C. D. BABCOCK.

WIRELESS COMMUNICATION.

APPLICATION FILED SEPT. 25, 1905.

929,745. Patented Aug. 3, 1909.

Fig. 1.

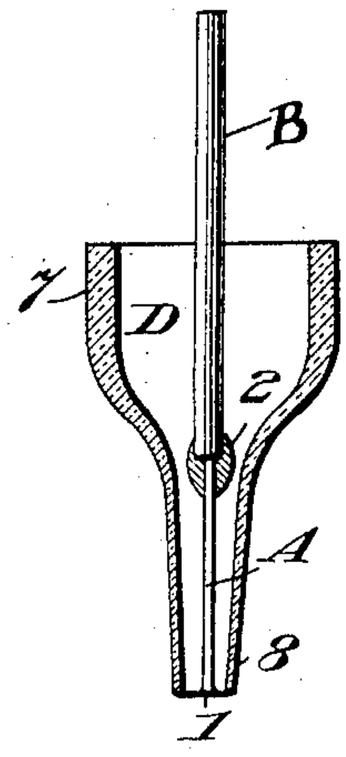


Fig. 3.

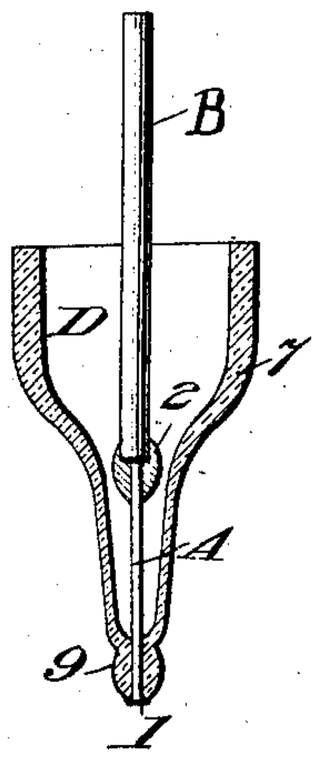


Fig. 4.

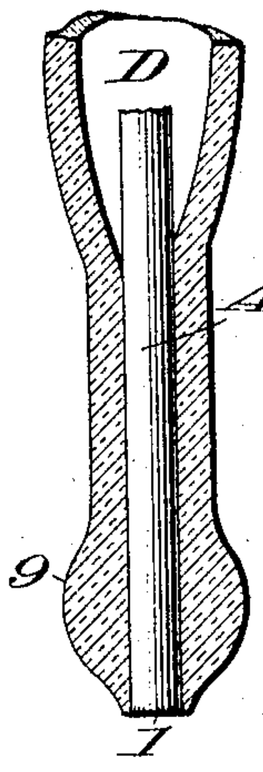
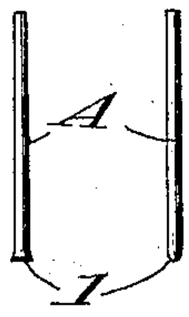


Fig. 2.



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UNITED STATES PATENT OFFICE.

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WIRELESS COMMUNICATION.

No. 929,745. Specification of Letters Patent. Patented Aug. 3, 1909.

Application filed September 25, 1905. Serial No. 279,883.

To all whom it may concern:

Be it known that I, CLIFFORD DUDLEY BABCOCK, a citizen of the United States of America, and a resident of the city of New York, State of New York, have invented certain new and useful Improvements in Systems of Wireless Communication, the principles of which are set forth in the following specification and accompanying drawings, which disclose the form of the invention which I now consider to be the best of the various forms in which the principles of the invention may be embodied.

This invention relates to improvements in the construction of oscillation detectors, and the invention herein consists in the method of construction, and the product thereof, which are hereinafter described and explained in the drawings, and claimed in the appended claims.

The object of the invention is the production of an efficient, durable and practicable liquid oscillation detector.

Of the drawings Figure 1 is an elevation, partly in section, of the parts of the invention, ready for the execution of an action permanently combining them; Fig. 2 comprises two different elevation views of a detached portion of the part A shown in Fig. 1; Fig. 3 is an elevation like that of Fig. 1, but showing the result of an action executed in pursuance of this invention; and Fig. 4 is an enlarged view of the lower part of Fig. 3.

These drawings are not intended as working or scale drawings, but must be understood in the light of the specification.

This invention concerns a means for using a substantial and comparatively large and stout electrode of any suitable shape, properly limiting that part of its area which is exposed to the liquid. As to the other and larger electrode, I prefer a form having a considerable exposed area wherein for good results, the electrode may consist of a plate of platinum or other suitable metal, having a plane surface of considerable area, with dimensions of about an eighth of an inch square and of any convenient thickness. It may have a much greater or a less exposed area, but its exposed area should be greater than that of the other electrode, in order to be commercially useful for long distance telegraphy.

As distinguished from the use of an extremely fine electrode, I prefer a comparatively large, stout, substantial terminal, which will not be affected by static discharges, for use with this invention, which terminal, when properly covered with insulation, does not require to be adjusted to varying conditions, and can be readily handled without injury during manufacture and use. Such a comparatively large terminal or electrode is not fragile, or liable to destruction by handling, and is laterally supported by the insulating covering so as to comprise a strong and durable device.

Fig. 1 shows a conducting part A which may be in the form of a wire, and may be of platinum, a metal which can be sealed with glass. This conducting portion may be large, as compared with the Wollaston wire, (about fifty times as large, or slightly less or much more), such as two mils in diameter or much larger or slightly smaller, although it should have at least a smaller area exposed to the liquid than the other electrode. This wire, which may be half an inch long, or more, or less, as convenient, may be obtained by shearing or cutting it off from a length of wire so that the part A has, as a result of the shearing, a V-edge 1, as shown in the two views in Fig. 2, one being from a view-point ninety degrees removed from the other, although this shape is not essential provided that the general structure to be described is produced.

To the upper end of the wire A (Fig. 1) is attached, by the solder 2, a conductor of electricity B, which may be, for example, a copper wire twelve mils in diameter, although its diameter, as well as its material and length, is not an essential of this invention.

In Fig. 1 is shown in elevation a drawn-out tube of glass D, which comprises the insulating covering for the lateral surface of the part A. The wall of the tube from which the part D is drawn, may be of the thickness of any common small glass tube, such as about sixteen mils, and the out-

side diameter may be about a tenth of an inch. The part D may be made in any manner well known to glass workers, either from such a tube, or in any other manner, provided that the thinnest part or end of the drawn-out wall is of sufficient thinness. When made from the tube, a part of the tube intermediate its ends, may be put into a suitable glass blower's flame, and the tube drawn out by hand until the smallest outside diameter of the drawn-out part is about the same as, or less than, the thickness of the wall of the undrawn-out portion. This outside diameter may vary considerably in practice, even with a comparatively invariable thickness of the wall of the drawn-out portion, and, as with the other constructional features, is largely dependent upon the skill of the constructor in executing the detailed description hereinafter. But such variation is not important, although the inner diameter of the drawn-out portion should be large enough to permit the part A to pass entirely through it, so that the end surface of the part A will be substantially flush with the end of the jacket. The thickness of the wall 8 at the end of the drawn-out portion will then be about the same as the diameter of the part A; and in general, although the part A may be considerably thicker than the said wall, or vice versa, they are of the same general order of magnitude, for the purposes of this invention. It will be seen from the above that the diameter of the opening in the smaller end 8 of the drawn-out tube may be many times larger than the diameter of the part A, and it is not necessary that the tube be a capillary tube. It is the thinness of the wall (as compared with the ordinary thickness of tubes) which is of importance, and not the size of the opening. The above dimensions are given as examples of satisfactory practical conditions, and not as being essentials. I have found that the best results follow the mode of drawing out the part A which consists in drawing it out as quickly as possible while kept as hot as possible as in a flame. This results in the peculiar form shown in the drawings, which will be described hereinafter. The part D will thus not only be tapered as a whole and have a tapering interior opening, but its wall will also be tapering. After being drawn out, the tube can be broken or cut off at the smallest part of the drawn-out portion, thus removing the part D (Fig. 1) from the tube.

As shown in Fig. 1, the parts are assembled so that the end surface of the part A is flush with the end of the part D, the interior walls of the smaller end 8 of the part D having been first suitably cleansed. Then the end 8 of the part D and the corresponding end of the inclosed part A, are inserted into the oxidizing part, or outer part of the lower portion of, a hydrogen flame, which may be the flame of a Bunsen burner supplied from an illuminating-gas main. In that flame the gas is heated to incandescence. Since the parts A and D, consisting of glass and platinum respectively, have substantially the same coefficient of expansion, they will, by this heating, be sealed together at their lower ends, thus leaving exposed only the minute end surface of the part A. This sealing may be effected in the case of the comparatively stout electrode of this invention, although an extremely fine electrode such as the Wollaston wire, or even wires of a much greater diameter, cannot be sealed in glass on account of the resulting fusion of the electrode. The reason that it is possible to construct the electrode in this manner, in pursuance of this invention, is that the part A is made comparatively large, so that it will not be readily fused; while the tapered wall 8 of the drawn-out portion of the part D is made comparatively thin, (with respect to the thickness of ordinary tubes), so that the little heat required to fuse it, for sealing to the part A, is not sufficient to fuse that metal part, which is stout as compared with the extremely fine terminals. The thin wall of the glass tube, and the stoutness of the electrode, as compared with extremely fine electrodes, each contributes to the accomplishment of the purpose of the invention.

I do not claim broadly the invention above described, but only the specific improvements thereon which will now be described, and the specific features of the above description which are connected with such improvements.

In executing the sealing operation, I observed that sometimes after the operation, the lower end of the sealed tube would have substantially the same shape which it had before the sealing; and that at other times it assumed a form like or similar to that shown at 9 in Fig. 3, and in Fig. 4 on a larger scale. The reason for the formation of the globule on certain occasions, and not on others, was at first obscure, but I determined by test that when it was formed, the device acted better in use in a detector. I found that when it was not formed the device worked better when the lower half of a device similar to Fig. 3, but having no globule, was bent upwardly so that the end of the part A was directed toward the surface of the liquid electrolyte in a vessel. This seemed to be due to the fact that the bubbles of liberated gas were free to rise up away from the end of the part A, whereas when that end pointed downward, the gas bubbles tended to remain at that end and impair the action of the device. But when the glass globule 9 was formed, the device

would operate satisfactorily even when its lower half was not bent upward, and the device would operate no better if its end were bent upwardly. It seemed that this might be due to the fact that the extreme thinness of the glass wall at the lower end of the globule, and the bulging shape of the globule above that thin wall, readily permitted the gas bubbles to exercise their tendency to rise, and caused them to be deflected up away from the end of the part A. It is probable that the formation of the globule draws upwardly some of the glass forming the lower end of the wall, so that that wall is even thinner than it would be in the cases when no globule is formed. The glass usually does not, when proper care is taken, flow farther than, or over the edge of, the end surface of the part A, but stops at the end of the lateral surface of the part A, in pursuance of the exercise of proper skill on the part of the constructor. The thickest part of the globule will be somewhat above the exposed end surface of the part A, and the part of the lateral surface of the part A just above the end surface and below the greater curvature of the globule, may be covered with only a very thin film of glass, but this thin film will be sufficient to insulate the part A from the liquid except as to the end surface, in pursuance of the general principles of the insulated electrode. Furthermore, such thin film will usually partake more or less of the tapered form of the entire tapered part 9, and is distinguished from the taper existing at 8 (Fig. 1) prior to the sealing operation, and subsequent to the drawing-out operation. This globular formation is the basis of the invention claimed herein. The globule 9 may approximate exteriorly more or less to the form of a perfect globe, depending upon varying conditions. The globule is to be distinguished from the tapering wall of the glass tube caused by drawing out. The globule is near the end of the electrode, while the latter tapered wall extends throughout the length of the drawn-out part of the tube.

The structure and function of the globular formation having now been described, there will now be disclosed in detail the method, discovered by me, of producing that formation with reasonable certitude and uniformity, instead of accidentally. In general it may be said that in practice the tips of the small ends of the glass point and inclosed wire are applied near the base of the bunsen flame, just above the upper edge of the burner, and while the parts are held in a substantially horizontal position, without being moved except in a direction to and from the flame. I have found that the globule cannot be produced at all, or at least not without great difficulty, unless the wall of the small end of the drawn-out glass tube be as thin as it is possible to make it, by drawing it out as quickly as possible while kept as hot as possible in a flame. This results in the form shown in the drawings, wherein below the straight part of the tube D there is first an abrupt taper which extends into a gradual taper terminating in a fine point. If the tube be drawn out too slowly or while not quite hot and soft, its thickness will be so great as to strongly militate against the chance of the formation of the globule. The less the thickness of the wall of the tube is, the more definite will be the tendency toward the formation of the globule. I have found further that even when the lower wall of the tube is of the required thinness, as described above, the globule will not be formed, or at least properly formed at the requisite place, under conditions of commercial manufacture in large quantities, unless the tips of the glass point and inclosed wire be applied to or dipped in the flame several successive times, at least twice, and usually as many as five to seven times. Each application should be very brief, in order to avoid entirely fusing off the end of the tube. After each application it is best to observe the result, (in order to determine whether or not the operation has proceeded sufficiently far,) either visually or by a quick tentative test in a detector. The respective applications, while permissibly in quick succession, are separated by a sufficient interval to allow considerable cooling of the glass. The variation in the number of the successive applications is due to many varying conditions, including the thinness of the drawn-out glass tube, and the more or less rough character of the broken-off end thereof, it being unnecessary to exercise great care in breaking the tubes apart after they have been drawn out. The essence of the method of producing the globule under commercial conditions, is, in brief, to draw out the glass tube quickly while hot as in the flame, to then insert the inner conducting part in the tube until its end is substantially flush with the end of the glass tube, and then to seal the parts together to form the globule by successive short applications to the flame, of the flush ends of the parts.

The manner of use of the invention hereof will be understood by those skilled in the art.

The device hereof possesses the following advantages. The extreme degree of thinness of the tip end of the sealed glass tube, (caused by the quick drawing out of the tube and by the formation of the globule), offers the least possible obstacle to the rise of gas bubbles up away from the end of the electrode, which is consistent with the cov-

ering with insulating material of the exposed thin edge or end of the conductor A. This obviates the desirability of bending up the electrode, so that the end of the conductor is thereby directed toward the surface of the liquid. The less excellent operation of a device without a globule, when it is not bent up, is probably due to two causes, among others, *i. e.*, first, that owing to the lack of this invention, there might be sufficient surface of glass left parallel with the exposed end surface of the wire, to act to retain gas bubbles; second, that a certain extent of flat surface of the end of the glass jacket might be caused by the grinding off of the electrode, such grinding being advisable in the lack of the invention hereof. The curvature of the globule guides away with certitude the gas bubbles, which are permitted to be deflected by reason of the thinness of the end wall of the glass tube, which extreme thinness is due to the quick drawing out of the tube and to the formation of the globule.

The method of making my new electrode is advantageous in that by it a practicable and operative electrode can be produced with certitude, quickness, and at a reasonably small cost. The successive applications in the flame, obviate the desirability of grinding or filing off any roughness of surface or non-flush projections of the ends of the broken or cut off point of the drawn-out tube and the end of the inclosed conductor, whereby in my device a sheared or cut end surface of the conductor is presented to the liquid (as distinguished from a roughened surface or one produced by grinding or filing), whereby any deleterious action on the conductor by the liquid is prevented. But the successive applications in the flame, in pursuance of my invention, enable the parts to become, during the formation of the glass globule, substantially flush with each other, thus obviating the requirement of any subsequent grinding or filing of the ends of the parts.

I claim:

1. The method of making an electrode for a liquid detector of wireless telegraphy oscillations, which consists in inserting a conductor into a glass tube having a thin wall, so that the end of the conductor is substantially flush with the end of the tube, and then heating the flush end of the tube while the conductor is so inserted, to seal together the proximate lateral surfaces of the tube and conductor near to and next their flush end surfaces and cause a part of the glass constituting the wall of the extreme flush end of the tube to be drawn away from the end while leaving covered with glass all the lateral surface of the conductor next its end, the heating being effected repeatedly and successively whereby there is formed an enlarged curved portion of glass above the end of the tube, thus reducing the thickness of the extreme end wall of the tube.

2. The method of making an electrode for a liquid detector of wireless telegraphy oscillations, which consists in inserting a metallic conductor into a glass tube having a thin wall, so that the end of the conductor is substantially flush with the end of the tube, and then sealing together the proximate lateral surface of the tube and conductor near to and next their flush end surfaces, by the application of heat thereto, the thickness of the wall of the flush end of the tube being sufficiently small to permit the heat used for sealing to cause a part of the glass constituting the wall of the extreme flush end of the tube to be drawn away from the end while leaving covered with glass all the lateral surface of the conductor next its end, the application of heat being made repeatedly and successively to form an enlarged curved portion of glass above the end of the tube, thus further reducing the originally slight thickness of the extreme end wall of the tube.

3. An electrode for a detector of wireless telegraphy oscillations, which comprises a glass jacket having an extremely thin wall at one extreme end, and a conductor inserted therein so that its end is substantially flush with the end of the jacket which has the extremely thin wall, the proximate lateral surfaces of the jacket and conductor being sealed together near to and next their ends, leaving the end surface of the conductor exposed from the jacket; and the jacket having an enlarged curved portion next its extremely thin end wall, the outer surface of which enlarged portion has a curvature extending outwardly and away from the extremely thin end wall of the jacket.

4. An electrode for a liquid detector of wireless telegraphy oscillations, which consists of a glass tube, and a conductor inserted therein, the wall of one end of the tube being straight and of slight thickness, the straight wall continuing into an abrupt taper and the abrupt taper extending into a more gradual taper which terminates in an end having a wall of less thickness than the wall of the straight part of the tube, and having an opening for the end surface of the conductor, the thickness of the extreme flush end wall of the tube being extremely slight, the proximate lateral surfaces of the tube and conductor being sealed together near to and next their ends, leaving the flush end surface of the conductor exposed from the end of the extremely thin wall of the tube; and the tube having an enlarged portion above its extremely thin end wall, the outer surfaces of which portion has a

curvature extending outwardly and away from the extremely thin end wall of the jacket.

5. The method of making an electrode for a detector of wireless telegraphy oscillations or other feeble electrical impulses, which consists in inserting a conductor into a glass tube having an extremely thin wall, so that the end of the conductor is substantially flush with the end of the tube; and then sealing the parts together and forming a globule by successive short applications in a flame, of the said flush ends of said parts.

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