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VARIABLE SPACE ABSORPTION CELL

Vincent J. Coates, South Norwalk, Conn., assignor
to The Perkin-Elmer Corporation, Norwalk,
Conn., a corporation of New York

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This invention relates to apparatus for use in determining the characteristic absorption of radiation by a liquid and is concerned more particularly with a novel cell for holding a sample of the liquid to be examined. The new cell is adjustable, so that the thickness of the sample can be varied as desired, and it is superior to prior similar cells, in that it is less expensive to produce and easier to assemble.

The new cell comprises, essentially, a barrel provided at one end with a cap having a central opening closed by a flat window transparent to the radiation to be employed and forming one transverse wall of the sample space. A hollow piston is mounted within the barrel and is movable lengthwise of the barrel but held against rotation relative to the barrel. The inner end of the piston is closed by a flat transparent window parallel to the first window and forming the second transverse wall of the sample space. A thimble threaded on the outside of the barrel is secured to the outer end of the piston in such manner that the thimble may have free rotational movement relative to the piston but the thimble and piston move in unison lengthwise of the barrel. The thimble and barrel are provided with co-operating scales for indicating the thickness of the sample space and means are provided for scaling the space, for preventing backlash in the threaded connection between the barrel and thimble, etc.

For a better understanding of the invention, reference may be made to the accompanying drawing, in which

Fig. 1 is a central longitudinal sectional view of the new cell;

Fig. 2 is a view in side elevation;

Fig. 3 is a view of the entrance end of the cell; and

Fig. 4 is a side elevational view of a spring used in the cell.

The new cell in the form shown in the drawing comprises a barrel 10 of generally cylindrical form provided at one end with an internal flange 11, the outer face of which is ground to lie in a plane normal to the axis of the barrel. An end cap 12 is externally threaded on the barrel at the flanged end and, at its end remote from the barrel, the cap is formed with a flange 13 having a central opening 14 defined by an externally threaded neck 15. A window 16 of a material transparent to the radiation to be employed is mounted with the end cap to engage the ground outer surface of flange 11 on the barrel, and the window is clamped against the

flange by a spacer ring 17 lying within the end cap and engaged by screws 18 threaded into openings through flange 13. The window is ground to have its opposite surfaces flat and parallel to one another and, when the window is mounted in position, its opposed surfaces lie normal to the axis of the barrel. A mounting plate 19, by means of which the cell may be mounted in position within the instrument, in which it is to be used, is telescoped over the neck 15 on the end cap, and the plate is held in place by a retainer ring 20, which is threaded on neck 15. The plate 19 is of generally oblong form and projects outwardly beyond the end cap 12.

A hollow piston 21 is mounted within the barrel and is provided at its inner end with an internal flange 22, the inner surface of which is of spherical form and serves as a seat for a transparent window 23 having a spherical edge fitting on the seat. The opposed faces of the window are flat and parallel to each other, and, when the window is properly seated, these surfaces lie normal to the axis of the barrel. The window is held in position on its seat by a spacer ring 24 engaged by a plurality of screws 25 in openings in a retainer ring 26, which is threaded into the barrel adjacent the seat.

The piston projects out of the barrel, and a flanged retainer ring 27 is threaded into the outer end of the piston with the flange extending radially. The flange engages an internal flange at one end of a thimble 28, which has internal threads interengaged with external threads 29 on the barrel. The flanges on the retainer 27 and thimble 28 are held in contact by a spacer ring 30 telescoped over the outer end of the piston and forced outwardly by a dished spring ring 31, which engages the inner end of the spacer ring and a shoulder 32 near the outer end of the piston. Inwardly from the shoulder, the piston is formed with a seat for a key 33, which enters an axial slot 34 in the inner wall of the piston.

The end section of the barrel outwardly from threads 29 is of reduced external diameter and forms a shoulder 35, and a spring member 36 is threaded into thimble 28 and telescoped over the end section of the barrel. The spring member is made up of an externally threaded ring 37 and a longitudinal neck 38 integral with the ring at one end and provided with arcuate arms 39 terminating in tabs 40 engaging shoulder 35. When the thimble is turned to move inwardly along the barrel, the arcuate arms 39 of the spring member are flexed, so that the spring member

serves to urge the thimble outwardly relative to the barrel and thus prevent backlash between the interengaged threads on the outside of the barrel and the inside of the thimble.

An internally threaded sleeve 41 carrying scales is mounted on the threads 29 on the barrel and held in place by a lock sleeve 42, also threaded in place. The inner end section 28a of the thimble is undercut, so that the section will telescope over the sleeves without contact therewith and section 28a is beveled off and provided with a circumferential scale cooperating with the scales on sleeve 41.

The sample to be examined is held within the space 43 within the barrel between the windows and the barrel is provided with diametrical openings leading through its wall into the sample space and receiving the necks of inlet fittings 44. Leakage from the sample space along the piston is prevented by a sealing ring 45, which lies between the outer surface of the piston and the inner surface of the barrel. The sealing ring is clamped against an internal collar 46 on the barrel adjacent the sample space by a retainer ring 47 threaded into the interior of the barrel and having a sliding fit with the outer surface of the piston. The sealing ring is made of a suitable synthetic material, which is deformable under pressure, an example of such material being that known commercially as "Teflon."

During the assembly of the new cell, the surfaces of the piston window 23 are brought into exact parallelism with the surfaces of window 15 by adjustment of screws 25 in the window retainer ring 24. Initially, the piston has a light force fit within the sealing ring 45 and, in a short period of time, the material of the ring flows sufficiently, so that the piston will run smoothly relative to the cylinder. The land 48 on the piston forming shoulder 32 acts as a guide for the piston during its movement, and key 33 prevents rotation of the piston with thimble 23. Accordingly, as the thimble is rotated, it imparts axial movement only to the piston. The spring 31 maintains the flanges on the piston retainer 27 and the thimble 23 in tight contact and also prevents axial pressure being applied to the windows, in the event that the windows are brought into contact by rotation of the thimble.

The scales 43 and 50 on sleeve 41 and scale 51 on the end section 28a of the piston make possible accurate setting of the piston within the barrel and accurate determination of the space between the windows. The thickness of the sample can, accordingly, be adjusted within the limits required.

The cell can easily be kept clean and, for this purpose, the thimble 23 is unscrewed from the barrel, after which the piston can be easily withdrawn. All parts of the sample chamber within the cell are then accessible.

I claim:

1. A variable thickness absorption cell, which comprises a hollow barrel, a closure for one end of the barrel including an open center cap secured to the barrel and a transparent window mounted in the cap and lying transverse to the axis of the barrel, a hollow piston mounted within the barrel, a transparent window carried by the piston and lying transverse to the axis of the barrel and closing the inner end of the piston,

interengaging means on the barrel and piston holding them against relative angular movement while permitting their relative longitudinal movement, a thimble telescoped over the barrel and having a threaded connection therewith, means connecting the thimble and piston for movement in unison lengthwise of the barrel in both directions, while permitting their relative angular movement, means between and engaging the opposed surfaces of the piston and barrel for sealing the space between the windows, and means for preventing backlash in the threaded connection, including a sleeve engagement with the thimble and barrel having a fixed engagement with one of these parts and a resilient engagement with the other.

2. A variable thickness absorption cell, which comprises a hollow barrel, a closure for one end of the barrel including an open center cap secured to the barrel and a transparent window mounted in the cap and lying transverse to the axis of the barrel, a hollow piston mounted within the barrel, a transparent window carried by the piston and lying transverse to the axis of the barrel and closing the inner end of the piston, interengaging means on the barrel and piston holding them against relative angular movement while permitting their relative longitudinal movement, a thimble telescoped over the barrel and having a threaded connection therewith, means connecting the thimble and piston for movement in unison lengthwise of the barrel in both directions, while permitting their relative angular movement, means between and engaging the opposed surfaces of the piston and barrel for sealing the space between the windows, and means for preventing backlash in the threaded connection, including a sleeve threaded into the thimble and having a resilient inner end section engaging the barrel.

3. A variable thickness absorption cell, which comprises a hollow barrel, a window closing one end of the barrel, a hollow piston within the barrel having its inner end closed by a window facing the first window, the outer end of the piston having a circumferential flange, means on the barrel and piston for preventing rotational movement of the piston, while permitting it to move axially, a thimble threaded on the outside of the barrel and having an internal flange at its outer end overlapping the piston flange, a spring urging the flanges together, an annular sealing member between the piston and barrel for sealing the space between the windows, said member guiding the piston in its movements, and means for preventing backlash between the thimble and barrel.

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