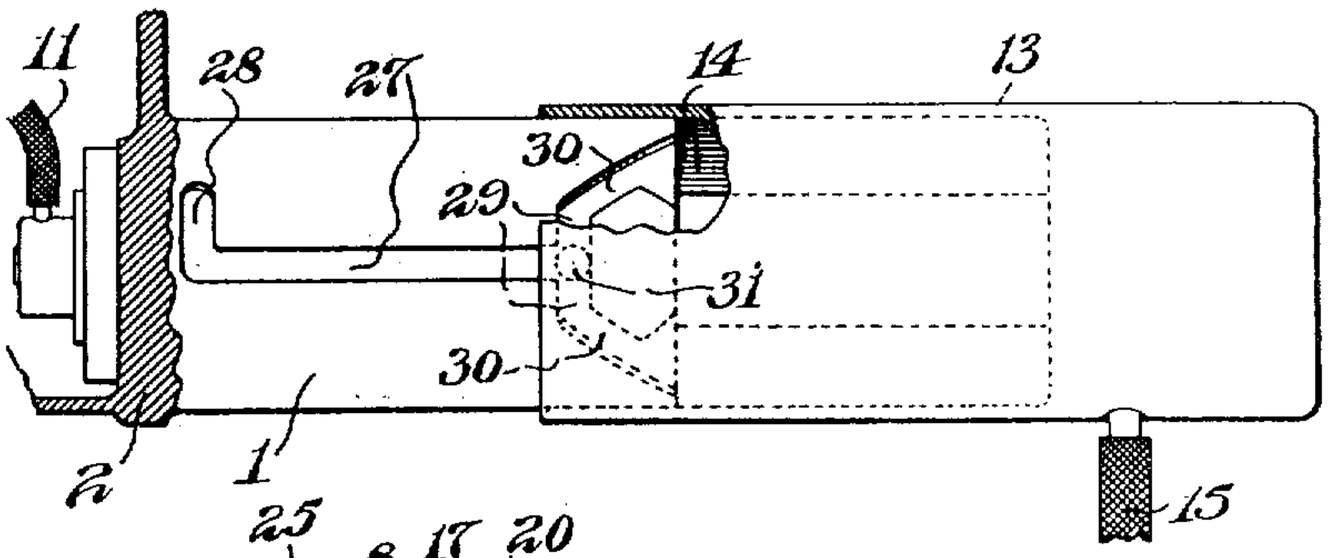
Jan. 2, 1923. 1,441,193.

C. W. WYMAN.

ELECTRIC CIRCUIT MAKING AND BREAKING DEVICE.

ORIGINAL FILED SEPT. 1, 1916.

Fig. 1.



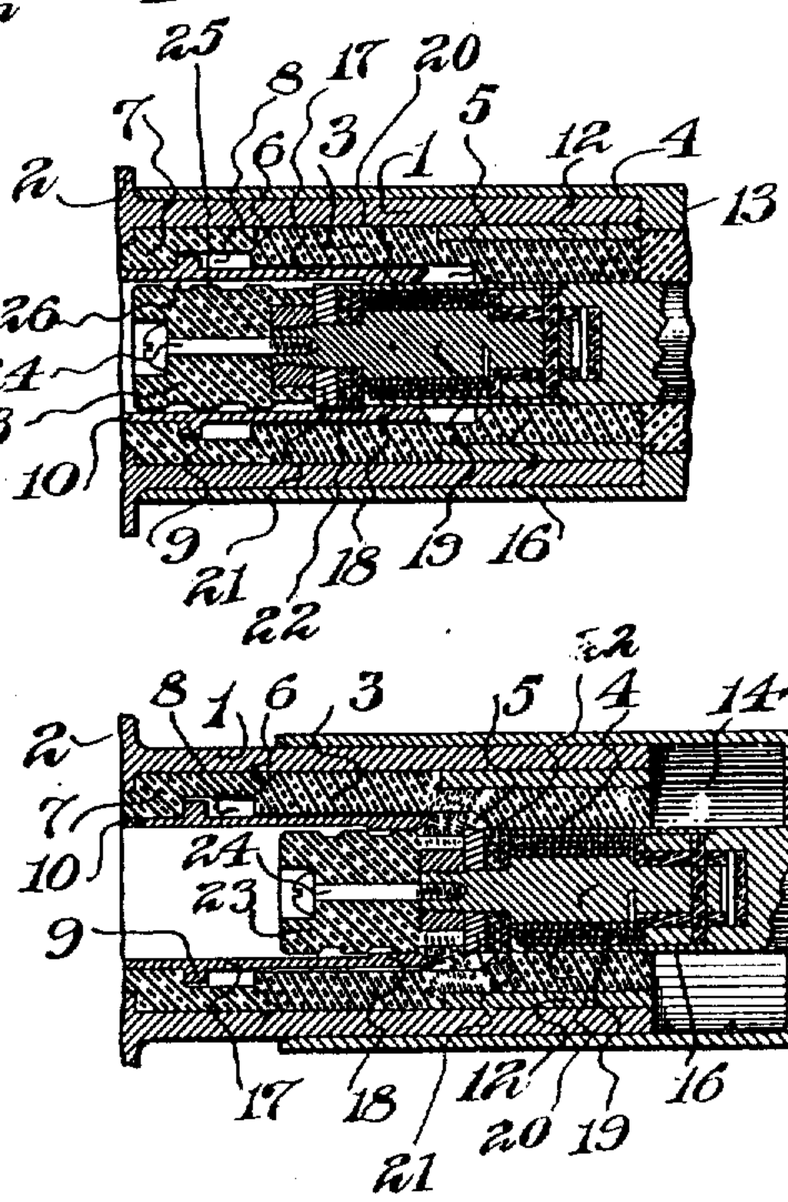


Fig. 2.

Fig. 3.

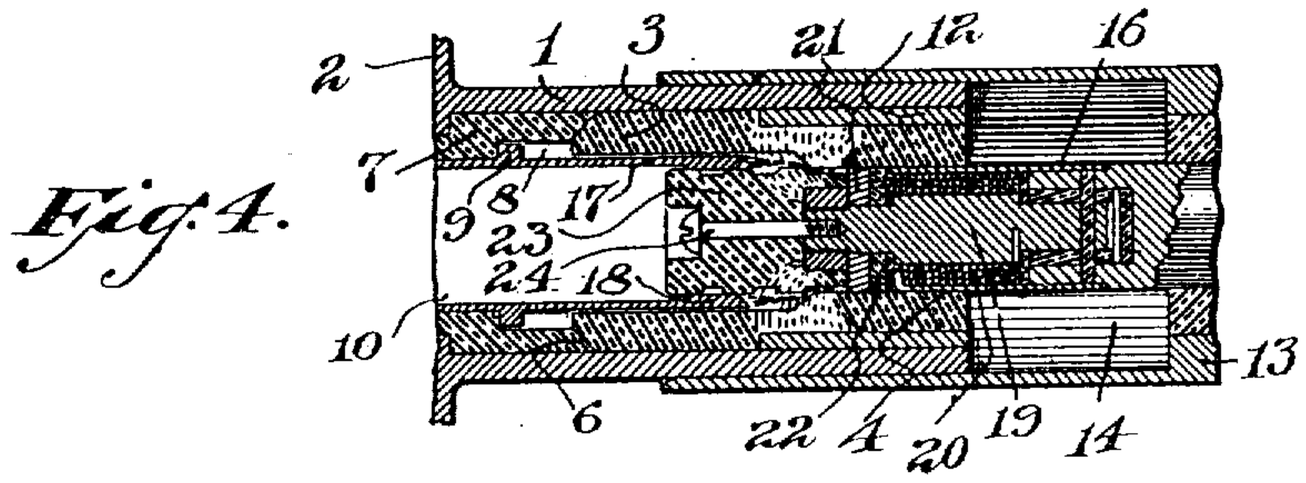


Fig. 4.

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UNITED STATES PATENT OFFICE.

CHARLES W. WYMAN, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

ELECTRIC-CIRCUIT MAKING AND BREAKING DEVICE.

Application filed September 1, 1916, Serial No. 118,043. Renewed October 2, 1922. Serial No. 591,988.

To all whom it may concern:

Be it known that I, CHARLES W. WYMAN, a citizen of the United States, residing at Claremont, in the county of Sullivan and State of New Hampshire, have invented certain new and useful Improvements in Electric-Circuit Making and Breaking Devices, of which the following is a full, clear, and exact specification.

My invention relates to electrical circuit making and breaking devices.

It has for its object to provide an improved circuit making and breaking device for electric circuits and, more especially, one adapted to use in gas-laden atmospheres such as encountered in mines and so constructed and arranged that the circuit may be broken at will without danger of igniting the gas. More specifically my invention has for its object to produce a new and improved connector whereby the arc caused by the breaking of the circuit is attenuated and broken and wherein the gases generated by the arc are thereafter confined for a predetermined cooling period in order effectually to prevent the ignition of the surrounding atmosphere should the same be laden with gas, coal particles, or the like.

In the accompanying drawings I have, for purposes of illustration, shown one embodiment which my invention may assume in practice, illustrating the same as applied to a connector of a type adapted to general use and especially adapted to use in mines or the like.

In these drawings:—

Figure 1 is a side elevation of my improved connector in open circuit position, certain parts thereof being broken away to facilitate illustration.

Figure 2 is a longitudinal partial sectional view of the same showing its parts in circuit closing position.

Figure 3 is a view similar to Figure 2 showing the circuit still closed but with the arc attenuated.

Figure 4 is a view similar to Figure 2, showing the circuit about to be broken, the arc being further attenuated and the arcing chamber about to be sealed.

In these drawings, I have illustrated a casing member 1 of a cylindrical form attached to a suitable support 2 which may, if desired, be carried by a fixed panel or a movable device such for instance, as a mining machine. This member 1 carries within the open end of the same a removable insulating sleeve 3 which is in turn provided with a restricted portion or throat 4 and an enlarged inner bore 5 having a beveled end 6 adapted to co-operate with a correspondingly beveled surface on a co-operating removable inner insulating sleeve 7. As shown this member 7 is internally grooved at 8 to receive an external flange 9 on a cylindrical contact member or sleeve 10 suitably removably attached to the support 2 and electrically connected to the circuit as for instance, by a conductor 11. As shown, the sleeve 3 also carries a soft iron ring or sleeve 12 located at the outer end of the sleeve 3 and disposed between the latter and the member 1 with one end thereof located intermediate the ends of the member 1 and adjacent the inner end of the throat 4 of the member 3 while the other end thereof is located nearer the free end of the member 1.

Co-operating with the member 1 and carrying means adapted to establish electrical connection with the contact member 10 housed therein, is a co-operating connector member 13 herein adapted to fit over the member 1 and receive the same in a chamber 14 formed therein as the member 13 is pushed home. or towards circuit closing position, from the open circuit position illustrated in Figure 1. This member 13 is as shown preferably supplied with current through a conductor 15 which is in turn electrically connected to a preferable cylindrical contact member 16 disposed coaxially within the member 13 and adapted to fit snugly within and move longitudinally of the contact member 10, the latter in a preferred form being provided with a resilient neck 17 to permit free movement of the said member and at the same time maintain a proper electrical contact between an elongated contact surface 18 on the outer end of the member 10 and the exterior of the cylindrical contact member 16.

In my improved construction, I have also provided means whereby, as the member 16 is withdrawn from the member 10, the arc will be prevented from burning the contacts as it is attenuated by the longitudinal separation of those members. These means co-operate with the ring or sleeve 12 described and include a soft iron core 19 pref-

erably disposed coaxially within the contact member 16. Obviously, when the core 19 is magnetized the poles of the ring 12 will be oppositely disposed. Thus, as the member 16 is withdrawn, its north pole will be brought opposite the south pole of the ring 12 with the result that, as the arc is attenuated, it is also caused to be moved laterally by the action of the flux passing between the poles of these members. In a preferred form of my invention, however, the arc is not drawn directly between the contact member 16 and the contact surface 18. Instead, the contact member 16 is electrically connected to a conductor 20 which is in turn coiled about the core 19 and electrically connected therethrough with a supplemental contact ring 21, disposed around the protruding end of the core 19 and insulated from the contact surface 16 by a suitable insulating ring 22. Thus, it will be noted that when the members 1 and 13 are separated, the arc is drawn between this supplemental member 21 and the contact surface 18 and that also the core 19 is only magnetized during the making of the connection between the ring 21 and the contact 18 and the drawing of the arc.

In my improved construction, I have also provided means, co-operating with the above described means for causing the arc to travel bodily around the contacts and not to burn the latter, whereby the gases generated by the arc are confined within the connector until those gases have time to cool sufficiently to prevent any possibility of their igniting the surrounding atmosphere. As shown in Figure 4, these means include an insulating nipple or tip 23 carried by the member 13 and forming a continuation of the contact member 16 thereof. As illustrated, this member 23 is suitably attached to the member 13 by suitable means 24, as, for instance, a nut and bolt or a screw connection, and is also provided with a plurality of annular flanges 25 thereon, spaced apart by corresponding grooves 26 and so arranged that one of these flanges is brought opposite the inner end of the throat 4 of the insulating sleeve 3 immediately after the moment of maximum flux flow between the north pole of the core 19 and the south pole of the magnet 12. Obviously, this tip may be made of any length desired to insure the production of a time interval sufficient to cool the arc gases before the same are liberated by the complete withdrawal of the tip.

In order, further, to insure against the separation of the connector members before the arc is broken or its gases have been cooled, I have also provided improved co-operating separation-retarding means on the members 1 and 13. These means obviously may assume various forms, a long overlap of the members mentioned being sufficient in certain instances. In a preferred form, however, the member 1 is provided with a longitudinally disposed slot 27, having a lateral extension 28 at its inner end, and oppositely disposed lateral extensions 29 at its outer end, the last mentioned extensions preferably communicating with angularly disposed right and left outlet-slots 30. Co-operating with these slots and carried upon the member 13, is also a slot engaging member or pin 31 adapted to move successively through the slots 28 and 27 and one of the sets of slots 29 and 30 as the circuit is broken and reversely as the circuit is closed. By this construction and a proper proportioning of the parts in such a manner that when the member 31 has passed through the slots 27 and 28 to the position shown in Figure 1 the circuit will be broken, it is impossible to separate the members 1 and 13 while there is any danger of igniting the surrounding gases, the co-operating slots 29 and 30, forming the right and left outlet passages, inserting the necessary time interval between the breaking of the circuit and the separation of the connector members, to insure the cooling of the arc gases.

In the operation of my improved device it will be evident that with the parts in their circuit closing position indicated in Figure 2 and with the current flowing from the conductor 15, when the member 13 is withdrawn from its co-operating element 1, the contact surface 16 will not leave the surface 18 until the contact member 21 has engaged the latter. Thus, current will then flow through the coil 20 in such a manner as to magnetize the core 19 and cause the arc drawn between the contact 18 and the supplemental contact ring 21 to be rotated rapidly in the magnetic field. This rapid rotation puts the arc under a heavy tension or stress which reduces its tendency to jump long distances and decreases its power of destroying materials, as the insulating member 23, which may get in its path. This action, it will be noted, takes place when the arc is attenuated and extending directly between the members 18 and 21 in the closed annular space, or chamber, provided between the contact surface 18 and the reduced throat of the member 3, the magnetic flux then being at its point of maximum intensity and acting directly across the arc in such a manner as to cause the same to move bodily around the space between the members 18 and 21. Attention is also directed to the fact that when the member 13 is further withdrawn as shown in Figure 4, if the arc has not already been interrupted by the action of the flux described, it will be interrupted by the insulating nipple or tip 23 which also immediately thereafter starts to close communication with the insulating

neck 4 and acts to maintain the arcing chamber sealed until the gases therein have cooled. It will also be apparent that, by the provision of some co-operating separation-retarding means on the casings 1 and 13, a further time interval may be inserted between the breaking of the circuit, and the separation of the connector elements so that it thus may be made impossible for those elements to be separated while there is any danger of firing the gallery. Moreover, it will be seen that, should an explosion occur within the casing members at the time of breaking the circuit, such explosion tending suddenly to separate said members by violently ejecting the member 13, the form and arrangement of the slots 27 and 29 is such as to prevent such separation, the pin or stud 31 being brought into engagement with the outer wall of the slot 29, and the outward movement of the member 13 being arrested until said member is turned manually.

Attention is here also directed to the fact that, in my improved construction, the arc is not drawn through insulating material in such a manner as to cause breaking down of the same but is, instead, drawn and broken in a separate enclosed chamber which is thereafter maintained closed by the tip 23 or, if desired, by the tip 23 and the separation-retarding means on the casings, for a sufficient length of time to permit the cooling of the gases generated by the arc. Another decidedly advantageous feature of my improved construction is that in the normal operation of the device the coil 20 is energized only during the separation of the connector elements and then only during the very part of this separation when current flow through the coil is needed to energize the core 19, i. e. when the arc is being drawn, all difficulties arising from heating or waste of current being thus avoided. Attention is also directed to the fact that the contact parts shown herein are of an exceedingly rugged nature adapted to long use in service and that these parts are securely though removably housed within the connector cases so that they may not be readily damaged by abuse of the latter at the hands of the operator. It should also be noted that, due to the long sliding motion necessary to the connection and separation of the connector casings, it is impossible for the operator to jam or damage the contact parts. Another decidedly advantageous feature of my construction is that, when it is desired to use the locking means for the connector elements above described, it is possible to lock those elements together and thereby insure against accidental separation of the same, the manipulation of the member 13 necessary to separate the same from the member 1 being such as to require an intention on the part of the operator. These and other advantages of my improved construction will, however, be clearly apparent to those skilled in the art.

It will, of course, be understood that in the use of my improved construction the conector members shown and the elements thereof may be transposed as desired and that various other changes may be made in the form or location of the elements of the device without in any way evading the spirit of the invention, it being my intention to include all such modifications within the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:—

1. In an electrical connector, co-operating reciprocable contact carrying members, contacts thereon, and means comprising parts carried by said members respectively for maintaining an arc drawn between said contacts in constant motion with respect thereto.

2. In an electrical connector, co-operating reciprocable contact carrying members, contacts thereon, and magnetic means comprising parts carried by said members respectively for maintaining an arc drawn between said contacts in constant motion in respect thereto until said arc is interrupted.

3. In an electrical connector, co-operating reciprocable contact carrying members, cylindrical contacts thereon, and magnetic means carried by said members for maintaining an arc drawn between said contacts in constant motion in respect thereto.

4. In an electrical connector, co-operating reciprocable contact carrying members, contacts thereon, and co-operating concentrically disposed magnetic means carried by said members for maintaining an arc drawn between said contacts in constant motion with respect thereto.

5. In an electrical circuit making and breaking device, cooperating contact carrying members movable toward and from each other, contacts thereon, magnetic arc moving means carried by said members, and means for rendering the same operative immediately prior to and during the drawing of an arc.

6. In an electrical connector, cooperating contact carrying members movable toward and from each other, contacts thereon, magnetic arc rotating means carried by said members, and means for rendering the same operative during the drawing of an arc and inoperative when said contacts are in normal circuit closing position.

7. In an electrical connector, cooperating contact carrying members movable toward and from each other, contacts thereon, magnetic arc rotating means carried by said members and including an electro-magnet through which the current flowing in the arc passes, and means for rendering the

same operative during the drawing of an arc but not when said contacts are in normal circuit closing position.

8. In an electrical connector, co-operating reciprocable contact carrying members, contacts thereon, magnetic means carried by said members for preventing an arc drawn between said contacts from remaining stationary, and co-operating means for insuring the cooling of the arc gases prior to the separation of said members.

9. In an electrical connector, co-operating reciprocable contact carrying members, one of the same having a chamber therein, contacts on said members, magnetic means carried by said members for maintaining an arc in constant motion of translation, and an insulating member carried on one of said members in rear of its contact.

10. In an electrical connector, co-operating reciprocable contact carrying members, contacts thereon, magnetic means carried by said members for maintaining in motion an arc drawn between said contacts, and means for thereafter delaying the separation of said members.

11. In an electrical connector, co-operating contact carrying members, contacts thereon, means on said members forming an enclosed arcing chamber during the separation of said contacts and for thereafter sealing said chamber for an interval, and means for maintaining in motion an arc drawn between said contacts.

12. In an electrical connector, co-operating contact carrying members, contacts thereon, means on said members forming an enclosed arcing chamber during the separation of said contacts, and insulating chamber-closing means on one of said elements movable across the path of an attenuated arc.

13. In an electrical connector, co-operating relatively movable contact carrying elements, contact members thereon, a supplemental contact member on one of said elements, and means for drawing an arc only between said supplemental contact member and a contact member on the other element.

14. In an electrical connector, co-operating relatively movable contact carrying elements, contact members thereon, a supplemental contact member on one of said elements, means for drawing an arc only between the supplemental contact member and the contact member on the other element, and co-operating magnetic means for preventing the burning of said members by said arc, by maintaining the latter in motion.

15. In an electrical connector, co-operating relatively movable contact carrying elements, contact members thereon, a supplemental contact member on one of said elements, means for drawing an arc only between the supplemental contact member and the contact member on the other element, and simultaneously operative magnetic means for rotating said arc bodily about said members.

16. In an electrical connector, co-operating relatively movable contact carrying members, contacts carried thereby and movable one relative to the other, a magnetizable member carried by one of said members, and a magnet carried by the other of said members and disposed on the opposite side of an arc drawn between said contacts.

17. In an electrical connector, co-operating relatively movable contact carrying elements, contact members thereon, a supplemental contact member on one of said elements, means for drawing an arc only between the supplemental contact member and the contact member on the other element, co-operating magnetic means for maintaining said arc in motion of translation, and co-operating means carried by said contact carrying members for delaying the liberation of the gases generated by the arc.

18. In an electrical connector, co-operating relatively movable contact carrying elements, contact members thereon, a supplemental contact member on one of said elements, means for drawing an arc only between said supplemental contact member and the contact member on the other element, co-operating magnetic means for moving said arc bodily over the surfaces of said member, co-operating means carried by said contact carrying members for delaying the liberation of the gases generated by the arc, and means co-operating with said last mentioned means for delaying the separation of said contact carrying members.

19. In an electrical connector, a pair of separable contact carrying elements collectively constituting a casing, co-operating contact members carried by said elements respectively within the same, and means for retarding the separation of said elements after the separation of said contact members.

20. In an electrical connector, a pair of separable contact carrying elements collectively constituting a casing, co-operating contact members carried by said elements respectively within the same, and means for preventing the separation of said elements under the influence of explosive action within the same after the separation of said contact members.

21. In an electrical connector, a pair of separable contact carrying elements collectively constituting a casing, co-operating contact members carried by said elements respectively within the same, and means for temporarily preventing the rectilinear separation of said elements after the separation of said contact members.

22. In an electrical connector, a pair of separable telescoping contact carrying ele-

ments collectively constituting a casing, and co-operating contact members carried by said elements respectively within the same, one of said elements being provided with a slot having an angular portion adjacent the outer end of said element, and the other of said elements having a stud co-operating with said slot.

23. In an electrical connector, a pair of contacts, electro-magnetic means carried by said connector operative to produce a magnetic field of uniform intensity at all points of separation of said contacts, and means for rendering the same operative immediately prior to and during arcing.

24. In an electrical connector, a plurality of alternately engageable and separable contacts, and means for simultaneously attenuating an arc drawn between said contacts when the latter are separated and maintaining both ends of said arc in motion of translation throughout its life.

25. In an electrical connector, a plurality of separable circuit breaking contacts, and means for moving an arc drawn between said contacts over the surface of said contacts when the latter are separated and for maintaining such movement throughout the life of the arc.

26. In an electrical connector, a plurality of separable contacts, and means for revolving the arc drawn between said contacts about the axial line of said contacts when the latter are separated.

27. In an electrical contact device, a plurality of contact members cooperating prior to their separation to form an annular surface of contact, and means for causing the rotation of an arc drawn between said contacts about said annulus when the contacts are separated.

28. In an electrical contact device, a plurality of contact members cooperating prior to their separation to form an annular surface of contact, and means for causing the rotation of an arc drawn between said contacts about said annulus when the contacts are separated and for attenuating said arc.

29. In an electrical device, a pair of contacts operative on separation to break contact along a line of considerable length in a single plane and separable only on relative movement in a direction perpendicular to the plane of separation, and means for producing an electro-magnetic field of uniform intensity perpendicular to an arc drawn at any point along the line of separation between said contacts.

30. In an electrical connector, a plurality of contacts, magnetic means for changing the direction of an arc drawn between said contacts when the latter are separated, and independent means for interrupting said arc.

31. In an electrical connector, a plurality of contacts, and independent means operative respectively to create a tension in an arc drawn between said contacts when the latter are separated and to interrupt.

32. In an electrical connector, a plurality of contacts, magnetic means for changing the direction of an arc drawn between said contacts when the latter are separated, and mechnical means for interrupting said arc.

33. In an electrical connector, a plurality of contacts, magnetic means for changing the direction of an arc drawn between said contacts when the latter are separated, and means for thereafter delaying the separation of said contacts.

34. In an electrical connector, a plurality of contacts, normally inoperative magnetic means for changing the direction of an arc drawn between said contacts when the latter are separated, means for interrupting said arc, and means for thereafter delaying the separation of said contacts.

35. In an electrical connector, a plurality of contacts, magnetic means for creatitng a tension in an arc drawn between said contacts when the latter are separated, means for interrupting said arc, and means for thereafter delaying the separation of said contacts.

36. In an electrical connector, a pair of contacts adapted when in engagement to close a circuit and when separated to interrupt said circuit, and means for moving over the surfaces of said contacts an arc drawn between said contacts upon their separation, as long as current is flowing in said circuit.

37. In a plural-part electrical connector, a device constituting one part of said connector and having a contact member adapted to serve as a circuit closure means when said circuit is closed, and a member in fixed relation thereto adapted to draw and support the arc upon opening of said circuit.

38. In an electrical connector, a device constituting one part of said connector and having a contact member adapted to serve as a circuit closure means when said circuit is closed, a member adapted to receive the arc drawn upon opening of said circuit, and magnetic arc controlling means connected between said members.

39. In an electrical connector, separable connector elements having members cooperating with each other to close a circuit, magnetic arc controlling means cooperating therewith and comprising a coil for producing a magnetic field transverse to the direction of an arc formed on opening of said circuit, said coil being normally dead, and means for energizing said coil prior to and during separation of said connector elements.

40. In an electrical connector, separable connector elements provided with contact members which have annular engagement

with each other, and magnetic arc controlling means cooperating therewith and comprising a coil for producing a magnetic field of uniform strength transverse to the direction of an arc formed on breaking the circuit by separation of said connector elements, irrespective of the point along said annular engagement at which said arc may be drawn.

41. In an electrical connector, separable connector elements provided with contact members which have annular engagement with each other, magnetic arc controlling means cooperating therewith and comprising a coil for producing a magnetic field of uniform strength transverse to the direction of an arc formed on breaking the circuit by separation of said connector elements irrespective of the point upon said annular members at which said arc may be drawn, said coil being normally dead, and means for causing a flow of current through said coil upon separation of said contact members.

42. In an electric circuit making and breaking device, cooperating contact members one of which is adapted to contact with the other when said device is in circuit closing operation and to be separated from the other when said circuit is open, a third contact member spaced from each of said contact members, and an electro-magnet arranged to blow the arc formed on opening of said circuit, one end of whose winding is connected to one of said first mentioned contact members and whose other end is connected to said third contact member, said parts being constructed and arranged so that as said device is operated to open the circuit engagement between one of said first mentioned contacts and said third mentioned contact member is effected prior to separation of said first and second mentioned contact members and for a short period thereafter whereby the circuit finally broken includes the resistance of said magnet.

43. In an electric circuit making and breaking device, relatively stationary and movable members each carrying contact means, the contact means on one of said members comprising a contact element adapted to serve as a circuit closure means when said circuit is closed, an element adapted to receive the arc drawn upon opening of said circuit, and magnetic arc controlling means connected between said members.

44. In an electric circuit making and breaking device, relatively stationary and movable members each carrying contact means, the contact means on one of said members comprising a contact element adapted to serve as a circuit closure means when said circuit is closed, an element adapted to receive the arc drawn upon opening of said circuit, and magnetic arc controlling means connected between said members, and the contact means on the other of said members successively engaging said elements on relative movement of said members.

45. In an electric circuit making and breaking device, cooperating contact members one of which is adapted to contact with the other when said device is in normal circuit making operation and to be separated from the other when said circuit is open, a third contact member spaced from each of said contact members when said circuit is open, and an electro-magnet arranged to blow the arc formed on opening of said circuit, one end of whose winding is connected to one of said first mentioned contact members and whose other end is connected to said third contact member, said parts being constructed and arranged so that as said device is operated to open the circuit a circuit is effected between said third mentioned contact member and the one of said first and second mentioned contact members to which it is not connected through said winding, before separation of said first and second mentioned contact members and for a short period thereafter whereby the circuit finally broken includes the resistance of said magnet.

In testimony whereof I affix my signature.

CHARLES W. WYMAN.