Nov. 29, 1949 M. RESNICK 2,489,723

COLOR COMPARATOR HAVING A HOLDER FOR REVERSING SAMPLES

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Fig. 1

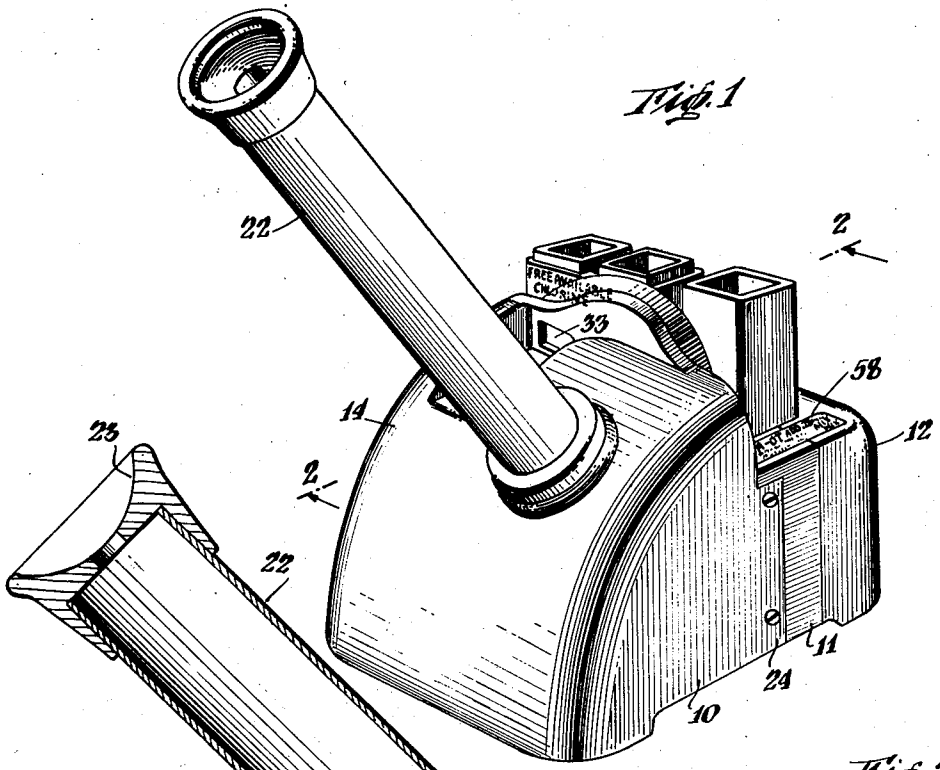



Fig. 2

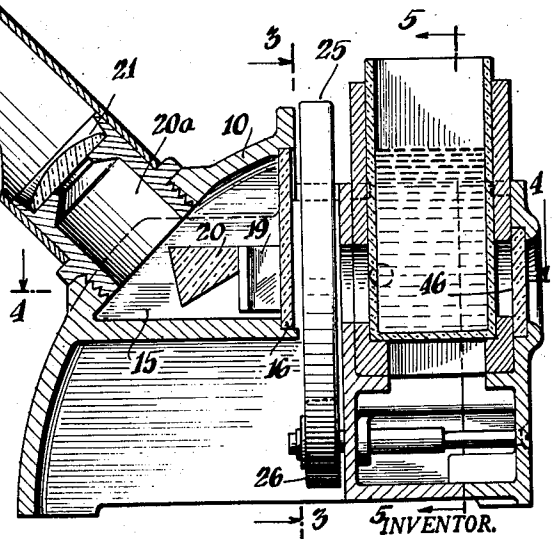
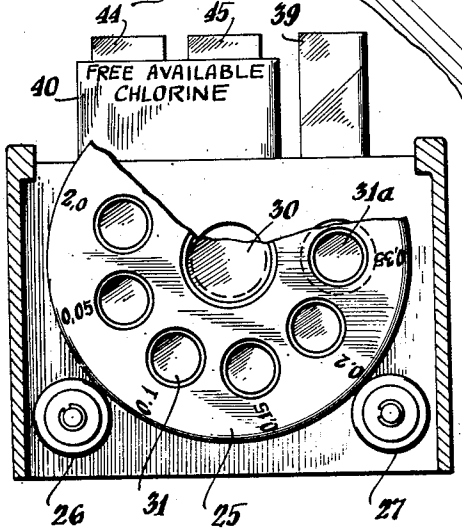



Fig. 3




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Fig. 4

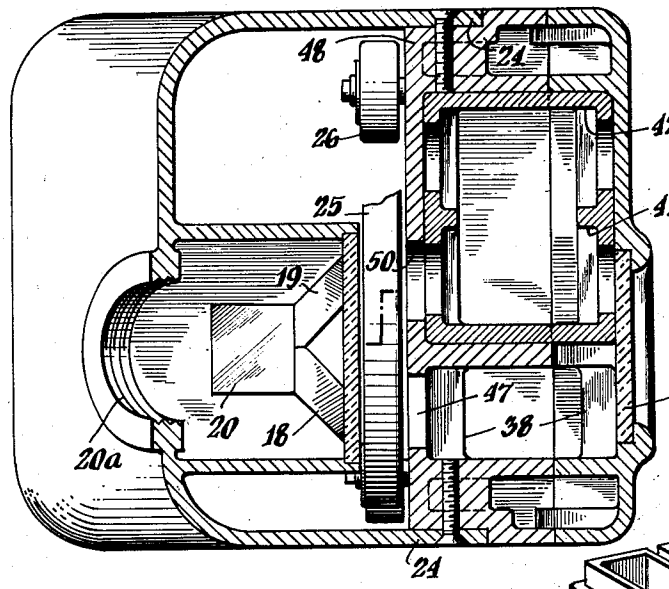



Fig. 7

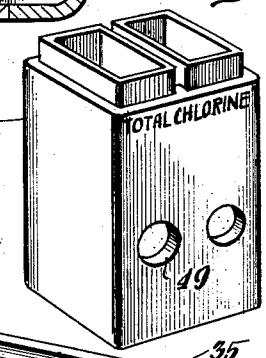
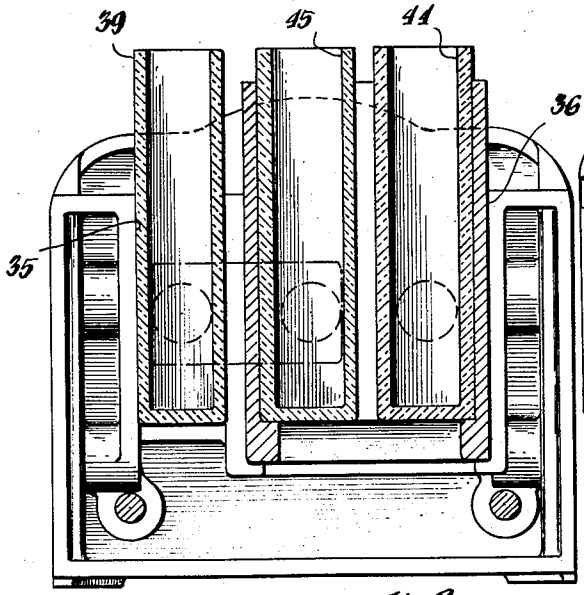



Fig. 5



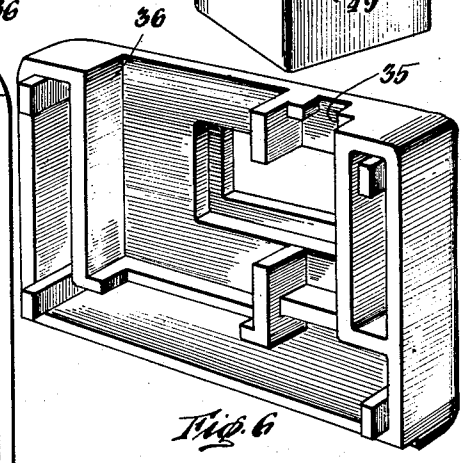




Fig. 6

Fig. 8

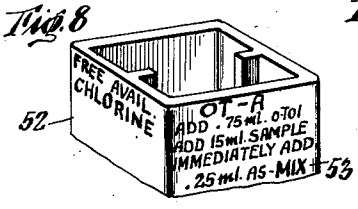
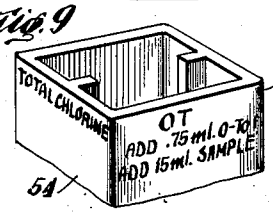



Fig. 9




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Fig. 10

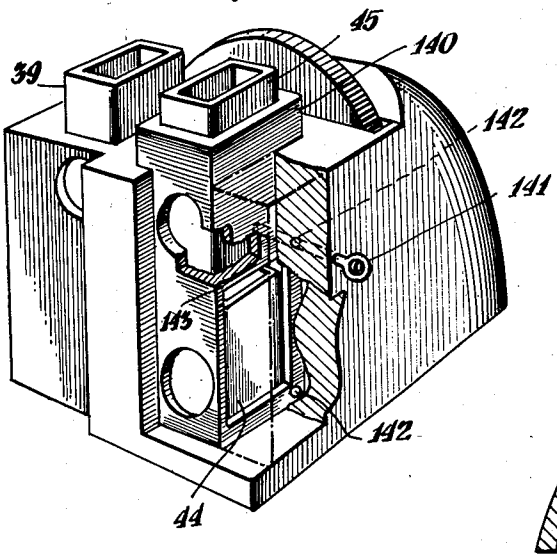



Fig. 12

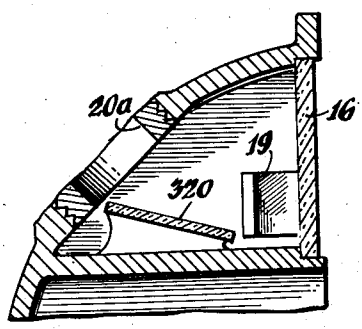



Fig. 11

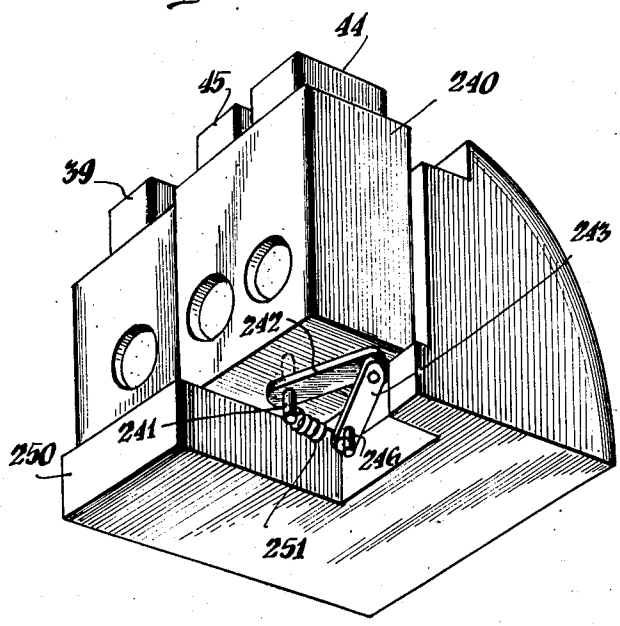
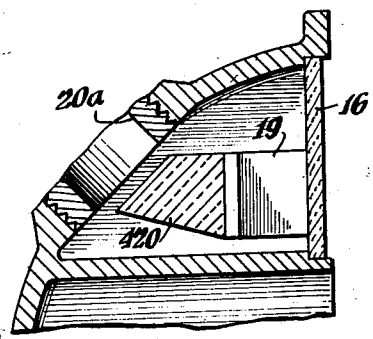



Fig. 13




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# UNITED STATES PATENT OFFICE

2,489,723

## COLOR COMPARATOR HAVING A HOLDER FOR REVERSING SAMPLES

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Application February 27, 1947, Serial No. 731,360

5 Claims. (Cl. 88—14)

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This invention relates to color comparators for use in testing liquids by comparing the color of the liquid with graduated standards, and more particularly relates to improvements in instruments of a type exemplified in the patents to Gerald D. Peet, No. 1,976,672 issued October 9, 1934, and No. 2,341,810 issued February 15, 1944, to which reference may be had for details of various parts therein disclosed to be useful in such devices.

Important objects of the present invention are to provide a novel device of the type described, wherein a plurality of colorimetric tests may be conveniently performed; to provide compact and improved apparatus adapted for use under a variety of circumstances, particularly in tests which may involve more than one comparison; to afford means whereby the performance of a series of colorimetric observations with a given liquid or set of liquids may be achieved with relatively little attention, on the part of the operator, to procedural details; and to provide improved and more effective instruments of the character described, which at the same time are sensitive, reliable, and rugged in construction.

While devices embodying the present invention may be employed for other types of tests, especially other observations where comparison of color must be made between a reference cell (e. g. as seen through selectable color standards) and a plurality of samples in succession, as to determine the effect of different strengths of solution on indicators, a particularly important purpose of the invention is to facilitate the performance of the so-called ortho-tolidine-arsenite test for determining the chlorine content of water that has been treated with chlorine or chlorine-supplying material to purify it for drinking or other uses.

For many years the more simple ortho-tolidine test has been employed for chlorine detection, based on the well known reaction with ortho-tolidine whereby a yellow-to-orange color is produced having a shade generally indicative of the amount of available chlorine present. In many cases, however, and particularly for results of the greatest accuracy, the ortho-tolidine test alone may not provide enough information. For example, other materials are occasionally present in the water, such as iron, manganese, and nitrites, which may themselves produce a color in the presence of ortho-tolidine. Furthermore the response of the reagent is rather slow to combinations of active chlorine with nitrogen compounds, i. e. combinations that are conveniently called

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chloramines, and where the latter may have been formed in the water, it is sometimes impossible to determine whether the reading of an ortho-tolidine test indicates free available chlorine alone or whether it also represents part or all of such chloramine as may be present.

Accordingly tests of a type identified by the name ortho-tolidine-arsenite have been developed, based on the fact that a material such as sodium arsenite will prevent the color reaction between chlorine or chloramines and ortho-tolidine, but will not affect the reaction of the latter with so-called "interference", e. g. manganese, nitrites, or iron, and will not affect any reaction between ortho-tolidine and chlorine or chloramine that may have already taken place before the arsenite is introduced. While with the supplemental use of an arsenite various sets of observations may be made comparing reacted samples with standards or blank samples, e. g. to provide separate measurements of chloramines and free chlorine, it has now been found that by a simple operation, e. g. involving only two comparisons, a determination can be directly and immediately obtained revealing both the value of total chlorine content and the value of free available chlorine content, in the treated water. In each instance the effect of interfering substances is eliminated, and if desired the amount of chloramine can also be found, since it is simply the arithmetical difference of the two readings mentioned. This particular procedure, which is described hereinbelow and which includes a direct reading of the total chlorine content (consisting of free chlorine plus chloramines), is of notable advantage in various water or sewage treatment plants where at other times or by other means a recording only of total chlorine content may have been had; readings by the improved procedure can then be readily compared or correlated with the data otherwise or previously obtained.

As intimated hereinabove, the apparatus of the present invention is adapted for performing a series of colorimetric observations for ortho-tolidine-arsenite or other tests; and it is peculiarly suited for the improved and presently preferred procedure just mentioned. Since operators of chlorine treatment systems are normally interested in readings of total chlorine and free chlorine residuals only, and less often have need to know the chloramine content, the invention is of further, specific value in providing direct determinations of total and free chlorine without supplemental computation.

To the foregoing and other ends a particularly advantageous embodiment of the invention is shown by way of example in the accompanying drawings, wherein:

Figure 1 is a perspective view of the comparator;

Fig. 2 is a vertical section on line 2—2 of Fig. 1 (see also Fig. 4);

Fig. 3 is a vertical section on line 3—3 of Fig. 2;

Fig. 4 is a horizontal section on line 4—4 of Fig. 2;

Fig. 5 is a vertical section on line 5—5 of Fig. 2, with the rearmost housing section removed;

Fig. 6 is a perspective view of the rearmost part of the supporting housing, with a window glass removed;

Fig. 7 is a perspective view of a removable sample carrier shown in Figs. 1 to 5 inclusive;

Figs. 8 and 9 are fragmentary perspective views of the carrier, facing respectively opposite corners;

Fig. 10 is a rear perspective view, partly broken away, of a modified form of the comparator;

Fig. 11 is a rear perspective view, seen from below, of another modification;

Fig. 12 is a fragmentary vertical section, similar to Fig. 2, showing another arrangement in the viewing means; and

Fig. 13 is a view like Fig. 12, showing still another optical arrangement.

Referring to the drawings, the illustrated apparatus includes a housing or supporting structure which, for convenience in manufacture, may be made in three sections, i. e. a front section 10, a central section 11, and a rear section 12. These parts may be castings of aluminum or other metal, or may be molded of plastic material such as Bakelite, hard rubber, or the like. The front housing section 10 has a curved front wall 14 and encloses a compartment 15 faced at its rear side by a preferably transparent window 16, for example of glass or Lucite. The window is disposed to be traversed by the spaced, parallel paths of light that extend respectively through two samples under inspection as hereinbelow explained, and appropriate optical means such as the prisms 18, 19, 20, which may be supported by cementing them to each other and to the window as shown, are provided to guide rays of light from the two paths into a closer parallel relationship and to direct them obliquely upwards through a sight opening 20a. A simple magnifying lens 21 of moderate power is placed over the sight opening, for better observation of the adjoining images reflected or refracted by the prism system, and if desired a long viewing tube 22 with an apertured eye piece 23 at its outer end may be mounted to extend from the sight opening so as to keep out extraneous light and to facilitate attainment of proper focal length for the eye of the observer in relation to the lens 21.

The housing section 10 has side portions 24 that overlap a part of the central section 11, and are fastened thereto with a space between the sections that thus constitutes a deep vertical slot extending transversely of the instrument, to receive a color standard disk 25. The disk is supported by a pair of free-running rollers 26, 27 at the lower corners of the slot, so that it may be rotated about its axis by manual displacement of its exposed upper edge. The disk includes a central transparent window 30, e. g. of clear glass or other predetermined standard



color, and also includes an annular series of windows 31 comprising glass or other transparent material colored in differing manner or shade as desired for the comparison to be made; for example in use of the apparatus for chlorine tests employing the ortho-tolidine reaction, the colors of the windows 31 may represent those developed by a graduated series of chlorine concentrations. Indicia representative of the chlorine concentration corresponding to the several windows 31 may be marked around the periphery of the outer face of the disk, to be viewed through an opening 33 in the front housing section 10, it being understood that at any given setting of the disk the number visible through the opening 33, for example measuring parts per million of chlorine, corresponds to the window 31 that occupies the position 31a in Fig. 3. As will be apparent from the drawings, the window 30 and the window selected to occupy position 31a are respectively interposed in the two parallel light paths which are observed by the viewing means described above.

The central and rear sections 11 and 12 of the housing, which are bolted together as shown, are cooperatively shaped to provide one compartment or socket 35 at one side of the structure, and a second compartment or socket 36 adjacent the first and having somewhat more than twice the horizontal cross sectional area of the first. The compartment 35, being open at the top and having partial floor portions 38, is adapted to receive and support a glass container 39 for a sample of liquid. The other compartment 36 similarly receives and supports a box-like carrier structure 40, the latter comprising, in effect, a pair of open-top compartments 41, 42, each provided with partial floor portions and each adapted to receive and support a glass sample-container identical with the container 39. Thus when the carrier 40 is inserted in the socket 36, the container 39 and the containers 44, 45 held by the carrier 40 are in effect disposed in a linear array in a plane parallel to and behind the disk 25.

It will be noted that the housing sections 11 and 12 together constitute a generally rectangular structure and that the rear wall of the section 12 includes a window 46 of milk glass or other preferably translucent, i. e. light-diffusing, rather than transparent material. The window 46 is disposed so that light entering it may traverse the container 39 and thence pass through an opening 47 in the front wall 48 of the central section 11, in registration with the disk window position 31a. The carrier 40 is provided with two spaced openings 49 in each of its front and rear walls so that if admitted, light may traverse either of the enclosed containers 44, 45, in a direction from the rear to the front of the carrier. Relative to the carrier the arrangement of the window 46 and of the opaque walls of the housing is also such, as shown, that there is no light path through one of the containers in the carrier, but light from the window traverses the other one, specifically the one nearest the container 39. This last-mentioned light path thus extends from the window 46 through a rear opening in the carrier, through the stated container and then through the corresponding front opening of the carrier and an adjacent opening 50 in the central housing wall 48. The described openings are all in registration with the central window 30 of the color disk 25.

The liquid containers or cells 39, 44 and 45 are

preferably identical and may each comprise a small rectangular jar of glass or other transparent material in which liquid under test can be placed. As explained, two parallel paths of light are provided through the apparatus, for simultaneously illuminating the liquid in the cell 39 and the liquid in the selected, adjacent one of the cells 44, 45—e. g. the cell 45 when the parts are disposed as shown in Figs. 3 and 5. The light paths extend through the color disk, respectively traversing the central window 30 and the peripheral window 31 selected for disposition at 31*a*, and by virtue of the described viewing means an observer looking through the eye piece 23 sees two regions of liquid side by side, each displaying a color in effect composed of its inherent shade plus such further coloring if any as is imparted by the window of the disk 25 that is interposed in the corresponding light path.

The carrier 40 is readily removable, simply by sliding it up from its socket 36, and can be inserted in either of two positions, viz. so that either selected one of the containers 44, 45 is disposed in the path of light rays through the central window 30 of the color disk. Thus a convenient way of making colorimetric observations with the described apparatus may simply involve placing in the glass jar 39 one sample of liquid, to provide a reference cell, and inserting other samples, involving modifications, in the jars 44 and 45 respectively. If it is desired to compare first one and then the other of the last-mentioned samples with the selectable color standards of the disk, the carrier 40 may be inserted first in one position, and a reading taken, and then it may be inserted in the other position, so that appropriate further reading may be taken. Where the contents under test in the cells are derived from a single original source, and where the colors to be observed in the cells 44 and 45 result from further treatments of the liquid, it will be seen that interposition of the reference cell 39 in the path of light rays through the color standard to be selected, prevents any inherent or casual tint or color of the original liquid from affecting the colors developed by further treatment of the portions in the cells 44 and 45—i. e. the undesired color is in effect balanced out.

A further feature of the present invention includes the correlation of the removable carrier 40 with appropriate data imprinted on its several vertical sides, serving to instruct the operator in the test procedure and at the same time to exhibit automatically the actual character or purpose of each particular test of the series.

For example, assuming that the apparatus is to be used for the ortho-tolidine-arsenite test, and referring particularly to Figs. 8 and 9, one face 52 of the carrier 40 may bear the legend "Free available chlorine" and on an adjacent side 53 of the carrier, which will be next to the container 39 when the carrier is inserted with the legend "Free available chlorine" facing forward, there may be imprinted instructions for the treatment of the sample in container 45 (Fig. 3) which is specifically to be observed for a determination of the character stated on the face 52, i. e. a test for free available chlorine. Likewise on the reverse face 54 of the carrier, as shown in Fig. 9, there may be imprinted the identification of another test, e. g. "Total chlorine," and the corresponding adjacent side 55 of the carrier may carry the instructions for treatment of the sample, in container 44, that is to be observed for such test.



Under such circumstances the performance of the tests is almost automatic. Having a supply of the chlorine-treated liquid for examination, the operator inserts a predetermined quantity in the "reference" cell 39, together with such chemical or chemicals as may be required and as may be specified by appropriate legend imprinted, if desired, on the comparator housing, e. g. on a plate 58 attached to an adjacent horizontal surface as shown in Fig. 1. Using further quantities of the liquid the operator also simply follows the instructions on the sides 53 and 55 of the carrier 40, with respect to the correspondingly adjacent cells. Then, for instance, he may insert the carrier in the first position so that the wording "Free available chlorine" faces him. Looking through the eye piece 23, a reading is taken by rotating the disk 25 until the observed areas of liquid have the same color or nearly the same color, the figure visible through the opening 33 then representing the amount of free available chlorine in the sample of liquid, as measured for instance in parts per million. Next the operator removes the carrier 40, turns it around, and reinserts it. The same observational procedure is followed and a measurement is obtained of the total chlorine, i. e. including chloramines, in the liquid. If desired, the first figure can then be subtracted from the second, yielding a further determination, i. e. the amount of chloramines present.

By way of example, one specific procedure for the free available chlorine test may involve adding 0.75 ml. (milliliters) of a standard ortho-tolidine solution to the cell 45, then adding 15 ml. of the water under test (supposed to have been treated with chlorine), then immediately adding 0.25 ml. of a standard arsenite (sodium arsenite) solution and mixing—according to instructions imprinted, say, on the surface 53 of the carrier. For the comparison, the reference cell is made up by adding 0.25 ml. of the arsenite solution to the cell 39, then adding 15 ml. of the water under test and mixing, then adding 0.75 ml. of the ortho-tolidine solution and mixing again—pursuant to instructions imprinted, say, on the plate 58 on the housing. At the same time, if desired, the operator may perform the procedure required for the cell 44, i. e. as specified on the side 55 of the carrier, by inserting 0.75 ml. of the ortho-tolidine solution and adding 15 ml. of the water under test. The free available chlorine is first read with the carrier 40 in the position of Figs. 1 and 2, and as explained above, the carrier is then turned around and reinserted, to permit a reading of the total chlorine.

In the procedure just described the arsenite added to the water in the reference cell 39 effectively prevents the subsequently added ortho-tolidine from developing any color by reason of residual chlorine or chloramine in the water, but permits such color development by reaction with any "interfering" substances, e. g. iron, manganese, or nitrites, that may be present. In the cell 45, corresponding to the side 53 of the carrier 40, the ortho-tolidine first added produces a practically complete development of color with both the free chlorine and the interfering materials, if any; but the almost immediate addition of arsenite solution in the same cell effectively prevents any chloramines from contributing to the color. That is to say, the neutralizing reaction between arsenite and chloramine then proceeds at once, before the much slower reaction between chloramine and the ortho-tolidine (as previously added) can have occurred to any appreciable extent.

In consequence the difference of color between the liquids in containers **45** and **39** is solely due to free available chlorine; and any coloration due to interfering substances, being developed alike in both samples, is balanced out.

The water sample and reagent having been introduced into the cell **44** before taking the reading for free chlorine with the other cell, sufficient time is permitted to elapse for full color development due to chloramines as well as free chlorine in the container **44**. If necessary, instructions specifying a waiting time, say 5 or 10 minutes, can be included to insure such full color development. Accordingly when the carrier is removed and reinserted in reversed position, the reading of difference of color between the cells **44** and **39** represents total chlorine, i. e. free chlorine plus chloramines, and again any color or intensification of color, due to interfering substances, has been developed over the same (but now longer) period of time in both containers and is balanced out. Thus an accurate determination is obtained for each stated characteristic without effect in either test by substances which are not to be measured and which might otherwise tend to give a false reading.

It will be seen that the apparatus of the invention affords a simple and convenient device for performing a series of tests of the character described. All that the operator need do is follow the explicit instructions imprinted on the equipment, and by virtue of the cooperating imprint stating the character of reading and particularly by reason of the removable and reversible nature of the carrier **40**, he is enabled to obtain successive determinations of specific characteristics in such a way that confusion is automatically avoided. At the same time the apparatus is rugged and yet capable of being built to standards of high precision so that the actual colorimetric results are accurate and reproducible. It will also be noted that the color disk can be removed simply by lifting it out, so that other disks may be readily inserted if readings of a different type or different range are to be made.

Fig. 10 shows a modified device wherein the cells are disposed one above the other in the carrier **140**, which can be slid vertically (in its socket in the housing) to locate them respectively in alignment with the viewing system. Suitable means such as a pin **141** removably sliding in a hole through the housing to fit into one or another of appropriate holes **142** in the carrier, can be employed to hold the carrier in either position. Although the cells can simply be stacked in such a carrier, a floor **143** can be provided for the upper cell, say cell **45**, and a side opening provided as shown for insertion of the lower cell **44** when the carrier **140** is removed. In the further modification of Fig. 11 the carrier **240** may resemble the carrier **40** of Figs. 1–9, but is pivotally mounted on a pin **241** which extends vertically into the center of the under side of the carrier and which is secured at the end of a link **242** pivoted in turn to another link **243**. The link **243** is pivoted at the pin **246** to the under side of the housing, which is open on two sides of the carrier so that by virtue of the described linkage the carrier **240** can be pulled out, turned around horizontally and replaced in reversed position. To hold the carrier in either relation in its rectangular socket, i. e. against the adjacent walls and the housing floor **250** as shown, a spring **251** can be provided under tension between the pins **241** and **246**.



By way of illustration of alternative optical means that may be used instead of the specific prism **20** of Figs. 2 and 4 between the prisms **18**, **19** and the sight opening **20***a*, Fig. 12 shows a mirror **320** mounted in a position suitably inclined to reflect the rays from the prisms **18**, **19** up through the sight opening, and Fig. 13 shows another type of prism **420** serving a like purpose and mounted (like the prism **20**, Figs. 2 and 4) on the outer faces of the prisms **18**, **19**.

It is to be understood that the invention is not limited to the specific structures herein shown and described but may be embodied in other forms without departure from its spirit.

I claim:

1. In a color comparator for colorimetric inspection of liquid material following a series of related test procedures, in combination, viewing means, supporting structure adapted to hold liquid samples in illuminated position for comparative observation through said viewing means, a movable device for holding two samples of liquid, said device having two opposite vertical walls carrying indicia identifying test readings to be taken with the two samples respectively, and said supporting structure having a socket adapted to receive said device in either of two mutually reversed positions respectively disposing one or the other of said two samples in a predetermined locality for observation by the viewing means, said socket receiving the device in each position with the aforesaid indicia on one or the other of its said walls in exposed position facing in the direction of the viewing means, said supporting structure including means for holding a third sample of liquid in another predetermined locality for the aforesaid comparative observation thereof with the sample in the first mentioned locality, and said device carrying two further sets of indicia, each set being disposed on a region of the device indicatively adjacent a corresponding one of the liquid samples and reciting procedure to be followed for the test identified by the indicia exposed as aforesaid when said sample is disposed in the first mentioned predetermined locality.

2. In a color comparator for colorimetric inspection of liquid material following a series of related test procedures, the combination, with viewing means, of supporting structure adapted to hold liquid samples in illuminated position for comparative observation through said viewing means, and a movable device having a base and vertical walls and comprising two chambers for respectively holding two samples of liquid in fixed positions in the device, said supporting structure having socket means comprising base and wall structure dimensionally conforming with the base and corresponding walls of the movable device, adapted to receive said device in either of two mutually different positions respectively disposing one or the other of said two samples in a predetermined locality for observation by the viewing means and with the sample that is disposed out of said locality screened from view by the viewing means, and said supporting structure including means for holding a third sample of liquid in another predetermined locality for the aforesaid comparative observation thereof with the sample in the first mentioned locality.

3. In a color comparator for colorimetric inspection of liquid material, in combination, a rotatably mounted color disk having a central light transmitting portion and a plurality of other light transmitting portions of differing color

values disposed in an annular series around the central portion, associated supporting structure including means for holding one sample of liquid behind the rear face of said disk and near the path of said annular series for inspection of said sample through any selected portion of said series, and a movable device having a base and vertical walls, and comprising two chambers for respectively holding to other samples of liquid in fixed positions in said device, said supporting structure comprising socket means having base and wall structure dimensionally conforming with the base and corresponding walls of the movable device, for selectively receiving and holding said device in each of two positions respectively disposing one or the other of said two other samples in a predetermined locality behind the central portion of the disk for inspection through said portion, said socket means holding the device in each position with the alternate of said two samples outside said locality of inspection.

4. In a color comparator for colorimetric inspection of liquid material, the combination, with viewing means adapted for comparative observation of light directed thereto along two parallel paths, of a rotatably mounted color disk having a central light transmitting portion intersecting one of said paths and a plurality of other light transmitting portions of differing color values disposed along an annular portion of the disk that intersects the other of said light paths, associated supporting structure including means for holding one sample of liquid in the last mentioned light path, and a movable device having a base and vertical walls and comprising two chambers for respectively holding two other samples of liquid in fixed positions in the device, said supporting structure including socket means comprising base and wall structure dimensionally conforming with the base and corresponding walls of the movable device, for receiving said movable device to position said other samples in a linear array with the first sample, parallel to a face of the disk, said socket means being adapted to receive and retain said device in either of two mutually reversed positions respectively



disposing only one or the other of said other two samples in the first mentioned light path.

5. In a color comparator for colorimetric inspection of liquid material following a series of related test procedures, the combination, with viewing means adapted for comparative observation of light directed thereto along two parallel paths, of associated supporting structure including means for removably holding a transparent container for liquid in one of the light paths, a carrier for removably holding two other transparent containers for liquid side by side, said carrier having opposite side walls each adjoined by both containers and cooperating end walls arranged in rectangular plan with the side walls, said supporting structure including a rectangular socket having a configuration conforming with the side and end wall structure of the carrier, for movably receiving said carrier in either of two mutually reversed positions endwise adjacent to the first container and with the carrier side walls perpendicular to the light paths, said carrier positions respectively locating one or the other of said two containers in the other light path, and with the alternate one of said two containers disposed outside of both light paths.

MORRIS RESNICK.


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| 2,386,878 | Nickerson | Oct. 16, 1945 |
| 2,423,370 | Butscher | July 1, 1947 |