Sept. 2, 1941. W. C. WHITE 2,254,719

FLUID-COOLED DISCHARGE DEVICE

Filed May 18, 1940

Fig. 1.

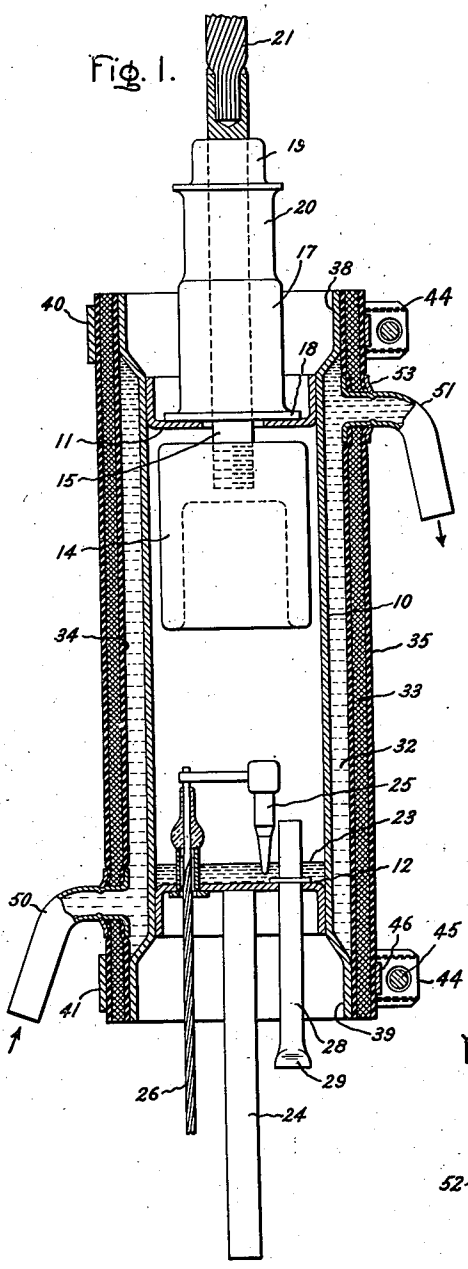


Fig. 2.

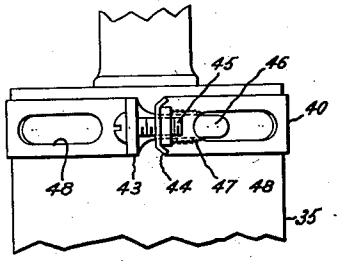


Fig. 3.

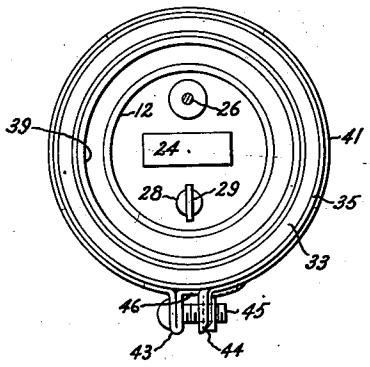
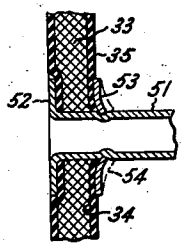


Fig. 4.



Inventor:
William C. White,
by Harry E. Dunham
His Attorney.

Patented Sept. 2, 1941

2,254,719

UNITED STATES PATENT OFFICE

2,254,719

FLUID-COOLED DISCHARGE DEVICE

William C. White, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application May 18, 1940, Serial No. 336,054

4 Claims. (Cl. 250—27.5)

The present invention relates to improvements in discharge devices for power conversion purposes.

There are now commercially available portable, metal-enclosed arc-discharge devices which are intended to operate with high values of discharge current. In order to enlarge the safe operating range of such devices as much as possible, liquid cooling is frequently resorted to. This is ordinarily accomplished by placing around the device a spaced metallic jacket which is welded or otherwise integrally joined to the device and within which the cooling fluid may be circulated.

Such jackets are relatively expensive, especially when constituted of corrosion-resistant steel, and tend to increase the difficulty of degassing the tube structure during exhaust. Moreover, the jackets are not removable so that any clogging of the fluid path due to accumulation of solid deposits may require replacement of the discharge device as a whole.

It is a primary object of the present invention to provide an improved cooling jacket which is free of the difficulties outlined above and which possess other inherent advantages not heretofore realizable. This is accomplished by forming the jacket of a deformable insulating tube, for example, a section of rubber hose material, which can be clamped to the discharge device to provide a fluid-tight arrangement and which can be removed by releasing the clamping means when occasion arises.

The features which I desire to protect herein are pointed out with particularity in the appended claims. The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the drawing, in which Fig. 1 is a longitudinal section of a discharge device suitably embodying the invention; Fig. 2 is a fragmentary detail view of the clamping means used in connection with the device of Fig. 1; Fig. 3 is a plan view of the bottom of the device of Fig. 1; and Fig. 4 is a detail view illustrating the method of securing the fluid conduits associated with the device of Fig. 1.

Referring particularly to Fig. 1, there is shown an arc discharge device which is enclosed within an elongated metal cylinder 10. This cylinder is closed at its ends by transverse headers 11 and 12, which, in combination with the cylinder, form a vacuum-tight discharge space.

Within the discharge space and at the upper end thereof there is provided an anode 14 which may appropriately consist of a cylindrical, partially hollow block of graphite. The anode is mounted on and supplied with current through a heavy conductive rod 15 which is itself supported by a pillar seal. This seal includes an open-ended metal part 17 having at its lower end a flange 18 which is welded or otherwise hermetically secured to the header 11 and a cap portion 19 to which the conducting rod 15 is joined. The parts 17 and 19 are insulatingly separated by means of an intermediate glass sleeve 20 which serves to insulate the anode structure from the body of the discharge device. A flexible conductor 21 is secured indirectly to the upper surface of the cap member 19 and may be employed to connect the anode to a source of potential (not shown).

At the lower end of the device and also within the discharge chamber, there is provided a cathode in the form of a mercury pool 23. Current is supplied to this cathode by means of a heavy rectangular conductor or stud 24 which is welded directly to the header 12. A hollow tube 28 which projects through the header 12 and extends above the surface of the mercury 23 may be used for removing gas from the discharge space when the device is being evacuated. In the completed device this tube is sealed off at its lower end as indicated at 29.

In order to initiate a discharge between the cathode 23 and the anode 14 the device is provided with a make-alive or ignition electrode consisting of a tapered rod 25 of semi-conducting material which is in contact with the mercury at its surface. This electrode, which may consist, for example, of boron carbide or a related substance, is supplied with control potential through a lead-in conductor 26 which is insulated from the remaining structure of the device.

In order to increase the safe current-carrying capacity of the device (i. e. the current which the device can carry without overheating) it is desirable to maintain a cooling liquid in contact with the outer surface of the tubular part 10. To this end there is provided a tubular jacket-forming part which is of larger diameter than the part 10 so as to provide a free space 32 for the circulation of cooling fluid. In accordance with my present invention the jacket-forming part consists of relatively deformable insulating material and preferably of a section of rubber hose material. As illustrated, it includes a central portion 33 which is formed of braided or woven fibers impregnated with rubber and is provided with inner and outer rubber layers 34 and 35 which render the surfaces of the jacket impervious to liquids.

In order to assist in the formation of liquid-tight joints between the jacket-forming part and the metal wall part 10, the latter is deformed at its ends to provide offset shoulders or terminal portions 38 and 39 which are coaxial with, but of greater diameter than the part 10. These terminal portions are preferably of such dimensions

as to engage snugly the inner surface of the rubberized layer **34**. A fluid-tight seal may be provided between the parts **38** and **39** and the flexible jacket by the use of clamping rings **40** and **41**. Each of these rings is of split character and is provided with outwardly extending portions (indicated at **43** and **44**) through which a clamping bolt **45** may be threaded. The use of a tongue **46** and a groove-forming part **47** assists in aligning the extremities of the ring. Openings **48** formed in the ring serve to increase its frictional grip on the outer surface of the part **35**. If desired, a suitable adhesive such as rubber-cement may be used to coat the inner surface of the layer **34** prior to clamping it against the cooperating parts **38** and **39**.

In order to permit the circulation of cooling fluid through the space between the jacket-forming part and the metal wall **10** appropriate inlet and outlet connections or conduits are provided as indicated at **50** and **51** respectively. A preferred method of joining such connections to the wall of the insulating jacket is illustrated in Fig. 4, which represents an enlargement of the outlet connection **51** of Fig. 1. The conduit **51** is provided with a flange **52** which abuts against the inner surface of the rubberized layer **34**. In order to provide a fluid-tight joint between the conduit and the wall of the jacket, use is made of a deformable washer **53** which corresponds in dimensions to the flange **52**. In its initial condition this washer is provided with a centrally deformed portion of frustro-conical aspect (shown in dotted outline at **54** in Fig. 4) which permits the washer to slide freely on the conduit **51**. In forming the sealed joint between the conduit and the jacket, a clinching tool is employed which acts to flatten the washer **53**, thus causing its inner peripheral edge to dig into the surface of the conduit and to become locked therewith as indicated in Fig. 4. The resultant joint, although simply formed, is of fluid-tight character and good mechanical strength.

The advantages of a jacket construction such as that described in the foregoing include the low cost of the rubber jacket material and the elimination of the necessity for applying a finishing paint to the surface of the jacket, a step ordinarily considered necessary in connection with metal jacket constructions. In addition, the insulating quality of the rubber jacket is of considerable assistance in eliminating shock hazard, since it serves to guard against casual contact with the metal parts of the device.

Even more important than the considerations stated in the foregoing is the fact that the jacket as a whole may be readily applied or removed by means of the clamping means **40** and **41**. As one result of this feature, it becomes feasible to apply the jacket after the exhausting operations are completed—a matter of considerable importance in facilitating thorough degassing of the metal parts. In addition, clogging of the fluid-circulating chamber experienced during operation of the device may be remedied without the necessity for replacing the discharge device as a whole.

While the invention has been described by reference to a particular structural embodiment thereof, it will be understood that numerous modifications may be made without actually departing from the invention. I, therefore, aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

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

1. In combination, an elongated tubular metal part defining a discharge space for electrodes enclosed thereby, said tubular part being outwardly deformed adjacent the ends thereof to provide terminal portions of greater diameter than the main body of the part, a tubular insulating part of deformable material surrounding said metal part, said insulating part being substantially coextensive in length with the metal part and being radially spaced therefrom to provide an annular chamber between the parts, means maintaining the end portions of said insulating part in fluid-tight engagement with the outer surfaces of the said terminal portions of the metal part, and means for introducing cooling fluid into the chamber between the parts.

2. In combination, an elongated tubular metal part defining a discharge space for electrodes enclosed thereby, said part being extended outwardly adjacent the ends thereof to provide terminal portions of greater diameter than the main body of the part, a tubular insulating part comprising a section of rubber hose material surrounding said metal part, said insulating part being substantially coextensive in length with the metal part and being radially spaced therefrom to provide an annular chamber between the parts, removable clamping means for maintaining the end portions of said insulating part in demountable fluid-tight engagement with the said terminal portions of the metal part, and means for introducing cooling fluid into the chamber between the parts.

3. A fluid-cooled discharge device comprising an elongated tubular metal part defining a discharge space, discharge-producing means within said space, a tubular part of deformable insulating material surrounding said metal part and spaced therefrom to provide an annular chamber between the parts, said metal and insulating parts being substantially coextensive in length, means of greater diameter than said metal part for providing outwardly directed offset shoulders which are engaged in fluid-tight relation by said insulating part adjacent the extremities of the metal part, thereby to seal the ends of said annular chamber, and means for introducing cooling fluid into the said chamber.

4. A fluid-cooled discharge device comprising an elongated tubular metal part defining a discharge space, discharge-producing means within said space, a tubular part of readily deformable insulating material surrounding said metal part and spaced therefrom to provide an annular chamber between the parts, said metal and insulating parts being substantially coextensive in length, circumferentially extending means bridging the gap between the metal and insulating parts adjacent their extremities for completing the enclosure of the said annular chamber, clamping means associated with the ends of the deformable insulating part for exerting compressive force on the part over regions coextensive with said circumferentially extending means, thereby to seal the said chamber, and means for introducing a cooling fluid into the chamber.

WILLIAM C. WHITE.