

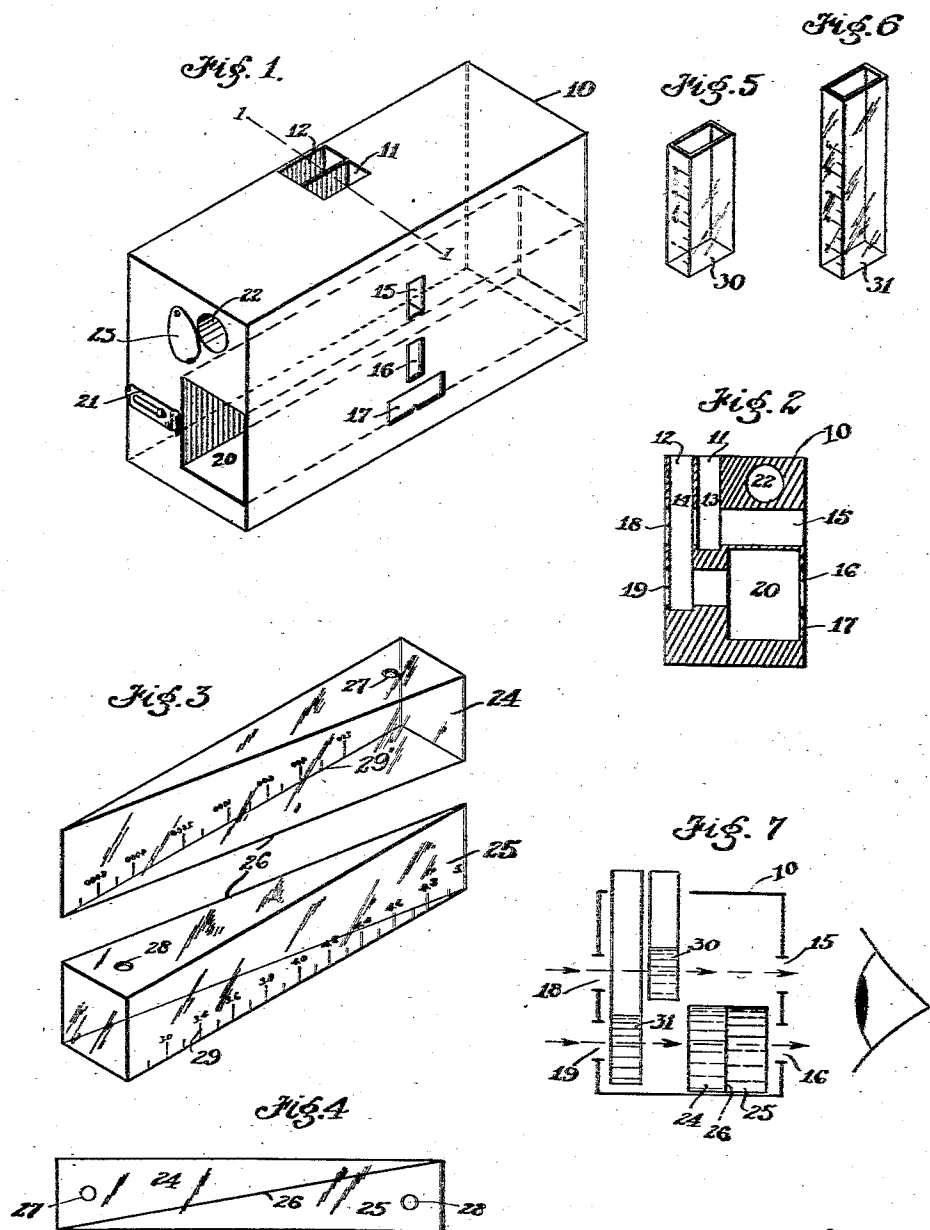
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METHOD AND APPARATUS FOR DETERMINING HYDROGEN ION CONCENTRATION

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METHOD AND APPARATUS FOR DETERMINING HYDROGEN-ION CONCENTRATION.

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This invention relates to apparatus for determining the hydrogen ion concentration of any substance and more particularly to a colorimetric method for making such determinations.

The importance of the hydrogen ion in all chemical, biological, and physiological reactions has been recognized in recent years. Heretofore, hydrogen ion concentrations have been determined with great accuracy by electrical methods but the results obtained by these methods are exceedingly more accurate than the usual laboratory requirements call for. The electrical apparatus now commonly employed for such calculations involves the application of considerable expensive and delicate apparatus that must necessarily be operated by an experienced technician. The expense of installing electrical apparatus is prohibitive for small laboratory requirements and the bulk of such apparatus prohibits its adaptation for field inspection work where it is necessary to carry on many experimental investigations.

The present day colorimetric apparatus and methods, while operable with fair accuracy and rapidity, are, like the electrical apparatus, too cumbersome to be readily carried into the field or on inspection trips. The many standard color tubes required in the manipulation of this apparatus require frequent refilling and careful observation to guard against their fading by deterioration.

The object of this invention is to provide an apparatus of the character designated whereby rapid and accurate calculations may be made of the hydrogen ion concentration of any transparent or translucent substance in solution or suspension.

It has for a further object, to provide an apparatus which shall be simple in operation and compact in structure.

It has for a further object to provide an apparatus which shall be inexpensive in construction and which lends itself readily to use in field work for rapidly making hydrogen ion calculations of any desired substance.

Further objects of my invention will hereinafter appear in the accompanying specification by reference to the drawings, in which;

Fig. 1 is an isometric view of an apparatus constructed in accordance with my invention;

Fig. 2 is a section taken on line 1—1, Fig. 1;

Fig. 3 is a perspective view showing parts of a prism;

Fig. 4 is a top view of the prism;

Figs. 5 and 6 are perspective views of rectangular cells used in the apparatus; and

Fig. 7 shows diagrammatically an embodiment of the features of my invention.

Referring to Fig. 1 of the drawing, indicates a rectangular casing which may be made of hard rubber or other suitable material. This casing has provided in the top portion thereof, openings 11 and 12, which communicate with compartments 13 and 14, respectively as shown in Fig. 2. Located in the front central portion of the casing are aligned apertures 15, 16 and 17. In the rear of the casing are also located apertures 18 and 19, shown in Fig. 2, the arrangement being such that a beam of light may traverse the casing by passing through front and rear apertures 15 and 18 respectively, and another beam of light may traverse the casing through front and rear apertures 16 and 19. Located within the casing 10 is a compartment, 20, which extends horizontally throughout the casing and is of sufficient size to accommodate a graduated prism shown in Figs. 3 and 4. Provided at the ends of the casing and projecting over the end portions of the compartment 20 are provided suitable spring clips 21 adapted to hold the prism in any desired position or to prevent it from slipping from the casing, as hereinafter mentioned. There is also provided within the casing 10, a suitable compartment 22 adapted to receive the necessary accessory instruments used in manipulating the apparatus. The compartment 22 is also provided with a suitable closure 23.

In Figs. 3 and 4 is shown a color standard composed of two rectangular wedge-shaped members 24 and 25 each of a designated color. These members may be secured in fixed relation to form a compact unit hereinafter referred to, as the prism. While I have designated this standard element as a rectangular prism, it is obvious that it may be made in various forms in order that the desired differential effect of the several colors may be obtained. These members may be made of glass, celluloid or other transparent material

The members 24 and 25 are shown as hollow receptacles or compartments which may be placed in overlapping relation with the oblique sides 26 in contact. However, I may construct this color standard as a single rectangular member and form two wedge-shaped compartments 24 and 25, by using a single diagonal partition 26. These compartments are provided with filling orifices 27 and 28 whereby the same may be filled with a fluid having the desired standard color. For example, compartment 25 may be filled with a colored solution or jelly, having a definitely known hydrogen ion concentration carefully prepared with chemical indicators or dyes. In a like manner, compartment 24 may be filled with a solution or jelly carefully prepared with the same chemical indicator or dye, but of different hydrogen ion concentration. This prism as shown, carries scales illustrated by 29 and 29', which are graduated to read directly the hydrogen ion concentration in any such units as may be desired.

While I have shown and described a hollow prism composed of two wedge-shaped compartments suitable for holding indicator solutions of definite hydrogen ion concentration, it is apparent that the prism may be made of two solid wedge-shaped pieces of glass or other transparent material colored to match as nearly as possible the colors of the indicators or dyes, used in the hollow prism, and these cemented or otherwise joined together to form a solid rectangular prism.

In Figs. 5 and 6 I show graduated cells 30 and 31, adapted to pass through openings 11 and 12, respectively, and fit into compartments 13 and 14 respectively. The cells may likewise be made of any suitable transparent material such as glass, celluloid and the like.

Fig. 7 shows a diagrammatic view of the relative position of the cells containing solution, the prism and the observer's eye, when making a hydrogen ion determination.

Having thus described an apparatus constructed in accordance with my invention, the operation thereof is as follows: Each of the compartments 24 and 25 comprising the standard comparator is filled with a solution of a selected indicator or dye that assumes a different color corresponding to different hydrogen ion concentration values. It is well understood in the art that extreme conditions of color are attained according to the acidity or alkalinity of the indicator. Accordingly, in compartment 24 is introduced a minute calculated quantity of an acid thus causing the fluid in that compartment to take on a definite color, the effective color as it appears to the eye varying in intensity from the base to the knife edge of the compartment. In a like manner, a definite minute quantity of an alkali is added to the indica-

tor or dye in compartment 25 and a color gradient is likewise had in that compartment. Thus it is to be noted that one compartment has a color indicative of acid content in hydrogen ion value, and the other compartment has a color indicative of alkali content in hydrogen ion value. Owing to the fact that the color solutions are in wedge shaped receptacles or compartments placed in overlapping relation, color gradients indicating the hydrogen ion concentration value according to the acidity or alkalinity of the substance are compared directly with the color of the substance under examination.

When it is desired to make a hydrogen ion determination, a portion of the solution to be tested or investigated, which may be an aqueous extract of an acid or alkali soil, a bacteriological culture medium, or any other transparent or translucent solution, suspension or jelly is placed in the small cell 30, and a definite amount of the indicator identical with that in the prism is added to the solution and the contents of the cell well mixed. The indicator then takes on a color corresponding to the hydrogen ion concentration of the liquid under examination. The cell is then placed within compartment 13 in casing 10, and a beam of light allowed to pass through aperture 18 and after having traversed the liquid in cell 30, emerges through aperture 15. Another beam of light is allowed to pass through aperture 19 and after traversing compartments 24 and 25, of the prism, emerges at aperture 16. The operator then views these two beams of light and moves the prism in slot 20 to the right or left, varying the color of the beam of light which passes through aperture 19, through the two compartments 24 and 25 of the prism and through aperture 16. When these two beams have the same shade or color, the scale carried by the prism is observed through aperture 17 and the hydrogen ion concentration read directly.

Should the liquid whose hydrogen ion concentration is desired be turbid or colored, the procedure is exactly as above except that cell 31 is filled partially with the liquid to be investigated, the level of the liquid being high enough to intercept the light passing through apertures 19 and 16, but not high enough to intercept light through apertures 18 and 15. It will be noted that no indicator is added to the solution in cell 31. This combination allows a reading to be taken such that the combined effect on the light passing through liquid in cell 31 and liquid in compartments 24 and 25 of the prism is equal to the effect on light passing through cell 30 alone. This is diagrammatically shown in Figure 7.

Having described in detail a particular embodiment of my invention, it is obvious that various changes and modifications may

be made in the details and arrangement without departing from the scope of the appended claims.

What I claim and desire to secure by Letters Patent of the United States, is:

1. In an apparatus of the character described, the combination of a double wedge prism, two receptacles for holding a portion of a sample under investigation, means whereby one beam of light may be caused to pass through one receptacle and the prism, and means whereby a second beam of light may be caused to pass through the other of said receptacles containing another portion of the sample mixed with a known quantity of a chemical substance adapted to react with the sample, thereby producing in said first mentioned beam a color corresponding to a value which is being sought in the sample.

2. In an instrument for determining hydrogen ion concentration, the combination with a casing of a receptacle adapted to contain a portion of a substance to be examined, a second receptacle containing another portion of said substance mixed with a chemical indicator adapted to react with said substance, a rectangular hollow receptacle divided into wedge-shaped sections, each sec-

tion adapted to contain a colored indicator of known hydrogen ion concentration, means for passing a beam of light through said first named receptacle and said prism, means for passing another beam of light through said second named receptacle, and means permitting relative movement of said prism and said receptacles whereby said beams of light are given equal color intensity.

3. The method of testing a translucent solution to determine its hydrogen ion concentration, which comprises utilizing a prism unit having two overlapping wedge-shaped prisms, each of which has a color corresponding to known hydrogen ion concentrations, placing a portion of the translucent solution adjacent to the prisms, dissolving another portion of the translucent solution in a chemical indicator of known concentration, placing the dissolved solution adjacent to the prisms, passing a beam of light through said translucent test solution and the prisms, passing a second beam of light through the dissolved solution, and moving the prism unit with respect to the solutions until an equal color intensity in each beam is obtained.

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