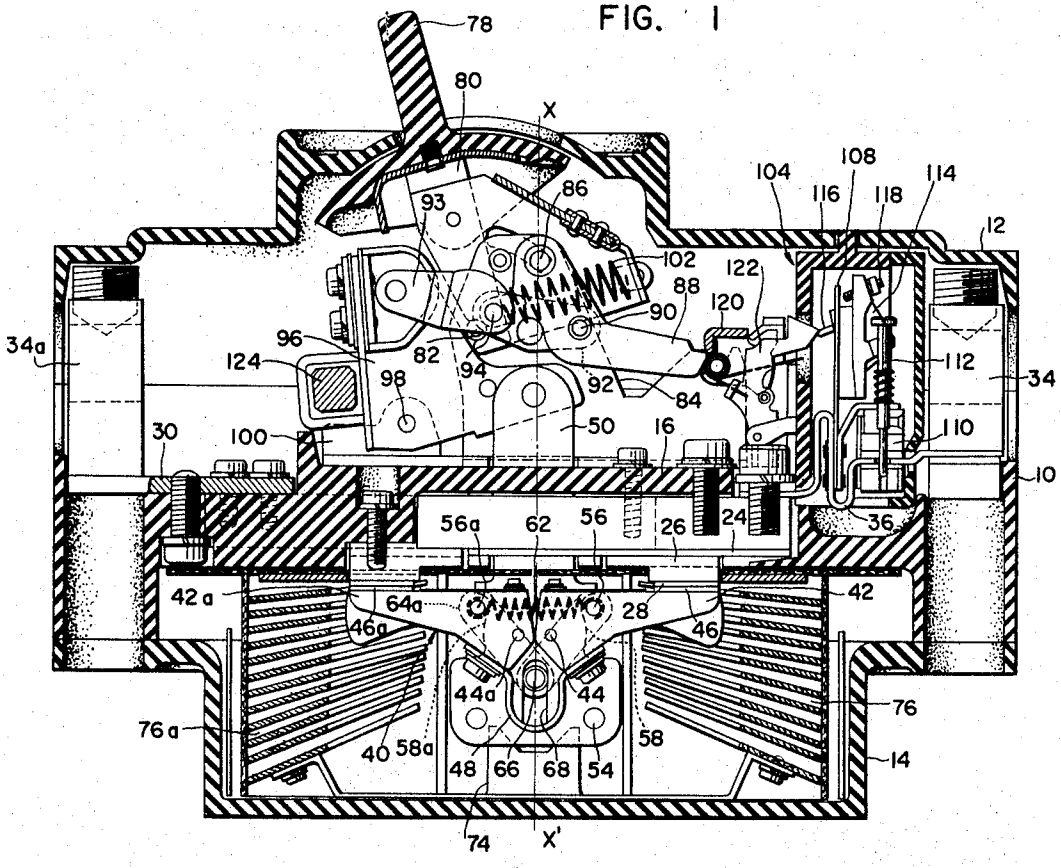
Sept. 19, 1967 WASABURO MURAI 3,343,108

HIGH SPEED CIRCUIT INTERRUPTER USING MAGNETIC BLOWOFF AND MEANS FOR DECREASING THE INERTIAL EFFECTS DURING INTERRUPTION

Filed May 6, 1966 4 Sheets-Sheet 1

FIG. 1



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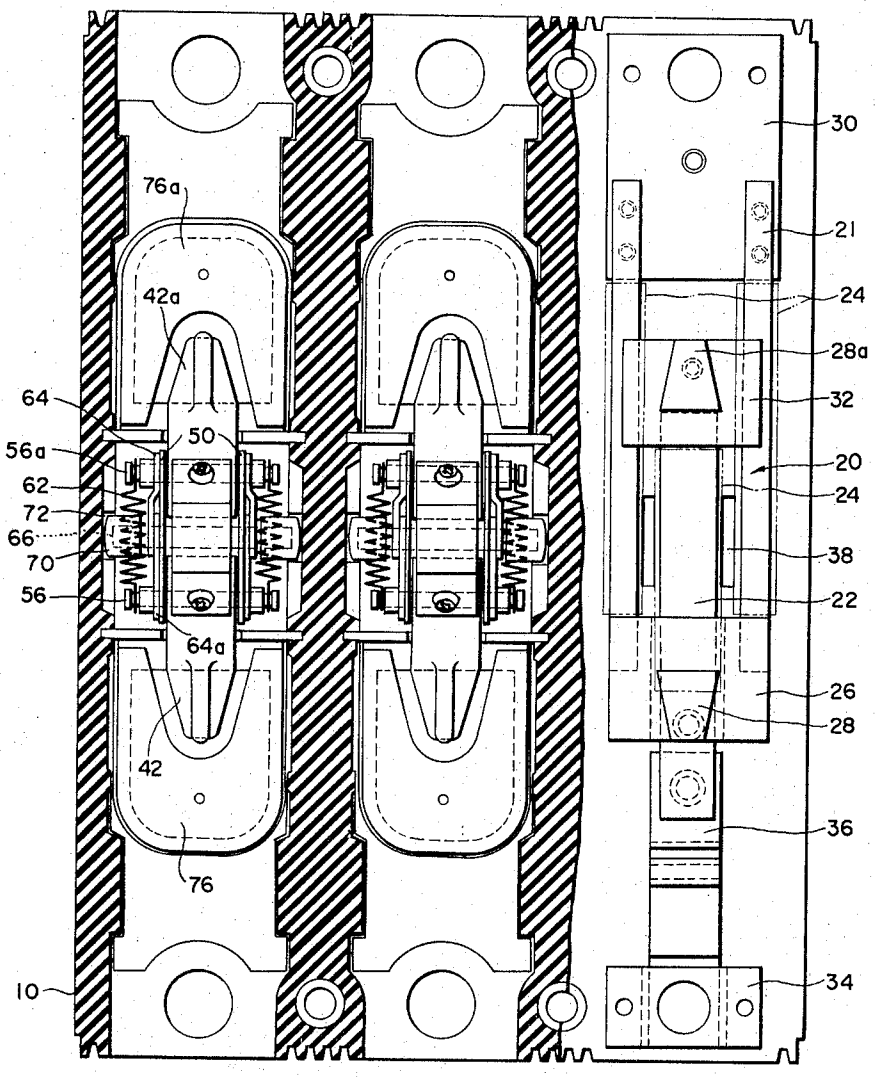
Filed May 6, 1966 4 Sheets-Sheet 2

FIG. 2



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Filed May 6, 1966 4 Sheets-Sheet 3

FIG. 3A

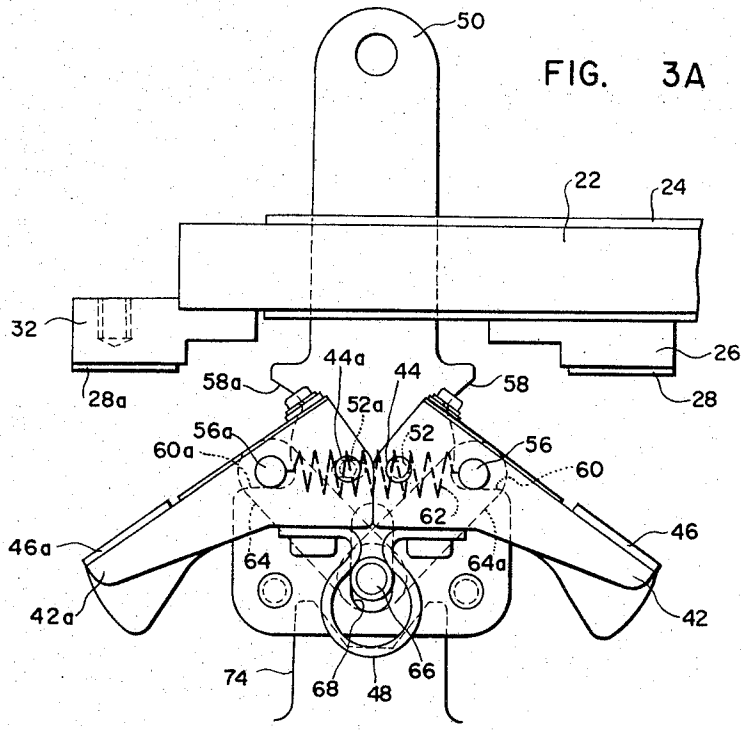
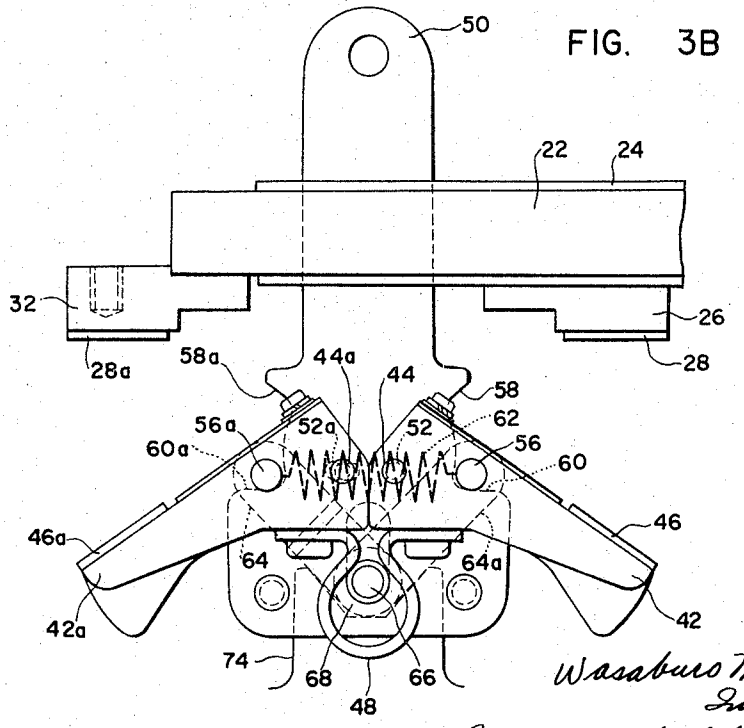


FIG. 3B



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Filed May 6, 1966 4 Sheets-Sheet 4

FIG. 3C

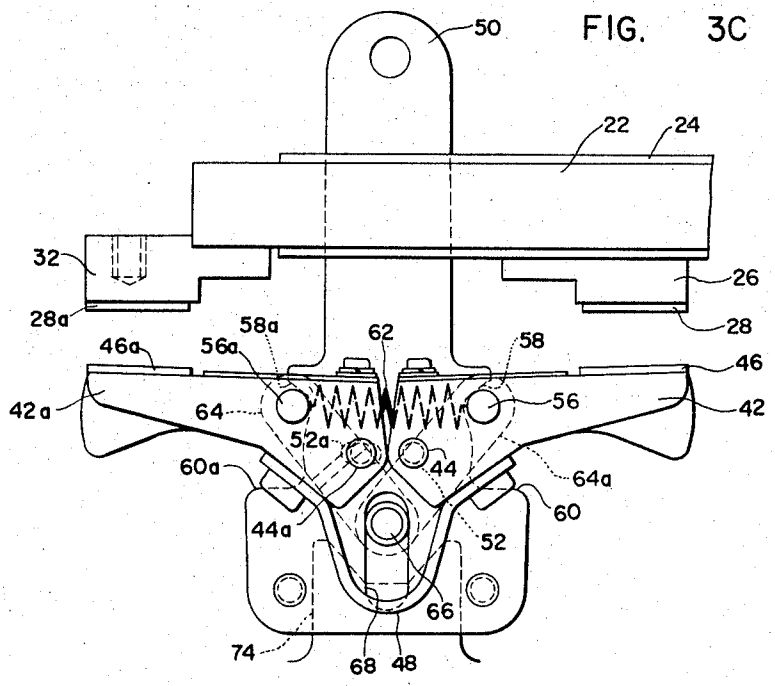
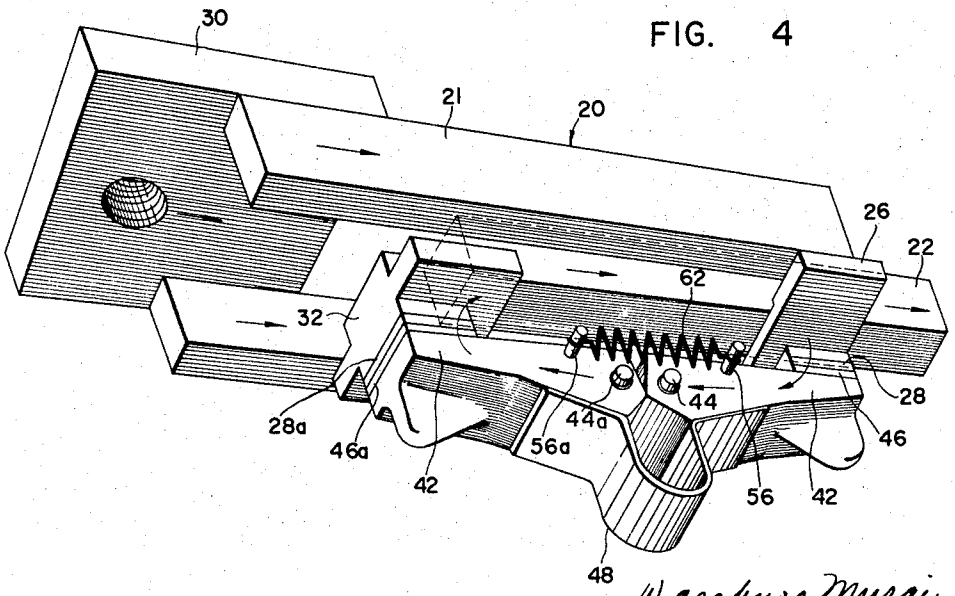


FIG. 4



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3,343,108

HIGH SPEED CIRCUIT INTERRUPTER USING MAGNETIC BLOWOFF AND MEANS FOR DECREASING THE INERTIAL EFFECTS DURING INTERRUPTION

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Claims priority, application Japan, Dec. 10, 1965, 40/75,601, 40/75,602, 40/100,012
7 Claims. (Cl. 335—16)

This invention relates to a circuit interrupter of the type wherein an electromagnetic repulsion developed between a stationary and a movable contact assembly serves to shorten the interruption period to exhibit the current limiting effect.

A general object of the invention is to provide an improved circuit interrupter of the type wherein, upon interruption of a flow of shortcircuiting current an electromagnetic repulsion developed between a stationary and a movable contact arm initiates to separate the movable arm from the stationary arm at a high speed to exhibit the current limiting effect and which is made in a small size and having a high interruption performance. It is well known that a two point interruption mechanism is effective for reducing the interruption period and limiting a current flowing the interrupter resulting in an increase in interruption performance.

The conventional type of circuit interrupters for interrupting a flow of current therethrough at two points includes a bridge type movable contact device generally comprising either a single movable contact arm having a pair of movable contacts carried at both ends or a movable contact arm divided into two portions. Such a single movable contact arm increased generally the inertia of the movable parts and was not suitable for high speed separation of contacts. Also the two part movable contact arm was not suitable for the interruption operation performed by the electromagnetic repulsion and tended to make the interruption mechanism complicated and to increase the dimension of the circuit interrupter.

An object of the invention is, accordingly, to provide an improved circuit interrupter of the type including a two-point interruption mechanism suitable for performing an efficient interruption operation through an electromagnetic repulsion developed between a stationary and a movable contact arm upon the occurrence of a shortcircuiting fault.

Another object of the invention is to provide an improved circuit interrupter of the type as described in the preceding paragraph including a stationary and a movable contact arm disposed so as to increase an electromagnetic force developed between the two contact arms upon shortcircuiting the associated load circuit and to utilize efficiently the increased electromagnetic force.

A further object of the invention is to provide an improved circuit interrupter of electromagnetic repulsion type including a movable contact arm divided into two portions and rotatable while maintaining contacting of the two divided portions at the dividing point thereby to effect smooth interruption at a high speed.

A still further object of the invention is to provide an improved circuit interrupter of electromagnetic repulsion type wherein a loss of the electromagnetic repulsion due to friction is reduced and a space occupied by conductors constituting a stationary contact arm decreases to permit the circuit interrupter to be made in a small size.

With the aforesaid objects in view, the invention resides in a circuit interrupter comprising a stationary contact arm on the source side and a stationary contact arm on the load side, one stationary contact carried by each of the stationary contact arms, a movable contact assembly separably engaging a pair of the stationary contacts to bridge the latter, switching means for engaging and disengaging the movable contact assembly with and from the stationary contacts, releasable means for separating the movable contact assembly away from the stationary contacts, and trip means responsive to a flow of overload current through the circuit interrupter to release the releasable means, the movable contact assembly being separable away from the stationary contacts through an electromagnetic repulsion developed between the stationary contact arms and the movable contact assembly immediately upon the occurrence of very high current flowing through the circuit interrupter, wherein said movable contact assembly is split into a pair of bilaterally symmetric movable contact arms rotatably carried on a holder plate by a pair of supporting pins, each of said movable contact arms having a contact bearing surface substantially flush with a contact bearing surface on the other movable contact arm in its closed position, a spring bridging said pair of movable contact arms to exert a contact pressure upon a common point on said movable contact arms where they contact each other, and upon the development of said electromagnetic repulsion said pair of movable contact arms are rotated in the opposite directions about the axes of the supporting pins while one of said movable contact arms is maintained in rolling contact with the other movable contact arm thereby to separate the said pair of movable contact arms away from the associated stationary contacts.

The invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is an elevational view, partly in section of a circuit interrupter embodying the principle of the invention;

FIG. 2 is a bottom view of the interrupter with a lower cover member for an arc-extinguishing chamber removed and with only a movable contact assembly for one pole removed to expose the associated stationary contact assembly;

FIG. 3A is a fragmental side elevational view of a movable contact assembly in its operative position where it has been just separated from the associated stationary contact assembly by the action of an electromagnetic repulsion developed therebetween;

FIG. 3B is a fragmental side elevational view of the movable contact assembly in its operative position where it begins to return back to its OFF position;

FIG. 3C is a fragmental side elevational view of the movable contact assembly in its operative position where a tripping operation has been completed and in OFF position; and

FIG. 4 is a perspective view of a pair of movable and stationary contact assemblies in closed position.

While the invention will now be described in terms of a three-pole circuit interrupter it is to be understood that it is equally applicable to circuit interrupters having any desired number of poles.

Referring now to the drawings and more particularly to FIG. 1 thereof, there is illustrated a circuit interrupter

embodying the principle of the invention. An arrangement illustrated comprises a housing **10**, an upper cover member **12**, detachably closing the upper end of the housing and a lower cover member **14** also detachably closing the lower end of the housing, all the members being formed of any suitable electrically insulating material by molding technique. The housing member **10** includes a mounting plate **16** which may be formed of the same material as the members **10**, **12** and **14** and dividing the interior of the housing member **10** into an upper and a lower compartments.

As best shown in FIG. 2, three stationary contact assemblies generally designated by the reference numeral **20** are disposed on the lower surface as viewed in FIG. 1 of the mounting plate **16** in spaced parallel relationship, one for each pole. Each of the stationary contact assemblies **20** is identical in construction to the other stationary contact assemblies, and therefore such an assembly for the central pole will now be described. The stationary contact assembly **20** comprises a pair of outer stationary contact arms **21** disposed in spaced parallel relationship and an intermediate stationary contact arm **22** interposed between and spaced away from the outer stationary contact arms **21**. All the stationary contact arms **21** and **22** are fitted into electrically insulating sleeves **24** respectively which are, in turn, secured in parallel grooves (not shown) disposed on the mounting plate **16** in order to ensure that the stationary contact arms are electrically insulated from each other.

As shown in FIGS. 2 and 4, the outer stationary contact arms **21** are bridged on one end portion by an electrically conductive contact block **26** having centrally mounted thereto a stationary contact **28** and electrically connected on the other end portions to a terminal plate **30** disposed on the upper surface as viewed in FIG. 1 of the mounting plate **16** adjacent the wall of the housing **10**. The intermediate stationary contact arm **22** is provided on one end portion interposed between the outer arms **21** with a contact block **32** having also centrally mounted thereto a stationary contact **28***a*. As shown in FIG. 2, each of the outer arms **21** is provided on its portion corresponding to the middle between the stationary contacts **28** and **28***a*′ with an elongated rectangular slot **38** for the purpose as will be apparent later.

As shown in FIG. 1, one pair of terminal members **34** and **34***a*′ for each pole are disposed in opposed relationship adjacent the wall of the housing and above the mounting plate **16**. The terminal **34***a* is electrically connected to the terminal plate **30** and the terminal **34** is electrically connected to the other end portion of the intermediate stationary contact arm **22** through a conductor **36**. That portion of the housing adjacent to each of the terminals **34** and **34***a* is opened whereby the terminals are accessible through the openings. One of the terminals, in this case, the terminal **34***a* is adapted to be connected to a source of electrical power (not shown) and the other terminal **34** adapted to be connected to a load (not shown). Therefore the outer stationary contact arms **21** and the stationary contacts **34***a*′ are on the source side while the intermediate stationary contact arm **22** and the stationary contact **34** are on the load side.

A movable contact assembly generally designated by the reference numeral **40** comprises a pair of movable contact arms **42** and **42***a* of bilaterally symmetrical shape rotatably disposed in end-to-end relationship directly below the stationary contact assembly **20**. It will be understood that in the arrangement illustrated three movable contact assemblies are provided one for each pole. Since all the movable contact assemblies are substantially identical in constructing to each other only the central movable contact assembly will now be described.

Each of the movable contact arms **42** or **42***a* is rotatably carried by a support pin **44** or **44***a* in the manner as will be described hereinafter and includes a movable contact **46** or **46***a* adapted to engage the associated stationary contact **28** or **28***a* in its closed position. The movable contact **46** is on the source side while the contact **46***a* is on the load side. It is to be noted that the adjacent end faces of both movable contact arms are constructed to be of a circular arc having its center on the axis of the associated supporting pin ensuring that the movable contact arms effect rotational movement while maintaining one of the arms in contact with the other.

The pair of movable contact arms **42** and **42***a* are electrically connected to each other by a flexible lead **48** attached on the lower sides or those sides of the arms remote from the respective contacts **46** and **46***a* for the purpose as will be apparent hereinafter.

A pair of longitudinal contact holder plates **50** in spaced parallel relationship (see FIG. 2) secured through the mounting plate **16** (see FIG. 1) and extend through the slots **38** on the outer stationary contact arms **21** so as to be electrically insulated from the latter. The holder plates **50** each are provided on that portions projecting downwardly beyond the mounting plate **16** with a pair of aligned holes **52** or **52***a* serving to rotatably support the supporting pin **44** or **44***a*′ respectively. One pair of holes in this case the holes **52***a* is slightly elongated in the direction perpendicular to the common longitudinal axis of the holder plates. The contact holder plates are made in a unitary structure by having revets **54** disposed on the lower end portions thereof.

Each of the movable contact arms has a pin **56** or **56***a* disposed in substantially parallel to the supporting pin **44** or **44***a* thereon and vertically movable within a longitudinal notch defined by a pair of spaced shoulders **58** or **58***a* and **60** or **60***a* formed on either side of each holder plates **50**. Anchored on the pair of the pins **56** and **56***a* is a coiled spring **62** functioning to provide a contact pressure under which the pair of movable contacts **46** and **46***a* contact the associated stationary contacts **28** and **28***a* also a contact pressure under which the adjacent end portions of the movable contact arms contact each other.

A pair of balancing rods **64** and **64***a* are rotatably mounted at one end to the pins **56** and **56***a* respectively and at the other end together to a common pin **66** which is, in turn, slidable within a pair of aligned longitudinal guide slots **68** formed on the end portions of the contact holder plates **50**. As shown in FIG. 2, the pin **66** is provided on both ends projecting beyond the holder plates **50** with a pair of rollers **70** movable within a pair of longitudinal grooves **72** disposed on the lower cover **16**. In order to limit downward movement of the rollers **10** the lower cover **16** is provided a notched projection **74** of electrically insulating material integral with the inner bottom surface of the lower cover member **16**.

As shown in FIG. 1, a pair of arc-extinguishing chambers **76** and **76***a* of the conventional design are disposed on both sides of the movable contact assembly **40** respectively.

The upper compartment as viewed in FIG. 1 is provided with means for engaging and disengaging the movable contact assembly **40** with and from the stationary contact assembly **20**.

A switching mechanism for opening and closing the contacts comprises a rockable operating handle **78** of any suitable electrically insulating material projecting externally beyond the upper cover member **12** and a U-shaped switching lever **80** fixed to the operating handle **78** and pivotably mounted on a pivot shaft **82** which, in turn, extends horizontally in the direction normal to the plane of FIG. 1 from a frame **84** erected on the mounting plate **16**. The frame **84** carries a horizontal trip pin **86** on which a trip lever **88** is pivotably mounted at one end and has the other end operatively coupled to a trip unit as will be described hereinafter. The trip lever **88** has a toggle pin **90** disposed on the central portion.

A releasable toggle mechanism comprises a pair of toggle arms **92** and **93**. The toggle arm **92** is pivotably

mounted on the toggle pin **90** at one end and articulated at the other end to the adjacent end of the other toggle arm **93** by a connecting pin **94**. Articulated at the other end of the toggle arm **93** is a contact operating lever **96** rockably supported at a pivot **98** to a support block **100** rigidly secured on the mounting plate **16**. The lever **96** is articulated at one end to the upper ends of the contact holder plates **50**. The toggle mechanism further comprises a spring **102** having both ends hooked on the trip and toggle pins **90** and **94** respectively.

A trip unit generally designated by the reference numeral **104** is disposed on the righthand portion of the upper compartment as viewed in FIG. 1. The trip unit comprises a housing **106** of any suitable electrically insulating material having accommodated therein trip means comprising a thermally responsive element such as a bimetallic element **108** and an instantaneous trip electromagnet device **110** to be responsive of any overload current flowing through the conductor **36** connecting the load terminal **34** and the intermediate stationary contact arm **22**. Disposed within the trip housing **160** are an instantaneous trip rod **112** operatively connected to the electromagnet device **100**, a trip shaft **114** including a pawl **116** and a trip adjusting screw **118**.

In order to operatively couple the trip lever **88** to the trip pawl **116**, there is a hook device including a primary hook member **120** releasably engaging the trip lever and a secondary hook lever **122** releasably connected to both the primary hook member **120** and the trip pawl **116**.

The trip unit **104** and the hook device **120–122** each may be of the conventional design and do not form a part of the invention.

In order to operate the three interrupter units for respective poles a connecting rod **124** is operatively connected to the respective contact operating levers **96** and hence to the associated contact holder plates **50**. It is also to be understood that the operating handle **18** is common to all the three poles.

FIG. 1 shows the circuit interrupter and more particularly the central interrupter unit in its ON position in which that face of the movable contact assembly **40** opposing to the stationary contact arms **21** and **22** is substantially in parallel to the latter in order to efficiently utilize with both an electromagnetic repulsion developed between the movable and stationary contact arms upon the occurrence of any shortcircuiting current. In order to move the interrupter from its ON position to its OFF position, the operating handle **78** can manually rock from its position illustrated in FIG. 1 to its OFF position or in the clockwise direction as viewed in FIG. 1. This causes the pair of toggle arms **92** and **93** to collapse to permit the contact operating lever **96** to turn about the axis of the pivot **98** in the clockwise direction as viewed in FIG. 1 which is accompanied by downward movement of the pair of contact holder plates **50**. The downward movement of the holder plate pair **50** causes the pair of movable contact arms **42** and **42***a* to be depressed while maintaining the contact bearing faces substantially parallel to the stationary contact arms **21** and **22** or flush with each other as in their ON position. At the same time the rollers **70** on both ends of the balancing pin **66** slide downwardly within the guide grooves **72** formed on the lower cover member **16** until the movable contacts **46** and **46***a* are separated away from the associated stationary contacts **28** and **28***a* whereupon the interruption operation has been completed.

Then if the interrupter is desired to be closed, the operation handle **78** can be manually returned back to its ON position as illustrated in FIG. 1 to contact the movable contacts **46** and **46***a* with the stationary contacts **28** and **28***a* through the process reversed from that above described.

It it now assumed that an ordinary magnitude of overload current flows through the circuit interrupter in its ON position. Then such a flow of current through the conductor **36** heats the bimetallic element **108** to deflect the latter to press the adjusting screw **118**. This causes the trip shaft **114** to be rotated in the clockwise direction as viewed in FIG. 1 to disengage the trip pawl **116** from the secondary hook member **122** resulting in rotational movement of the secondary and primary hook members **112** and **120** in the clockwise direction. Therefore the primary hook member **120** disengages from the trip lever **88** to permit the toggle arm pair **92, 93** to collapse whereby the movable contacts **42** and **42***a* are separated away from the associated stationary contacts **28** and **28***a* in the same manner as previously described in conjunction with the opening operation until the state as illustrated in FIG. 3C is reached.

If a flow of overload current equal in magnitude to from eight to 10 times a flow of rated current occurs, the electromagnet device **110** is immediately operated to cause the trip rod **112** to rotate the trip shaft **114** in the same manner as above described with reference to the tripping operation until the movable contact assembly **40** reaches its position illustrated in FIG. 3C.

It is now assumed that a flow of heavy current such as a shortcircuiting current has occurred. Then an electromagnetic repulsion is developed between the pairs of movable and stationary contact arms **42, 42***a* and **21, 22** arranged in substantially parallel relationship, by that current flowing through the arms in the opposite directions and immediately causes the pair of movable contact arms **42** and **42***a* **28***a* to be rotated about the respective supporting pins **44** and **44***a* in the opposite directions whereupon the movable contacts **46** and **46***a* are separated from the associated stationary contacts **28** and **28***a* with the contact holder plates **50** remaining in ON position. More specifically, the balancing pins **66** slides downwardly within the longitudinal guide slot **68** to displace the pins **56** and **56***a* downwardly. Then the spring **62** spanned between the pins **56** and **56***a* and tending normally to press the movable contacts against the stationary contacts is reversed in the direction to exert its force. This causes the movable contact arms **42** and **42***a* to be rotated about the supporting pins **44** and **44***a* in the opposite directions thereby to separate the movable contacts **46** and **46***a* away from the stationary contacts **28** and **28***a* respectively until the movable contact arms are bent and maintained in V-shape.

Under these circumstances, downwardly movement of the pins **56** and **56***a* is accompained by downward movement of the pin **66** having the balancing levers **64** and **64***a* connected together thereto within the aligned guide slots **68** on the contact holder plates **50** and also by downward displacement of the rollers **70** on the pin **66** in the grooves **72** on the lower cover **16**.

In this way the movable contact assembly **40** and the associated parts have reached their position as illustrated in FIG. 3A where the movable contacts **46** and **46***a* have been separated away from the stationary contacts **28** and **28***a*. However the movable contact arms **42** and **42***a* can not return back to their original position provided that they are kept intact. Slightly after the contacts have been separated away from each other in the manner as above described, the shortcircuiting current having flowed through the conductor **36** will operate the electromagnetic trip device to release the operating mechanism from its constrained position in the manner as previously described. This causes the contact holder plates **50** to move downwardly.

During this downward movement of the contact holder plates **50**, the repelled contact arms **42** and **42***a* are moved downwardly along with the holder plates **50** until the rollers **70** on the pin **66** strikes against the stop **74**. At that time the repelled contact arms **42** and **42***a* begin to be retored its previous state in which the contact bearing surfaces thereof are substantially flush with each other (see FIG. 3B).

More specifically, the contact holder plates **50** are depressed while being locked by the pin **66** to raise the

movable contact arms 42 and 42*a* by the balancing rods 64 and 64*a* through the pins 56 and 56*a*. This reverses the direction in which the spring 62 exerts its force on the movable contact arms 42 and 42*a* thereby to permit the latter to be restored to their position where the contact bearing surfaces thereof are substantially flush with each other. Thus the movable contact assembly 40 is maintained in its normal open or OFF position (see FIG. 3C). Then a resetting operation may be performed to make the interrupter ready for the subsequent closing operation.

From the foregoing it will be apparent that the stationary contact arms 21 and 22 on the source and load sides respectively are adapted to have a flow of current therethrough opposite in direction to that through the bridge type movable contact arm pair 42–42*a* disposed in substantially parallel relationship with respect to the stationary arms. Upon the occurrance of a flow of very high current such as a shortcircuiting curent an electromagnetic repulsion developed between the stationary and movable contact arms is utilized to rotate the two-part moveable contact arms 42 and 42*a* about the axes of their supporting pins 44 and 44*a* respectively. In order for the electromagnetic repulsion to efficiently provide a force with which the movable contact arms 42 and 42*a* are rotate, it is desirable to dispose the movable contact arms close to the stationary contact arms 21 and 22 and also to permit the full magnitude of the shortcircuiting current to flow through the rotating contact arms 42 and 42*a*. Furher it is necessary to effect smooth rotation of the movable contact arms 42 and 42*a* while maintaining them in contact with each other at a point where the movable contact arms are divided. To this end, that side surface of one of the movable contact arms 42 and 42*a* successively contacting the corresponding surface of the other movable contact arm should be formed into a circularly arcuate rolling surface having its longitudinal axis on the axis of the associated supporting pin 44 or 44*a*. This permits the movable contact arms to be rotated in the opposite directions about the axes of the respective support pins while maintaining rolling contact therebetween with the spring 62 serving to provide a proper contact pressure under which such rolling contact is maintained.

As will be readily understood, it is difficult to shape each of the contacting surfaces on both movable contact arms into such a circular arcuate segment that both movable contact arms 42 and 42*a* can be rotated about the axes of the supporting pins 44 and 44*a'* respectively while maintaining the arms in perfect contact with each other. The circularly arcuate surface has inevitably partially minor irregularities. Under these circumstances, a fixed distance between the centers of the pins 44 and 44*a* leads to the difficulty of maintaining both the movable contact arms under a constant stable contact pressure for the reason that during rotation of the contact arms the contact point at which both arms contact each other is moved with respect to the arms resulting in a variation in contact pressure occurring at the contact point.

The invention avoids this difficulty by the provision of one pair of aligned bearing openings in this case the openings 52*a* shaped in an elongated slot within which the associated supporting in 44*a'* is movable in accordance with movement of the contact point at which both arms contact each other, relative to the arms whereby movement of the pin 52*a* compensates for any irregularities of the arms. This insures that both the movable contact arms 42 and 42*a* effect smooth rotational movement about the axes of the respecting bearing pins 44 and 44*a'* while maintaining the same in stable contact with each other.

If, upon the occurrence of a flow of shortcircuiting current one of the movable contact arms would have been subject to an electromagnetic repulsion different in magnitude as does the other movable contact arm then both the arms may be different from each other in speed of rotation and therefore in interruption distance by which the movable contact is separated from the associated stationary contact resulting in interruption at one point. This leads to a serious damage to both the movable contacts and their arms and decreases the interruption performance of the circuit interrupter.

In order to eliminate the abovementioned disadvantage according to the invention, the pair of movable contact arms 42 and 42*a* are connected together by the pin 66 through the pair of balancing rods 64 and 64*a'* and the pin 66 is adapted to slide in the guide slots 68 on the holder plates 50. This measure insures that both the movable contacts 46 and 46*a* are separated away from the associated stationary contacts 28 and 28*a* while maintaining their interruption distances substantially equal to each other and that the movable contacts are in such a constant state that they are ready for simultaneous engagement with the associated stationary contacts.

Further it is presumed that when the movable contact arms 42 and 42*a* is rotating in the opposite directions about the axes of the respective support pins 44 and 44*a* while continuously contacting the arms at their dividing point, a change in both the electromagnetic repulsion and contacting of the movable contact arms may be accompanied by arcing at the contact point, leading to a damage to the movable contact arms. To minimize or substantitally eliminate the occurrence of arc at the contact point, the flexible shunt lead 48 in loose state has been provided which electrically connects both the movable contact arms 42 and 42*a*.

It is recalled that the two movable contact arms 42 and 42*a* of bridge type are operatively connected to the holder plate pair 50 and adapted to be moved toward and away from the associated stationary contact arms 21 and 22. In order to effect movement of the movable contact arms, the pin 68 serves to connect the movable contact arms together through the pair of balancing rods 64 and 64*a'* and has been provided on both ends projecting beyond the guide slots 68 on the holder plates 50 with a pair of the rollers 70 which, in turn, is adapted to vertically slide in the guide grooves 72 on the lower cover 16. This measure permits both the movable contact arms to be of a bilaterally symmetric shape with respect to the common longitudinal axis of the holder plates 50 and ensures that even in the normal opening operation both the movable contacts are always maintained in balanced interruption distance.

As previously described, an electromagnetic repulsion developed between the movable and stationary contact arms due to a flow of shortcircuiting current therethrough causes the pair of movable contact arms 42 and 42*a* to be rotated in the opposite directions to be brought into their open position through the reversion of direction in which the spring 62 applies its forces to both movable contact arms. If the movable contact arms are kept intact, they can not perform the subsequent closing operation. Therefore the movable contact arm must be brought into their position where the contact bearing surfaces thereof are substantially flush with each other. To this end, the trip unit 104 is adapted to operate keeping pace with rotational movement of the movable contact arms and to release the operating mechanism from its constrained position slightly after the movable contact arms have been rotated thereby to lower the holder plates 50 to put the movable contact arm in their OFF position and simultaneously to return the spring 62 to its original state in the manner as previously described. Therefore a resetting operation may be performed to make the movable contact arms ready for the subsequent closing operation.

In order to increase a magnitude of electromagnetic repulsion for rotating the movable contact arms 42 and 42*a* about the axes of the respective supporting pins 44 and 44*a*, and to improve the high speed interruption effect, the movable and stationary contact assemblies 20 and 40 are constructed and arranged such that a flow of current through the pair of outer stationary contact arms 21 is equal in direction to that through the intermediate

stationary contact arm **22** while at the same time the flow of current through all stationary contact arms is opposite in direction to that through the pair of movable contact arms **42** and **42***a* as shown by the arrows in FIG. 4. In addition the three stationary contact arms are arranged such they have flowing therethrough no component of a current in attraction relationship with respect to or in phase with a current flowing through the movable contact arms. This measure makes it possible to reduce a volume of space occupied by the stationary contact arms and therefore the dimension of the interrupter measured along the direction designated by line X–X'. Further the fact that the three stationary contact arms are composed of straight conductors disposed in a place permits the arms to be enclosed with the electrically insulating sleeves ensuring that the source arms **21** are satisfactorily insulated from the load arm **22.**

While the invention has been shown and described with reference to a preferred embodiment thereof it is to be understood that various changes in the details of construction and the combination and arrangement of parts may be resorted to without departing the spirit and scope of the invention.

What I claim is:

1. A circuit interrupter comprising stationary contact arm on the source side and a stationary contact arm on the load side, one stationary contact carried on each of the stationary contact arms, a movable contact assembly separably engaging a pair of the stationary contacts to bridge the latter, switching means for engaging and disengaging the movable contact assembly with and from the stationary contacts, releasable means for separating the movable contact asesmbly away from the stationary contacts, and trip means responsive to a flow of overload current through the circuit interrupter to release the releasable means, the movable contact assembly being separable away from the stationary contacts through an electromagnetic repulsion developed between the stationary contact arms and the movable contact assembly immediately upon the occurrence of very high current flowing through the circuit interrupter, wherein said movable contact assembly is split into a pair of bilaterally symmetric movable contact arms rotatably carried on a holder plate by a pair of supporting pins, each of said movable contact arms having a contact bearing surface substantially flush with a contact bearing surface on the other movable contact arm in its closed position, a spring bridging said pair of movable contact arms to exert a contact pressure upon a common point on said movable contact arm where they contact each other, and upon the development of said electromagnetic repulsion said pair of movable contact arms are rotated in the opposite directions about the axes of the supporting pins while one of said movable contact arms is maintained in rolling contact with the other movable contact arm thereby to separate the said pair of movable contact arms away from the associated stationary contacts.

2. A circuit interrupter as claimed in claim **1**, wherein said roller plate is provided with at least one slot relatively elongate transversely to the longitudinal axis to receive the corresponding supporting pin for one of said movable contact arms, said corresponding supporting pins being movable within said slot during rotational movement of said movable contact arms in the opposite directions about the axes of the supporting pins whereby said pair of movable contact arms are always maintained in stable contact with each other during rotational movement.

3. A circuit interrupter as claimed in claim **1**, comprising a guide slot formed on said holder plate, a connecting pin movable in said guide slot, and a pair of balancing rods connected together at one end by said connecting pin to operatively connect said pair of movable contact arms so as to effect rotational movement of one of said movable contact arms in one direction accompanied by rotational movement of the other movable contact arm in the other direction, the arrangement being such that said connecting pin is movable in said guide slot to permit said pair of movable contact arms to be separated away from the associated stationary contacts while being maintained substantially equidistant from the latter.

4. A circuit interrupter as claimed in claim **1**, comprising a flexible conductor for electrically connecting said pair of movable contact arms to provide a shunt path around the latter.

5. A circuit interrupter comprising a stationary contact arm on the source side and a stationary contact arm on the load side, one stationary contact carried on each of the stationary contact arms, a movable contact assembly separably engaging a pair of the stationary contacts to bridge the latter, switching means for engaging and disengaging the movable contact assembly with and from the stationary contacts, releasable means for separating the movable contact assembly away from the stationary contacts and trip means responsive to a flow of overload current through the circuit interrupter to release the releasable means, the movable contact assembly being separable away from the stationary contacts through an elecromagnetic repulsion developed between the stationary contact arms and the movable contact assembly immediately upon the occurrence of a very high current flowing through the circuit interrupter, wherein said movable contact assembly is split into a pair of bilaterally symmetric, movable contact arms rotatably mounted on a pair of parallel holder plates by a pair of supporting pins, each of said movable contact arms having a contact bearing surface substantially flush with a contact bearing surface on the other movable contact arm in its closed position, a spring bridging said pair of movable contact arms to exert a contact pressure upon a common point on said movable contact arms where they contact each other, and upon the development of said electromagnetic repulsion said pair of movable contact arms are rotated in the opposite directions about the axes of said supporting pins while one of said movable contact arms is maintained in rolling contact with the other movable contact arm thereby to separate said pair of movable contact arms away from said associated stationary contacts, and wherein said pair of holder plates are longitudinally movable to engage and disengage said movable contact arms with and from said stationary contacts, and provided with a pair of aligned guide slots having movable therein a connecting pin, a pair of balancing rods connected together at one end by said connecting pin operatively connects said pair of movable contact arms, and one roller mounted on each end of said connecting pin projecting beyond said pair of holder plates is capable of slide in a guide groove disposed on a housing for said circuit interrupter.

6. A circuit interrupter as claimed in claim **1**, wherein after said pair of movable contact arms have been separated away from said associated stationary contacts through said electromagnetic repulsion, said trip means are operated to release said switching means from their constrained position to move said pair of holder plates downwardly while during downward movement of said holder plates said rollers on both ends of said connecting pin strike against a stop disposed on the housing to stop and a further downward movement of said holder plates is accompanied by upward movement of said movable contact arms through said balancing rods thereby to return said spring to its position relative to said movable contact arms where the arms are in its closed position and also to put said movable contact arms in its OFF position where the contact bearing surfaces on the movable contact arms are substantially flush with each other whereby the circuit interrupter is ready for the subsequent closing operation.

7. A circuit interrupter as claimed in claim **1**, wherein said stationary contact arms respectively on the source and load sides include those portions disposed in juxta-

posed parallel relationship, said stationary contact arms and said movable contact arms being arranged such that currents flow in the same direction through said juxtaposed and parallel portions of said stationary contact arms while at the same time a flow of current through said stationary contact arm is opposite in direction to a flow of current through said movable contact arms.

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