

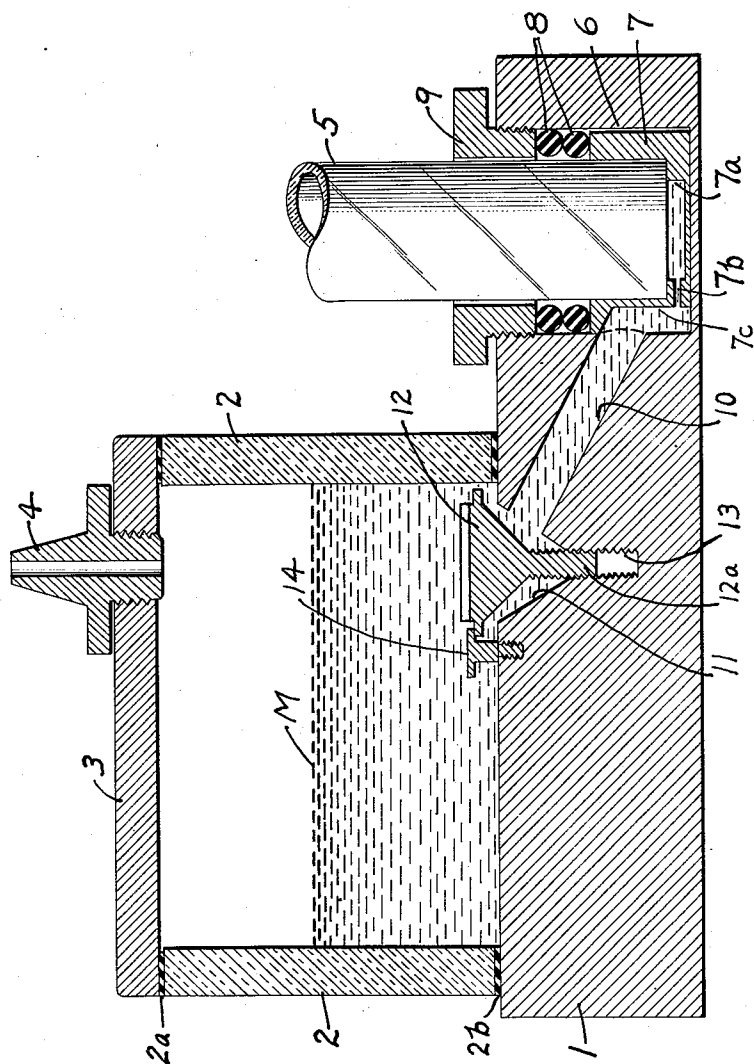
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VACUUM GAUGE

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VACUUM GAUGE

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This invention relates to vacuum gages of the type using a mercury column connected with a body of mercury which is influenced by the vacuum pressure to be measured.

In vacuum gages of this type the mercury column is located in a vertical tube which is sealed at its upper end and is free from gases, the lower end of the tube being connected to a closed cistern containing a body of mercury and being connected to the source of vacuum pressure to be measured.

In gages of this type, when operating at low pressures approaching absolute zero, gases are liberated within the gage, and some of these gases find their way into the mercury tube and cause incorrect readings. These gases may have different sources, such as leakage of air through the gasket or packing surrounding the lower end of the tube, occluded gases driven off from internal parts of the gage or from impurities in the metal base, and leakage of air through the metal base due to the porosity of the metal.

The main object of the present invention is to devise an improved connection between the mercury column tube and the cistern to minimize the possibility of gas entering the tube.

The preferred form of the invention is illustrated in the accompanying drawing which shows a sectional view of the improved connection, the view being taken on a vertical plane passing through the center of the tube and through the center of the cistern, the mercury tube however being shown in elevation.

Referring to the drawing the base of the gage is a flat metal plate 1 preferably formed of steel. Supported upon the upper face of the plate 1 is a cistern for the mercury M having a cylindrical wall 2 and a cover 3. The wall 2 may be formed of glass or other transparent material, or it may be formed of metal such as steel. The cover plate 3 preferably is formed of metal, and a nipple 4 is threaded into the cover plate for the purpose of completing a connection from the cistern to the source of vacuum pressure to be measured. Suitable sealing gaskets 2a and 2b are provided between the cylinder 2 and the cover plate 3 and the base plate 1 respectively for the purpose of rendering the cistern air-tight.

The lower end of the tube 5 for the mercury column is positioned within a bore or cylindrical cavity 6 formed in the upper face of plate 1 adjacent the cistern 2. The bore 6 extends downwardly to a point near the lower face of the plate 1, and the lower end of the tube 5 is seated within a metal cup 7 which is seated in the bottom

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of the bore 6. The cup 7 may be formed of dense metal such as steel, and it has a bore sufficiently large to receive the tube 5 and to allow for the usual manufacturing tolerances in the diameter of such tubes.

The lower end of tube 5 is seated in the bottom of the cup by a "ground fit," that is, the end of the tube is seated in the bottom of the cup by applying grinding material between the ends of the tube and the bottom of the cup and oscillating the tube about its axis until the two engaging surfaces have been ground to be flat and parallel with each other. After the grinding material has been removed from the two surfaces, a very close fit would be obtained between the end of the tube 5 and the bottom of the cup 7.

The tube 5 is secured within the bore 6 by means of a ring of packing material 8 surrounding the tube above the cup 7, and packing gland 9 threaded in the upper end of the bore 6 is provided for compressing the packing ring 8 against the upper edge of cup 7 and into sealing relation with tube 5 and the wall of bore 6. The ring 8 may be formed of rubber or rubber-like material. The ring is shown in an uncompressed condition in the drawing.

The connection between the lower end of tube 5 and the cistern 2 is completed by means of a counterbore 7a formed in the center of the bottom of the cup 7, and the small horizontal bore 7b formed radially through the bottom wall of the cup 7 and communicating at its inner end with the bore 7a and opening at its outer end into a vertical channel formed by having a portion of the outer face of the cup 7 cut away as shown at 7c. This vertical channel communicates at its upper end with an inclined channel or bore 10 formed in the plate 1 for connecting the bore 6 with a bore 11 formed in the upper face of plate 1 within the cistern 2 and immediately below the nipple 4. It is convenient to form the bore 11 of conical shape as shown in the drawing, but it could have other circular shapes. A plug 12 having a threaded stem 12a engaging the threaded hole 13 in the plate 1 below the bore 11 is provided for the purpose of closing the upper opening of the channel 10 to the cistern 2. A stop screw 14 is threaded into the upper face of plate 1, and the head of this screw extends over a radial flange formed on the head of the plug 12 to limit the upward movement of the plug and prevent its removal. The upper face of plug 12 is provided with a transverse slot for receiving a screw-driver which

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may be inserted through the top of the cistern by removing the nipple 4, it being noted that the plug 12 is located directly beneath the nipple 4.

The construction described above and shown in the drawing is very effective in minimizing the amount of gas that finds its way into tube 5 when the cistern is subjected to very low vacuum pressures. The cup 7 serves very important functions in securing this result. For example, it locates the sealing ring 8 at a considerable distance above the lower end of the tube 5, and it provides a baffle over the lower end of the tube 5 so that any gases that are released within the bore 6 are deflected around the end of the tube and into the lower end of the passage 10. Also, any leakage of air through the thin bottom wall of the cavity 6 will not pass through the cup 7, because there is no differential of pressure on opposite sides of the bottom wall of the cup, but such leakage will pass along the outside of the bottom of the cup and into the vertical passage connected with the lower end of the channel 10. The cup 7 also provides an effective seal for the lower end of the tube 5 except for the small horizontal bore 7b which provides a restricted passage for the mercury between the tube 5 and the cistern.

The small size of this passage reduces the possibility of gas entering the tube 5 through the passage, and it also serves to damp any oscillations of the mercury within the tube when there is a sudden change in pressure applied to the cistern. I have found that good results are obtained when the bore 7b has a diameter within the range of 0.080-0.090". For effective exclusion of gas from the lower end of the tube 5, it is important that the lower end of channel 10 should open into the bore 6 at a point above the bore 7b preferably as close to the upper end of the cup 7 as possible.

The screw-plug 12 is useful for trapping the mercury within the cistern during shipping of the gage. This is accomplished by tilting the base plate 1 in a direction to drain the mercury from tube 5 through the channel 10 into the cistern, and after all the mercury has been drained into the cistern plug 12 is screwed down till it seals off the cavity 11 which forms a port on the upper end of passage 10.

While I have illustrated and described one form of my invention, it will be obvious that the invention is not limited to this specific embodiment and variations in the details of construction are possible within the scope of the appended claims.

What I claim is:

1. In a vacuum gage, the combination of a flat base plate having a vertical cylindrical bore formed in the upper face thereof and extending downwardly to a point near the lower face thereof, a mercury cistern supported upon the upper face of said plate adjacent said bore, said base plate having an inclined passage formed therein with the upper end of the passage opening into said cistern and the lower end opening into said bore near the top thereof, a cup seated in said bore and extending above the opening of said inclined passage into said bore and having a channel formed in the outer surface thereof from said opening to the bottom of said bore, a vertical tube having the lower end thereof seated

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in said cup, a packing ring surrounding said tube above said cup, a gland arranged in the upper end of said bore and pressing said packing ring against the upper edge of said cup, and said cup having a small radially extending bore formed in the bottom wall thereof with its outer end opening into said vertical channel and its inner end communicating with the inner space of said tube through a port formed in the upper face of the bottom wall of said cup.

2. In a vacuum gage, the combination of a flat base plate having a vertical cylindrical bore formed in the upper face thereof and extending downwardly to a point near the lower face thereof, a mercury cistern supported upon the upper face of said plate adjacent said bore, said base plate having an inclined passage formed therein with the upper end of the passage opening into said cistern and the lower end opening into said bore near the top thereof, a cup seated in said bore and extending above the opening of said inclined passage into said bore and having a channel formed in the outer surface thereof from said opening to the bottom of said bore, a vertical tube having the lower end thereof seated in said cup, a packing ring surrounding said tube above said cup and sealing said tube within said bore and said cup having a small radially extending bore formed in the bottom wall thereof with its outer end opening into said vertical channel and its inner end communicating with the inner space of said tube through a port formed in the upper face of the bottom wall of said cup.

3. In a vacuum gage, the combination of a flat base plate having a vertical cylindrical bore formed in the upper face thereof and extending downwardly to a point near the lower face thereof, a mercury cistern supported upon the upper face of said plate adjacent said bore, said base plate having an inclined passage formed therein with the upper end of the passage opening into said cistern and the lower end opening into said bore near the top thereof, a cup seated in said bore, a vertical tube having the lower end thereof seated in said cup, the opening of said passage into said bore and sealing said tube in said bore, a packing ring surrounding said tube above the lower end of said tube being positioned below the opening of said inclined passage into said bore, and said cup having a small radially extending bore formed in the bottom wall thereof with its outer end opening into said bore and its inner end communicating with the inner space of said tube through a port formed in the upper face of the bottom wall of said cup.

4. A vacuum gage according to claim 3 wherein the lower end of said tube is seated on the bottom wall of said cup by a ground fit.

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