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3,186,100

SUPPORTING STRUCTURE OF PIPE-TYPE BUBBLE TUBES

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FIG. 1

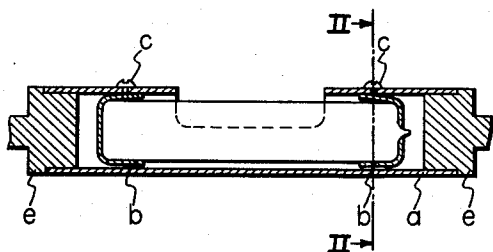


FIG. 2

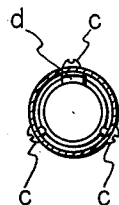


FIG. 3

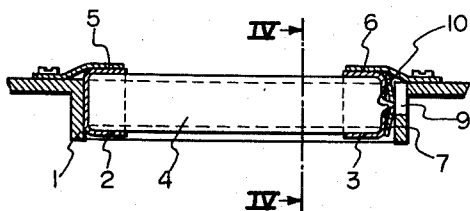
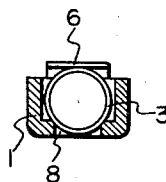


FIG. 4



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1 Claim. (Cl. 33—211)

This invention relates to a supporting structure of pipe-type bubble tubes.

A clear concept of the scope and purpose of this invention may be obtained from the following description taken with the drawing in which:

FIGURE 1 shows a front longitudinal section of prior supporting structure for pipe-type bubble tubes;

FIGURE 2 shows cross-sectional view at line II—II of FIGURE 1;

FIGURE 3 shows a longitudinal section of a supporting structure of an embodiment of this invention; and

FIGURE 4 shows the end cross-sectional view along line IV—IV of FIGURE 3.

In conventional supporting structures for pipe-type bubble tubes, the bubble tube is placed in a cylindrical metal tube and the gap is filled up with plaster, or the bubble tube is placed in a metal tube *a*, as shown in FIGURES 1 and 2, and elastic caps *b* are put on both ends of the bubble tube and the capped end regions supported, for example, by three screws *c*. In this instance a pair of slits is made in the cylindrical wall of the caps, and the tongue *d* between the two adjacent slits is bent slightly upward, and one of the three screws *c* is to register with tongue *d* elastically to press against it. Suitable metallic fittings *e* are required at both ends of the metal tube *a* to affix tube *a* containing the bubble tube to, for example, a surveying instrument. However, the fittings of tube *a* and metallic fittings *e* become a source of warping, and the parts required are rather numerous and the structure is complicated. Accordingly, high accuracy can not be obtained and mass production is not possible by using prior structures of this type.

This invention eliminates the above-mentioned defects and provides a novel supporting structure for pipe-type bubble tubes for the purpose of enabling mass production and improving the accuracy of such structures.

Referring to FIGURES 3 and 4, this invention provides a support for pipe-type bubble tubes employing simple parts of stable accuracy for such instruments as, for example, a surveying instrument. A pipe-type bubble tube 4, provided at both ends with thin metal caps 2 and 3, is placed supported within plate-like metallic fitting 1 which is a channel U-shaped in cross-section having groove 8 of a narrower width than the diameter of the bubble tube. Caps 2 and 3, at the respective ends of the bubble tube, are supported by a two-point contact on the inside edges of the groove 8 of the receiving metal fitting 1, as also by one-point contacts where the upper region of the bubble tube caps is pressed by elastic plates 5 and 6. The side walls of the tube-receiving metal fitting or channel 1 are spaced apart a distance greater than the diameter of the tube, while both its ends are formed as upstanding brackets for endwise closing the channel.

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Thus, the degree of freedom of the bubble tube is restricted by the three-point contact. Caps 2 and 3 are used to support only the respective ends of the bubble tube and prevent direct contact of the bubble tube 4 with the supporting metal fitting 1. The material of caps 2 and 3 is such as to be easily deformable by the restricting pressure. Restriction in the longitudinal direction is obtained by using a metallic plate spring 7 bearing against one end of the bubble tube whereby the other end of the tube is always pressed against one side (the left side in FIGURE 3) of the receiving metal fitting 1. Groove 9 is provided in the upper portion of one of the bracket end regions of metallic fitting 1, to the right as seen in FIGURE 3. The width of groove 9 is a little larger than the diameter of the foot part of the sealing projection 10 at one end of tube 4, thus provides a refuge for projection 10 to prevent damage to tube 4 when inserting it into the fitting 1.

The effect of the difference of the coefficients of thermal expansion between the supporting fitting 1 and the bubble tube 4 is relieved by the elastic plates 5 and 6 pressing against the upper region of the bubble tube thus preventing the formation of strain in the bubble tube and the supporting metal fitting.

In this invention as stated above the supporting metal fitting 1 for the bubble tube can be affixed directly to, for example, a surveying instrument with, for example, screws because of the plate-like configuration of the receiving metal fitting 1. Thus, mass-productivity is furthered and stable accuracy is obtained. Furthermore, since all parts can be made by stamping or die-casting favors not only is mass-production enhanced but also reduction of cost.

What I claim is:

A support for bubble tubes having a projecting sealing tip at one end comprising a rigid channel U-shaped in cross section having in the base of the channel a longitudinal groove in a width less than the diameter of the tube, the side walls of the channel being spaced apart a distance greater than the diameter of the tube and of a height somewhat less than the tube diameter, each end of the channel being formed as a bracket closing the channel ends, one of the brackets being provided with a groove in its upper portion, the width of the bracket groove being somewhat larger than the diameter of the foot portion of the tube sealing tip, an easily deformable cap over each of the tube ends, a plate spring inserted between the cap at the tube end having the sealing tip and the bracket having the groove in its upper portion, and an elastic plate affixed to the top of each bracket and pressing against the upper region of the cap adjacent to the respective bracket.

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ISAAC LISANN, *Primary Examiner.*