United States Patent

[11] 3,600,539

[72] Inventors Eugene J. Walker; Donald G. Portman, both of Beaver, Pa.
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[73] Assignee Westinghouse Electric Corporation Pittsburgh, Pa.

[54] MULTIPOLE CIRCUIT INTERRUPTER
10 Claims, 6 Drawing Figs.

[52] U.S. Cl. .... 200/153 G, 335/41
[51] Int. Cl. H01h 9/24
[50] Field of Search .... 335/41; 200/153, 153 C

[56] References Cited

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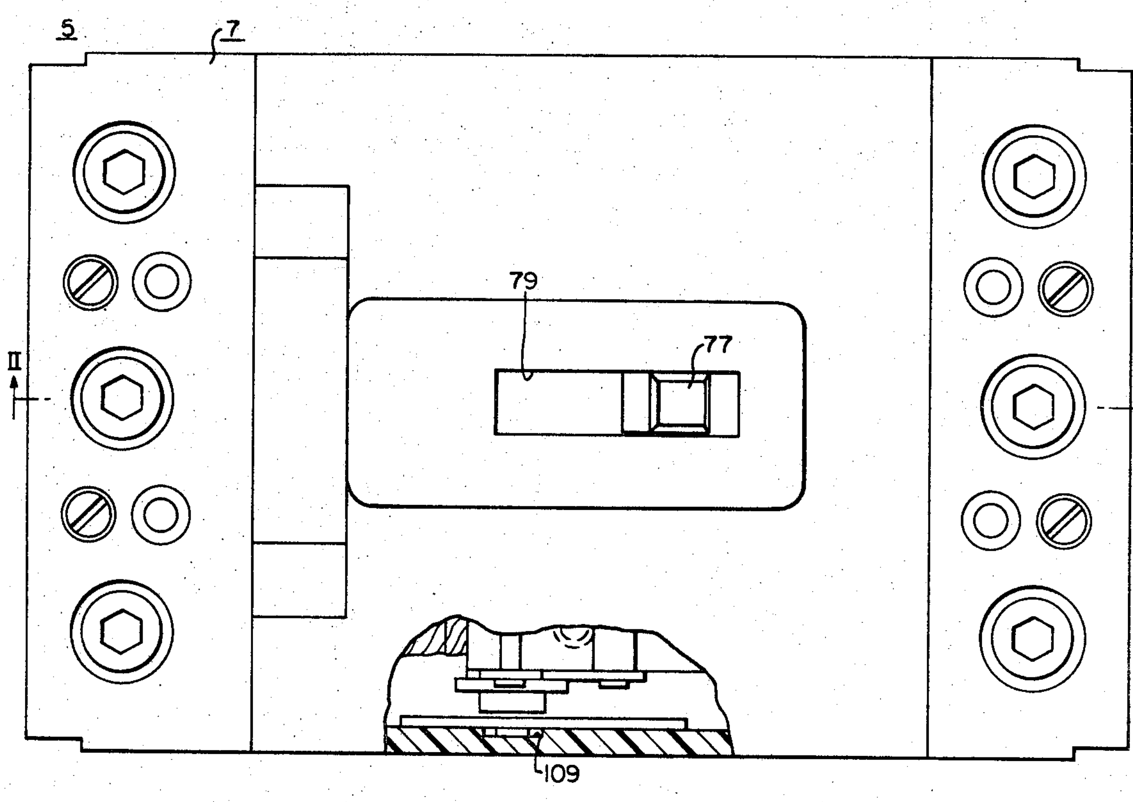
Primary Examiner—Milton O. Hirshfield
Assistant Examiner—B. A. Reynolds
Attorneys—A. T. Stratton, C. L. McHale and W. A. Elchik

ABSTRACT: A multipole circuit interrupter, having an elongated metal-core tie bar supporting the plurality of movable contact arm structures, comprises improved means supporting the tie bar for pivotal movement with insulating means preventing a phase-to-phase fault through the metal core.



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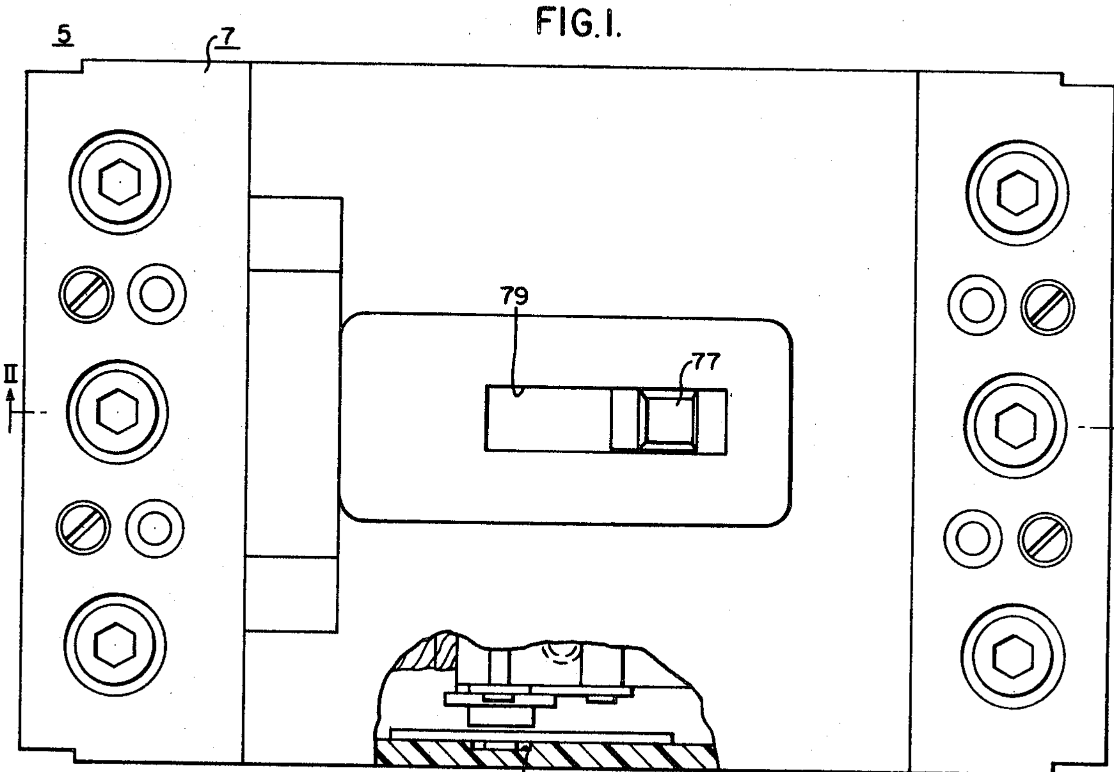
SHEET 1 OF 2

FIG. I.



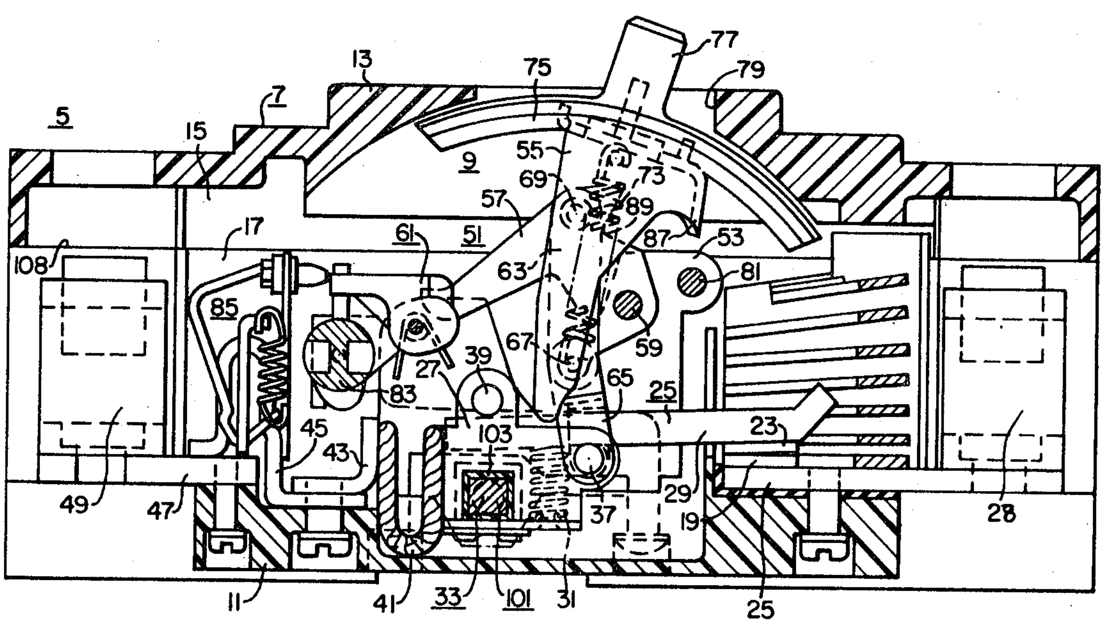


FIG. 2.

WITNESSES

Theodore F. Wrobel

James F. Young

INVENTORS
Eugene J. Walker
and Donald G. Portman
BY

William A. Elchik
ATTORNEY

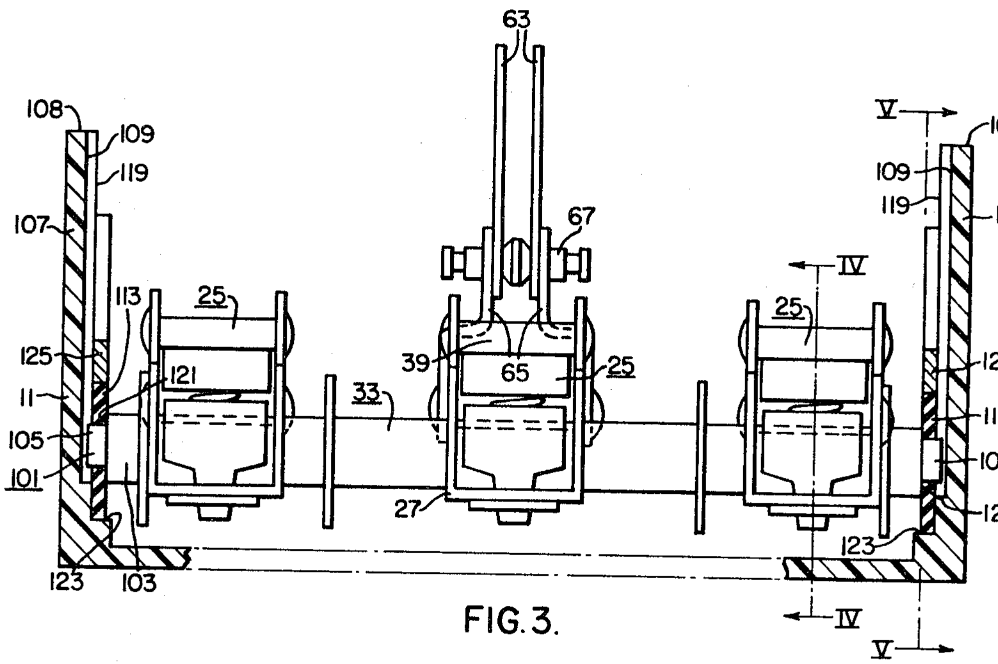


FIG. 3.

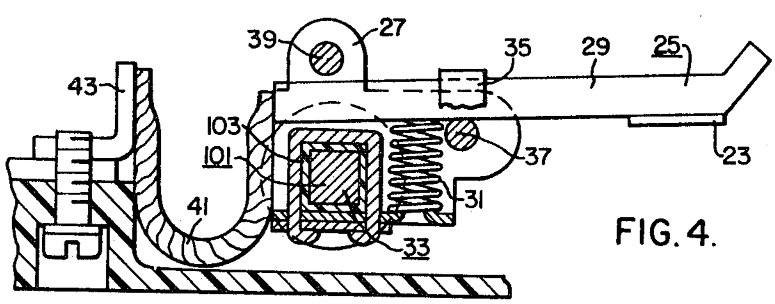


FIG. 4.

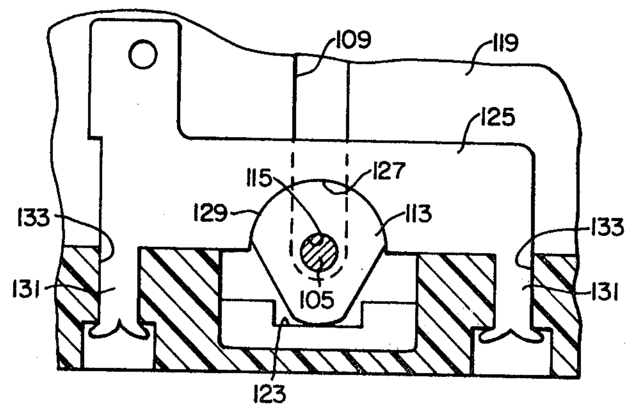


FIG. 5.

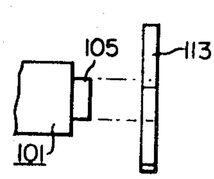


FIG. 6.

MULTIPOLE CIRCUIT INTERRUPTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to multipole circuit interrupters of the type comprising a metal-core tie bar supporting a plurality of movable contact arms structures for simultaneous movement between open and closed positions. In this type of interrupter, it is necessary to insulate at least one end of the metal core from the associated metal support plate in order to avoid a phase-to-phase fault from the one outer pole-unit contact arm structure to the one metal core then through the metal core to the other metal support plate to the other outer pole-unit contact arm structure. For some applications, it is necessary to insulate both ends of the metal core from the associated metal support plates for adequate protection against phase-to-phase fault between the outer pole units.

2. Description of the Prior Art

One prior art way of supporting the metal-core tie bar and insulating the interrupter to avoid the above-mentioned phase-to-phase fault through the metal core is to drill holes in the ends of the metal core and cement insulating pivot support pins in those holes. The insulating pivot support pins are then pivotally supported on two outer metal support plates in openings in the support plates, and insulating washers are mounted on the insulating pins between the metal core and the sidewalls of the metal support plates.

SUMMARY OF THE INVENTION

The movable contact arm structures of a multipole insulating-housing-type circuit breaker are supported, for simultaneous movement, on a tie bar that comprises a rigid metal core and an insulating cover on the core. The metal core is machines at the opposite ends thereof to provide a pair of metal support pins. A pair of flat insulating bearing members are mounted on the pins, and the assembly is dropped into the base of the housing with the pins moving down in sidewall slots provided in the housing base. Each of the insulating bearings engages the associated housing sidewall at one side thereof and the steel core at the other side thereof to support the tie bar against lateral movement. A pair of flat metal support plates are dropped in the housing along the sidewalls of the housing over the insulating bearings with an undersurface of each of the plates engaging the front surface of the associated insulating bearing to support the associated insulating bearing and tie bar against upward movement. The insulating bearings, and tie bar, are supported against backward movement by the engagement of the back surfaces of the insulating bearings with support surfaces on the housing base. Each of the metal support plates comprises a pair of legs that are moved through associated openings in the bottom of the base and spun over or riveted over to fix the support plate on the base. Thus, the tie bar, which is readily assembled in the housing base, is supported on the insulating bearings for pivotal movement about the elongated axis thereof with the insulating bearings providing adequate insulation to prevent a phase-to-phase fault between the outer pole units through the metal core.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view, with parts broken away, of a three-pole circuit breaker constructed in accordance with principles of the invention;

FIG. 2 is a side sectional view through the center pole unit taken generally along the line II–II of FIG. 1;

FIG. 3 is an end view with parts broken away of the tie bar and parts of the insulating base;

FIG. 4 is a partial sectional view taken generally along the line IV–IV of FIG. 3;

FIG. 5 is a partial sectional view taken generally along the line V–V of FIG. 3; and

FIG. 6 is a partial view illustrating the end of the tie bar and one of the insulating bearings before the bearing is moved onto the tie bar.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown, in FIGS. 1 and 2, a multipole molded-case-type circuit breaker **5** comprising an insulating housing **7** and a circuit breaker structure **9** supported in the housing **7**. Except for the means for supporting and insulating the tie bar, the circuit breaker structure **9** is of the type that is more specifically described in the U.S. Pat. to E. J. Walker et al. No. 3,418,607 which discloses a two-pole circuit breaker as opposed to the three-pole circuit breaker shown in FIGS. 1 and 2. Thus, only a brief description of the circuit breaker structure **9** is herein provided.

The insulating housing **7** is a two-part housing comprising a molded insulating base **11** and a molded insulating cover **13** secured to the base **11**. A pair of insulating barriers **15** (only one being seen in FIG. 2) molded integral with the insulating cover **13**, cooperate with a pair of insulating base **11**, to separate the housing into three adjacent internal pole-unit compartments for housing the three pole units of the circuit breaker.

Each pole of the circuit breaker includes a stationary contact **19** and a movable contact **23**. The stationary contact **19** is mounted on the inner end of a conductor **25** that extends into an open cavity in the one end of the housing where a solderless terminal connector **28** is secured to the conductor **25** to enable connection of the pole unit in an electric circuit. The movable contact **23** is part of a movable contact arm structure **25** the includes a switch arm **27**, a contact arm **29** having the contact **23** secured thereto, and a contact arm **29** having the contact **23** secured thereto, and a contact-pressure spring **31**. The switch arm **27** is fixedly secured to a common tie bar **33**. The contact arm is pivotally supported on the switch arm **27** by means of an inverted U-shaped strap **35** (FIG. 4) that is secured to the contact arm **29** and that is provided with openings in the opposite legs thereof for receiving a pin **37**. The switch arm **27** is a generally U-shaped member comprising a pair of sidewalls with the pin **37** being supported thereon between the sidewalls of the switch arm. A pin **39** (FIG. 4) is supported between the sidewalls of the switch arm **27** for limiting clockwise movement of the switch arm **29** about the pivot **37**. A contact-pressure spring **31** is supported between the bight portion of the generally U-shaped switch arm **27** and the undersurface of the contact arm **29** to bias the contact arm **29** in a clockwise direction about the pin **37** to thereby provide contact pressure between the contacts in the closed position of the contact arm structure. In each pole unit, a flexible conductor **41** is connected at one end thereof to the associated contact **41** is connected at one end thereof the the associated contact arm **29** and at the other end thereof to a conductor **43** that is in turn secured to a looped conductor **45** that is in turn secured to a conductor **47** that extends into a cavity at the outer end of the circuit breaker where a solderless terminal connector **49** is secured to the conductor **47** in order to permit connection of the pole unit in an electric circuit. As can be understood with reference to FIG. 2, the circuit through each pole unit extends from the terminal connector **49** through the conductor **47**, conductor **45**, conductor **43**, flexible conductor **41**, contact arm **29**, movable contact **23**, stationary contact **19**, conductor **25** to the other solderless terminal connector **27**.

The contact arm structures **25** for the three-pole units are simultaneously operated between the open and closed positions by operation of a single operating mechanism **51** that is located in the center pole-unit compartment. The operating mechanism **51** is supported on a pair of supporting plates **53** (only one of which is seen in FIG. 2) that are supported in the center pole-unit compartment. An inverted generally U-shaped operating member **55** is pivotally supported at the inner ends of the legs thereof in U-shaped notches in the frame or plates **53**. A releasable trip member **57** is pivotally supported on the plates **53** by means of a pin **59**. One end of the releasable trip member **57** is latched in the operating position seen in FIG. 2 by means of a latch mechanism **61**. A pair of toggle links **63** and **65** are pivotally connected together by means of a knee pivot **67**. The upper toggle link **63** is pivotally connected to the releasable trip member **57** by means of a pivot pin **69** and the lower toggle link **65** is pivotally connected to the switch arm **27** of the center pole unit at the pivot pin **37**. A pair of tension springs **73** (only one of which is seen in FIG. 2) are supported under tension between the knee pivot **67** and the bight portion of the operating member **55**. An insulating member **75**, which is connected to the front portion of the operating member **55**, comprises a handle part **77** that protrudes out through an opening **79** in the housing cover to permit manual operation of the circuit breaker.

The tie bar **33** is supported for pivotal movement about the elongated axis thereof in a manner to be hereinafter more specifically described. In order to manually open the circuit breaker, the handle **77** is moved from the closed position seen in FIG. 2, in a counterclockwise direction about the pivot at the inner legs of the operating member **55**, to the open position. During this movement, the line of action of the overcenter springs **73** is moved to the left to collapse the toggle **63**, **65** to thereby move the contact arm structure **25** of the center pole unit to the open position which movement, because all three of the contact arm structures **25** are fixed to the tie bar **33**, pivots the tie bar **33** to simultaneously move all three contact arm structures **25** to the open position. The contact arm structures **25** are stopped in the open position by engagement of the center-pole contact arm **29** with a stop pin **81** that is supported between the center-pole supporting plate **53**. The circuit breaker is manually closed by moving the operating member **55** in a clockwise direction which movement moves the line of action of the tension spring **73** to the right to erect the toggle **63**, **65** thereby moving the contact arm structure **25** for the center-pole unit to the closed position seen in FIG. 2 which movement, because all three of the contact arm structures **25** are fixedly secured to the common tie bar **33**, pivots the tie bar **33** to simultaneously move all three contact arm structures **25** to the closed position.

The latch structure **61** (FIG. 2) is latched by means of a common insulating trip bar **83** that is operated upon the occurrence of an overload in any of the pole units to release the latch structure **61** to thereby release the trip member **57** to effect a tripping operation of the circuit breaker. In each pole unit, there is a thermal and magnetic trip device **85** that is operated upon the occurrence of overload currents to move the trip bar **83** to the tripped position. The operation of the trip device **85** and the tripping operation of the circuit breaker, along with the resetting operation following a tripping operation, is more specifically described in the abovementioned patent to E. J. Walker et al. U.S. Pat. No. 3,418,607. When the trip member **57** is released, the tension springs **73** pivot the trip member **57** in a clockwise direction and the springs collapse the toggle **63**, **65** to move the contact arm structures **25** to the open position. Following a tripping operation, the circuit breaker is reset by movement of the handle **77** to a position slightly past the full "off" position during which movement a shoulder portion **87** of the operating member **55** engages a shoulder portion **89** on the trip member **57** to rotate the trip member **57** in a counterclockwise direction, and the trip member **57** is relatched in a well-known manner by the latch structure **61** at the end of this movement. Thereafter, the operating handle **77** can be released and the circuit breaker can be operated in the same manner as was hereinbefore described.

The trip bar **83** and tie bar **33** both extend transversely across the circuit breaker into all three pole-unit compartments. The insulating barriers **17** on the base **11** are provided with slots or openings therein to permit mounting of the trip bar **83** and tie bar **33** extending through the openings in the barriers **17** to reach all three compartments. During the assembly of the breaker, when the housing cover **13** is removed, the trip bar **83** and tie bar **33** are dropped down into the base **11** into the mounted position on the base. The openings in the barriers **17** are then closed by suitable interlocking barriers. When the assembly of the complete mechanism on the base is completed, the cover **13** is secured to the base **11**, and cover barriers **15** cooperate with the base barriers **17** and the additional barriers to thereby insulate the adjacent pole-unit compartments from each other.

Improved means is provided for pivotally mounting the tie bar **33** in the circuit breaker housing for providing adequate insulation to prevent a phase-to-phase fault through the metal core of the tie bar **33**. Referring to FIGS. 2—4, the tie bar **33** comprises a rigid steel core **101** and an insulating sleeve cover **103** on the steel core **101**. The steel core **101** is machined at the opposite ends thereof to form steel pivot pin parts **105** at the opposite ends of the steel core. The outer sidewalls **107** (FIG. 3) of the insulating base **11** are formed with slots **109** (FIGS. 2, 3 and 5) therein which slots are open at the top of the open base **11**. The top of the housing base **11** is illustrated at the line **108** (FIGS. 2 and 3) where the cover **13** engages the base **11**. A pair of flat rigid insulating bearings **113**, each of which has an opening **115** (FIG. 5) therein for receiving the associated pin **105** to support the pin **105** for pivotal movement therein, are mounted on the support pins **105** at the opposite ends of the tie bar **33**. During the assembly operation, when the housing cover **13** is removed, the tie bar **33**, with the movable contact structures **25** mounted thereon and with the insulating bearings **113** mounted on the pivot support pins **105**, is dropped down into the base **11** through the open top of the base **11**, during which movement, the pins **105** move down into the slots **109** which are open at the top of the base **11**. As can be understood with reference to FIG. 3, each of the insulating bearing members **113** engages the associated inner sidewall **119** of the associated housing sidewall **107** at one flat face thereof and the surface area **121** of the steel core at the other flat side thereof to support the tie bar **33** against lateral, or axial, movement. The surface area **121** (FIG. 3) of the steel core is that surface area that is left at the end of the steel core after machining the core to provide the pivot pin parts **105**. Each of the insulating bearing members **113** engages a bottom surface **123** (FIGS. 3 and 5) of the insulating base **11** to support the tie bar **33** against downward movement. A pair of flat rigid metal support plates **125** are then dropped down into position on the base and secured to the base to support the bearings **113** against upward movement in the housing. As can be best understood with reference to FIG. 5, each of the support plates **125** comprises an annular undersurface (a thickness or end surface) **127** that engages and mates with an annular front surface (a thickness or end surface) **129** of the associated insulating bearing **113** to limit upward or frontward movement of the insulating bearing **113**. Each of the support plates **125** comprises a pair of legs **131** that extend through openings **133** in the bottom of the base **11**, with the outer ends of the legs **131** being riveted over or spun over to fixedly secure each supporting plate **125** in position on the housing base **11**. As can be understood with reference to FIG. 5, the insulating bearing member **113** provides insulation between the periphery of the metal support pin **105** and the surface **127** of the metal support plate **125**. Each insulating bearing member **113** engages a surface **123** of the housing base **11** to support the bearing **113** and tie bar **33** against backward or downward movement, and the surface **127** of the associated support plate **125** to support the bearing **113** and tie bar **33** against frontward or upward movement. As was hereinbefore set forth, each insulating bearing member **113** engages the surface **119** of the associated sidewall **107** of the insulating base **11** at one side thereof and the surface **121** (FIG. 3) of the tie bar **33** at the other side thereof to support the tie bar **33** against lateral or axial (FIG. 3) movement. In the closed position of the contacts (FIG. 4) the contact-pressure spring **31** is compressed between the contact arm **25** and switch arm **27** to exert a downward force on the tie bar **33** with the insulating bearings **113** engaging the surfaces **123** of the base **11** to support the insulating bearings 113 and tie bar 33 against downward movement. The circuit breaker is shown in the closed position in FIG. 2. As was hereinbefore set forth, when the circuit breaker is operated to either the open or the tripped positions, the springs 73, which are under tension, collapse the toggle 63, 65 to operate the contact arm structures 25 to the open position. When the toggle 63, 65 is collapsed, the tension springs 73 have not fully discharged and that they are still under some tension operating against the knee pivot 67 to operate through the toggle link 65 to bias the tie bar 33 generally frontward or upward with the tie bar 33 being supported against frontward or upward movement by the engagement of the front surfaces 129 (FIG. 5) of the insulating bearing members 113 with the undersurfaces 127 of the supporting plates 125. During operation of the circuit breaker, the insulating bearing members 114 remain stationary with the pivot pin parts 105 of the steel core of the tie bar 33 pivoting in the openings 115 of the bearing members 113. One of the bearing members 113 and part of the tie bar 33 are shown in the exploded position in FIG. 6. The assembly of the tie bar 33 in the breaker base 11 is easy in that the bearings 113 are merely placed on the pivot pins 105 and the tie bar is dripped down into the base with the pins 105 moving down in the slots 109 of the housing base sidewalls 107, and thereafter the support plates 125 are dropped down into the base with the leg portions 131 passing through the openings 133 in the bottom of the base to be riveted over as shown in FIG. 5 in order to securely mount the tie bar 33 in position for pivotal operating movement. The insulating bearings 113 provide the additional insulation to prevent a phase-to-phase fault or flashover from the one outer pole-unit contact arm structure 25 (FIG. 3) through the one steel support plate 125, the steel core 101 of the tie bar 33, the other steel support plate 125 to the other movable contact arm structure 25 of the other outer pole unit. For some applications, it is sufficient to provide an insulating bearing member 113 at only one end of the tie bar 33 and to pivotally mount the other end of the tie bar 33 in a suitable opening in a suitable metal support plate 125. For other applications, it is desirable to provide two of the insulating bearing members 113 for adequate insulation to protect against the phase-to-phase fault between the two outer pole units through the steel core 101. The insulating bearing members 113 can be any suitable rigid insulating material. For example, they can be made of a paper or cloth base resin-impregnated laminate. Bearing members 113 of a phenolic resin cotton laminate constructed in accordance with the above description have worked satisfactorily.

I claim:

1. A multipole circuit interrupter comprising an insulating housing, a circuit interrupter mechanism supported in said insulating housing,

said circuit interrupter mechanism comprising a stationary contact for each pole, a movable contact arm structure for each pole cooperating with the associated stationary contact, an elongated tie bar common to all of said poles, said movable contact arm structures being supported on said tie bar for simultaneous movement with said tie bar, said tie bar comprising a rigid metal bar and an insulating cover on said metal bar,

support means supporting said tie bar for pivotal movement about the elongated axis thereof, said tie bar at at least one end thereof comprising a metal support pin, an insulating bearing having an opening therein receiving said support pin for pivotal movement in said opening, a support surface on said housing engaging said insulating bearing to support said insulating bearing against backward movement in said housing, and a metal support plate over said insulating bearing secured to said housing to support said insulating bearing against frontward movement in said housing.

2. A multipole circuit interrupter according to claim 1, said metal bar comprising a shoulder surface at said one end thereof in proximity to said support pin, said insulating housing comprising a sidewall having a slot therein, said support pin being positioned in said slot with said insulating bearing engaging said shoulder surface of said metal bar at one side thereof and the internal sidewall surface of said housing adjacent said slot at the other side thereof to support said tie bar against axial movement toward said sidewall.

3. A multipole circuit interrupter according to claim 2, said support plate being a flat support plate having a thickness undersurface, said insulating bearing being a flat insulating bearing having a thickness front surface engaging said thickness undersurface of said support plate to limit frontward movement of said insulating bearing.

4. A multipole circuit interrupter according to claim 3 said insulating housing having a pair of openings in the back thereof, said support plate comprising a pair of legs extending through said openings and being riveted over to fixedly support said support plate in said housing.

5. A multipole circuit interrupter according to claim 4, said insulating housing being a two-part housing comprising an insulating base and an insulating cover secured to said insulating base, said slot being in the sidewall of said insulating base and being open at the front of said insulating base whereby said tie bar is mounted by being dropped in said base with said insulating bearing thereon during which movement said support pin moves down through the open front of said slot to the mounted position in said base.

6. A multipole circuit interrupter according to claim 3, ans said insulating bearing separating the periphery of said support pin from said undersurface of said support plate by a dimension greater than the diameter of said support pin.

7. A multipole circuit interrupter according to claim 1, said tie bar comprising a separate metal support pin at each of the two opposite ends thereof, a pair of said insulating bearings, each of said insulating bearings having an opening therein receiving a different one of said support pins, a pair of said support surfaces on said housing engaging said insulating bearings to support said insulating bearings an tie bar against backward movement in said housing, a pair of said metal support plates, each of said metal support plates being supported over a different one of said insulating bearings and being secured to said housing whereby said metal support plates support said insulating bearings and tie bar against frontward movement in said housing.

8. A multipole circuit interrupter according to claim 7, said metal bar comprising a separate shoulder surface at each end thereof with each shoulder surface being in proximity to the associated support pin, said insulating housing comprising a pair of sidewalls with each sidewall having a slot therein, said support pins being positioned in said slots with each of said insulating bearings engaging the associated shoulder surface of said metal bar at one side thereof and the associated internal sidewall surface of said housing adjacent the associated slot at the other side thereof whereby said insulating bearings support said tie bar against axial movement in said housing.

9. A multipole circuit interrupter according to claim 8, each of said support plates being a flat support plate having a thickness undersurface, each of said insulating bearings being a flat insulating bearing having a thickness front surface engaging the associated thickness undersurface of the associated support plate to limit frontward movement of the insulating bearing.

10. A multipole circuit interrupter according to claim 9, said insulating housing being a two-part housing comprising an insulating base and an insulating cover secured to said insulating base, said slots being in the sidewalls of said insulating base and being open at the front of said insulating base whereby said tie bar is mounted by being dropped in said base with said insulating bearings thereon during which movement said support pins move down through the open front of said slots to the mounted position in said base, said insulating base having a pair of openings in the back thereof for each of said support plates, each of said support plates comprising a pair of legs ex-

tending through the associated openings and being riveted over to fixedly support the support plate in said housing, and each of said insulating bearings separating the periphery of the associated support pin from the associated undersurface of the associated support plate by a dimension greater than the diameter of the associated support pin.