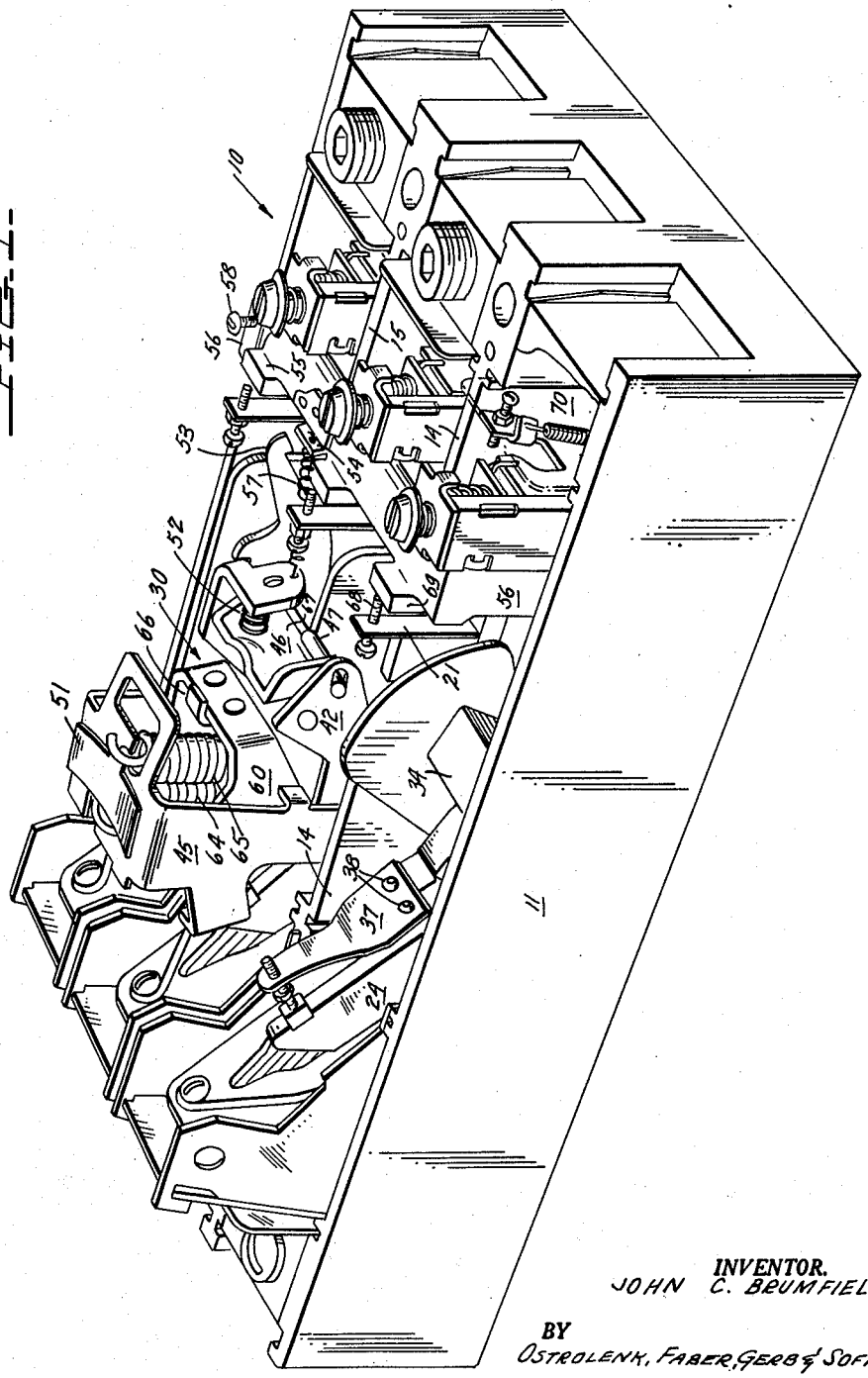
May 4, 1965 J. C. BRUMFIELD 3,182,157

OVER-CENTER CAM AND ANTI-REBOUND MEANS

Filed May 9, 1961 6 Sheets-Sheet 1

FIG. 1



INVENTOR.
JOHN C. BRUMFIELD

BY
OSTROLENK, FABER, GERB & SOFFEN

ATTORNEYS

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OVER-CENTER CAM AND ANTI-REBOUND MEANS

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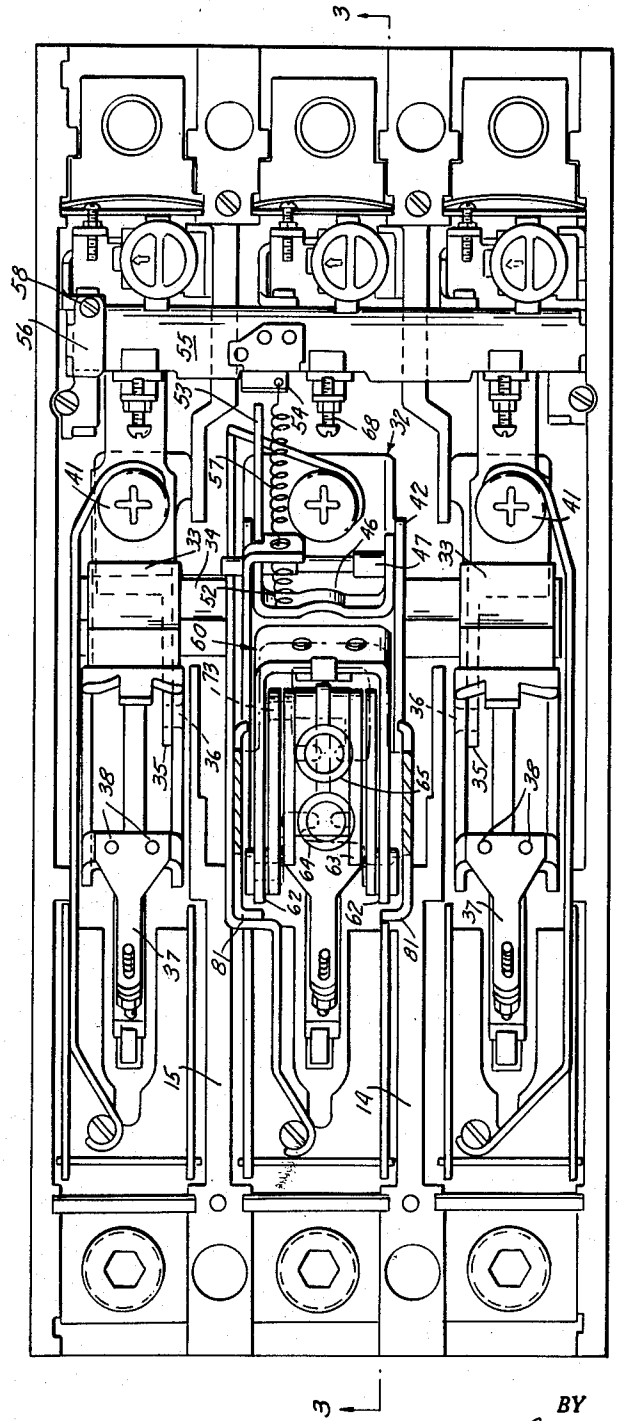


FIG. 2.

INVENTOR.
JOHN C. BRUMFIELD

BY
OSTROLENK, FABER, GERB & SOFFEN

ATTORNEYS

May 4, 1965 J. C. BRUMFIELD 3,182,157

OVER-CENTER CAM AND ANTI-REBOUND MEANS

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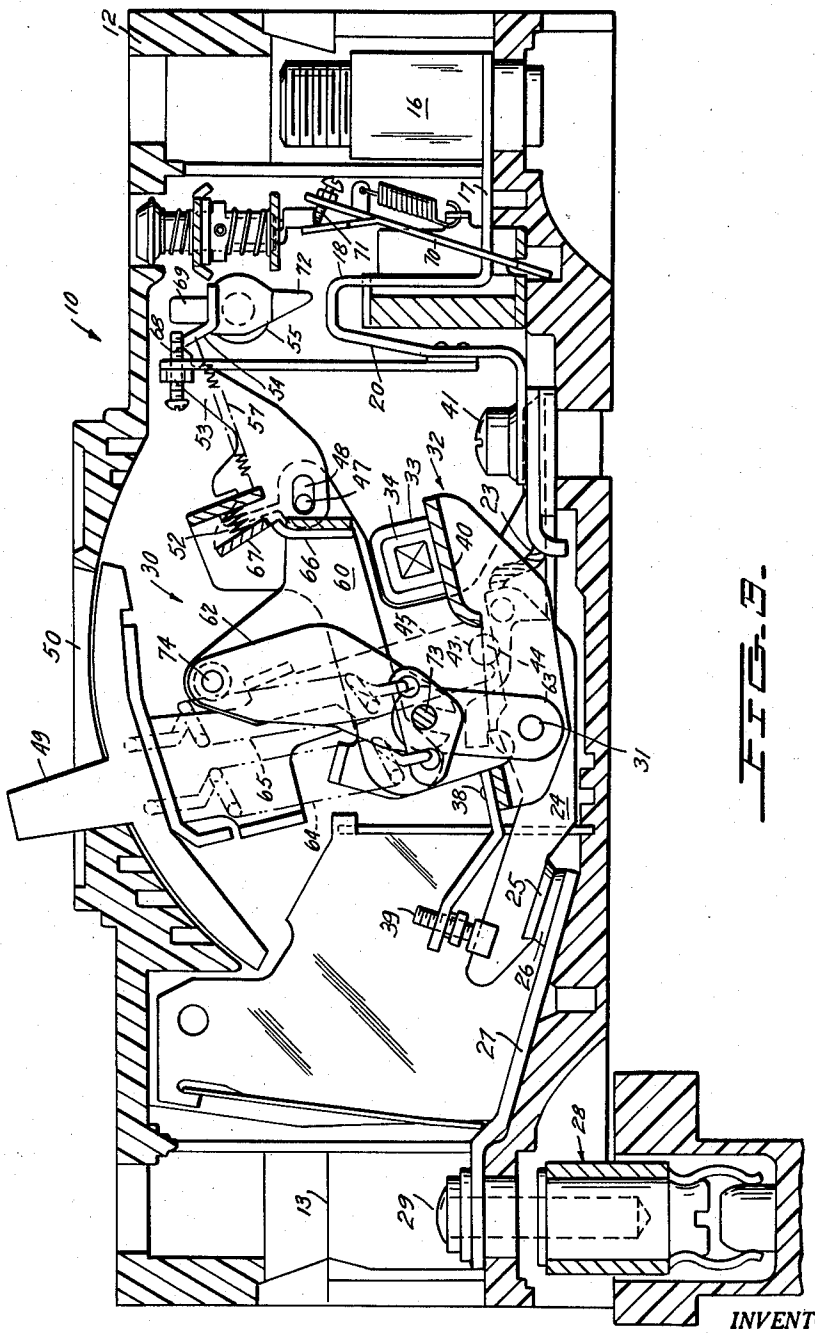


FIG. 3.

INVENTOR.
JOHN C. BRUMFIELD

BY
OSTROLENK, FABER, GERB & SOFFEN

ATTORNEYS

May 4, 1965 J. C. BRUMFIELD 3,182,157

OVER-CENTER CAM AND ANTI-REBOUND MEANS

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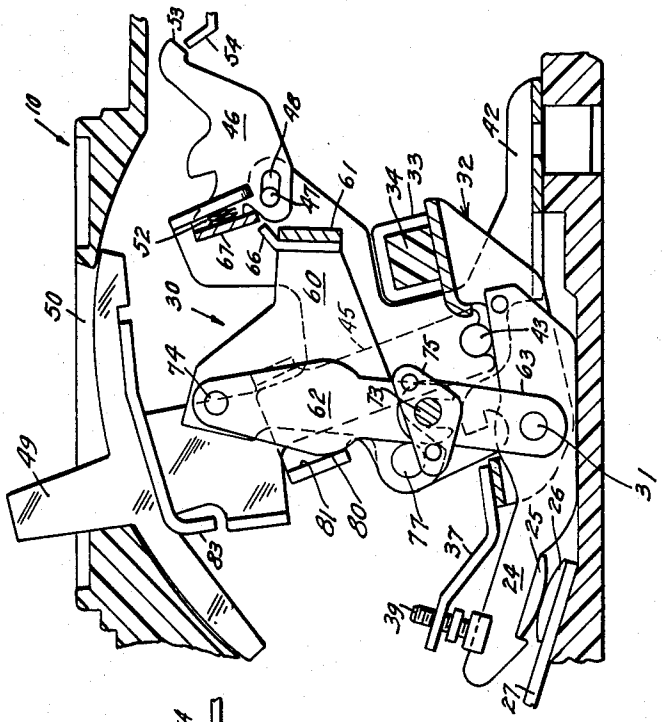


FIG. 5.

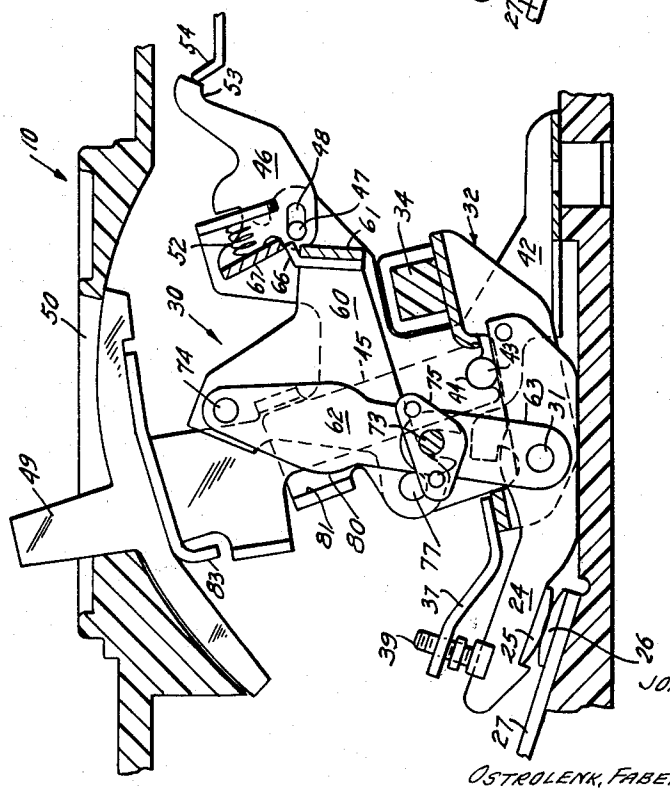


FIG. 4.

INVENTOR.
JOHN C. BRUMFIELD

OSTROLENK, FABER, GERB & SOFFEN
ATTORNEYS

May 4, 1965 J. C. BRUMFIELD 3,182,157

OVER-CENTER CAM AND ANTI-REBOUND MEANS

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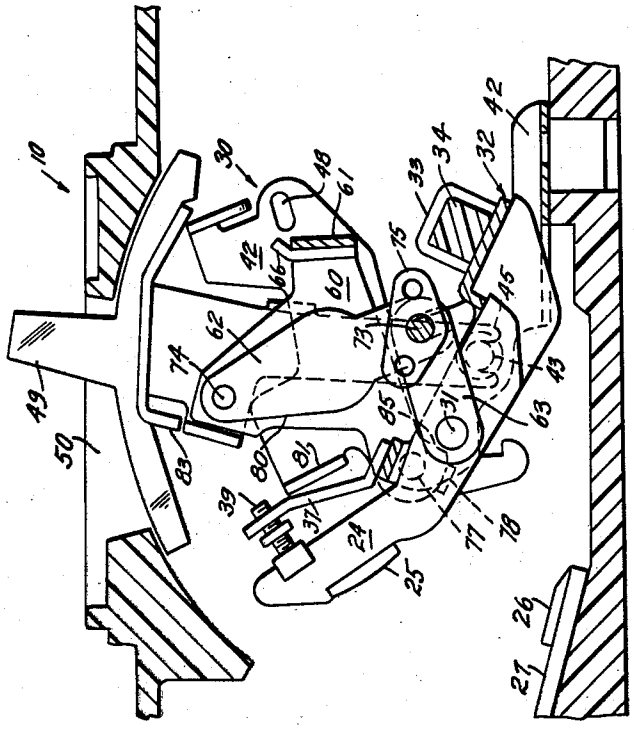


FIG. 7

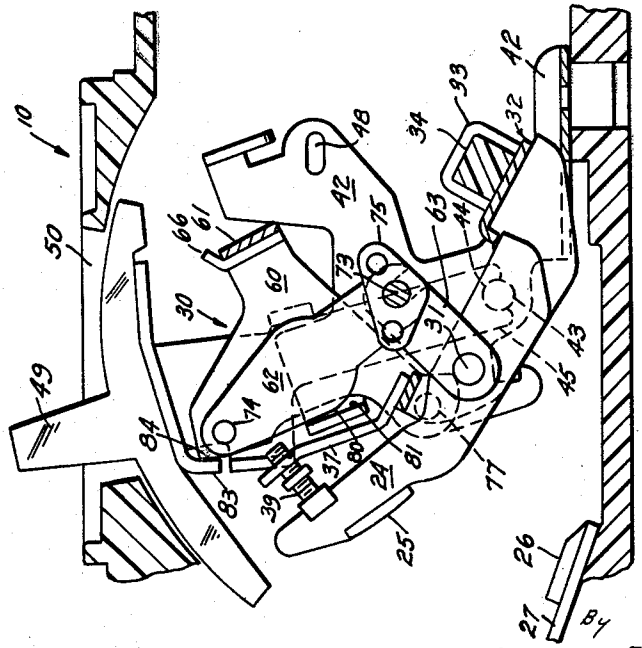


FIG. 6

INVENTOR.
JOHN C. BRUMFIELD

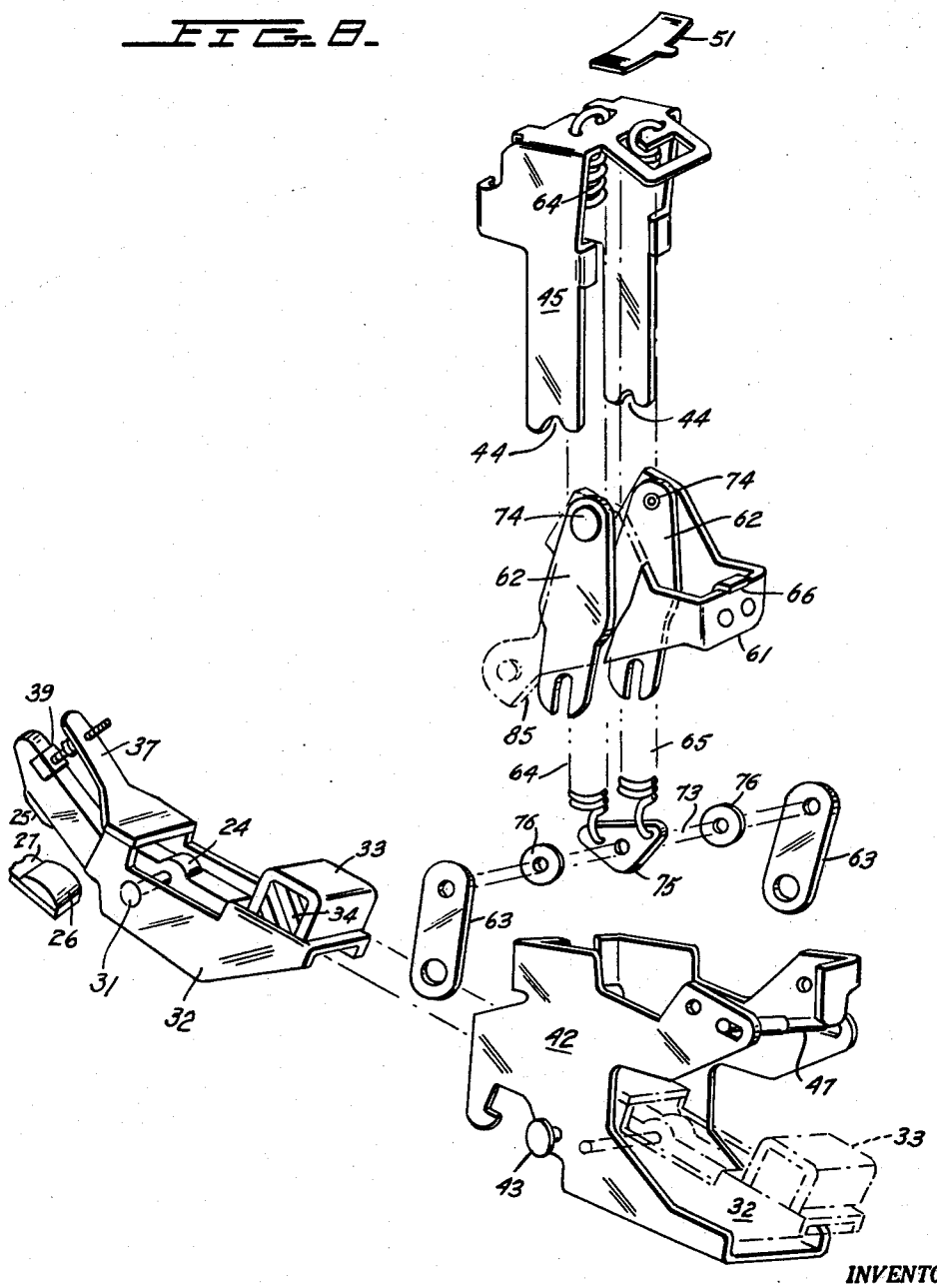
By
OSTROLENK, FABER, GERB & SOFFEN
ATTORNEYS

May 4, 1965 J. C. BRUMFIELD 3,182,157

OVER-CENTER CAM AND ANTI-REBOUND MEANS

Filed May 9, 1961 6 Sheets-Sheet 6

FIG. 8.



INVENTOR.
JOHN C. BRUMFIELD

BY
OSTROLENK, FABER, GERB & SOFFEN
ATTORNEYS

United States Patent Office 3,182,157 Patented May 4, 1965

3,182,157

OVER-CENTER CAM AND ANTI-REBOUND MEANS

John C. Brumfield, Philadelphia, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed May 9, 1961, Ser. No. 108,811
11 Claims. (Cl. 200—153)

This invention relates to multi-phase molded case circuit breakers in general and more particularly to a novel construction for the contact operating mechanism thereof, including a U-shaped cradle the utilization of which achieves faster contact speed and enables greater contact separation for a given overall case size.

In multi-phase molded case circuit breakers it is customary to utilize a single contact operating mechanism for all phases. Typically, a circuit breaker of this type is a three-phase unit in which the current carrying paths through the phases are identical and parallel to each other with the single operating mechanism positioned in the center phase.

The contact operating mechanism usually comprises a latchable cradle mechanism for supporting a toggle linkage operatively connected to move the movable contacts into and out of engagement with the stationary contacts under the influence of the main operating springs. With the cradle unlatched the mechanism cannot operate the toggle linkage so as to bring the contacts into engagement.

In previous designs the cradle was placed in the center plane of the mechanism between the toggle linkages and the operating springs. As larger contact travel was required in order to obtain greater contact separation, it became necessary to move the cradle pivot away from the area of contact motion or else shape the movable contact arm in such a manner as to clear the cradle bushing when the contacts were disengaged. Either prior art arrangement required increased overall mechanism height which is usually not available. It was thought that moving the cradle bushing would solve the problem. However, it was found that additional clearance for the operating springs was required when the cradle bushing was moved.

As a means of saving material and space, circuit breaker designers have for years been striving to achieve more compact constructions. For the reasons outlined above, a limiting factor appeared to be the cradle bushing.

The circuit breaker construction to be hereinafter described overcomes the difficulty of the prior art by providing a latchable cradle constructed as a U-shaped member with the bushings therefor extending outwardly from the arms of the U. The toggle linkage and operating springs are placed between the arms of the U. Since the cradle bushing does not span the toggle linkage and spring area, the cradle bushing does not interfere with movement of the spring or contact linkage, so that greater contact travel and increased operating forces are possible within smaller space limits than was possible with prior art constructions.

Prior art constructions, in order to preserve symmetry, required that an equal number of springs be positioned on each side of the cradle. Thus, at least two springs were required. With the utilization of a U-shaped cradle, a single operating spring may be utilized, thereby reducing the number of parts and the number of handling operations required during assembly. Even when two springs are utilized they may be placed side by side in the center plane of the mechanism so that overall width may be

maintained at a minimum. In prior art constructions the springs were on opposite sides of the center plane.

The instant invention provides a construction whereby contact travel is more rapid during an automatic tripping operation than in contact travel of prior art devices. In prior art devices, during the tripping operation the movable contact arm moved very little during the initial large movement of the cradle until such time as the knee of the toggle was moved over center. By this time the operating springs had expended most of their energy, so that movement of the contact arm thereafter for most of its travel was at relatively slow speed.

In the device of the instant invention, the knee of the toggle rests against the cradle when the circuit breaker is closed. Upon automatic tripping the cradle and toggle move as a unit for a very short distance. Thereafter, a stationary surface is engaged by a rounded surface of one of the toggle links, driving the knee of the toggle over center very soon after movement of the cradle is initiated and while the operating springs are still heavily loaded. Thus, from this point on, movement of the contact arm is very rapid, resulting in improved interruption.

The construction provided by this invention is such that with the contacts fully separated after an automatic tripping operation, the rounded surface of the toggle, previously mentioned, is positioned extremely close to a stationary surface. If the movable contact tends to rebound, the rounded surface rengages the stationary surface, thereby limiting the rebound of the contact arm to a very short travel. Additional travel is strongly resisted by the operating spring. In addition, oscillations are very slight since the operating spring is very lightly loaded until the surfaces engage on rebound.

In prior art circuit breakers, as the contacts are brought into engagement, the toggle linkage, as it is brought over center, has the movement thereof abruptly arrested by engagement with a surface positioned normal to its direction of toggle travel. This places a great strain on the connecting pins of the toggle and cradle. In the device of this invention, upon circuit breaker closing, the knee of the toggle engages a surface of the cradle positioned at an incline with respect to the knee direction of travel. The sloping surface permits overtravel with the contact pressure spring absorbing excess energy.

Accordingly, a primary object of this invention is to provide a novel contact operating mechanism for a circuit breaker.

Another object is to provide a circuit breaker mechanism having novel means for kicking the knee of a toggle mechanism over center during automatic tripping.

A further object is to provide a circuit breaker contact operating mechanism having novel antirebound features.

A still further object of this invention is to provide a contact operating mechanism with novel means for reducing wear of the cradle and toggle linkage pins.

These as well as other objects of this invention shall become readily apparent after reading the following description of the accompanying drawings in which:

FIGURE 1 is a perspective of a circuit breaker constructed in accordance with the teachings of the instant invention. The cover of the circuit breaker is removed to reveal the internal mechanism thereof.

FIGURE 2 is a plan view of the circuit breaker in FIGURE 1 with the cover removed.

FIGURE 3 is a cross-section taken through the center phase of the circuit breaker through line 3—3 of FIGURE 2 looking in the direction of arrows 3—3.

FIGURES 4–7 are side elevations of the contact operating mechanism with certain elements partially cut away. In FIGURE 4 the circuit breaker is in the closed position. In FIGURE 5 the circuit breaker, after having been in a

closed position, is tripped and the upper toggle has just engaged a stationary surface of the frame, which will rapidly force the knee of the toggle over center. In FIGURE 6 the mechanism is in the tripped open position. In FIGURE 7 the mechanism is in the manual open or reset position.

FIGURE 8 is an exploded view of the contact operating mechanism.

Now referring to the figures; circuit breaker **10** is provided with a molded insulated housing comprising base **11** and removable cover **12** joined along line **13**. Circuit breaker **10** is a three-phase unit, so that base **11** is divided into three parallel compartments by partitions **14**, **15**. Each of the parallel compartments houses the current carrying members for the respective phases.

Since each phase is comprised of identical current carrying members, only the current carrying parts of the center phase will be described. These current carrying parts comprise load terminal connector **16**, load terminal **17**, the looped extension **18** thereof extending through instantaneous trip magnet **19**, through a portion **20** of terminal **17** having a reduced cross-section so as to serve as an indirect heater for bimetal time delay tripping element **21**. The current path continues through conductor **22**, flexible braid **23**, movable contact arm **24**, and movable contact **25** to stationary contact **26**, which is mounted upon line terminal strap **27**, having tulip line terminal connector **28** mounted thereto by screw means **29**.

The movable contacts **25** of all three phases are operated simultaneously into and out of engagement with their respective stationary contacts **26** by means of a single operating mechanism **30** which is positioned in the center compartment. Each of the movable contact arms **24** is pivotally mounted at **31** to its individual U-shaped holder **32** between the arms thereof. Each holder is provided with a portion **33** which defines a rectangular opening having insulating tie rod **34** disposed therein. Tie rod **34** extends through all three housing compartments so that the contact arm holders **32** of all three phases are mounted thereto. The outer phases are each provided with angle brackets **35** which provide support for bearing pins **36** to which holders **32** are pivotally mounted. It is clearly seen that movement of tie rod **34** brings about the simultaneous movement of all three contact arms **24**.

Leaf spring **37**, fixedly mounted to holder **32** by rivet **38**, acts upon adjusting screw **39** to urge contact arm **24** in a counterclockwise direction with respect to FIGURE 3 toward engagement with holder surface **40**. As clearly seen in FIGURE 3, when contacts **25**, **26** are in engagement, contact arm **24** is spaced from holder surface **40**. In the outer two phases, screw means **41** secures load terminal member **17**, conductor **22** and bracket **35** to base **11**, while in the center phase screw means **41** secures load terminal strap **17**, conductor **22** and mechanism frame **42** to base **11**.

Frame **42** is a somewhat U-shaped member having pins **43** extending outwardly from the arms thereof. Operating member **45** straddles frame **42** with pins **43** being disposed within the open ended slots **44** at the lower end (with respect to FIGURE 1) of operating member **45**. Manual operating handle **49** is mounted at the upper end of member **45** and includes a portion extending externally of housing **11**, **12** through aperture **50** in cover **12**. Spring **51**, interposed between member **45** and handle **49** biases a portion of handle **49** against the inner surface of cover **12**.

Intermediate latch member **46** is pivotally mounted on shaft **47** whose ends are guided by elongated slots **48** in the load end of frame **42**. Spring **52**, interposed between frame **42** and latch member **46**, biases latch member **46** counterclockwise about pivot **47** toward latching position. Latch extension **53** of member **46** extends toward the breaker load end and is engageable with latch plate **54** carried by common tripper bar **55**.

Bar **55** is an insulating member extending across all three base compartments being pivotally mounted at the ends thereof to uprights **56**. Tension spring **57** biases bar **55** counterclockwise to latching position which is established through its engagement with adjusting screw **58** threadably mounted to one of the uprights **56**.

Operating mechanism **30** also includes cradle **60**, a toggle linkage comprising links **62**, **63**, and operating spring means **64**, **65**. As best seen in FIGURE 2, cradle **60** is a generally U-shaped member whose web **61** faces the load end of circuit breaker **10** when cradle **60** is in latched position as in FIGURES 4 and 7. Cradle **60** is maintained in this position through the engagement of latch plate **66**, mounted to web **61**, with the web **67** of intermediate latch member **46**, whose extension **53** is in engagement with latch plate **54**, carried by tripper bar **55**. Cradle **60** is biased to its tripped position of FIGURE 6 by spring means **64**, **65**, as will become evident as this description proceeds.

Common tripper bar **55** is rotatable in a clockwise direction upon the occurrence of predetermined circuit conditions to release the cooperative engagement of members **53**, **54** and **66**, **67**. That is, upon the occurrence of a persisting fault the free end of bimetal **21** deflects to the right with adjusting screw **68** engaging tripper bar extension **69**. Upon the occurrence of a severe overload, armature **70** will be attracted by magnet **19** with adjusting screw **71** moving to the left to engage tripper bar extension **72**.

Pins **77** extending outwardly from the arms of cradle **60** pivotally mount cradle **60** to frame **42**. Toggle linkage **62**, **63** as well as spring means **64**, **65** are mounted between the arms of cradle **60**. It is to be noted that each of the toggle links **62**, **63** are split members.

Lower toggle link **63** is connected at one end to movable contact arm **24** at pin **31** while the other end is connected to pin **73** which forms the knee of toggle linkage **62**, **63**. Upper toggle link **62** is connected at one end to pin **73** and at the other end is pivotally connected at **74** to cradle **60**. The upper ends of springs **64**, **65** are secured to operating member **45** while the lower ends of springs **64**, **65** are secured to plate **75** which is pivotally mounted to pin **73**. Collars **76** position links **62**, **63** axially on pin **73**.

Springs **64**, **65** are tension members so it is readily seen that they bias cradle **60** counterclockwise about pins **73**, bias operating member **45** against pins **43**, and bias contacts **25**, **26** both into and out of engagement depending upon the position of toggle knee **73**.

Circuit breaker **10** is operated manually between the On (FIGURE 4) and Off (FIGURE 7) positions by means of handle **49**. With circuit breaker **10** closed movement of handle **49** to the right with respect to FIGURE 4 moves the upper end of springs **64**, **65** to the right. At such time as the force of springs **64**, **65** acts along the line positioned to the right of the line joining knee **73** and pivot **74**, knee **73** will be drawn over center to the right and contacts **25**, **26** will be operated to the disengaged positions of FIGURE 7. It is to be noted that contact arm **24** has passed through a line extending between the cradle bushings formed by spaced pins **77** so that a large contact separation is obtained. The open position of contact arm **24** is established by the engagement of holder projections **78** with cradle **60** near its pivot **77**.

In operating contacts **25**, **26** into engagement toggle knee **73** moves rapidly to the left with respect to FIGURE 7. Its movement must be arrested in a very short time interval. This is accomplished by having the ends of knee pin **73** engage cradle surface **85**. It is to be noted that surface **85** is positioned at a substantial incline, approximately 45°, with respect to the direction of travel of pin **73** just prior to its stoppage. Inclined surface **85** causes a downward component of force to be exerted on contact arm holder **32** with this component of force being absorbed by contact arm biasing spring **37**.

As circuit breaker 10 operates from the On position of FIGURE 4 to the tripped position of FIGURE 6, cradle 60 and toggle links 62, 63 move substantially as a unit clockwise about bushing 77 for a short distance during which the contacts remain engaged. Thereafter, as seen in FIGURE 5, the rounded cam surface 80 engage the frame inward extension 81.

Cradle 60 continues counterclockwise carrying the pivot 74 for toggle link 62 to the left forcing toggle knee 73 rapidly to the right. Thus, for a relatively short cradle movement toggle knee 73 moves over center and an almost fully loaded spring means 64, 65 is then free to bring about rapid contact separation.

Not only does the engagement of surfaces 80, 81 serve to kick toggle knee 73 over center but it also serves as an anti-rebound means. That is, when circuit breaker 10 trips open, contact arm 24 tends to rebound closed from the tripped position of FIGURE 6. In doing so toggle 62, 63 must be extended soon bringing cam surface 80 into engagement with frame 42 at 81. Continued movement of contact arm 24 toward closed position is strongly resisted by springs 64, 65 which in this position require strong forces for loading thereof.

Cradle 60 is returned to latched position through the engagement of operating member projection 83 which engages cradle 60 at 84.

Although there has been described preferred embodiments of this invention, many variations and modifications will now be evident to those skilled in the art and, therefore, the scope of this invention is to be limited not by the specific disclosure herein detailed, but only by the appended claims.

I claim:

1. In a circuit breaker, a pair of cooperating contacts and a mechanism for operating said contacts into and out of engagement; said mechanism comprising a latchable cradle, a movable contact arm carrying one of said cooperating contacts, first means connecting said cradle and said contact arm in a manner such that said contacts cannot be operated into engagement unless said cradle is in a latched position, an operating spring means urging said cradle to a tripped position; said first means comprising a toggle linkage with one end connected to said cradle and the other end connected to said contact arm; a frame to which said cradle is pivoted; said frame including a first portion positioned along the direction of travel of said toggle linkage; said toggle linkage including a second portion remote from the knee thereof; said second portion of said toggle engaging said frame first portion prior to passage of the toggle knee over center as said cradle moves toward tripped position to drive said knee over center shortly after said cradle begins movement to its tripped position.

2. In a circuit breaker device as set forth in claim 1 in which the said second portion comprises a curved section at the edge of a link of said toggle.

3. In a circuit breaker device as set forth in claim 1 in which the first and the second portions are spaced from each other in close proximity when said contacts are engaged and when said contacts are disengaged with said cradle in tripped position whereby the toggle knee in rebounding from tripped toward closed position effects engagement of said first and second portions to prevent straightening of said toggle and thereby prevent rebounding of said cooperating contacts into engagement.

4. In a circuit breaker, a pair of cooperating contacts and a mechanism for operating said contacts into and out of engagement; said mechanism comprising a latchable cradle, a movable contact arm carrying one of said cooperating contacts, first means connecting said cradle and said contact arm in a manner such that said contacts cannot be operated into engagement unless said cradle is in a latched position, an operating spring means urging said cradle to a tripped position; said first means comprising a toggle linkage with one end connected to said

cradle and the other end connected to said contact arm; a frame to which said cradle is pivoted; said frame including a first portion positioned along the direction of travel of said toggle linkage; said toggle linkage including a second portion remote from the knee thereof; said second portion of said toggle prior to passage of the toggle knee over center as said cradle moves toward tripped position to drive said knee over center shortly after said cradle begins movement to its tripped position; said toggle having a third portion engageable with a four portion of said cradle to establish the position for said toggle when said contacts are engaged; said fourth portion comprising a surface inclined to the direction of travel of said third portion immediately prior to engagement of said third and said fourth portions.

5. In a circuit breaker, a pair of cooperating contacts and a mechanism for operating said contacts into and out of engagement; said mechanism comprising a latchable cradle, a movable contact arm carrying one of said cooperating contacts, first means connecting said cradle and said contact arm in a manner such that said contacts cannot be operated into engagement unless said cradle is in a latched position, an operating spring means urging said cradle to a tripped position; said first means comprising a toggle linkage with one end connected to said cradle and the other end connected to said contact arm; said toggle having a first portion engagable with a second portion of said cradle to establish the position for said toggle when said contacts are engaged; said second portion comprising a surface inclined to the direction of travel of said first portion immediately prior to engagement of said first and said second portions.

6. In a circuit breaker, a pair of cooperating contacts and a mechanism for operating said contacts into and out of engagement; said mechanism comprising a latchable cradle, a movable contact arm carrying one of said cooperating contacts, first means connecting said cradle and said contact arm in a manner such that said contacts cannot be operated into engagement unless said cradle is in a latched position, an operating spring means urging said cradle to a tripped position; said cradle comprising a U-shaped member pivotally mounted on pins extending outwardly of the U-arms; said contact arm and said first means being positioned between the U-arms; said first means comprising a toggle linkage with one end connected to said cradle and the other end connected to said contact arm; a frame to which said cradle is pivoted; said frame including a first portion positioned along the direction of travel of said toggle linkage; said toggle linkage including a second portion remote from the knee thereof; said second portion of said toggle engaging said frame first portion prior to passage of the toggle knee over center as said cradle moves toward tripped position to drive said knee over center shortly after said cradle begins movement to its tripped position.

7. In a circuit breaker device as set forth in claim 6 in which the said second portion comprises a curved section at the edge of a link of said toggle.

8. In a circuit breaker device as set forth in claim 6 in which the first and the second portions are spaced from each other in close proximity when said contacts are engaged and when said contacts are disengaged with said cradle in tripped position.

9. In a circuit breaker, a pair of cooperating contacts and a mechanism for operating said contacts into and out of engagement; said mechanism comprising a latchable cradle, a movable contact arm carrying one of said cooperating contacts, first means connecting said cradle and said contact arm in a manner such that said contacts cannot be operated into engagement unless said cradle is in a latched position, an operating spring means urging said cradle to a tripped position; said cradle comprising a U-shaped member pivotally mounted on pins extending outwardly of the U-arms; said contact arm and said first means being positioned between the U-arms; said first

means comprising a toggle linkage with one end connected to said cradle and the other end connected to said contact arm; a frame to which said cradle is pivoted; said frame including a first portion positioned along the direction of travel of said toggle linkage; said toggle linkage including a second portion remote from the knee thereof; said second portion of said toggle engaging said frame first portion prior to passage of the toggle knee over center as said cradle moves toward tripped position to drive said knee over center shortly after said cradle begins movement to its tripped position; said toggle having a third portion engageable with a fourth portion of said cradle to establish the position for said toggle when said contacts are engaged; said fourth portion comprising a surface inclined to the direction of travel of said third portion immediately prior to engagement of said third and said fourth portions.

10. In a circuit breaker, a pair of cooperating contacts and a mechanism for operating said contacts into and out of engagement; said mechanism comprising a latchable cradle, a movable contact arm carrying one of said cooperating contacts, first means connecting said cradle and said contact arm in a manner such that said contacts cannot be operated into engagement unless said cradle is in a latched position, an operating spring means urging said cradle to a tripped position; said cradle comprising a U-shaped member pivotally mounted on pins extending outwardly of the U-arms; said contact arm and said first means being positioned between the U-arms; said first means comprising a toggle linkage with one end connected to said cradle and the other end connected to said contact arm; said toggle having a first portion engageable with a second portion of said cradle to establish the position for said toggle when said contacts are engaged; said second

portion comprising a surface inclined to the direction of travel of said first portion immediately prior to engagement of said first and said second portions.

11. In a circuit breaker, a pair of cooperating contacts and a mechanism for operating said contacts into and out of engagement; said mechanism comprising a latchable cradle, a movable contact arm carrying one of said cooperating contacts, first means connecting said cradle and said contact arm in a manner such that said contacts cannot be operated into engagement unless said cradle is in a latched position, an operating spring means urging said cradle to a tripped position; said first means comprising a toggle linkage including a first link connected to said cradle and a second link connected to said contact arm; a pivotal connection between said links comprising a toggle knee; a frame to which said cradle is pivoted; said frame including a first portion positioned along the direction of travel of said toggle linkage; said toggle linkage including a second portion remote from the knee thereof; said second portion of said toggle engaging said frame first portion prior to passage of the toggle knee over center as said cradle moves toward tripped position to drive said knee over center shortly after said cradle begins movement to its tripped position; said second portion comprising a curved section at an edge of said first link.

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BERNARD A. GILHEANY, *Primary Examiner.*

ROBERT K. SCHAEFER, *Examiner.*