

April 13, 1965 **C. C. PATTERSON** **3,178,537**
CIRCUIT INTERRUPTER HAVING IMPROVED CONDENSER FOR
COOLING THE PRODUCTS OF ARCING
Filed April 30, 1958 4 Sheets-Sheet 1

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4 Sheets-Sheet 1

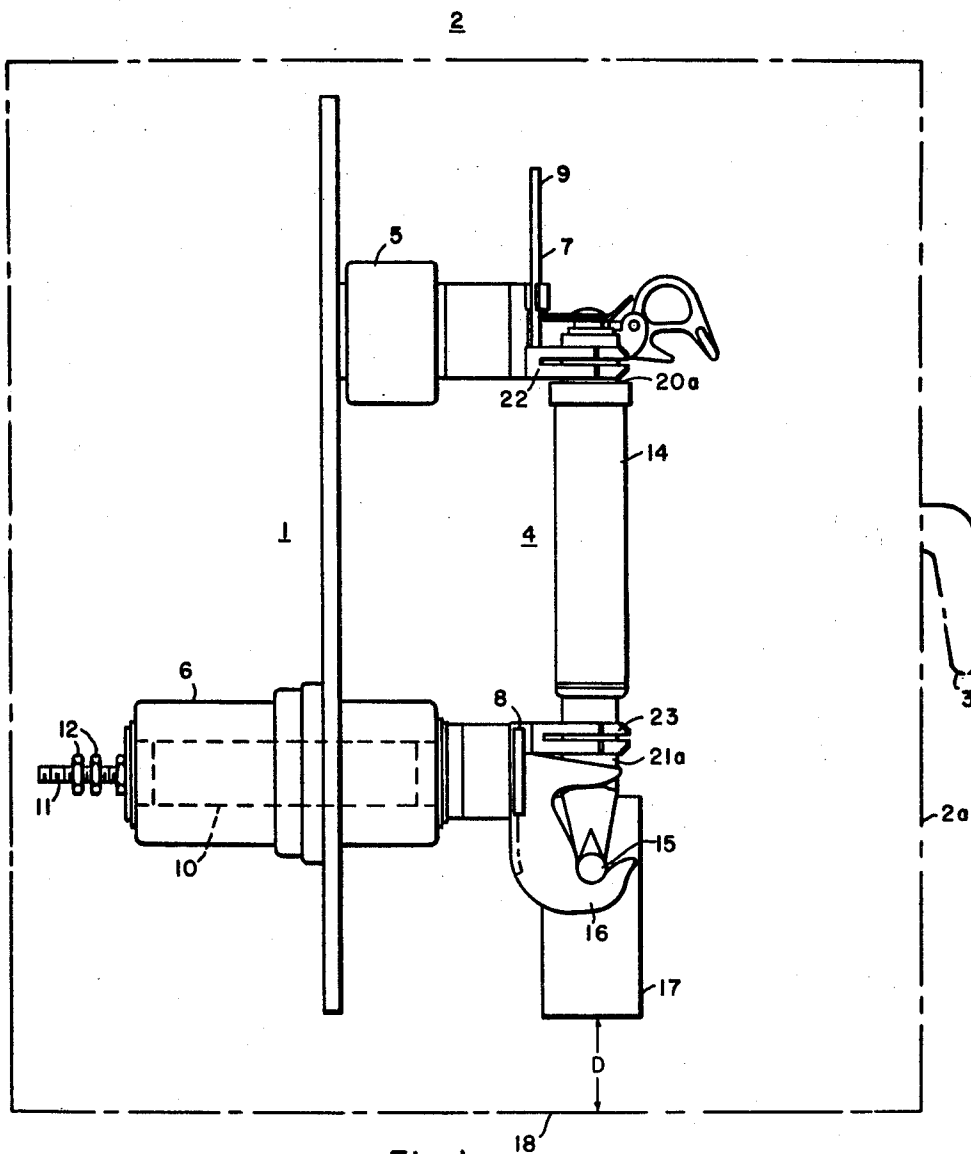


Fig. 1

WITNESSES

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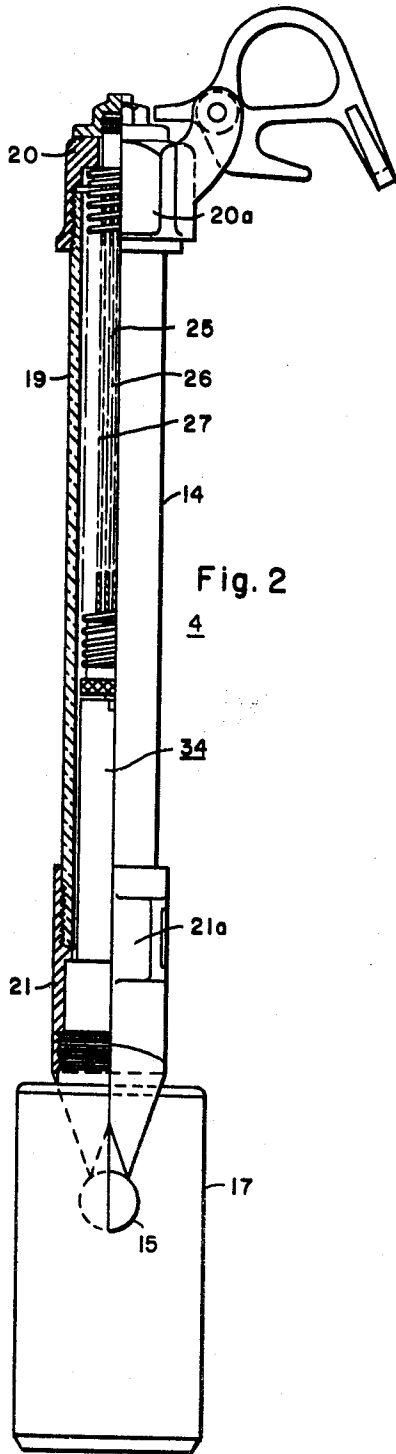
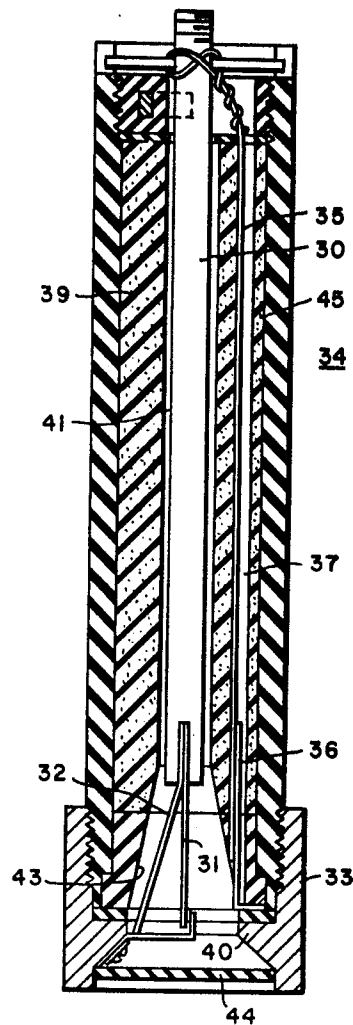
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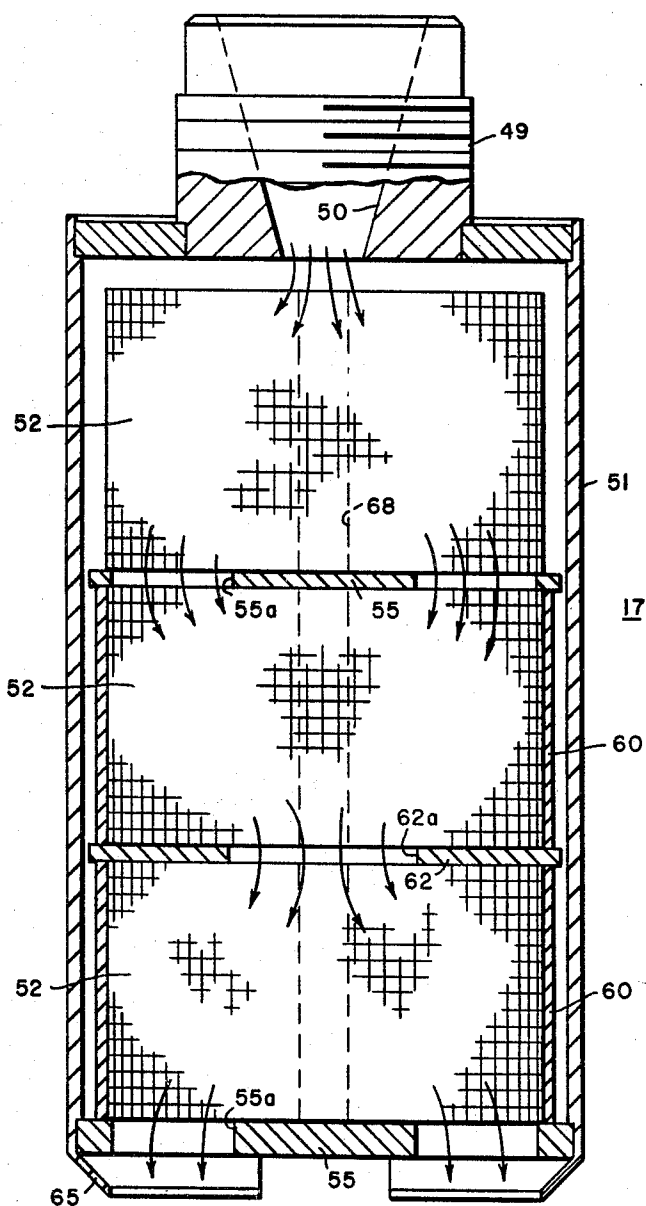


Fig. 4

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Fig. 7

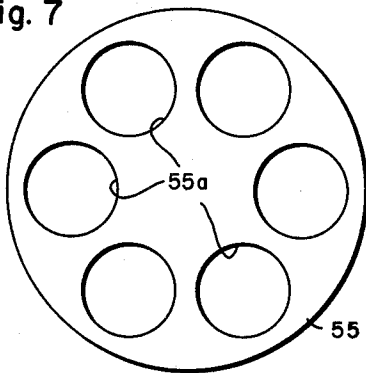


Fig. 5

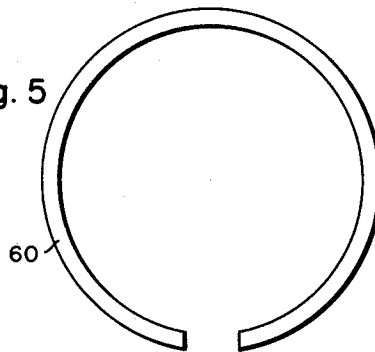


Fig. 6

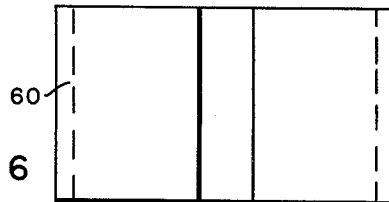


Fig. 9

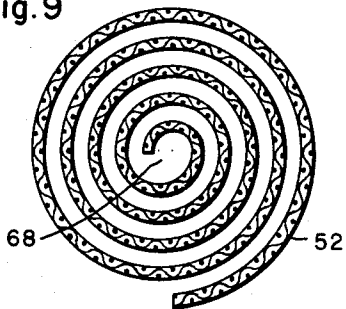


Fig. 8

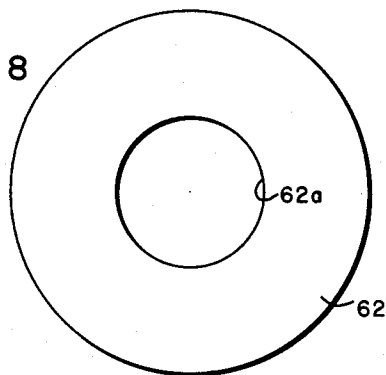


Fig. 10

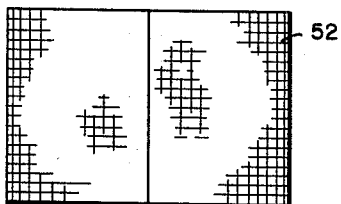
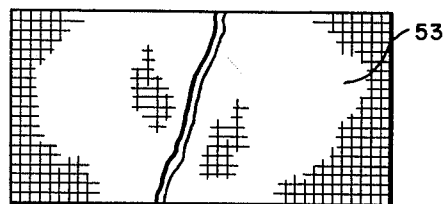


Fig. 11



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CIRCUIT INTERRUPTER HAVING IMPROVED CONDENSER FOR COOLING THE PROD- UCTS OF ARCING

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This invention relates to circuit interrupters in general and, more particularly, to expulsion-type circuit interrupting devices, wherein the arc is drawn along a restricted passage having a material evolving gas, and wherein a cooling condenser, or a muffler, is positioned over the end of the arc passage to receive and to cool the gases given off during arc interruption.

This invention is an improvement over the condenser construction set forth in United States Patent 2,184,760, issued December 26, 1939, to James M. Wallace, and assigned to the assignee of the instant application.

In the application of expulsion-type power fuses, for example, it is often necessary to enclose the fuse mounting inside of a cubicle or other enclosing structure. Since in normal operation there is expelled from the lower end of the power fuse a large amount of incandescent or ionized gas, which, if allowed to escape freely, might result in a flashover, it is usual to equip such inside-mounted fuse holders with condensers.

These condensers are attached to the lower end of boric acid type power fuses, for example, and allow only the relatively deionized gas to escape into the space where flashovers are possible. With the use of such condensers, there is no visible display at the time of operation, since the incandescent gases resulting from decomposition of the boric acid are condensed to liquid form. Thus, the possibility of flashover is eliminated by the use of such a condenser.

One disadvantage to the use of the aforesaid condensers, as known to the art, is the derating with respect to interrupting ability which accompanies their application. This derating amounts to approximately $\frac{1}{4}$ to $\frac{1}{3}$; that is, with a condenser attached to the lower end of the fuse holder, it may be used on a system having only $\frac{3}{4}$ or $\frac{2}{3}$ of the short-circuit capacity of one on which the vented-type holder is employed.

The present invention is concerned with a condenser, or muffler, which can be used on existing type circuit interrupters, or with existing fuse holders and mountings, and provides a means for condensing the incandescent gases, with sufficient relief of the internal back pressure to allow the combination of condenser and fuse holder to be used at the full interrupting capacity of the vented-type fuse holder. Thus, there need be no derating.

Accordingly, it is a general object of the present invention to provide an improved circuit interrupter employing an improved condenser, or muffler to highly effectively permit the exhausting of the arc gases without back pressure, and at the same time effect a substantially complete deionization of the arc gases, so that there will not be the possibility of flashover to adjacently disposed housing structures.

Another object of the present invention is to provide an improved condenser, or muffler which will be so effective that there will be no derating of the fuse holder in its application.

Yet a further object of the present invention is the provision of an improved circuit interrupter employing rolls of screening and a baffle construction, so supported, as to effectively bring about the substantially complete deionization of exhausted arc gases, while at the same

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time preventing any possibility of collapse of such screening, which, if allowed to occur, would act as a solid, impeding block to the exhaust-gas flow.

An ancillary object of the present invention is the provision of an improved condenser for a fuse structure, in which baffle plates of particular apertured configuration are employed between serially arranged rolls of screening, such that a relatively long tortuous path is provided for the gas flow to completely bring about the deionization and cooling of incandescent exhaust arc gases.

A further object of the present invention is the provision of a circuit interrupter employing a condenser, or muffler of very small compact size, which will be highly effective in bringing about the deionization of exhaust arc gases during circuit interruption, thereby permitting relatively close spacing between such circuit interrupting device and a surrounding enclosing housing.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

FIGURE 1 is a side elevational view of a circuit interrupting device embodying the principles of the present invention, and located within an enclosing cubicle housing;

FIG. 2 is an enlarged side elevational view, in quarter section, of the fuse holder utilized in the circuit interrupting device of FIG. 1;

FIG. 3 is a vertical sectional view through the fuse-refill element employed in the fuse holder of FIG. 2, the fuse elements being in their intact unfused condition;

FIG. 4 is an enlarged side elevational view, partially in vertical section, of the improved condenser, or muffler, of the present invention;

FIGS. 5 and 6 are respectively plan and side elevational views of one of the support rings employed in the improved muffler;

FIGS. 7 and 8 are plan views of baffle plates employed in the muffler construction of the present invention; and

FIGS. 9-11, respectively, illustrate plan, side elevational, and developed views of the screening employed in one of the rolls of screening used in the improved muffler of the present invention.

Referring to the drawings, and more particularly to FIG. 1 thereof, the reference numeral 1 generally designates a circuit interrupting device enclosed within a surrounding cubicle structure 2. Preferably, the cubicle housing 2 has a handle 3 for opening and closing a door 2a, so that a station attendant may inspect the condition of the circuit interrupting device 1.

In this particular form of the invention, the circuit interrupting device 1 assumes the form of a fuse structure 4 including insulator supports 5, 6, in turn supporting relatively stationary contact structures 7, 8.

The stationary contact structure 7 may include a line terminal plate portion 9, to which a line connection may be made. The stationary contact structure 8, in this instance, has a stud portion 10 extending interiorly through the support insulator 6 and terminating at a threaded line-terminal stud 11, having nuts 12 thereabout, to which a second line connection may be made.

As well known by those skilled in the art, the fuse structure 4 will provide desired short-circuit protection; and in addition, by the employment of a suitable hook-stick, a station attendant may effect the rotation of the fuse holder 14 about the trunnion pins 15 positioned in the stationary contact jaws 16 to effect thereby disconnection of the controlled circuit.

It will be observed that only a relatively small spacing, designated by the distance D, exists between a condenser, or muffler 17, associated with the lower end of the fuse holder 14, and the bottom wall 18 of the cubicle housing 2. This spacing is relatively close, since, as well known

by those skilled in the art, generally adjacently disposed apparatus is employed in conjunction with the circuit interrupting device 1, and consequently, invariably space is at a premium. Thus, the demands of the industry are such that the spacing distance D is relatively small.

According to the present invention, there is provided a condenser, or muffler 17 associated with the fuse holder 14, such that complete deionization of the exhaust arc gases is effected, and yet no detrimental back pressure is permitted to form, to interfere with proper expulsion action of the fuse device 4.

FIG. 2 more clearly shows the internal construction of the fuse holder 14. It will be observed that there is provided a fiber fuse tube 19 having terminal ferrules 20 and 21 threadedly secured to its upper and lower ends. The upper terminal ferrule 20 has a side contact portion 20a (FIG. 1), which makes sliding contact with fuse clips 22, supported at the upper stationary contact 7 of the interrupting device 1.

The lower fuse terminal ferrule 21 also has a side contact portion 21a, which makes contact with a lower set of fuse clips 23 (FIG. 1) in the closed-circuit position of the device.

Disposed interiorly within the fiber fuse tube 19 is a spring assembly 25 including a tension spring 26 and a plurality of flexible connectors 27. As shown more clearly in FIG. 3, the tension spring 26 biases a contact rod 30 upwardly to the open-circuit position. The lower end of the contact rod 30 has affixed thereto a fuse link 31 and a strain wire 32, which are connected to the lower ferrule 33 of the fuse-refill unit 34. In addition, an auxiliary fuse wire 35 movable with the contact rod 30 engages a relatively stationary wire 36 within an auxiliary fuse passage 37 for a purpose explained hereinafter.

Surrounding the movable contact rod 30 is a molded hollow cylinder of boric acid 39. During the opening operation, the arc, which is established between the lower end of the movable contact rod 30 and the interior portion 40 of the fuse ferrule 33 of refill unit 34, is drawn upwardly through the restricted arcing passage 41 provided by the boric-acid liner 39. This causes the formation of boric oxide (B_2O_3) and evolution of water vapor, which is expelled downwardly through the open end 43 of the fuse passage 41, displacing a loosely positioned plate 44. During fuse operation, the disc 44 vaporizes.

As more fully set out in United States Patent 2,590,524, issued March 25, 1952, to Andrew W. Edwards, and assigned to the assignee of the instant application, during the interruption of high-current arcs, the interrupting action takes place within the large bore 41 of boric-acid liner 39, since, although the auxiliary fuse wire 35 separates last from the stationary wire 36, the high arc voltage compels a transfer to the main bore 41 of the fuse refill unit 34. During the interruption of relatively low overload currents, since the fuse wire 35 separates last from the fuse wire 36, arc establishment and arc extinction occurs only within the smaller auxiliary arc passage 37.

It will be apparent that the spring assembly 25 rapidly draws the movable contact rod 30 upwardly during the opening operation to bring about very rapid arc lengthening. It will also be obvious that during the interruption operation, particularly for heavy current short-circuit conditions, that a considerable volume of incandescent and ionized exhaust gas will be projected downwardly through the open end 43 of the fuse passage 41. To effect the condensation and deionization of such exhaust arc gases, as well as to prevent external flame emission, and, in addition, to bring about noiseless interruption, it is desirable to provide a condenser, or muffler attachment 17 associated with the lower end of the fuse holder 14.

FIG. 4 more clearly shows the internal construction of the condenser 17. Briefly, the condenser 17 includes a threaded nipple 49 having a restricted V-shaped passage 50 provided therein, an enclosing tube 51, which, in this par-

ticular instance, is formed of steel, and interiorly disposed rolls of copper screening 52.

FIGS. 9-11 more clearly show how the rolls of screening 52 are fabricated. As illustrated in FIG. 11, the substantially rectangular piece of screening 53 of the requisite length is rolled up into a roll of copper screening 52, as illustrated in FIGS. 9 and 10. Such roll of copper screening 52 is then positioned within the interior of the steel casing 51. Then follows a perforated baffle plate 55 having a configuration more clearly shown in FIG. 7 of the drawings. With reference to FIG. 7, it will be noted that holes or perforations 55a are provided in spaced relation around the periphery of the circular steel plate 55. Then follows a second roll of copper screening 52, which is surrounded by a split steel support sleeve 60, more clearly shown in FIGS. 5 and 6 of the drawings.

Below the second roll of copper screening 52 is positioned a second perforated baffle plate 62, having a configuration more clearly shown in FIG. 8 of the drawings. The baffle plate 62 has a centrally disposed hole or perforation 62a provided therethrough. A third roll of copper screening 52 is then inserted into the steel tube 51, and about it is positioned a second split steel support sleeve 60. Finally, a second perforated baffle plate 55 is positioned at the lower end of the condenser 17, and the lower end 65 of the steel tube 51 is turned over by a suitable tool to maintain the several elements in the proper position.

It will be observed that the nipple 49 directs the exhaust arc gases through the conically-shaped orifice opening 50 down to a diameter, which is substantially the same as the diameter of the hole 68 extending through the top roll of screening 52. The exhaust gases are then compelled to traverse the screening of the upper roll 52 before they can pass through the openings 55a provided in upper baffle plate 55 adjacent the upper end of condenser 17. Following this, such gases are then compelled to traverse the screening in the intermediate roll of screening 52 before they can pass through the central opening 62a of the intermediate baffle plate 62. Finally, such gases are again compelled to traverse the lower roll of screening before being exhausted through the openings 55a of the second, lowermost baffle plate 55, prior to their exhaustion out of the condenser 17.

From the foregoing description, it will be apparent that there is provided a highly effective condenser, or muffler 17 which condenses the incandescent arc gases and renders their exhaustion innocuous. In other words, after passing in an undulating path through the condenser 17, such exhaust gases are rendered harmless and will not flash over to ground, even though the spacing distance D, illustrated in FIG. 1, is very small.

Experimental tests have proved that the inclusion of the nozzle nipple 49 with the conically-shaped orifice bore 50 is very important in guiding the exhaust gases properly into the muffler 17. Tests have proven that the top roll of screening 52 is much less damaged through the use of such a flow guide 49. As a result, the muffler 17 operates much better. The rolls of screening 52 had, for example, a $\frac{3}{8}$ " center hole. If the gas from the fuse blowing was directed in a stream of approximately the same diameter as the hole in the screen roll 52, the gas dispersed through the screen roll 52 better. Without the flow guide 49, the blast of gas crushed the screen roll 52, thereby restraining the flow of gas.

Another very important feature of the muffler 17 is the provision of the two split-sleeve support rings 60. Prior to the use of such support rings 60, the gas blast would push the baffles 62, 55 toward the bottom of the muffler, and in this process the screening 52 was crushed and crammed together, acting substantially as a solid block to the gas flow. Successive operations very nearly simulated a condenser and derated the muffler progressively. With the use of the steel split support sleeves 60, the baffles 55, 62 did not move downwardly due to the

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pressure of the gas, and, therefore, the screen rolls 52 were not crushed.

The employment of the flow nozzle 49 and the support rings 60 rendered the functioning of the screen rolls 52 so effective, that the muffler operated successively at least five times at the interrupting rating of vented fuses, that is, fuses employing no condenser or muffler attachment. The muffler 17 of the present invention did not derate the vented fuse, while at the same time it did deionize the gasses from the fuse so that no flashover occurred between the muffler and ground, even with a 6" striking distance. The result is a highly effective muffler 17, which may be applied to a fuse structure 4 without causing a derating of the latter during its application.

From the foregoing description, it will be apparent that there is provided, according to the present invention, an improved circuit interrupter, in which the exhaust arc gases are effectively directed by a nozzle structure into a condenser, or muffler containing metallic cooling means having many interstices. Not only is a nozzle structure provided to effectively direct the entering exhaust gas stream in a proper direction, but also suitable baffle members having a properly apertured configuration are provided in spaced relation to effectively cause a considerable undulating length of travel of the heated exhaust arc gases prior to final ejection from the condenser or muffler 17. As described hereinbefore, the baffle members 55, 62 are prevented from crushing or otherwise effecting collapse of the metallic cooling means 52, such as rolled up screening, by the employment of split supporting sleeves 60 of the required structural strength, which, while effecting a constant spacing between the baffle members 55, 62, nevertheless did not interfere with the desired flow passage of the gases through the muffler structure 17.

The various component parts of the muffler 17 are not only highly effective in performing their intended function, but also it will be noted that, considered individually, they are relatively cheap to manufacture. In addition, the structure is such as to facilitate rapid assembly. The application of the described condenser, or muffler structure 17, to a fuse device 4 results in such an effective cooling and deionization of the exhaust arc gases, that the entire structure may be suitably enclosed within a housing cubicle construction 2, such as that illustrated in FIG. 1, with very close spacing, such as the spacing distance D, between the exhaust end of the muffler 17 and the grounded bottom wall 18 of the cubicle housing.

Although there has been illustrated and described a particular condenser or muffler construction, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the invention.

I claim as my invention:

1. A circuit interrupter including means for establishing an arc, a muffler chamber for receiving the exhaust arc gases and for cooling and deionizing the same, said muffler chamber having a flow directing nozzle at the inlet end thereof, the flow-directing nozzle having a restricted V-shaped passage provided therein converging in the direction of exhaust gas flow, metallic cooling means having a generally centrally located opening disposed within said muffler chamber for cooling and deionizing the entering hot arc gases, and said restricted V-shaped passage in the nozzle directing the hot exhaust gases toward said generally centrally located opening in the cooling means.

2. The combination in a circuit interrupting device of means for establishing an arc, an elongated arc passage within which said arc is established, a muffler chamber disposed at one end of said elongated arc passage to receive the exhaust arc gasses and to cool and deionize the same, a nozzle having a restricted V-shaped flow-directing

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orifice at the inlet end of said muffler chamber, said V-shaped flow-directing orifice converging in the direction of exhaust flow, at least one roll of screening having a substantially central hole therethrough, and the V-shaped nozzle directing the exhaust arc gases toward said substantially central hole in the roll of screening.

3. A muffler for a circuit interrupter including a tubular body casing, a plurality of rolls of screening disposed therein, a V-shaped nozzle at one end of said tubular body casing for directing the exhaust gases into the muffler, and an apertured baffle plate between contiguous rolls of screening.

4. A circuit interrupter including means for establishing an arc, means for extinguishing said arc, a muffler for cooling the exhaust arc gases, said muffler including three rolls of screening, a pair of apertured baffle plates between contiguous rolls of screening, one baffle plate having a plurality of circumferentially spaced holes therearound, and the other baffle plate having a substantially centrally disposed hole therethrough.

5. A circuit interrupter including means for establishing an arc, means for extinguishing said arc, a muffler for cooling the exhaust arc gases, said muffler including three rolls of screening, a pair of apertured baffle plates between contiguous rolls of screening, one baffle plate having a plurality of circumferentially spaced holes therearound, the other baffle plate having a substantially centrally disposed hole therethrough, and a support sleeve between the pair of apertured baffle plates.

6. A muffler for a circuit interrupter including a tubular casing, means including a V-shaped nozzle for directing the gases axially through a relatively restricted orifice opening into one end of the muffler, a baffle plate having a plurality of circumferentially spaced holes and disposed in spaced relation from said nozzle, metallic cooling means between said V-shaped nozzle and said baffle plate, and another spaced baffle plate having only a substantially centrally located hole therethrough.

7. A muffler for a circuit interrupter including a tubular casing, means including a V-shaped nozzle for directing the gases axially through a relatively restricted orifice opening in one end of the muffler, a baffle plate having a plurality of circumferentially spaced holes and disposed in spaced relation from said V-shaped nozzle, metallic cooling means between said nozzle and said baffle plate, another spaced baffle plate having a substantially centrally located hole therethrough, and a support sleeve between the two baffle plates.

8. A muffler for a circuit interrupter including a tubular casing, means including a V-shaped nozzle for directing the gases through a relatively restricted orifice opening into one end of the muffler, a baffle plate having a plurality of circumferentially spaced holes and disposed in spaced relation from said V-shaped nozzle, metallic cooling means between said V-shaped nozzle and said baffle plate, another spaced baffle plate having only a substantially centrally located hole therethrough, and additional metallic cooling means between the two spaced baffle plates.

9. A circuit interrupter including means for establishing an arc, a muffler for cooling and deionizing the exhaust arc gas following interruption including a tubular casing, three spaced perforated baffle plates, the perforations in the three perforated baffle plates being in misalignment, and at least two rolls of screening disposed between the spaced perforated baffle plates.

10. A circuit interrupter including means for establishing an arc, a muffler for cooling and deionizing the exhaust arc gas following interruption including a tubular casing, a V-shaped flow directing nozzle having a restricted orifice disposed at the inlet end of said tubular casing, three spaced perforated baffle plates, the perforations in the three perforated baffle plates being in misalignment, and at least two rolls of screening disposed between the spaced perforated baffle plates.

11. A muffler for a circuit interrupter including a tubularly-shaped muffler casing having a roll of metallic screening therein, said roll of metallic screening having a central hole provided therein which is positioned axially of the tubularly-shaped muffler casing, a V-shaped flow directing nozzle disposed at the inlet end of the muffler for directing exhaust gases into the muffler, the V-shaped nozzle having the V-shaped restriction converging in the direction of exhaust gas flow, and the V-shaped nozzle directing the exhaust gases toward said central hole and axially of the tubularly-shaped muffler casing.

12. A muffler for a circuit interrupter including a tubularly-shaped muffler casing, a flow-directing nozzle at the inlet end of the muffler having a restricted V-shaped passage provided therein, a plurality of rolls of metallic screening disposed in end-to-end relationship axially within said tubularly-shaped muffler casing, at least one perforated baffle plate disposed between a pair of contiguously disposed rolls of metallic screening, and a split spacing sleeve for supporting said perforated baffle plate in position.

13. The combination in an elongated tubularly-shaped muffler for a circuit interrupter of a tubular muffler casing, a flow-directing nozzle at the inlet end of the muffler having a restricted V-shaped passage provided therein, a plurality of rolls of metallic screening disposed in end-to-end relationship axially within said tubular muffler casing, a pair of spaced perforated baffle plates, at least one of said perforated baffle plates being disposed between a pair of contiguously disposed rolls of metallic screening, and a split spacing sleeve disposed between said pair of perforated baffle plates for support and to prevent collapse of one roll of screening.

14. In a circuit interrupter, in combination, means for establishing an arc and causing a flow of condensible gas

at high temperature and pressure, an elongated cylindrical shell providing a cylindrical chamber for receiving said gas at one end and centrally thereof, a closure at the other end of said chamber secured to said shell against detachment under those conditions in said chamber of temperature and pressure likely to be developed within the rated capacity of the circuit interrupter, and annular wire screen means filling the major portion of said cylindrical chamber, said annular wire screen means being reticulated lengthwise and transversely of said chamber with the inner surface defining a cylindrical passageway therethrough along the longitudinal axis having one end closed by said closure, said closure having a plurality of ports extending therethrough and out of alignment with said passageway and permitting communication to the atmosphere from said chamber only through said wire screen means.

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