United States Patent

[11] 3,602,671

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[54] **OIL CIRCUIT INTERRUPTER HAVING IMPROVED STACK INSULATING WASHER STRUCTURE**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** ..... **200/150 B**
[51] **Int. Cl.** **H01h 33/68**
[50] **Field of Search** ..... 200/149.1, 149, 150 B, 150 D, 150 G

[56] **References Cited**

UNITED STATES PATENTS

2,118,355	5/1938	Matthews	200/149 A
2,130,999	9/1938	Petermichl	200/149 A
2,192,045	2/1940	Linde	200/149 A
2,253,009	8/1941	Baker	200/150 G
2,294,801	9/1942	Rawlins	200/149 A

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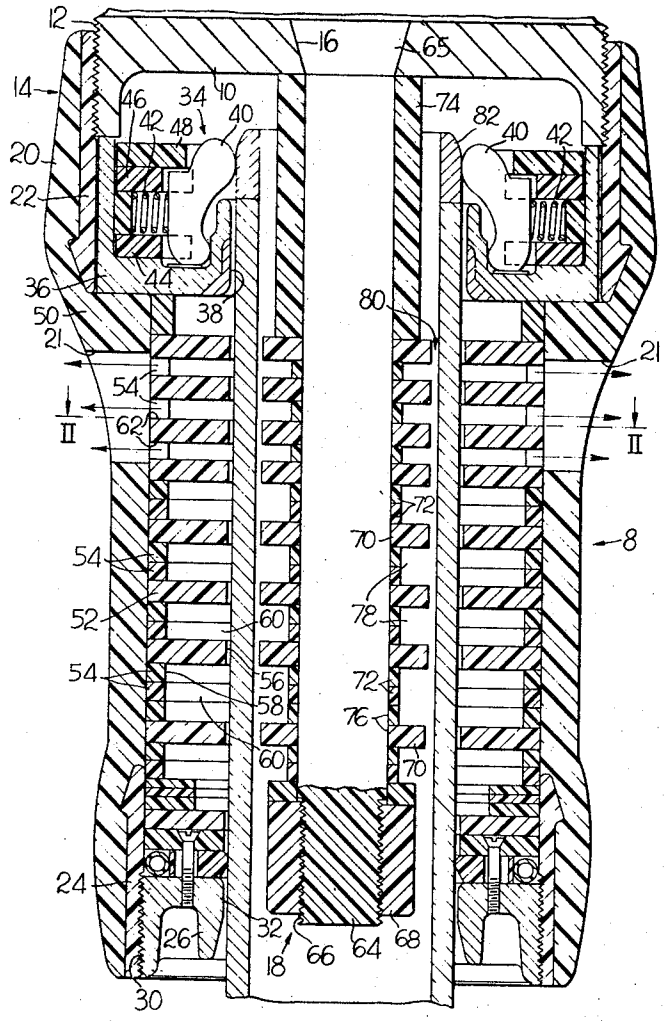
ABSTRACT: An arc interrupting device for use in an oil-type circuit interrupter comprises a hollow tubular insulated external structure with annular oil pockets on the interior surface thereof and oil flow nozzles through the wall thereof. The external structure houses an electrically conductive stationary contact assembly. A cylindrical insulated internal structure with annular oil pockets on the exterior surface thereof is concentrically disposed inside the external structure. An electrically conductive hollow cylindrical bayonet contact is movable in the annular space between the external and internal structures. During withdrawal of the bayonet, the arc formed between it and the stationary contact is constricted in the narrow annular space and is thereby more readily cooled and extinguished.

In another embodiment, the bayonet contact and the space which accommodates it both have a C-shaped cross-sectional configuration.



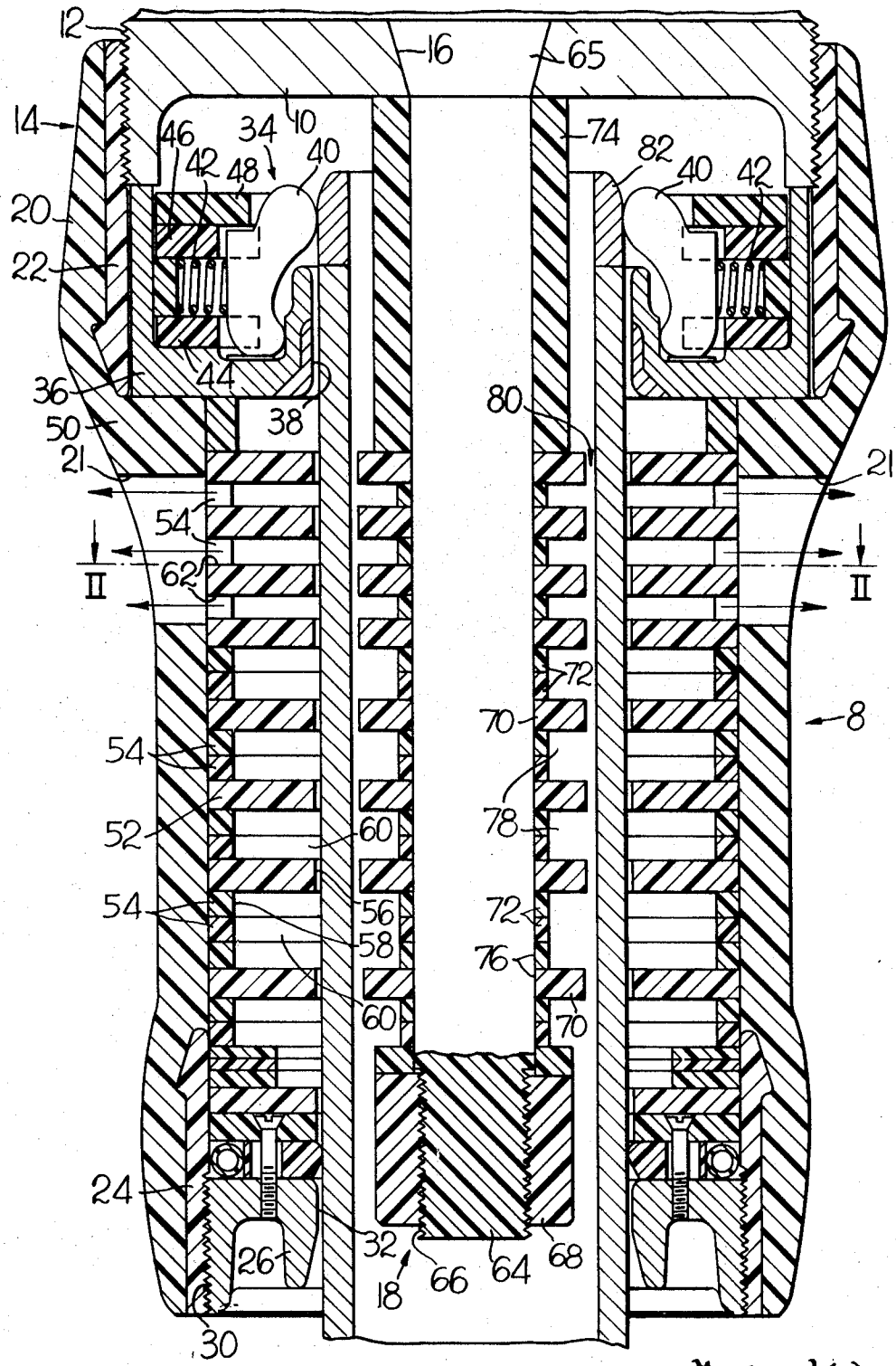


Fig. 1

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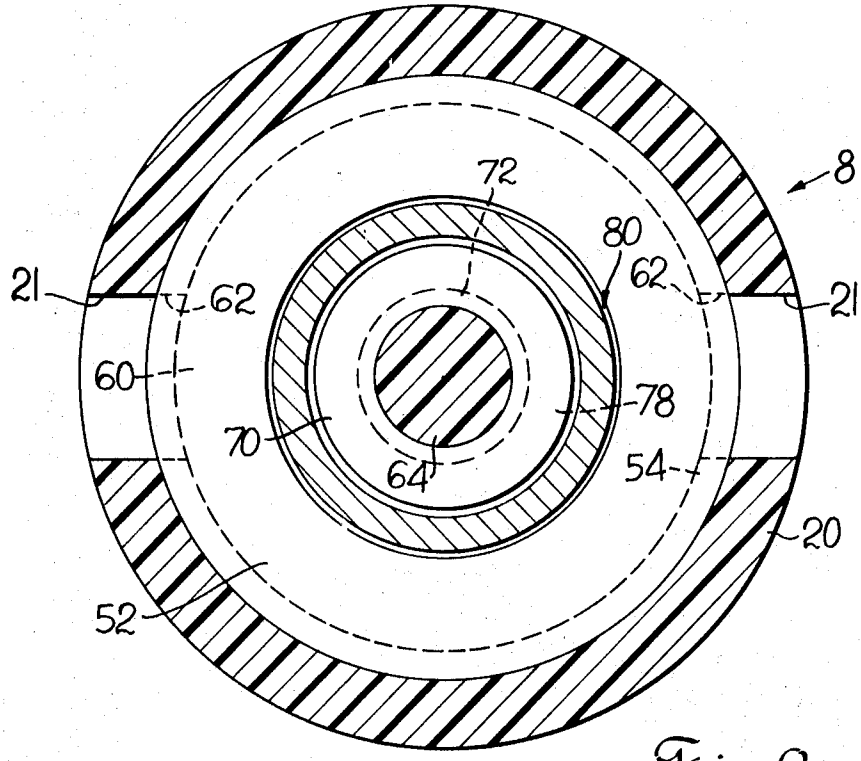

Fig. 2

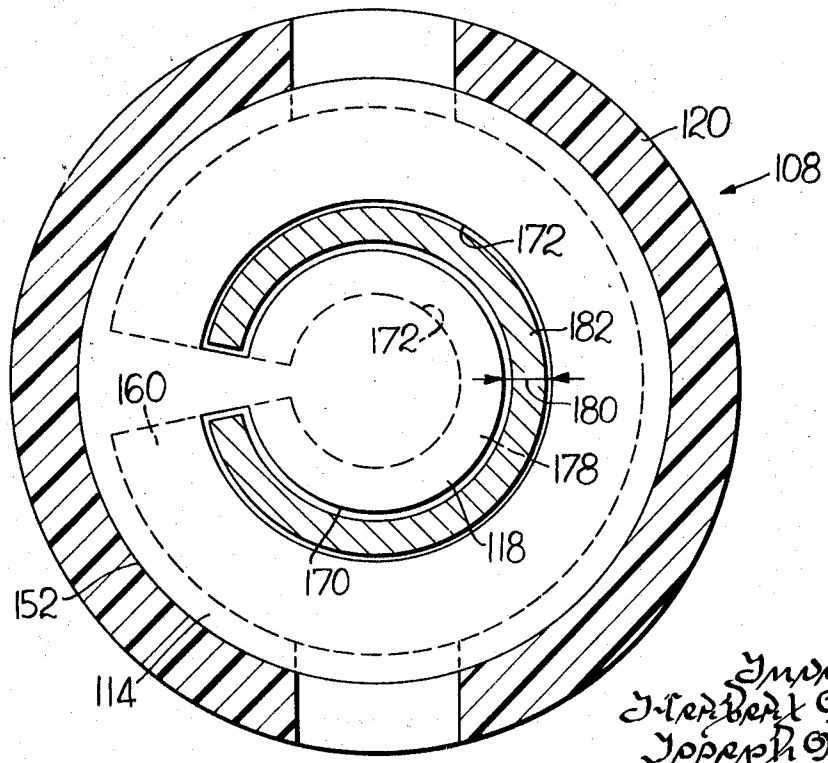

Fig. 3

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OIL CIRCUIT INTERRUPTER HAVING IMPROVED STACK INSULATING WASHER STRUCTURE

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

The present application discloses a sliding contact which is disclosed and claimed in U.S. application Ser. No. 785,227, filed Dec. 19, 1968 for "Sliding Contact" by Joseph M. Ramrath and assigned to the same assignee as the present application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to oil-type electric circuit interrupters and, particularly, to arc interrupting devices employed therein.

2. Description of the Prior Art

A typical oil-type circuit interrupter comprises an oil filled tank in which one or more arc interrupting devices are disposed and submerged in oil. Each device, for example, comprises a housing made of insulating material in which a stationary contact is located. A movable bayonet-type contact is adapted to be inserted into the housing to engage the stationary contact. Arcing which occurs in the housing upon contact separation is quenched by oil flow through the housing. In some interrupters the bayonet is relatively large, i.e., on the order of 2 inches in diameter in order to carry heavy continuous currents. However, such large diameter bayonets generally reduce the interrupting performance of the interrupting device. This is because the arc time constant is a measure of the thermal recovery of an arc plasma column and is proportional to the arc radius squared. The problem is overcome to some extent by using small diameter bayonets which are shunted by contact arrangements having larger cross-sectional area but this solution is costly, space consuming and requires extra components. It is known that, if the diameter of the arc can be kept relatively small, then it can be cooled more rapidly and faster dielectric recovery of the arc path can be obtained. For example, U.S. Pat. No. 3,140,374 issued to F. H. Cole shows a solid bayonet contact having an insulated tip which is of smaller diameter than the bayonet. Thus when the bayonet is withdrawn from the interrupter device, the arc is confined to a narrower space than would otherwise be the case and is more readily quenched. U.S. Pat. Nos. 2,591,950 and 2,671,144 show other solutions to this problem. However, it is desirable to provide improved interrupters wherein the arc is completely constricted but wherein large current carrying components can still be employed.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided an arc interrupting device for submersion in oil which comprises a hollow tubular external structure made of insulating material and preferably having annular oil pockets on the interior surface of the wall and oil flow nozzles through its wall. A stationary contact assembly is associated with one end of the structure. An internal structure made of insulating material and preferably having annular oil pockets on its exterior surface is concentrically disposed inside the external structure and cooperates therewith to define a narrow annular space. A relatively large diameter hollow movable bayonet contact for cooperation with the stationary contact is adapted to be inserted in and withdrawn from the space, surrounding the internal structure in the process. The arc which occurs upon withdrawal of the bayonet contact is drawn into the narrow space wherein its diameter is necessarily reduced and it is easily cooled by vaporized and dissociated gas from the oil until interruption occurs. In another embodiment of the invention, the space and bayonet contact have substantially C-shaped cross sections, rather than annular cross sections.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide improved arc interrupting devices for electric circuit breakers.

Another object is to provide devices of the aforesaid character which employ movable bayonet contacts and have improved means for constricting the arc formed as the bayonet contact is withdrawn from the device.

Another object is to provide devices of the aforesaid character wherein the arc is constricted substantially along its entire length.

Another object is to provide devices of the aforesaid character wherein the constricted arc is exposed to an increased number of oil turbulence pockets along its entire length.

Other objects and advantages of the invention will hereinafter appear.

DESCRIPTION OF THE DRAWING

The accompanying drawing illustrates several preferred embodiments of the invention but it is to be understood that the embodiments illustrated are susceptible of modifications with respect to details thereof without departing from the scope of the appended claims.

In the drawing:

FIG. 1 is a cross-sectional view of an arc interrupting device in accordance with the invention and of a type such as is used in oil-type circuit interrupters;

FIG. 2 is a view taken along line II—II of FIG. 1; and

FIG. 3 is a cross-sectional view of another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2 of the drawing, an arc interrupting device 8 in accordance with the invention is adapted to be disposed inside the tank of a high voltage-high current oil circuit breaker and is completely submerged in oil. The device is mounted on an electrically conductive contact member or casting 10 which is understood to be connectable to one side of the line in an electric circuit which a circuit interrupter controls. Casting 10 is understood to be circular in shape and is provided with screw threads 12 on its outer periphery by means of which an external interrupter structure 14 of the interrupting device is supported on the casting. Casting 10 is further provided with a central opening 16 by means of which an internal interrupter structure 18 is supported on the casting.

External structure 14 comprises a hollow cylindrical outer shell 20 which is made of insulating material and has a plurality of nozzle openings 21 through the wall thereof to accommodate oil flow. Shell 20 is provided with cylindrical, internally threaded inserts or collars 22 and 24 at its top and bottom ends, respectively. Top insert 22 engages the threads 12 on casting 10. Bottom insert 24 is adapted to engage a closure member or plate 26 which is circular in shape and is provided with screw threads 30 on its outer periphery and with a central opening 32.

External structure 14 has a stationary contact assembly 34 near its upper end, which assembly is of a type completely described in U.S. patent application Ser. No. 785,227 hereinbefore referred to. Assembly 34 comprises an electrically conductive circular retainer 36 having a central opening 38 therein. Retainer 36 carries a plurality of electrically conductive contact fingers 40 which are radially arranged around opening 38 and biased inwardly by springs 42. A plurality of retaining rings 44, 46 and 48 made of insulating material maintain the contact fingers 40 and the springs 42 in proper position. Stationary contact assembly 34 is held in position by entrapment of its retainer 36 between contact casting 10 and a shoulder 50 formed in shell 20 of external structure 14. An electrically conductive path exists between each contact finger 40, retainer 36 and contact casting 10.

A plurality of washers such as 52 and 54 made of insulating material are stacked within outer shell 20 of external structure 14 and held in place by entrapment between the bottom of contact retainer 36 and closure plate 26. The washers 52 and 54 have the same outside diameter but the diameter of a central opening 56 in each washer 52 is smaller than that of a central opening 58 in each washer 54. Consequently, disposition of one or more washers 54 between each pair of washers 52 provides a series of annular oil pockets 60 along the interior of external structure 14. The washers 54 adjacent the oil nozzles 21 are provided with openings 62 which accommodate oil flow.

Internal interrupter structure 18 comprises an elongated solid cylindrical insulating support member or rod 64 having a tapered head 65 which engages opening 16 in contact casting 10. The lower end of rod 64 is provided with screw threads 66 on which a nut 68 made of insulating material is disposed. A plurality of washers 70 and 72 made of insulating material are stacked on rod 64 and held in place by entrapment between nut 68 and a cylindrical sleeve 74 made of insulating material and located at the top of the rod. The washers 70 and 72 have central openings 76 which are of the same diameter but the outside diameter of each washer 70 is greater than that of each washer 72. Consequently, disposition of one or more washers 72 between each pair of washers 70 provides a series of annular oil pockets 78 along the exterior of internal structure 18.

The external structure 14 and internal structure 18 define a cylindrical space 80 into and out of which a hollow, cylindrical electrically conductive bayonet contact 82 is axially movable. It is to be 54 understood that contact 82 is electrically connectable to the other side of a line in a circuit which the circuit interrupter controls. Clearance between the inside and outside surfaces of bayonet contact 82 and the washers 70 and 52 is preferably at a minimum consistent with good engineering practice. In practice, for example, bayonet contact 82 has an outside diameter on the order of 3½ inches and has a cross-sectional area suitable for carrying high continuous current and higher momentary currents. A large bayonet diameter provides a proportionately large circumference and permits many contact fingers such as 40 to be in engagement therewith and this reduces overall contact resistance.

An arc interrupting device according to FIGS. 1 and 2 operates as follows. Assume first that bayonet contact 82 is in contact closed position as shown in the drawing wherein its tip is in electrical contact with the contact fingers 40 of stationary contact 34. Further assume that there is current flow through the contacts. To open the contacts, bayonet contact 82 is moved downwardly by suitable means (not shown) and an arc is drawn between the tip of contact 82 and the contact fingers 40. As downward travel of contact 82 continues, the arc terminals transfer from the contact fingers 40 to the lower inner edge of retainer 36 of stationary contact 34 and the arc is completely confined or contained in the annular space vacated by bayonet contact 82 between external structure 14 and internal structure 18. The arc being so constricted has a smaller diameter along its entire length than would otherwise be the case and is effectively cooled by vaporized and dissociated gases formed from the oil until interruption occurs. If the arc being interrupted is an alternating current arc, more rapid cooling of the arc occurs by the time the current zero point is reached and faster dielectric recovery along the arc path is obtained. Oil flow and circulation through the nozzles 21, through the annular space vacated by bayonet contact 82, and in the plurality of oil pockets 60 and 78 enhances the cooling effect and the arc is eventually extinguished.

As is apparent from the foregoing, withdrawal of bayonet 82 causes exposure of more and more oil pockets 60 and 78 and turbulence increases as the arc elongates until it is extinguished.

FIG. 3 shows an embodiment of the invention wherein an interrupting device 108 comprises external and internal structures 114 and 118, respectively, which are integrally formed and therefore provide a space 180 which has a substantially C-shaped cross section and accommodates a bayonet contact 182 which has a substantially C-shaped cross section. Device 108 comprises a cylindrical shell 120 in which a stack of insulating disks, each having an exterior section 152 and an integrally formed interior section 170 and an opening 172. The openings 172 align to provide the space 180 which accommodates bayonet contact 182. By providing a stack of disks which have openings 172 of different sizes, oil pockets such as 160 and 178 are provided. Device 108 is similar to device 8 as regards construction, components and operation except that no separate supporting means such as rod 64 in device 8 are required.

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

1. An arc interrupting device for use in an oil-type circuit interrupter and adapted for electrical and mechanical connection to an electrically conductive contact member, said device comprising:
   - a hollow insulating shell having one end adapted for mechanical connection to said member,
   - said shell having at least one nozzle opening in the wall thereof,
   - stationary contact means mounted in said shell near said one end thereof and adapted for electrical connection to said member,
   - a plurality of stacked insulating disks in said shell providing an external insulating structure and an internal insulating structure between which a space is defined for accommodating passage of a hollow bayonet-type contact,
   - some of said disks having different configurations than others so as to provide oil turbulence pockets on the interior of said external structure and on the exterior of said internal structure,
   - the disks located adjacent said nozzle opening being provided with openings which communicate between said nozzle opening and said space,
   - means at the other end of said shell for supporting said plurality of disks in said shell,
   - and a hollow bayonet-type contact for cooperative engagement with said stationary contact means and movable in said space and surrounding at least a portion of said internal structure.

2. A device according to claim 1 wherein said plurality of stacked insulating disks comprises a first set of stacked disks which provides said external insulating structure and a second set of stacked disks which provides said internal insulating structure, wherein said hollow bayonet-type contact is cylindrical in cross section, and wherein said means for supporting said plurality of disks comprises a closure member engaging said shell for holding said first set of disks in place and further comprises an insulated support member mechanically connected to said contact member and on which said second set of disks are mounted,
   - said insulated support member having a threaded end on which a nonconductive nut is mounted.

3. A device according to claim 1 wherein said plurality of stacked insulating disks comprises disks which have a substantially C-shaped opening therein, wherein said openings align to provide said space for said contact and said oil turbulence pockets, wherein said hollow bayonet-type contact is C-shaped in cross section, and wherein said means for supporting said plurality of disks comprises a closure member engaging said shell.

4. A device according to claim 2 wherein said closure member is externally threaded and engages a threaded insert in said shell.

5. A device according to claim 3 wherein said closure member is externally threaded and engages a threaded insert in said shell.