

Jan. 31, 1967

G. A. WILSON

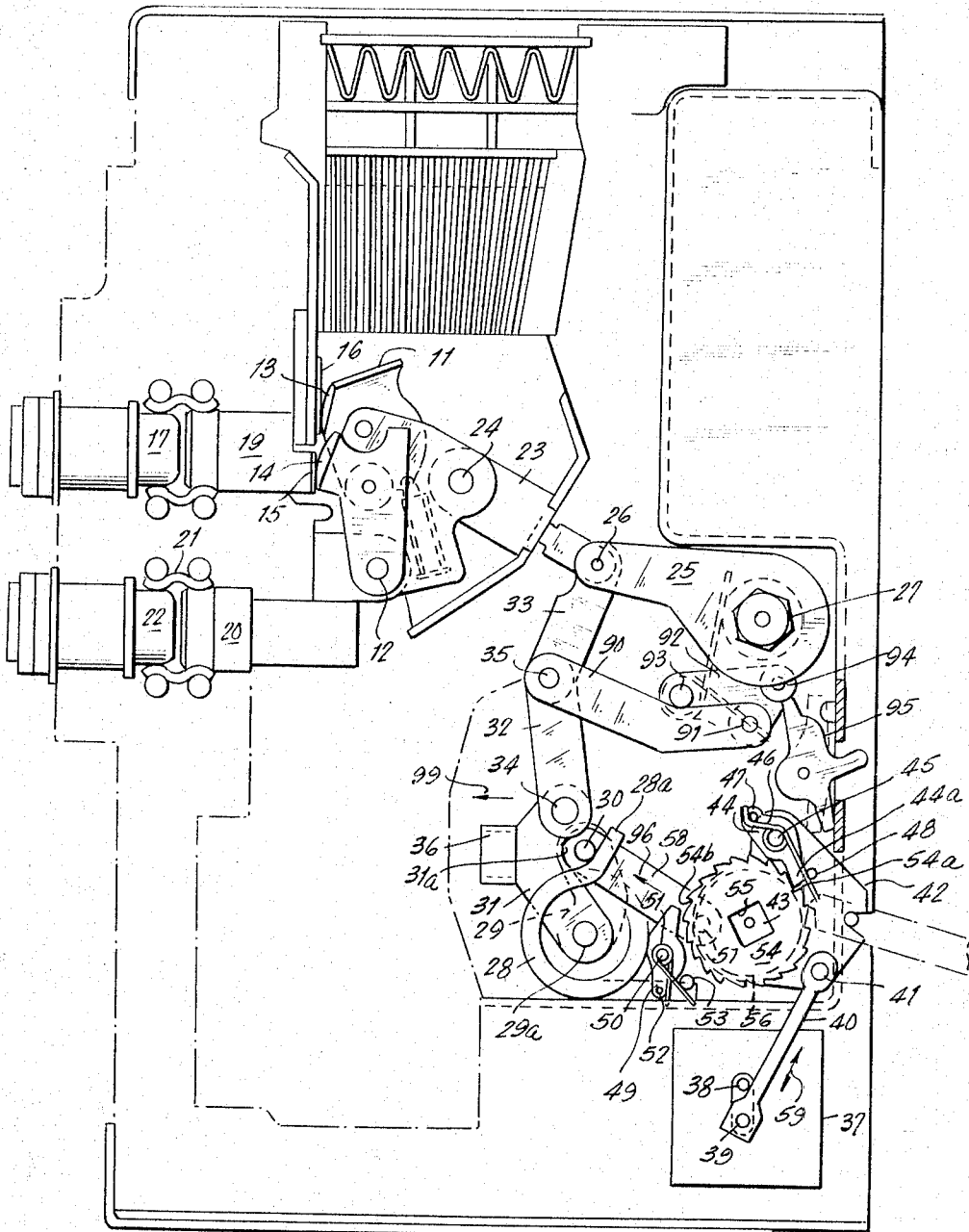
3,301,984

SPRING CLOSED CIRCUIT BREAKER

Filed March 2, 1965

3 Sheets-Sheet 1

FIG. 1.



10

INVENTOR.
GEORGE A. WILSON

BY

OSTROLEK, FABER, GERB & SOFFEN
ATTORNEYS

Jan. 31, 1967

G. A. WILSON

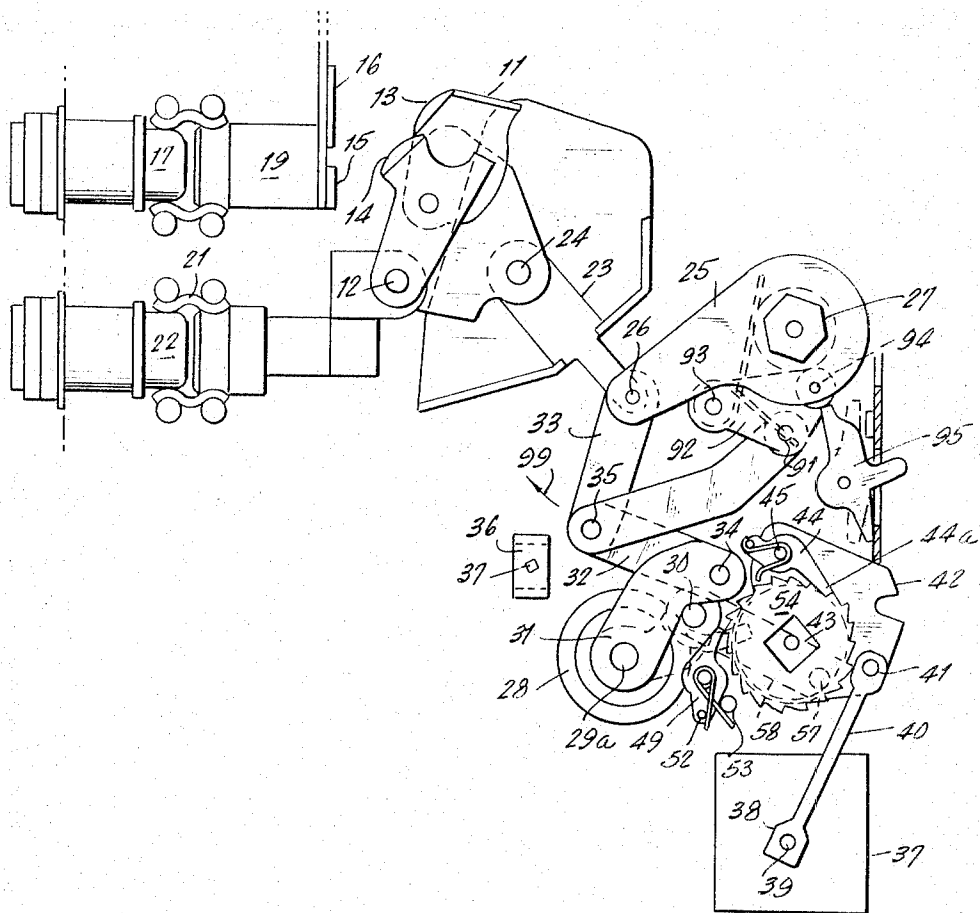
3,301,984

SPRING CLOSED CIRCUIT BREAKER

Filed March 2, 1965

3 Sheets-Sheet 2

FIG. 2.



INVENTOR.
GEORGE A. WILSON

BY

OSTROLENK, FABER, GERB & SOFFEN
ATTORNEYS

1

2

3,301,984

SPRING CLOSED CIRCUIT BREAKER

George A. Wilson, Media, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed Mar. 2, 1965, Ser. No. 436,425

5 Claims. (Cl. 200—153)

The instant invention relates to circuit breakers and more particularly to a spring closing mechanism for circuit breakers having a spring closing lever arm which performs straight line operation and yields a closing force far superior to present day devices.

Circuit breakers presently in use typically employ spring closing mechanisms which close the breaker cooperating contacts through the operation of a closing cam. The eccentric closing cam is mounted upon a common shaft with a charging ratchet wheel which is typically motor driven in one direction only and is not capable therefore of exhibiting reverse rotation. This requires the eccentric closing cam to rotate through 360° to complete a full closing cycle. The closing spring is attached to the common shaft of the aforementioned system by a crank arm which is attached to the end of the shaft carrying the cam and ratchet members. Rotation of the crank shaft through the motor charging means, in turn, rotates the crank arm to store energy in the closing spring. The energy is not released until the shaft rotates through 180° of its total travel, at which point the crank arm passes its fully charged or top dead center position. The closing spring gives up its energy just slightly after 180° of travel of the cam shaft. At this point, which is the start of the closing stroke, the fully charged spring exerts very little torque around the cam shaft due to the initially small lever arm. The lever arm at the end of the closing stroke is also small so that very little advantageous effect is derived from the spring except in the mid-way area of the closing phase. This results in a dissipation of the spring energy in friction at the start of the closing phase and in non-effective over travel at the end of the closing stroke. The eccentric cam member, which operates upon a cam follower member in the toggle system which is connected to the movable arm of the circuit breaker, creates a considerable amount of noise, and the large diameter of the cam requires a considerable amount of space. Such cams are also expensive to manufacture.

While one end of the closing spring is mounted to a suitable stationary member, the opposite end, which is anchored to the crank member which is capable of rotating through 360°, causes the closing spring to whip through an arc which, in turn, causes a breaker structure to vibrate due to the sudden change in direction of the spring mass. Thus, present day breaker structures employing spring closing mechanisms have the disadvantages of requiring a closing cam which is expensive in manufacture and which occupies a considerable amount of space; the mechanism generates an extremely large amount of noise during the closing operation and the breaker structure undergoes an inertia jump due to the curved path followed by the mass of a heavy closing spring.

The instant invention provides a novel spring closing mechanism which eliminates all of the above disadvantages as well as eliminating the need for an eccentric cam member and employs a substantially large lever arm capable of utilizing all of the energy stored in the closing springs for closing the breaker cooperating contacts.

The instant invention employs a convention toggle assembly which is coupled between the movable arm of the breaker structure and a stationary point and further employs a conventional ratchet wheel charging system comprised of a ratchet mounted upon a shaft of substantially

rectangular cross-section, which ratchet is driven into rotation by a motor driven charging means. The closing springs do not act upon the ratchet wheel shaft, but are charged by means of crank arms and cooperating link members which are mechanically coupled to the shafts. The closing springs do not act through the crank arms, but operate through a link member pivoted about a second shaft independent from the ratchet member shaft with this rotating link member having a first surface which bears against one end of the closing spring member and a second surface which bears against one cooperating surface of a link forming the circuit breaker toggle system.

The closing spring is of the torsion spring type and is mounted about the second independent shaft above-mentioned with a first end thereof being anchored to a suitable stationary point and with the second end projecting outward so as to be free to make engagement with the link pivoted to the second independent shaft. Operation of the spring charging motor drives the ratchet member into rotation, causing the rectangular shaft to likewise rotate. This rotation is coupled through a crank arm to a connecting link which is pivotally connected between the shaft crank arm and the rotatably mounted link. Rotation of the crank arm causes the connecting link to rotate the rotatably mounted link about its pivot point, thereby driving a first surface thereof against the free end of the torsional closing spring so as to fully charge the spring.

The closing operation is effected through the release of a prop latch mechanism which holds the spring in the fully charged position. Release of the prop latch mechanism permits the torsional closing spring to discharge all of its energy, driving the opposite surface of the rotatable link into a rotatable link which forms an integral part of the toggle assembly. Prior to the closing operation, the toggle assembly is in a collapsed position. Driving of the rotating link into the lowermost toggle link urges the toggle assembly into the fully extended position thereby driving the movable arm of the circuit breaker into engagement with its cooperating stationary contact.

The above-mentioned spring closing circuit breaker mechanism thereby totally eliminates the need for an eccentric closing cam and the space required therefor and provides a lever arm superior to the lever arm employed in present day spring closing mechanisms wherein the length of the lever arm is not critical and, in the case of limited space requirements, may be made shorter while in not too critical space requirements the arm may be made to any desired length, thereby providing a lever arm which takes full advantage of the total stored energy in the spring mechanism for use in the closing operation. The free end of the torsion spring member undergoes "straight line" movement as opposed to the "whipping" movement experienced by present day spring closing mechanisms so that the circuit breaker structure does not experience an inertia jump which exists in present day circuit breaker structures due to the curved path which the spring free end travels along. In addition, the space required for such curve path travel is totally eliminated.

It is therefore one object of the instant invention to provide a novel spring closing mechanism for use in rapidly closing circuit breaker structures and the like.

Another object of the instant invention is to provide a novel spring closing mechanism for use in circuit breakers and the like comprising a closing spring of the torsion spring type which is not directly coupled to the spring charging mechanism so as to provide a substantial lever arm advantage over conventional spring closing mechanisms.

Still another object of the instant invention is to provide a novel spring closing mechanism for use in circuit

3

breaker structures and the like comprising a spring charging mechanism mounted to a first shaft and having a crank arm coupled to said first shaft and which is employed to charge a closing spring of the torsion spring type through a first connecting link coupled to a second rotatable link having a first surface which bears against the free end of the torsion spring during charging thereof and which has a second surface bearing against the toggle mechanism during the closing operation thereof for release of the stored energy in the closing spring in order that the circuit breaker be rapidly moved to its fully closed position.

These and other objects of the instant invention will become apparent when reading the accompanying description and drawings in which:

FIGURE 1 shows an elevational view of the circuit breaker and the spring closing mechanism with the circuit breaker housing being removed to expose the spring closing mechanism. FIGURE 1 shows the circuit breaker in the fully closed position with the closing spring fully discharged.

FIGURE 2 is an elevational view of the circuit breaker and spring closing mechanism of FIGURE 1 with the circuit breaker being shown in the fully open position and the spring closing member being in the fully charged position.

FIGURE 3 is an elevational view showing a portion of the circuit breaker mechanism of FIGURES 1 and 2 in greater detail for the purpose of understanding the operation of the prop latch mechanism.

Referring now to the drawings, and more particularly to FIGURES 1 and 2, there is shown therein a circuit breaker structure 10. While the specific configuration of the circuit breaker described herein lends no specific novelty to the device of the instant invention, portions of the circuit breaker will be described herein to set the environment for the device of the instant invention and its inner-action with the inventive structure.

The circuit breaker 10 is provided with a movable bridge 11 pivoted at 12 and having main and arcing contacts 14 and 13, respectively. These contacts cooperate with the stationary main and arcing contacts 15 and 16, respectively. With the circuit breaker in the fully closed position, as shown in FIGURE 1, the electrical path extends through the upper terminal 17, the tulip connector 18, circuit breaker conductor block 19, contact pairs 13-15 and 14-16, movable bridge 11, conductor block 20, tulip connector 21 and lower stationary terminal 22.

The movable bridge 11 is rotated under control of a connecting member 23, pivotally connected to bridge 11 at 24 and to jack shaft 25 by means of pivot pin 26. The jack shaft arm 25 is pivoted to rotate about the hexagonal jack shaft 27. A closing spring 28 of the torsion spring type is wound about a shaft 29a and has its free end 28a bearing against rod 30. A first link comprising the L-shaped arm 29 is provided with a rod 30, which bears against a rotating member 31 at the curved portion, or inner portion of the knee 31a. The arm 31, being in the position shown in FIGURE 1, indicates that a closing operation has already taken place and that the circuit breaker is now in the fully closed position. The upper end of arm 31 is pivotally connected by pin 34 to connecting link 32 which is, in turn, pivotally connected by pin 35 to connecting link 33. The opposite end of connecting link 33 is connected by pin 26 to both the jack shaft arm 25 and the connecting member 23. The connecting links 33, 32 and 31 form the toggle mechanism for the circuit breaker with the position shown in FIGURE 1 being the fully extended position which, as can be seen from FIGURE 1, is a position in which the circuit breaker cooperating contacts are fully engaged. The knee formed by links 31 and 32 is prevented from moving any further toward the left with reference to FIGURE 1, due to the stop member

4

36 which is stationary and which is secured to the circuit breaker supporting structure in any suitable manner.

The spring charging mechanism is comprised of a motor 37 which may be driven by any suitable local source of energy. The motor 37 is designed to have its output shaft 38 driven in only one direction continuously. This shaft is coupled through a crank pin 39 to a connecting link 40. The opposite end of connecting link 40 is coupled through pin 41 to a plate 42 which is mounted to a circular portion (not shown) of shaft 43 and is designed to rotate independently of shaft 43 for this reason. The flat rigid plate 42 is provided with a pawl 44 coupled to plate 42 by pin means 45. The pawl 44 is provided with a torsion spring 46 having a first end bearing against pin 47 on the pawl and a second end bearing against pin 48 which is rigidly secured to plate 42.

A second holding pawl 49 is secured to the circuit breaker supporting structure (not shown) by a pin 50. A second torsion spring 51 is wound about pin 50 and has a first end bearing against a pin 52 provided on pawl 49 and has a second end bearing against a pin 53 which is stationary and mounted to the circuit breaker supporting structure (not shown) in any well known manner.

The pawls 44 and 49 engage a ratchet member 54 having a rectangular opening 55 for receiving the rectangular shaped portion of shaft 43, as shown in FIGURE 1.

A substantially circular shaped crank member 56 is mounted near one end of shaft 43 and is provided with a rectangular shaped opening substantially identical to the rectangular cross-section of shaft 43 so as to be rotated therewith. The crank member 56 is provided with a crank pin 57 for receiving one end of a coupling link 58. The opposite end of coupling link 58 is coupled through pin 30 to the angular shaped arm 29. The pin, or rod 30 bears against the free end 28a of torsion spring 28 for the purpose of charging the torsion spring.

The charging operation is as follows:

The energization of motor 37 causes the connecting link 40 to undergo a substantially reciprocating action as represented by the double arrow 59. Each time the connecting arm 40 moves in substantially the downward direction, this causes plate 42 to rotate clockwise about shaft 43, in turn, causing pawl 44 to rotate clockwise about shaft 43. The forward end 44a of pawl 44 drives against one of the teeth 54a of ratchet member 54, causing the ratchet member to be rotated clockwise about the longitudinal axis of shaft 43. When the connecting arm 59 moves in the upward vertical direction, ratchet member 54 is prevented from rotating in the counterclockwise direction due to the holding pawl 49 which engages another tooth 54b of ratchet member 54.

The rotation of ratchet member 54 is imparted to the shaft 43 which, in turn, imparts clockwise rotation to the pin 57 about the longitudinal axis of shaft 43 which, in turn, causes the connecting link 58 to move substantially from the left toward the right in FIGURE 1.

The rightward movement of the connecting link 58 is coupled to the substantially L-shaped arm 29 through rod 30, causing the L-shaped arm to move from the position shown in FIGURE 1 toward the position shown in FIGURE 2.

This clockwise rotational movement of L-shaped arm 29 about its pivot 29a drives rod 30 against the free end 28a of torsion spring 28, causing the torsion spring to become charged. This operation continues until the fully charged position of torsion spring 29 is reached, which position is shown in FIGURE 2.

FIGURE 3 shows the closing latch arrangement of the instant invention which is employed for the purpose of maintaining the torsion spring 28 in the fully charged position in readiness for performance of a closing operation upon release of the closing latch mechanism.

The mechanical closing means 60 is shown therein and

5

is comprised of a closing latch 53 which is arranged to pivot about a shaft 61. The closing latch is provided with a second extending arm 53a, the lower edge of which bears against a first roller 62. Roller 62 is affixed to an L-shaped member 63 by pin means 64. The L-shaped member 63 is arranged to pivot about a pin member 65. Also affixed to L-shaped member 63 is a second roller member 66 affixed thereto by a pin 67. The surface of roller member 66 bears against a shoulder 54a provided in the substantially annular crank member 56 which is arranged to pivot with the rectangular shaft 43, as was previously described.

The annular crank member 56 is provided with a pin 57, as was previously described, which pivotally connects the link 58' thereto. It should be understood that the views of FIGURES 1 and 2 are taken from one side of the circuit breaker structure and the view of FIGURE 3 is taken from the opposite side of the structure and that there is a pair of crank arms 56 and a pair of connecting links 58 and 58' which are mounted at the extreme ends of the shaft 43. The opposite end of link 58' is coupled to pin, or rod 30, which bears against the free end 28a of the helical type torsion closing spring 28, which rod 30 is further connected to the substantially L-shaped arm 29 in the manner shown in FIGURES 1 and 2.

With the closing spring 28 in the fully charged position, as shown in FIGURE 3, the free end 28a thereof drives against rod 30 in order to drive it in a substantially linear direction, the direction being shown by arrow 30a, while the free end 28a of torsion spring 28 moves in substantially the same straight line of travel.

The closing spring 28 is unable to so move due to the fact that pin 30 which bears against free end 28a prevents discharge of the spring. However, upon clockwise rotation of trip latch 53 about its shaft 61, as shown by arrow 77, this causes the lower edge 53 of arm 53a to move out of engagement with roller member 62. This enables the free end 28a of spring means 28 to move in the direction shown by arrow 30a, causing the pin 30 which bears against it to move substantially in that clockwise direction. This further causes the annular member 56 to rotate counterclockwise, as shown by arrow 79, about the rectangular shaped shaft 43. This operation is permissible due to the fact that the roller member 62, which has been free by arm 53a of trip latch 53, permits the L-shaped member 63 to pivot counterclockwise about its pivot pin 65, as shown by arrow 80, enabling the shoulder 56a of annular crank member 56 to move roller 66 out of engagement with annular member 56, enabling the closing spring 28 to discharge and further moving pin 30 in the direction shown by arrow 38.

Returning now to FIGURE 2, it can be seen that the discharge of torsion spring 28, through the movement of its free end 28a causes the angularly shaped connecting link 29 to be rotated counterclockwise from the position shown in FIGURE 2 toward the position shown in FIGURE 1, due to the fact that the outer end of arm 29 is coupled to rod 30. It should be understood that a pair of angular shaped arms 29 are mounted to the shaft 29a with the outer ends of both arms being coupled to the ends of pin 30. The pin 30 bears against the surface 31a of the toggle member 31, causing this member to be driven counterclockwise about the shaft 29a from the position shown in FIGURE 2 toward the position shown in FIGURE 1. It should be understood that a pair of arms 31 are likewise provided with both of the arms having surfaces 31a against which the rod 30 bears.

The movement of arm 31 counterclockwise about its pivot shaft 29a causes the lower end of link 32 to move from the position shown in FIGURE 2 to the position shown in FIGURE 1. The links 32 and 33 move from the position shown in FIGURE 2 to the position shown in FIGURE 1 during a closing operation due to the link 90 which has a first end coupled to pin 35 and a second end coupled to pin 91 provided on the triangular shaped

6

member 92. Triangular shaped member 92 is mounted to rotate about pin 93 and has a third pin or roller 94 which cooperates with a latch 95 designed to provide trip-free operation even during a closing operation.

As the link 31 which forms part of the toggle assembly rotates counterclockwise from the position shown in FIGURE 2 toward the position shown in FIGURE 1, this drives knee pin 35 in the direction shown by arrow 99. Thus the link 32 of the toggle linkage moves from a substantially diagonal alignment toward a substantially vertical alignment, shown in FIGURE 1, with the knee pin 35 being guided by means of link 33 and link 90. This causes the link 33 to move from a substantially horizontal position toward a substantially vertical position, as shown in FIGURE 1 and, in turn, causes the jack shaft arm 25 to rotate clockwise about the longitudinal axis of shaft 27, in turn, causing the movable bridge 11 to move from the open position shown in FIGURE 2 to the closed position of FIGURE 1.

The trip-free operation mentioned previously is performed by moving the latch 95 from the solid-line to the dotted line position, as shown in FIGURE 1, thereby releasing the roller member 94 and enabling the knee pin 35 to move in a direction shown by arrow 99 causing the knee formed between links 32 and 33 to break, thereby enabling movable bridge 11 to move to the open position. Although not shown in the drawings, it should be understood that this operation is under control of a suitable torsion spring wound about shaft 27 which causes the knee formed between toggle links 32 and 33 to break very rapidly.

It can therefore be seen that the instant invention provides a novel spring closing mechanism employing a spring charging mechanism which is not directly coupled to the torsion type closing spring and which provides a lever arm substantially greater than that provided in conventional devices at the start and end of stroke, thereby utilizing all of the charging energy in the closing spring 28 for use in the closing operation. It should be understood that the distance between crank arm pin 57 and the center of shaft 43 can be made substantially greater in cases where space requirements are not critical so as to greatly increase the lever arm. Since the free end of the closing spring travels in substantially a straight line, the circuit breaker structure does not experience a whipping or jerking action due to the movement of a closing spring which travels through an arc of usually 180° in conventional devices. The charging and closing mechanism completely eliminates the need for a closing cam and also eliminates the space required for such an eccentric cam, as well as the manufacturing costs involved in providing a cam.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appending claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. A circuit breaker having a stationary and a co-operating movable contact, a bridge rotatably mounted at one end and receiving said movable contact at the other end thereof; a toggle assembly having a stationary first end and being pivotally linked at the second end thereof to said bridge; torsion spring means positioned adjacent said toggle assembly first end and having a stationary end and a movable end; a first link pivotally mounted at said toggle assembly first end; rotatable spring charging means spaced apart from said toggle assembly first end and having a crank arm linked to the second end of said first link by a lever arm; said first link having a rod coupled to the second end thereof and engaging said torsion spring movable end to charge said

7

spring under control of said spring charging means; said toggle assembly having at least one collapsible knee; latch means positioned adjacent said crank arm and having bias means for abutting said crank arm to latch said torsion spring in the fully charged position; means for releasing said latch means to drive said first link rod against said collapsible knee to rapidly close said cooperating contacts.

2. The device of claim 1 further comprising stationary stop means positioned near said toggle assembly first end to limit the movement of said collapsible knee under control of said torsion spring.

3. The device of claim 1 wherein said toggle assembly further comprises a second collapsible knee; means coupled to said second knee comprising releasable latch means for enabling said second knee to collapse providing trip-free operation of said circuit breaker.

8

4. The device of claim 1 wherein said spring charging means is comprised of a ratchet wheel mounted for rotation with a first shaft; first reciprocating pawl means coupled to motor means for driving said ratchet in a first direction; second stationary pawl means biased toward engagement with the teeth of said ratchet wheel for preventing rotation of said ratchet wheel in a second direction.

5. The device of claim 4 wherein said crank arm is keyed to said shaft for charging said torsion spring.

No references cited.

ROBERT K. SCHAEFER, *Primary Examiner.*

H. HOHAUSER, *Assistant Examiner.*