United States Patent [19]

Rohrbaugh

[11] **3,785,773**

[45] **Jan. 15, 1974**

[54] **CHEMICAL ANALYSIS TUBE MODULE**

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[73] Assignee: **Beckman Instruments, Inc.,** Fullerton, Calif.

[22] Filed: **Mar. 2, 1972**

[21] Appl. No.: **231,350**

[52] **U.S. Cl.** ..... **23/253 R,** 23/259, 23/292

[51] **Int. Cl.** **G01n 1/10,** G01n 1/14, G01n 1/18

[58] **Field of Search** 23/259, 253, 292

[56] **References Cited**

UNITED STATES PATENTS

3,487,862	1/1970	Soderblom	23/259 X
3,532,470	10/1970	Rochte	23/253
3,540,856	11/1970	Rochte et al.	23/253 X
3,713,771	1/1973	Taylor et al.	23/259 X
3,713,985	1/1973	Astle	23/253 X

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Assistant Examiner—R. E. Serwin
Attorney—Thomas L. Peterson et al.

[57] **ABSTRACT**

An integral, thin wall thermoplastic chemical analysis tube module has a plurality of test tubular receptacles disposed normally to an elongated rectangular planar area and has a surrounding first wall frame segment of uniform height secured to and supportively disposed around a perimeter major segment of the planar area. A first uniform stiffener lip is integrally secured to and disposed around the first frame segment opposite the planar area. An opposed pair of second wall frame segments having a second uniform height is secured to and supportively oppositely disposed around a pair of opposed perimeter minor segments of the planar area. The second wall height is precisely greater than the first wall height. A pair of second uniform stiffener lips is secured to and disposed around the second frame segment perimeter, also opposed to the planar area. The temporary compressive displacement of the second pair of stiffener lips inside the perimeter of the first pair of stiffener lips provides an expansive precise jaw clamp on release of the clamp, which can secure the tube module combination in a configured cut out aperture in a supporting plate.

8 Claims, 6 Drawing Figures

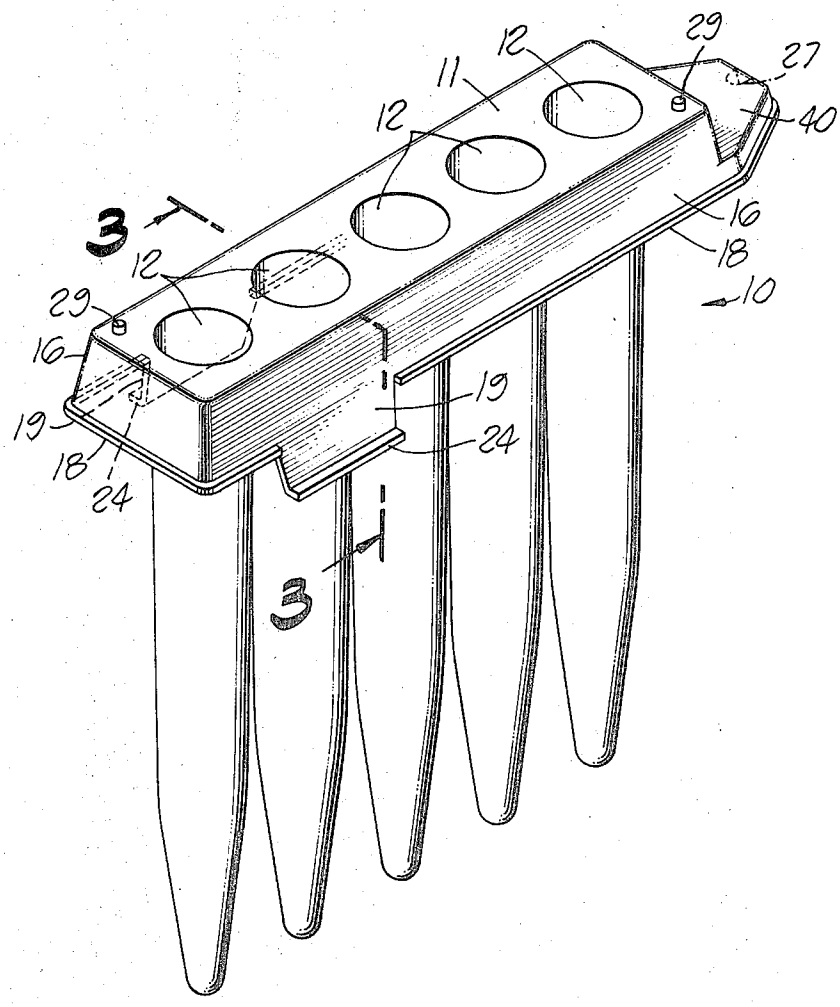


FIG. 1.

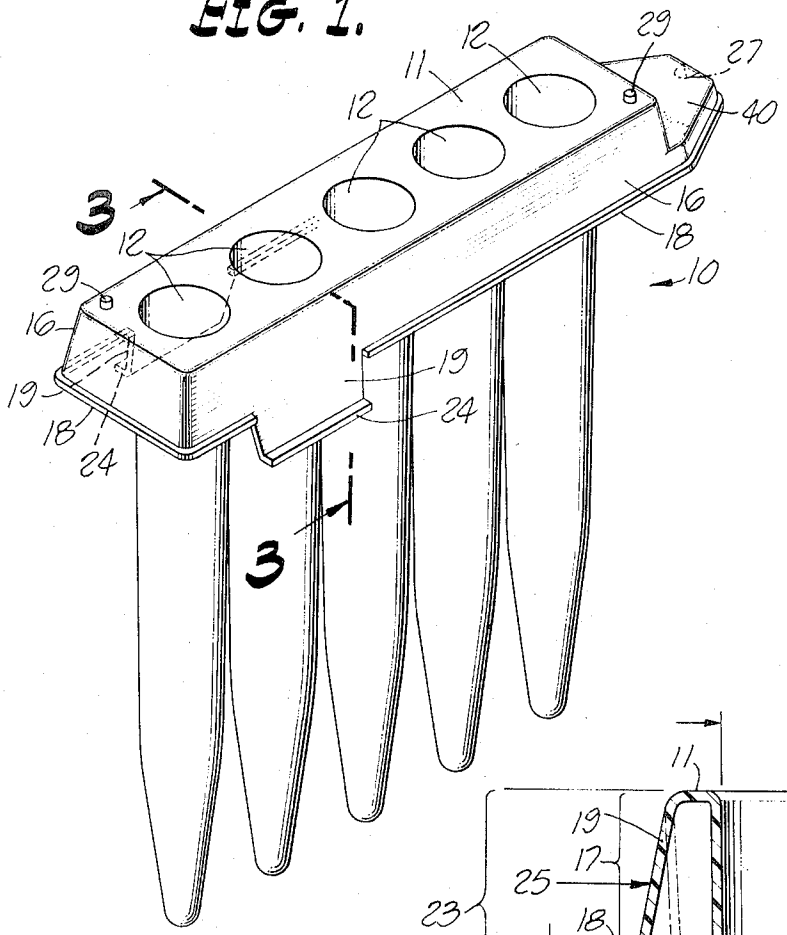


FIG. 3.

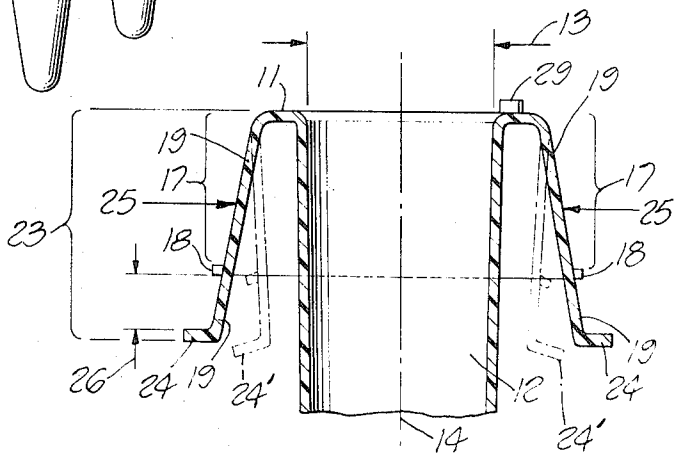
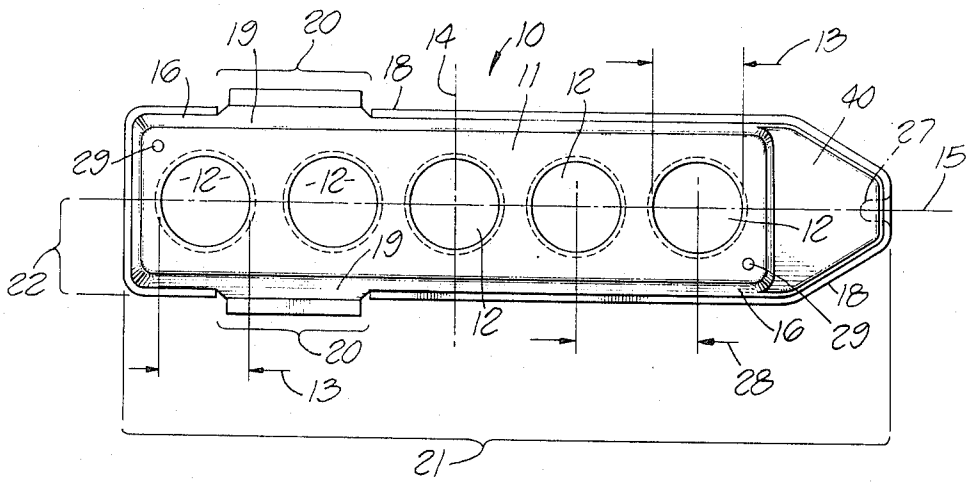


FIG. 2.



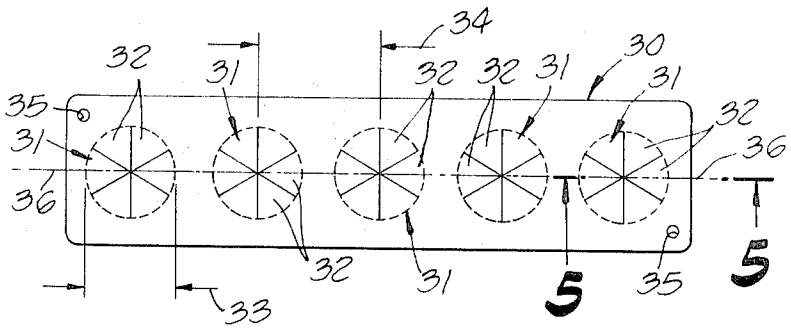


FIG. 4.

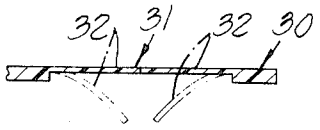


FIG. 5.

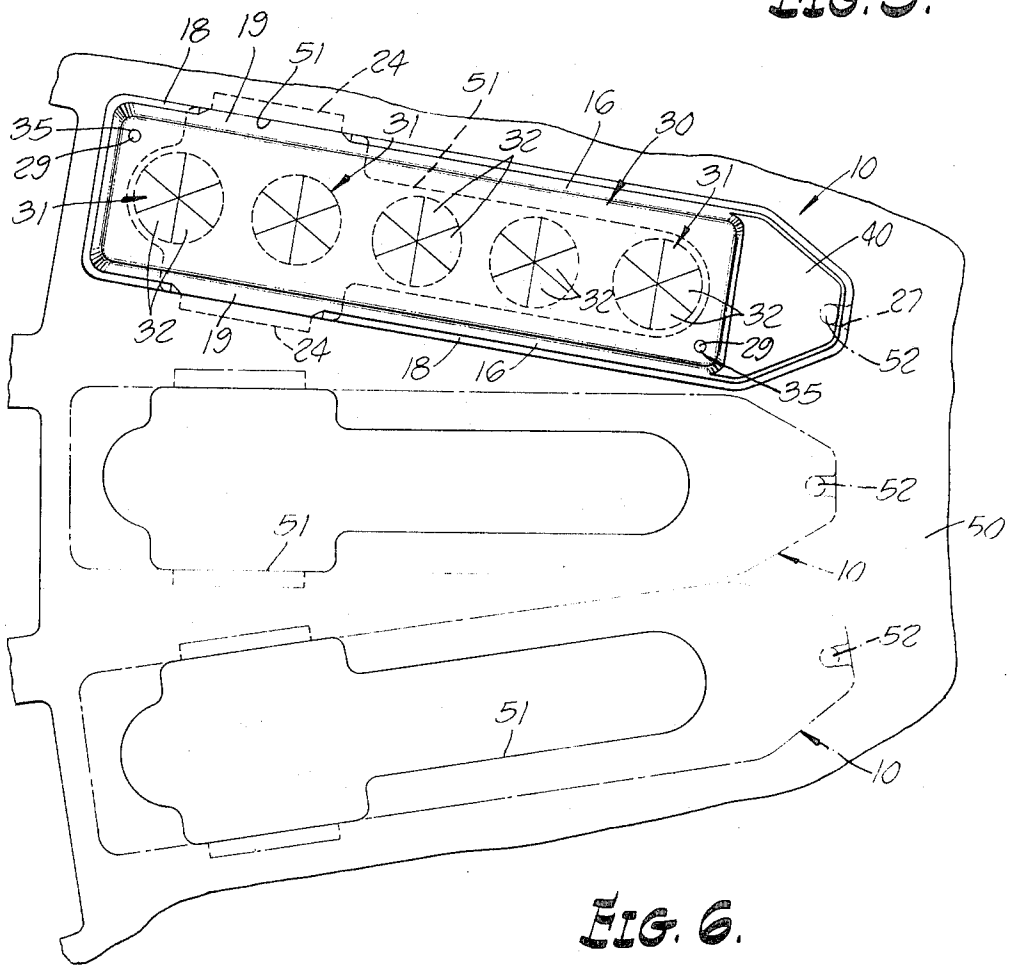


FIG. 6.

CHEMICAL ANALYSIS TUBE MODULE

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is related to the following applications, all assigned to the same assignee as the present application:

Ser. No. 177,555 for TABLET DISRUPTOR DEVICE by Donald B. Rohrbaugh and Everett Petersen, Jr., filed Sept. 18, 1971;

and the following applications filed herewith,

Ser. No. 231,348 for CHEMICAL SAMPLE REACTOR MODULE by Donald G. Rohrbaugh;

Ser. No. 231,268 for CHEMICAL ANALYSIS SAMPLE DISSOLVER MODULE by Donald G. Rohrbaugh, Everett Petersen, Jr., and C. P. Chase;

Ser. No. 231,353 for CHEMICAL ANALYSIS ROTARY MODULE by Donald G, Rohrbaugh and William R. Pearson; and

Ser. No. 231,351 for AUTOMATED CHEMICAL ANALYSER SYSTEM by Donald G. Rohrbaugh, William R. Pearson, Everett Petersen, Jr., and C. P. Chase.

BACKGROUND OF THE INVENTION

The chemical analysis tube module of this invention is particularly useful in automated chemical analysis requiring wet chemical analysis of substances dissolved in solution. It is very desirable to have a simple, relatively inexpensive, chemically clean test tubular module in which a set of wet chemical analysis procedures can be conducted. After one or more analyses of a specific composition the module may be discarded, if desirable.

A sample capsule and filtering mechanism relating to the present invention is disclosed in U.S. Pat. No. 3,540,856 to J. E. Rochte and Jack L. Hoffa. A sample capsule has a cup of special form in which a precipitate is formed and a filter cup with a filter paper bottom is received atop the precipitate. A mechanism is provided for automatically dropping the filter cup into the capsule and applying a vacuum to the cup, drawing clear filtrate through the filter paper into the cup for further processing.

Unger in U.S. Pat No. 3,533,744 discloses an automated apparatus and method, particularly adapted to patient blood sample analysis.

Baruch and Travaglio in U.S. Pat No. 3,192,968 disclose an apparatus for performing analytical procedures, treating liquid samples in accordance with predetermined analytical methods.

In Canadian Pat. No. 868,484 Rochte, Martin, Hoffa, and Moore also teach an automated chemical analyzer, utilizing the sample capsule and filtering mechanism of Rochte et al referenced above.

SUMMARY OF THE INVENTION

An integral thin wall thermoplastic chemical analysis tube module combination provides a plurality of test tubular receptacles which is quickly positioned and locked in place in an automated chemical analysis device. The tube module provides means in which the wet chemical analysis of a sample solution can be sucessively carried out in a plurality of tubular receptacles. A volume of liquid sample and the required volumes of reagent solutions can be transferred from one test tubular receptacle to another as required, prior to a final automated analysis measurement by spectro-photometer or the like. The integral tube module combination has an elongated rectangular planar area having a plurality of uniform aperture test tubular receptacles normally disposed to and integrally secured to the planar area. The tubular receptacles are symmetrically disposed along the elongated line of symmetry of the planar area. A first wall frame segment, having a first uniform height, is integrally secured to and supportively disposed around a major fractional segment of the perimeter of the planar area. A first uniform stiffener lip is secured to and disposed around a perimeter of the first frame segment, opposed to the planar area. An opposed pair of second thin wall frame segments, each one having a second uniform height, is secured to and supportively oppositely disposed around a pair of minor fractional segment perimeters of said planar area. The second wall height is precisely greater than the first wall height. A pair of second uniform stiffener lips is secured to and disposed around the pair of second frame segment perimeters opposed to the planar area. All of the above components are integrally joined and provide a flexible hinge displacement of the opposed pair of second frame segments with respect to the first frame segments, on the application of compressive force to the pair of second segments. The hinge displacement is adapted to an unclamping and clamping movement of the pair of second lips in a configured cut out aperture in a supporting plate. The lip height difference between the first and second stiffener lips provides a precise jaw clamp, securing the module combination in the configured cut out aperture.

Other aspects and advantages of this invention are taught in the following description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The description of this invention is to be read in conjunction with the following drawings:

FIG. 1 is a perspective elevational view of the chemical analysis tube module of this invention illustrating the plural test tubular receptacles and the precise jaw clamp provided by the hinge displacement of the first and second stiffener lips.

FIG. 2 is a plan view showing the elongated rectangular planar area having a plurality of test tubular receptacles disposed in and secured to the planar area, symmetrically along the elongated line of symmetry of the area.

FIG. 3 is a sectional view through 3—3 of FIG. 1.

FIG. 4 is a plan view of a cover plate which can be indexed coplanarly over the planar area illustrated in FIG. 2.

FIG. 5 is a cross sectional view through 5—5 of FIG. 4.

FIG. 6 is a planar view of a supporting plate in an automated chemical analyser, wherein the chemical analysis tube module is shown disposed in an operative configuration in the analyser table, together with a configured cut out aperture in the supporting table into which the tube module fits.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1, 2 and 3 in detail, the chemical analysis tube module 10 is first shown in a perspective view, having an elongated rectangular thin wall planar

area 11. The area 11 has a plurality of uniform aperture test tubular receptacles 12 normally disposed to and integrally secured to the area 11. The uniform aperture diameter 13 has a typical line of center 14 for the receptacle 12. The elongated line of symmetry 15 of the planar area 11 bisects the plurality of receptacles 12. The receptacles are disposed the spaced distance 28 on the line of symmetry 15. A first thin wall frame segment 16 has a first uniform wall height 17, and is integrally secured to and disposed around the major fractional segment perimeter of the planar area 11. A first uniform stiffener lip 18 is integrally secured to and disposed around the perimeter of the first frame segment 16, opposed to the planar area 11.

An opposed pair of second thin wall frame segments 19 each have a second uniform wall height 23 integrally secured to and supportively oppositely disposed around a pair of minor fractional segment perimeters of the planar area 11. The first thin wall frame segments 16 and the second thin wall frame segments 19 are integrally secured together and to the planar area 11. Typically the first uniform stiffener lip 18 is disposed the major fractional perimeter of the tube module 10 over the length 21, excepting for the minor fractional perimeters of the pair of opposed second thin wall frame segments 19. Over the second thin wall frame segments 19 having the lengths 20, the pair of second uniform stiffener lips 24 is disposed. The pair of lips 24 is integrally secured to and disposed opposed to the planar area 11.

As illustrated in FIG. 3, the lip height difference 26 between the stiffener lip 18 and the opposed pair of stiffener lips 24 provide a precise jaw clamp, useful for securing the tube module combination 10. By utilizing a flexible thermoplastic, thin wall material, the compressive displacement force 25 on the pair of segments 19, inwardly displaces the second pair of stiffener lips 24 to the position of the displaced lips 24'.

Referring now to FIG. 6, the compressed second frame segments 19 and their pair of inwardly displaced stiffener lips 24' can then be inserted through the configured cut out aperture 51 in a supporting plate 50, then released. The inwardly displaced pair of stiffener lips 24' will then return outwardly towards their normal position of stiffener lips 24 remaining slightly compressed, providing a precise jaw clamp for the test module 10, and securing 10 in a precisely fixed position in a cut out aperture 51.

Thus each one of a multiplicity of tube module combinations 10 can be placed in a single configured cut out aperture 51 in a rotary indexing table or the like, positioning the tube module for a systematic uniform automated analytical procedure.

FIGS. 2 and 4 taken in conjunction with FIG. 1 illustrates a pair of diagonally opposed indexing means apertures 35 provided in the cover 30, suitable for indexing the cover 30 with its appropriate pair of indexing pins 29.

Referring to FIGS. 4, 5 and 6 in detail, the cover plate 30 is illustrated, having plural apertures 31 disposed therein, each one of the apertures 31 being spaced along the elongated line of symmetry 36 of the cover 30. The typical spaced distance 34 between a pair of apertures 31 provides a confronting aperture 31 for each one of the uniform aperture diameters 13 of tube module 10. Each one of the apertures 31 has multiple sectors 32 formed therein by incising divisions radially directed from the circular center of apertures 31. The diameters 33 of the plural apertures 31 are substantially equal to the uniform aperture diameter 13 of the test tubular receptacle 12.

FIG. 5 indicates in a cross sectional view of FIG. 4 that the multiple sectors 32 are thin films, easily flexed in a hinged manner, as they are attached to the body of the cover 30. Thus in FIG. 6, it is possible to insert a liquid volume sample probe through the cover 30 over tube module 10 inserting a liquid sample or providing a reagent for a chemical reaction. The multiple sectors 32, when bent downward on insertion of a tubular probe, also provide an important wiping action when the probe is removed, the exterior of the probe being wiped by the flexing sectors 32. The sectors 32 then return to their normally planar horizontal position after the removal of the probe tube.

FIG. 6 discloses in planar view a tube module 10 covered by a cover 30. The cover 30 is secured by the pair of indexing pins 29, 29. The plural apertures 31 are shown having multiple sectors 32 disposed in horizontal planar position. An indexing land 40, which is a component of the tube module 10 is shown disposed in a position suitable for activating an indexing switch or the like. When the table 50 in which the tube modules 10 are disposed, rotates beneath a pressure activated switch, the indexing land 40 can activate the switch, sending an electrical signal through a desired electrical circuit. A tube module 10 can have an indexing aperture 27 as illustrated in FIG. 2, disposed adjacent the land 40, as an indexing means useful for further precisely locating the module 10, or the like. The aperture 27 can be indexed with a locating pin 52 which can be secured on the table 50, or the like, adjacent the typical cut-out aperture 51.

The specific embodiment of the tube module 10 has five test tubular receptacles. The plurality of test tubular receptacles can typically range from two to seven. Each receptacle can provide an analytically clean volume in which a liquid sample can be disposed and reacted when necessary with reagents to produce a desired chemical step, in an analytical procedure suitable for automated analysis. Typically each single test tube receptacle can range in volume from 2 to 20 millimeters, or the like, depending upon the volume required for analysis.

It is becoming increasingly necessary in terms of the variety and complexity of consumer oriented masses of chemical, pharmaceutical and food products that automated means be provided for analyzing the products in order to safeguard the health and safety of the consumer populace. The invention disclosed herein provides an inventive advance in the art of automated chemical analysis.

Obviously, many modifications and variations in the improvement in a chemical analysis tube module can be made in the light of the above illustrative embodiment, and teaching. It is therefore understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. An integral, thin wall thermoplastic chemical analysis tube module combination comprising:

an elongated rectangular, planar area having a plurality of test tubular receptacles of uniform apertures normally disposed to and secured to said planar

area, said tubular receptacles disposed along the elongated line of symmetry of said planar area;

a first thin wall frame segment having a first uniform height secured to and supportively disposed around a major fractional segment perimeter of said planar area,

a first uniform stiffener lip secured to and disposed around the perimeter of said first frame segment, opposed to said planar area,

an opposed pair of second wall frame segments, each one having a second uniform height, secured to and supportively oppositely disposed around a pair of minor fractional segment perimeters of said planar area, said first and second thin wall frame segments secured together, and said second wall height precisely greater than said first wall height,

a pair of second uniform stiffener lips secured to and disposed around said pair of second frame segment perimeters opposed to said planar area,

said first frame segment, first lip, pair of second frame segments, pair of second lips providing a flexible hinge displacement of said opposed pair of second frame segments with respect to said first frame segment on application of compressive force to said pair of second segments, said hinge displacement suitable for an unclamping and a clamping movement of said lips in a configured cut out aperture, and

the lip height difference between said first and said second stiffener lips providing a precise jaw clamp, rigidly securing said tube module combination in said configured cut-out aperture in a supporting plate.

2. A chemical analysis tube module as set forth in claim 1 wherein said plurality of test tubular receptacles range from two to seven.

3. A chemical analysis tube module as set forth in claim 1 wherein each test tubular receptacle ranges from a volume of 2 to 20 milliliters.

4. A chemical analysis tube module as set forth in claim 1 wherein a signal land area is disposed across said elongated line of symmetry adjacent to and being a minor fractional area of said rectangular planar area.

5. A chemical analysis tube module as set forth in claim 1 wherein a thermoplastic cover plate having indexing means coplanarly securing said cover to said rectangular planar area has a cover aperture disposed over each test tubular receptacle aperture, each said cover aperture formed of a plurality of thin, flexible, radial sector divisions flexibly hinged to the perimeter of said cover aperture.

6. In an integral, thin wall, thermoplastic chemical analysis tube module having an elongated rectangular planar area to which a plurality of test tubular receptacles of uniform apertures are normally secured along the elongated line of symmetry and having a thin wall frame which is supportively disposed around the planar area perimeter, the combination comprising:

a first wall frame segment of uniform height, forming a major fractional segment perimeter of said planar area,

a first uniform stiffener lip integrally secured to and disposed around the perimeter of said first frame segment, opposed to said planar area,

an opposed pair of second wall frame segments, each one having a second uniform height, supportively oppositely disposed around a pair of minor fractional segment perimeters of said planar area, said second wall height precisely greater than said first wall height,

a pair of second uniform stiffener lips integrally secured to and disposed around said pair of second frame segment perimeters opposed to said planar area,

said first frame segment, first lip, pair of second frame segments, and pair of second lips providing a flexible hinge displacement of said opposed pair of second frame segments with respect to said first frame segment on application of compressive force to said pair of second segments, said hinge displacement suitable for an unclamping and a clamping movement of said lips in a configured cut-out aperture, and

the lip height difference between said first and said second stiffener lips providing a precise jaw clamp, rigidly securing said tube module combination in said configured cut-out aperture in a supporting plate.

7. A chemical analysis tube module as set forth in claim 6 wherein a signal land area is disposed across said elongated line of symmetry, adjacent to and being a minor fractional area of said rectangular planar area.

8. A chemical analysis tube module as set forth in claim 6 wherein a thermoplastic cover plate having indexing means coplanarly securing said cover to said rectangular planar area has a cover aperture disposed over each test tubular receptacle aperture, each said cover aperture formed of a plurality of thin, flexible, radial sector divisions flexibly hinged to the perimeter of said cover aperture.

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