Oct. 12, 1965 D. W. CROUCH ETAL 3,211,866

VACUUM TYPE ELECTRIC CIRCUIT INTERRUPTER WITH PLURAL PARALLEL-CONNECTED CONTACT POINTS

Filed Feb. 5, 1963 3 Sheets-Sheet 1

FIG. 1.

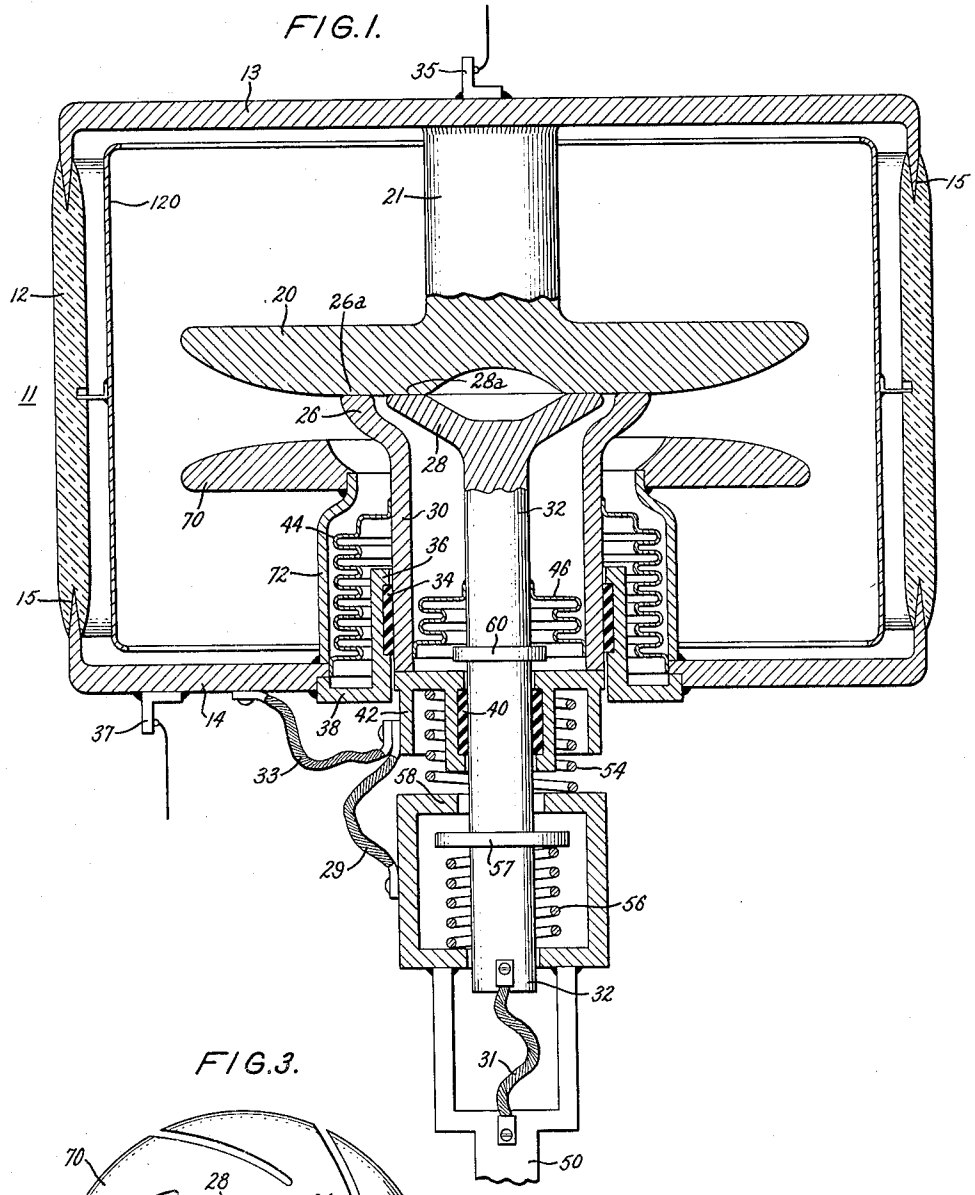

FIG. 3.

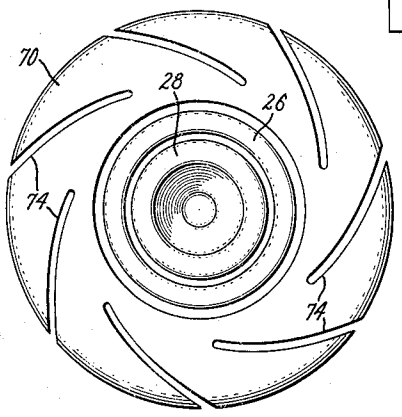

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FIG.2.

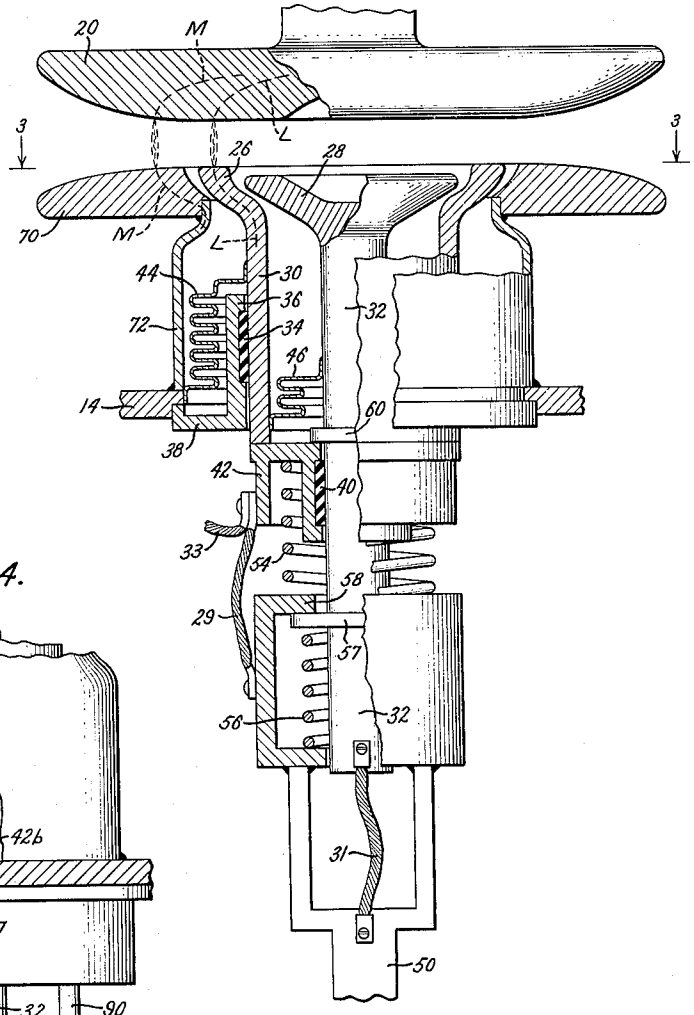

FIG.4.

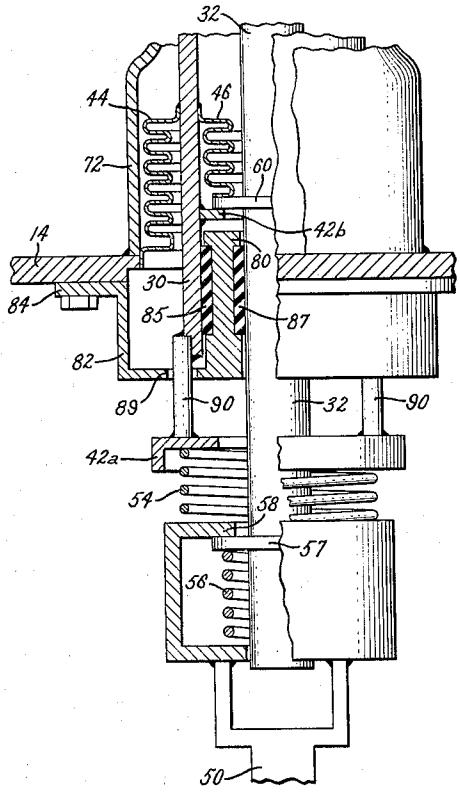

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FIG. 5.

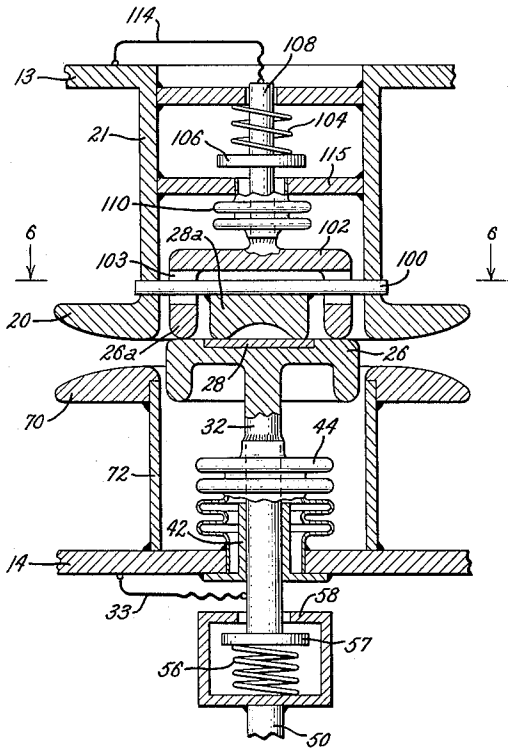


FIG. 6.

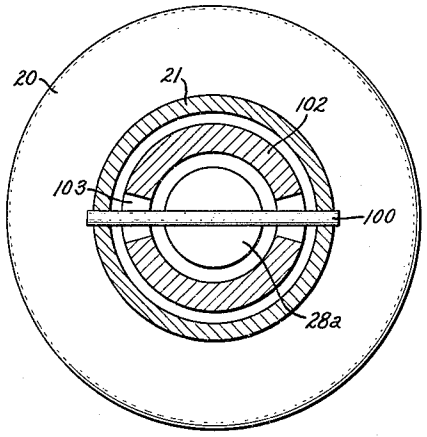
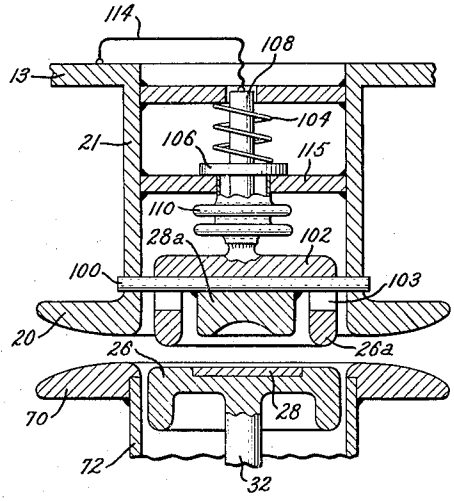


FIG. 7.



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VACUUM TYPE ELECTRIC CIRCUIT INTERRUPTER WITH PLURAL PARALLEL-CONNECTED CONTACT POINTS

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Filed Feb. 5, 1963, Ser. No. 256,295
13 Claims. (Cl. 200—144)

This invention relates to an electric circuit interrupter of the vacuum type and, more particularly, to a circuit interrupter of this type in which a plurality of movable contacts are relied upon to provide a plurality of contact points connected in parallel.

To render a circuit interrupter capable of handling high continuous and momentary currents, it is customary to provide the circuit interrupter with a plurality of movable contacts that can provide parallel-connected paths through the interrupter. The total current flowing through such an interrupter is divided between these parallel paths, thus reducing the magnetic forces and heating effects at each contact point as compared to an arrangement in which fewer or only a single contact point is present.

In a preferred form of our invention, two parallel-connected movable contacts are provided, and these contacts are surrounded by an annular electrode that is physically spaced from the two movable contacts and is electrically connected to them. The arc or arcs established by operation of the movable contacts are transferred to this annular electrode and are driven about it to aid in extinguishing them.

An object of our invention is to construct the contact structure in such a manner that the arc established by operation of the movable contacts is required to move only a minimum distance to reach the annular electrode and to transfer across only the gap between the annular electrode and the movable contact nearest it.

In a vacuum-type circuit interrupter, it is customary to support any movable part located inside the evacuated envelope by means of a bearing located outside the envelope since bearings that operate in a vacuum are usually not very reliable. This ordinarily means that for each movable contact there must be a bearing outside the envelope, a rod projecting through the envelope and supporting the movable contact on the bearing, and a bellows around the rod to provide a seal that prevents leakage into the evacuated envelope.

An object of our invention is to arrange these parts in such a manner that one of the bellows is required to deflect through only a small distance, considerably less than the total opening stroke.

Another object is to arrange the contacts in such a manner that they can be readily operated by only a single mechanism of a simple construction.

In carrying out our invention in one form, we provide two movable contacts, one of which is operated by an annular rod and the other of which is operated by a second rod located internally of the annular rod. The bellows for the annular rod is located between the envelope and the annular rod, but the bellows for the second rod is located between the annular rod and the second rod. The bellows for the annular rod is flexed through the entire opening stroke, but the other bellows is flexed only through the relative movement that occurs between the two movable contacts.

For a better understanding of our invention, reference may be had to the following description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a cross sectional view through a vacuum-type circuit interrupter embodying one form of the invention. In FIG. 1 the circuit interrupter is shown in its closed position.

FIG. 2 is a sectional view similar to that of FIG. 1 except showing the parts of the interrupter in an open position.

FIG. 3 is a sectional view along the line 3—3 of FIG. 2.

FIG. 4 illustrates a modified form of our invention.

FIG. 5 illustrates another modified form of our invention. The circuit interrupter of FIG. 5 is in the closed position.

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 5.

FIG. 7 is a view of a portion of the interrupter of FIG. 5 except showing the interrupter in the open position.

Referring now to FIG. 1, the circuit interrupter shown therein comprises an evacuated envelope **11** that comprises a tubular housing **12** of a suitable insulating material such as glass. At opposite ends of the housing **12** are metallic end plates **13** and **14** that are joined in vacuum tight relationship to the glass housing **12** by means of suitable seals **15**. The envelope is evacuated to a pressure of 10^{-4} mm. of mercury or even lower.

Disposed within the envelope **11** is a stationary contact structure **20** that is supported from the top plate **13** by means of a conductive rod **21** that also provides an electrical connection between the end plate **13** and the stationary contact structure **20**. This stationary contact **20** is preferably in the form of a circular disk. Engageable with this stationary contact structure **20** are two movable contacts **26** and **28**, each of an annular shape. These annular movable contacts **26** and **28** are disposed in generally concentric relationship, with the contact **26** surrounding the contact **28**. The annular portion of the contact structure **20** that is engaged by inner movable contact **28** may be thought of as a first stationary contact **28*a***, and the annular portion of stationary contact structure **20** that is engaged by the outer movable contact **26** may be thought of as a second stationary contact **26*a*** surrounding the first contact **28*a***.

The outer contact **26** is supported on a cylindrical rod **30** at the upper end of the rod. The inner contact **28** is supported on a rod **32** that is located within the cylindrical rod **30** in generally coaxial relationship thereto. Each of these rods **30** and **32** is of a conductive material so as to enable current to be carried through the rod to or from the contacts supported thereon. The two conductive rods are electrically connected together in parallel relationship and to the lower end plate **14** by suitable means, such as the conductive flexible braids **29, 31, 33**. Thus, when the interrupter is closed, current will flow through it between an upper terminal **35** and a lower terminal **37** through the two movable contacts **26** and **28** in parallel and the stationary contact structure **20** in series with the two movable contacts. Using two movable contacts instead of the usual one distributes the current between the two contacts, thus decreasing the amount of current that each contact point is required to conduct. This desirably reduces the magnetic forces and heating effects at each contact point, enabling the interrupter to handle higher continuous and momentary currents.

Each of the rods **30** and **32** is movable along its longitudinal axis to effect circuit-controlling movement of its respective contact. For guiding the outer rod **30** during such longitudinal movement, a stationary sleeve bearing **34** is provided about the rod **30**. This sleeve bearing **34** is carried by a tubular bearing support **36** that has a radially extending flange **38** suitably secured to the lower end plate **14**. The cylindrical rod **30** is freely slidable in a longitudinal direction within this bearing **34**.

For guiding the inner rod 32, a second sleeve bearing 40 is provided. This sleeve bearing 40 is preferably supported on the cylindrical rod 30 by means of a bearing support 42 suitably secured to the cylindrical rod 30. The inner rod 32 is freely slidable in a longitudinal direction within this bearing 40.

For providing a seal about the outer rod 30 a flexible metallic bellows 44 is provided. This bellows 44 projects into the evacuated envelope 10 and is secured in sealed relationship at its respective opposite ends to the end plate 14 and the outer rod 30. For providing a seal about the inner rod 32, a second flexible metallic bellows 46 is provided. This bellows 46 is secured in sealed relationship at its respective opposite end to the cylindrical rod 30 and the inner rod 32. Each of these bellows 44 and 46 permits movement of its respective operating rod to occur without impairing the vacuum inside the envelope 11. It will be noted that the bearings 34 and 40 are located on the atmospheric side of the two bellows 44 and 46 and are thus disposed outside the evacuated chamber.

For imparting opening and closing movement to the movable contacts 26 and 28, a vertically movable common operating member 50 is provided. In FIG. 1, the operating member 50 is shown in its uppermost or fully closed position, where it is held by suitable latch means (not shown). The operating member 50 is coupled to the two contact operating rods 30 and 32 by wipe springs 54 and 56, respectively. The wipe spring 54 is a compression spring that bears at its lower end against the common operating member 50 and at its upper end against the cylindrical operating rod 30. The other wipe spring 56 is a compression spring that bears at its lower end against the common operating member 50 and at its upper end against a shoulder 57 fixed to the inner operating rod 32. Thus, the wiper springs 54 and 56 urge their respective contacts 30 and 32 into the closed position shown so long as the common operating member 50 is in its uppermost or fully closed position shown in FIG. 1. The basic purpose of the wipe springs is to maintain at least a predetermined amount of contact pressure on the contacts despite limited wear of the contacts that might occur after repeated operations.

Opening of the interrupter is effected by driving the common operating member 50 in a downward direction from its position of FIG. 1. Such downward motion first causes an internal shoulder 58 carried by the common operating member 50 to engage the shoulder 57 on the inner operating rod 32, thereby forcing the inner contact 28 in a downward opening direction away from the stationary contact structure 20. After a small amount of such downward opening travel has occurred, sufficient to separate the inner contact 28 from the stationary contact structure, another shoulder 60 rigid with the inner operating rod 32 engages the part 42 that is fixed with respect to the outer contact operating rod 30. This engagement in between parts 60 and 42 forces the cylindrical operating rod 30 in a downward opening direction to separate outer contact 26 from the stationary contact 20. After the shoulder 60 has engaged part 42, it will be apparent that the two contacts 26 and 28 will move toward their fully open position substantially in unison. The fully-open position of the parts is illustrated in FIG. 2.

Closing of the circuit interrupter is effected by driving the common operating member 50 in an upward direction from its fully-open position of FIG. 2 into its closed position of FIG. 1. This closing operation will be discussed assuming that the springs 54 and 56 are sufficiently stiff that no appreciable deflection of the springs occurs until the movable contacts engage the stationary contact. Initial upward movement of member 50 applies an upward force to cylindrical operating rod 30 through the spring 54, thereby driving the operating rod 30 upwardly. Such upward movement carries the inner operating rod 32 upwardly due to the engagement between parts 42 and 60, so that the two contacts 26 and 28 move upwardly toward closed position in unison. Since the outer contact 26 projects slightly above the inner contact 28 during this interval, the outer contact will engage the stationary contact structure 20 first. This terminates upward movement of the contact 26, but the common operating member 50 continues moving upwardly compressing spring 54 and applying wiping force to the outer contact 26. The inner contact 28 also continues moving upwardly after the outer contact 26 engages the stationary contact structure due to the upward force being applied to the inner contact 28 through spring 56. After a small amount of such upwardly travel independently of the outer contact 26, the inner contact 28 engages the stationary contact structure 20. This terminates upward motion of the inner contact 28, but the common operating member 50 continues moving upwardly, compressing the lower wipe spring 56 and applying wiping force to the inner contact. Finally, upward motion of the common operating member 50 will be terminated by a suitable stop (not shown), at which time the parts will be in the position of FIG. 1.

It will be apparent that during this closing operation, the bellows 46 was flexed only during the small amount of travel of the inner contact 28 occurring after the outer contact 26 engages the stationary contact 20 and before the inner contact 28 engages the stationary contact 20. This small amount of travel is equal to the spacing between shoulder 60 and part 42 shown in FIG. 1. Thus, the inner bellows 46 was not flexed through the whole operating stroke of either of the contacts but only through the difference in the operating strokes of the two contacts. This is true during an opening stroke as well since relative movement between the inner contact 26 and the outer contact 28 during opening ceases as soon as shoulder 60 engages part 42.

To aid in extinguishing the arc that is drawn during an opening operation, an annular arc-running electrode 70 is provided about the two movable contacts 26 and 28. This electrode 70 is a stationary part and is supported on the lower end plate 14 by means of a tubular sleeve 72. This sleeve 72 is of a conductive material and serves to carry current to and from the electrode 70 when an arc is located thereon. Preferably, this electrode 70 is provided with spiral slots 74 of the general configuration shown and claimed in U.S. Patent No. 2,949,520—Schneider assigned to the assignee of this invention. These slots, which are shown in FIG. 3, are intended to provide a magnetic effect for driving any arc on the electrode 70 in a circumferential direction.

It will be recalled that during an opening operation, the inner movable contact 28 moves out of engagement with the stationary contact structure 20 before the outer movable contact 26 does so. Thus, the arc that is established during opening will normally be established at the outer contact 26. No arc is normally established at the inner contact 28 since the outer contact is still in engagement with the stationary contact structure 20 when the inner contact separates from the stationary contact structure. The arc that is established as the outer contact 26 is magnetically driven radially outward as the opening stroke progresses, causing the arc to transfer across the gap between contact 26 and electrode 70. The arc then moves radially outward on the electrode 70 and is then driven in a circumferential direction by the magnetic effect produced by slot 74. This motion continues until the first current zero, at which time the arc vanishes and is prevented from restriking by the high dielectric strength of the vacuum.

The above-described radially-outward force on the arc results from the fact that the current path through the arc is of a loop-shaped configuration, bowing radially-outward, as indicated by L in FIG. 2. As is well known, the magnetic effect of such a path is to force the arc in a direction to lengthen the loop, which in FIG. 2 would be radially-outward. This current path is still in the

form of a radially-outward bowing loop when the arc reaches the electrode **70**, as illustrated at M in FIG. 2, thus causing the arc to continue traveling radially-outward toward the outer periphery of electrode **70**.

A factor that is responsible for the radially-outward bowing configuration on the loop circuit L is that the current path through the contact-support **30** is located radially inwardly of any point at which the arc is normally present on the contact **26**. Similarly, the current path through support **72** is located radially inwardly of the points on electrode **70** at which the arc is normally present so as to accentuate the radially-outward bowing configuration of the loop-shaped path M.

Since the outer contact **26** normally establishes the arc, rather than the inner contact **28**, it will be apparent that the arc is required to move across only a single gap to reach the arc-running electrode **70**. It is unnecessary to move the arc across the gap between the contacts **28** and **26**, as would be required if the arc were established at the inner contact **28**.

It will be noted that the outer contact **26** will be subject to some arc erosion since it is exposed to the arc. But despite this arc erosion, it will still be possible to obtain good contact pressure for contact **26** without interfering with the ability of the other contact **28** to engage the stationary contact **20** with the proper contact pressure. This desirable relationship is made possible by the fact that each of the contacts **26** and **28** has its own wipe spring and by the additional fact that the wipe spring **54** permits enough movement of the common operating member **50** to allow the inner contact **28** to be forced into engagement with the stationary contact and to allow the wipe spring **56** for the inner contact **28** to be compressed.

FIG. 4 illustrates a modified embodiment having its parts shown in an open position corresponding to that depicted in FIG. 2. In the embodiment of FIG. 2, there are relatively movable supports **38** and **42** for the contact rods **30** and **32**. But in the embodiment of FIG. 4, only a single bearing support is relied upon for the two contact rods **30** and **32**. This single bearing support is illustrated at **80** carried by a cup-shaped member **82** having a flange **84** fixed to the lower end plate **14**. The tubular contact rod **30** is guided by means of a sleeve bearing **85** carried by the stationary support **80** and disposed between the outer periphery of the support **80** and the inner periphery of the tubular contact rod **30**. The inner contact rod **32** is guided by means of a sleeve bearing **87** carried by the stationary support **80** and disposed between the inner periphery of the stationary support and the outer periphery of the contact rod **32**.

The cup-shaped support **82** for the bearing support **80** contains a series of angularly spaced holes **89**. Angularly-spaced rods **90** fixed to the tubular contact rod **30** extend freely through these holes **89** and are secured at their lower ends to a crosshead **42***a* generally corresponding to the part **42** of FIG. 2. The crosshead **42***a* can be moved upwardly to impart closing movement to the contact rod **30** and downwardly to impart opening movement to rod **30**. The actuating means **50–58** of FIG. 4 is essentially the same as the correspondingly designated means of FIG. 2 and functions in the same manner. A shoulder **42***b* is fixed to the tubular contact rod **30** and this bears against a shoulder **60** on the inner contact rod **32** in the same manner as parts **42** and **60** engage in FIG. 2.

FIGS. 5–7 illustrate still another embodiment of our invention. In this embodiment, as in the others, there are two sets of relatively movable contacts disposed in generally concentric relationship and a stationary annular arc runner surrounding the contacts of each set. The contacts of one set of these relatively movable contacts are designated **28** and **28***a*, respectively; and the contacts of the other set are designated **26** and **26***a*. The contacts **26** and **26***a* are of an annular form and respectively surround the contacts **28** and **28***a*. The stationary arc runners are designated **20** and **70**, respectively, with arc runner **20** surrounding the upper contacts **26***a* and **28***a* and the arc runner **70** surrounding lower contacts **26** and **28**. The outer contacts **26**, **26***a* may be thought of as being located between the inner contacts **28**, **28***a* and the stationary arc runners **20**, **70**.

The lower two contacts **26** and **28** are movable contacts that are fixed relative to each other. Both of these contacts **26** and **28** are mounted on a movable conductive rod **32**.

One of the upper contacts **28***a* is a stationary contact that is carried by the tubular support **21** for the upper arc runner **20**. Preferably, a conductive cross bar **100** extends diametrically across the tubular support **21** and is fixed to the upper contact **28***a* and the tubular support **21** to provide a stationary mounting for the contact **28***a*.

The other upper contact **26***a* is formed by the lower end of a tubular flange of a cup-shaped member **102** that is mounted for limited vertical movement. This tubular flange has a pair of diametrically opposed openings **103** through which the cross bar **100** extends with enough clearance to allow for the desired vertical movement of the cup-shaped member **102**. This cup-shaped member **102** is spring-biased in a downward direction by means of a spring **104** located outside the evacuated envelope **11**. This spring **104** acts against the shoulder **106** fixed to a rod **108** that is fixed to the cup-shaped member **102**. A suitable bellows **110** provides a vacuum-tight seal about the movable rod **108**.

The two upper contacts **26***a* and **28***a* and upper arc runner **20** are electrically connected together by means including a conductive jumper **114** located outside the envelope **11**. This conductive jumper is connected at one end to the conductive rod **108** and at its other end to the upper end plate **13**. End plate **13** is electrically connected to contact **28***a* through the cross bar **100** and the tubular support **21**. The two lower contacts **26** and **28**, which are electrically connected to each other through a suitable brazed joint, are electrically connected to the lower arc runner **70** by means of a conductive jumper **33** and the conductive support **72** or the arc runner **70**. When the circuit interrupter is in its closed position of FIG. 5, the two sets of contacts **26**, **26***a*, and **28**, **28***a* are connected in parallel, and current may flow through the interrupter via either set of contacts. The contacts **28** and **28***a* are held in engagement under pressure by means of a wipe spring **56** corresponding to a similarly designated wipe spring in FIG. 1. The contacts **26** and **26***a* are held in engagement under pressure by means of the upper spring **104**.

Opening of the circuit interrupter of FIG. 5 is effected by driving the contact rod **32** downwardly. This immediately separates the inner contacts **28** and **28***a*, but no arcing occurs at these inner contacts since the outer contacts **26** and **26***a* are still in engagement. The outer contacts **26** and **26***a* continue in engagement since the upper spring **104** is capable of driving the upper contact **26***a* through a limited downward stroke in follow-up relationship to the downwardly moving contact **26**. This engagement between contacts **26** and **26***a* continues until the stationary plate **115** is engaged by the shoulder **106** on the rod **108**, which is integrally connected to the contact **26***a*. This engagement between parts **115** and **106** arrests the downward movement of the contact **26***a*, but contact **26** continues moving downward into its fully open position of FIG. 7, establishing a gap between contacts **26** and **26***a*. An arc is established across this gap between contacts **26** and **26***a*, after which the arc moves radially outward to the annular arc runners **20** and **70**. The arc runners **20** and **70** are slotted, as in FIG. 3, to provide for rotation of the arc about the arc runner until extinguished in the same manner as described in connection with FIGS. 1 and 3. It will be apparent that in FIG. 5, as well as in FIG. 1, the terminals of the arc are required to jump across only

a single gap in order to reach the stationary arc runners **20** and **70**. This follows from the fact that the arc is initiated at the outer set of contacts **26**, **26***a* rather than the inner set **28**, **28***a*.

The downward force for effecting the above described opening operation was transmitted to the contact rod **32** through a main operating rod **50** and shoulders **58** and **57**, corresponding to similarly designated parts in FIG. 1.

Closing of the interrupter is effected by driving the main operating member **50** upwardly from its open position of FIG. 7. This action drives the operating rod **32** and contacts **26** and **28** upwardly. After a predetermined amount of such upward motion, contact **26** engages annular contact **26***a*, which is then in its position of FIG. 7, forcing annular contact **26***a* upwardly against the wipe spring **104**. After a predetermined amount of this upward motion of contacts **26** and **26***a* together, the inner movable contact **28** engages the stationary contact **28***a*. The main operating member **50** continues moving upwardly for a slight additional distance, compressing the wipe spring **56** at the lower end of contact rod **32**, thus providing contact pressure for the contacts **28** and **28***a*.

It will be apparent that during closing the bellows **110** in FIG. 5 is flexed only during the small amount of travel occurring after the contacts **26** and **26***a* engage and before the contacts **28** and **28***a* engage. This small amount of travel is equal to the clearance between shoulder **106** and the plate **115**, as seen in FIG. 5. In view of the shortness of this travel, the bellows **110** can be only a short one. The lower bellows **44** on the other hand must be a longer one capable of being flexed through the entire operating stroke. A suitable bearing **42** is provided inside the bellows **44** for guiding the contact rod **32**.

In each of the interrupters, the insulating housing is protected from the condensation of arc-generated vapors thereon by means of a suitable tubular metallic shield, such as shown at **120** in FIG. 1.

While we have shown and described particular embodiments of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from our invention in its broader aspects, and we, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A vacuum-type circuit interrupter comprising:
(a) generally stationary contact structure,
(b) a first movable contact engageable with said stationary contact structure when said interrupter is closed,
(c) a second movable contact of annular configuration surrounding said first movable contact and engageable with said stationary contact structure when said interrupter is closed,
(d) said second movable contact being relatively movable with respect to said first movable contact,
(e) a generally stationary arc-running electrode of annular configuration spaced from said generally stationary contact structure and surrounding said first and second movable contacts,
(f) means for electrically interconnecting said first movable contact, said second contact, and said generally stationary arc-running electrode when said interrupter is open,
(g) opening means operable during an opening operation to first separate said first movable contact from said stationary contact structure and then separate said second movable contact from said stationary contact structure,
(h) and means for driving one terminal of an arc established by separation of said second movable contact from said stationary contact structure on to said arc-running electrode.

2. The circuit interrupter of claim **1** in combination with means for driving said arc in a circumferential direction about said arc-running electrode.

3. A vacuum-type circuit interrupter comprising:
(a) generally stationary contact structure,
(b) a first movable contact engageable with said stationary contact structure when said interrupter is closed,
(c) a generally stationary arc-running electrode of annular configuration spaced from said generally stationary contact structure and surrounding said first movable contact,
(d) a second movable contact located between said first movable contact and said stationary arc-running electrode and relatively movable with respect to said first movable contact,
(e) means for electrically interconnecting said first movable contact, said second movable contact, and said generally stationary arc-running electrode when said interrupter is open,
(f) opening means operable during an opening operation to first separate said first movable contact from said stationary contact structure and then separate said second movable contact from said stationary contact structure,
(g) and means for driving one terminal of an arc established by separation of said second movable contact from said stationary contact structure on to said arc-running electrode.

4. The interrupter of claim **3** in combination with an evacuated envelope housing said contacts, a tubular rod coupled to said second movable contact and projecting through a wall of said envelope, an additional rod coupled to said first movable contact and projecting through a wall of said envelope, said additional rod being located within said tubular rod, tubular bearing means located between said two rods and outside said envelope for guiding said two rods, said tubular rod being slidably mounted on the exterior of said tubular bearing means and said additional rod being slidably mounted internally of said tubular bearing means.

5. The interrupter of claim **3** in combination with an evacuated envelope housing said contacts, a tubular rod coupled to said second movable contact and projecting through a wall of said envelope, an additional rod coupled to said first movable contact and projecting through a wall of said envelope, said additional rod being located within said tubular rod, a first bearing disposed externally of said tubular rod and externally of said envelope for guiding said tubular rod, a second bearing located between said tubular rod and said additional rod and located externally of said envelope for guiding said additional rod within said tubular rod.

6. The interrupter of claim **3** in combination with an evacuated envelope, a tubular rod coupled to said second movable contact and projecting through a wall of said envelope, a first flexible bellows connected between said envelope and said tubular rod and providing a seal between said envelope and said tubular rod, an additional rod coupled to said first movable contact and projecting through said envelope, said additional rod being located within said tubular rod, a second flexible bellows connected between said tubular rod and said additional rod for providing a seal between said rods.

7. The circuit interrupter of claim **6** in combination with means for transmitting opening motion from said additional rod to said tubular rod after said additional rod has moved said first contact out of engagement with said stationary contact structure during an opening operation.

8. The circuit interrupter of claim **6** in combination with an operating member for actuating said two rods and a pair of wipe springs, one of which is located between said operating member and said additional rod and the other of which is located between said operating member and said tubular rod, said wipe springs urging said

movable contacts into engagement with said stationary contact structure when said contacts are closed.

9. A vacuum type circuit interrupter comprising:
(a) an evacuated envelope,
(b) a first pair of relatively movable contacts engageable with each other at a generally central location within said envelope,
(c) a generally stationary arc-running electrode of annular configuration surrounding one contact of said first pair and physically spaced from said one contact,
(d) a second pair of relatively movable contacts, one contact of said second pair being located between said annual arc-running electrode and the one contact of said first pair surrounded by said annular electrode,
(e) means for electrically connecting said annular arc-running electrode with said one contact of said first pair and said one contact of said second pair when said interrupter is open,
(f) opening means operable during an opening operation to first separate said first pair of contacts from each other and then separate said second pair of contacts from each other,
(g) and means for driving one terminal of an arc established by separation of said second pair of relatively movable contacts from said one contact of said second pair on to said stationary arc-running electrode.

10. The circuit interrupter of claim 9 in which:
(a) one contact of said first pair and one contact of said second pair are mechanically connected together for movement in unison.
(b) the other contact of said second pair being movable with respect to the other contact of said first pair.

11. The circuit interrupter of claim 9 in which:
(a) one contact of said first pair and one contact of said second pair are stationary contacts,
(b) and the other contacts of said first and second pair are movable contacts that are also mounted for movement with respect to each other.

12. A vacuum type circuit interrupter comprising:
(a) an evacuated enevelope,
(b) a generally stationary annular arc-running electrode,
(c) a generally stationary contact surrounded by said annular arc-running electrode,
(d) a generally annular contact surrounding said stationary contact and surrounded by said annular arc-running electrode,

(e) means for mouting said annular contact for movement relative to said stationary contact,
(f) a pair of movable contacts for respectively engaging said stationary contact and said annular contact,
(g) means for mechanically connecting said movable contacts together for movement in unison,
(h) spring means for causing said annular contact to follow and thus remain in engagement with its mating movable contact during a portion of an opening operation occurring after said stationary contact and its mating contact have separated,
(i) means operable after said stationary contact and its mating contact have separated to block said annular contact from following its mating movable contact, thereby establishing an arcing gap between said annular contact and its mating movable contact,
(j) and means for driving the arc established at said gap on to said stationary annular arc-running electrode.

13. The vacuum type circuit interrupter of claim 12 which is further characterized by:
(a) said spring means being located outside said envelope and at one end of said envelope,
(b) force transmitting means extending through a wall of said envelope for transmitting force between said spring means and said annular contact,
(c) a bellows mounted about said force-transmitting means and providing for movement thereof without impairing the vacuum inside said envelope,
(d) additional force transmitting means for operating said movable contacts,
(e) said additional force transmitting means extending through the opposite end of said envelope,
(f) and an additional bellows about said additional force transmitting means to provide for movement thereof without impairing the vacuum inside said envelope.

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