

**Feb. 15, 1944.**

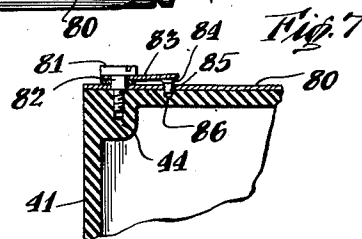
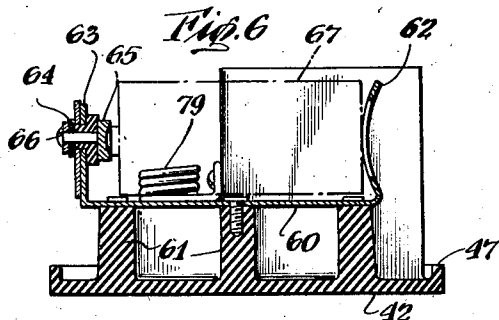
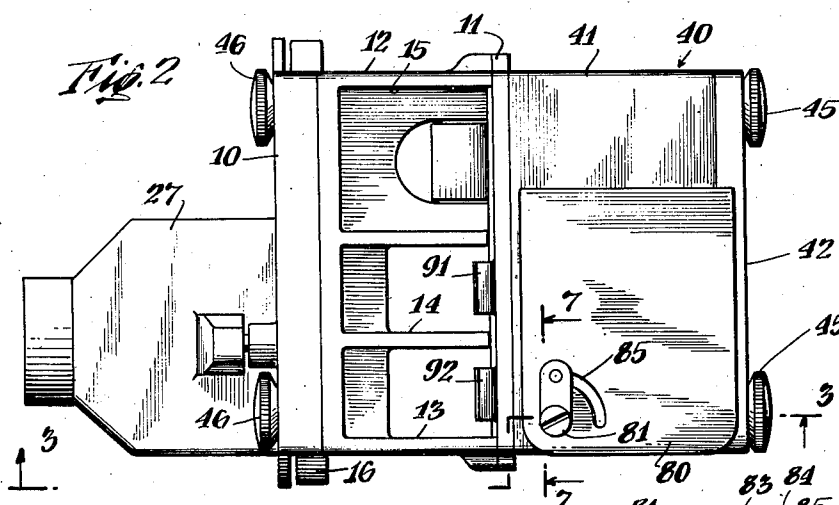
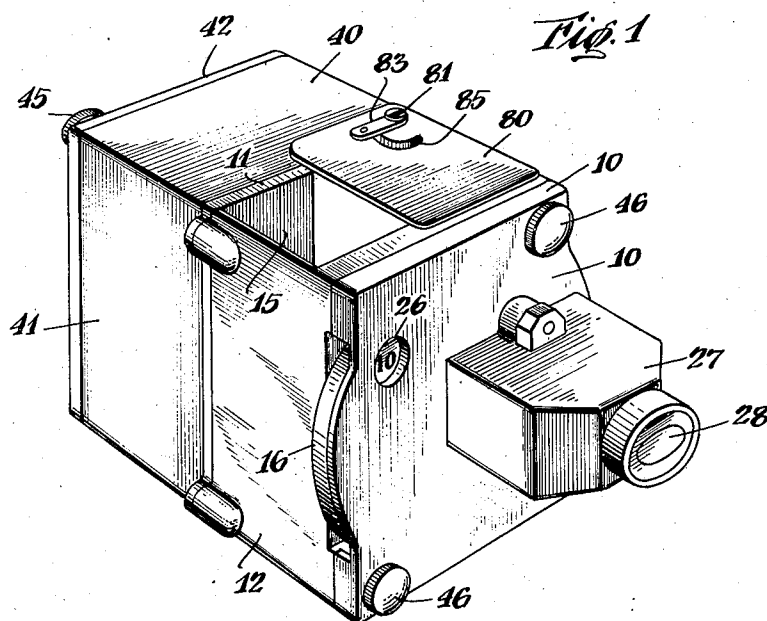
**G. D. PEET**

**2,341,810**

## COLOR COMPARATOR

Filed Sept. 30, 1941

2 Sheets-Sheet 1



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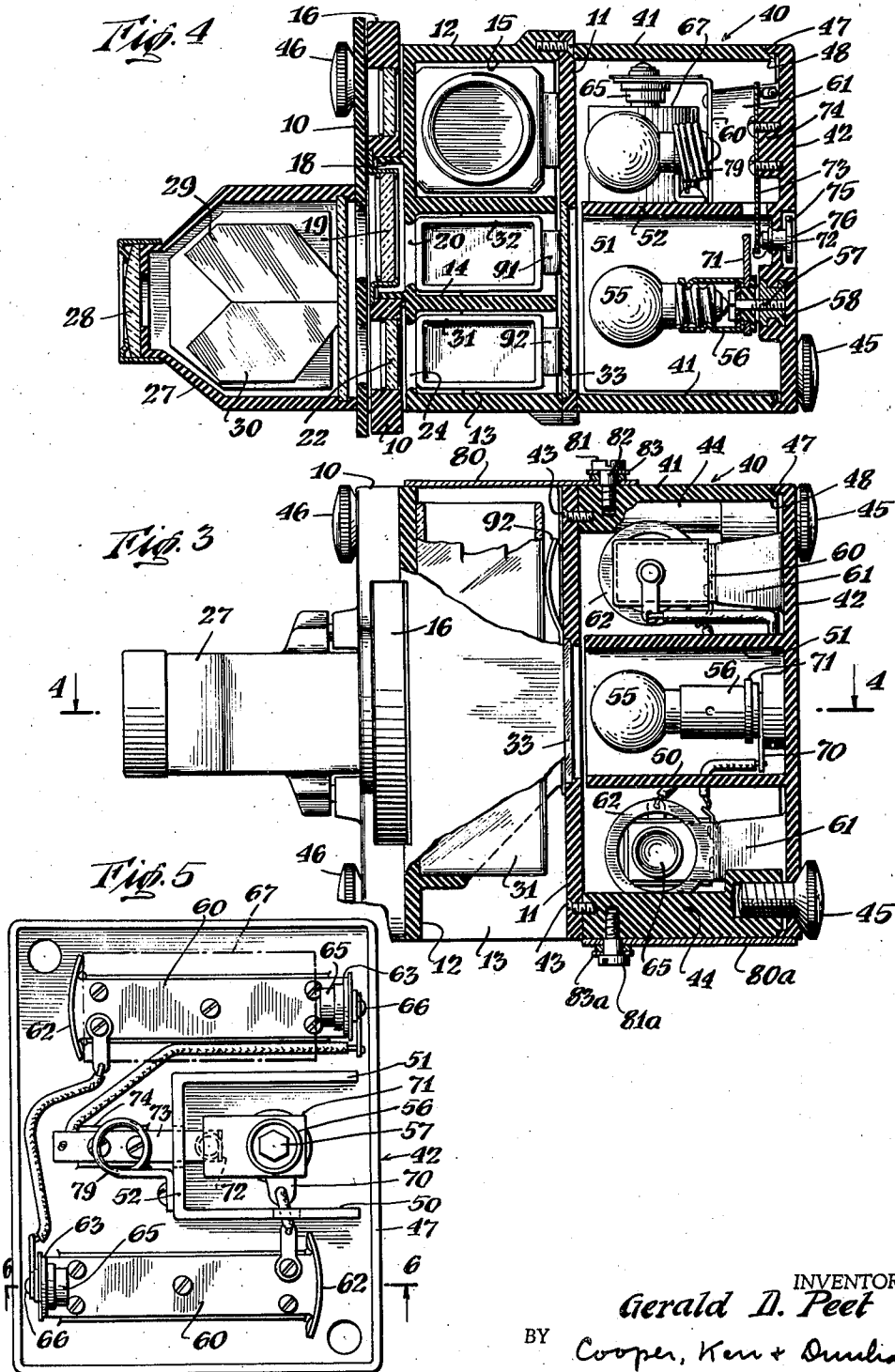
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COLOR COMPARATOR

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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,341,810

## COLOR COMPARATOR

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Application September 30, 1941, Serial No. 413,050

6 Claims. (Cl. 88-14)

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 small portable instruments of the character disclosed in my Patent No. 1,976,672, issued October 9, 1934.

Important objects of the invention are to extend the range of use of such devices; to improve their accuracy and reliability; and especially to provide a self-illuminated structure which is simple and fool-proof in construction and at the same time affords use of the apparatus at night or under other conditions where natural illumination may be unavailable or unreliable.

A primary purpose of these instruments is for determining, as by the so-called ortho-tolidin test, the free or residual chlorine content of water that has been treated with chlorine to purify the water for drinking or other purposes, and the apparatus of the invention is of particular utility in emergency or field conditions where temporary water supplies must be chlorinated for immediate use as by means of portable or mobile equipment. Further objects are to provide a sturdy but economical structure for an illuminated color comparator; to avoid the inaccuracy or unreliability sometimes attendant upon the use of devices that are illuminated by natural light, which may vary widely; to provide a device requiring infrequent and indeed almost no attention for renewal of lamps or batteries; and to provide a completely self-contained instrument which is light in weight, convenient to operate and susceptible of use under an infinite variety of conditions. Another object is to provide a portable, illuminated comparator of such character that it may be used, for example by military forces in the open at night, and while affording satisfactory illumination for its operation, will shed or emit no surplus light for detection by enemy aircraft or other observers.

To these and other ends, such as will be hereinafter stated or apparent, or such as are incidental to the described features and combinations, an advantageous and presently preferred embodiment of the invention is set forth, by way of example, in the accompanying drawings. Referring to the drawings:

Fig. 1 is a perspective view of the complete instrument;

Fig. 2 is a plan view;

Fig. 3 is a side elevation, looking toward the lower side of Fig. 2, but with certain parts cut away, or in section generally on line 3-3 of Fig. 2;

Fig. 4 is a horizontal section on line 4-4 of Fig. 3;

Fig. 5 is an inside elevation of the rear cover of the device, showing the parts attached thereto;

Fig. 6 is a section on line 6-6 of Fig. 5; and Fig. 7 is a fragmentary section on line 7-7 of Fig. 2.

It will be observed that certain features of the instrument, particularly the arrangement of liquid containers, color disk and viewing prisms, are identical or substantially identical with the device illustrated and described in my aforesaid Patent No. 1,976,672; to which reference may be had for a more complete description of these elements and their associated mounting or retaining parts.

In general, the structure comprises a pair of spaced walls or plates 10, 11, on opposite sides of a casing structure 12 which includes vertically extending compartments 13 and 14 respectively holding glass containers of the liquids to be compared, and a further vertical compartment 15 which may removably retain a supply bottle of suitable reagent or indicator of which a portion is added to one of the liquid samples for the purpose of color comparison. A color standard disk 16 is mounted to rotate on the cylindrical flange 18 of the casing 12 and beneath the cover plate 10, so that a central glass plate 19 of standard color (i. e., standard light-transmitting character) is maintained continuously in front of an aperture 20 for the compartment 14 and any one of a series of variously colored standard glasses 22, may be selectively presented according to the rotation of the disk, in front of a like aperture 24 for the compartment 13.

As more fully explained in my aforesaid patent, the disk 16 is provided with a series of index numbers which give readings of chemical composition corresponding to the several color standards 22, and which are so disposed as to be successively visible through an aperture 26 in the cover plate 10. An eye piece or viewing device comprising a light excluding casing 27 and a magnifying lens 28, is disposed in front of suitable apertures in the cover plate which register with the windows 20, 24, for simultaneous observation of the two liquids as seen through the standard glasses or color filters 19, 22. For better comparison, the viewing device includes a pair of prisms 29, 30, so that the two bodies of liquid are seen as if fully juxtaposed.

As the device is shown in my aforesaid patent, the liquids in the containers 31, 32 of the respec-

tive compartments 13, 14, are illuminated by light through a window 33 (comprising a milk-glass or other suitable diffusing pane) in the rear wall 11, and as the operator looks through the eye piece, the disk 16 is rotated until the two liquids, as seen through the standard 19 and one or another of the standards 22, seem the most alike in color. Thus if the two containers hold samples of the same liquid, and if a suitable indicator or the like, for example, has been added to the liquid in container 32, to produce a color representative of the chemical condition of the liquid, the condition of equality as seen through the eye piece will be represented by a suitable number in the index position 26, which then affords the desired reading of the chemical composition of the liquid; and coloring other than that due to the indicator is balanced out.

It will be understood that the colors of the standard 19 and the selectable standards 22 are chosen or calibrated, so to speak, for anticipated or likely conditions of use. For instance, the selectable standards or light filters 22 may be a graduated series of colors equal or corresponding to possible color effects produced by the indicator in the liquid. While in some cases the standard "color" 19 may be simply clear glass, it may be preferable in many cases, as to permit more accurate coloring of the selectable standards, or for other reasons, to have the central standard 19 of a predetermined light-modifying color or shade, which is then balanced out, so to speak, in each of the other standards 22.

It may be noted that suitable means, such as the spring structure 91, 92, may be employed to hold the containers 31, 32 and the reagent bottle, removably in place in their respective chambers 13, 14 and 15—as more fully described in my aforesaid patent.

Although useful for pH readings or for a wide variety of other colorimetric determinations, the instrument is of special importance for determining the chlorine content of water which has been purified by treatment with chlorine. To that end an appropriate reagent solution is supplied in the bottle in chamber 15, such as orthotolidin which produces a yellow color of varying character dependent upon the amount of chlorine actually remaining in the water. It will be understood that to insure that a desired sterilization has taken or is taking place, for example for purposes of drinking water, the water, after treatment, should have a certain minimum content of free or residual or otherwise still available chlorine. At the same time, from the standpoint both of economy and taste, it is undesirable to have a great deal more than the prescribed and ordinarily very minute minimum amount of chlorine in the treated water. For these determinations the scale or index figures on the color disk may read simply in parts per million of chlorine, the color standards being designed and calibrated to indicate various chlorine concentrations below, at and above the desired optimum value.

In accordance with the present invention, the illustrated apparatus includes a further light-tight casing generally designated 40 and comprising a rectangular body or wall portion 41, and a rear cover plate 42. The body 41 is peripherally congruent with the main casing 12 and is mounted against the rear wall 11 of the latter (to enclose the window 33), as by suitable screws 43 threaded into integral corner reinforcements 44 of the body 41. To avoid corrosion, both parts of the casing 40 may conveniently be made of suit-

ably resistant material, such as Bakelite or hard rubber, like the main structure as more fully described in my aforesaid patent.

The rear wall 42 is removably clamped against the wall portion 41 by a pair of large screws 45, which are threaded into enlarged portions of the reinforcements 44 at diagonally opposite corners and which are conveniently made of Bakelite, hard rubber or the like and identical, i. e., interchangeable, with the screws 46 that retain the plate 10. It will be noted that for ease of location and to insure the exclusion of light, the periphery of the cover 42 has a flange 47 which seats around a corresponding shoulder 48 on the wall portion 41.

A pair of vertical walls 50, 51, and a horizontal wall 52 joining them, extend integrally from the cover plate 42 and in cooperation with an adjacent portion of the side wall structure 41, provide a lamp chamber which opens upon and registers with the window 33. The inner surface of this chamber may be painted white or otherwise treated or lined to provide maximum and preferably diffuse reflection of light toward the window. Mounted in the chamber to hold a bulb 55 having a miniature (e. g., standard flashlight) base for illuminating the window 33, is a small socket 56, which has its supporting post 57 threaded into a nut 58 embedded in a suitable boss on the inside of the cover plate 42.

The cover plate 42 also has (see particularly Figs. 3, 5 and 6) means for carrying a source of current for the lamp, within the casing 40. As shown, this structure consists of a pair of devices each adapted for removably retaining a small dry cell, as of the flashlight type. Each device comprises a clip having a flat longitudinal base portion 60 screwed to a reinforced supporting frame 61 extending integrally inward from the cover plate 42; the turned-up ends of the clip consist respectively of a ring-shaped portion 62 at one end and an arm 63 at the other. Mounted on the arm 63 and insulated therefrom by a suitable bushing 64, a concave contact disk 65 faces the opposite end 62 of the clip, electrical connection being made to the disk by its mounting rivet or screw 66. The elements 62, 63 are resiliently biased toward each other so that a small flashlight cell 67 (e. g., "Eveready" size C, 1½ inches long) may be inserted and held between them by spring pressure, good electrical contact being thus made between the elements and the opposite ends of the cell.

The ring portion 62 of each clip is preferably curved convexly toward the cell end, about an axis parallel to the clip base, as shown in Fig. 5, to facilitate insertion of a cell, and it will be noted that without sacrifice of resilience or of strength due to thickness of material the ring-shaped structure of the part 62 likewise facilitates cell replacement (by reducing the stiffness of the clip) and at the same time promotes electrical contact. Moreover, the illustrated clip structure insures insertion of cells in proper direction, it being immediately apparent to the user that the flat negative end of the cell container must go against the ring 62 and the opposite positive pole against the contact button 65. It will be noted that both of the cell holders are alike, but for compactness and convenience in wiring are disposed in opposite directions and on opposite sides of the illuminating chamber, parallel with the longer sides of the latter.

The socket 56 has a connecting lug 70 extending at one side thereof, and another connecting

lug 71, conveniently connected to the shell of the socket and insulated from the supporting shank 57, extending toward the inner wall 52 of the illuminating chamber. The lug 71 may comprise a relatively rigid plate and be disposed above the slightly upturned end 72 of a contact spring 73 which is mounted on a raised portion 74 of the cover plate 42, the mounting of the spring being advantageously in the space on the cover plate beyond the wall 52, and the latter having a suitable aperture through which the spring 73 extends. A push button or stud 75 extends through a hole in the cover plate 42, as shown in Fig. 4, and is adapted to engage the side of the spring 73 and push its upturned portion 72 into contact with the plate 71. The operating face 76 of the button 75 is sunk in a suitable recess in the outer surface of the cover plate and an inner retaining flange may be so positioned on the stud, as shown, that the button face 76 cannot move out beyond a position slightly recessed from the outer surface of the plate 42.

By suitable conductors extending, as shown in Figs. 3 and 5, to the clip bases 60 and their positive terminals 66, the cells are connected in series between the socket lug 70 and the contact spring 73; and thus the circuit to the lamp 55 is normally held open by the resilience of the spring, but may be closed to light the lamp by pushing the button 75. A spare bulb may also be carried in the casing 40, as in the coiled wire holder 79 mounted on the outer side of the wall 52, as shown.

It will now be seen that for replacement of batteries or bulb, or for other attention, the casing 40 is opened simply by removing the screws 45 and taking off the cover plate 42. All of the enclosed structure is conveniently attached, as explained above, to the cover plate, so that upon removal of the latter, everything is fully and instantly accessible. It will also be noted that the walls 50, 51, 52 of the lamp chamber and the several supporting frames and projections for the other parts described are all molded integrally with the cover plate, i. e., the latter may thus be manufactured inexpensively as a one-piece structure by a single molding operation. The wall or body portion 41 may likewise be molded in one piece, including all four walls and the described corner reinforcements, with like advantages of economy and ease of manufacture.

The casing 40 also serves to support the movable light-confining means now to be described. At the top of the assembled device (Figs. 1, 2, 3 and 7) there is pivotally mounted a plate 80 which is disposed flat-wise and when swung into the position shown in Fig. 1 is adapted to cover completely the upper ends of both the chambers 13, 14. This plate, which may be made of metal, or, if desired, of corrosion-resistant material (and which may be black in color, like the rest of the apparatus except the inside of the lamp chamber), is pivoted at a corner of the casing wall part 41 adjacent the juncture of the latter with the wall 11, by means of a screw 81 threaded into the adjacent reinforcing portion 44 and having an enlarged upper shank 82 to provide a bearing for the cooperating hole in the plate 80. Fastened beneath the head of the screw and extending transversely from it, is a short spring strip 83 carrying a downwardly projecting stud 84 which passes freely through an arcuate slot 85 in the plate 80 and conveniently extends into a slight recess 86 in the upper surface of the casing wall 41. The cooper-

ation of the stud 84 and the slot 85 provides appropriate stops, at the ends of the slot, for movements of the plate 80 between its open position of Fig. 2 and its closed or light-interrupting position of Fig. 1. At the same time the spring pressure urging the inwardly tapered head of the stud against the upper edges of the slot, holds the plate 80 in satisfactorily flat-wise engagement with the upper surface of the apparatus, and exerts sufficient friction to keep the plate from swinging accidentally while permitting manual movement when desired. By virtue of the conformity of the upper surface of the casing 40 and that of the forepart of the apparatus to be covered, the plate 80 is held flat against a supporting surface or structure in the same plane at all times in its permitted range of movement and thus there is no danger of the plate being bent out of shape so as to impair its light-confining function, as might easily occur if any substantial part of it were permitted to extend free of a supporting surface or framework. It will now be seen that when the containers 31, 32 have been filled for test and the plate 80 has been moved over as shown in Figs. 1 and 3, escape of illumination from the upper ends of the chambers 13, 14 is effectively prevented.

To complete the light-sealing arrangement, an exactly similar pivoted plate structure 80a is disposed on the similarly flat underside of the apparatus, and mounted by a pivoted screw 81a and short spring 83a in exactly the same fashion as the plate 80, so as to be movable into and out of corresponding position for covering the open lower ends of both the chambers 13, 14.

By virtue of its reliable and easily operated light-confining structure, the instrument is particularly valuable for use by military forces in the field, or for other emergency use in wartime, and obviates the danger of showing light to enemy aircraft or other observers. At the same time, the illuminating structure, including the casing 40 and the instrumentalities and combinations thereof as described, cooperate to provide a simple and highly efficient illuminated comparator. In military operations, for example, where supplies of drinking water may often have to be established at night or under other conditions of urgency, the device is exceptionally convenient for testing the water and determining its purification as by chlorine treatment. All that is necessary is to fill the containers 31, 32 with treated water—the container 32 to a measured extent as explained in my aforesaid patent—then to add the necessary drops of reagent from the bottle in chamber 15 to the liquid in container 32, move the plates 80, 80a into position over the ends of the chamber, and look into the eye piece. As the push button 75 is depressed, the operator at the same time rotates the color disk 16 slowly and when substantial equivalence of color is reached, reads the chlorine content—or other desired indication—at the index window 26. To avoid any need for use of visible exterior illumination, the index numerals seen through the opening 26 may be printed with a luminous or "radium" paint, or they may be printed with a fluorescent ink which can be read with so-called "black" light, i. e., radiation of a wave-length outside the visible spectrum; or in some cases, the index numbers may be printed directly on the glasses 22.

It will be noted that not only is the spring push button arrangement adapted to save cur-

rent and thus prolong the life of the battery, in that the current is only turned on so long as the button is pushed, but the recessed structure of the button prevents inadvertent closure of the circuit should the adjacent wall 42 rest or, as in a carrying case, be urged against some other surface. As previously explained, the apparatus may be readily opened for adjustment or replacement of portions of the illuminating structure; and yet the whole device is complete in itself, and is sufficiently rugged and reliable to withstand rough handling and to perform its expected health-guarding function whenever needed and with only infrequent attention to the electrical parts.

In addition to the fact that it may be used anywhere at night as well as in the daytime, a further advantage of the instrument resides in its constancy and accuracy of reading at all times. Variations in the intensity of daylight, or in the spectral characteristics thereof at different times of day or under various weather conditions or by reason of nearby reflecting surfaces, are sometimes apt, when such light is used for illumination of a color comparator, to reduce its sensitivity to small differences in color produced by the indicator in the liquid under test, or even to modify the color relations in such way as to produce false readings. The present device affords a constant illumination of desired intensity and spectral characteristics (preferably, for example, the bulb 55 is of the "daylight" type, i. e., daylight-simulating), so that all such difficulties are avoided and the calibration of the instrument is uniform and accurate for all conditions of use. The movable light-interrupting plates 80, 80a also cooperate to that end, even when the device is used in daytime, in preventing unpredictable variations due to stray light coming through the ends of chambers 13, 14, and reflected or refracted by the glass containers or by the liquid or by matter suspended in the liquid. At the same time, the apparatus is all self-contained in a small, readily portable instrument, (in a commercial example of the device, the structure included by the covers 10, 42 measures 3½" x 3¾" x 4", with the eyepiece in proportion), and the illuminating and light-confining means are so constructed that they may be easily added as a unit, if desired, to existing devices such as are shown in my aforesaid patent.

It is to be understood that the invention is not limited to the structure and arrangement herein shown and described, by way of example, but may be embodied in other forms without departure from its spirit as defined by the following claims.

I claim:

1. In a color comparator comprising a pair of vertical chambers, means in each for removably retaining a transparent liquid container, said chambers being open at both ends to facilitate insertion and removal of the containers, a wall common to said chambers and having a window for admission of light thereto, viewing means for observation of light passing through the chambers from the window and means intermediate said viewing means and said chambers for selectively disposing one of a plurality of predetermined color filters intermediate one of said chambers and said viewing means, the combination of an opaque casing mounted to the device for enclosing said window, said casing comprising a removable part, an electric

lamp mounted on said removable part for illumination of said window, means carried by said removable part for removably retaining electric cell means, a switch in said casing having an operating member extending through the wall of the casing for access exteriorly thereof, said switch being biased to open position and being adapted, upon depression of said operating member, to connect the cell means with the lamp, said operating member being recessed in said casing whereby its outer extremity is below the outer surface of the casing, a cover plate pivoted to the casing and adapted to be swung into and out of position for covering the aforesaid chambers at one end against escape of light therefrom, and a second cover plate pivoted to the casing and adapted to be swung into and out of position for similarly covering the opposite ends of the chambers.

2. In a portable color comparator for colorimetric inspection of liquid material, which includes a pair of adjacent open-ended chambers each adapted to receive and removably retain a transparent container for liquid to be inspected, window means at one side of said chambers for admitting light through the same, and viewing means on the opposite side of said chambers, the combination of enclosed means for illuminating said window means, including an electric lamp and electric cell means for energizing said lamp, switch means for connecting said cell means with said lamp at desired times, and shiftable light-excluding cover means adapted to be moved to enclose said open-ended chambers for preventing escape of light therefrom and shiftable out of said position for access to said chambers.

3. In a color comparator having mutually spaced window and viewing means, means holding in the path of light intermediate said window and viewing means, a plurality of samples of liquid and a selected color standard, for simultaneous comparative observation of one of said samples with another of the samples as modified by the color standard, said comparator having a rear wall which includes said window means but which has an opaque portion of substantial area, the combination of a light-excluding casing enclosing said window means, a compartment in said casing opening on said window means and having light-reflecting interior surfaces, a lamp socket in said compartment, means in the casing for removably retaining and making contact with electric cell means, said cell-retaining means being disposed to hold the cell means beside said compartment and adjacent the opaque portion of the comparator rear wall, and said casing comprising separably fastened wall structure removable as a unit, whereby upon removal of said wall structure access may be had simultaneously to said lamp socket and said cell-retaining means, a switch spring-biased to open position and having an operating member extending through a wall of the casing, and connections intermediate said cell-retaining means, switch and socket whereby the switch may be operated to light a lamp in the socket for illuminating the window means.

4. In a color comparator for colorimetric inspection of liquid material, in combination, a casing having a smooth upper surface, a vertical chamber opening at said surface for removably receiving a container of liquid to be inspected, light-producing means contained in the casing for directing illumination to the

chamber, a cover plate upon and substantially conforming to the upper surface of the casing, and means pivotally mounting said plate for swinging movement across said surface into and out of position for covering the opening of the chamber.

5. The comparator of claim 4, wherein the casing has a similarly smooth under surface, and wherein the vertical chamber opens at the under surface as well, to facilitate manually pushing a container up out of the chamber, and which includes a cover plate beneath and substantially conforming to the under surface of the casing and means pivotally mounting said plate for swinging movement across said under surface into and out of position for covering the lower opening of the chamber.

6. In a color comparator having a housing with a flat upper surface, a vertical chamber opening at said surface for removably receiving a container of liquid to be inspected, and a vertical wall having a window for admission of light to the chamber, the combination of an open-backed casing mounted against said wall and having a flat upper surface flush with the

upper surface of the comparator housing, a cover removably attached to the back of said casing, clip means carried on the inside of said cover for removably holding electric cell means, a lamp socket mounted on the inside of said cover for holding a lamp to illuminate the window, a switch on said cover spring-biased to open position and having an operating member accessible exteriorly of the cover, means for electrically connecting the clip means to the socket when the switch is operated, a light-interrupting plate, means pivoting the plate at a corner thereof to the upper casing surface whereby the plate may be swung flatwise, against said surface, to and from a position to cover the opening of the vertical container chamber, an arcuate slot in the plate about the pivoting means, and a fixed member extending radially from the pivot and having a projection frictionally entrant into the slot, for urging the plate flatwise against the upper surfaces of the housing and casing and arresting displacement of the plate at the ends of the slot.

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