Feb. 9, 1954 C. M. MARQUARDT 2,668,438

BUBBLE TUBE FOR SPECIFIC GRAVITY METERS

Filed Aug. 13, 1948

FIG. 1.

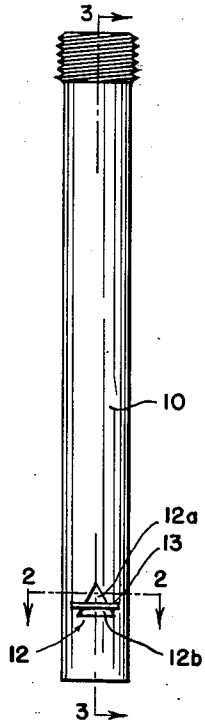


FIG. 2.

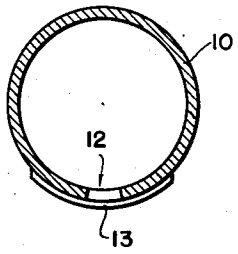


FIG. 3.

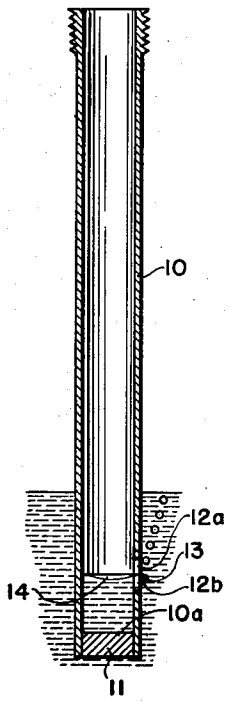


FIG. 4.

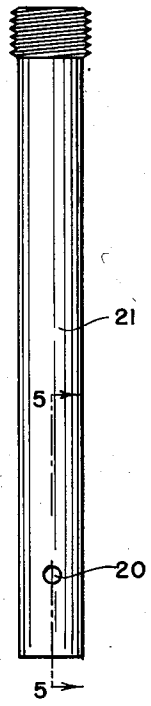


FIG. 6.

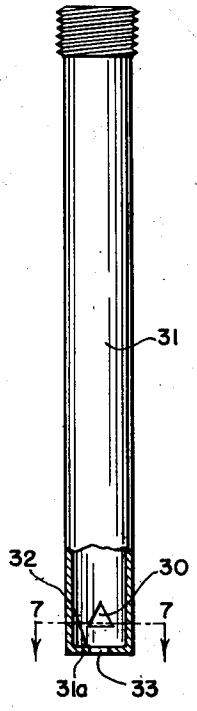


FIG. 5.

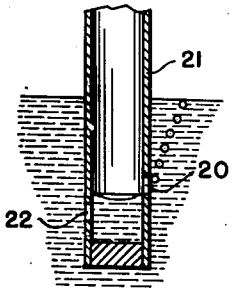
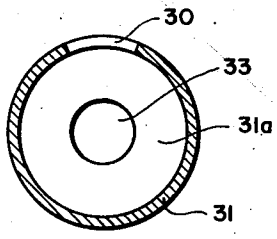


FIG. 7.



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BUBBLE TUBE FOR SPECIFIC GRAVITY METERS

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5 Claims. (Cl. 73—32)

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This invention relates to specific gravity or liquid density meters of bubble type wherein the pressure required to maintain a constant stream of air bubbles issuing from the submerged orifice of a bubble tube is utilized in the measurement of the specific gravity or density of a liquid or semi-liquid in which the orifice of the bubble tube is submerged. The invention is particularly concerned with the construction of the bubble tube or tubes employed in such meters.

Heretofore, most bubble tubes have been open at the bottom and provided with a V-shaped notch converging upwardly of the tube from the bottom edge surrounding the opening. The stream of air bubbles emerges through the notch during operation.

A serious disadvantage encountered in the use of such conventional bubble tubes is the great amplitude of pulsation and the unsteady character of the liquid meniscus occurring immediately below the issuing stream of air bubbles, especially where there is considerable turbulence in the body of liquid, as is usual in instances of ore pulps in classifiers. Such heavy pulsations and unsteadiness of the liquid meniscus makes accurate reading of the pressure gauge extremely difficult, if not altogether impossible.

Accordingly, a primary object of the present invention is the provision of an improved bubble tube construction whereby pulsation and unsteadiness of the liquid meniscus is reduced to a minimum.

Another object is to provide such a construction as will render the liquid meniscus substantially insensitive to normal changes in the air supply.

Pursuant to the invention I have found that by eliminating the customary bottom opening of the submerged end of the tube and providing a pair of correlated openings, one above the other, the desired objectives are accomplished by what appears to be a damping effect.

The upper one of the pair of openings is suitably dimensioned to pass a uniform stream of air bubbles, while the lower opening is merely large enough to maintain a liquid level in the form of a meniscus within the tube and at the base of the upper opening.

The form of the invention presently preferred for most purposes, particularly in connection with ore pulps, comprises a bubble tube whose open bottom end is completely plugged and closed. A triangular opening is provided in the wall of the tube at a location spaced above the closed bottom end, the triangle being of substantially equilateral formation with the base lowermost and extending

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substantially horizontal. Such triangular opening is considerably larger than would be the case if it were to be used only as a bubble-emitting orifice, and a narrow strip of material—preferably a length of wire—is secured across the body of the opening intermediate its height and substantially in parallel with the base thereof. Thus, the single, large, triangular opening is divided into a relatively small, upper, triangular, bubble-emitting orifice and a truncated, meniscus-providing, lower orifice which exerts a damping effect.

Further objects and features of the invention will be apparent from the following detailed description of the presently preferred specific construction illustrated in the accompanying drawings.

In the drawings:

Fig. 1 represents a side elevation of one preferred form of bubble tube pursuant to the invention;

Fig. 2, a horizontal section taken on the line 2—2 of Fig. 1 and drawn to a somewhat enlarged scale;

Fig. 3, a central vertical section taken on the line 3—3 of Fig. 1;

Fig. 4, a side elevation of another form of bubble tube pursuant to the invention;

Fig. 5, a central vertical section taken on the line 5—5 of Fig. 4;

Fig. 6, a side elevation of still another form of bubble tube pursuant to the invention, wherein the damping orifice is provided in the otherwise closed bottom end of the tube; and,

Fig. 7, a horizontal section taken on the line 7—7 of Fig. 6 and drawn to the enlarged scale of Fig. 2.

Referring now to the drawings: the bubble tube of Figs. 1, 2, and 3 is in large part of conventional construction, being of such material, and so dimentioned, as to conform with the requirements of the particular installation, in accord with practice common to the art.

For use in connection with many types of semi-liquids or suspensions, such as ore pulps, the hollow tubular part 10 may be a length of one-half inch galvanized iron pipe having its upper end threaded for connection with an air-flow conduit. The normally open bottom end of the tubular part 10 is tightly closed by a metal plug 11, see Fig. 3, which is advantageously soldered or welded in place.

Spaced upwardly from the closed bottom of the tubular part 10, a distance insuring freedom from sediment which tends to collect on the floor 10a

thereof and formed through the side wall of such tubular part, is a triangular opening 12, its base being substantially parallel with the said closed bottom so as to be substantially horizontal when the bubble tube is positioned vertically in a body of liquid, as is customary. The triangular opening 12 is preferably equilateral in formation for reasons which will be apparent hereinafter.

I have found that where a one-half inch pipe is used for the tubular part, it is desirable, when working with ore pulps, to locate the base of the triangular opening approximately one-half inch from the floor 10*a* of the tube, and to make the altitude of the triangular opening approximately three-eighths of an inch in height. However, the dimensions here given are not critical and may be varied extensively in accordance with particular operating conditions.

Extending substantially parallel with the base of the triangular opening 12 and intermediate the height of said opening is a fine wire 13, which divides such opening into a triangular, upper, bubble-emitting orifice 12*a* and a truncated, lower, meniscus-providing orifice 12*b*. The fine wire 13 is preferably a short length soldered to the tubular part 10 exteriorly thereof and at the margins of the opening 12, as illustrated, although it may equally as well—from a functional standpoint—be a wire band encircling the tubular part and fastened thereto in any secure manner. Furthermore, in certain instances, the fine wire may be advantageously replaced by a narrow strip of any suitable material, the width of the strip being determined by the dimensional requirements of the correlated upper and lower orifices 12*a* and 12*b*.

In the illustrated instance, the fine wire 13 divides the area of the triangular opening 12 into two approximately equal parts, though the wire or strip may be placed as found desirable in any particular instance of use.

One advantage of making the opening an equilateral triangle resides in the fact that the respective areas of the upper and lower openings, for any placement of the dividing wire 13, may be easily calculated; another in the fact that the bubble-emitting opening is always symmetrical, which aids in maintaining uniform bubble formation and bubble detachment.

In operation, it has been found that the column of air descending within the bubble tube emerges only through the upper orifice 12*a*, and that the lower orifice 12*b* apparently exerts a damping effect on the liquid meniscus 14 within the tube. Such meniscus is maintained substantially at the level of the wire 13, and, while it is not possible to eliminate all pulsation thereof, the amplitude of pulsation and the unsteadiness due to turbulence in the body of liquid are materially reduced.

Furthermore, it has been found that abrupt changes in the quantity of air supplied the bubble tube have only a very small effect on the position of the meniscus, which is contrary to what occurs under similar conditions in conventional types of bubble tubes.

A singular advantage of the improved bubble tube of the invention is the fact that internal flushing of the tube may be carried out with great effectiveness, for the flush water is all directed through the triangular opening 12 with considerable force, thereby dislodging all deposits of silt and other sediment which tend to clog the orifices.

While the afore-described embodiment of the invention is preferred in many instances, other embodiments having different arrangements of the upper and lower orifices may be satisfactorily utilized. For example, in the embodiment of Figs. 4 and 5, the upper bubble-emitting orifice 20 is disposed in the side wall of the tubular part 21 at one side thereof, while the lower orifice 22 is also disposed in the side wall of the bubble tube, but at the opposite side thereof, see especially Fig. 5. Both orifices in this instance are circular, and both are spaced upwardly from the floor of the tube.

Again, in the embodiment of Figs. 6 and 7, the upper bubble-emitting orifice 30 is of triangular formation and disposed in the side wall of bubble tube 31. In the illustrated instance, the tube 31 is completely integral, being molded or otherwise shaped from a suitable material such as a plastic, glass, metal, or the like. The lower orifice 33 is provided centrally of the bottom closure 31*a* of the tube. As shown, such lower orifice may be circular, though the shape is of little consequence so long as the area is properly correlated into the area of the upper orifice to produce the desired damping effect.

These embodiments merely indicate some of the diversified forms the invention may assume in practice, the particular form adopted in any instance being dependent upon the conditions of use, as will be obvious to those skilled in the art.

In any instance the relative size of the upper and lower orifices will depend somewhat upon the particular circumstances of use, namely, the nature of the liquid suspension and the degree of turbulence encountered in operation, but, generally speaking, when the upper orifice is one-third the area of the lower orifice, satisfactory results will be attained.

It should be realized that trial and experience in connection with any particular liquid or semi-liquid is a better criterion for the exact proportioning of the upper and lower orifices than anything that can be said here. The important thing is to select the relative areas of the respective orifices in any given instance so that a uniform, unhampered flow of bubbles is attained substantially without disturbance of the elevation of the meniscus and with a maximum damping effect. The fact that damping can be attained by dividing or separating the bubble-emitting orifice from the orifice which imparts the meniscus-forming, hydrostatic head within the tube, and by making the latter orifice smaller than customary, is an important basic concept of the invention. In certain instances, the lower orifice may be of less area than the upper, bubble-emitting orifice.

Whereas this invention is here illustrated and described with respect to certain preferred forms thereof, it should be understood that these merely exemplify the invention and that various changes may be made therein and various other forms may be constructed on the basis of the teachings hereof, by those skilled in the art, without going beyond the scope of the following claims.

I claim:

1. A bubble tube for specific gravity meters, comprising a hollow tube having its lower end closed; a single opening formed in the side wall of the tube; and a divider element applied to the tube dividing said single opening into an upper, bubble-emitting orifice and a lower orifice correlated in size with said upper orifice to effect damping.

2. The combination recited in claim 1, where-

in the single opening is of triangular formation having its base lowermost.

3. The combination recited in claim 2, wherein the triangular formation is equilateral.

4. The combination recited in claim 3, wherein the divider is a wire secured to the tube wall and extending across the triangular opening in substantially parallel relation with the base thereof.

5. A bubble tube for specific gravity meters, comprising a hollow tube having its lower end closed; a bubble-emitting orifice formed in a sidewall of said tube; and a second orifice formed in the sidewall of the tube directly and immediately below the first orifice and separated therefrom by a relatively narrow divider element, said second or lower orifice being correlated in size with said first or upper orifice to effect dampening.

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