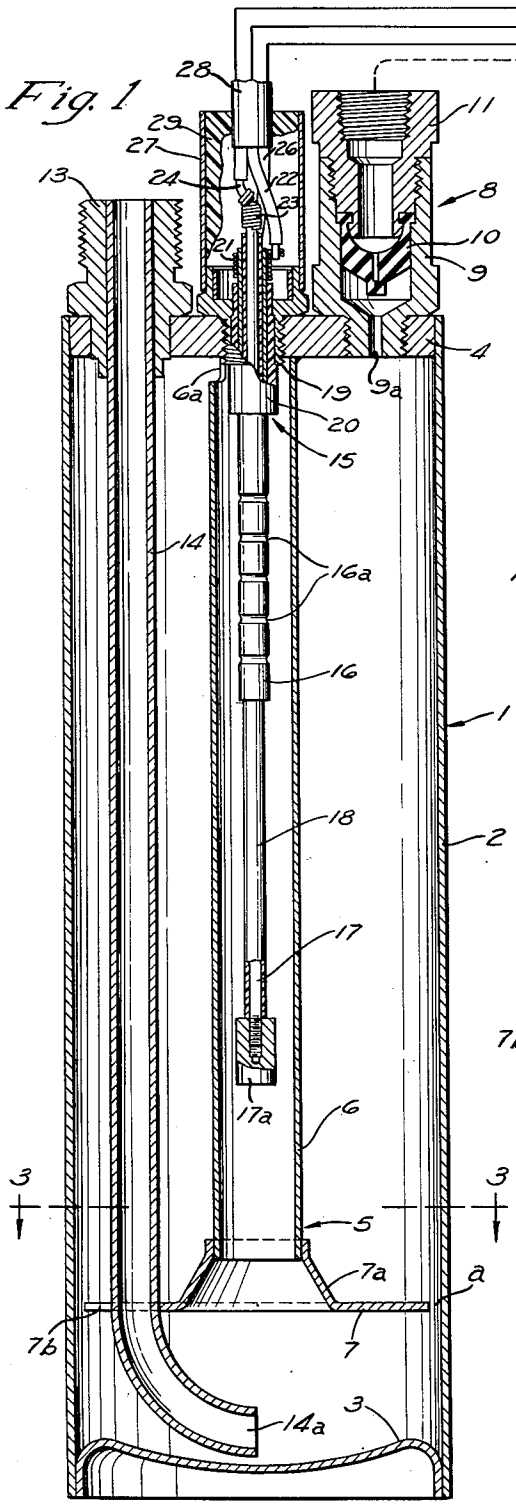
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LIQUID LEVEL CONTROL MEANS

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Fig. 1



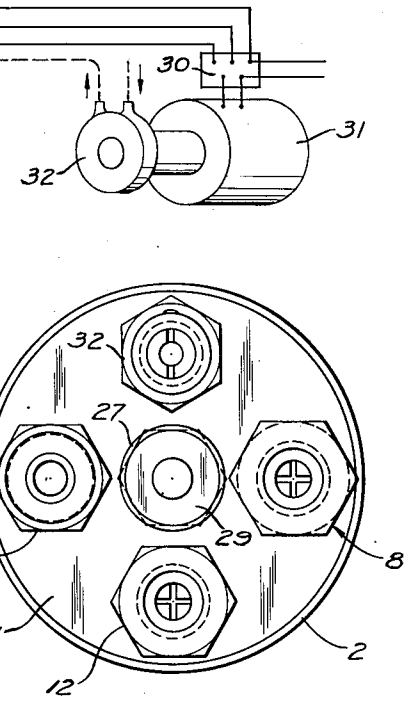


Fig 2

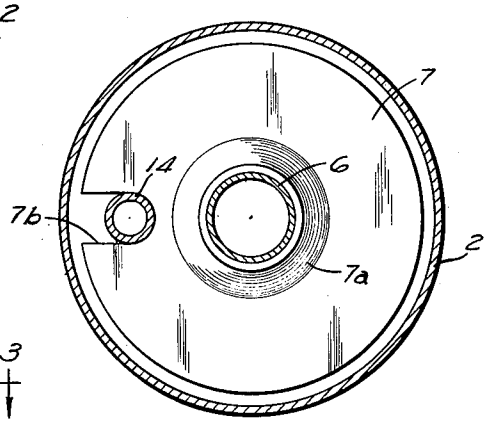


Fig. 3

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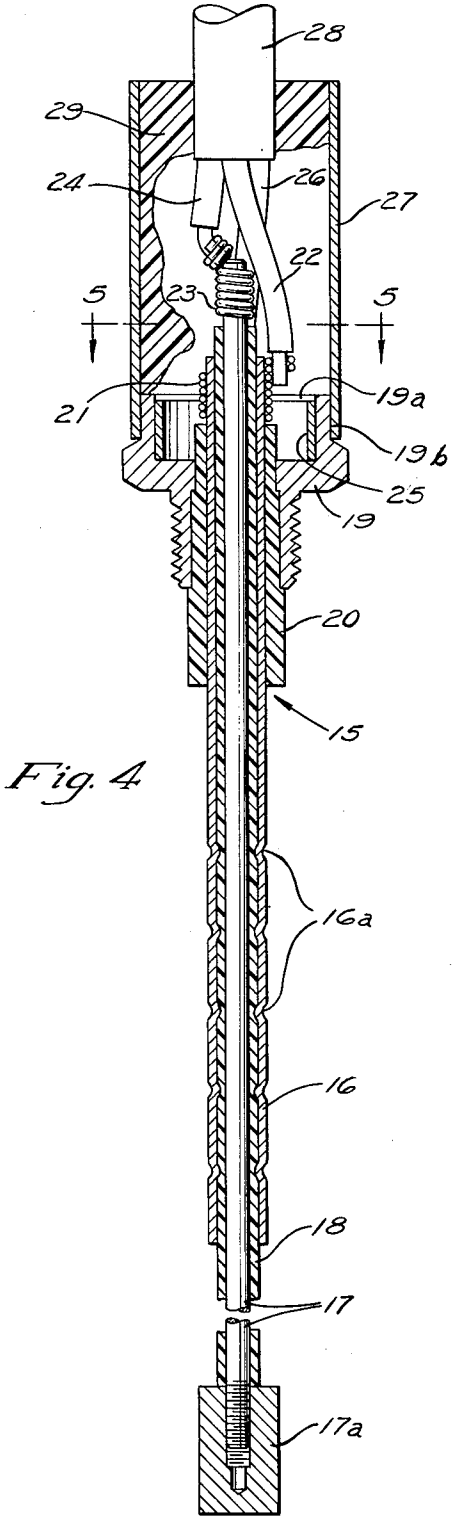


Fig. 4

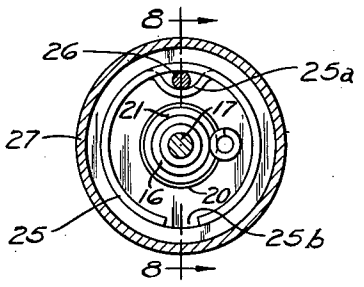


Fig. 5

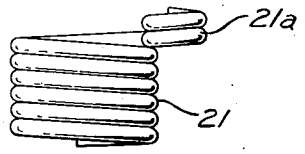


Fig. 6

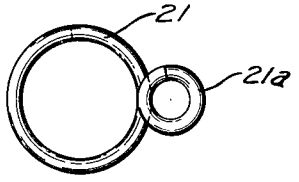


Fig. 7

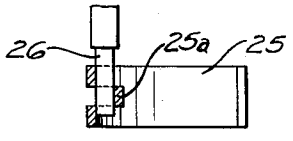


Fig. 8

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LIQUID LEVEL CONTROL MEANS

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Application January 27, 1956, Serial No. 561,786

7 Claims. (Cl. 200—152)

This invention relates to improved liquid level control means of apparatus for the simultaneous treatment of gaseous and liquid materials under superatmospheric pressures, of which liquid carbonating apparatus is typical.

It is an object of the invention to provide for such apparatus liquid level electrode control means which is marked by great structural simplicity, compactness and ease of fabrication and which is reliable in operation under relatively high interior pressures and which by reason of its compactness makes possible greater compactness and lower cost of the apparatus controlled.

With the foregoing objects in view the invention consists in various forms, arrangements and combinations of parts hereinafter described as embodied in the carbonating apparatus shown in the accompanying drawings, the said invention being particularly defined by the claims appended to the description.

In the drawings,

Fig. 1 is a vertical sectional view of a carbonator embodying the invention, the section being taken through the vertical axis of the cylindrical carbonator tank or shell, and the figure also including a diagrammatic showing of automatic means for supplying to the tank liquid to be carbonated.

Fig. 2 is a plan view of the carbonator shown in Fig. 1.

Fig. 3 is a horizontal section on the line 3—3 of Fig. 1.

Fig. 4 is a detached axial sectional view of the electrode parts of the apparatus shown in Fig. 1, the view being on an enlarged scale and a portion of one of the electrodes being broken away to permit the larger scale illustration.

Fig. 5 is a horizontal section on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged side elevation of the electric slip connector for one of the electrodes shown in Figs. 1 and 4.

Fig. 7 is an enlarged plan view of the slip connector shown in Fig. 6.

Fig. 8 is a vertical transverse section of the electrical slip connector of the ground conductor of the apparatus, the section being taken on the line 8—8 of Fig. 5.

Referring in detail to the construction illustrated in the drawings, 1 designates as an entirety a carbonator embodying the present invention. The carbonator comprises a blank or shell having a seamless tubular side wall 2 of sheet metal, a bottom wall 3 also of sheet metal, and top wall 4 of heavy metal plate, the joints between the side wall and the bottom and top walls, respectively, being suitably welded to provide a hermetically tight vessel.

Within the tank is a baffle structure generally designated by the numeral 5, consisting of a tubular member 6 and a circular apertured disc 7 welded to the lower end of the tube 6, the disc being formed with a central truncated cone part 7*a*. The upper end of tube 6 is welded to the under side of closure plate 4 so that the baffle structure 5 is rigidly supported in the tank. The upper end of the tube 6 is notched at 6*a* so that the space inside and outside of the tube are in free communication with each other at the upper end of the carbonator chamber. The

diameter of the circular baffle disc 7 is somewhat smaller than the interior diameter of the shell wall 2 so that there is a small circumferential opening *a* between the periphery of disc 7 and the wall 2.

The closure plate 4 is formed with a threaded aperture to receive a liquid inlet fitting generally designated by the numeral 8 which consists of a tubular part 9 formed at its lower end with a nipple threaded to engage the said aperture in the plate 4, a rubber check valve 10 of conventional type and a pipe coupling member 11 which is threaded into member 9 and secures the check valve 10 in operative position. The lower end of the part 9 is formed with a straight elongated passage 9*a* designed to introduce liquid under pressure into the carbonator in the form of a solid stream or jet pointed directly toward the upper surface of the baffle disc 7, in a manner to avoid directing the introduced liquid through the opening *a*.

As shown in Fig. 2, the top plate 4 of the carbonator shell is provided with a fitting 12 for the introduction of carbonic acid gas under pressure. This fitting 12 may be identical with the fitting 8 and adapted for connection to a cylinder of liquified carbon dioxide through suitable pressure control devices in a manner well known in the carbonator art. Diametrically opposite the liquid inlet fitting 8 the closure plate 4 of the carbonator shell is provided with an unthreaded aperture to receive a liquid outlet fitting 13, which is welded in position in the plate with a hermetically tight joint. The upper end of fitting 13 is threaded to receive a pipe coupling. A liquid discharge tube 14, which has its upper end welded in the bore of the fitting 13 with a hermetically tight joint, extends downward to the bottom of the tank chamber where it is curved inward and has its lower open end 14*a* disposed approximately at the lower axis of the vertical shell and the central baffle tube 6. The disc 7 is notched at 7*b* to accommodate tube 14.

Within the baffle tube 6 and extending above the top wall 4 of the carbonator tank is disposed improved liquid level control means generally designated by the numeral 15 and comprising a tubular electrode 16 and a rod-shaped electrode 17 of greater length than electrode 16. Electrode 17 is fitted with a tubular insulating sheath 18 of flexible plastic material, the sheath being of a diameter to snugly fit the inner wall of the tubular electrode 16 and support the rod electrode in coaxial relation to the tubular electrode.

The coaxial electrode unit thus formed is mounted in a support fitting 19 by means of an insulating tube 20 which is preferably formed of solid plastic material such as Du Pont nylon. The inner surface of tube 20 has a pressed fit on the electrode 16 and its outer surface has a pressed fit in the bore of the support fitting 19. The upper end of inner electrode 17 extends above the insulating tube 18 and its lower end extends below the lower end of the insulating tube and is threaded to receive an enlarged tip 17*a* of carbon or graphite in accordance with known practice.

In the fabrication of the electrode unit comprising the electrodes 16, 17 and interposed insulating sheath 18, after the three elements have been telescoped together in the relation shown in Fig. 4, the outer electrode 16 is compressed at a plurality of points along its length to form interior annular beads 16*a* which compress the plastic sheath 18 as shown in Fig. 4. This creates a corresponding number of zones extending longitudinally of the electrodes in which extremely tight fits are formed between the outer electrode and the plastic sheath and between the inner electrode and the plastic sheath. The compressing or crimping operation on the outer electrode is preferably carried out by chucking the three-part electrode assembly in a rotary spindle and forming the several

internal beads of the outer electrode simultaneously by a spinning operation. By reason of the simultaneous compressing actions it will be seen that the treatment positively compresses the plastic material of sheath **18** occupying the spaces between adjacent beads as well as establishing at the beads very high pressures between the two electrodes and the sheath. The result is that the joints between the respective coaxial electrodes and the interposed sheath are rendered permanently resistant to longitudinal leakage between the electrodes to an extremely high degree.

After the three-part electrode unit has been assembled in the sleeve **20** the latter is forced into the bore of the support **19**. In this operation the outer surface of the sleeve **20**, or the inner surface of the support **19**, is advantageously coated with a suitable varnish such as General Electric Glyptal No. 1294, which serves as a lubricant to facilitate the assembly and which, when hardened, additionally insures a liquid-proof joint. It will be appreciated that in effecting the force fit of the plastic sleeve **20** in the bore of the support **19** resultant inward pressures are transmitted from the support to the joint between the sleeve **20** and the tubular eletcrode **16**.

The lower end of the electrode support **19** is threaded to engage a central threaded aperture in the tank plate **4** so as to provide a tight joint between the support and the said plate.

It will be noted, in Figs. 1 and 4, that the upper end of the electrode tube **16** extends somewhat above the insulating sleeve **20**, thus providing an exposed cylindrical surface to receive the slip connector **21** of a conductor **22** (Figs. 6, 7). The connector **21** is in the form of a helical wire coil of a diameter to slip over the end of electrode **16** by resiliently expanding slightly, the conductor being preferably formed at its upper end with a smaller diameter coil **21***a* to which the end of conductor **22** is soldered.

Similarly the upper end of the inner electrode **17** which extends above the insulating sheath **18** is adapted to receive a slip connector **23** of a conductor **24** formed similarly to connector **21** but of suitable smaller diameter to fit the smaller electrode.

To provide a ground connection for the electrical system the conductor support **19** is formed with an upwardly extending collar having an inner cylindrical surface **19***a* in which is slidably disposed a resilient expansible connector **25** which is connected to a ground conductor **26**. The connector **25** is in the form of an interrupted band (Figs. 5, 8), to permit its contraction and expansion, and is formed intermediate its ends with a loop **25***a* to receive the end of the conductor **26** and facilitate the making of a soldered joint.

The collar of support **19** also is formed with a cylindrical outer surface **19***b* to receive a tube **27** of a height to surround the lower ends of the cable **28** and its conductors **22**, **24**, **26**. After the slip connectors of the three conductors have been applied to the electrodes and the support **19** as shown in Fig. 4, the space within the tube **27** may be filled with a suitable sealing material **29** such as epoxy resin. Thus sealed, the upper part of the entire electrode assembly and the electrical connections thereto are rendered completely water proof.

As is shown in Fig. 1, the cable conductors **22**, **24** and **26** are extended to a relay **30**, which, in turn, is connected to the terminals of an electric motor **31** which drives a rotary pump **32** connected to supply water or other liquid to the fitting **8** of the carbonator. The motor driven pump and the electrode control means operate in known manner to automatically supply liquid to be carbonated and the electric devices diagrammatically indicated in the drawing may be of known character such, for example, as those shown in U. S. Patent No. 2,249,994.

The top closure plate **4** of the tank **1** is preferably provided at a point diametrically opposite the gas inlet fitting **12** with a threaded aperture to receive a relief valve **32** (Fig. 2), such as is commonly provided for carbonator apparatus of the character in question.

In accordance with the usual practice all parts of the carbonating apparatus which are contacted by the carbonating liquid are formed of corrosion-resistant metal, such as stainless steel.

With the carbonator connected to a source of CO_2 gas adapted to supply the gas at a suitable pressure, such as 80–100 p. s. i., and with the liquid pump connected with a source of liquid and designed to supply liquid to the carbonator fitting **8** at a pressure of 120–140 p. s. i., the operation of the apparatus is as follows.

The motor driven pump under control of the electrodes is started and stopped to maintain the level of the liquid in the carbonator between the maximum and minimum levels coinciding with the lower ends of the electrodes **16** and **17**, respectively. When, because of draft of carbonated liquid through discharge tube **14**, the liquid level in the carbonator falls below the bottom of the electrode tip **17***a* and the pump **24** is thereby started, liquid at the pump discharge pressure is delivered through the bore **9***a* of the supply fitting **8** until the liquid level in the carbonator rises to the bottom of the shorter electrode **16**, whereupon the pump is automatically stopped. The liquid is delivered through the bore **9***a* of the fitting **8** in the form of a solid jet which is projected into the body of liquid in the carbonator at high velocity and causes the liquid to vigorously boil and bubble in the presence of the compressed gas which is maintained under the predetermined supply pressure. The space surrounding the baffle tube **6** and above the baffle disc **7** is thus occupied by a vigorously agitated mass of mixed liquid and gas and the large liquid surfaces thus developed favor rapid solution of the gas in the liquid. However, the space within the baffle tube **6** is relatively quiescent so that the electrodes are able to perform their motor control function with adequate uniformity. The space below the baffle disc **7**, although it is in communication with the space above the disc through the restricted circumferential opening *a*, is also relatively quiescent. Nevertheless, during withdrawal of carbonated liquid from the carbonator, the space below disc **7** to a substantial extent receives small bubbles of undissolved gas which pass downward with liquid through the opening *a*. As this mixture of liquid and bubbles moves from opening *a* downward and radially inward toward the inlet opening **14***a* of the discharge tube **14** the bubbles rise and find their way into baffle tube **6** where they move upward through the quiescent liquid and deliver their gaseous contents to the gas space above the liquid level in the carbonator. The use of the distinctively formed and arranged jet nozzle, baffle structure and carbonated liquid discharge tube herein disclosed is not herein claimed since it is the subject of claims in U. S. patent to Lance, No. 2,735,665.

It will be understood that in the operation of the carbonator it is subjected to an interior pressure at least equal to the carbonated gas pressure employed and that the joints of the carbonator structure must be hermetically tight. Since level-controlling electrodes supported in the carbonator chamber must be insulated from the metal walls of the chamber the attainment of reliably tight joints between the electrodes and the carbonator tank wall have always posed a somewhat difficult problem. In the present carbonator this problem has been solved with notable success by means of the construction which has been described. The relatively small diameter of the threaded section of the support fitting **19** facilitates the attainment of a tight joint between the support and the top plate of the carbonator. Similarly the forced fit of the plastic sleeve **20** in the bore of the fitting **19** and on the tubular electrode **16** insures permanently tight joints between these parts. Finally, the series of the annular beads **16***a* formed in the electrode **16** with resultant high compression of the insulating sheath **18** between the two electrodes in a plurality of zones, produces joints between the sheath and

the electrodes capable of withstanding extremely high pressures without leakage of gas.

As will be noted in Fig. 1 of the drawing, the small diameter of the electrode assembly permits the use of a small baffle tube 6. This, in turn, permits some reduction in the diameter of the tubular side wall 2 of the carbonator tank without sacrificing the volumetric capacity of the agitation zone of the carbonator and the result is a reduced materials cost of the tank and baffle structure.

The construction of the coaxial electrode assembly achieves additional savings in cost by virtue of reduction of the amounts of the construction materials employed, the utilization of standard rod and tubular forms for the metal electrode members and the ease with which the assembly of the electrode parts and the electrical connections is effected.

It will be understood that the specific constructions of the improved carbonator which are herein disclosed and described are presented for purposes of explanation and illustration and are not intended to indicate limits of the invention, the scope of the invention being indicated by the following claims.

What is claimed is:

1. Electric liquid-level control means of apparatus for the simultaneous treatment of gaseous and liquid materials under super-atmospheric pressure, the said means comprising the combination with a hermetically closed metal tank for holding gas and liquid to be treated; of a metal tube-like electrode support having a gas-tight mounting in the top wall of the tank to provide a passage therethrough; a bushing of solid dielectric material disposed in the passage through the support with a gas-tight forced fit therein; a tubular metal electrode extending upward through and somewhat above the upper end of the bushing and having a gas-tight forced fit in the bushing; and a rod-shaped electrode unit of greater length than the tubular electrode extending through the latter with a gas-tight fit, the said unit comprising a metal rod and a deformable dielectric tube tightly fitting the rod with portions of the rod exposed at each end of the dielectric tube and the said tubular electrode being formed with a plurality of annular inwardly projecting beads that highly compress the wall of the dielectric tube between the surfaces of the beads and the surface of the electrode rod.

2. Control means as claimed in claim 1 in which adjacent annular beads of the tubular electrode act also, in conjunction with the tubular and rod electrodes, to maintain the material of the dielectric tube disposed between the adjacent beads in a state of positive compression.

3. Control means as claimed in claim 1 which additionally comprise three electrical conductors, two of which have end fittings having resilient slip engagement with the upper ends of the tubular and rod electrodes, respectively, and the third of which has resilient slip connection with the upper end of the electrode support.

4. Control means as claimed in claim 3 in which the conductor fittings for slip engagement with the electrodes each consists of a primary helical wire coil formed to slip over and resiliently grip the upper end of its electrode and a secondary coil integrally attached to the primary coil and soldered to its conductor.

5. Electric liquid level control means of apparatus for the simultaneous treatment of gaseous and liquid materials under super-atmospheric pressure, the said means comprising the combination with a hermetically closed metal tank for holding gas and liquid to be treated; of a metal tube-like electrode support having a gas-tight mounting in the top wall of the tank to provide a passage therethrough and being formed at its upper end with an upstanding annular collar; a bushing of solid dielectric material disposed in the passage through the support with a gas-tight forced fit therein; a tubular metal electrode extending upward through and somewhat above the upper end of the bushing with a gas-tight fit therein; a rod-shaped electrode unit of greater length than the tubular electrode extending through the latter, the said unit comprising a metal rod and a deformable dielectric tube surrounding the rod with portions of the rod exposed at each end of the tube and forming a gas-tight packing between the rod and tubular electrode elements; two electrical conductors having resilient slip engagement with the upper ends of the tubular and rod electrodes, respectively; a third conductor having a resilient slip engagement with the inner surface of the annular collar of the electrode support; an upstanding tube having its lower end tightly engaging the outer surface of the collar of the electrode support; and a solid body of dielectric material filling the upstanding tube and forming a water-proof cover for the lower end parts of the three conductors.

6. Electric liquid level control means comprising a metal tube-like electrode support; a bushing of solid dielectric material disposed in the passage through the support with a fluid-tight forced fit therein; a tubular metal electrode extending upward through and somewhat above the upper end of the bushing with a fluid-tight fit therein; a rod-shaped electrode unit of greater length than the tubular electrode extending through the latter, the said unit comprising a metal rod and deformable dielectric tube surrounding the rod with portions of the rod exposed at each end of the tube and the said tubular electrode being formed with a plurality of annular inwardly projecting beads that highly compress the wall of the dielectric tube between the surfaces of the beads and the surface of the electrode rod; and three electrical conductors, two of which have end fittings having resilient slip engagement with the upper ends of the tubular and rod electrodes, respectively, and the third of which has a resilient slip connection with the upper end of the electrode support.

7. Electric liquid level control means comprising a metal tube-like electrode support formed at its upper end with an upstanding annular collar; a bushing of solid dielectrical material disposed in the passage through the support with a fluid-tight fit therein; a tubular metal electrode extending upward through and somewhat above the upper end of the bushing with a fluid-tight fit therein; a rod-shaped electrode unit of greater length than the tubular electrode extending through the latter, the said unit comprising a metal rod and a deformable dielectric tube surrounding the rod with portions of the rod exposed at each end of the tube and forming a fluid-tight packing between the rod and tubular electrode elements; two electrical conductors having resilient slip engagement with the upper ends of the tubular and rod electrodes, respectively; a third conductor having a resilient slip engagement with the inner surface of the annular collar of the electrode support; an upstanding tube having its lower end tightly engaging the outer surface of the collar of the electrode support; and a solid body of dielectric material filling the upstanding tube and forming a water proof cover for the lower end parts of the three conductors.

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