Feb. 13, 1968 J. D. AULT 3,368,287

LEVEL BUBBLE ILLUMINATION BY MEANS OF A RADIOACTIVE GAS AND A PHOSPHOR ELEMENT

Filed April 23, 1964

FIG. 1

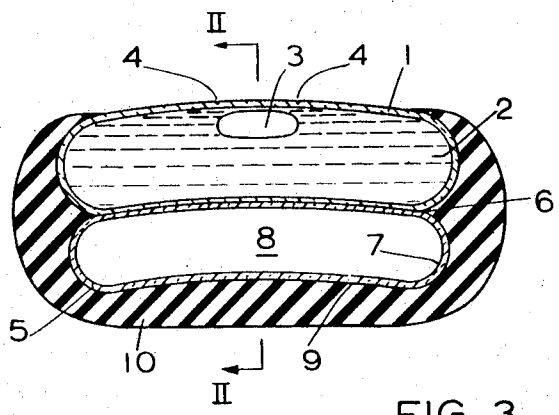


FIG. 2

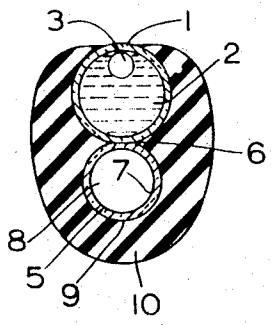


FIG. 3

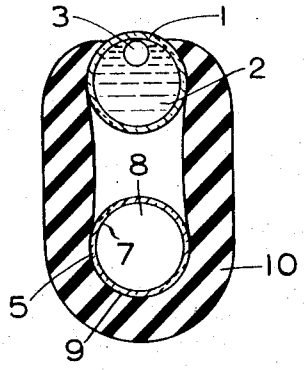
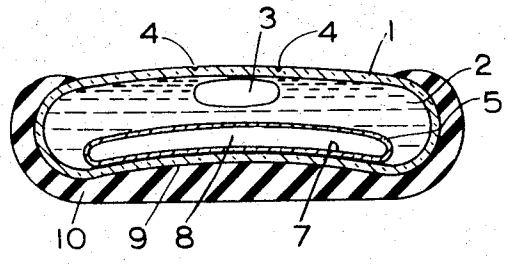


FIG. 4



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LEVEL BUBBLE ILLUMINATION BY MEANS OF A RADIOACTIVE GAS AND A PHOSPHOR ELEMENT

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5 Claims. (Cl. 33—211)

This invention relates to illumination of the bubble of a level or like instrument by light sources of the self-luminous type for use, although not exclusively, with surveying equipment.

It is current practice to illuminate equipment of this type with luminous paint, but this suffers from some serious disadvantages. The degree of light intensity of luminous paint currently reaches its practical limit at approximately 50 micro lamberts and this intensity is inadequate to permit close positioning of the bubble of a level, and also requires a period of time for darkness adaptation. There are difficulties associated with increasing this light intensity, as the Radioactive Substances Act 1960(a) limits the quantity of isotope in solid form to an amount that does not permit sufficient luminous paint to be used to produce a satisfactory light level.

Even at a light level of 50 micro lamberts the light life of luminous paint is probably no more than one year, and replacement of such paint is both expensive and hazardous.

It is, therefore, an object of the invention to provide a levelling bubble with means of illumination which is self-luminous and compared with current means has a relatively high degree of brightness, a long light life and generates negligible radiation external to itself.

The invention consists in means for illuminating the bubble of a level or like instrument by self-luminous light source means of the type comprising a phosphor excited to luminescence by a gaseous radionucleide.

Such means of illumination provides a greatly improved light level in the region of from 200 to 400 micro lamberts without significant external radiation, and a useful light life of approximately twenty years. The radioactive source uses less than two curies of tritium gas, and at this level persons using the device are exempted from registration under the Radioactive Substances Act 1960(a).

These and further objects and advantages of the invention will become more readily apparent from the following detailed description of various embodiments of the invention which are by way of example only with reference to the accompanying drawings, wherein:

FIGURE 1 is a longitudinal section of a means of illuminating the bubble of a level according to the invention.

FIGURE 2 is a transverse section along II—II of FIGURE 1.

FIGURE 3 is a transverse section of a second embodiment of the invention indicating an alternative way of attaching the means of illumination to the chamber containing the bubble.

FIGURE 4 is a longitudinal section of a still further embodiment of the invention wherein the self-luminous light source is enclosed within the chamber containing the bubble.

Referring to FIGURES 1 and 2, a level chamber **1**, such as in common current use containing spirit **2**, a bubble **3**, and registering marks **4** is optically sealed to a luminescent source **5** at a surface **6** which is ground flat in a transverse direction.

The luminescent source **5** consists of a glass tubular envelope which is internally coated with a phosphor **7** having luminescent properties. Sealed within the said glass envelope is a radionucleide gas **8**, preferably tritium, which bombards the phosphor **7** with beta radiation particles to excite it into luminescence. The outer surface of the luminescent source **5** is coated on all sides, other than that which is optically sealed to the bubble chamber, with suitable reflective means **9**. The bubble chamber **1** and the luminescent source **5** are mounted for protection within a shockproof mounting **10**.

FIGURE 3 shows a alternative method of positioning the luminescent source **5** with respect to the bubble chamber **1** using a bond of optically clear rubber such as Silcoloid, a registered trademark. This method obviates the necessity of forming flat ground faces on the bubble chamber **1** or on the luminescent source **5**.

FIGURE 4 shows a further embodiment of the invention wherein the luminescent source **5** is secured within the bubble chamber **1** to provide a more compact unit.

In operation of the invention, when viewed from the direction facing the registering marks **4**, the luminescent source **5** provides a background illumination of the bubble **3**, enabling the bubble to be clearly observed when adjusting the bubble chamber **1** or any associated housing to position the bubble **3** between the registering marks **4**. Furthermore, the liquid **2** in the bubble chamber **1** tends to produce a dark outline around the bubble **3** when viewed against the bright background.

To those skilled in the art it will be obvious that numerous modifications and refinements may be made without departing from the scope of the invention. For example, more than one luminescent source may be provided around the bubble chamber or within it. The shape of the luminescent source may be varied in any way in order to illuminate the bubble more conveniently. For example, with bubble chambers of the oblate spheroid type, where the bubble is positioned towards the centre of a circular surface of the oblate spheroid for levelling in more than one direction, the luminescent source may also take the form of an oblate spheroid or other convenient circular horizontal cross-section for more satisfactory illumination.

Furthermore, instead of the luminescent source being coated with reflective means the shockproof housing may provide reflective means, for example by being coated with reflective material or by being manufactured of white rubber or other suitable reflective material. The bubble chamber, the luminescent source or the shockproof mounting may be provided for some applications with attachment means. For extra protection the whole device may be protected with an abrasive resistant sheath of transparent material or any other material provided with appropriately situated windows.

In a situation where the device is in no danger of fracture the shockproof mounting may even be omitted.

I claim as my invention:

1. A level indicating device comprising: an outer casing having a window opening, an elongated first chamber mounted in the casing and filled with a liquid except for a movable gas bubble located therein, a first side of said first chamber being visible through the said casing window for observing the position of the bubble, a second elongated chamber mounted in the said casing so that its center lies on the side of the center of the first chamber away from the said window, said second chamber comprising a self-luminous light source including a phosphorous material on the internal surface of the second chamber, and a radioactive tritium gas within said second chamber for exciting the said phosphor material to luminescence, and a reflective surface located on the side of the second chamber away from the first side.

2. A level indicating device as claimed in claim 1 wherein the said second chamber is positioned within the said casing adjacent the first chamber on the side thereof away from the said window, the facing surfaces of the first and second chambers being ground flat and optically sealed to each other.

3. A level indicating device as claimed in claim 1 wherein the said second chamber is spaced from the first chamber within said casing by an optically clear rubber.

4. A level indicating device as claimed in claim 1 wherein the said second chamber is located within the first chamber adjacent the side of the first chamber away from the said window.

5. A level indicating device as claimed in claim 1 wherein the said outer casing is of a shockproof material.

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