May 27, 1947. M. MASS 2,421,344

COLORIMETER

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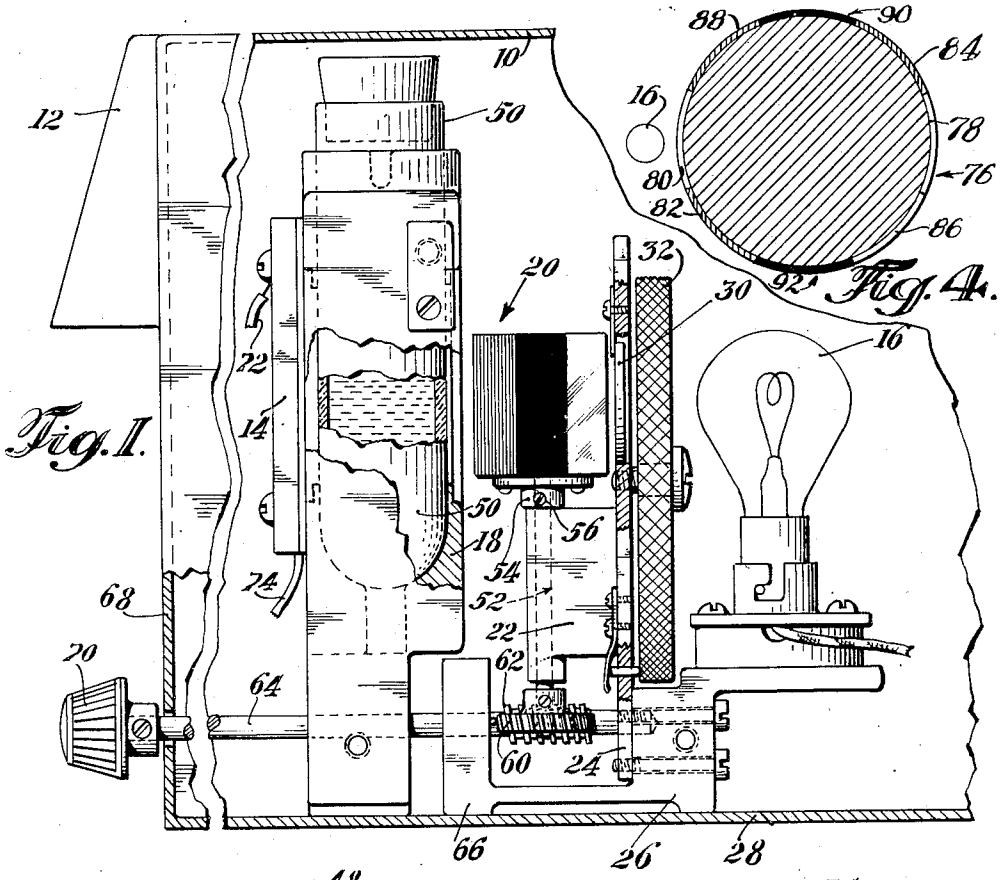


Fig. 1.

Fig. 4.

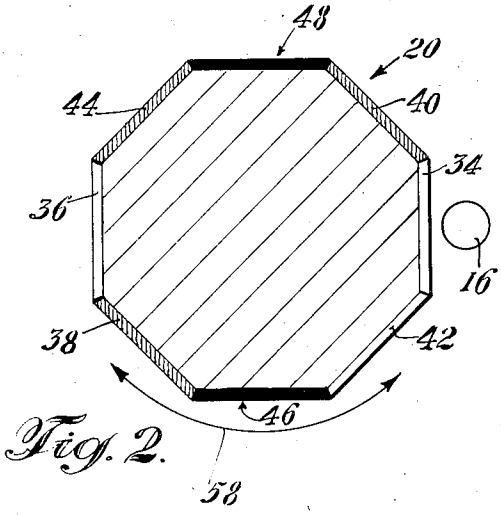


Fig. 2.

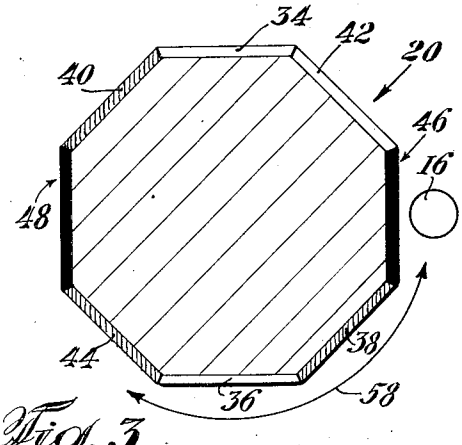


Fig. 3.

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COLORIMETER

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5 Claims. (Cl. 250—41.5)

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This invention relates to colorimeters and more particularly to the light valve supplied therewith.

In this specification, I illustrate my invention as applied to a colorimeter which employs a photoelectric cell of the type that converts light energy into electrical energy, the electromotive force generated in the cell being a function of the light intensity directed thereon.

In prior colorimeters, in order to standardize the instrument reading, the intensity of light directed through the substance tested onto the photoelectric cell was adjusted by means of a light valve, such as an iris diaphragm, shutter or the like. Such light valves because of their construction were subject to mechanical difficulties, with attendant break down and repair, and did not lend themselves to the closeness of selective adjustment sought for the satisfactory operation of an instrument dependent upon a selected intensity of light radiation for its operation.

The present invention contemplates the provision of a light valve by means of which the intensity of light passing therethrough can be selectively accurately adjusted with comparative ease and speed and with relative uniformity, fineness and sensitivity of adjustment, this being accomplished by a construction and arrangement that has relatively few mechanical parts.

To enable those skilled in the art so fully to comprehend the underlying features of my invention and other and further objects thereof so that they may embody the same in any modifications in the structure and relative arrangement of the parts thereof contemplated by my invention, as a part of this disclosure, drawings depicting certain forms of my invention have been annexed hereto, in which drawings

Fig. 1 is a side elevation of a colorimeter according to my invention, the case in which the elements thereof are arranged being broken away to disclose only so much as is required for an understanding of the invention.

Fig. 2 is a plan view of a form of light valve according to my invention, in the position assumed by it in Fig. 1.

Fig. 3 is a similar view of the light valve rotated into another position relative to the source of light radiation.

Fig. 4 is a plan view of a modified light valve according to my invention.

Referring now to Fig. 1, I have there illustrated one form of my invention applied to one type of conventional colorimeter, the elements of which are well known in the art and need here only be sufficiently illustrated for an understanding of my invention.

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The parts of such a colorimeter are housed in a case 10, at the front end of which is arranged a galvanometer or ammeter 12 which registers the potential or current generated by the photoelectric cell 14 under the influence of light rays directed on it from a light source 16, such as an incandescent filament.

As is well known the greater the intensity of the light rays falling upon the photoelectric cell, the larger will be the potential or current generated by the cell, which characteristic phenomenon is used to determine the concentration of the specimen to be tested, for example the hemoglobin content of a specimen of blood or for example the vitamin C content of a substance under test or other concentrations of other elements or compounds in different substances.

This is accomplished by first placing in the cup or container housing 18 a standard with which the transmission (that is absorption) of light through the specimen to be tested is compared.

For example a test tube containing the solvent in which the specimen to be tested dissolves, as for example in some cases distilled water, is placed in the cup 18 and the light valve 20 (the construction and operation of which will be explained in detail hereinafter) adjusted so that the intensity of light passing therethrough and the standard onto the cell is sufficient to obtain a predetermined standard deflection on the galvanometer or ammeter 12, which in practice is arbitrarily taken at say 100.

The standard solvent is then removed (the light valve remaining in the adjusted position) and the specimen to be tested is substituted therefor. Since the transparency of the specimen is less than the solvent alone, light rays passing through the specimen will be absorbed in amount corresponding to the concentration of the substance in solution to thereby reduce the potential and current generated in the cell 14 and reduce the galvanometer or ammeter deflection to less than 100, from which the specimen concentration may be determined.

Heretofore the light intensity was adjusted by means of a light valve in the form of an iris diaphragm, light shutter or the like, which valves were not fully satisfactory because it was difficult to closely adjust the light intensity to obtain the standard meter setting and which because of the type and number of movable parts were subject to mechanical breakdown and in addition were relatively more expensive to manufacture than the light valve 20 here contemplated.

In one modification of my light valve 20 (illustrated in Figs. 1, 2 and 3,) I provide a multi-

sided cylinder, preferably octagonal in shape which is interposed between the source of light 16 and the cup 18 and is rotatably carried in the journal bracket 22 extending from the arm 24 of the supporting frame 26, which may be secured to the base 28 of the case 10 in any suitable manner.

Inasmuch as heat waves (infra red) from the light source 16, which are generated by the incandescent filament, will cause fatigue of the photoelectric cell, it is customary to interpose between the light and the cell a heat filter 30, which is carried in position by the arm 24.

When using colorimeters, it is frequently desired to use a monochromatic light and a color filter frame 32 is mounted for rotation on the arm 24 between the light source 16 and the heat filter 30. The color filter frame 32 is customarily provided with a plurality of filters, each of a selected color so that a monochromatic light of desired wave length may be directed through the specimen upon proper rotative positioning of the color filter frame 32 to bring into registration the selected color filter.

I prefer to make the light valve 20 from a plastic such as "Lucite," which is a methylmethacrylate ester, or a polystyrene plastic or any other transparent plastic or material which also has the index of light refraction of glass. Plastics are more durable than glass, since they are infrangible in ordinary usage and as will be seen they are further highly desirable in the application of my invention because they can be uniformly and evenly dyed, without painting, by invasion into the plastic of the pigment, which if properly chosen is solvent in the plastic upon immersion thereinto of the valve.

Referring now to Fig. 2, the opposite surfaces 34 and 36 are clear so that they are fully transparent, the opposite faces 38 and 40 are frosted so that they are translucent, one of the opposite faces 42 and 44 is frosted and the other face clear so that more light will pass therethrough than through the frosted faces 38 and 40 but less than the intensity of light passing through the clear faces 34 and 36; and the opposite faces 46 and 48 are dyed black so that they are opaque.

It will be apparent that the radiation transmitting characteristics of any two opposed surfaces differ from the radiation transmitting characteristics of any other two diametrically opposed surfaces.

The light valve 20 is constructed and positioned between the color and heat filters and the specimen carrying test tube or container 50, so that the light rays from the source 16 pass through opposite faces of the valve when they are brought into alignment therewith as illustrated in Fig. 2. In that position, the light valve 20 permits the transmission therethrough of the maximum intensity of light rays since the clear or transparent faces 34 and 36 are in registration with light source 16 and the specimen tube 50.

Rotation of the light valve 20 in either direction by the shaft 52, to which it may be detachably secured as by means of the collar 54 and set screw 56, as indicated by the arrow 58 (Figs. 2 and 3), brings a corresponding set of opposite faces totally or partially in a selected magnitude into alignment, thereby reducing the light transmitted through the valve to any desired degree, the light being completely cut off when the opaque faces 46 and 48 are brought into the position illustrated in Fig. 3.

It will be recognized that by selectively positioning a clear, translucent or opaque face, either completely or in a selected partial combination with an adjoining face, the intensity of light transmitted through the valve can be adjusted, as desired, from the maximum down to a complete cut off.

In order to provide means for operating the light valve from the exterior of the case 10, the supporting shaft 52 is journalled in a bearing provided in the bracket 22 and I secure on the lower end of the shaft 52 a gear 60 which meshes with the worm 62 secured on the cross shaft 64.

The cross shaft 64 is journalled for rotative movement in the rear arm 24 and front arm 66 of the supporting frame 26 and the front end wall 68 of the case 10, through which it extends. The knurled knob 70 is secured to the exterior end of the cross shaft underneath the meter 12 so that it is in a convenient position to adjust the meter deflection to the standard setting. It will be recognized that, upon turning the knob 70, the light valve is correspondingly positionally rotated to adjust the light intensity and thereby the meter deflection.

I prefer a worm drive since it is more accurate and sensitive because there is no play between the gears which are therefore positive in action.

It is not necessary to illustrate the circuits or electrical elements used to connect the cell lead wires 72 and 74 to the meter 12 or the light 16 and the instrument to a source of power supply as these are all conventional, the invention not being concerned therewith other than its application to a workable instrument for the purposes contemplated.

While I herein illustrate and describe the application of the light valves here concerned with as applied to a particular type of colorimeter, it is to be understood that they may be used equally well with any other type of colorimeter or for that matter with any device wherein it is desired to regulate the intensity of radiation emitted from a source to an objective.

Referring now to Fig. 4, I have there illustrated a cylindrical or round in cross section light valve 76, which may be substituted for the multi-faced octagonal light valve 20 (Figs. 1, 2 and 3). The cylindrical light valve 76 may likewise be mounted on a supporting shaft 52 between the source of light 16 and the test specimen 50 with the axis of rotation thereof likewise corresponding to the axis of the cylinder.

The cylinder of the light valve 76 may be, as desired, divided into equal sectors, for example also eight, the peripheral surface of each sector likewise parallel to the cylinder axis and corresponding to a face of the octagonal shaped light valve 20 and the opposite surfaces 78 and 80 being clear or transparent; the opposite surfaces 82 and 84 being frosted and therefore translucent; one of the opposite surfaces 86 and 88 being clear or transparent and the other being frosted or translucent; and the two remaining surfaces 90 and 92 being dyed black and therefore opaque. Rotation of the cylinder 76 by means of the knurled knob 70 turns the light valve into a selected position so that the intensity of light transmitted through the valve to the test specimen may be similarly selectively adjusted so that the meter deflection is set at the standard of reference desired.

While I have described in specific detail certain embodiments of my invention, I do not intend to be limited thereto since various modifications may be made therein which will readily occur to

those skilled in the art without departing from the scope of the invention.

1. A valve for controlling the intensity of energy transmitted therethrough to an object comprising a cylinder having faces arranged around the periphery thereof in opposed pairs, each face of energy transmitting characteristic differing from that of an adjoining face, the valve rotatable about an axis parallel to the faces, said faces arranged on the periphery of the valve in the following arrangement of pairs: a pair of opposed faces, each opaque to energy transmission; a pair of opposed faces, each transparent to energy transmission; a pair of opposed faces, one being transparent to energy transmission and the other of reduced transparency to energy transmission and a pair of opposed faces, each of reduced transparency to energy transmission; and means for rotating the valve about its axis.

2. In a colorimeter, a housing; a source of light, a photoelectric cell and means for suspending a specimen between the source of light and the photoelectric cell for transmission of light rays from the source through a suspended specimen on to the photoelectric cell, arranged in the housing; a cross shaft mounted in the housing for rotation therein and accessible from the exterior of the housing; a worm on the cross shaft; a light valve in the housing for adjusting the intensity of light projected from the said source of light through a suspended specimen onto the photoelectric cell and comprising a multi-faced, transparent cylinder, a pair of opposed faces of the light valve being opaque, a pair of opposed faces of the light valve being transparent, a pair of opposed faces of the light valve being translucent and one face of a pair of opposed faces of the light valve being transparent and the other face of said last mentioned pair of faces being translucent; said valve mounted on a shaft in the housing; a gear on the last mentioned shaft engaging the said worm; the said faces being parallel to the axis of rotation of the light valve on the shaft.

3. In a colorimeter, a housing having a floor, sides, front and rear ends and top, a supporting frame on the floor of the housing, a platform mounted on the supporting frame, a source of light on the platform, a member on the supporting frame extending upwardly from the supporting frame, a color filter comprising a frame and a plurality of filters mounted in the frame, said frame rotatably mounted on the member for selectively positioning the filter on the member to move a selected filter into the path of light from the source of light, a bracket on the member, a shaft journaled in the bracket for rotation therein, a light valve on the shaft and rotatable therewith, said color filter positioned between the source of light and the light valve, a specimen cup vertically spaced from the housing floor, a photoelectric cell mounted on the cup in rear of a specimen carried in the cup, said cup, source of light, filter and light valve positioned in line relatively to each other so that rays of light from the light source are projected through the color filter, the light valve and a specimen in the cup onto the photoelectric cell, a second shaft extending into the housing through the front end to the supporting frame, said second shaft journaled for rotation in said front end of the housing and said supporting frame, intermeshing gear means on the shafts for translating rotative motion of the second shaft into corresponding rotative motion of the first shaft to rotate the light valve between the specimen cup and the source of light to selectively adjust the intensity of the rays of light projected from the source of light through the color filter and a specimen in the cup onto the photoelectric cell.

4. In a colorimeter, a housing having a floor, sides, front and rear ends and top, a supporting frame on the floor of the housing, a platform mounted on the supporting frame, a source of light on the platform, a member on the supporting frame extending upwardly from the supporting frame, a specimen cup vertically spaced from the housing floor, a bracket on the member between the source of light and the specimen cup, a shaft journaled in the bracket for rotation therein, a light valve on the shaft and rotatable therewith and positioned between the source of light and the specimen cup, a photoelectric cell mounted on the cup in rear of a specimen carried in the cup, said cup, source of light, light valve and photoelectric cell positioned in line relatively to each other so that rays of light from the light source are projected through the light valve and a specimen in the cup onto the photoelectric cell, a second shaft extending into the housing through the front end thereof to the supporting frame and journaled in said front end and said supporting frame for selective rotation, said light valve having a plurality of flat light transmitting surfaces and a plurality of flat opaque surfaces, adjacent light transmitting surfaces separated by an opaque surface, said light valve positioned in the path of light directed from the source of light to thereby, upon movement of the first mentioned shaft and corresponding rotation of the light valve, interpose in said path of light different proportions of the light transmitting surfaces and the opaque surfaces whereby different intensities of light from zero intensity to full intensity may be selectively projected from the source of light through the specimen cup onto the photoelectric cell, intermeshing gear means on the shafts for translating movement of the second shaft into corresponding movement of the first shaft to selectively position the light valve and thereby adjust the intensity of the rays of light projected through a specimen in the cup onto the photoelectric cell.

5. The colorimeter of claim 4, in which said first shaft extends vertically and the flat light transmitting surfaces of said light valve, when in normal position to transmit full intensity of light, are at right angles to the axis of the light beam from the source of light.

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