

Jan. 7, 1941.

F. REYNOLDS

2,227,511

SEAL AND METHOD OF MAKING THE SAME

Filed Aug. 30, 1938

Fig. 1.

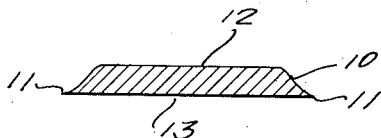


Fig. 2.

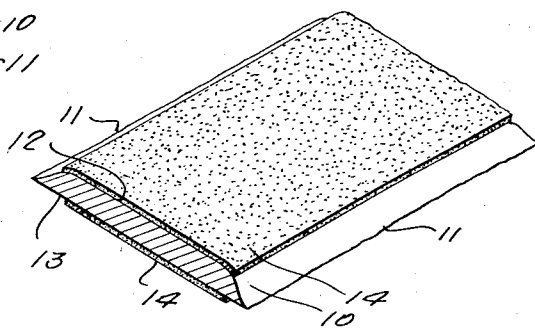


Fig. 3.

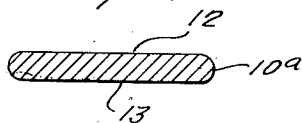


Fig. 4.

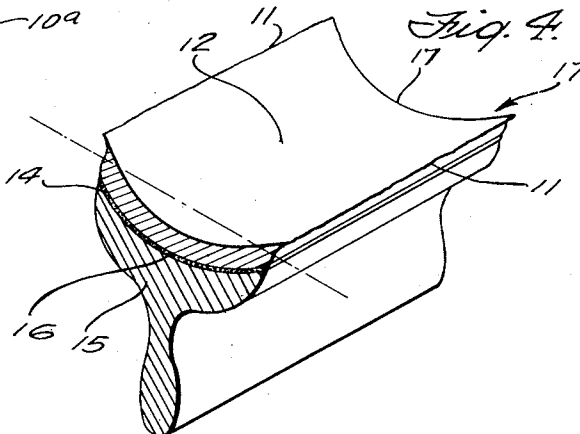
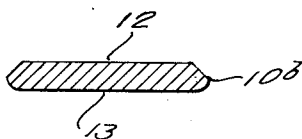


Fig. 5.



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## UNITED STATES PATENT OFFICE

2,227,511

## SEAL AND METHOD OF MAKING THE SAME

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Application August 30, 1938, Serial No. 227,534  
In Great Britain August 30, 1937

11 Claims. (Cl. 49—81)

This invention relates to pressure-tight seals (including vacuum or reduced pressure as well as superatmospheric pressure) between thin metal parts and vitreous materials. More particularly this invention relates to seals for electric current conductors or other thin metallic parts which are a part of or pass through the walls of pressure-tight vessels of fused quartz glass or other vitreous materials and which are designed to accommodate relatively wide temperature fluctuations.

Pressure-tight seals for current leads into fused quartz glass in which thin metal strip forms the seal to the fused quartz glass have been known for a long time; the metals tungsten, molybdenum and tantalum, for example, may be fused into fused quartz glass to form a vacuum-tight seal providing the metal is in the form of a very thin strip not greater than 0.02 mm. thick. The width of the strip is not important and may be chosen according to requirements as regards the electric current which the seal will be required to carry, for example, a seal can be made using a piece of molybdenum strip 0.02 mm. thick and 8 mms. wide and such a seal will carry 20 amperes without becoming unduly hot.

It has been found, however, that these seals are not always pressure-tight, that is to say, out of a number of seals made some may be found to be quite pressure-tight whilst others may not be pressure-tight.

It has already been suggested that the reason why some of the seals are not pressure-tight is because of leakage of air along lateral grooves which may be present on the surface of the strip, the grooves having been produced in the manufacture of the strip. It has further been suggested that by roughening the surface of the strip by treating with fluid which attacks the metal of which the strip is made, the physical characteristics of the grooves are changed. Seals made with the strip after the surface has been roughened in this way will not leak. This method has the disadvantage, however, that treatment with the fluid to roughen the surface necessarily reduces the thickness of the strip and consequently its current carrying capacity. It appears, moreover, that the smooth surface and accurately predetermined thickness produced by the mechanical working in the manufacture of the strip is superior to the etched surface so far as the central flat portion of the strip is concerned.

Surprisingly, although in general the seal will be more perfect, the thinner the ribbon or foil,

we have found by experiment that the presence of a burr along the edges of the strip is frequently the sole cause of failure of such seals to be pressure-tight. Our tests have shown that if a burr is present along the edges of the strip the fused quartz glass will eventually crack adjacent to the burr when the seal has cooled down.

The action appears to be that as the seal cools down after making, the metal strip shrinks more than the surrounding fused quartz glass, but so long as the metal strip is sufficiently thin, and the edges are not burred the stresses set up in the fused quartz glass, due to this differential expansion, are not great enough to cause its fracture. If, however, the edges of the strip are burred the burr forms an additional anchorage for the strip and a line of weakness in the fused quartz glass and the resulting inward pull by the burr on the fused quartz glass on the cooling down of the seals produces additional localized stresses which result in fracture of the fused quartz glass along the line of the burr.

It is accordingly an object of the present invention to provide a seal in which localized stresses are avoided and which may be heated and/or cooled through relatively wide temperature ranges without failure or leakage of the seal between the metal and the vitreous material.

According to my invention, the burr may be removed by abrading or polishing the edges of the strip, or the edges of the strip may be subjected to acid treatment.

One method of carrying out my invention in practice will now be described by way of example. A length of molybdenum strip, hereinafter referred to as "the strip," 5 mms. wide and not greater than 0.02 mm. thick is coated on both sides with paraffin wax or with an acid resisting paint, the narrow edges of the strip being left uncoated, if the strip is coated by dipping into the wax or paint, whichever is used, the wax or paint can be removed from the narrow edges of the strip by wiping. The strip is then dipped into any suitable acid which will dissolve molybdenum, such as aqua-fortis and left in it for about 5 minutes or for a length of time which has previously been found necessary by trial, to dissolve sufficient off the edges of the strip to remove the burr, the strip is then removed from the acid and washed. The wax or paint is then removed and the mechanically worked surface of the strip will be found to be preserved as originally. The strip may then be cut into suitable lengths for making the seal (if it was not cut to

length before the acid treatment) and the process of sealing the strip into the fused quartz glass may be carried out as is now well-known by those skilled in the art. The strip may be sealed into the fused quartz glass for only part of its length so that its ends extend beyond the seal to permit an electrode and/or conducting wire or wires to be attached to it or the strip may be suitably attached to an electrode and/or conducting wire or wires before the strip is sealed into the fused quartz glass, in the latter case the fused quartz glass may be sealed over the full length of the strip and on to the ends of the electrode and/or conducting wire or wires.

In the accompanying drawing I have illustrated a preferred embodiment as described above and an alternative as will be described below. In the drawing:

Figure 1 is a cross sectional view of a ribbon as manufactured prior to my invention and as used for purposes of the prior invention showing the ribbon, of course, greatly enlarged in dimensions and with its scale distorted for better illustration;

Figure 2 shows in perspective a ribbon prepared for etching treatment;

Figure 3 is a view similar to Figure 1, showing the ribbon after etching;

Figure 4 shows in perspective a ribbon backed and prepared ready for grinding or polishing; and

Figure 5 is a view similar to Figure 1 showing the ribbon after grinding or polishing treatment.

Figures 1 to 3 inclusive illustrate particularly the example just described above. In Figure 1 the strip is shown in cross section, its thickness greatly exaggerated. The shape of the edges 10 and the position and shape of the burrs 11 will, of course, depend primarily upon the method used for the manufacture of the strip and particularly for cutting the edges. That shown in the drawing is considered only as one example.

As shown in Figure 2, the central smooth surfaces 12 and 13 formed during the process of manufacture of the strip are coated with a wax coating 14 which extends to the edges 10 but leaves at least the burr 11 projecting uncoated with the wax. When this coated strip is dipped in or painted with an acid the acid attacks the exposed burrs 11 while leaving the central surfaces 12 and 13 untouched. The result will be substantially as shown in Figure 3 with the edges 10a being smoothly rounded and etched by the acid, whereas the surfaces 12 and 13 remain substantially the same as in Figure 1.

Removal of the burr by treatment with acid as above described, is generally preferable to its removal by abrasion on the score of cost and ease of carrying out. When, however, the burr is to be removed by abrasion, one method of doing this is to mount a length of the strip by the aid of suitable adhesive materials, such as wax, on to a concave metal surface so that the edges of the strip are raised above its middle, the burr on the edge of the strip may then be ground away, for example, by contact with the flat side of a fine grinding wheel or hone leaving the edges of the strip more or less tapered.

In Figures 4 and 5 I have shown by way of illustration one example as described above. The backing 15 shown in Figure 4 is provided with a concave face 16 to which the thin strip or ribbon 17 is cemented with its edges approximately coincident with the edges of the back and held above the central face 12 by reason of the concavity. When this is ground and/or polished on

a flat abrasive surface the result is to remove the burrs 11 from the edges and to leave the rounded or obtuse edges as shown at 10b in Figure 5. In this case, as in the case illustrated in Figures 1 to 3, the surfaces 12 and 13 remain substantially unchanged.

What I claim is:

1. Pressure-tight seals for electric current leads into fused quartz glass comprising a strip of molybdenum, tungsten or other suitable metal of a thickness not greater than 0.02 mm. characterized in that the burr along the edges of the metal strip (which normally is produced when cutting to the required width) is removed but the original surface and thickness of the metal strip in the central portion thereof remains undisturbed, and a body of quartz glass embracing said edges and central portion and adhering to the strip.

2. Pressure-tight seals for electric current leads into fused quartz glass according to claim 1, wherein the edges of the metal strip are etched, whereas the central portions of the metal strip retain the mechanically worked surface with predetermined thickness.

3. A seal for a pressure-tight vessel which comprises a thin metallic member of a thickness not greater than 0.02 mm., but of substantial width and a vitreous material fused onto said metal member around its edges which is characterized by having all burrs removed from the edges thereof but having on the broad sides thereof the mechanically worked surface resulting from the manufacture of said piece.

4. The method of making a seal between a flat metal member and a vitreous material which comprises forming a flat piece of metal of thickness not greater than 0.02 mm., cutting said piece mechanically to the desired shape and size, removing the sharp burrs resulting from cutting the edges of said piece, while retaining the surface on the flat sides of said piece, and thereafter fusing the vitreous material around said edge and flat sides.

5. The method of making a ribbon seal which comprises forming by mechanical working a flat piece of metal of a thickness not greater than 0.02 mm., cutting a ribbon of the desired width therefrom, removing the sharp burr resulting from said cut, and fusing a vitreous tube around said ribbon and into adhering relation thereto.

6. The method of making a ribbon seal which comprises forming mechanically a flat piece of metal of a thickness not greater than 0.02 mm., cutting a ribbon of the desired width therefrom, protecting the flat sides of the ribbon with an acid-proof coating leaving exposed the sharp edges resulting from said cut, treating the ribbon while thus protected with acid whereby to etch the edges only to remove the burr, and fusing a vitreous tube around said ribbon and into adhering relation thereto.

7. The method of making a ribbon seal which comprises forming mechanically a flat piece of metal of a thickness not greater than 0.02 mm., cutting a ribbon of the desired width therefrom, mounting the ribbon on a support by means of an adhesive, grinding the edges only to remove any burr produced by cutting, and fusing a vitreous tube around said ribbon and into adhering relation thereto.

8. The method of making a ribbon seal which comprises forming mechanically a flat piece of metal of a thickness not greater than 0.02 mm., cutting a ribbon of the desired width therefrom,

mounting the ribbon on a concave support by means of an adhesive, grinding on a flat surface whereby the burrs on the cut edges are removed leaving smooth blunt edges, and fusing a vitreous tube around said ribbon and into adhering relation thereto.

5 9. A pressure-tight seal for electric current leads through vitreous material which comprises a flat current lead of thickness less than 0.02 mm., having a smooth mechanically worked surface top and bottom and microscopically blunt

edges free from burrs, and a body of vitreous material fused into adhesion with said top, bottom and edges.

10. A pressure-tight seal as defined in claim 9, in which said edges are etched to a microscopically blunt form. 5

11. A pressure-tight seal as defined in claim 9, in which said edges are honed to a microscopically blunt form.

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