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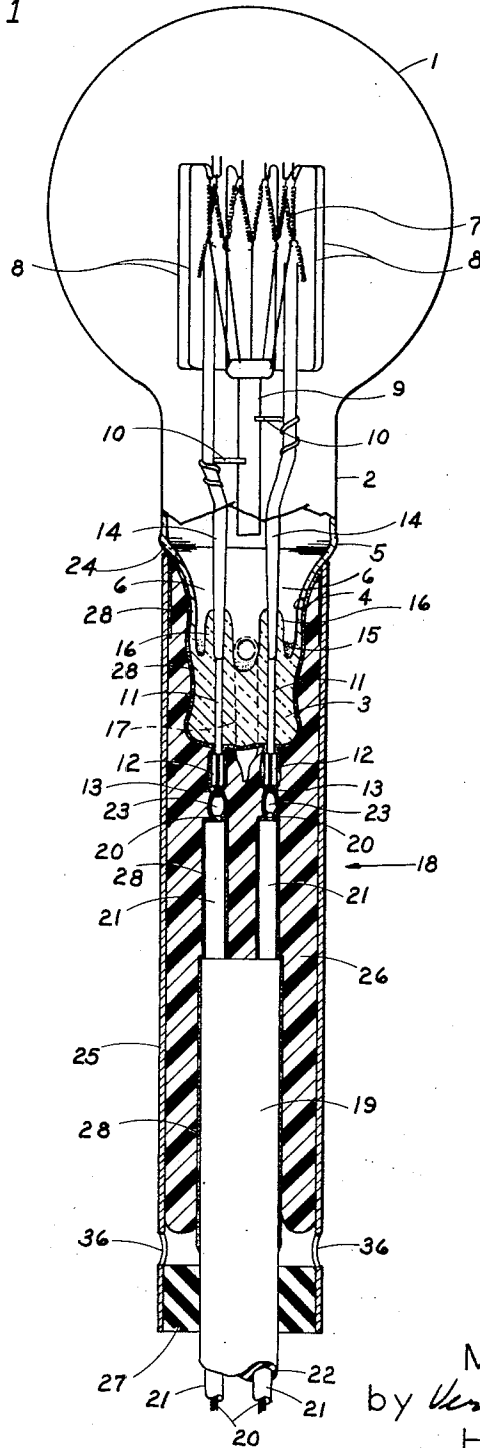
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WATERTIGHT BASE CONNECTION FOR ELECTRIC LAMPS

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2 Sheets-Sheet 1

Fig. 1



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Fig. 2

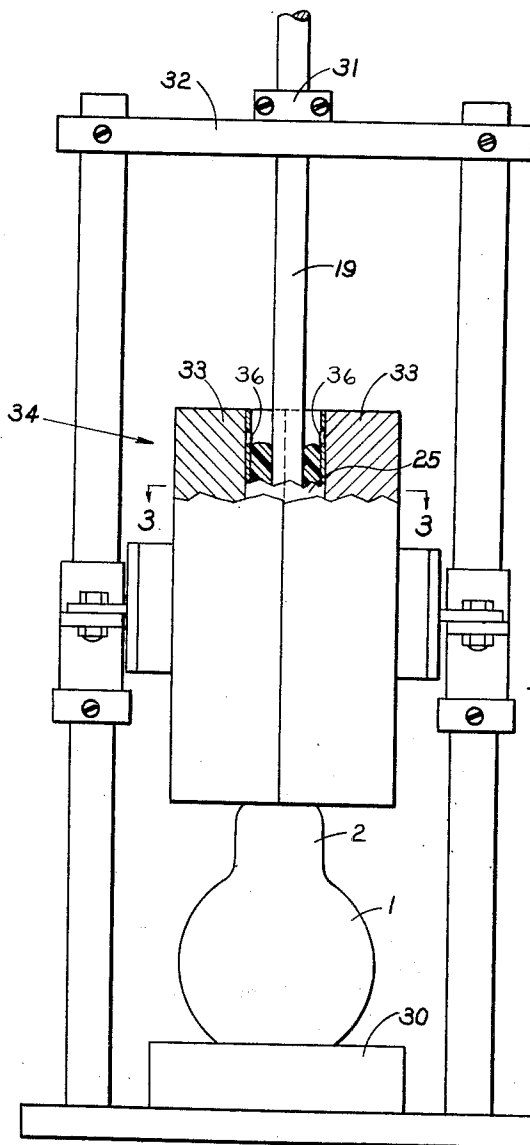
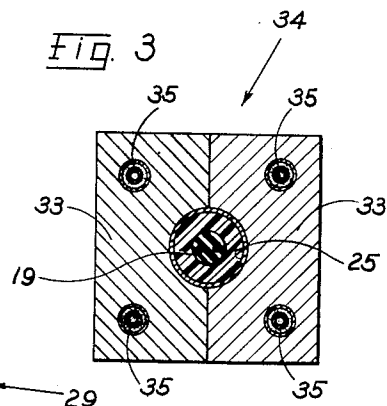


Fig. 3



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WATERTIGHT BASE CONNECTION FOR ELECTRIC LAMPS

Max E. Arnold, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York; patent dedicated to the Public insofar as it relates to lamps and lamp parts to the extent stated in document recorded in the United States Patent Office, January 4, 1954, Liber U-238, page 394

Application September 20, 1952, Serial No. 310,673

2 Claims. (Cl. 174—50.52)

My invention relates in general to electric incandescent lamps, and more particularly to a watertight base construction and to a basing method therefor.

Electric incandescent lamps customarily employed for underwater illumination purposes by deep-sea divers require a watertight connection between the lamp and a rubber-covered current-supply cable the conductors of which are electrically connected exteriorly of the lamp to the lead-in conductors thereof. The operating specifications for such underwater lamps usually require the watertight connection to be impermeable to water under a pressure of the order of 300 p. s. i. and to withstand a hydrostatic pressure of the above magnitude for a period of at least one to two minutes.

Heretofore, these watertight connections for such underwater service lamps have been formed by manually wrapping and building up raw rubber around the lamp-to-cable junction and around the neck end of the glass envelope to form a solid cylindrical-shaped mass of rubber over which a brass sleeve is then forced. Such a manufacturing procedure, however, is not only time-consuming but, in addition, occasionally resulted in breakage of the glass lamp seal.

It is an object of my invention, therefore, to provide an electric lamp provided with a current-supply cable connected thereto by a watertight connection which will effectively withstand the hydrostatic pressure normally encountered in service and which is relatively simple to construct.

Another object of my invention is to provide a method of basing an electric lamp to form a watertight connection between the lamp and a current-supply cable therefor.

In accordance with the invention, a watertight base connection of the above-described general character is formed by a molded solid mass of an insulative elastomeric plastic compound, consisting essentially of a plastisol, which compound substantially fills a metal base tube positioned around and projecting from the neck of the lamp envelope and completely embeds the neck end of the lamp envelope as well as the lamp-to-cable connection, the plastic compound being intimately and firmly bonded to the embedded parts of the lamp and cable, and to the inner end portion only of the surrounding metal tube, so as not to leave any voids or cavities therebetween, by a layer of an adhesive material.

Further objects and advantages of my invention will appear from the following detailed description of a species thereof and from the accompanying drawing.

In the drawing,

Fig. 1 is an elevation, partly in section, of an electric incandescent lamp provided with a watertight base connection comprising my invention.

Fig. 2 is an elevational view, partly in section, illustrating the manner of making the watertight base connection according to the invention.

Fig. 3 is a section on the line 3—3 of Fig. 2.

Referring to Fig. 1, the electric incandescent lamp there

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shown comprises a sealed light-transmitting glass envelope or bulb 1 having a neck portion 2 terminating at its outer end in a stem press 3, the outer reduced diameter end portion 4 of the bulb neck 2 being constituted by a so-called inverted lamp stem which is sealed to the bulb 1, as indicated at 5, with its press portion 3 disposed outwardly of the lamp bulb instead of inwardly thereof as is usually the case with incandescent lamps. Sealed through the stem press 3 are a pair of relatively heavy, rigid lead-in conductors or wires 6, 6 which are connected, interiorly of the bulb 1, to a filament 7 such as a coiled tungsten wire draped over and supported at a plurality of points intermediate its length by anchor wires 8 extending from an insulative member 9 such as a glass arbor which is in turn supported by wires 10 fastened to the lead-in conductors 6.

The lead-in conductors or wires 6 are of multisection construction comprising tungsten seal or press lead portions 11 which are embedded and sealed in the stem press 3 and project a short distance outwardly therebeyond where they are connected by nickel clips 12 to outer lead portions 13 in the form of stranded conductors the individual strands of which may consist of nickel-plated copper wire. The tungsten press lead portions 11 are butt-welded at their inner ends to inner lead portions 14 composed of heavy nickel wire. The bulb 1 preferably contains a small quantity of loose tungsten powder 15 for scrubbing off and removing from the inner wall of the bulb the blackening particles which are normally deposited thereon during the operation of the lamp by the vaporization of the filament 7. To prevent short-circuiting of the inner leads 14 by such loose tungsten powder 15, the inner leads 14 may be encased in a sleeve 16 of glass extending for a short distance inwardly of the bulb from the stem press 3. The bulb 1 is exhausted and gas-filled through an exhaust tube 17 projecting from the stem press 3 and communicating with the interior of the bulb through a passageway in the stem press. After exhaustion and gas-filling, if any, of the lamp bulb 1 through the exhaust tube 17, the latter is then tipped-off adjacent the stem press 3 to thereby hermetically seal the bulb.

Mounted on the neck end 2 of the bulb 1 is a base construction 18 according to the invention, the said base construction affording a watertight connection with a rubber-covered current-supply cable 19 for the lamp. The cable 19 comprises a pair of stranded conductors 20, 20 provided with individual insulative coverings 21, 21 and embedded in a common outer rubber covering 22. The cable conductors 20, 20 are electrically connected to the outer lead portions 13, 13 of the lamp lead-in conductors 6, 6, as indicated at 23. This connection 23 is customarily made by spreading apart the strands of the cable conductors 20 at the end thereof to be connected to the lamp, lapping the open strands of the cable conductor 20 over the outer lead 13 of the respective lead-in conductor 6 so as to overlap and extend alongside the latter for a short distance of, for example, 5 mm. or so, and then wrapping a copper wire around the overlapped strands of the cable conductor 20 so as to bind them to the outer lead 13 of the lamp, and then soldering together the overlapped strands of the cable conductor 20 and the lamp outer lead 13.

Extending over and enclosing the stem end portion 4 of the bulb neck 2, and abutting against a shoulder 24 formed thereon, is a rigid metal sleeve or tube 25 of a non-corroding or non-rusting character, such as brass for instance. The metal tube 25, which is of a diameter such that its wall is spaced from the enclosed stem end portion 4 of the bulb neck 2 when axially aligned therewith, extends outwardly beyond the stem press 3 a distance sufficient to enclose the exposed portions of the lamp outer

leads 13 and cable conductors 20 as well as the outer rubber insulation covering 22 of the cable 19 for a short distance beyond the exposed individual conductors 20 of the cable. In accordance with the invention, the metal tube 25 is filled with a solid mass 26 of a molded plastic insulating material which completely fills the tube 25 and embeds all the parts of the lamp and cable enclosed thereby except for a short length of the cable inwardly from the outer end of the tube 25, which portion of the cable is supported in place in the tube by a rubber bushing 27 fitted in the end of the tube. The plastic insulating material 26 is firmly bonded to the parts of the lamp and cable encased thereby, as well as to a short length of the outer metal tube 25 at the bulb-enclosing inner end thereof, by a layer 28 of a suitable adhesive or primer material such as described hereinafter.

According to the invention, the plastic insulating material 26 comprises an elastomeric plastic compound which consists of the fused product of any one of the class of compounds generally referred to as plastisols and consisting of dispersions of finely divided vinyl acetate-chloride resins (i. e., copolymers of vinyl acetate and vinyl chloride) or high molecular weight polyvinyl chloride resins, in suitable liquid plasticizers. The flexibility of such plastisol compounds varies from a soft rubbery state to semi-rigid depending on the type and amount of plasticizer used. For the purposes of the invention, the type and amount of plasticizer used preferably is such as to impart to the final fused plastisol compound a condition which is intermediate a soft rubbery and a semi-rigid state. However, it should be understood that any elastomeric plastisol is entirely suitable for the intended purpose, ranging from a soft rubbery to a semi-rigid state. A specific example of a plastisol which has been found to be particularly suitable is that commercially known as Ameran Compound No. 370-34699 and marketed by American Anode Inc. of Akron, Ohio. This particular plastisol material comprises a colloidal suspension of a finely divided high molecular weight polyvinyl chloride resin commercially known as Geon 121 in a plasticizer consisting of dioctyl phthalate, and containing in addition a stabilizer consisting of dibasic lead phosphite.

The primer or adhesive material employed for the binder layer 28 may be any suitable material which will firmly bond the plastic compound 26 to the glass of the lamp bulb 1 as well as to the various metal parts to which the plastic compound is to be bonded. A primer material which has been found particularly suitable for this purpose is that commercially known as Unichrome Primer 219-PX marketed by United Chromium, Inc. of New York, New York, and which is a pigmented, thermoplastic adhesive based on synthetic resin components, in a mixture of ketone-type solvents. Other primers may also be prepared using mixtures of vinyl-chloride copolymers and Hycar rubber.

To produce the above-described base construction 18 according to the invention, and insure that the plastic compound 26 not only completely embeds but intimately surrounds and contacts the parts of the lamp and cable enclosed thereby so as to be entirely free of any voids or cavities therebetween and thus provide a watertight connection which will withstand the hydrostatic pressures encountered in service, the parts of the lamp bulb 1, the lamp and cable conductors 12, 13 and 20 and the cable proper 19 which are subsequently embedded in the plastic compound 26, as well as the inside wall of the outer metal tube 25 for a short distance only (around $\frac{3}{4}$ inch or so) inward from the end thereof which is to enclose the bulb neck 2, are all coated with a thin layer 28 of an adhesive or primer material capable of bonding the plastic compound to the said coated parts. The primer or adhesive coating 28 is then dried and baked in a suitable manner, as by heating the primer coated parts in a hot air oven. The metal tube 25 is then slipped over the cable 19 until its interiorly primer-coated end surrounds the stem

portion 4 of the bulb neck 2 and abuts against the shoulder 24 thereon. The bulb 1 with its attached cable 19, and with the metal tube 25 positioned around its neck portion 4, is then supported in an upright neck-up position in a fixture 29 as shown in Fig. 2, the bulb 1 resting on a bottom support member 30 and the cable 19 being held fast in a suitable clamp or retaining clip 31 mounted on an upper cross bridge 32 of the fixture. The two laterally separable halves or sections 33, 33 of a solid aluminum heater or oven 34, in which oven sections electric heating elements 35 are embedded, are then closed around the metal tube 25 to support and position it on the bulb neck 4 in longitudinal alignment therewith. The plastisol compound 26, in the form of a viscous liquid, is then introduced into the upper end of the metal tube 25 up to a level sufficient to embed at least a short linear extent of the outer insulation 22 of the cable 19 contiguous to the lamp-to-cable connection 23, but short of the apertures 36 which are provided in the tube 25 near its outer end for the purpose of allowing water to enter and equalize internal and external pressures during the use of the lamp. The plastisol compound 26 is then heated and baked in the oven 34, through energization of its heating units 35, to the fusion temperature of, and for a sufficient period of time to effect the fusion of the plastisol compound 26. While the fusion temperature of various plastisol compounds will vary somewhat depending on the particular ingredients therein, the fusion temperature of such compounds is generally of the order of from 350 to 375 degrees Fahrenheit. With the particular heating arrangement 34 shown and described in Figs. 2 and 3, a heating or baking time of around 40 minutes is required to heat the plastisol 26 to its fusion temperature and effect the necessary fusion or curing thereof.

During the heating and baking of the plastic compound 26 to effect the curing or fusion thereof it undergoes a certain amount of expansion. Upon subsequent cooling, the plastisol shrinks an amount comparable to its said expansion. If the entire portion of the inner wall of the metal tube 25 which is contacted by the plastisol 26 is provided with a primer or adhesive layer 28, then the plastisol, because of its above-mentioned shrinkage upon cooling, adheres to the metal tube 25 rather than to the parts of the lamp and cable enclosed by the plastisol. As a result, the plastisol 26 pulls away from the parts of the lamp and cable enclosed thereby and leaves voids or cavities along the cable 19 and the interconnected conductors 12, 13 and 20, as well as around the stem press 3, such voids or cavities then causing failure of the connection to withstand the required hydrostatic pressures without leakage. In addition, the contraction of the plastisol in such case results in frequent breakage or cracking of the stem press 3. However, by omitting, in accordance with the invention, the internal primer or adhesive layer 28 from all but the very inner end portion of the metal tube 25, i. e., by confining the primer or adhesive layer 28 to only that portion of the inner end of the tube 25 which surrounds that section of the bulb neck portion 4 intermediate the stem press 3 and the shoulder 24, the plastisol compound 26, on cooling and contracting, is free to pull away from the outer metal tube 25 so that it then remains firmly adherent to and in intimate contact with the embedded parts of the lamp and cable, thereby avoiding the formation of any voids or cavities therein adjacent the embedded parts and at the same time eliminating the cracking of the glass stem press 3. A watertight connection is thus produced which will effectively meet and withstand the hydrostatic pressures which are normally encountered in service.

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

1. An electric lamp comprising a glass bulb having a tubular neck provided with an outer end portion of reduced diameter forming a shoulder on said neck and terminating outwardly in a press, lead-in conductors sealed

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through said press and extending outwardly therefrom, a current supply cable comprising conductors electrically connected to said lead-in conductors and having an insulative covering, a metal tube butting against said shoulder on said neck with an inner end portion thereof around the reduced diameter end portion of said neck, said tube enclosing said press, the connections between said lead-in conductors and said cable conductors and extending outwardly beyond said connections to enclose the said insulative covering of said cable for a short distance back from said connections, a solid mass of elastomeric insulative plastic compound filling said tube and intimately surrounding so as to embed therein the reduced diameter portion of said neck, said press, said conductors and also said insulative cable covering, and a coating of an organic primer material on the parts of said lamp embedded in said mass and bonding said mass to said lamp parts, and a similar primer coating on the inner wall of the inner end portion only of said tube around the reduced diameter portion of said neck and bonding the plastic compound to that portion only of the tube while leaving the entire remainder of the mass of plastic compound

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in the tube unbonded thereto so as to be free to contract during the heating and curing of the compound whereby to prevent the formation of voids between the compound and the lamp parts embedded in said mass.

2. An electric lamp as set forth in claim 1 wherein the said elastomeric insulative plastic compound comprises a plastisol.

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