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 [33] **France**  
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 13/18 SOD; 313/231

[56] References Cited  
 UNITED STATES PATENTS

|           |         |                      |        |
|-----------|---------|----------------------|--------|
| 3,160,768 | 12/1964 | Geoschel et al. .... | 310/11 |
| 3,219,952 | 11/1965 | Brill.....           | 310/11 |
| 3,355,604 | 11/1967 | Klein et al.....     | 310/11 |

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[54] **ELECTRODE FOR MAGNETOHYDRODYNAMIC GENERATOR**  
 6 Claims, 3 Drawing Figs.

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**ABSTRACT:** Electrode for an MHD generator, consisting of a metal element borne by a support in which it can move in the direction of its axis; the support and metal element surfaces exposed to hot gases flowing in the nozzle duct are electrically insulated by means of an insulating layer of cooling liquid vapor covering the surface of the lower part of the support.

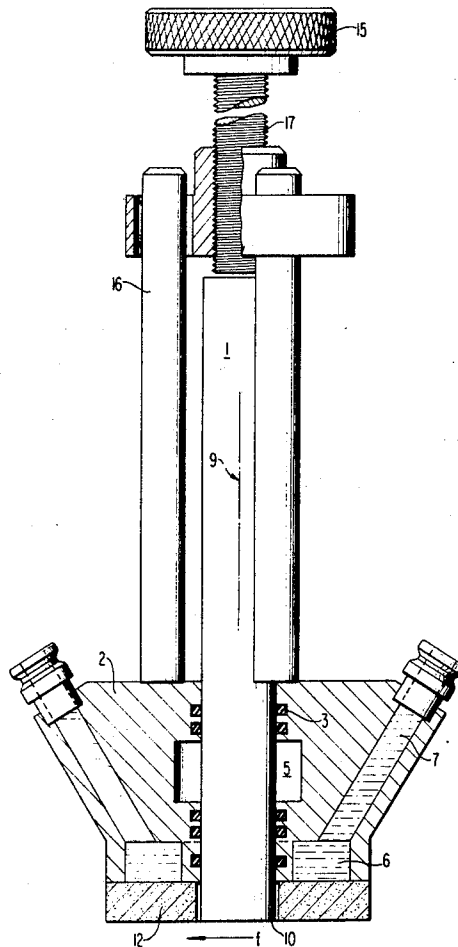


**FIG 1**

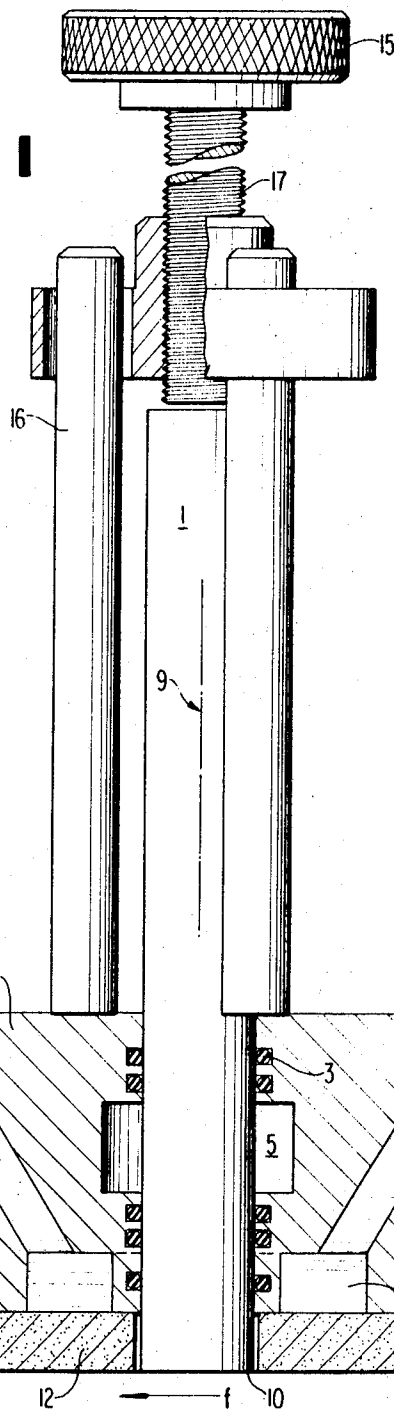


**FIG 2**

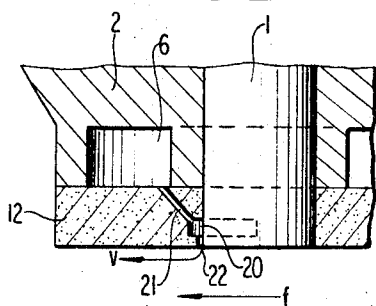
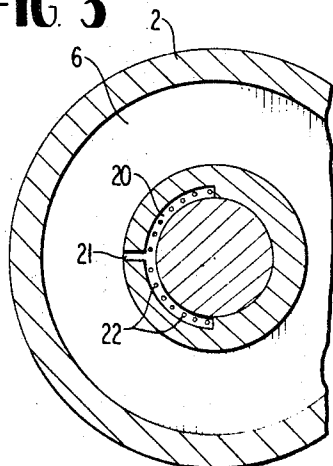


**FIG 3**



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# ELECTRODE FOR MAGNETOHYDRODYNAMIC GENERATOR

The present invention relates to a magnetohydrodynamic generators and is concerned more particularly with a long-lasting electrode structure which allows for a correct operation of the magnetohydrodynamic generator.

It is known that one of the technical problems inherent in magnetohydrodynamic generators relates to the fact that the circulation of the hot gases, particularly when they are charged with potash, in the nozzle duct results in a certain amount of corrosion on the parts of the electrodes which are in contact with these hot gases. In order to compensate for the erosion of the exposed part, it is known to inject into the nozzle duct zirconium powder mixed with the hot gases seeded in a manner such as to compensate for the erosion of the part of the electrode being exposed to the hot gases.

It is the object of the present invention to propose an electrode for a magnetohydrodynamic generator which is susceptible to advance at a given speed in the axial direction thereof and renders it possible that any electric arc formation between the electrode and the adjacent metallic parts be effectively avoided.

The present invention is concerned with an electrode for a magnetohydrodynamic generator comprising a nozzle in which hot ionized gases circulate and which consists of a metallic piece 1 having an elongated shape, characterized by virtue of the fact that the aforementioned piece 1 is held by means of a support 2, one portion 12 of which constitutes a part of the inner wall of the nozzle, this support comprising a cavity into which the piece 1 is placed in such a manner that one extremity 10 of this piece is in contact with the hot ionized gases, and being equipped with a channel 5 serving for the circulation of refrigerating fluid which assures cooling of the metallic piece 1 and of the support; means 15-17 being provided for the purposes of allowing the aforementioned piece to slide within the cavity in proportion with the wear and tear of the aforementioned extremity, the walls of this cavity being equipped with an electric insulation for the purpose of insulating the support 2 and the piece 1; means 6-12, 6-21-22 being provided in order to assure the electric insulation and particularly in order to avoid the formation of electric arcs between the extremity of the aforementioned piece 1 and the parts of the aforementioned support 2 being in contact with the hot ionized gases.

Further characteristics of the present invention will become apparent from the following description taken in connection with the accompanying drawing, wherein

FIG. 1 is a partial cross-sectional view through an electrode according to the present invention, and

FIGS. 2 and 3 are respectively two partial cross-sectional views of a modified embodiment of the electrode proposed by the present invention.

FIG. 1 represents a cross-sectional view through an electrode movable in the axial direction thereof in such a manner that it is possible to compensate for the erosion of the part which is exposed to the hot gases circulating in the nozzle duct. In this figure, the electrode consists of a metallic piece 1 resting upon a support 2 which is metallic, for example, but whose surfaces in contact with the metallic piece 1 are covered with an electrical insulating material.

The metallic piece 1 which serves an electrode is cooled by means of the circulation of a refrigerating liquid within a channel 5 delimited by a groove which is disposed within the support 2 and the surface opposite the metallic piece 1, and the distance of this channel to the wall 10 of the metallic piece 1 which is exposed to the hot gases circulating in the direction indicated by the arrow *f* is chosen according to the desired operating temperature; in other words, according to the temperature desired for the part 10 and the thermal characteristics of the material of the piece 1.

The support 2 itself is cooled by circulation of a refrigerating liquid in a channel 6 disposed in this support and supplied by way of a conduit 7 for admitting this liquid. Joints such as

the joint 3 are arranged between the support and the metallic piece and assure fluidtightness between these elements.

The operation, at elevated temperature, of the magnetohydrodynamic generator particularly in the presence of potash involves the corrosion of the metallic surface 10. With a view toward compensating for this effect, the metallic piece 1 is rendered movable in the direction of the axis 9 thereof, and this is accomplished manually by rotation of a screw 15 provided on a stand frame 16 integral with the support 2, whereby the rod 17 of the screw 15 will come to bear against the face of the piece 1 in such a manner as to cause it to glide or slide in the support 2.

According to a modified embodiment of the present invention, the support 2 may have any desired shape or configuration, and cooling particularly of the part of the support 2 may be provided by means of the refrigerating fluid which circulates in the single channel 5. Likewise, the metallic piece may be rendered movable in the axial direction thereof either by means of any pneumatic or equivalent mechanical system, or by an automatic system which is regulated as a function of the temperature to which one subjects the surface 10 which is in contact with the hot gases, and as a function of the thermal characteristics of the metallic piece 10.

In order to avoid the electric arc formation between the face 10 of the piece 1 and the downstream portion 12 of the support 2, it is proposed to cover particularly the face of the part 12 with an electrical insulating layer. For this purpose, particularly the portion 12 of the support 2 is made from porous metal, for example bronze or copper, and forms one of the walls of the channel 6; a gaseous layer insulating the liquid refrigerant vapor is thus produced which will come to cover the downstream face of the support 2 which is exposed to the hot gases by vaporization of the refrigerating liquid flowing in the channel 6 which penetrates the part 12.

FIGS. 2 and 3 represent two partial cross-sectional views of another embodiment according to the present invention which renders it possible to prevent the creation of electric arcs between the part 12 of the support 2 and the metallic piece 1. The downstream portion 12 of the support 2 is equipped, near the face thereof which is exposed to the hot gases and is in contact with the metallic piece 1 constituting the electrode, with a circular half-groove 20 supplied with refrigerating fluid, for example from the channel 20 through a conduit 21, which places the channel 6 and the groove 20 in communication with each other. Channels 22 being disposed in the portion 12 of the support 2 and being preferably parallel to the axis 9 of the electrode piece 1, place the groove 20 and the nozzle duct in communication with respect to each other in such a manner as to produce through the downstream portion 12 and near the electrode 1 a circulation of refrigerating fluid which is volatilized on the face of the part 12 being in contact with the hot gases, as has been shown by the arrow *v*.

The present invention has been described solely with respect to those embodiments that were given by way of example. It is understood that modifications of details may be applied thereto without departing from the spirit and scope of the present invention.

We claim:

1. An electrode assembly for a magnetohydrodynamic generator having a nozzle duct in which not ionized gases circulate, comprising a metallic electrode having an elongated shape, a support for said metallic electrode, one portion of which constitutes a part of the inner wall of said nozzle duct in contact with the hot ionized gases, said support having a cavity in which electrode is placed in a manner such that one extremity of said electrode is in contact with the hot ionized gases in said nozzle duct and said support being equipped with a cooling channel serving for the circulation of refrigerating liquid assuring the cooling of the metallic electrode and of said support, adjusting means for sliding said electrode within said cavity to reposition said electrode in proportion with the wear and tear of said extremity, electric insulation provided on the walls of said cavity in order to insulate said support from said

electrode and insulating means providing electric insulation, particularly for avoiding the formation of electric arcs, between said extremity of said piece and said portion of said support which is in contact with said hot ionized gases, wherein said portion of the support in contact with said hot gases is made from porous material, a first surface of which constitutes a part of the inner walls of the nozzle duct and a second surface of which defines with the other portion of the support said cooling channel for the circulation of a refrigerating fluid.

2. An electrode assembly according to claim 1, characterized in that said adjusting means providing for the sliding movement of said electrode comprises a screw assembly integral with said support having a translatable threaded rod for exerting a pressure on said electrode when said threaded rod is put in rotation.

3. An electrode assembly according to claim 1, wherein said insulating means assuring the electrical insulation between said extremity of said electrode and said portion of the support in contact with said hot ionized gases comprises a layer of insulating vapor of refrigerating liquid passing through said porous material and covering said portion of the support which is in contact with said hot gases.

4. An electrode assembly according to claim 1, wherein said support includes a half-circle groove therein in communication with said cavity in said portion constituting a part of the inner wall of said nozzle duct and opening toward said metallic electrode, a first conduit interconnecting said groove and said cooling channel for the circulation of refrigerating fluid

formed in said support and a plurality of second conduits being preferably parallel to the axis of said metallic electrode placing said groove and the interior of said nozzle duct in communication with each other.

5. An electrode assembly for a magnetohydrodynamic generator having a nozzle duct in which hot ionized gases circulate, comprising an elongated metallic electrode, a support for positioning one extremity of said metallic electrode in contact with the hot ionized gases in said nozzle duct, one surface of said support surrounding said extremity forming a portion of the inner wall of said nozzle duct and said support including a cooling channel for the circulation of refrigerating liquid assuring the cooling of the metallic electrode and the support, and means forming part of said support for providing at least one passage for refrigerating liquid from said cooling channel to said one surface of said support, wherein said means providing a passage for refrigerating liquid to said one surface comprises a porous member having a first surface which constitutes a part of the inner wall of the nozzle duct and a second surface which defines at least a portion of said cooling channel.

6. An electrode assembly according to claim 5, wherein said means providing a passage for refrigerating liquid to said one surface comprises a half-circle groove in said support in communication with said metallic electrode, a first conduit interconnecting said groove and said cooling channel, and a plurality of apertures connecting said groove to said one surface of said support.

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