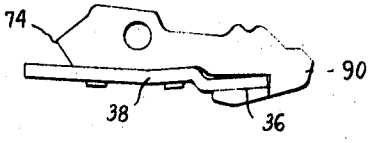


FIG. 5

INVENTORS
GEORGE E. GAUTHIER,
KEITH W. KLEIN
BY Robert G. Casey
ATTORNEY

ELECTRIC CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

Our invention relates generally to electric circuit control devices and more particularly is directed to new and improved contact arm assemblies for electric switches, circuit breakers and the like.

Heretofore movable electric contact arm assemblies for switches such as circuit breakers and the like have conventionally consisted essentially of a flat plate of relatively highly conductive material with a contact mounted on one edge thereof. The conductive plate was disposed generally perpendicular to the abutting surfaces of the contacts in the closed circuit position in order to best resist the high compressive forces exerted thereagainst during operation. Unfortunately such assemblies inherently possess the structural weaknesses associated with the use of high electrical conductivity materials. Accordingly it has been necessary to increase the cross-sectional area of such parts for purely structural purposes beyond the size required to carry the current of the switch or circuit breaker. This, of course, unnecessarily adds to the cost of the device, since the high conductivity materials (such as copper) are comparatively expensive.

In addition, such prior art contact arms presented a problem in that the mounting of the contact member on one edge portion of the contact arm member was difficult to accomplish. This is because the welding of contact members to supporting metallic members is best accomplished by an assembly which presents two opposed generally flat relatively wide planar surfaces which may be engaged by opposed electrodes of a welding machine, sandwich fashion, during the welding process. Contact arm assemblies of the type referred to of the prior art, however, present an edge portion of the support member as one of the two opposed surfaces which must be engaged by the welding electrodes. This makes the welding process more time consuming and also causes a higher number of defective welds to occur.

Furthermore, in addition to the above, the relatively small area of engagement between the edge portion of the supporting member and the generally planar back surface of the contact member of such prior art constructions does not provide a very good path for the conduction and dissipation of heat generated between the contacts in closed circuit position.

In addition to the above problems, the process of welding, as is well known, creates intense heat in the parts to be welded, with the result that the support member is softened or "annealed" by the welding. This weakens the support member at the precise point where strength is important, that is, at the point at which force is exerted thereon because of the engagement of the contacts in the closed position.

OBJECTS OF THE INVENTION

Accordingly, it is a general object of the present invention to provide a new and improved contact arm assembly for circuit control devices of the type described which uses a minimum of relatively expensive high electrical conductivity material.

It is another object of the invention to provide a supporting arm for a movable contact member including mounting means for the contact on the supporting arm which is readily adapted to standard welding processes and machines.

A further object of the invention is to provide a supporting arm for a movable contact member which also provides for good heat conductivity and dissipation of heat from the movable contact, and which furthermore nevertheless utilizes a minimum of relatively expensive high conductivity material.

It is another object of the present invention to provide a contact arm assembly for supporting a movable contact member of an electric switch or circuit breaker in which a minimum of relatively expensive high conductivity metallic material is required, but which nevertheless presents a contact supporting portion to which a contact may be welded, which is generally wide and flat in a direction parallel to the back surface of the contact member to be attached thereto, while yet providing required structural strength in the assembly.

It is a further object of the invention to provide a contact supporting arm construction of the type including a contact support member having a contact engaging portion of relatively high conductivity material, the contact being attached thereto by welding, the nature of the assembly being such that softening or weakening of the contact engaging portion of the assembly by said welding process does not detract from the required structural strength of the assembly.

A further general object of the present invention is to provide an improved contact arm assembly comprised of a composite metal construction exhibiting high strength, endurance and dependable operating characteristics.

A further object of the invention is to provide a switch or circuit breaker including a composite contact supporting arm comprising a minimum amount of relatively expensive high conductivity material combined with relatively inexpensive low conductivity high strength material in which the high conductivity portion is disposed and arranged to shield the main body of the low conductivity material from direct impingement by an arc drawn between the contacts.

SUMMARY OF THE INVENTION

In accordance with the present invention these and related objects are attained by providing an electric circuit breaker of the type described with a new and improved movable contact arm assembly comprising an elongated contact carrier mounted for pivotal movement along a path between open and closed circuit positions and including a conductor blade disposed substantially perpendicular to a plane lying along the carrier's path. The contact carrier is a composite member comprising a platelike current conductor blade mounting the contact on its wide surface at one end thereof and a structural support member upstanding from the conductor at substantially a right angle thereto.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be better understood from the following detailed description taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a side elevation view of a circuit breaker, partly broken away and partly in section, illustrating one embodiment of the contact arm assembly of the present invention in its closed circuit position, its open circuit position being shown in phantom;

FIG. 2 is a fragmentary plan view illustrating only the movable contact arm assembly of FIG. 1;

FIG. 3 is an exploded isometric view of the contact arm assembly shown in FIG. 2;

FIG. 4 is a sectional view of the contact carrier of the assembly illustrating one manner of securing the backing member to the conductor blade; and

FIG. 5 is a side elevation view of another embodiment of a contact carrier of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawing in greater detail, wherein like reference numerals indicate like parts throughout the several FIGS., the invention is shown in FIG. 1 as incorporated in a multipole electric circuit breaker having an insulating housing or casing comprised of a generally rectangular base member **10** and an overlying cover **12** mounted thereon. A manually operated ON/OFF button **14** protrudes through the cover **12** and is suitably connected through an operating mechanism, such as the spring driven overcenter toggle linkage **16** (shown in phantom), to each of the circuit breaker's contact arm assemblies, generally designated by the numeral **20**. As illustrated in FIG. **1** the assembly **20** is mounted within the insulat-

ing casing for movement between its closed circuit position shown in full line and its phantom line open circuit position.

A terminal strap **22** associated with a line terminal of the circuit breaker is fixedly secured to the base member **10** of the casing and mounts a stationary contact **24** at one end thereof. As will be appreciated each of the movable contact arm assemblies **20** are operable in unison by the overcenter operating linkage **16** through a common contact cross arm **26** which extends transversely of the casing and provides a common pivot axis therefor. A flexible electric conductor or braid **28** is connected to each movable contact arm assembly **20** and is suitably associated with a load terminal on the opposite end of the breaker to complete the circuit thereacross.

Upon movement of the manually operated button **14** to its OFF position, the overcenter toggle linkage **16** moves the pivotal contact arm assembly **20** to the phantom line position shown in FIG. **1**, opening the circuit and preventing the flow of electric current therethrough. Conversely, upon movement of the manually operated button **14** to its ON position illustrated in FIG. **1**, the contact arm assembly is rapidly and effectively driven in a clockwise direction as viewed in FIG. **1** causing firm pressurized surface engagement between the movable contact **32** carried by the contact arm assembly **20** and the stationary contact **24** carried by the load terminal strap **22**.

Upon the occurrence of an abnormally high current condition in the circuit controlled by the breaker, a suitable tripping mechanism, not shown, which may be of a thermal or magnetic character or a combination thereof, is activated to cause movement of the toggle linkage **16** a sufficient distance to permit operation of the overcenter mechanism and the resultant counterclockwise movement of the contact arm assembly **20** to its open circuit position. Upon correction of the condition resulting in the high current short circuit, the breaker may be manually reset by moving the manually operated button **14** to its OFF position.

In accordance with the present invention the pivotal contact arm assembly **20** comprises a contact operator **34** firmly mounted on the common cross arm **26** and a composite contact carrier including a current conducting blade **38** and support member **40** pivotally mounted on the contact operator **34** by means of an interconnecting pivot pin **42**. The contact operator **34**, best shown in FIG. **3**, is a generally U-shaped member comprised of a substantially flat base portion **44** which rests against a flat surface **46** of the cross arm's square hub **48** and a pair of opposed sides **52** provided with aligned generally square openings **54** at their point of juncture with the base portion **44** for receiving the common cross arm **26** therethrough. As shown in FIGS. **1** and **2**, the base portion **44** is held in secure fixed engagement with the common cross arm **26** by means of the fastener **56** whose tabs **58** extend through apertures **50** in the base portion **44** and bend over the outside surface thereof in locking engagement. The spaced generally parallel sides **52** of the contact operator are each provided with forwardly extending pinched-in journal tabs **60** spaced in substantial parallelism by a distance approximately equal to the width of the contact carrier's support member **40**. In this manner the tabs **60**, which are provided with aligned apertures **62** for receiving the pivot pin **42**, securely mount the contact carrier therebetween for limited pivotal movement as discussed in greater detail hereinafter.

The current conducting blade **38** of the contact arm assembly is an elongated, generally rectangular strip or bar of copper or other suitable conductive material to which the movable contact **32** is affixed at one end thereof. It is an advantage of the present invention that the blade **38** is mounted in such a manner that the plane thereof is disposed at substantially a right angle to the assembly's path of travel between its open and closed circuit positions. More particularly the conductive blade **38** presents its wide bottom surface to the arcing area of the circuit breaker so that the blade's flat face portion **36** which mounts the contact **32** lies in confronting planar relationship to the terminal strap **22** and the stationary contact **24** mounted thereon. As mentioned, the blade **38** is preferably a flat copper strip or bar which provides excellent current conducting properties and is of sufficient length to provide for the secure attachment of the flexible conducting braid **28** which electrically interconnects the movable contact **32** with the load terminal of the circuit breaker.

The support member **40** of the composite metal contact carrier is a flat, generally rectangular plate formed from rigid, high strength material, such as steel. The support member **40** is disposed at substantially a right angle to the conductor blade **38** so that its bottom longitudinal edge **64** rests on the broad top surface **66** of the blade imparting a generally T-shaped cross-sectional configuration to the contact carrier, as best seen in FIG. **4**. A pair of depending securing lugs **68** extend downwardly from longitudinal edge **64** and interfit within central apertures **70** provided in conductor blade **38** to provide a secure interconnection therebetween when staked in the manner illustrated in FIG. **4**. The support member **40** is further provided with a central aperture **72** for receiving the pivot pin **42** and facilitating pivotal interconnection with the operator **34** of the contact arm assembly. Thus, the upright support member **40** provides a strong, durable support backing for the current conducting blade **38** in the form of a beam capable of imparting to the assembly the strength and durability necessary for prolonged trouble-free operation.

Although the contact carrier is pivotally mounted on its contact operator **34**, the pivotal movement thereof is substantially limited. For example, when the circuit breaker is fully assembled with the contact arm assembly **20** mounted on the common cross arm **26**, the clockwise rotation of the contact carrier assembly when the parts are in the open circuit position is limited by the interfering engagement of a tapered tail portion **74** of the support member **40** with the fastener **56**. Additionally, rotation in a counterclockwise direction as viewed in FIG. **1** is resisted by a wire spring **76** held by the operator **34** and pivot pin **42** for engagement with the top longitudinal edge **78** of the support member **40**. As shown in FIG. **1** the spring **76** passes beneath pivot pin **42** and rests within its locking grooves **82** while the spring's free ends **80** are held within the side apertures **84** of the operator **34**. Thus, it will be appreciated that as the snap action of the overcenter mechanism drives the contact arm assembly **20** in a clockwise direction toward the closed circuit position and brings movable contact **32** into surface engagement with stationary contact **24**, the spring **76** permits only limited counterclockwise rotation of the current conducting blade **38** and support member **40**. Consequently, clockwise rotational movement of the common contact cross arm **26** beyond that necessary for engagement between the contacts will load spring **76** and assure full pressurized engagement between the contacts at their closed circuit position and a minimum electrical contact resistance.

The support member **40** of the assembly is also provided with a forwardly protruding nose portion **86** which advantageously provides a terminal point **88** suitable for operation as an arc runner for the movable contact arm assembly. As shown in FIG. **5** an alternative embodiment of the nose portion is depicted. In the latter embodiment the nose portion **90** extends below the flat face portion **36** of the blade's bottom surface toward the terminal strap **22**.

As will be seen from the foregoing detailed description, the present invention provides a new and improved composite metal contact arm assembly which exhibits improved interruption characteristics on high current short circuits. The assembly is comprised of a current conducting blade oriented so as to dispose its broad flat surface toward the arcing area of the circuit breaker and a structural backing member capable of imparting increased rigidity and durability to the assembly. The T-shaped cross-sectional configuration of the contact arm assembly not only provides the desirable strength and electrical conductivity characteristics required for circuit breaker operation but also appears to provide a beneficial heat dissipating effect over the large conductive surface presented to the arc during the circuit breaking operation. In addition, an

important advantage of the T-shaped cross-sectional configuration disclosed is that the wide dimension of the highly conductive blade **38** shields the support member **40**, which is desirably of a higher strength but lower conductivity material, from the action of an arc drawn between the contacts. Thus as previously noted, the blade portion **38** is preferably constructed of copper or a copper alloy, while the portion **40** is preferably constructed of steel or a steel allow. In the form of FIG. **5**, the portion **40** is extended to provide an arc runner portion **90**, but damage to this portion, such as by erosion due to effects of arcing, will not adversely affect the function of the part **40** as a strength beam or reinforcing member.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above-described will become readily apparent without departure from the spirit and scope of the invention.

Certain aspects of the structure disclosed herein, particularly relating to the spring means for biasing the contact carrier assembly with respect to the contact operator **34**, are disclosed and claimed in our copending application Ser. No. 4,836 filed 1–22–70and assigned to the same assignee as the present invention.

We claim:

1. A movable contact arm assembly for an electric circuit breaker comprising a contact; an elongated composite contact carrier including a generally rectangular platelike current conducting blade having a bottom surface including a substantially flat face portion mounting said contact adjacent one end of the blade; an elongated structural support member having a longitudinal edge mounted in direct contact with the top surface of said blade, said support member being secured to the blade intermediate the ends thereof and including a pointed nose portion extending beyond the end of said blade mounting said contact; a contact operator pivotally mounting said carrier and including means for limiting pivotal movement of said carrier in a first pivotal direction and biasing means mounted on said operator for urging said carrier in said first pivotal direction to provide releasable engagement between said carrier and said limiting means.

2. In an electric switching device comprising a casing, a first contact mounted in said casing, a second contact in said casing having a surface adapted to engage a surface of said first contact, a movable contact arm assembly mounting said second contact for movement into and out of surface engagement with said first contact, and drive means moving said contact arm assembly toward and away from said first contact, the combination wherein the contact arm assembly includes a composite contact carrier comprising a platelike current conducting blade and a backing member for the blade in intimate supporting engagement therewith, said blade having a face portion disposed in confronting relationship to the first contact during surface engagement between said contacts; said blade being a generally rectangular strip having a bottom surface including said face portion, said second contact mounted on said face portion adjacent one end of said blade, the backing member having a longitudinal edge mounted in secured abutting relationship to said blade, and said backing member including an arc runner portion mounted adjacent said second contact.

3. A movable contact arm assembly for an electric circuit breaker comprising a contact, an elongated contact carrier including a platelike current conducting blade having a face portion mounting said contact and a structural support member secured to the blade, a contact operator mounting said carrier for limited movement in a first direction and biasing means operable against said support member for urging said carrier in said first direction, said blade being a generally rectangular strip having a bottom surface including said face portion, said contact mounted on said face portion adjacent one end of the blade, the support member having a longitudinal edge mounted in secured abutting relationship to said blade, the contact arm assembly including a contact operator mounting the carrier for limited movement in a first direction and biasing means associated with said operator for urging said carrier in said first direction.

4. In an electric switching device of the type comprising a casing, a normally stationary contact supported in said casing, a movable contact arm assembly supported in said casing and including a movable contact portion movable along a predetermined path into and out of engagement with said stationary contact, the combination wherein said movable contact arm assembly comprises:

a. an elongated relatively wide, thin, flat current conducting member;

b. a movable contact member rigidly and conductively mounted on a first wide surface of said current conducting member adjacent one end thereof;

c. a backing member of relatively high strength material rigidly affixed to said current conducting member at a second wide surface thereof opposite said first wide surface, said backing member comprising a relatively wide, thin, flat member having its wide surfaces extending generally perpendicular to said wide surfaces of said current conducting member and having a longitudinal edge portion mounted in abutting relationship to said second wide surface of said current conducting member; and

d. said contact arm assembly disposed in said casing with said first and second wide surfaces of said current conducting member extending substantially perpendicular to said predetermined path of movement of said movable contact member.

5. The combination as set forth in claim **13** wherein:

a. said current conducting member comprises a relatively high electrical conductivity metallic material;

b. said backing member comprises a metallic material having an electrical conductivity substantially lower than that of said current conducting member; and

c. said backing member further being composed of a material having a mechanical strength greater than that of said current conducting member.

6. The combination as set forth in claim **4** wherein:

a. said current conducting member comprises copper; and

b. said backing member comprises steel.

7. The combination as set forth in claim **4** wherein said backing member is disposed substantially along the longitudinal center line of said current conducting member and is attached thereto by means of integral lug portions which extend through corresponding holes in said current conducting member.

8. The combination as set forth in claim **4** wherein said one end of said current conducting member is offset from the general plane of said current conducting member in a direction toward said first wide surface, and said backing member has its said longitudinal edge portion conforming to the contour of said offset at the portion abutting thereagainst.

9. The combination as set forth in claim **4** wherein said backing member has a nose portion extending beyond said current conducting member at said one end thereof and having a depending portion extending in the direction of said contact, said nose portion having a longitudinal edge portion extending substantially flush with the contacting face of said contact to provide an arc runner capable of readily accepting transfer of an arc from said contacting face of said contact.

10. The combination as set forth in claim **4** wherein said combination also comprises means supporting said contact arm assembly for pivotal movement in said casing between open and closed circuit positions with respect to said stationary contact, and flexible conductor means connected directly to said current conducting member of said contact arm assembly adjacent the end thereof opposite said one end whereby all current entering said current conducting member enters directly and without having to first pass through any portion of said backing member.