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HERMETICALLY SEALED ELECTRIC INSULATOR

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FIG. 1.

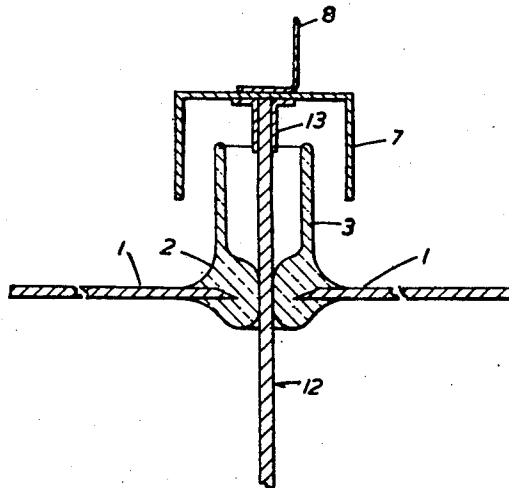
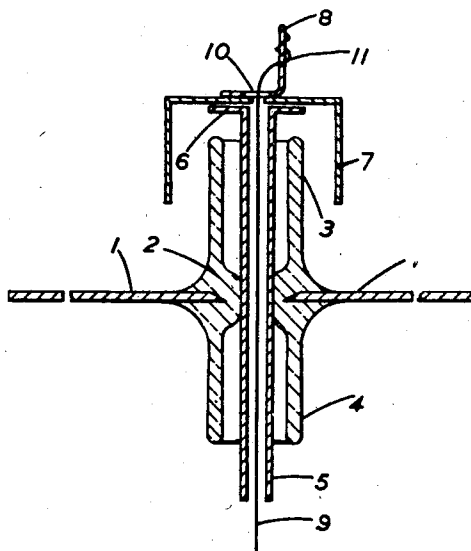


FIG. 2.



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HERMETICALLY SEALED ELECTRIC
INSULATOR

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6 Claims. (Cl. 174-151)

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The present invention relates to insulated terminals for electrical elements or apparatus, and is particularly concerned with a type of terminal adapted for an element intended to be enclosed in a hermetically sealed case. Such terminals may, however, also be used when hermetic sealing is not a requirement.

Such insulated terminals have, of course, been previously used for elements such as condensers, inductances, resistances, transformers and the like which are to be assembled in air-tight cases, either exhausted or filled with a gas at a suitable pressure, so that the elements will not be affected by oxidation, or by changes in atmospheric humidity, or the like. This arrangement avoids difficulties associated with the use of sealing compounds which often given considerable trouble.

In these terminals, metal-to-glass seals of well known type have previously been used. Such terminals have, however, frequently suffered from defects due to mechanical weakness of the seal, and there is often risk of damage to the seal occasioned by the heating of the terminal when making soldered connections thereto.

The principal object of the present invention is to provide a terminal in which these defects are overcome, and in which, furthermore, a long leakage path is provided over the insulating material. This is of particular importance where such a terminal is used under conditions of high voltage, and/or of high and variable atmospheric humidity such as are encountered with air-borne or sea-borne electrical equipment. Hermetically sealed terminals of known types do not generally provide a long leakage path, as the insulating material usually comprises a relatively small bead or rod of glass or the like. Changes of humidity may result in the deposition of a film of moisture on the insulator, and the insulation resistance may be seriously reduced.

According to the invention, there is provided an insulated electrical terminal comprising a tubular member of fusible insulating material sealed through an aperture in a metal sheet, and a conductor member smaller than the internal bore of the said tubular member passing co-axially therethrough and being sealed to the internal surface of the said tubular member through a constricted portion thereof.

The invention also provides an insulated electrical terminal comprising two tubes of fusible insulating material arranged co-axially end-to-end, and a conductor member smaller than the internal bore of the said tubes passing co-axially therethrough, the two tubes being sealed to a

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metal sheet on opposite sides thereof and being also sealed together through an aperture therein, the said tubes being further sealed around the said conductor member.

According to the invention also, the terminal comprises a conductor passing co-axially through a tube of fusible insulating material of larger internal diameter than the said conductor, the said tube being sealed to a metal sheet through an aperture in the said sheet, and around the said conductor.

In its broadest aspect, the invention consists in an insulated electrical terminal comprising a conductor member, a metal sheet having an aperture, and an insulator of fusible material providing a long electrical leakage path between the said conductor and at least one side of the said sheet, the said conductor member being sealed through the said aperture by the said insulator.

Two embodiments of the invention will be described with reference to the accompanying drawing, of which Figs. 1 and 2 give sectional views.

In Fig. 1 a metal sheet 1 is fragmentarily shown and may be of any convenient size. The sheet is provided with a circular aperture with feathered edges through which is sealed a glass tubular member or detail 2. This detail is made by sealing through the hole from one side of the plate 1 a short length of glass tube 3. Through the centre of the tube 3 is passed a conductor member comprising a metal rod or wire 12 which is sealed to the internal surface of the tube at the constriction formed in the neighbourhood of the aperture in the plate 1. The external diameter of the rod 12 is smaller than the internal diameter of the glass tube 3, so that it will be out of contact with it except at the seal.

The seal may be made by first softening the end of a piece of glass tube 3 and pressing it through the aperture so that the glass flows around the feathered edge, leaving the central channel still open. The rod 12 may then be passed through, and the glass reheated, so that it flows around the rod thus completing the seal. Alternatively, the rod 12 and the plate 1 may be suitably held in the proper positions and the glass may be sealed simultaneously to both at one heating.

The rod may be provided at the upper end with a ferrule 13 to which is soldered or otherwise secured an inverted metal cup-shaped cap 7 resembling, for example, the cap terminal often used for the anode of a thermionic valve.

Alternatively, the ferrule may be omitted and

a flat nail-head may be punched or otherwise formed on the end of the rod to provide a suitable soldering flange.

The cap 7 extends downwards and shrouds without touching the upper end of the tube 3. A terminal tag 8 is secured to the outside surface of the cap 7.

The details of the arrangements may be varied in a number of ways. For example, the tag 8 could be omitted, and in that case the external connection could be made to the cap, if desired, by means of a clip terminal such as is used for the anode lead of the type of valve mentioned above. Furthermore, the cap 7 could be omitted altogether, the upper end of the rod 12 being used for connection to the external wire.

Suitable materials for the seal components would be lime-soda glass for the tube 3 and copper for the sheet 1 and rod 12, though other fusible material and metals which seal satisfactorily together could be used.

It will be evident that the tube 3 provides a very long leakage path between the rod 12 and sheet 1. Furthermore, the cap 7 provides mechanical protection for the tube 3 and also an appreciable radiating surface for the heat produced when soldering an external lead to the tag 8. The heat has also to travel a considerable length of the rod 12 before reaching the seal, and for both these reasons, the seal is unlikely to be dangerously heated by the soldering operation. The heating of the seal is also minimised by the metal sheet 1 which forms a good heat conducting and radiating surface tending rapidly to cool the seal.

The sheet 1 may form the lid, or part of the lid, which encloses a container for an electrical element. If the joint between the sheet 1 and the rest of the container is properly soldered, or otherwise hermetically sealed, then the whole container will be hermetically sealed and may be exhausted, or filled with a dry gas. It is to be noted that the container could be an envelope of glass or other transparent material, for example, the sheet 1 being sealed thereto round the edges to close the envelope by a metal-to-glass seal in the well known way. This would render the contents visible. The sheet 1 could clearly be provided with any number of terminals of the type described each sealed through a corresponding aperture provided in the sheet.

Fig. 2 shows an alternative type of insulated terminal according to the invention. It differs from Fig. 1 in two principal particulars. First, a second glass tube 4 is sealed on from the other side of the plate 1 providing a long leakage path on both sides of the plate, and forming a glass tubular detail 2 which can be considered as having been sealed through the aperture. Secondly, the rod or wire 12 is replaced by a hollow metal tube 5 spun over at the upper end to form a flange 6 for soldering to the cap 7. Holes are provided for the passage of a conductor wire 9 which is soldered or otherwise secured to the tag 8 at 11. The wire 9 passes through the tube 5 and is intended to be connected to the electrical element inside the container (not shown). The holes 10 are afterwards closed with solder.

The wire 9 is not essential, and may be omitted, in which case no holes 10 are necessary. Likewise the tag 8 can be omitted if desired.

The arrangement of Fig. 2 is rather less simple than that of Fig. 1, and the existence of the soldered joints at the top of the tube 5 might be a

source of difficulty in securing and maintaining a vacuum inside the container.

It is to be noted that although in Fig. 2 a long leakage path has been provided on both sides of the sheet, this will very often be strictly necessary only on one side, on the outside of a sealed container, for example. In such a case the tube 4 can be omitted, and the seal with the sheet 1 and the tube 5 can be made from the outside only, as shown in Fig. 1. Furthermore, if desired, a glass tube like 4 may be added on the underside of the plate 1 in the arrangement of Fig. 1, as described with reference to Fig. 2.

It is to be noted that to simplify the process of making the various soldered joints, the melting points of the solders used may be graded in such manner that accidental unsoldering of joints already made during the making of later joints is prevented.

It is further to be noted that the disc 1 and central conductor 5 (or 12) could be of different metals, and the tubular member 2 could be composed of two different types of glass suitable for sealing respectively to the two metals. Thus, the disc 1 could be of copper, and a preliminary annular button of lead glass could be sealed thereto through the aperture. The central conductor could then be of some other metal or alloy, for example, chrome-iron, and it could satisfactorily be sealed through the end of a piece of lime or soda glass tube. The conductor may now be passed through the centre of the button, and the two glasses sealed together forming a complete insulating member looking like 2 of Fig. 1. A double ended insulator could be obtained, if desired, by sealing a second glass tube of either kind of glass to the button on the other side of the disc.

In cases where very severe humidity conditions are expected, the leakage path can still be further increased without making the tube 3 inconveniently long by providing a second glass tube (not shown) of larger diameter co-axially surrounding the tube 3 and sealed thereto at the lower end. The cap 7 would then preferably be suitably increased in diameter so as to surround the larger tube without touching it. The same arrangement could also be adapted on the underside of the sheet 1, though it is very unlikely to be necessary, particularly when a sealed container is used. Obviously the leakage path could be still further increased by using a third larger glass tube sealed in the same way to the second tube, and so on.

It should be noted that insulated terminals of the kind described are very suitable as cable-head terminals for a multi conductor cable. In this case the cable head would be hermetically closed by a metal sheet provided with the desired number of terminals sealed therethrough in the manner explained, and each of these terminals would be connected on the inside to one of the cable conductors. Owing to the long external leakage path of the terminals, such a cable head would have a high insulation under humid conditions.

What is claimed is:

1. A terminal insulated from a metal sheet through an aperture of which said terminal passes, comprising a tubular member of fusible insulating material sealed to said sheet through said aperture, a conductor member smaller than the internal bore of said tubular member passing co-axially therethrough and being sealed to the internal surface of said tubular member at a constricted portion thereof adjacent said seal

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between said tubular member and said sheet, said constricted portion being located a substantial distance from both ends of said tubular member, and a metal cap member attached to the external end of said conductor member and having a skirt shrouding the end of said tubular member, the internal diameter of said skirt being larger than the external diameter of said tubular member.

2. A terminal according to claim 1 in which the said conductor member is a metal tube, and further comprising a conducting wire electrically connected to the said cap and passing through the said metal tube.

3. An insulating electrical terminal for making an electrical connection through a metal sheet having an aperture therethrough comprising a tubular member of fusible insulating material and a conductor member passing coaxially through said tubular member and having an external diameter which is smaller than the internal diameter of said tubular member, said tubular member being sealed to said metal sheet through said aperture and around the said conducting member, said seal being a common seal for said sheet and said conductor member and being located at a substantial distance from the ends of said tubular member.

4. A terminal according to claim 3 in which the said conductor member comprises a solid metal rod or wire.

5. A terminal according to claim 3 in which the conductor member and the sheet are composed of different metals or alloys, each being sealed to a particular type of fusible material

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forming portions of the tubular member at the respective points of sealing.

6. An insulated electrical terminal for making an electrical connection through a metal sheet having an aperture therethrough comprising, two tubes of fusible insulated material arranged coaxially end to end, and a conductor member smaller than the internal bore of the said tubes and passing coaxially therethrough, the two tubes being sealed at one end to said metal sheet on opposite sides thereof and being also sealed together through the aperture therein, the said tubes being further sealed around said conductor member at a point a substantial distance from the unsealed ends of said tubes.

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