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Method for making multiple glass–tungsten rod seals

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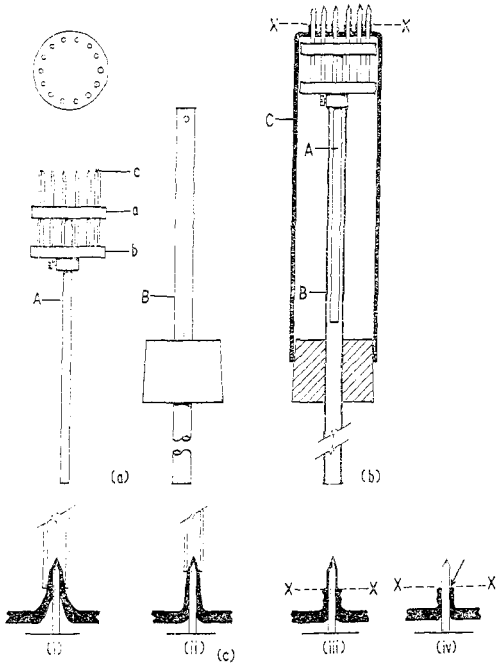
A simple method for sealing suitable metal rods into a glass envelope is described. This technique is especially recommended for multiple seals, used for experimental purposes.

Recent activities in the ultra-high vacuum field have necessitated the development of components involving multiple glass-to-metal seals. For commercial purposes the method of pressing the lid in a graphite mould filled partly with glass powder and then heating by an induction coil heater has been used with success. For laboratory purposes, however, this process is rather cumbersome.

A method for manufacturing such lids in lampwork has been described (Steel 1959). The suggested graphite jig is less difficult to make, but the construction process itself is somewhat tedious. Besides this, rather fierce heating in the flame will be necessary. Tungsten vapour and other impurities may be introduced between the pressed seals. Enclosed pinholes are also hard to avoid.

This note describes a simple method of construction which does not involve moulding equipment. The method has been applied in the development of an omegatron tube containing 14 tungsten rods, 1 mm in diameter, sealed into a Pyrex tube 30 mm in outside diameter. The glass–metal seals had to withstand frequent outgassing temperatures of up to 400° c.



A simple holder (according to (*a*) in the figure) A + B is easily constructed. It consists of one fixed perforated disk a, preferably made of stainless steel, coated with 'Aquadag'. The number and position of the holes is decided according to the required number of rods and their position. Disk b is not perforated, but movable with an arresting device. B consists of a glass tube with cork. In the figure (*b*) shows the holder inserted into the glass tube. Tungsten rods c are pointed on the upper end and can also be prepared with sleeves in which case B is used as a blowing tube. If metal rods are sealed without sleeves, B is used as an inlet for inert gas to avoid over-oxidation of the rods.

When the flat end of the tube is sealed, the glass tube is pushed gently, thus pressing the rods into softened glass. To achieve a good wetting contact between glass and metal, a brass or copper tube, approximately 4 mm in inside diameter (according to whether it is sealed with or without sleeves), is used to push the rising glass back against the rod. This is repeated until the first disk reaches the flat glass section. Then the upper parts of the rods are heated and another piece of tubing of approximately 2 mm in inside diameter is used and the surrounding glass thinned, thus forming a little bead at X (see (*b*)). (Care must be taken, however, that the metal remains covered with glass.)

The finished seal is reheated and slightly flame-annealed. When the seal has been cooled down, the upper section X is immersed in a 10% hydrofluoric acid bath which will etch off the surrounding glass. As the bond of the glass–metal is much more readily attacked by hydrofluoric acid than the glass itself, the end of the glass–metal seal which is usually most strained is largely removed (arrow in (*c*) (iii)).

If the surrounding glass is too uneven or the metal becomes uncovered the etched section (arrow) may become too deep. The progress of the wetting process—glass to metal—is shown in (*c*): (i), (ii), (iii) ((iv) after etching).

As only the outside surface of the glass envelope is heated, no foreign matter from the gas, metal vapour, etc., can be introduced into the seal itself.

Pinholes very rarely occur in seals made by the methods described.

References

STEEL, E., 1959, *Fusion*, **6**, 20.