United States Patent [19]

McGarrity

[11] **4,321,436**

[45] **Mar. 23, 1982**

[54] **ELECTRICAL CIRCUIT INTERRUPTORS**

[75] Inventor: **Richard V. McGarrity**, Drexel Hill, Pa.

[73] Assignee: **Federal Pacific Electric Company**, Newark, N.J.

[21] Appl. No.: **137,232**

[22] Filed: **Apr. 4, 1980**

[51] **Int. Cl.**[3] **H01H 31/00**

[52] **U.S. Cl.** .... **200/48 KB**; 200/162; 200/15

[58] **Field of Search** .... 200/48 KB, 162, 153 G, 200/271, 15

[56] **References Cited**

U.S. PATENT DOCUMENTS

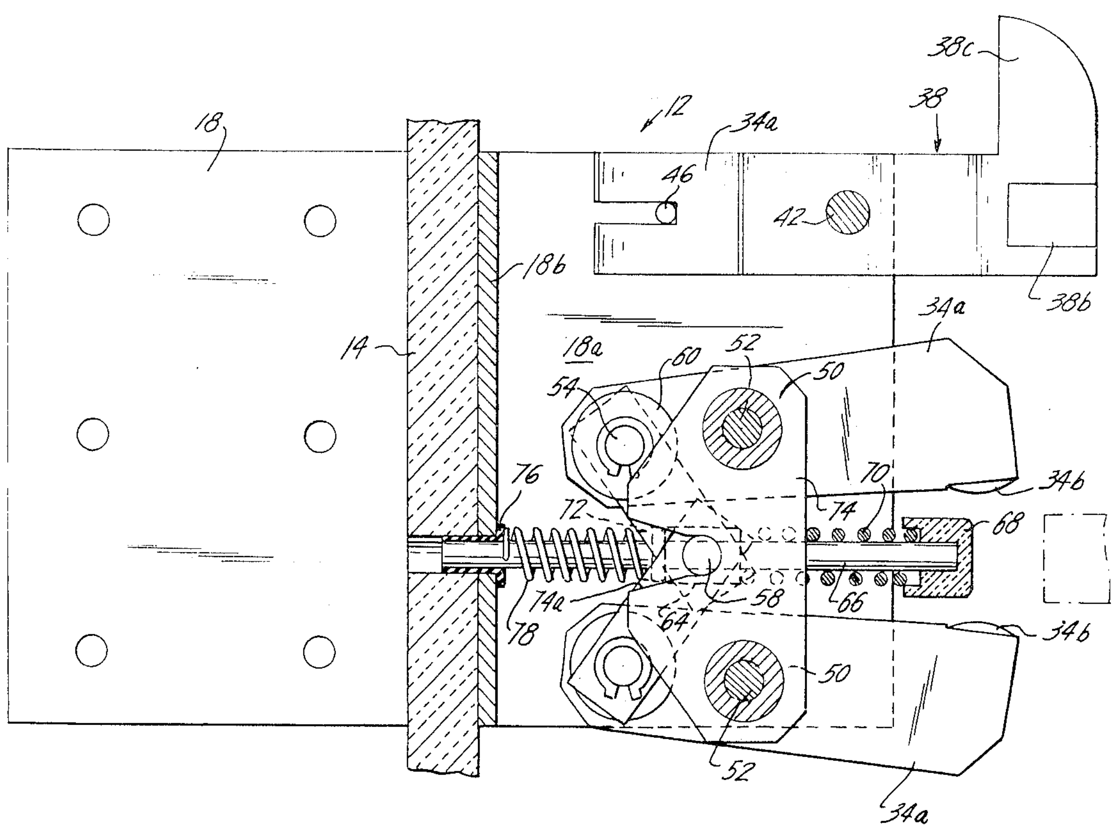
1,337,105 4/1920 Templeton .... 200/48 KB
1,997,082 4/1935 Reynolds .... 200/48 KB
2,309,909 2/1943 Koppitz et al. 200/162
2,650,284 8/1953 Volgovskoy 200/162
2,743,338 4/1956 Graybill 200/164
2,765,380 10/1956 Graybill 200/162
3,097,275 7/1963 Wiktor 200/78

Primary Examiner—Willis Little
Attorney, Agent, or Firm—Ronald R. Stanley; Roy F. Hollander

[57] **ABSTRACT**

The disclosed circuit breaker includes a movable contact which enters the space between stationary contact jaws, the movable contact acting through a spring to bias a jaw-closing toggle toward erect condition, so that contacts on the contact jaws firmly grip the movable contact.

7 Claims, 9 Drawing Figures



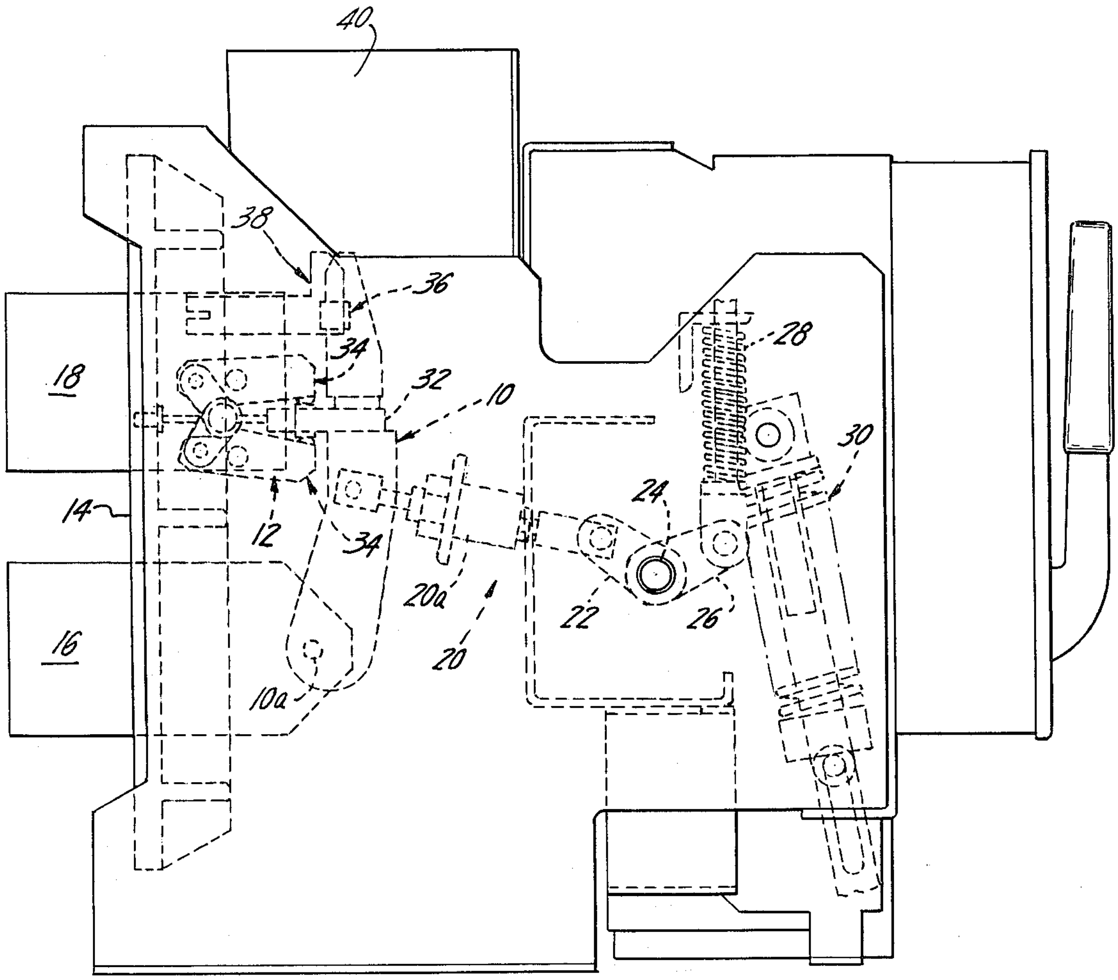


FIG. 1

FIG. 2

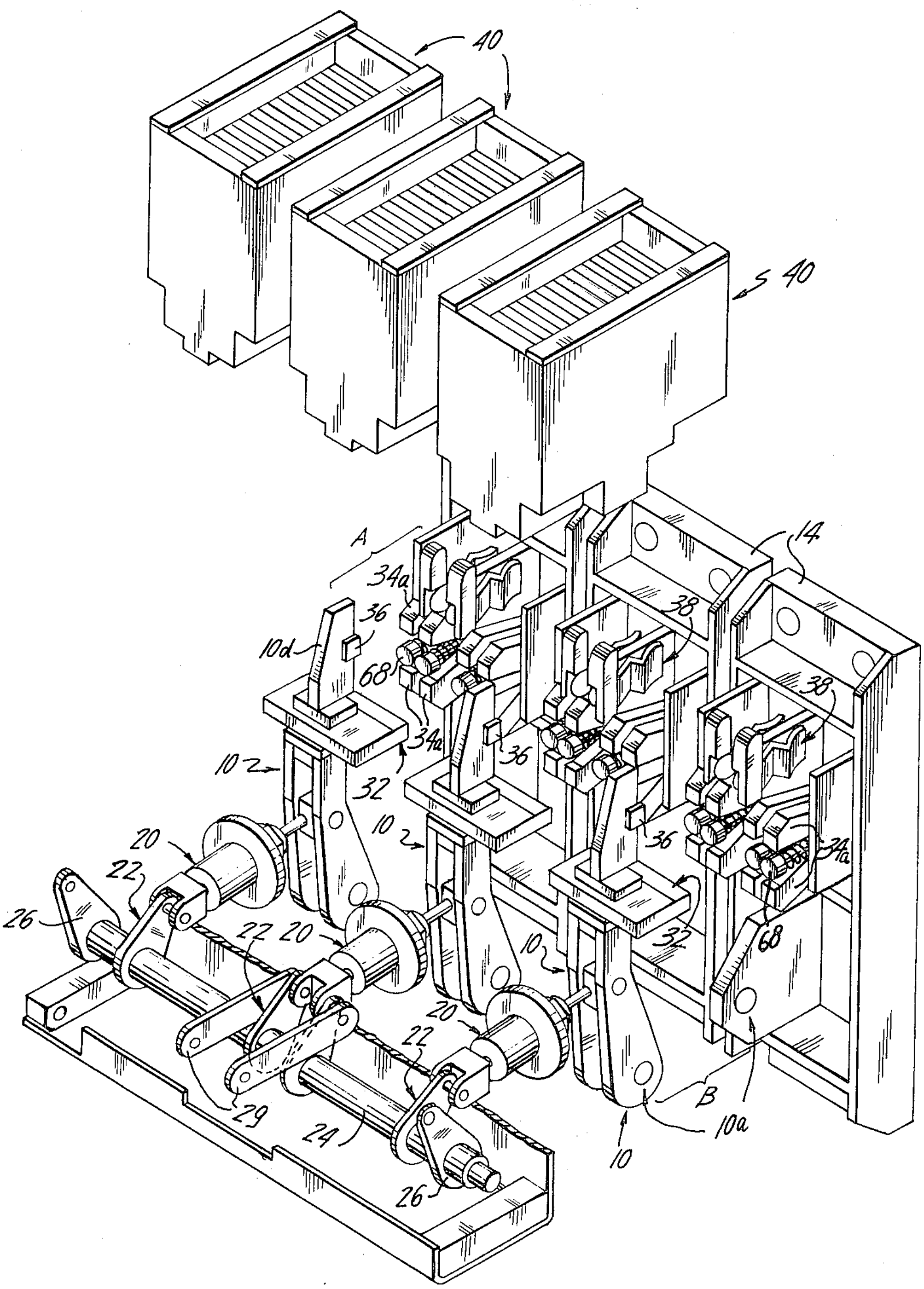

40
40
A
14
34a
36
10d
68
38
38
34a
10
32
36
10
36
34a
20
22
32
26
22
20
10
68
20
22
B
29
24
10a
10
26

FIG. 3

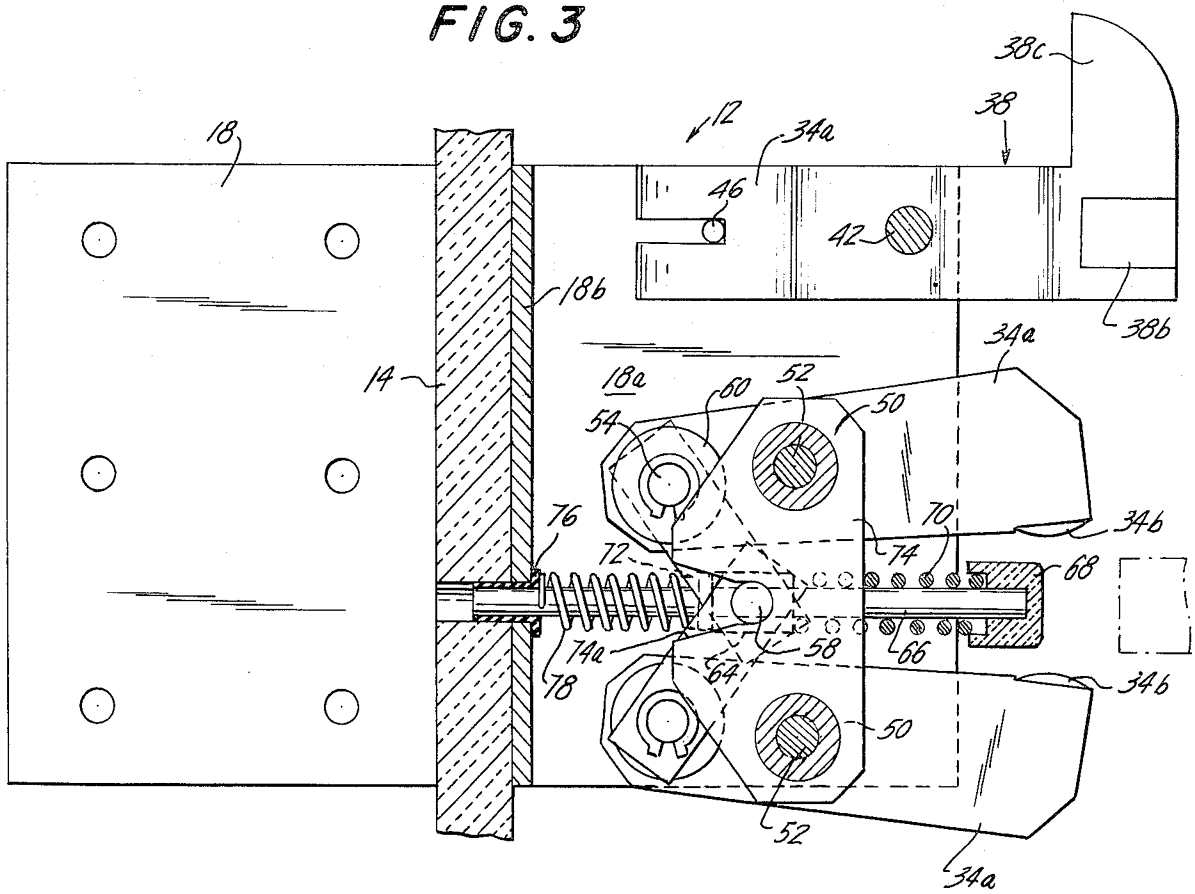
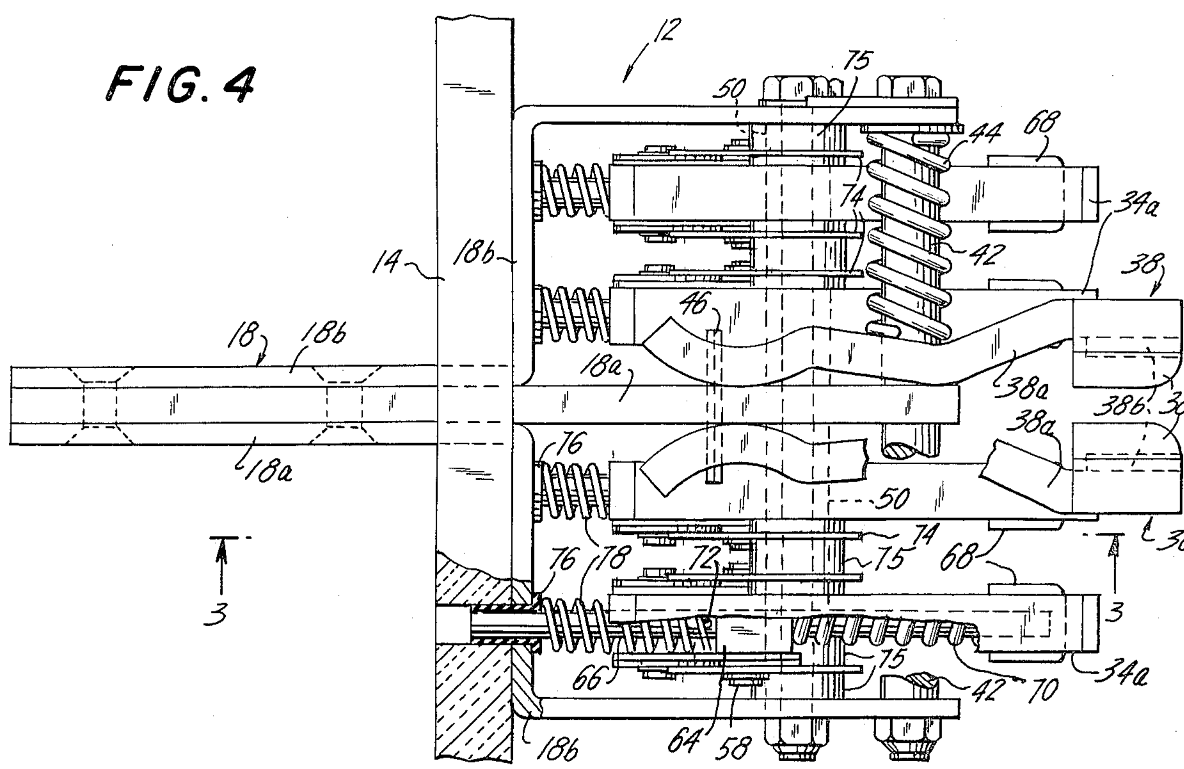

38c
38
12
34a
18
46
42
18b
38b
34a
14
18a
52
60
50
54
76
70
34b
72
74
68
74a
58
66
78
64
34b
50
52
34a

FIG. 4


12
75
50
44
68
34a
74
42
14
18b
38
46
18
18b
18a
38a
38b
38c
18a
76
38a
50
74
38
76
78
72
75
68
3
66
75
42
70
34a
18b
64
58
3

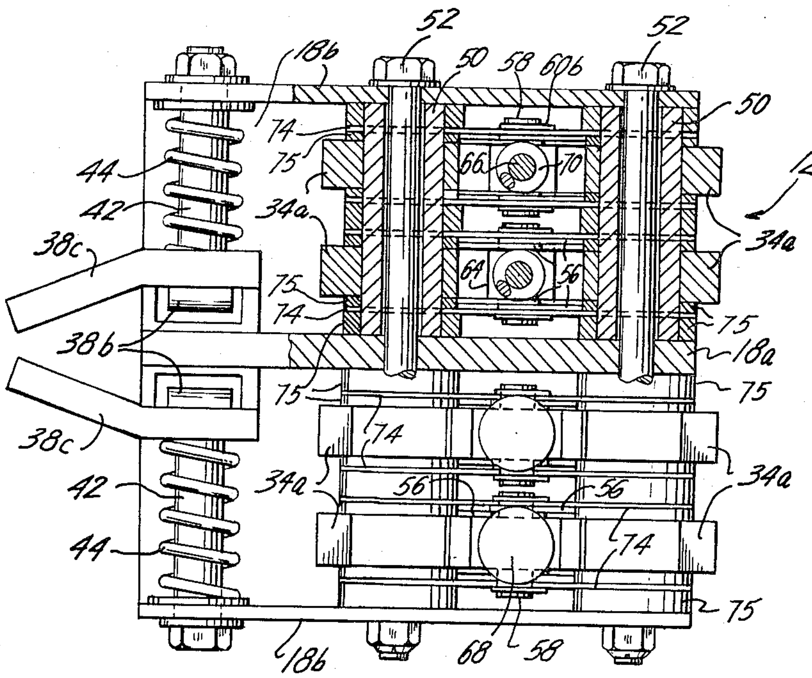

52
52
18b
50
58
60b
50
12
74
75
66
70
44
42
34a
34a
38c
64
56
75
74
75
38b
18a
75
75
74
38c
34a
34a
42
56
56
74
44
75
18b
68
58

FIG. 5

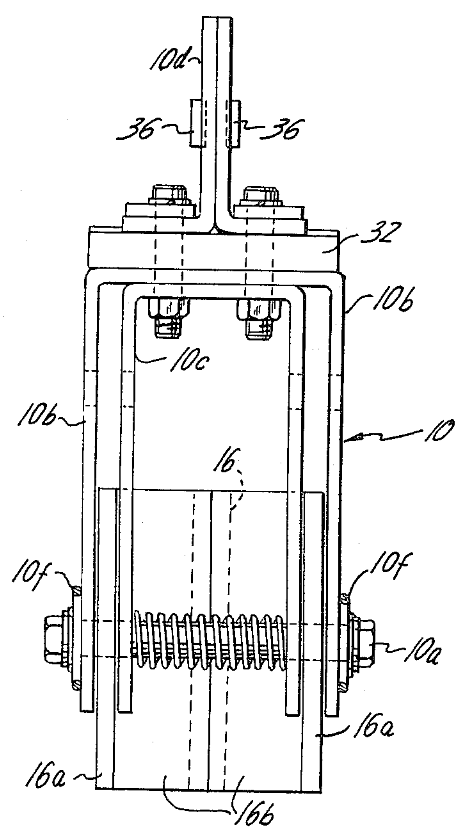

10d
36
36
32
10b
10c
10b
10
16
10f
10f
10a
16a
16a
16b

FIG. 6

FIG. 7

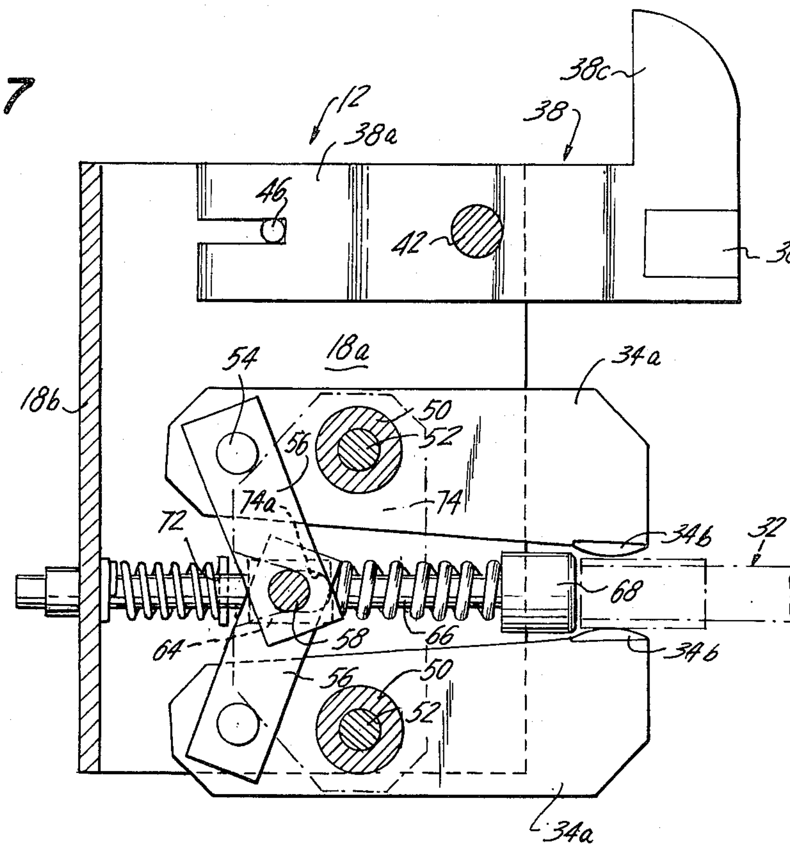


FIG. 8

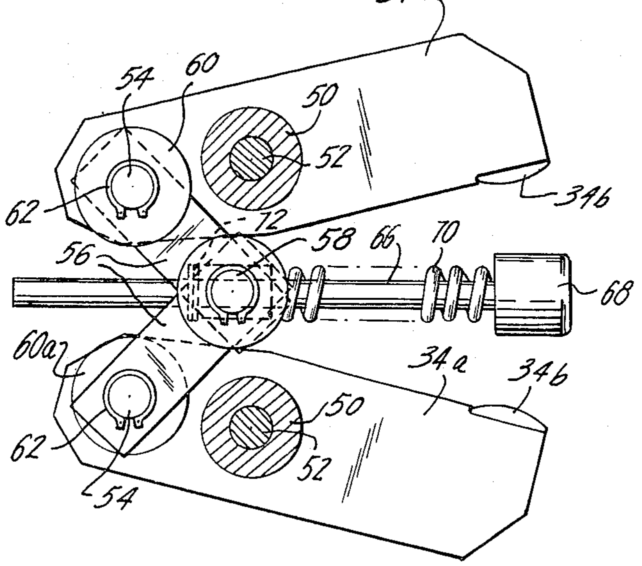
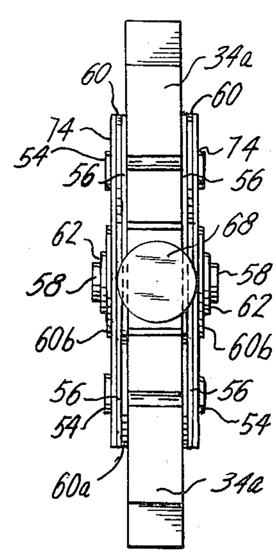


FIG. 9



ELECTRICAL CIRCUIT INTERRUPTORS

BACKGROUND

The present invention relates to circuit making and breaking devices, and particularly to their contact structures.

The present invention will be considered in connection with "circuit breakers" although it will become apparent that the novel features are widely applicable to other forms of circuit making and breaking devices. The term "circuit breaker" as used in the art signifies apparatus for making and breaking a circuit at any level of current up to its rated current and extending to overcurrents and into the short-circuit range. Circuit breakers having rated currents of several hundred to several thousand amperes may be used in circuits where short-circuit current may reach 75,000 amperes for example. Circuit breakers are required to interrupt short-circuits repeatedly, safely and non-destructively. They are also required to close safely and non-destructively where there is a pre-existing short circuit at the load side of the circuit breaker, resisting electro-dynamic forces that might damage or even weld the contacts if there were any hesitation about completing the contact-closing operation. After closing on a pre-existing short-circuit, the circuit breaker mechanism is of course activated promptly into its opening operation, for safely and effectively interrupting the flow of current.

Circuit breakers for use in the 480 volt and 600 volt class are of the so-called "air-break" class, where an arc that develops in the course of current interruption is quenched in air in an arc chute, without benefit of coils on magnetic cores to drive the arc away from the contacts and into the arc chute. Large circuit breakers almost always have so-called main contacts and arcing contacts. The closing operation involves initial engagement of the arcing contacts which momentarily carry the current of the circuit. The main contacts close immediately afterward and virtually all of the current is then diverted away from the arcing contacts. During a reverse operation for interrupting current flow, the main contacts part initially, transfering the current to the arcing contacts, and when these contacts part, an arc develops which expands into the arc chute where it is quenched. Arcing should not occur at the main contacts when they part and, consequently, the main contacts remain clean, and provide a low contact-resistance current path through the circuit breaker while it is closed. This is true even during the very short time when short-circuit current flows and until the main contacts part and cause transfer of the current to the arcing contacts.

Traditionally, circuit breakers designed for meeting these arduous conditions have utilized so-called "butt" main contacts and either butt or "knife-blade" arcing contacts. When butt contacts close, the high speed of the moving contact tends to cause contact "bounce", which in turn may cause slight contact-damaging arcs. Powerful closing-spring mechanisms are usually provided to minimize contact bounce.

So-called "knife-blade" contacts have been used in switches designed for heavy currents, but "knife-blade" contacts have rarely been used as the main contacts of circuit breakers. Some finite time is spent while a moving knife-blade contact parts from companion stationary contacts in a wiping-contact motion; and under these conditions, during opening operations, small but damaging high-current arcs may develop at times, with resulting arcing damage to the contact surfaces. Thereafter, when the arc-damaged contact surfaces are again in engagement, objectionably high contact resistance and excessive heating tend to develop at the contacts. Worse, still, is the possibility of knife-blade contacts becoming welded together. Butt contacts tend to act abruptly in parting operations, and minimize these problems.

Knife-blade contacts are commonly used in simple switches, which are not intended to open under short-circuit conditions. Knife-blade contacts provide broad contact areas and they tend to be self-polishing due to the wiping action in the opening and closing motions of the switch, representing a low-resistance cool-operating contact configuration. Low resistance depends in part on the contact pressure; and in order to achieve high-contact pressure, powerful switch-closing effort must be available. An adaptation of the knife switch is the so-called bolted-pressure switch. These are basically knife-blade switches wherein, during the final operation of the closing mechanism, the fixed and moving contacts are tightened against each other by a threaded or cammed clamping mechanism, activated by the arm that carries the moving contact or by its operating means. The clamping mechanism is activated near or at the fully-closed phase, so that the requisite closing effort is minimized even though high contact pressure is developed.

SUMMARY OF THE INVENTION

The illustrative embodiment of the invention shown in the accompanying drawings and described in detail below is a three-pole circuit breaker having moving main and arcing contacts operated in closing and opening motions by means of a stored-energy spring operating mechanism that effects high-speed closing and opening operations of the contacts. As is customary, the arcing contacts close before the main contacts as the circuit breaker closes, and the main contacts part before the arcing contacts. The main contacts are protected against occurrence of arcing, to have low-resistance cool-operating contacts while the circuit breaker is closed.

The main contacts provide a sustained low-contact-resistance current path while closed, so that only a limited temperature rise occurs. They comprise one or more pairs of jaws that are widely separated when the circuit breaker is open. As the moving contact member enters the space between contacts carried by the jaws, the moving contact member acts on jaw-closing means that operates rapidly, forcing the jaws grip the moving contact member tightly. To special advantage, the moving contact member drives a spring to erect (incompletely) a jaw-closing toggle. As the moving contact member completes its stroke, it wipes against the gripping contacts of the jaws. There is little if any tendency of contact-parting to occur as the moving contact member completes its closing motion so that the stored-energy operating mechanism does not need excess capacity for suppressing contact bounce.

Where a toggle or its equivalent is used for developing tight grip of the stationary contacts against the moving contact member, the contacts tend to maintain firm engagement and thus suppress arcing even if electrodynamic forces were to develop under short-circuit conditions tending to part the main contacts.

The above-mentioned toggle for closing the stationary contact jaws on the moving contact member, where the moving contact member acts through a spring in driving the toggle toward erect condition, has the further advantage of compensating for wear and erosion of the contacts. As some wear occurs, the spring causes the toggle to become more nearly erect.

The operation of the movable contact member in the opening direction is accompanied by relaxation of the bias of the toggle-erecting spring. Furthermore, another spring is advantageously included to induce the toggle to buckle, thereby parting the jaws from the movable contact member.

The foregoing summary includes certain details regarded as exemplary. However the nature of the invention and its further novel aspects and features will become more apparent and will be better appreciated from consideration of the illustrative embodiment that is shown in the accompanying drawings and described in detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a lateral view of a circuit breaker embodying features of the invention;

FIG. 2 is an exploded perspective view of internal portions of the circuit breaker in FIG. 1;

FIG. 3 is a lateral cross-section at the plane 3—3 in FIG. 4 of the stationary contact assembly of the circuit breaker in FIGS. 1 and 2;

FIG. 4 is a top plan view, with portions broken away for clarity, of the stationary contact assembly of FIG. 3;

FIG. 5 shows the stationary contact assembly of FIGS. 3 and 4, partly in cross-section, as viewed from the right of FIG. 4;

FIG. 6 is a vertical elevation of one of three moving contact arms in FIG. 2, as viewed from the lower left hand corner of FIG. 2;

FIG. 7 is a view similar to FIG. 5 of the stationary contact assembly with the main contacts thereof "closed" and gripping the main moving contact which is shown in phantom, and including a toggle-guide-plate in phantom;

FIG. 8 is a view similar to FIG. 3 of certain components of the main stationary contacts; and

FIG. 9 is a view of a pair of main contact jaws and its operating parts viewed from the right of FIG. 3.

THE ILLUSTRATIVE EMBODIMENT

Referring now to FIG. 1, a circuit breaker is shown incorporating novel features of the invention. The circuit breaker includes a moving contact arm 10 that cooperates with a stationary contact assembly 12 carried by blocks or plates 14 of insulation. Terminals 16 and 18 extend through each plate 14, bearing moving contact assembly 10 and stationary contact assemby 12, respectively. Moving contact assembly 10 is shown "closed", in cooperation with the stationary contact assembly, so that a circuit is made between terminals 16 and 18.

As seen in FIG. 2, the circuit breaker has three poles, including three contact arms 10 which are operated by links 20, pivoted to and operated by respective cranks 22 on operating shaft 24. Cranks 26 which are fixed to shaft 28 near the opposite ends of the shaft enable compression coil springs 28 to apply contact-opening bias to shaft 24 and, in turn, to the moving contact arms 10. Each link 20 incorporates an insulating member 20*a*.

A pair of links 29 (FIG. 2) couple cranks 22 of the center pole to a stored-energy spring operating mechanism for closing the contacts. In FIG. 1 the spring operating mechanism is symbolically represented by closing spring 30. Such spring operating mechanisms are well known and, for example, may take the form shown U.S. Pat. No. 3,097,275 issued July 9, 1963 to D. Wiktor. Energy is stored in the springs of this mechanism either by a motor or a hand-operated ratchet mechanism; and after the spring has been fully charged, it (or a linkage that restrains it) is selected for driving shaft 24 in the contact-closing direction abruptly and at high speed, providing a substantial amount of contact-closing force. In FIG. 2, the vertical contact arms 10 are shown in their "closed" position but, because the drawing is an exploded view, the drawing includes a space A between the moving contact end of arm 10 and the companion stationary contacts, and there is a space B in FIG. 2 between the two portions of pivot 10*a* at the lower end of each contact arm 10. Spaces A and B appear in FIG. 2 so that the elements are more recognizable than they would be were such spaces eliminated.

The stored-energy spring closing mechanism closes the breaker when a manual or remote-control latch is released, for a quick contact-closing motion of shaft 24. When cranks 22 become nearly aligned with links 20, contact arms 10 are in their "closed" positions. A current path may be traced through the circuit breaker from terminal 16, via contact arm 10, main contact member 32, main contact assembly 34, to terminal 18. A further current path can be traced from terminal 16 and contact arm 10 to moving arcing contact 36 companion stationary arcing contact 38, and terminal 18. These current paths (as viewed in FIG. 1) represent curves or loops basically including terminal 16, arm 10 and terminal 18. Under normal conditions, this current path in the form of a loop does not pose any important problem. However, both when a short circuit develops while the circuit breaker is closed as well as when the circuit breaker closes against a short circuit, a large amount of blow-off force develops in contact arm 10 due to the electrodynamic forces identified with such a current loop. The fact that cranks 22 and links 20 are nearly aligned when the closed condition of the circuit breaker is attained is a factor assisting the stored-energy spring mechanism in its contact-arm closing operation. However, when a short circuit exists or develops a release latch enables the contact arms to be opened, being driven by springs 28 and by the electrodynamic contact-opening forces of the current loop. Springs 28 are also effective for opening the contact arms when the current level is not high enough to develop significant blow-open force. The contact-opening release mechanism becomes effective in the event of an overload or a short-circuit, or when remote-release is required, and when the circuit breaker is opened by manual operation of a release latch.

The foregoing discussion of the closing and opening mechanisms and the electrodynamic forces encountered in the operation of the illustrative type of circuit breakers is intended to provide a perspective for appreciation of the operating conditions encountered by the contact mechanisms to be described hereinafter.

Circuit breakers of this type commonly include arc chutes 40, shown in FIG. 2 as being lifted away from their normal positions seen in FIG. 1. When a circuit breaker of this type opens, the current path from the moving contact member 32 to the companion stationary contacts **34** is interrupted initially so that the current through the circuit breakers transfers to the moving and fixed arcing contacts **36** and **38**. When those contacts part during flow of light or heavy current, an arc develops which blows up into the arc chute where it is quenched.

As seen in FIG. **6**, contact arm **10** has a pivot **10***a* that extends through two parallel plates **16***a* extending at right-angle bends from integral parts **16***b* of terminal **16**. Arm **10** includes inverted-U-shaped bars **10***b* and **10***c* as of copper, carrying movable contact member **32**. Contacts **36** are fixed to brackets **10***d* bolted to the main contact member **32**. Compression coil spring **10***e* presses bars **10***c* against plates **16***a*, and conical springs **10***f* presses bar **10***b* against plates **16***a*.

Stationary contact mechanism **12** is shown in detail in FIGS. **3–5** and **7–9**. Terminal **18** is formed of three plates of copper or other high-conductivity metal, including a flat center-plate **18***a* and two outer plates **18***b*. These three plates are united at the back of each insulating block **14**. As seen in FIG. **2**, one insulating block **14**, is provided for each of the three poles. At the front of insulating block **14**, plates **18***b* are bent flat against insulating block **14** and extend away from each other, and they extend forward from second bends, parallel to each other.

As best shown in FIGS. **3** and **4**, stationary arcing contact members **38** for each of the three poles of the circuit breaker include a pair of bars **38***a* as of copper that carry refractory contact members **38***b* as of silver-tungsten. Arcing horns **38***c* extend upward from arcing contact members **38***b*. A bolt **42** extends through plate **18***a* and both plates **18***b* and carries a pair of compression coil springs **44** which bias bars **38***a* firmly against plate **18***a* when the circuit breaker is open. Bars **38***a* are slotted at the rear and receive a locating pin **46** which is fixed in plate **18***a*. When one contact arm **10** is driven into its closed position, arcing contacts **36** as of silver tungsten are forcibly driven between stationary arcing contacts **38**, driving the contact-bearing ends of bars **38***a* farther apart than is shown in FIG. **4**, against the bias of springs **42**. Bars **38***a* remain firmly biased against blade **18***a* near pin **46**. Bars **38** provide parallel current paths, so that they are pressed firmly against plate **18***a* and contacts **36** during moments of high currents, due to electrodynamic attraction.

The main "stationary" contact assembly which is companion to the moving main contact member **32** includes (for example) four pairs of rigid jaws or bars **34***a* (FIGS. **4** and **5**) bearing contacts **34***b* that are normally of pure silver, to provide low contact-resistance when in engagement with moving contacts of silver on main moving contact member **32**. Jaws **34***a* are pivoted between their ends on long tubes **50** of copper or other high-conductivity metal. A single bolt **52** extends in succession through one plate **18***b*, a first tube **50**, plate **18***a*, a second tube **50**, and the second plate **18***b*. Bolt **52** is tightened to provide a low-resistance current path from each jaw **34***a* to plates **18***a* and **18***b* that constitute terminal **18**. One bolt **52** and two tubes **50** provide mechanical support for four upper contact jaws **34***a*, and (See FIGS. **3** and **5**) another bolt **52** and two more tubes **50** provide mechanical support for four lower contact jaws **34***a*.

As seen in FIGS. **3**, **8** and **9** there is a pivot pin **54** through the end of each jaw **34***a* remote from contact **34***b*. A pair of upper and lower toggle links **56** are pivoted on pins **54** at the remote ends of these links, and both toggle links **56** form a knee at pivot pin **58**. As seen in FIGS. **4**, **5** and **9** there is a pair of toggle links **56** at each side face of each pair of jaws **34***a*. A spacing washer **60** on pivot pin **54** overlies the upper toggle link **56**; and a snap-ring **62** (received in a groove in pivot pin **54**) holds washer **60** and link **56** against contact jaw **34***a*. The same construction is provided at both sides of the upper bar **34***a* (FIGS. **5** and **9**). A spacing washer **60***a* is provided between a side face of contact bar or jaw **34***a* and the lower link **56** at a pivot pin **54**. A snap ring **62** (received in a groove in pivot pin **54**) retains lower link **56** and washer **60***a* against one side face of contact bar **34***a*. A like construction of spacing washer **60***a*, lower toggle link **56** and retainer **62** is found at the opposite side face of lower contact bar or jaw **34***a*.

A pair of pivot pins **58** at which the knee of the toggle is formed extend integrally from opposite sides of block **64**. Rod **66** is slidably received in a bore in block **64**. At the right-hand extremity of rod **66** as seen in FIG. **8**, a head **68** of insulation is fixed to the rod. A compression coil spring **70** is confined between block **64** and head **68**. Pin **72** extends through rod **66** and limits the extent to which block **64** can be moved away from head **68**.

As seen in FIG. **3**, a stationary plate **74** is supported on tubes **50**, flanking the toggle knee, there being a one such plate **74** at each side of an upper and lower pair of jaws or contact bars **34***a*. Washers **75** on tubes **50** act to fix plates **74** at the proper places. A pair of toggle links **56** is disposed between each plate **74** and one side of each pair of jaws **34***a*. Pivot pin **58** extends through a slot **74***a* in plate **74**. The edges of slot **74***a* diverge from right to left as viewed in FIG. **3**. Rod **66** extends through a bushing **76** of insulation, for example, nylon, that is received in a bore through plate **18***b* and backplate **14** of insulation. A compression coil spring **78** surrounding rod **66** is confined between pin **72** and insulating bushing **76**. When the circuit breaker is open, spring **78** biases pin **72**, block **64** and the pivot-pin extensions **58** of block **64** toward the right and into the right-hand extremity of slot **74***a*. Washer **60***b* on pivot pin **58** slides against the outside face of plate **74** and is held in place by a snap ring **62** which is received in a groove in pin **58**. Plate **74** forms an outer guide for a respective pair of toggle links **56**, and washer **60***b* assures stable retention of the toggle knee-pivots **58** in slot **74***a*.

The parts illustrated in FIG. **3** represent the open condition of the stationary contact assembly **34**. Moving contact member **32** moves from the left in FIG. **3** in the closing operation of the circuit breaker. Following engagement of member **32** against head **68** of insulation, further movement drives rod **66** to the left, carrying stop pin **72** with it. Spring **70** pushes block **64** with its pivots **58** to the left as pin **72** withdraws to the left. During this operation, both compression springs **70** and **78** become further compressed. Movement of rod **66** to the left displaces pin **72** and allows springs **70** (at opposite sides of each pair of jaws **34***a*) to bias block **64** to the left. Springs **70** thus apply bias to erect the toggles. As the toggles become progressively more erect, the contacts at the right hand extremities of contact bars **34***a* (as viewed in FIG. **3**) close against silver contacts at the top and bottom surfaces of moving contact member **32**. When the contacts **34***b* are pressed firmly against contact member **32**, further erecting motion of the toggle links is prevented. Moving contact member **32** can and normally will continue its motion in the closing direction and thereby displace rod **66** further to the left. However when further erecting operation of the toggle links can no longer occur because closing motion of contacts **34***b* has been arrested. Rod **66** simply slides in block **64** and moves pin **72** away from block **64** (FIG. 7). During this final motion of contact member **32**, the moving contacts on member **32** are in firm wiping contact with the contacts **34***b*. Such wiping motion of contacts while they are firmly in engagement is highly desirable in that such action tends to restore smoothness to the contact surfaces in case unusually pitting or balling of the contact material should develop in a previous contact-opening operation. Such wiping contact also has the effect of clearing away any surface contamination that might develop over a period of time, which otherwise would cause increased contact resistance. Low contact resistance is considerably enhanced by the heavy contact pressure attained as a result of the erecting toggles. Those toggles are all operated resiliently (rather than positively) by spring **70**. As a result, firm contact pressure develops over many operations of the circuit breaker despite possible erosion of the contacts due to wear and to occasional slight arcing. Contact pressure of the main contacts **34***b* against moving contact member **32** is increased during moments of high short-circuit current because the bars **34***a* then carry current in the same direction along parallel paths so that jaws **34***a* are attracted toward each other electrodynamically.

When the circuit breaker opens, contact arm **10** carries moving contact member **32** to the right, away from the position represented in FIG. 7. Relaxed pressure against head **68** and rod **66** allows spring **78** to push pin **72** and block **64** to the right, thereby biasing the toggle to buckle. As this action occurs, the grip of contacts **34***b* on moving contact member **32** is relaxed, and jaws **34***a* lift contacts **34***b* away from member **32**. Pivot pins **58** move in slot **72** toward the right. The slow guides pivot pins **58**, and maintains contacts **34***b* in symmetry at opposite sides of member **32** as contacts **34***b* move away from each other and from moving contact member **32**. During the contact-opening operation of the main contacts, movable arcing contacts **36** slide between stationary arcing contacts **38***b*. After separation of the main contacts is assured, the arcing contacts part. Current in the arcing contacts forms an arc, which travels up arcing horns **38***c*, and the arc then expands into the arc chute where it is quenched.

Despite the abrupt motions of the stationary contact parts that occur in the extremely short time between the initial contact of head **68** by movable contact member **32** and the completion of the closing motion of the movable contact member, intense stresses are avoided which might otherwise cause premature wear of the parts. This is explained in part by the interposition of spring **70** between head **68** and the knees of the toggles for each pair of contact jaws, and by the mechanical advantage of the toggle while becoming more erect in operating the jaws **34***a* to grip member **32**, and by the limited moment of inertia of each jaw **34***a*. The circuit breaker as a whole has been found remarkably durable and it has also been found highly effective in preserving the low contact resistance of the main movable and stationary contacts of the circuit breaker. The contact mechanism has proved to be highly effective in withstanding the wide variety of arduous conditions that may be encountered.

The foregoing detailed description of the illustrative embodiment of the invention is susceptible of modification and varied application of its novel features. Consequently the invention should be construed broadly in accordance with its full spirit and scope.

What is claimed is:

1. An electrical circuit making and breaking device including stationary contact means, movable contact means including a main movable contact member, means for operating the movable contact means into and out of cooperation with the stationary contact means, said stationary contact means including a pair of main contact jaws having respective pivots bearing contact surfaces that are opposite each other but spaced apart, a toggle operable toward an erect condition as the movable contact member advances in the space between said contact surfaces for driving said contact jaws so that said contact surfaces grip and are slidably engaged by the main movable contact member, and means on said movable contact means for operating said toggle.

2. An electrical circuit making and breaking device as in claim **1**, wherein said means operating said toggle includes resilient means interposed between the toggle and the movable contact means.

3. An electrical circuit making and breaking device as in claim **1**, wherein said means operating said toggle includes resilient means biasing the toggle toward a buckled condition.

4. An electrical circuit making and breaking device as in claim **1**, wherein said means operating said toggle includes resilient means interposed between the toggle and the movable contact means, and resilient means biasing the toggle toward a buckled condition.

5. An electrical circuit making and breaking device as in claim **1**, wherein said means operating said toggle includes a rod slidably extending through the knee of the toggle and arranged to be moved along its length by engagement of an end of the rod by said movable contact member, a compression spring interposed between the knee of the toggle and said end of the rod of resiliently biasing the toggle toward an erect condition as the movable contact member completes its closing stroke, and a compression spring biasing the toggle toward a buckled condition for opening the main contact jaws when the main movable contact member is retracted.

6. An electrical circuit making and breaking device including stationary contact means, movable contact means including a main movable contact member, means for operating the movable contact means into and out of cooperation with the stationary contact means, said stationary contact means including a pair of main contact jaws pivoted between first and second opposite ends thereof, main contacts on the first ends of said jaws, respectively, having contact surfaces that are opposite each other but spaced apart, and means operable by said movable contact means as the movable contact member enters the space between said contact surfaces for driving said second ends of the contact jaws farther from each other, thereby forcing the contact surfaces of the jaws to grip slidably the main movable contact member, said driving means including a toggle operable from a relatively collapsed condition when the contacts are open, toward an erect condition when the contacts are closed.

7. An electrical device as in claim **6**, wherein said operable means includes an actuator engageable by said movable contact member as it enters the space between said contact surfaces.

* * * * *