Dec. 19, 1939. H. A. TRIPLETT 2,183,728

FUSE

Original Filed June 17, 1936

Fig. 1.

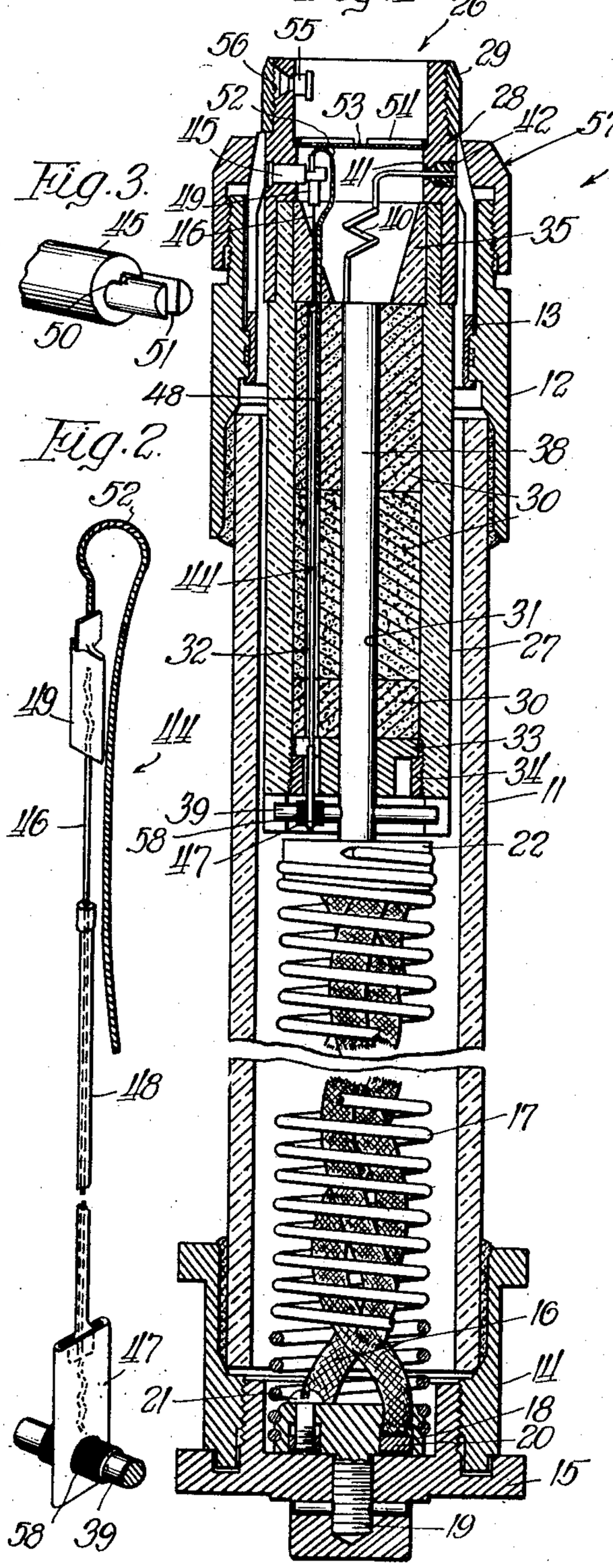
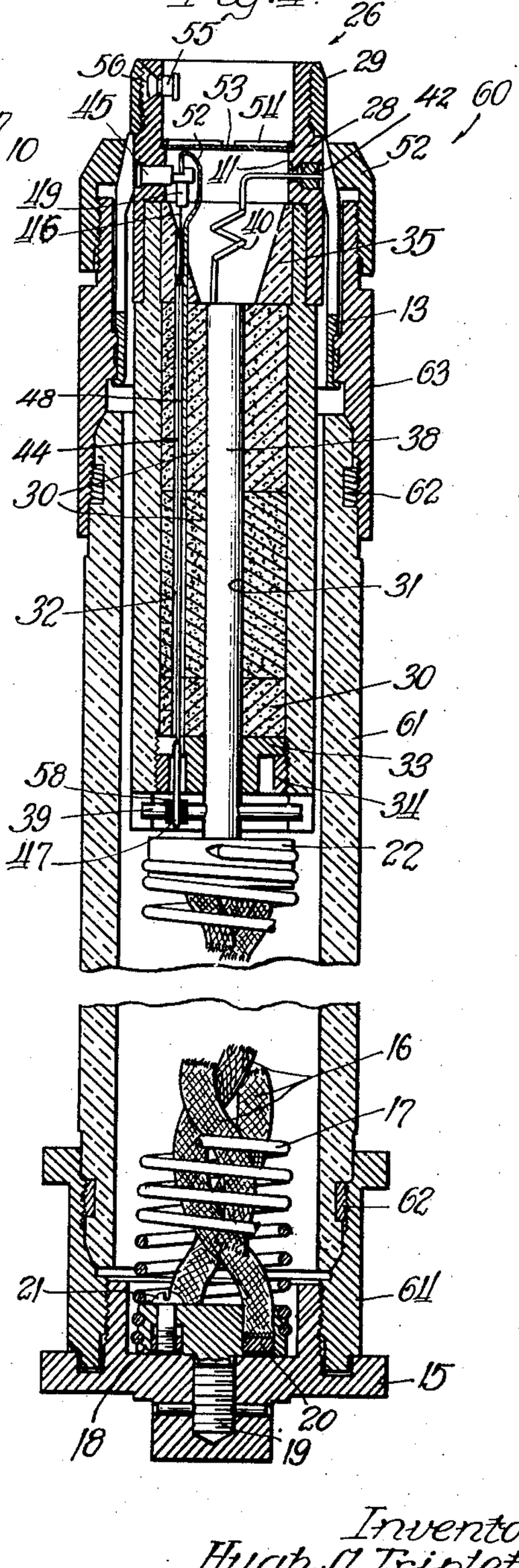


Fig. 2.

Fig. 3.

Fig. 4.



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FUSE

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42 Claims. (Cl. 200—117)

My invention relates generally to electric circuit interrupters and it has particular relation to fuses.

It is now well known to those skilled in the art that an arc drawn between the separable terminals of a circuit interrupter within a body of arc extinguishing material, such as magnesium hydroxide or boric acid, may be extinguished by the vapor which is evolved from this material due to the heat of the arc. Circuit interrupters have been constructed in which the arc extinguishing material is provided with two longitudinal bores, one a main and centrally located bore and the other an auxiliary bore of smaller diameter than and positioned parallel to the main bore. An arcing terminal is provided in the main bore which may be retracted from the adjacent end terminal of the circuit interrupter or fuse by a spring when the fusible element connecting these terminals melts. If the current is relatively small, an arc is established in the auxiliary bore where a conductor is positioned having one end connected to the arcing terminal and the other end disposed in such relation to the adjacent end terminal as to form a small gap therebetween. This gap is broken down on the formation of an arc caused by the blowing of the fusible member or element and, as a result, no arc is required to be extinguished in the main bore under certain conditions.

However, if the current causing the fusible element to melt is relatively great, such as that which flows on short circuit, an arc will persist in the main bore. Since the arcing terminal will now have traveled a considerable distance, the arc path in the main bore will be lengthened and, due to this condition and the vapor which is evolved from the arc extinguishing material, the arc will be extinguished with a minimum of disturbance.

It has been the practice to hold the arcing terminal against the force of the spring by means of the fusible element which is connected between the arcing terminal and the adjacent end terminal of the fuse or circuit interrupter. Since the force exerted by the spring is relatively great, a considerable stress is imposed upon the fusible element. This is undesirable particularly in the lower ratings of fuses, since the time-current characteristic of the fuse cannot be predetermined with the desired degree of accuracy. It is, therefore, preferable to relieve the fusible element of all tension stress and to design it solely with regard to its time-current function and without consideration to stress requirements.

Fusible element assemblies applied in fuses of the assignee's previous designs have consisted of two elements which were electrically connected in parallel. One element consisted of a high conductivity, low resistance, metallic section which was proportioned to carry the major portion of the current and calibrated to give the desired time current characteristics. The second element consisted of a high strength, high resistance, metallic member, the principal function of which was to relieve said first element of mechanical stresses. When such a fusible assembly is blown by overload or short circuit currents, the low resistance portion fuses, shunting the current to the strain element which then fuses and an arc forms between the severed ends of the strain element.

In fuses in which a solid arc extinguishing material is applied, the interrupting capacity of the bore, through which the arc is lengthened following fusion of the fusible section, varies with the diameter of the bore. For a bore of given diameter and length, there will be a certain minimum value of current which can be promptly cleared and also a maximum value of current which can be cleared without rupture of the fuse container. It is necessary in most cases to have two bores in such fuses, one of which is relied upon to interrupt low fault current, and the other bore of larger diameter which is relied upon to interrupt the possible short circuit current. These bores are proportioned so that the maximum interrupting capacity of the small bore exceeds the minimum interrupting capacity of the larger bore.

It is therefore an object of my invention, generally stated, to provide a fuse or circuit interrupter which shall be simple and efficient throughout its range of operation and which may be readily and economically manufactured and installed.

An important object of my invention is to provide for supporting the arcing terminal of a fuse of the solid arc extinguishing material type against the retractile force of its spring independently of the fusible element interconnecting the arcing terminal and the adjacent terminal, thereby permitting the fusible element to be constructed solely with regard to its time-current characteristics.

Another important object of my invention is to provide for combining the features of the parallel conductor and strain wire in a fuse of the solid arc extinguishing material type into a single element whereby no mechanical stress will be ap-

plied to the main fusible element and small current arcs will be extinguished in the auxiliary bore.

Still another important object of my invention is to provide for definitely transferring the current path in a fuse of the solid arc extinguishing material type from the main bore to the auxiliary bore to initiate the arcing in the auxiliary bore when the fusible element in the main bore melts.

A specific object of my invention is to provide a strain wire in the auxiliary bore of a fuse of the solid arc extinguishing material type for relieving the main fusible element of the retractile stress that would otherwise be imposed by the spring and for causing small current arcs to be extinguished in the auxiliary bore.

Other objects of my invention will in part be obvious and in part appear hereinafter.

My invention, accordingly, is disclosed in the embodiments hereof shown in the accompanying drawing and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the constructions hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of my invention reference may be had to the following detailed description taken in connection with the accompanying drawing in which:

Figure 1 is a view, partly in side elevation and partly in section, illustrating one embodiment of my invention, the fuse housing or tube being composed of glass;

Figure 2 is a perspective view on an enlarged scale of the strain wire assembly shown in Figure 1;

Figure 3 is a perspective view at an enlarged scale of the strain wire pin shown in Figure 1; and

Figure 4 is a view similar to Figure 1 showing the construction of a fuse provided with a housing formed of a phenolic condensation product which may be purchased under the name of "Bakelite."

According to my invention I have provided a fuse having a body of arc extinguishing material such as magnesium hydroxide or boric acid in one end of the housing while a tension spring is positioned in the other end of the housing. The body of arc extinguishing material is provided with a centrally located main bore and an auxiliary bore of smaller diameter disposed parallel to the main bore. An arcing terminal, in the form of a rod, is mounted in the main bore and is arranged to be retracted by the spring. A main fusible element, such as a silver wire is interconnected between the arcing terminal and the adjacent end terminal of the fuse. In order to hold the arcing terminal against the retractile force of the spring and to relieve the main fusible element of this duty a strain wire is provided which is connected in parallel with the main fusible element.

Since it is desirable to form the small current arc in the auxiliary bore and further since it has been the practice in the past to position a conductor in this bore, which will not be fused at low current values up to values that are greater than the main current that can be extinguished in the main bore, advantage is taken of these requirements to position the strain wire in the auxiliary bore. In other words advantage is taken of the current transfer which occurs from the main bore to the auxiliary bore to place the strain wire in the auxiliary bore where, following fusion, it will be effective in low current interruption. In this position it serves not only to relieve the main fuse element of the retractile force of the spring but it also provides the shunt conducting path in the small bore for the formation therein of low current arcs. The strain wire assembly is so constructed that the strain wire will fuse at the arcing end of the arc extinguishing material with the result that the arc is drawn into the smaller auxiliary bore and is there extinguished. A flexible cable, connected to the outer end of the strain wire, is provided for sliding engagement therewith to maintain a metallic circuit through the fuse until the terminal in the main bore has been withdrawn an appreciable distance. The flexible cable is insulated, as by enameling, so that it does not shunt the fusible section of the strain wire until after this section has parted. The insulation of the cable is then broken down and the conducting path therethrough is then formed.

The arcing terminal, arc extinguishing material and the strain wire assembly are arranged in cartridge form so that the fuse housing or tube may be refused after the fuse blows. The construction is such that the blown cartridge may be readily removed and a new one inserted.

Referring now particularly to the embodiment of the invention shown in Figure 1, it will be observed that a fuse or circuit interrupter, shown generally at 10, is there illustrated. The fuse 10 comprises a housing or fuse tube 11, in this embodiment composed of glass, having an upper ferrule 12 with which a cooperating ferrule contact 13 is disposed and a lower ferrule 14. The ferrules 12 and 14 may be secured in position on the ends of the fuse tube 11 by cement, as illustrated. The ferrule contact 13 is provided with a plurality of upstanding spring fingers, the function of which will be set forth hereinafter. For the purposes of illustration and description the fuse 10 is shown with the ferrule 12 at the top and the ferrule 14 at the bottom. It will be understood, however, that the fuse 10 is mounted in a reverse position with the ferrule 12 at the bottom and the ferrule 14 at the top.

The lower ferrule 14 is provided with a ferrule cap 15 and it has connected thereto cables 16, formed preferably of flexible conductors, and a tension spring 17 by means of a spring and cable fastener 18. The spring and cable fastener 18 is provided with a threaded stud 19 for threaded engagement with the ferrule cap 15 as illustrated. The cables 16 are secured in a suitable groove in the spring and cable fastener 18 by means of a clamp washer 20 that is held in place by screws 21, only one of which is shown. The end convolutions of the spring 17 are secured in suitable helical grooves in the outer periphery of the spring and cable fastener 18. The upper ends of the cables 16 and the upper end of the spring 17 are secured to a spring and cable fastener 22 which is similar in construction to the spring and cable fastener 18.

The portion of the fuse 10 that has just been described in detail constitutes the part thereof which is not replaced on the operation of the fuse. The parts which will presently be described constitute a removable cartridge, which is shown generally at 26.

The cartridge 26 comprises a cartridge tube 27, formed preferably of "Bakelite" or like material, at the upper end of which is positioned a

cartridge ferrule 28 having a shoulder nut 29 threaded on the end thereof. Within the cartridge tube 27 a body of arc extenguishing material 30 is provided. This material may either be in the form of a continuous cylinder or it may be sectionalized as indicated. The arc extinguishing material may comprise magnesium hydroxide or boric acid or other like material which will evolve a vapor in the presence of an arc that will assist in extinguishing the arc with a minimum of disturbance. The body of arc extinguishing material 30 may be termed an arcing tube and it has positioned therein a main bore 31 centrally located and extending longitudinally therethrough and an auxiliary bore 32 of smaller diameter and disposed parallel to the main bore. The arcing tube 30 is secured in position within the cartridge tube 27 by means of a cartridge washer 33 at the lower end and a threaded clamp ring 34, as illustrated. At the upper end a retaining ring 35 of insulation is provided, the internal section of which is outwardly flared to form an arcing chamber.

An arcing terminal or plunger 38 is slidably mounted in the main bore 31 of the arcing tube 30 and is secured to the spring and cable fastener 22 by threaded engagement therewith. At the lower end of the arcing terminal 38, which is rod-like in form and which may be composed of copper, an arcing terminal pin 39 is provided extending transversely through the arcing terminal 38 and into a transverse slot in the lower end of the cartridge tube 27. One of the functions of the arcing terminal pin 39 is to prevent the arcing terminal 38 from turning relative to the cartridge tube 27 when the refusing operation takes place.

The upper end of the arcing terminal 38 is connected by a fusible element 40, formed preferably of a silver wire, to the cartridge ferrule 28. One end of the fusible element 40 is secured in a suitable slot, not shown, in the upper end of the arcing terminal 38 while the other end is disposed in a transverse opening 41 in the side wall of the cartridge ferrule 28 and is secured therein by frictional engagement with a contact bushing 42 that is preferably formed of annealed copper and driven into position.

In order to relieve the fusible element 40 of the retractile force that would be otherwise exerted thereon by the spring 17, a strain wire assembly, shown generally at 44, and positioned in the auxiliary bore 32, is provided. The upper end of the strain wire assembly 44 is connected to a strain wire pin 45, Figure 3, which is positioned in a suitable opening in the wall of the cartridge ferrule 28 while its lower end is secured to the arcing terminal pin 39. The construction of the strain wire assembly is shown more clearly in Figure 2. As there shown, the strain wire assembly 44 comprises a strain wire 46 the lower end of which is waved and has mounted thereon a strain wire terminal 47 of such mass that it is relatively infusible as compared to the strain wire 46. The terminal 47 is formed preferably of a soft copper tube which may be readily flattened out and compressed upon the waved lower end of the strain wire 46. A suitable opening is provided in the strain wire terminal 47 through which the arcing terminal pin 39 may project.

It is desirable that the strain wire 46 be melted at its upper end in the vicinity of the arcing chamber formed by the retaining ring 35. A strain wire tube 48 is provided surrounding the strain wire 46 for accomplishing this result as well as for another purpose which will be presently set forth. The tube 48 may be formed of soft copper and its ends may be pinched onto the strain wire 46 as illustrated, the lower end being pinched by the strain wire terminal 47. Since the area of metal available for forming a conducting path through the strain wire assembly 44 will be at a minimum at the upper end of the strain wire 46, it will be readily understood that it will fuse in this portion.

The upper end of the strain wire 46 is also waved and has pinched thereon a strain wire terminal 49 which also is formed preferably of soft copper tubing and, like terminal 49, is also relatively infusible. As illustrated, the upper end of the strain wire terminal 49 is pinched in a plane at right angles to the lower portion for the purpose of interfitting in a slot 50 formed in the upper surface of a pair of projecting fingers 51 from the strain wire pin 45, Figure 3.

With a view to maintaining a conducting path through the auxiliary bore 32 after the strain wire 46 has parted, a cable 52 is provided which is preferably formed of a plurality of strands of copper wire having an enameled coating thereon. It will be understood that other suitable forms of insulation may be employed as desired. One end of the cable 52 has pinched thereon the upper portion of the strain wire terminal 49 and the other end of the cable 52 is arranged to be disposed along the tube 48 inside of the auxiliary bore 32. Since the strands of the cable 52 are provided with an insulating coating, the fusible portion of the strain wire 46 is not shunted. However, after the strain wire 46 has parted, the insulated coating of the cable 52 is broken down and a conducting path is formed between it and the tube 48 as will be readily understood.

When the fusible element 40 and the strain wire assembly 44 are blown on operation of the fuse, portions thereof are expelled through the opening in the cartridge ferrule 28. In order to readily permit the expulsion of these parts and still prevent extraneous matter from entering the interior of the fuse before it has operated, a mica disc 53 is provided, as illustrated, for covering the opening in the cartridge ferrule 28 and it may be secured in position by a retaining ring 54 in the form of a split spring wire.

A pull-up pin 55 is provided in a suitable opening 56 in the wall of the cartridge ferrule 28 to which a suitable pull-up device, not shown, may be attached for placing the cartridge 26 in operative position in the fuse 10.

In assembling the fuse 10 the cables 16 and the spring 17 are connected to the spring and cable fasteners 18 and 22. The spring and cable fastener 18 is then threaded into the ferrule cap 15. The cartridge 26 is then placed in position by threading the arcing terminal 38 into the spring and cable fastener 22. The assembly may then be positioned in the fuse tube 11 from its lower end. In this condition the tension spring 17 is retracted and the cartridge 26 is positioned well within the fuse tube 11. A suitable pull-up device, such as a strap, is now connected to the pull-up pin 55 and the cartridge 26 is drawn upwardly, thereby stressing the tension spring 17. The cartridge 26 is drawn upwardly until the shoulder nut 29 passes beyond the spring fingers of the ferrule contact 13, whereby the cartridge 26 will be locked and prevented from moving inwardly under the influence of the spring 17. A clamp nut 57 may then be screwed on to the upper ferrule 12 to secure the spring fingers of the fer-

rule contact 13 in engagement with the outer periphery of the cartridge ferrule 28.

It will now be observed that the retractile force of the spring 17 tending to move the arcing terminal 38 downwardly is entirely taken up by the strain wire assembly 44 which is connected between the arcing terminal pin 39 and the strain wire pin 45. Thus the fusible element 40 is entirely relieved of any tensile stress and may be designed with reference solely to the desired time-current characteristic.

In operation, when the current flow through the fusible element 40 is such that it is melted, the current flow is then transferred to the strain wire 46 and it melts in the arcing chamber formed by the retaining ring 35, the upper end of the terminal 38, and disc 53 or in the bore in the ring 35 through which it extends and releases the spring 17. The strain wire 46 fuses in the reduced section between the strain wire tube 48 and the terminal 49 forming an arc and releasing the arcing terminal 38 for movement inwardly through the bore 31 under the influence of the spring 17. The arc thus formed destroys the insulation on the flexible cable 52 and insures the maintenance of the arc in the small bore 32 until the end of the strain wire tube 48 passes the end of the flexible cable 52. The arc is then interrupted in the small bore and the movement of the arcing terminal 38, which has taken place in the large bore 31 during the above operation, will be sufficient to prevent restriking of the arc therein.

During a short circuit, the current transfers from the main current carrying element to the strain element in the same manner. However, under this condition, the entire section of the strain element may fuse and reestablish the arc in the main bore before any appreciable movement of the arcing terminal 38 has taken place in it.

In the low current fuse ratings, such as 1 to 5 amperes if it is desired to insure that no current is conducted by the strain wire 46 until after the main fuse element 40 blows, the strain wire terminal 47 may be insulated from the arcing terminal pin 39 as by the provision of an insulating sleeve 58 thereon. The insulating sleeve 58 should be relatively thin, thereby permitting the gap formed between the strain wire terminal 47 and the arcing terminal pin 39 to be readily broken down for completing the circuit through the strain wire 46. In this construction the arc would first strike in the main bore 31 and at current zero the recovery voltage breaks down the insulating sleeve 58 to establish the circuit through the strain wire 46. The sequence of operation will then be as described above.

The fuse shown generally at 60 in Figure 4 is similar in construction to the fuse 10 described hereinbefore. The distinction resides in the construction of the housing 61 which may be formed of an opaque material such as "Bakelite" or any similar material. At each end of the fuse tube housing 61 a threaded snap ring 62 is disposed in a suitable circumferential groove onto which ferrules 63 and 64 may be threaded, as illustrated. Since the construction and functioning of the remaining elements of the fuse 60 are identical with those set forth in connection with the description of the fuse 10 shown in Figure 1 of the drawing, a further description of the fuse 60 will not be set forth herein.

Since certain further changes may be made in the foregoing constructions and different embodiments of the invention may be made without departing from the scope thereof, it will be understood that all matter shown in the accompanying drawing or described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In combination a housing having fixed terminals, a tension spring in one end of the housing, a body of arc extinguishing material in the other end of the housing having a main bore and a separate parallel auxiliary bore, a rod-like terminal in the main bore connected to the tension spring, a main fusible element connected between the rod-like terminal and the adjacent fixed terminal, and an auxiliary fusible element of less current carrying capacity than said main fusible element disposed in the auxiliary bore, said main fusible element being free of the tension of said tension spring.

2. In a circuit interrupter the combination of means providing a main bore and an auxiliary bore of smaller size than the main bore and disposed in parallel therewith, said means under the influence of an arc in a bore causing a flow of a gaseous arc extinguishing medium through such bore, a pair of separable arcing terminals for the main bore, means tending to separate said terminals, and a conductor means in said auxiliary bore for restraining said pair of arcing terminals from separating, said conductor means including a relatively small current carrying section.

3. In a circuit interrupter the combination of a housing containing a spring, a body of solid arc extinguishing material having two parallel bores therethrough comprising a main bore and an auxiliary bore, a retractile plunger in said main bore operatively connected to said spring and constituting a main arcing terminal of large current carrying capacity, a high tensile strength conductor of small current carrying capacity disposed in said auxiliary bore and adapted to hold the plunger against retraction by said spring.

4. In combination a housing having fixed terminals, a tension spring in one end of the housing, a body of arc extinguishing material in the other end of the housing, said body having a main longitudinal bore and a separate auxiliary longitudinal bore in parallel with the main bore, a rod-like terminal in the main bore adapted to be retracted by the spring, a fusible conductor connecting said rod-like terminal and the adjacent fixed terminal, and a parallel conductor of small current carrying capacity disposed in said auxiliary bore and mechanically holding said plunger against retraction by said spring.

5. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore, holding said arcing terminal against the retractile force of said spring, said strain wire disposed to be fused after said main fusible element is fused to release said spring, [illegible] for localizing the part of said strain [illegible] fused.

6. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other [illegible]

said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, and a conductor connected in parallel with a portion of said strain wire for effecting fusion along a limited portion thereof.

7. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, and a metallic tube surrounding said strain wire along a portion thereof and having its ends pinched thereon for localizing the part of said strain wire that is fused.

8. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, a pair of tubular terminals pinched onto the ends of said strain wire for securing it in position, and a metallic tube surrounding said strain wire, said metallic tube being secured at one end to one of said tubular terminals and the other end being pinched onto said strain wire in spaced relation to said other tubular terminal.

9. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, and means for maintaining a metallic conducting path through said auxiliary bore after said strain wire is fused.

10. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said sprng, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, and conductor means connecting the end of said strain wire away from said spring with the end adjacent said spring after said strain wire is fused.

11. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, a flexible cable disposed to provide a sliding connection in said auxiliary bore between the ends of said strain wire after it is fused, and means for insulating said cable from said strain wire.

12. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body of arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, a pair of tubular terminals pinched onto the ends of said strain wire for securing it in position, and a conductor connected to one of said tubular terminals and extending in insulated relation along said strain wire to provide a conducting path through said auxiliary bore after said strain wire is fused.

13. A circuit interrupter comprising, in combination, a housing having fixed terminals, a tension spring in one end of said housing, a body or arc extinguishing material in the other end of said housing having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and the adjacent fixed terminal, a fusible strain wire disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain wire being disposed to be fused after said main fusible element is fused to release said spring, a pair of tubular terminals pinched onto the ends of said strain wire for securing it in position, a metallic tube surrounding said strain wire, said metallic tube being secured at one end to one of said tubular terminals and the other end being pinched onto said strain wire in spaced relation to said other tubular terminal, and a conductor connected to the other of said tubular terminals and extending in insulated relation along said metallic tube in said auxiliary bore.

14. A strain element for a fuse comprising a strain wire, terminals at the ends of said strain

wire, and a conducting member connected in parallel with the strain wire along a portion of its length and to one of said terminals for determining the fusing portion thereof.

15. A strain element for a fuse comprising a strain wire, terminals at the ends of the strain wire, and a conducting tube surrounding the strain wire and secured at one end to one of said terminals, the other end of the tube being pinched on the strain wire at a position spaced from the other of said terminals.

16. A strain element for a fuse comprising a strain wire, a tubular terminal pinched onto each end of the strain wire, and a metallic tube surrounding the strain wire throughout a portion of its length, one end of the metallic tube being pinched conjointly with one of said tubular terminals on one end of the strain wire and the other end being pinched onto the strain wire.

17. A strain element for a fuse comprising a strain wire, a tubular terminal pinched onto each end of the strain wire, a metallic tube surrounding the strain wire throughout a portion of its length, one end of the metallic tube being pinched conjointly with one of said tubular terminals on one end of the strain wire and the other end being pinched onto the strain wire, and a flexible insulated conductor connected to the other of said tubular terminals by being pinched thereby and disposed to be positioned along the adjacent end of said metallic tube to provide a conducting path between said terminals after the strain wire is fused.

18. In a fuse device, a stationary terminal, a relatively movable rod-like terminal, a fusible element interconnecting said stationary terminal and one end of said rod-like terminal, and a strain element interconnecting said stationary terminal and said rod-like terminal, said strain element being connected to said rod-like terminal at a point remote from said one end thereof.

19. A strain element having its ends attached to the separable terminals of a fuse comprising a strain wire, means for determining the location of melting of said strain wire, and means for determining the extent of relative movement of the ends of said strain wire before the arc formed therebetween is extinguished.

20. In a fuse having separable terminals, a fusible element, a strain element mounted independently of and disposed to be connected in parallel with said fusible element between said separable terminals, relatively infusible terminal members secured to the ends of said strain element, conductor means extending from each of said terminal members toward the other in overlapping relation, and means for insulating the overlapping portions of said conductor means from each other as long as said strain element remains intact, said insulating means being broken down on melting of said strain element to determine the extent of relative movement of the ends of said strain element before the arc formed on melting thereof is extinguished.

21. For combination in a fuse, a strain wire, metallic terminals secured to the ends of and electrically in contact with said strain wire, support means for each of said terminals, and means for insulating at least one of said terminals from the support means individual thereto.

22. A strain element for a circuit interrupter comprising a strain wire, a first conducting means connected between one end of said strain wire and a point intermediate its ends to determine the fusing portion of said wire, and a second conducting means connected to the other end of said strain wire and extending along said first conducting means, said conducting means being insulated from each other.

23. A strain element for a circuit interrupter comprising a strain wire, terminals secured to the ends of said strain wire, a first conductor connected between one of said terminals and said strain wire at a point intermediate said terminals for determining the fusing portion of said strain wire, and a second conductor connected to the other of said terminals and extending along said first conductor, said conductors being insulated from each other.

24. In a circuit interrupter the combination of means providing a main bore and an auxiliary bore of smaller size than the main bore and disposed in parallel relation therewith, said means under the influence of an arc in a bore causing a flow of gaseous arc extinguishing medium through such bore, a pair of separable arcing terminals for the main bore, a conductor of relatively small current carrying capacity in said auxiliary bore for restraining said pair of arcing terminals from separating, and means insulating said conductor from at least one of said arcing terminals.

25. In a circuit interrupter the combination of means providing a main bore and an auxiliary bore of smaller size than the main bore and disposed in parallel relation therewith, said means under the influence of an arc in a bore causing a flow of gaseous arc extinguishing medium through such bore, a pair of separable arcing terminals for the main bore, one of said arcing terminals being arranged and adapted to be moved through the main bore to extinguish the arc drawn therein between it and the other arcing terminal, a conductor in said auxiliary bore connected electrically at one end to said other arcing terminal, and means insulating the other end of said conductor from said one arcing terminal.

26. A terminal for a fusible element arranged to withstand tension stress comprising a tubular member flattened at one end onto the fusible element, the other end of the tubular member being flattened at right angles to the one end to provide shoulders for supporting the same.

27. In a fuse device, in combination, a housing, a terminal at one end of said housing, a support pin carried by said terminal, a pair of fingers carried by said pin having a transverse slot across the upper sides of said fingers, and a terminal for a fusible element arranged to withstand tension stress and to be carried by said support pin, said last named terminal comprising a tubular member flattened at one end onto the fusible element and disposed to interfit between said fingers, the other end of said tubular member being flattened at right angles to the one end to provide shoulders for interfitting with said slot.

28. In a circuit interrupter, in combination, a body of arc extinguishing material having a relatively long bore therethrough, a stationary terminal at one end of said bore and a movable terminal at the other end of said bore, a spring biasing said terminals apart, conductor means within said bore for interconnecting said terminals and restraining said spring from moving them apart, said conductor means on fusing forming an arc in said bore, means for determining the portion of said bore in which the arc is formed, and means within said bore for deter-

mining the distance through which said movable terminal moves before current flow is interrupted in said bore.

29. In a circuit interrupter, in combination, a pair of separable terminals between which an arc is adapted to be formed, means biasing said terminals apart to extend the arc formed therebetween on separation thereof, a body of arc extinguishing material having a relatively long bore therethrough, conductor means within said bore arranged and adapted to interconnect said terminals and to restrain movement thereof apart, said conductor means on fusing forming an arc in said bore, means for determining the portion of said bore in which the arc is formed, and means within said bore for determining the distance through which said terminals are moved apart before current flow is interrupted in said bore.

30. In combination, a housing having a pair of fixed terminals, a spring in one end of said housing, a body of solid arc extinguishing material in the other end of said housing having at least one longitudinal bore therethrough, a rod-like terminal in said bore mechanically connected to said spring and electrically connected to one of said fixed terminals, a fusible element electrically interconnecting said rod-like terminal and the other of said fixed terminals, and strain means disposed exteriorly of said bore for relieving said fusible element of the tension of said spring, said strain means being arranged and adapted to be released on blowing of said fusible element to permit said rod-like terminal to be retracted in said bore by said spring.

31. In a circuit interrupter the combination of insulated support means carrying a spring, a body of solid arc extinguishing material carried by said support means and having two parallel bores therethrough comprising a main bore and an auxiliary bore, a retractile plunger in said main bore operatively connected to said spring and constituting a main arcing terminal of large current carrying capacity, and a high tensile strength conductor of small current carrying capacity disposed in said auxiliary bore and adapted to hold the plunger against retraction by said spring.

32. In combination, a pair of line terminals disposed in insulated spaced relation, spring means reacting against one line terminal, a body of arc extinguishing material secured to the other line terminal, said body having a main longitudinal bore and a separate auxiliary longitudinal bore in parallel with the main bore, a rod-like terminal in the main bore adapted to be retracted by said spring means, a fusible conductor connecting said rod-like terminal and said other line terminal, and a parallel conductor of small current carrying capacity in said auxiliary bore mechanically holding said plunger against retraction by said spring means.

33. A circuit interrupter comprising, in combination, a pair of line terminals disposed in insulated spaced relation, spring means reacting against one line terminal, a body of arc extinguishing material secured to the other line terminal and having a main bore and a parallel auxiliary bore, an arcing terminal in said main bore disposed to be retracted by said spring, a main fusible element connecting said arcing terminal and said other line terminal, a fusible strain element disposed in said auxiliary bore for holding said arcing terminal against the retractile force of said spring, said strain element being disposed to be fused after said main fusible element is fused to release said spring, and means for maintaining a metallic conducting path through said auxiliary bore after said strain element is fused.

34. In combination, insulated support means, line terminals in spaced relation on said support means, a body of solid arc extinguishing material carried by said support means and having at least one longitudinal bore therethrough, a rod-like terminal in said bore electrically connected to one line terminal, a fusible element electrically interconnecting said rod-like terminal and the other line terminal, spring means biasing said rod-like terminal for movement relative to said bore, and strain means disposed exteriorly of said bore for relieving said fusible element of the biasing force of said spring means, said strain means being arranged and adapted to be released on blowing of said fusible element to permit relative movement between said rod-like terminal and said bore.

35. In combination, insulated support means, line terminals in spaced relation on said support means, a body of solid arc extinguishing material carried by said support means having main and auxiliary parallel longitudinal bores, a rod-like terminal in said main bore electrically connected to one line terminal, a fusible element electrically interconnecting said rod-like terminal and the other line terminal, spring means biasing said rod-like terminal for movement relative to said bore, and strain means in said auxiliary bore for relieving said fusible element of the biasing force of said spring means, said strain means being arranged and adapted to be released on blowing of said fusible element to permit relative movement between said rod-like terminal and said body of solid arc extinguishing material.

36. In a circuit interrupter, in combination, a body of solid arc extinguishing material having main and auxiliary parallel longitudinal bores, a stationary terminal at one end of said main bore, a rod-like terminal movable in said main bore and projecting out of its other end, a fusible element interconnecting said terminals, and a strain means in said auxiliary bore secured at one end to the projecting end of said rod-like terminal and at the other end to said stationary terminal, said strain means characterized by providing a predetermined definite distance between its points of attachment to said terminals.

37. In a replaceable unit for a circuit interrupter comprising, in combination, a body of solid arc extinguishing material having main and auxiliary parallel longitudinal bores, a plunger in said main bore constituting a main arcing terminal of large current carrying capacity and adapted to be retracted therethrough, and a high tensile strength strain element of small current carrying capacity in said auxiliary bore adapted to hold said plunger against retraction through said bore.

38. A replaceable fuse cartridge comprising, in combination, a body of solid arc extinguishing material having main and auxiliary parallel longitudinal bores, a terminal at one end of said body, a rod-like terminal in said main bore adapted to be retracted therethrough, a fusible element interconnecting said terminals, and a high tensile strength strain element in said auxiliary bore also interconnecting said terminals and relieving said fusible element of strain resulting from stress tending to separate said terminals.

39. A replaceable fuse cartridge comprising, in combination, a body of solid arc extinguishing material having main and auxiliary parallel longitudinal bores, a terminal at one end of said body, a rod-like terminal in said main bore adapted to be retracted therethrough, a fusible element interconnecting said terminals, a high tensile strength strain element in said auxiliary bore also interconnecting said terminals and relieving said fusible element of strain resulting from stress tending to separate said terminals, a portion of said strain element being fused after said fusible element is fused to release said rod-like terminal for movement through said main bore, and means for maintaining a metallic conducting path through said auxiliary bore after said portion of said strain element is fused.

40. In a fuse device, in combination, a housing, a terminal at one end of said housing, a support pin carried by said terminal and projecting radially inwardly therefrom, the outer end of said pin being bifurcated, and a terminal for a fusible element arranged to withstand tension stress and to be carried by said support pin, said last-named terminal comprising a tubular member flattened at one end onto the fusible element and disposed to fit in the bifurcated end of said support pin, the other end of said tubular member being flattened at right angles to the one end to provide shoulders for bearing against one side of the bifurcated end of said support pin.

41. In circuit interrupting apparatus, in combination, arc extinguishing material providing parallel main and auxiliary bores having respectively large and small cross-sectional areas, a stationary terminal at one end of said bores, and main and auxiliary relatively infusible terminals in said main and auxiliary bores respectively adapted on being moved away from said stationary terminal to draw an arc first in an auxiliary bore and subsequently in the main bore if the arc in the auxiliary bore is not extinguished.

42. In circuit interrupting apparatus, in combination, arc extinguishing material providing main and auxiliary bores, a terminal at one end of said bores, main and auxiliary arcing terminals in said main and auxiliary bores respectively connected together at the opposite end of said bores, a fusible element interconnecting said terminal and said main arcing terminal, and a strain element interconnecting said terminal and said auxiliary arcing terminal.

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