Nov. 7, 1950 W. F. GRETHER 2,528,513

SELF-ADMINISTERING COLOR VISION TEST

Filed Oct. 21, 1949 3 Sheets-Sheet 1

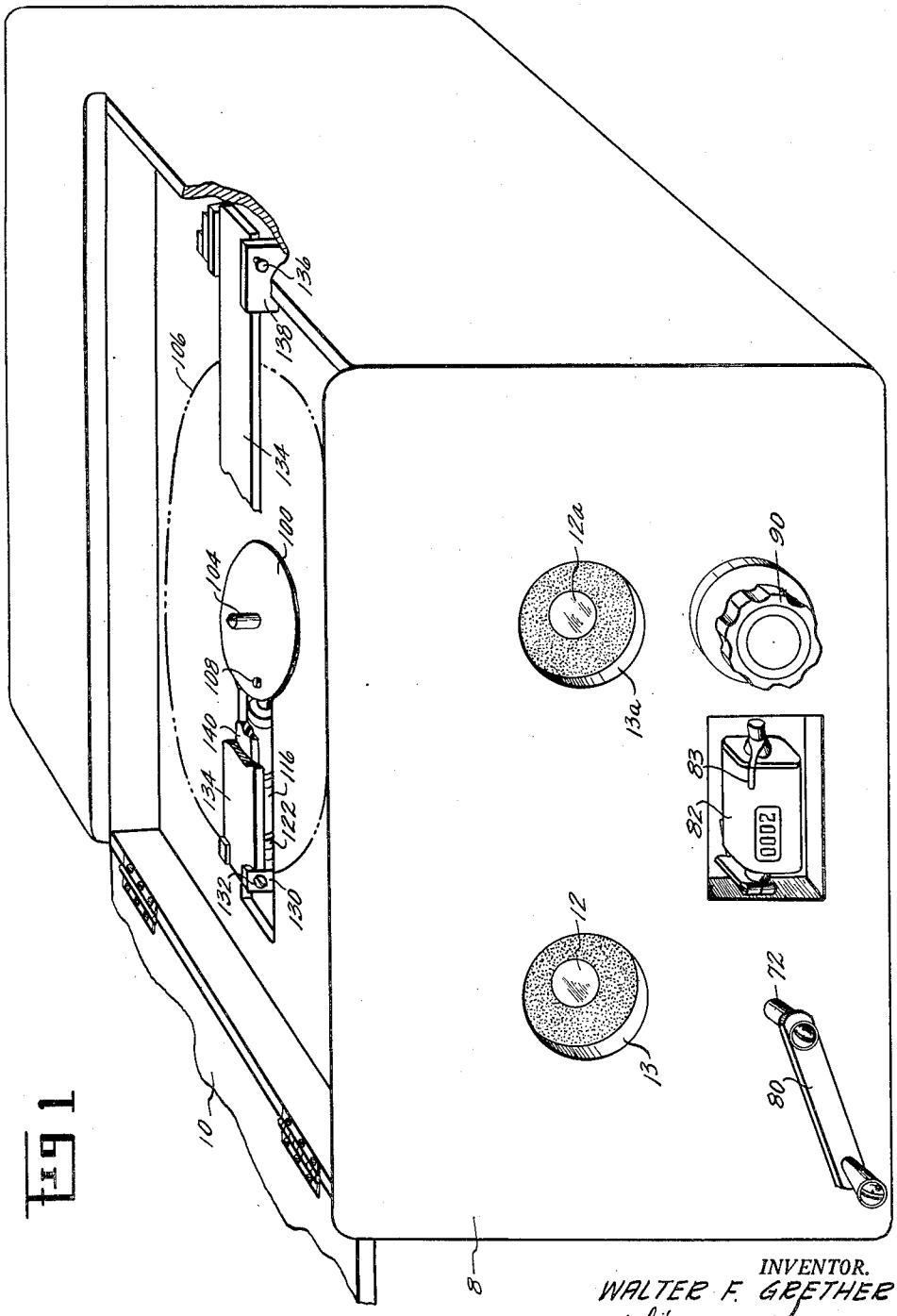


Fig 1

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SELF-ADMINISTERING COLOR VISION TEST

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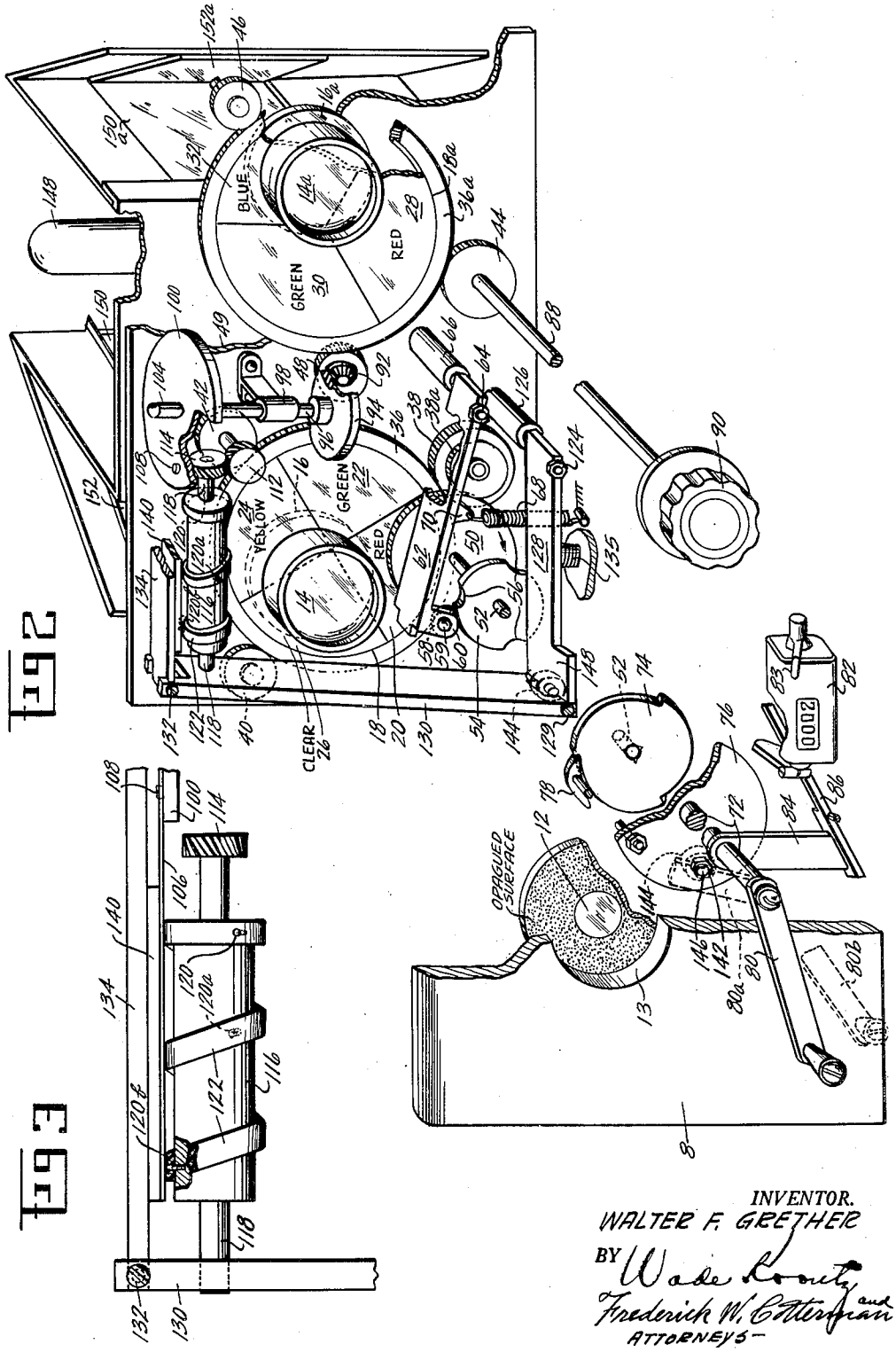


Fig. 2

Fig. 3

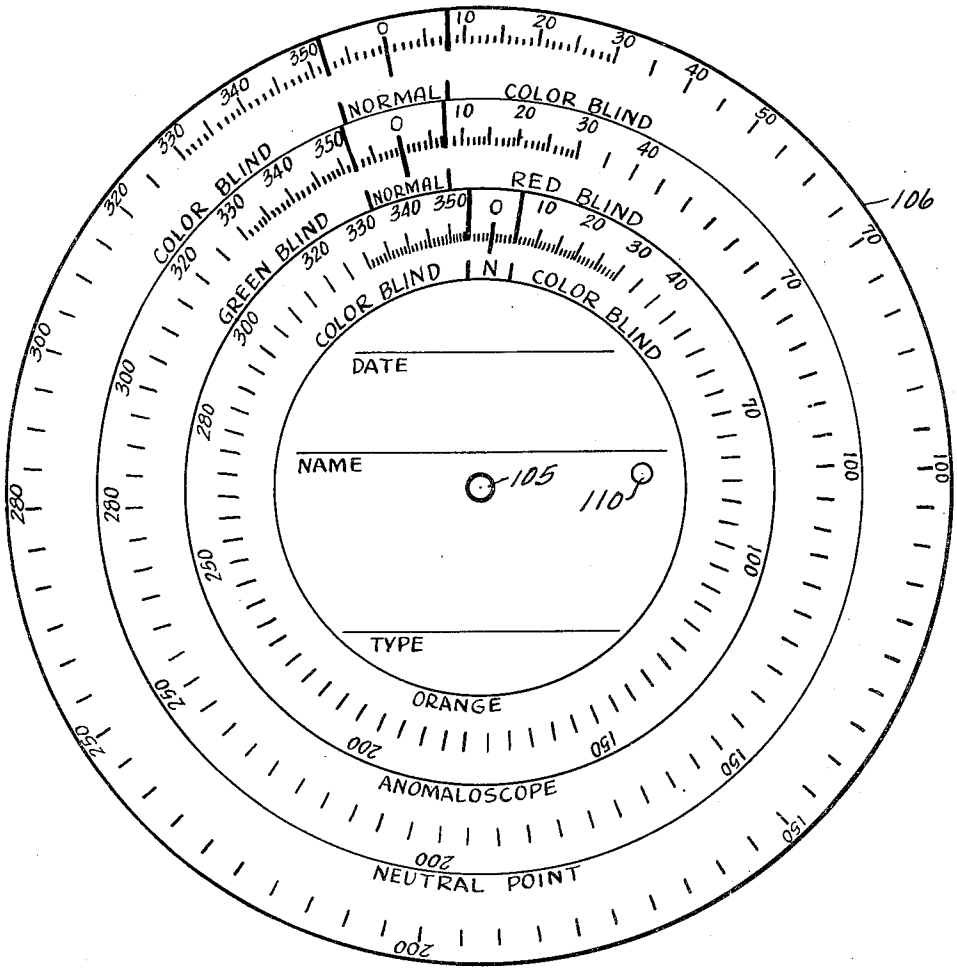
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SELF-ADMINISTERING COLOR VISION TEST

Filed Oct. 21, 1949 3 Sheets-Sheet 3

Fig 4



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UNITED STATES PATENT OFFICE

2,528,513

SELF-ADMINISTERING COLOR VISION TEST

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Application October 21, 1949, Serial No. 122,821

9 Claims. (Cl. 346—108)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to an improved device for detection, measurement and analysis of color blindness in human beings, the test preferably being self-administered and its results self-recorded.

The device essentially comprises a closed cabinet provided on the front side with two stimulus windows and a manual control means for each said window, with color lighting mechanism within the cabinet operable by said controls to set up a test color in one of the stimulus windows with one of the controls and match the test color by setting up a corresponding color in the other stimulus window with the other control. Means are provided for recording the accuracy with which the examinee has matched the test color with the matching color, said means of recording being automatically operable by the examinee during the process of operating said controls. A resettable counter visible from the front of the cabinet records the number of trial matches which the examinee has completed and recorded.

An object of the invention is to provide a device of the above character which is of simple construction, effective in operation and accurate in its recording of the result.

I attain this and other objects by the illustrative embodiment of the invention hereinafter described, reference being had to the drawings, wherein:

Fig. 1 is a perspective view of the outside of the embodiment of the invention herein disclosed, the lid of the cabinet being opened to show some of the operating mechanism within.

Fig. 2 is an exploded schematic perspective view of the operative mechanism of the device shown in Fig. 1, the greater portion of the cabinet being broken away to more clearly illustrate the operating mechanism within.

Fig. 3 is an enlarged view of the recording cylinder shown in Fig. 1 assembled with other parts.

Fig. 4 is a plan view of the circular card upon which a record of the examinee's accuracy in matching colors is recorded.

Like reference characters refer to like parts throughout the several views.

Referring to the drawings and more particularly to Figs. 1 and 2, a cabinet 8 has a lid 10 and two laterally spaced stimulus windows 12 and 12*a* fixed to the front wall inside the cabinet over openings 13 and 13*a*. Windows 12 and 12*a* are made of diffusing glass.

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Axially aligned with the stimulus window 12 are spaced apart lenses 14 and 16 and axially aligned with the stimulus window 12*a* are spaced apart lenses 14*a* and 16*a*.

Intermediate the axially spaced lenses 14 and 16, and having its axis parallel to but offset with respect to the axis of the lenses 14 and 16, is a circular color filter 18 made up of a number of sectoral parts of different colors 20 red, 22 green, 24 yellow and 26 neutral. Likewise, intermediate the axially spaced lenses 14*a* and 16*a*, and having its axis parallel to but offset with respect to the axis of the lenses 14*a* and 16*a*, is a circular color filter 18*a* made up of a number of sectoral parts of different colors 20 red, 30 green and 32 blue. Circular filters 18 and 18*a* are surrounded and supported respectively by externally toothed ring gears 36 and 36*a*. Externally toothed ring gear 36 is supported for rotation in circumferentially spaced pinions 38, 40 and 42 while externally toothed ring gear 36*a* is supported for rotation in circumferentially spaced pinions 44, 46 and 48. Pinions 38, 40, 42, 44, 46 and 48 have rotative bearings (not shown) supported in a partition 49 in the cabinet 10.

Fixed for unitary rotation with the pinion 38 is a smaller pinion 38*a* which engages a relatively large gear 50 fast on the rotatable shaft 52, whereby turning of the rotatable shaft 52 rotates the ringe gear 36 and its filter 18 through equal angular movement.

Forward of the gear 50 and fast on the rotatable shaft 52 is a detent cam 54 having three detent notches 56 adapted to be successively engaged by a small detent roller 58 rotatable on a stud 59 which is carried on a depending lug 60 on a lever 62. The lever 62 is hinged on a stud 64 carried on a support 66 extending from the partition 49 of the cabinet 8 or any other suitable stationary part of the structure. A spring 68 has the lower end fixed to any convenient stationary member and the upper end attached at 70 to the lever 62, whereby the detent roller 58 is sequentially seated in the several notches 56 as the shaft 52 is rotated to bring the several elective patterns, which the examinee proposes to match, into operative position.

Coaxial with the rotatable shaft 52 is an operating shaft 72, the forward end of the rotatable shaft 52 having fixed thereon a three-toothed ratchet 74, and the rearward end of the operating shaft 72 having affixed thereto a disc 76 which carries the pawl 78 for engaging the teeth of the ratchet 74. A crank 80 fast on the forward end of the operating shaft 72 is provided for rocking the operating shaft 72 alternately clockwise

to a position 80*a* and anticlockwise to a position 80*b*. Positions 80*a* and 80*b* are shown in dotted outline (see Fig. 2).

A resettable counter 82 is recessed into the front of the cabinet 8 for recording the number of trials completed by the examinee. When the crank 80 is turned anticlockwise to the limit of its angle of rotation, i. e., to dotted position 80*b*, the cam 84 engages the lever 86 and advances the counter one unit. A resetting or turn-to-zero lever 83 is provided and is intended to be operated by an examinee just before beginning his test. The overall angular movement of the crank 80 should preferably be but slightly greater than the angular distance between ratchet notches, i. e., one hundred twenty degrees in the embodiment shown. This hundred twenty degree movement includes the movement necessary to cause the cam 84 to advance the counter 82 one unit, i. e., the angular movement of crank 80 between 80*a* and 80*b* in the instant disclosure in one hundred twenty degrees.

As a means for manual rotation of the matching filter 18*a*, the shaft 88, which carries the pinion 44, is prolonged and provided at the forward end with a hand knob 90.

Coaxially positioned on and fastened to the side of the pinion 48 is a bevel pinion 92 which is in toothed engagement with a crown gear 94 on the lower end of a vertical shaft 96. The vertical shaft 96 is rotatably supported in a bearing 98 which may in turn be supported by the partition 49 within the cabinet or any other suitable stationary member of the structure. A circular turntable 100 is fast on the shaft 96 near its upper end, the shaft projecting upwardly through the turntable thus providing a pilot 104 adapted for registry with an opening 105 in the circular record card 106 (see Fig. 4). A drive pin 108 extends upwardly from the turntable 100 through a hole 110 in the record card 106 to compel unitary rotation of the card and turntable.

Mounted for one-to-one rotation with the pinion 42 is a helically toothed pinion 112 which is in right angle driving engagement with another helically toothed pinion 114. Pinion 114 drives the recording cylinder 116 which is rotatably supported in bearings 118 projecting forwardly from the partition 49, the direction of rotation of the cylinder 116 being clockwise when viewed from right to left. Recording pins 120, 120*a*, and 120*b* (see Fig. 3) are fast in the cylinder 116 with the points projected radially outward. The number of pins should correspond to the number of positions to which the filter 18 may be set, that is, to the number of notches in the detent cam 54 or in the ratchet 74, and the ratio and direction of rotation of the gearing should be such that setting the test filter to "orange," "yellow" or "neutral" will respectively bring the inner, middle, and outer pins 120, 120*a* and 120*b* to their top or recording position. The circumferential or angular spacing of the pins should therefore, in the embodiment shown, be one hundred twenty degrees, and the axial spacing of the recording pins should be such that the radius from the axis of the pilot 104 to the pins 120, 120*a* and 120*b* should equal the radius from the center of the record card 106 to the mean radii of the recording areas on the cards 106 marked "orange," "anomaloscope," and "neutral point" respectively. The "orange" setting of the test filter is accomplished by stopping in a position which mixes red and green. A sponge rubber ribbon 122 is wound helically around the recording cylinder 116 to enclose the several pins, the ribbon 122 being fastened to the cylinder 116, the thickness of the ribbon and the length of the pins being such that the points of the pins do not reach through the ribbon except when the rubber ribbon is depressed.

Hinged at 124 to a stationary support 126 is a horizontally disposed bar 128, the movable end of which is hinged at 129 to the lower end of a vertical bar 130. The upper end of the vertical bar 130 is hinged at 132 to the left end of the pressure bar 134 which operates to press the paper record card 106 onto the selected one of the pins 120, 120*a*, or 120*b*, the right end of the pressure bar 134 being hinged by a removable pin 136 (see Fig. 1) to a bracket 138 which is carried on the cabinet 8. The underside of the pressure bar 134 is faced with a felt strip 140 of somewhat greater compressive resistance than the sponge rubber ribbon 122. The felt strip 140 receives the points of the pins 120 and protects them from injury when they reach through the ribbon 122 and through the paper record card 106.

A small stud 146 projects rearward from the rear face of the disc 76 and carries a small roller 144. Stud 146 is held in the disc 76 by a nut 142 as seen in Fig. 2. Fig. 2, however, is an exploded view, the disc 76 and ratchet 74 having been moved axially forward in the drawing to facilitate illustration. When the disc 76 and ratchet 74, seen in the drawing, are moved axially rearward to the position they actually occupy in the testing device, the roller 144 will rest lightly on a lateral extension 148 of the bar 128 as shown in phantom in Fig. 2. Thus properly assembled, the operation of the crank 80 anticlockwise through several degrees of rotation to the anticlockwise position 80*b* shown in dotted lines will actuate the horizontal bar 128, vertical bar 130, and pressure bar 134 to thereby force the selected one of the recording pins 120, 120*a* or 120*b* through the record card 106. An expansion spring 135 operates against the underside of the bar 128 to raise the vertical bar 130 and pressure bar 134 and thereby allow the sponge rubber ribbon 122 to strip the paper record card 106 off the pin 120*b* and coincidentally return the counter arm 86 for its next movement.

That part of the cabinet which is rearward of the partition 49 houses the lighting means of the apparatus. Light from a single incandescent lamp 148 is diffused by two opal flashed glass windows 150 and 150*a*. Mirrors 152 and 152*a*, placed at 45 degrees, reflect the light from the windows 150 and 150*a* directing it through the lenses 16 and 16*a*, through the color filters 18 and 18*a*, through the lenses 14 and 14*a*, then through the stimulus windows 12 and 12*a*, which are made of diffusing glass. The lenses 14, 16, 14*a* and 16*a* are of such focal length that images of the diffusing windows 150 and 150*a* are focused upon the stimulus windows 12 and 12*a* and the light rays between each lens pair are parallel. The color filter discs 18 and 18*a* are placed in the optical light path between the lenses where the rays are parallel. Because of the rays being parallel through the filters, any colors which intercept the light between the lenses will be uniformly mixed when the rays come into focus on the stimulus windows 12 and 12*a*. Rotation of the color filter discs 18 and 18*a* will thus produce variations in the colors appearing in the stimulus windows 12 and 12*a*. For any given position of a color filter disc the resulting stimulus color will depend upon the area and relative

light transmission of the filters intercepting the light path.

The three test stimulus colors, orange, yellow and white are produced in the test stimulus window 12 by positioning the filter disc 18 sequentially in the three positions delineated by the notches 56 in the detent cam 54, the orange being produced by a notch which positions part of the red sector 20 and part of the green 22 in the light path, the yellow by a second notch which positions the yellow sector 24 in the light path, and the white being provided by a third notch which positions the neutral sector 26 in the light path. The colors thus selectively appearing in the test stimulus window 12 are to be matched by the examinee on the matching stimulus window 12*a* by rotation of the control knob 90, which, through the pinion 44 and gear 36*a* rotates the matching filter 18*a*. By continuous rotation, the three colors 28 red, 30 green and 32 blue are combined in varying proportions to provide a continuous cycle of color variation as on the rim of the well known psychological color circle as follows: red, orange, yellow, yellow-green, green, blue-green, blue, violet, purple, purple-red and red. The construction of the recording mechanism has been hereinbefore described. The procedure of the examinee in testing and recording the accuracy of his color vision is preferably substantially as follows:

The lid 10 of the cabinet 8 is raised, the pin 136 is withdrawn, the pressure bar 134 is swung upwardly on the hinge 132 after which a recording card 106, Fig. 3, is placed on the turntable 100 and the pressure bar 134 and pin 136 are returned to the position shown. If it has not previously been done, the counter 82 should be returned to zero by means of the lever 83.

The crank 80 is next turned clockwise, from the unactuated or home position 80 shown in solid lines to the clockwise position 80*a* shown in dotted outline which is the angular distance from the home position corresponding to the span between two notches of the ratchet 74 less the angular distance through which the crank 80 must be turned anticlockwise from the home position to effect actuation of the counter 82 and of the recording mechanism, which turns the test filter 18 clockwise to a position where the light rays pass half through the red sector 20 and half through the green sector 22, the mixture being brought to the stimulus window 12 as orange. At this point the roller 58 will have nested in one of the notches 56 of the detent cam 54.

Coincidentally with the movement of the test filter 18 to the orange position, the pressure cylinder 116 moves the inner recording pin 120 to top center.

The matching knob 90 is now turned by the examinee for the first test until a matching color satisfactory to the examinee is attained, then the crank 80 is turned anticlockwise past the home position 80 shown in Fig. 2 to the dotted line position 80*b*, which will cause the cam 84 to move the counter 82 up one unit and simultaneously will press the pressure bar 134 on to the pressure cylinder 116 thereby to puncture the record card through the orange space with the pin 120. When the crank 80 is released, the spring 135 will return the pressure bar 134 to the position 80 shown in solid lines in Fig. 2, thereby withdrawing the pin 120 from the record card and simultaneously the counter 82 will be readied for the next indexing.

In the embodiment of the invention herein shown the total angular movement of the crank 80 clockwise from the position shown in Fig. 1, or Fig. 2 plus the lesser angular movement anticlockwise from that same position, is equal to one hundred twenty degrees. It is important that the correct angular movement be maintained so that the examinee is always compelled to operate the counter and the recording mechanism in order to allow the pawl 78 to drop in behind a ratchet tooth for indexing to the next test color.

The crank 80 is now again turned clockwise from the home position shown in solid lines to the dotted line position 80*a*, i. e., through one hundred twenty degrees less the anticlockwise movement between home position 80 and position 80*b* required to effect operation of the counter and the test recording mechanism, which will bring the yellow sector 24 into operative position between the lenses 14 and 16, thereby showing yellow in the stimulus window 12, and coincidentally setting the middle recording pin 120*a* on top center of the cylinder 116 which readies the device for the second test.

The yellow color which is now in the test stimulus window 12 is matched in the matching stimulus window 12*a* by rotation of the matching color filter 18*a*, then, by anticlockwise rotation of the crank 80 to its extreme anticlockwise position 80*b* the recording pin 120*a* is made to punch the card 106 in the anomaloscope space, the punch mark being proportionately as far removed from normal circumferentially as the examinee's judgment in matching colors deviates from the normal.

The third and last cycle of operations in the test comprises clockwise rotation of the crank 80 to 80*b* to set the test filter 18 at neutral and the recording pin 120*b* on top center, then matching the neutral test color, then effecting anticlockwise rotation of the crank to punch the record card 106 in the outer or neutral area and adding a third unit to the counter 82.

The three concentric rings on the test record card 106, Fig. 3, are labelled "orange," "anomaloscope," and "neutral point" representing the test colors, orange, yellow and white respectively. In each ring there is an area labeled normal, in the center of which is a zero mark. For each of the colors the holes will be punched into the record card in the corresponding ring. For persons with normal color vision, all deviations from the zero line should fall within the normal areas. For color blind individuals errors will be made which fall outside the normal range. The direction and magnitude of these errors identifies the type and severity of the color blindness. The errors can be measured in degrees plus or minus from the degree scales on the record card. These degree scales correspond to positions on the rim of the psychological color circle. Errors of color matching can therefore be described in terms of degrees displacement along the rim of the color circle.

The test herein disclosed utilizes three characteristics of human color blindness as a means of detecting this condition, and each of the three test colors is designed to detect one of these deficiences.

1. *Yellow.*—One of the test colors is yellow produced by Wratten Filter No. 73. This color is matched by the subject with a mixture of red and green. For normal human beings a particular ratio of red to green is required to duplicate

appearance of the yellow test color. Practically all color blind persons fit into either of two types, green blind and red blind. Those who are green blind will use an excess of green in the mixture to match yellow. Red blind will use an excess of red. Either type is thus identified. This is known as the "anomaloscope" test.

2. *White.*—One of the test colors is the unfiltered color of the incandescent lamp, that is, a yellowish white. For a normal person this can be matched quite closely by a mixture of red and green which appears yellowish-green. For most color blind individuals the matching color for the white will be green or blue-green, and in some cases purple. The degree of deviation from the normal match is a measure of the severity of the color blindness. This is known as the "neutral point" test.

3. *Orange.*—In his capacity to discriminate colors the deficiency of the color blind is greatest in the yellow, orange, and red regions of the spectrum. In this test an orange produced by a mixture of red and green is matched by a similar mixture of red and green. A color blind person will show less accuracy in making this match than the normal individual.

The method disclosed offers the following advantages over existing color vision tests:

1. The test is self-administering and does not require the presence of an examiner to operate the test and record the results.

2. The test is self-scoring and automatically produces a permanent record which describes the examinee's color vision.

3. It is the first test, designed for testing large groups of people, which measures the severity of color blindness by the degree of displacement of the spectral neutral point from the normal location.

4. It is the first color vision test which combines the anomaloscope, neutral point, and orange tests into a single device.

5. It is the only known test which gives quantitative indications of color vision deficiency in terms of degrees displacement on the color circle of errors on the anomaloscope, neutral point and orange tests.

I claim:

1. Apparatus for testing color vision which comprises a closed cabinet, a vertical partition in said cabinet, a test stimulus window and a matching stimulus window in the front wall of said cabinet, a pair of spaced apart test lenses in said cabinet axially aligned with each other and with said test stimulus window, a like pair of spaced apart matching lenses in said cabinet axially aligned with each other and with said matching stimulus window, both said pairs of lenses being supported on said vertical partition, an incandescent light bulb medially placed in back of said partition, two opposite opal flashed glass windows alongside said light bulb in back of said vertical partition positioned to pass the light from said bulb laterally, two angle mirrors positioned to direct said light through said pairs of lenses, a circular test color filter made up of four sectors of neutral, yellow, green and red transparencies axially spaced between said test lenses and having its axis parallel to but offset from the axis of the test lenses, a circular matching color filter made up of three sectors of red, green, and blue transparencies axially spaced between said matching lenses and having its axis parallel to but offset from the axis of the matching lenses, means to support said test color filter for rotation about its axis, means to support said matching color filter for rotation about its axis, a test shaft for rotating said test color filter, a matching shaft for rotating said matching color filter, a three-notched detent cam and a three-toothed clockwise rotating ratchet on said test shaft, detent means including a detent roller spring pressed into said notches, gear means drivably connecting said test shaft to said test filter, gear means drivably connecting said matching shaft to said matching filter, a rock shaft rockably supported in coaxial relation with said test shaft, a disc on said rock shaft, a pawl carried by said disc for engagement with said ratchet for rotating said test filter clockwise, a crank for rocking said rock shaft, a horizontally disposed recording cylinder rotatably supported on bearings carried on said vertical partition, gear means drivably connecting said recording cylinder to said test color filter, three radially extending recording pins carried by said cylinder axially spaced one near each end and the third midway between the two, and circumferentially spaced on thirds, a turntable rotatable on a vertical axis in bearings carried on said vertical partition, said turntable having a central pilot and a drive pin positioned radially outward therefrom, gear means drivably connecting said turntable to said matching color filter, a circular record card having a central opening for receiving said pilot and an eccentric opening for said drive pin, and having three concentric rings radially beyond said drive pin, the mean radii of the several said rings corresponding to the distance from said pilot to the several recording pins, a sponge rubber cover surrounding said cylinder and imbedding said recording pins, a horizontally disposed pressure bar hinged at one end and overlying said cylinder, a felt strip facing the underside of said pressure bar for receiving the points of the recording pins when the felt strip is pressed upon the sponge rubber cover by said pressure bar, a pressure bar operating roller eccentrically positioned on said rock shaft disc, and lever means actuated by said pressure bar operating roller upon anticlockwise rotation of said operating shaft to press said pressure bar and said rubber strip onto said sponge rubber cover and said recording pins.

2. Apparatus for testing color vision which comprises a cabinet, a partition in said cabinet, a test stimulus window and a matching stimulus window in the same wall of said cabinet, a pair of spaced apart test lenses in said cabinet axially aligned with each other and with said test stimulus window, a pair of spaced apart matching lenses in said cabinet axially aligned with each other and with said matching stimulus window, an incandescent light bulb in back of said partition, two opal flashed glass windows alongside said light bulb positioned to pass light rays from said bulb laterally, two angle mirrors positioned to direct said rays through said pairs of lenses, a circular test color filter made up of four sectoral transparencies, one neutral, one yellow, one green and one red axially spaced between said test lenses and having its axis parallel to but offset from the axis of the test lenses, a circular matching color filter made up of three sectoral transparencies, one red, one green, and one blue axially spaced between said matching lenses and having its axis parallel to but offset from the axis of the matching lenses, means to support said test color filter for rotation about its axis, means to support said matching color filter for rotation about its axis, a test shaft for rotating said test color

filter, a matching shaft for rotating said matching color filter, a detent means and a clockwise rotatable ratchet on said test shaft, power transmitting means drivably connecting said test shaft to said test filter, power transmitting means drivably connecting said matching shaft to said matching filter, a rock shaft supported in coaxial relation with said test shaft, a pawl carrying member on said rock shaft, a pawl carried by said pawl carrying member for engagement with said ratchet for rotating said test filter clockwise, a crank for rocking said rock shaft, a horizontally disposed recording cylinder rotatably supported on bearings carried on said partition, power transmitting means drivably connecting said recording cylinder to said test color filter, three radially extending recording pins carried by said cylinder axially spaced along said cylinder, and circumferentially spaced to correspond to said ratchet, a turntable rotatable on a vertical axis, said turntable having a central pilot and driving means positioned radially outward therefrom, power transmitting means drivably connecting said turntable to said matching color filter, a circular record card having a central opening for receiving said pilot and means to engage said driving means, and having three concentric rings radially beyond said driving means, the mean radii of the several said rings corresponding to the distance from said pilot to the several recording pins, a soft rubber cover surrounding said cylinder and imbedding said recording pins, a horizontally disposed pressure bar hinged at one end and overlying said cylinder, a felt strip facing the underside of said pressure bar for receiving the points of the recording pins when the felt strip is pressed upon the soft rubber cover by said pressure bar, a pressure bar operating roller eccentrically positioned on said rock shaft disc, and lever means actuated by said pressure bar operating roller upon anticlockwise rotation of said operating shaft to press said pressure bar and said felt strip onto said soft rubber cover and said recording pins.

3. Apparatus for testing color vision which comprises a test stimulus window and a matching stimulus window, a pair of spaced apart test lenses axially aligned with each other and with said test stimulus window, a pair of spaced apart matching lenses axially aligned with each other and with said matching stimulus window, light means in said cabinet, angle mirrors for directing light from said light means through said pairs of lenses, a circular test color filter made up of a plurality of transparencies of different colors, said test color filter being axially spaced between said test lenses and having its axis parallel to but offset from the axis of the test lenses, a matching color filter made up of a plurality of transparencies of different colors, said matching color filter being axially spaced between said matching lenses and having its axis parallel to but offset from the axis of the matching lenses, means to support said test color filter for rotation about its axis, means to support said matching color filter for rotation about its axis, a test shaft for rotating said test color filter to a number of test positions, a matching shaft for rotating said matching color filter to matching positions, a detent and a clockwise rotatable ratchet having a number of teeth corresponding to the number of test positions on said test shaft, means drivably connecting said test shaft to said test filter, means drivably connecting said matching shaft to said matching filter, a rock shaft supported in coaxial relation with said test shaft, pawl carrying means on said rock shaft, a pawl carried by said pawl carrying means for engagement with said ratchet for clockwise rotation, a crank for rocking said rock shaft, a rotatable recording cylinder, means drivably connecting said recording cylinder to said test color filter, radially extending recording pins axially spaced along said cylinder, and circumferentially spaced to correspond to the number of teeth on said ratchet, a rotatable turntable, said turntable having a central pilot and a record card drive means positioned radially outward therefrom, means drivably connecting said turntable to said matching color filter, a circular record card having a central opening for receiving said pilot and means for engaging said record card drive means, and having a number of concentric rings corresponding to the number of recording pins radially beyond said drive means the mean radii of the several said rings corresponding to the distance from said pilot to the several recording pins, a cover of highly yieldable material surrounding said cylinder and imbedding said recording pins, a pressure bar overlying said cylinder, a felt strip facing the underside of said pressure bar for receiving the points of the recording pins when the felt strip is pressed upon the highly yieldable cover by said pressure bar, a pressure bar operating roller eccentrically positioned on said rock shaft disc, and lever means actuated by said pressure bar operating roller upon anticlockwise rotation of said operating shaft to press said pressure bar and said felt strip onto said highly yieldable cover and said recording pins.

4. Apparatus for testing color vision which comprises a pair of spaced apart coaxial test lenses, a pair of spaced apart coaxial matching lenses, means for directing light through said pairs of lenses, a test color filter made up of a plurality of rotatable test color transparencies inserted between said test lenses, a matching color filter made up of a plurality of rotatable matching color transparencies inserted between said matching lenses, rotatable means to support said test color filter for rotating it from one color to another, rotatable means to support said matching color filter for rotating it from one color to another, a test color filter rotating means, a matching color filter rotating means, detent means for holding said test color filter rotating means in a selected color position, ratchet and pawl means for moving said test color filter rotating means in one direction only, a rotatable recording cylinder, means drivably connecting said recording cylinder to said test color filter, radially extending recording pins axially spaced along said cylinder and circumferentially spaced to correspond to the number of teeth on said ratchet, a rotatable turntable joined for unitary rotation with said matching filter, having means to hold and rotate a circular record card and having a number of concentric rings corresponding to the number of recording pins radially beyond said holding and rotating means, the mean radii of the several rings corresponding to the distance from the center of said turntable to the several recording pins, a helical strip of sponge rubber or the like surrounding said cylinder and imbedding said recording pins, a pressure bar overlying said cylinder, a felt strip facing the underside of said pressure bar, a rock shaft associated with said detent and said ratchet and pawl means whereby rocking said rock shaft in one direction rotates said test color filter from one

color to the next and means carried on said rock-shaft for operating said recording means upon rocking said rock shaft in the other direction.

5. The device of claim 4 with a counter mechanism, and means on said rock shaft operative by anticlockwise rotation to operate said counter mechanism.

6. In an apparatus for testing color blindness, means for setting up a test color to be matched and means for mixing colors to match said test color, said test color setting up mechanism and said matching color mechanism each including two axially spaced coaxial lenses with a color filter composed of a series of transparencies of different colors movable through the space between the lenses, a light supplying means in back of said lenses, a test color filter setting mechanism, a matching color filter setting mechanism, a detent on said test color filter setting mechanism for stopping said test color filter in a plurality of predetermined positions, a ratchet on said test color filter setting mechanism, a test recording mechanism comprising a turntable driven as one-to-one ratio by said matching filter and a cylinder driven at one-to-one ratio by said test filter, said cylinder having its axis normal to the turntable axis, said turntable having means to hold and rotate a circular record card which card comprises a series of rings corresponding in number to the number of said predetermined positions, and said cylinder having a series of recording pins equally spaced axially and circumferentially and positioned axially so that one pin will come within the confines of each ring when said card is on said turntable, a test color filter operating mechanism, a pawl on said operating mechanism for engaging said ratchet whereby movement of said operating mechanism in one direction moves said test color filter from one position to the next, and means on said operating mechanism operative when said operating mechanism is moved in the other direction to operate said recording mechanism.

7. The device of claim 6 with a counter, and with a cam on said operating mechanism adapted when said operating mechanism is moved in the said other direction to advance said counter one unit.

8. In an apparatus for self-examination and self-recording of color blindness which consists of a test color control means manually rotatable by the examinee to different positions for selecting a test color, a matching color control means manually rotatable by the examinee for selecting or for mixing a color for matching said test color, a circular record card, means associated with said matching color control means for supporting and for rotating said circular record card at one-to-one ratio with said matching means, said circular record card being divided into as many concentric annular zones as there are positions in said test color control means, and each zone having a circular graduation which is positioned to be at zero when the test color represented by said annular zone is perfectly matched, a record card piercing means associated with said test color control means and rotatable at one-to-one ratio by said test color control means and adapted, when said test color control means is manually operated to pierce that zone which represents the color set up for test, said piercing being circumferentially as far from zero as the examinee deviates in matching his selected test color.

9. In an apparatus for self-examination and self-recording of color blindness, which consists of a test color control means manually movable by the examinee to different positions for selecting a test color to be matched, a matching color control means manually movable by the examinee to different positions for matching the test color selected, a record card divided into as many zones as there are positions to which the test color control means may be set, means for moving said card in coincidence with said matching control means and said card having a graduation wherein the card is at zero when the matching control means is set to match the selected test color perfectly, and means associated with said test color control means for piercing said card in the zone which corresponds to the test color selected and as far from zero on the graduation as the matching color of the examinee is removed from his test color.

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