

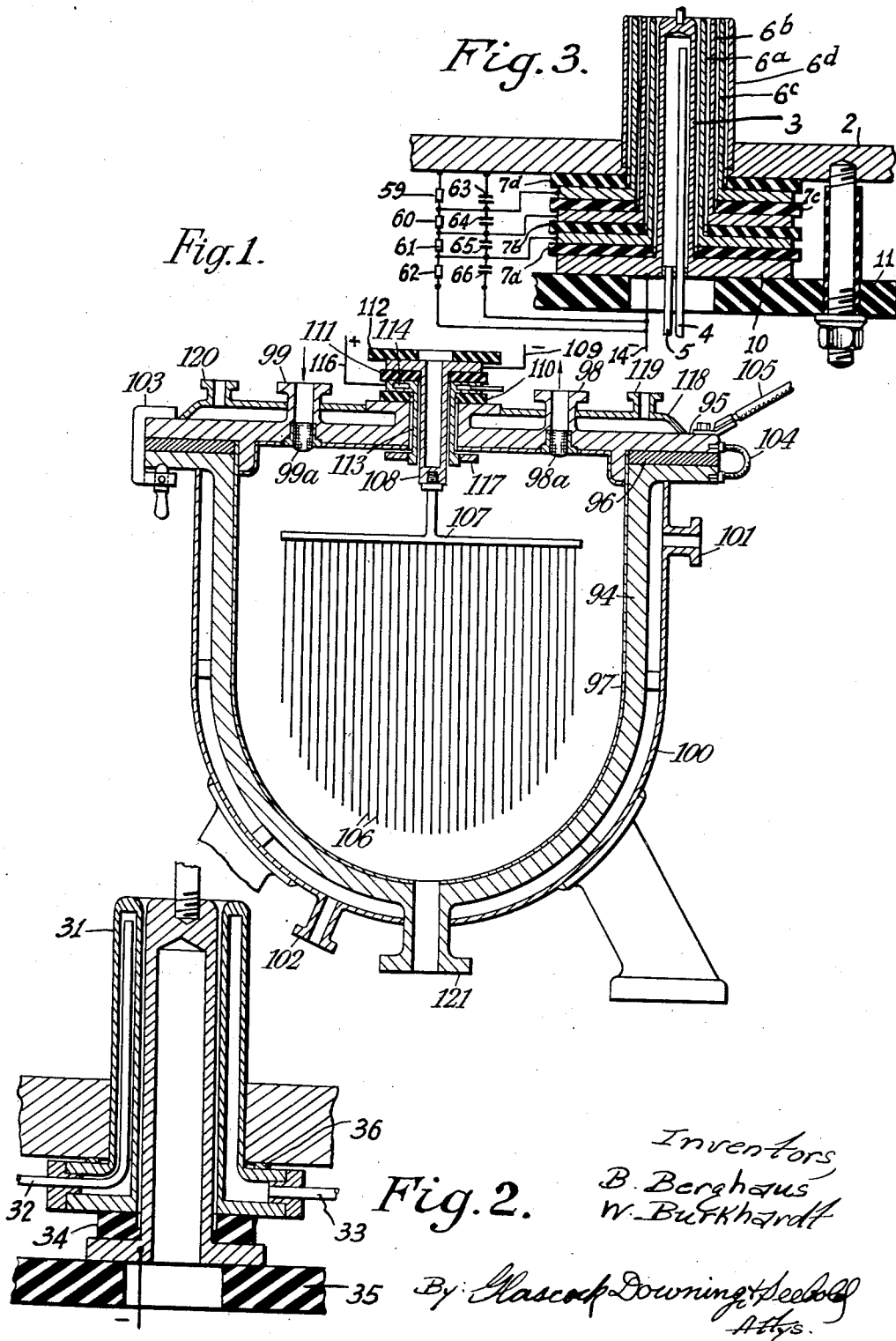
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ELECTRICAL DISCHARGE APPARATUS

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ELECTRICAL DISCHARGE APPARATUS

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The invention relates to a lead-in conductor for vacuum, reaction apparatus, the characteristic feature of which is that the insulating material is protected by a gap against any attack by the gas discharge.

The invention also relates to a lead-in conductor for electric vacuum reaction apparatus, the characteristic feature of which is that the insulated cathode conductor, to which the required voltage is applied for the chemical reaction by means of an electric discharge at reduced pressure, is provided with a metal covering at a short distance, preferably projecting into the vacuum reaction chamber. The insulating and sealing material of the conductor is so arranged that it is not reached by the charge carriers and metal vapour present in the vacuum reaction chamber. The distance between the conductor and the metal covering is made smaller than the width of the glow fringe which is formed around the conductor and the electrodes, more particularly, the cathode. The distance of the metal covering from the conductor depends upon the nature of the gas, the pressure and temperature of the gas being about 0.1 to 20, preferably 0.5 to 5 millimeters, and the metal covering has such a length that the glow and the charge carriers from the ionised atmosphere of the furnace, as well as the metal vapour, do not reach the insulating and the sealing material. The length of the protective gap is preferably a multiple of its width. The insulated metal covering may lie in the ionised gas space without any direct electric connection and carry a positive potential. Further, it may be in electric contact with the casing of the vacuum, reaction chamber and be even earthed. The metal covering of the lead-in conductor may also be insulated with respect to the casing, in addition to being insulated from the conductor and carry a different voltage than the casing or the conductor. The screen of the conductor is preferably so shaped as to avoid as much as possible the presence of edges and points.

The insulation and sealing of the conductor is preferably provided outside the vacuum reaction chamber so that they are easily accessible. The conductor may be constructed as a round hollow member, the inner wall of which is capable of being cooled by a cooling means, such as air, oil, or water.

A further feature of the invention resides in the fact that the conductor is surrounded by a plurality of concentric metal coverings, which are arranged in an insulated manner and at a short distance with respect to one another and

to the conductor. The metal coverings may carry different voltages with respect to one another and the conductor. In order to regulate the distribution of the voltage on the metal coverings use is preferably made of condensers or resistances. The flange of the screening sleeves may be made so as to be capable of being cooled, in order to protect the insulator.

The invention has the advantage that, owing to the gradation of the voltage between the individual metal coverings, high voltages can be reliably introduced in the vacuum reaction chamber in the case of large powers. The device offers a special advantage when the lead-in conductor is used in metallic reaction chambers wherein the high voltage is applied between the wall of the chamber and the conductor. Both the conductor and the wall of the chamber may carry the negative voltage. The same advantages are obtained with the lead-in conductor when the direction of the current is continuously varied, as is, for instance, the case when an alternating current voltage is applied. By using a lead-in conductor such as described it was possible to apply voltages up to 10,000 volts and more, and over 100 kilowatts, without in any way damaging or destroying the insulating part, even with a long period of operation.

The present invention avoids the difficulties hitherto encountered with lead-in conductors owing to the undesirable glow and arc discharges at the point where the lead-in conductors enter into the vessel, which would otherwise lead to the destruction of the sealing and insulating material. The lead-in conductor allows powers of 100 kw. for voltages of a few thousand volts to be reliably supplied to vacuum apparatus of any desired construction in which the wall of the vessel forms permanently or temporarily the cathode. A direct or alternating current voltage may be applied to the lead-in conductor.

The invention is illustrated by way of example and diagrammatically in the accompanying drawing, in which—

Fig. 1 is a sectional elevation of vacuum reaction apparatus in which the wall is connected as the cathode of a glow discharge with respect to an anode introduced in an insulated and screened manner.

Fig. 2 is a sectional view of a lead-in conductor showing another form of screen for vacuum reaction apparatus.

Fig. 3 is a sectional view of the lead-in conductor showing a modified screen assembly and electrical connections therefor.

Referring to Fig. 1, which is a sectional elevation of a vacuum apparatus for carrying out chemical reactions in which the wall of the apparatus serves as a cathode, 94 is the reaction vessel which is closed in an airtight manner by a lid 95 through the interposition of a packing 96. The whole interior of the reaction apparatus, that is to say, the lid as well as the vessel, is coated with a suitable electrode material 97, which may consist of any desired metal, a metal alloy or a metalloid. The following metals may be used, copper, iron, aluminium, light metals and the like. The vacuum pump, which is not shown, is connected up to the pipe connection 98 in the lid, whilst the pipe connection 99 serves for the purpose of supplying the component parts of the reaction. The reaction vessel is surrounded by a jacket 100 to which a cooling medium, for instance water, oil or air, is supplied through the pipe connection 101. The cooling medium is discharged through the pipe connection 102. The lid is secured to the vessel by clamps 103 and may be conductively connected to the vessel by the removable conductor 104. The negative voltage is supplied by the cable 105 which is secured to the lid. When use is made of catalysts 106, these are suspended, for instance, from a frame 107, which is secured to the insulated and screened lead-in conductor 108, and may be connected by the cable 109 to the negative pole of a source of direct current voltage. The connection of the catalysts to the source of direct current may also be interrupted, so that the catalysts are then suspended in the reaction vessel neutral. 110, 111 and 112 are rings of insulating and packing material and 113 is the metallic screening sleeve, the hollow flange 114 of which is adapted to be cooled by a cooling medium, and which is clamped on to the lid by means of screws 115, for the sake of clearness, have not been illustrated. The positive voltage is applied to the screening sleeve by the cable 116. The screening sleeve may carry at its end an anode 117 which is for instance in the form of a plate. Between the anode 117 and the wall 97 of the reaction vessel, which is connected as a cathode, there is then produced a gas discharge at a pressure between 40 and 0.001 and preferably between 5 and 0.1 millimeters of mercury, for carrying out the chemical reaction.

Also the lid of the vessel is provided with a jacket 118, to which the cooling medium is supplied by the pipe connection 119 being discharged through the pipe connection 120.

According to the invention a filter 99a is built in the gas supply 99 and a filter 93a in the gas discharge 98, which prevents the gas discharge, more particularly the glow discharge, from striking into the gas supply or discharge pipe. The mesh of the sieve is, for instance, less than 1 mm. Liquid reaction products which may be formed are discharged through the pipe connection 121.

The lead-in conductors hereinbefore described are suitable for direct current as well as for alternating current such as multi-phase currents, for instance three phase currents.

The form of construction illustrated in Fig. 2 includes a metallic screening sleeve 31 surrounding the lead-in conductor and constructed as a hollow body capable of being cooled, to which the cooling medium is supplied through the pipe 32 and discharged through the pipe 33. 34 is an insulating member and 35 is the clamping ring of insulating material, while 36 is a packing ring.

Referring to the form of construction illustrat-

ed in Fig. 3, 2 is the metallic wall of the vacuum chamber into which the conductor 3 is introduced through a hole in the wall. The conductor is for instance made hollow and cooled by a cooling medium, such as water, oil or air. The cooling medium is introduced through the pipe 4 and is discharged through the pipe 5. The conductor 3 is surrounded by a plurality, for instance four, cylindrical metal sleeves 6a, 6b, 6c, 6d, which are provided at one end with a flange, while at the other end they project into the reaction chamber to such an extent that no discharges or metal particles can reach from the reaction space through the narrow annular spaces between the conductor 3 and the sleeve 6a, as well as between the other sleeves to the insulation and packings which are arranged outside the vacuum chamber. 7a, 7b, 7c and 7d are rings used for insulating purposes. The flange 10 of the conductor 3 is firmly clamped by means of a ring 11 of insulating material and screws 12. 14 is a lead through which current is supplied to the conductor 3. 59, 60, 61, 62 are resistances. 63, 64, 65, 66 are condensers for regulating the voltage on the screening sleeves. By means of the lead-in conductor hereinbefore described voltages up to 10,000 volts can be applied without destroying the insulation, even in the case of high temperatures in the vacuum reaction apparatus.

What we claim is:

1. In electric vacuum reaction apparatus adapted to support a gas discharge therein, a metallic housing having an opening therein, a hollow conductor extending into the housing through said opening, a screening sleeve extending into the housing through said opening and surrounding said conductor in such a spaced relation that the gas discharge cannot extend outside the housing through said space, and means arranged outside the housing for sealing and insulating said conductor with respect to the housing.

2. In electric vacuum reaction apparatus adapted to support a gas discharge therein, a metallic housing having an opening therein, a hollow conductor extending into the housing through said opening, a screening sleeve extending into the housing through said opening and surrounding said conductor in such a spaced relation that the gas discharge cannot extend outside the housing through said space, means arranged outside the housing for sealing and insulating said conductor with respect to the housing, and means for introducing a cooling medium into said conductor.

3. In electric vacuum reaction apparatus adapted to support a gas discharge therein, a metallic housing having an opening in the wall thereof, a hollow conductor extending into the housing through said opening, a hollow screening sleeve extending into said housing through said opening and surrounding said conductor in such a spaced relation that the gas discharge cannot extend outside the housing through said space, means arranged outside the housing for sealing and insulating said conductor with respect to the housing, and means for introducing a cooling medium into said hollow screening sleeve.

4. In electric vacuum reaction apparatus adapted to support a gas discharge therein, a metallic housing having an opening in the wall thereof, a hollow conductor extending into said housing through said opening, a plurality of concentrically arranged screening sleeves extending into said housing through said opening, said

5 sleeves being spaced with respect to each other and the innermost sleeve being spaced with respect to said conductor so that the gas discharge cannot extend outside said housing through said spaces, means arranged outside said housing for insulating and sealing said conductor with respect to the innermost sleeve, means arranged

outside said housing insulating and sealing said sleeve with respect to each other, and means arranged outside the housing for sealing the outermost sleeve with respect to the housing.

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