Dec. 16, 1969 H. W. RITTER 3,483,997

TEST TUBE RACK AND TEST TUBE CAPPING DEVICES

Filed July 3, 1967 3 Sheets-Sheet 1

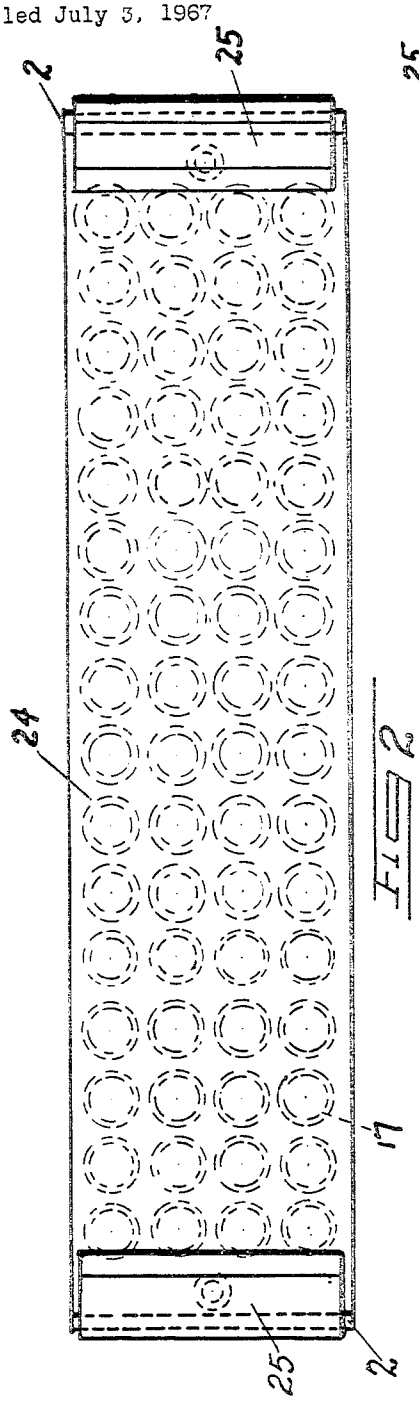

FIG 2

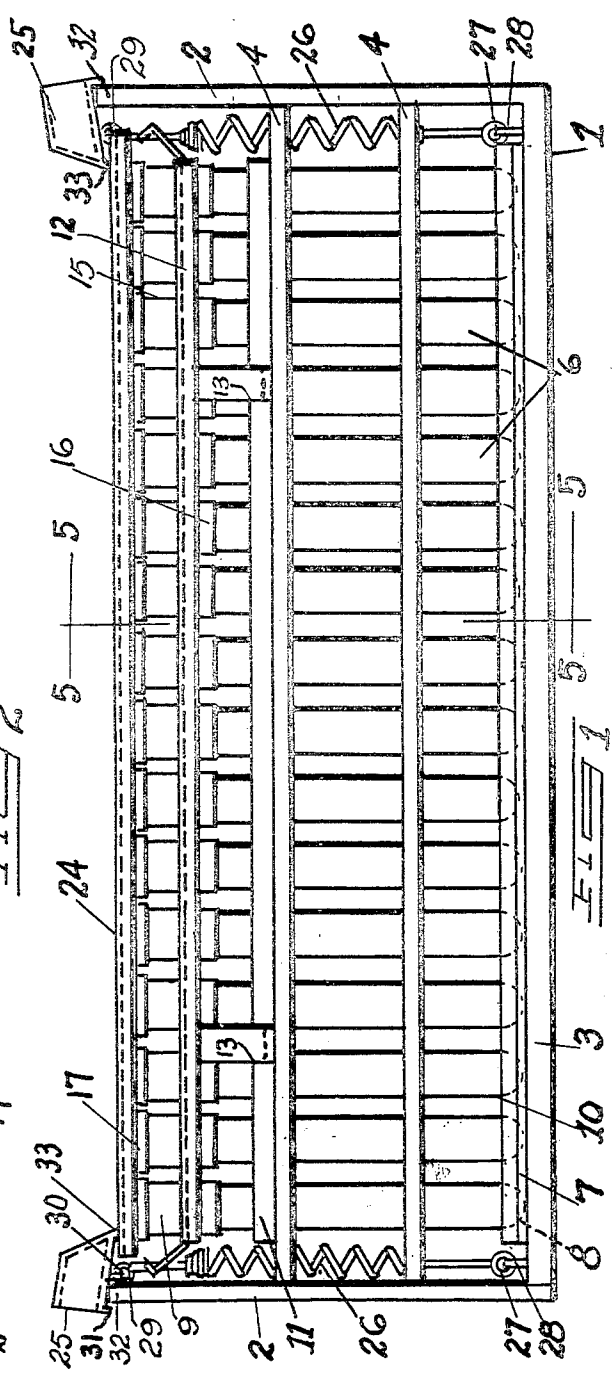

FIG 1

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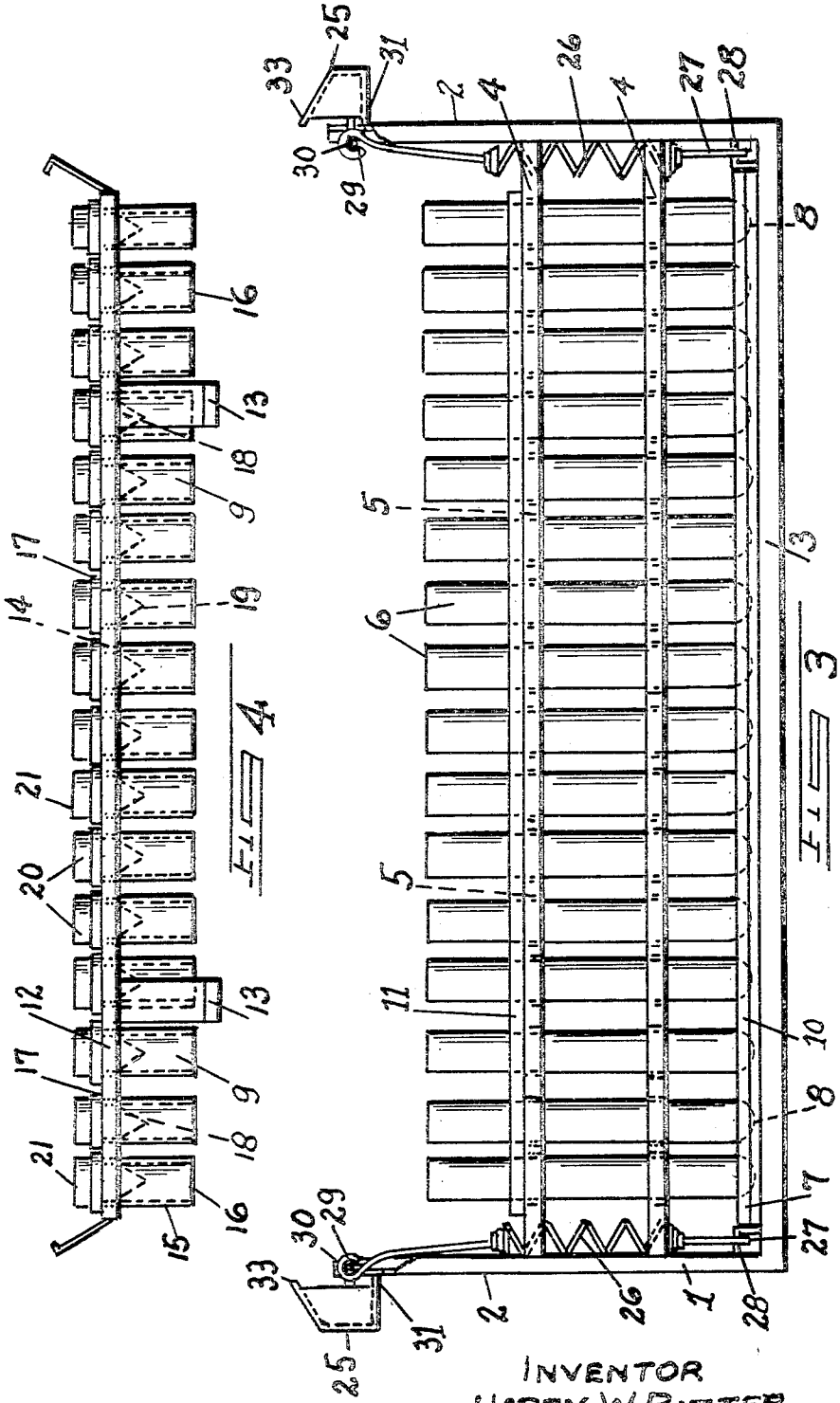

FIG 4

FIG 3

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TEST TUBE RACK AND TEST TUBE CAPPING DEVICES

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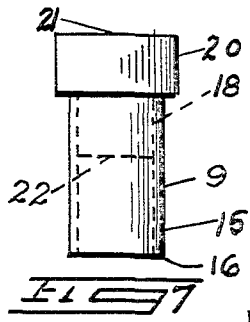

FIG 7

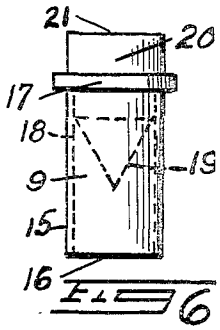

FIG 6

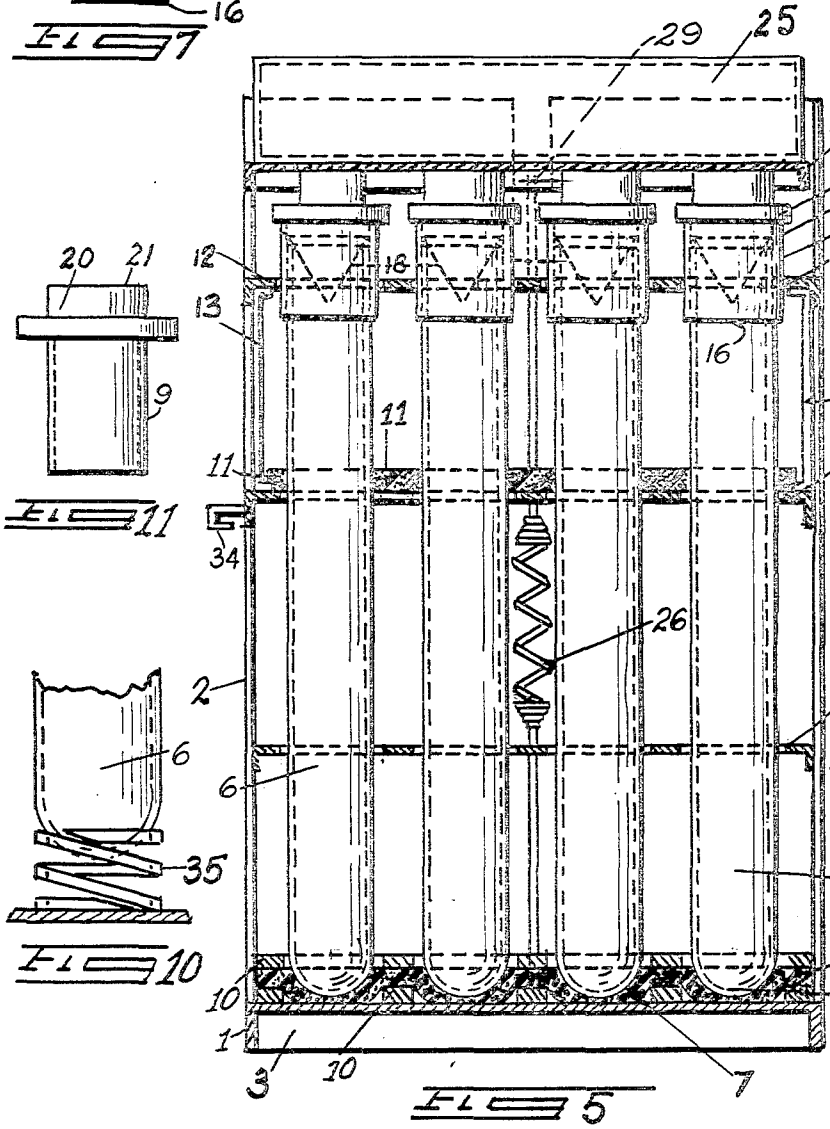

FIG 5

FIG 11

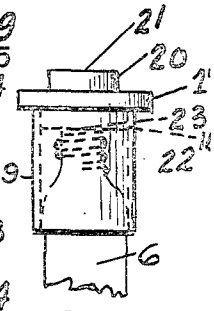

FIG 8

FIG 10

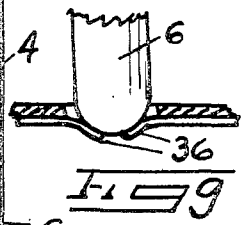

FIG 9

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TEST TUBE RACK AND TEST TUBE CAPPING DEVICES

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Int. Cl. A47b 73/00
U.S. Cl. 211—76 13 Claims

ABSTRACT OF THE DISCLOSURE

The invention comprises a rack for retaining multiple spaced test tubes. The test tubes being arranged in longitudinal and lateral rows and secured from breakage. A removable tray is provided for supporting caps for the spaced test tubes and to simultaneously position or remove the caps from the test tubes and another removable plate is adapted to apply pressure on top of the caps when the caps are placed over and in sealing position on the test tubes.

This invention relates to caps and pressure means for sealing and unsealing a multiple of test tubes arranged in racks for holding the test tubes in spaced positions.

It is an object of my invention to provide a test tube sealing cap, together with pressure means, for holding the caps on the test tubes when the test tubes are used as culture tubes in a laboratory.

Another object of my invention is to provide a cap for a test tube with pressure means for holding a multiple of caps on a multiple of test tubes in a rack, together with a tray that permits individual tubes to be uncapped and also provides a means, in cooperation with the caps, to uncap simultaneously all of the test tubes in the rack.

These and other objects of my invention will become apparent in the following description when taken in conjunction with the accompaning drawings wherein like characters denote like or corresponding parts throughout the several views.

FIGURE 1 is a side elevation of a rack with test tubes in capped condition by my pressure means.

FIGURE 2 is a top plan view of the rack shown in FIGURE 1.

FIGURE 3 is a side elevation of the rack illustrating the test tubes without caps, cap removal tray and pressure plate.

FIGURE 4 is a side elevation of the cap removal tray with the caps held in the removal tray.

FIGURE 5 is an end view in section through the rack taken on line 5—5 of FIGURE 1.

FIGURE 6 is a side view of a cap having a tapered inner plug for directing the plug into a test tube.

FIGURE 7 is a side view of an alternate type of cap without a tapered plug to seal a no-lip type of culture test tube.

FIGURE 8 is a side view illustrating the use of my cap on screw cap type of test tubes.

FIGURE 9 is a fragmentary side view of a test tube and leaf spring bumper for the bottom of test tubes.

FIGURE 10 is a fragmentary side view of a coil spring used as a bumper for the bottom of test tubes.

FIGURE 11 is a side view of a cap having no inner seal for test tubes where it is not necessary to exclude air from the test tubes.

During tissue work involving the growing of animal (or vegetable) cells in vitro for various studies, the tubes containing the cells, nutrients etc. must be opened a number of times. Where screw caps or standard rubber stoppers are employed, these many opening and closing procedures become laborious and time consuming, also the chance of contamination is increased.

My holding mechanism and cap make it possible to manipulate many caps at one time thus eliminating the individual handling of tube and cap when it is desired to uncap all the tubes in a rack. Anyone of the tubes, when closed by the new cap, may be examined individually with the cap remaining on the tube thereby reducing the chances of contamination and excessive air exposure of the tube contents.

The cap may be used with tubes having a threaded neck (screw cap type). This makes it possible to use the new unit with tubes currently in use in large numbers by many laboratories doing tissue culture studies.

A flat seal in the cap enables it to be used on a standard bacteriological type no-lip culture tube.

The cap is adapted to be used in tissue culture studies where an air-tight seal is required on the tube. However, by eliminating the insert plug or integral seal from inside the cap, a non air-tight closure will result. Thus, the altered cap may be used on standard bacterial or fungal culture tubes.

The rack, with capped tubes and cap holding device in place, may be incubated statically or secured to a standard roller drum as commonly used in tissue culture work to obtain roller or non static cultures.

The cap holding mechanism may be fabricated from aluminum, stainless steel or other generally non-corrosive heat stable material.

The material for the caps is made of heat stable, i.e. polypropylene. The insert or seal in the cap is a non-toxic, resilient, heat stable material, preferably rubber of the white silicone type. The seal may also be an integral part of the cap. Caps may also be fabricated from a non-thermostable plastic, viz polyethylene.

In the case of polyethylene, the seal may be an integral part of the cap, since the resiliency of polyethylene lends itself to this type of closure. Caps fabricated from this non-thermostable material would be disposable and intended for use on disposable glass tubes. The tube and cap would thus be considered a unit and could be sterilized by other means than by heat i.e. ethylene oxide gas etc.

Referring to FIGURE 1, there is illustrated a rack **1** having ends **2** with a base **3** secured together. There are shelves **4** secured in stationary position to the ends **2**. Each of these shelves have spaced holes **5** that are adapted to loosely position test tubes **6** that are spaced in rows in the shelves. All the holes are in vertical axial alignment. Covering the top of the base there is a resilient pad **7** upon which the bottoms **8** of the test tubes rest. The resilient pad reacts to downward pressure on caps that are on the test tubes and preserves them from breakage when pressure is applied on the caps **9** to seal the test tubes. A plate **10** is superimposed on the pad and has spaced holes in line with the holes on the shelves. This plate positions and holds the bottoms of the test tubes. It is superimposed over the entire surface of the resilient pad which provides a means to compensate for the variable lengths of the test tubes.

Secured to the top of one of the shelves there is a pad **11** of a resilient noncontaminating material having holes centered on the holes in the shelves. The holes in the resilient pad are slightly smaller in diameter than the test tubes and the internal walls of these holes slidably and frictionally engage the outside of the test tubes and hold the test tubes in place in the rack when the rack, with the tubes in it, is inverted.

A cap removable tray **12** is supported on the top shelf **4** by legs **13**. This tray has holes **14** sufficient in size to slidably receive the outer body diameter **15** of the caps **9** and the holes are centered on the holes in the shelves.

When the tray is in place in the rack, ends **16** of the cap extend considerably lower than the tray to in-

sure that the caps will remain in the tray when the tray is at rest on the shelf 4. When the tray is raised from rest on the shelf 4, all of the caps will be raised by it and uncap all of the test tubes simultaneously when it is raised from capping position.

The caps have a flange 17 larger in diameter than the outer diameter of the cap. This flange is also larger in diameter than the holes in the tray 12. These flanges, together with the tray, are the means for raising all of the caps simultaneously from the test tubes in the rack. The caps are essentially a tube having an inner diameter that is larger than the outside diameter of the test tubes and allows them to readily slide down on the test tubes. The flanges may be integral with the cylinder of the cap or integral with resilient plugs 18. The plugs are secured on the tops of the caps. One form of plug, see FIGURE 6, has a tapered bottom 19 internal of the cap to facilitate the locating of the plug within the test tube when the caps are in tray 12 and all of the caps are lowered together for placing them on the test tubes and simultaneously sealing the test tubes. Each of the caps have a resilient button 20 that is compressible and pressure on tops 21 of the resilient buttons forces the plugs into or on top of the test tubes to seal them. Another form of plug (see FIGURES 7 and 9) has a flat bottom adapted to be pressed on lips 23 of the test tubes and it likewise seals the tubes against air leakage and contamination. Another form of caps is shown in FIGURE 11. This cap does not have an inner plug and is used where test tubes need not be hermetically sealed but air is allowed or required for standard bacterial or fungal culture tubes.

A top pressure plate 24 is removably secured on top of the buttons of the plugs on the caps. Pressure is transmitted on the plugs by means of rotatable handles 25 connected to coil springs 26 having hooked ends 27 movably secured in eyes 28 that are fixed in the base of the rack. The coil springs have other hooked ends 29 that are movably secured in other eyes 30 that are fixed in the rotatable handles. The coil springs react on the handles and the handles in turn react and apply pressure on the top pressure plate.

Bottoms 31 of the handle rest on tops 32 of the ends of the rack. These tops provide a fulcrum for the handles when the springs react on the handles. Ends 33 of the handles rest on top of the pressure plate and these ends of the handles are the means for transmitting the force of the springs through the handles to the pressure plate which in turn applies pressure on the resilient buttons of the caps thereby simultaneously seal or unseal all of the tubes.

The racks have clips 34 secured on sides of the ends and these clips are provided to enable the racks, with the tubes, to be placed in a position slightly tilted to the horizontal plane so that maximum incubation throughout the tubes can be obtained.

In FIGURES 9 and 10 there are illustrated alternate means for supporting bottoms of test tubes. These alternate means comprise a coil spring 35 and leaf springs 36 which react to the pressure exerted by the top pressure plate thereby keeping the tubes in sealed condition.

To utilize my invention my caps are placed in the tray 12. The test tubes, with their culture, are positioned in the holes of the shelves in the rack and made ready to receive the caps with their plugs. When the rack is loaded with the test tubes the tray, with the caps, is placed in position so that each test tube will simultaneously be capped. When the caps are in place on the test tubes, the top pressure plate is placed on top of the caps. When the top pressure is in place the handles are rotated together on the top edges of the stand until other ends of the handles rest on the top pressure plate. The reaction of the springs connected to the handles will pull the handles down on the pressure plate which in turn will apply pressure on the caps and seal all the test tubes simultaneously.

During incubation, if it is desired to uncap all the tubes simultaneously, the handles are rotated to remove the pressure on the top pressure plate. After removing the pressure plate the tray, with the caps on them, is raised and all of the tubes will be uncapped simultaneously. If it is desired to inspect tubes individually, the tray is left in place and then each and every tube can be handled separately without uncapping any and all the test tubes.

With my caps having plugs it is possible to rotate the rack, with the tubes in it, around vertical and horizontal axis without spilling or leakage from the tubes.

Caps without inner plugs do not seat on the lips of the test tubes. This type of cap will be used on tubes for standard bacterial or fungal cultures. These caps allow air to enter the tubes.

Having thus described my invention, I claim:

1. A combined test tube rack and test tube capping device comprising;
   - a bottom together with horizontal shelves spaced vertically each to the other and fixed to end standards, said shelves having spaced holes in vertical axial alignment for positioning test tubes in said rack, a compressible resilient bumper superimposed on top of said base providing a leveling and pressure absorbing means for said test tubes when downward pressure is applied on tops of said test tubes,
   - a removable tray supported on one of said shelves having spaced holes adapted for alignment with the holes in said shelves,
   - caps for said test tubes slidable vertically in said tray and said tray adapted to lower the caps simultaneously from and to on top of said test tubes when said tray is raised or lowered in said rack said caps having a hollow cylindrical body portion of sufficient length to insure said caps will remain in said tray when said tray is at rest on said shelf or any surface outside said rack,
   - a removable plate adapted to be placed in said rack on top of said caps to apply downward pressure on said caps to seal said test tubes,
   - rotatable spring tensioned means pivoted on said standards adapted to impinge on said plate and transmit downward pressure on said plate to hold said test tubes in sealed condition by said caps.

2. A combined test tube rack and capping device as set forth in claim 1;
   - each of said caps having a flange larger in diameter than the holes in said removeable tray providing a means for uncapping said test tubes simultaneously when said pressure plate is removed and said tray is raised from said test tubes.

3. A combined test tube rack and capping device as set forth in claim 1;
   - and each of said caps having a tapered inner resilient plug adapted to be inserted in said test tubes to seal said test tubes.

4. A combined test tube rack and capping device as forth in claim 1;
   - and each of said caps having flat bottomed resilient plug adapted to be seated on top lips of said test tubes to seal said test tubes when pressure is applied on said caps.

5. A combined test tube rack and capping device as set forth in claim 1;
   - and each of said caps having a resilient compressible cushion on its top adapted to react to the pressure on the plate to seal the test tubes and hold said test tubes in fixed position in the rack and between the pressure plate and resilient bumper on said bottom of said rack.

6. A combined test tube rack and test tube capping device comprising;
   - a bottom together with horizontal shelves spaced vertically each to the other and fixed to end standards, said shelves having spaced holes in vertical axial alignment for positioning test tubes in said rack,

a compressible resilient bumper superimposed on top of said base providing a leveling and pressure absorbing means for said test tubes when downward pressure is applied on tops of said test tubes,

a removeable tray supported on one of said shelves having spaced holes adapted for alignment with the holes in said shelves,

caps for said test tubes slidable vertically in said tray and said tray adapted to lower the caps simultaneously from and to on top of said test tubes when said tray is raised or lowered in said rack, said caps having a hollow cylindrical body portion of sufficient length to insure said caps will remain in said tray when said tray is at rest on said shelf or any surface outside said rack,

a removable plate adapted to be placed in said rack on top of said caps to apply downward pressure on said caps to seal said test tubes,

rotatable spring tensioned means pivoted on said standards adapted to impinge on said plate and transmit downward pressure on said plate to hold said test tubes in sealed condition by said caps,

said caps adapted to be suspended in said tray around and away from tops of said test tubes to expose the contents of said test tubes to air.

7. A combined test tube rack and test tube capping device as set forth in claim **1**;

said bumper on said base being a resilient compressible pad adapted to absorb shock and pressure applied on said test tubes during capping of said test tubes and preserve said test tubes from breakage and hold said test tubes in sealed condition.

8. A combined test tube rack and capping device as set forth in claim **1**;

said bumper being a coil spring adapted to retain a bottom end of said test and adapted to absorb shock and pressure applied to said test tubes during capping of said test tubes and retain said test tubes in sealed condition between said caps and spring bumper.

9. A combined test tube rack and capping device as set forth in claim **1**;

said bumper being leaf springs adapted to upward pressure on bottoms of said test tubes to counteract downward pressure on said test tubes and hold said test tubes in sealed condition between said pressure plate and leaf springs.

10. A combined test tube rack and capping device as set forth in claim **1**;

one of said fixed shelves having a resilient pad superimposed on and fixed to it with holes in axial alignment with the holes in the shelves and said holes in said pad being smaller in diameter than the holes in the shelves whereby the test tubes are frictionally engaged to retain the test tubes in the rack when the rack, with the test tubes in it, is inverted.

11. A monostyle cap for a test tube comprising:

an elongated hollow cylindrical body portion, adapted to slidably surround an upper exterior portion of said test tube having an enlarged flange at one end thereof integral therewith and extending exterior of said body portion, thereby providing a means for raising and lowering said cap around said test tube,

an elongated resilient compressible plug secured to the interior of said cylindrical body on the underside of said flanged end of said body portion, and;

a resilient compressible button secured on top of said flanged end of said cylindrical body portion, to removably secure said cap on said test tube,

said plug adapted to be removably inserted interior of said test tubes to seal the test tubes when pressure is applied on said resilient button.

12. A cap for a test tube as set forth in claim **11**;

said elongated resilient compressible plug having a tapered end adapted to guide said plug into said test tube to seat the plug within the test tube prior to sealing the test tube with the plug by the application of pressure on said compressible button.

13. A cap for a test tube as set forth in claim **11**;

said elongated resilient compressible plug having a flat end interior of said cylindrical body adapted to be removably secured on a top rim of a test tube to seal said test tube by the application of and the release of pressure on said compressible button.

References Cited

UNITED STATES PATENTS

561,191	6/1896	Barnhart	215—82
1,520,088	12/1924	Schenkein	215—83
1,659,333	2/1928	Roberts	211—76
2,056,253	10/1936	Carroll	215—83
2,576,580	11/1951	Edwards	215—83 X
2,710,694	6/1955	Carr	211—76
2,970,700	2/1961	Lacy	211—74
3,191,790	6/1965	Coven	215—83

FOREIGN PATENTS

1,315,748	12/1962	France.

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U.S. Cl. X.R.

215—38, 83