April 6, 1954

E. D. CLARKE

2,673,984

ARTIFICIAL EYE

Filed July 27, 1944

3 Sheets-Sheet 1

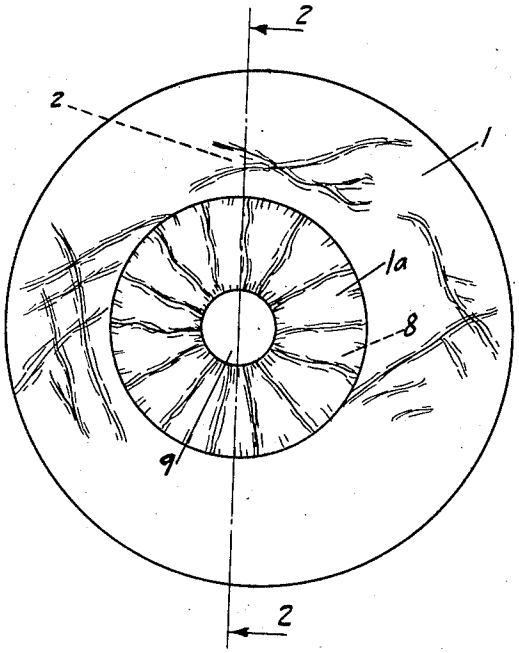


FIG. 1.

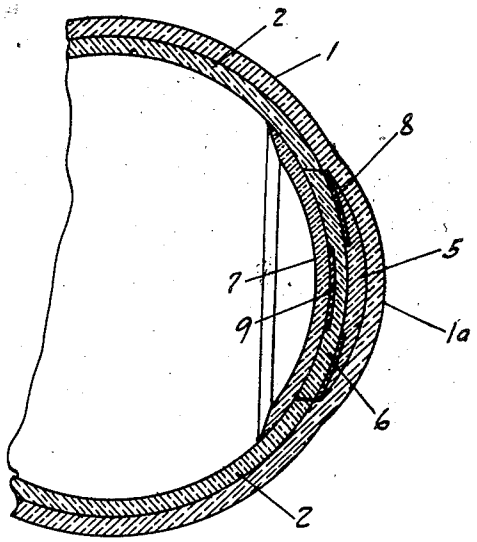


FIG. 2.

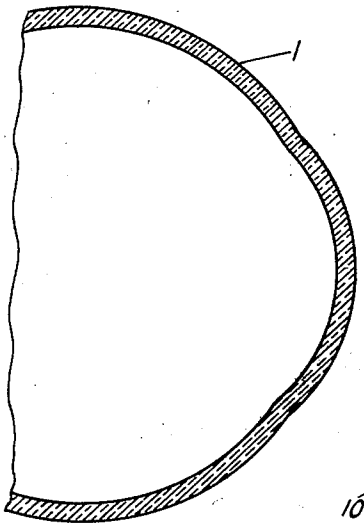


FIG. 3.

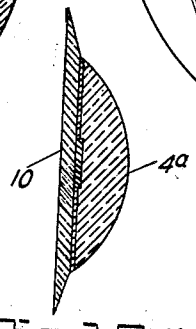


FIG. 12.

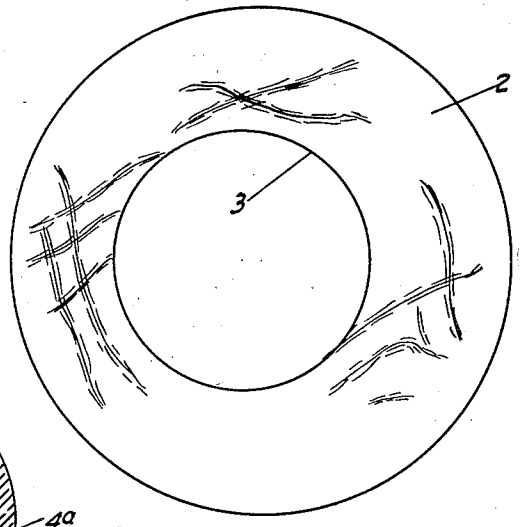


FIG. 4.

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April 6, 1954 E. D. CLARKE 2,673,984

ARTIFICIAL EYE

Filed July 27, 1944

3 Sheets-Sheet 2

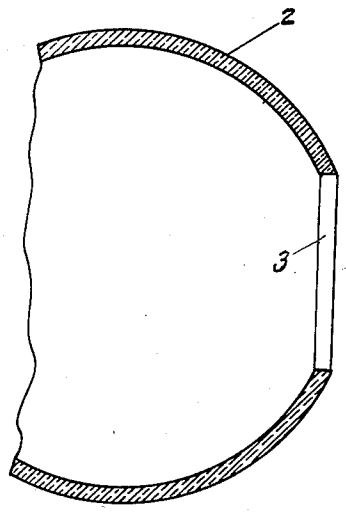


FIG. 5.

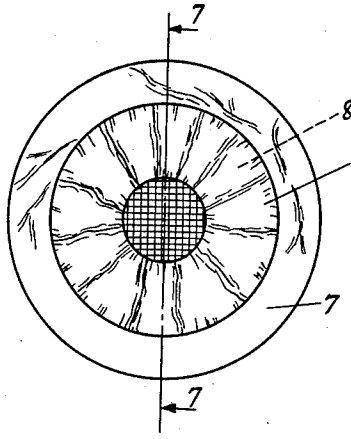


FIG. 6.

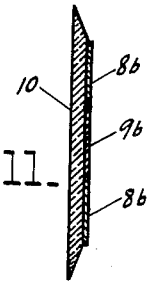


FIG. 11.

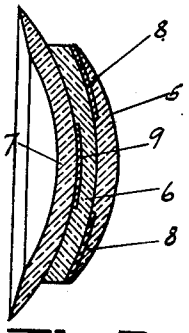


FIG. 7.

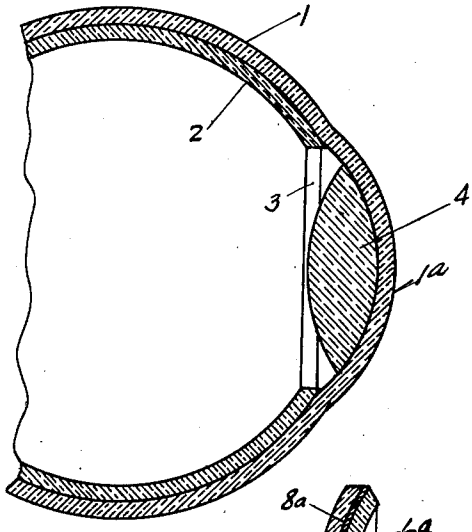


FIG. 8.

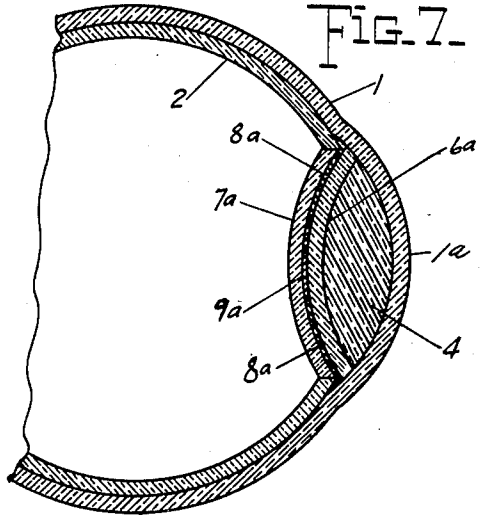


FIG. 9.

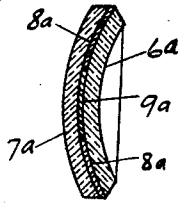


FIG. 10.

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April 6, 1954

E. D. CLARKE

ARTIFICIAL EYE

2,673,984

Filed July 27, 1944

3 Sheets-Sheet 3

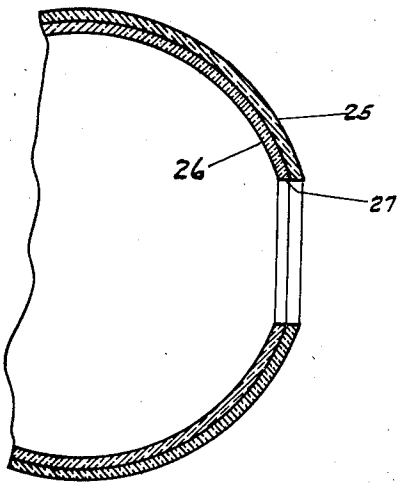


Fig. 13.

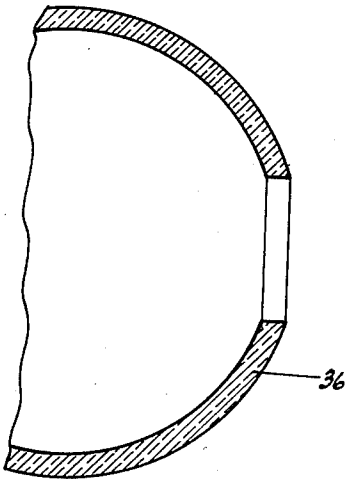


Fig. 14.

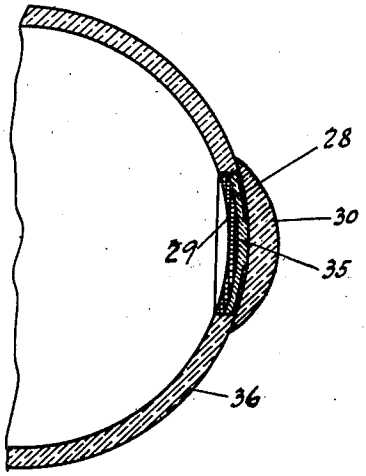


Fig. 15.

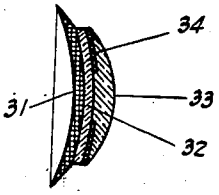


Fig. 16.

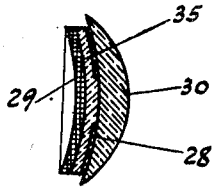


Fig. 17.

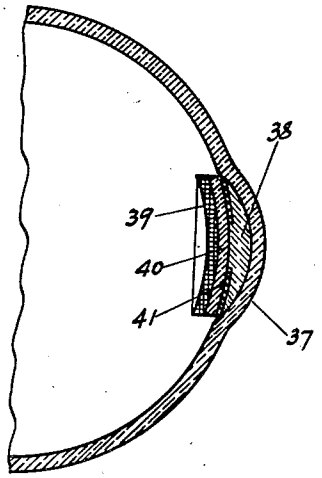


Fig. 18.

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Patented Apr. 6, 1954

2,673,984

UNITED STATES PATENT OFFICE

2,673,984

ARTIFICIAL EYE

Eric D. Clarke, Cleveland, Ohio

Application July 27, 1944, Serial No. 546,763

5 Claims. (Cl. 3—13)

1

This invention involves new improvements in the art of producing or manufacturing artificial eyes.

A primary object of the invention has been to provide an artificial eye structure embodying a novel assemblage of sections or parts corresponding largely to those of the natural eye, capable of being made on a production basis, so to speak, and so combinable in the final assemblage as to facilitate the obtaining of an artificial product closely imitative of the human eye to be reproduced.

A further object of this invention is to use a sectional structure, in putting together the parts of my artificial eye, such that a more naturalistic article is produced, especially in reference to avoiding in the formation of the eye structure the stare appearance so common in artificial eyes as they are made today. To this end my new product is made more closely after the manner of the natural human eye formation than heretofore resorted to.

By reason of my making my new eye in sectional parts, I achieve an especial advantage incident to ability to interchangeably assemble the parts, and particularly the sclera and iris members, which are the peculiar colored members required to be matched, before the final fusing together of the eye structure in the completed formation for use. On the above account I am enabled to so interchangeably arrange the parts of the artificial eye, preliminarily, in such a wide range of combinations, as to more quickly and accurately arrive at the determination of the final matched colored members that will provide the closest possible imitation of the natural eye of the person being fitted.

My formation of the parts of my artificial eye is furthermore designedly conducive to the production thereof from sheet material, preferably plastics such as have been found suitable for the purpose in this art, and, indeed, in manufacturing, recourse may be had to punching and die pressing technique or practice such as employed in sheet metal manufactures. Molding practice may also be used, though that first mentioned is desirable because of ability to avail of standard machinery.

My sectional artificial eye construction contemplates the use of a prefabricated or assembled sclera and cornea unit, or units, for interchangeable preliminary assembly with a prefabricated iris and pupil unit, or units, for facilitating the color matchings of the sclera and iris members to provide the ultimate assembled eye structure. When the matching of said parts or units is satisfactory to the patient they will be fused or permanently connected together to constitute the final eye to be used. This feature of my invention enables a great reduction in the stocks of eye parts necessary to be maintained at the selling outlets.

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I know of no artificial eye made today in which this facility of variable matching may be carried out, as obtained with my invention, respecting the prefabricated sclera unit and the prefabricated iris and pupil unit, in combinations thereof, and the advantageous results of the foregoing will become apparent hereinafter.

According to my invention, I may use plastic material entirely for my eye construction, or I may use plastics or glass parts in combination, the use of some plastic being desirable because of the facility for final fusing or welding together of the properly assembled combinations of colored units, thus obtained, using ordinary heat and pressure methods known to the art.

As regards the prefabricated sclera and iris units, of my invention, I contemplate using alternative types of construction. In one form the iris unit may be assembled posteriorly, or into the hollow of the ball member (sclera and cornea unit), from the rear. Or, according to another form of my artificial eye, I may apply the iris unit to the outside front portion of the sclera and cornea unit (eye ball proper), and weld or fuse it in place there, whether the iris unit is made largely of plastic or made of plastic, glass, and other suitable material.

My invention comprises additionally other detail features, the purpose of which will appear more fully in the following detailed description and disclosed in the accompanying drawings, in which latter:

Figure 1 is a front elevation of an artificial eye embodying my invention, in one preferred form thereof.

Figure 2 is a vertical sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a sectional view showing the cornea member only of the form in Figures 1 to 4.

Figure 4 is a front view of the sclera member alone.

Figure 5 is a vertical cross sectional view of the sclera member alone.

Figure 6 is a front view of the assembled iris and pupil unit as when ready for insertion to combine with the cornea, sclera, and other parts of the Figure 2 type of structure.

Figure 7 is a detail sectional view of the iris

and pupil unit, as used in the structure of the previous figure.

Figure 8 is a sectional view illustrating the combined cornea, humor, and sclera unit in the condition ready to receive the unit which is shown in Figure 10, by posterior insertion therein.

Figure 9 is a view similar to Figure 2, illustrating a modification of the invention.

Figure 10 is a sectional view of the pupil and iris unit as used in the modification of Figure 9.

Figure 11 is a sectional view of a modified form of iris and pupil insertable unit formed with a single layer of plastic for cheapening of cost.

Figure 12 is a detail section of a modified form of iris, pupil and humor unit, of glass, adapted for use in ball or sclera units like those of Figures 2, 13, and 14.

Figure 13 shows a modified form in section, of a combined pre-formed sclera and cornea unit having an iris unit centering or positioning opening therethrough.

Figure 14 is a modification showing in section a pre-formed sclera having a centering hole or opening to receive an iris and pupil unit as shown in Figures 16 and 17, or to be assembled with a pre-formed iris, pupil and cornea unit as shown in Figure 18, the structure of Figure 18 to be emplaced in front of that of Figure 14.

Figure 15 is a view of the parts of Figures 14 and 22 assembled, no cornea member provided.

Figure 16 is a view of a modified form of a fabricated iris, pupil and cornea member wherein the pupil member is weldable and would be emplaced from the posterior side, the pupil member being made of black plastic material.

Figure 17 is a view of a modified form of a fabricated iris, pupil and humor member, wherein the humor member is weldable and would be placed from the anterior side into the constructions of Figures 13 or 14, the pupil being black plastic, or it may be constructed as shown in Figure 7.

Figure 18 is a view of a modified form of a fabricated iris, pupil and humor member to be made integral with the cornea member and adapted to be fitted over the constructions of Figures 5 or 14 for color matching and welding into place. The pupil is made of black plastic.

The views of the drawings are exaggerated or much enlarged as compared with the normal size of an artificial eye made in accordance with the invention, in order that the structural characteristics of the composite parts of the eye may be clearly depicted.

Referring to Figures 1 to 8 inclusive, and specifically describing my artificial eye, it is notable that I employ for providing the body or ball of the eye the outer shell or cornea member 1 which is substantially a continuous sheet of plastic material, preferably, and embodies a rounded partial ball-like formation of hollow nature. This plastic of the cornea member 1 is transparent and to conform with the natural eye is slightly bulbous at 1*a* approximately at the front axis thereof. Adapted to fit into the cornea member 1 is the sclera member 2 which, as clearly seen in the drawings, is formed with an approximately central opening 3, the axis of the opening in fact being disposed slightly lateral of the axis of the cornea member as apparent from Figures 1 and 4, dependent upon whether the eye is left or right, in this respect necessarily conforming to the natural eye of a person. The members 1 and 2 fit together in close contact when assembled as will be clear from Figure 2. At the inner side of the bulbous portion 1*a* of the cornea 1 I provide what I term the humor member 5, the front of which is curved to conform with the inner curvature of the part 1*a* and the rear of which is curved on an arc approximately similar.

The parts above described, when assembled, are adapted to receive from the rear or into the hollow portion of the eyeball structure provided thereby, the iris and pupil unit which is depicted best in Figures 2 and 7, the same shown by itself in the latter figure. The iris and pupil unit is made up of an outer plastic layer 5 at its thickest portion of substantially the thickness of the cornea member 1, a middle layer of plastic 6 of substantially the thickness of the sclera member 2, and an inner layer of plastic 7 of sufficient size to overlap the inner portion of the sclera member 2 at the part surrounding the opening 3. The layers 5 and 6 of plastic are of transparent material, whilst the layer 7 may be of transparent or opaque material, this not being consequential.

Between the layers 5 and 6 there is received the iris member 8 which is of generally circular form to correspond with the roundness of the iris of the human eye, and is provided with a central opening as illustrated.

Between the layers of material designated 6 and 7 and in rear of the opening in the iris member 8 is provided the pupil member 9. This pupil member may be formed by India ink or a black or suitably colored pigment resembling the eye pupil, and is spaced a slight distance from the opening in the iris member 8 for the special purpose of providing a depth factor for the pupil member in rear of the iris member. It is found that this is advantageous in that it tends to eliminate the staring appearance that is incident to ordinary artificial eye structures. It is within the purview of the invention that if the layer 7 of the pupil and iris unit is made of a substantially black opaque material, such coloring of the material may eliminate the separate formation of the pupil member as by stamping or use of special pigment for such purpose.

The sclera member 2 is of course of one of the color variations of white that corresponds with the sclera of the human eye, and as seen in Figure 1 this member will be provided on its outer surface with imitation veins or lines corresponding with the veins or blood vessels in the sclera of the human eye. These veins may be obtained by using suitable colored ink lines or ravelings of silk or wool and they will of course be provided of a color that matches the natural eye of the person who is being fitted with the artificial eye.

In like manner, it is contemplated that the iris member 8 shall be of the color of the iris of the natural eye of the person to whom the artificial eye is supplied, and of course varying colors running from blue, gray, greenish-gray, brown, brownish-green, brown in lighter or darker tints, and other colors corresponding with human eye coloring of the iris will be employed in the making of the iris member 8. This iris member may be color-printed upon paper or a thin plastic or cellulose layer, within the contemplation of the invention. The transparent cornea member 1 attached, fused or welded to the colored sclera member 2 may constitute one prefabricated unit of the eye. The unit of Figure 7 may constitute the second or other prefabricated unit. The two units are those required to be matched before assembling finally.

A special feature of the invention lies in the peculiar manner in which the edges of the rela-

tively round layers 5 and 6 of the pupil and iris unit are chamfered or bevelled. This structure is calculated to more readily afford the complete simulation of the natural eye structure in that the coloring at the outer periphery of the iris member 8 is caused to thus merge into the blue-white coloring of the sclera member. The blending achieved is most natural in appearance.

The pupil and iris unit as seen in Figure 7 may be said as a whole to be generally concavo-convex with the concave at the rear side. In Figure 9 I have provided a modified construction wherein the rear side of the humor member is convexed toward the rear of the eye and the pupil and iris unit is of similar conforming curvature. In this modification, however, the iris member 8*a* has a line of curvature substantially in line with the plane of the pupil member 9*a*. In this construction, furthermore, I utilize only two layers of plastic, the outer transparent layer 6*a* and the inner transparent or opaque layer 7*a*, between which layers the pupil member 9*a* and the iris member 8*a* lie or are received and held. Figure 10 illustrates the pupil and iris unit of the Figure 9 construction alone and more clearly. In this construction the final fusing of the various eye parts by pressure and heat will effect blending of the color areas of the iris and sclera.

In Figure 11 a single flat plastic layer 10 carries the iris member 8*b* and pupil member 9*b*. Being made of plastic, it may be curved if desired while subjected to heat and/or pressure.

In both of the constructions of my artificial eye as above set forth the prefabricated welded pupil and iris unit is insertable into the prefabricated or welded unit of the cornea and sclera structure from the rear of the eye. The making of these separate units affords the capability of divers color combinations, for simulating the natural eye, not heretofore obtained, and when the desired combination is made and approved by the patient, the two units may be connected in union by resorting to common heat and pressure operations, thus completing the artificial eye ready to be used. As regards the detail forming of the iris and pupil unit as one, the same technique may be employed in uniting the plastic layers 5 and 6. If desired, the layers 6 and 7 may be permanently united after the provision of the pupil member 9 therebetween, and subsequently the layers 6 and 7 will be welded together by the heating technique previously referred to, the iris having been mounted between the layers 5 and 6 and these correspondingly united.

Various modifications in the "bringing-together" technique for the various plastic members may be resorted to within the purview of the invention.

In describing the parts of my artificial eye, I have used terms having certain appropriateness because of the relation of the parts to corresponding parts of the human eye, these terms being purely descriptive and definitive so as to enable an understanding of the invention. So far as the humor member 4 is concerned, it is a member which in effect supplies the physical nature and action of the aqueous humor which is posterior to the cornea in the actual human eye. This humor member 4 may be integral with the layer of plastic from which the cornea is made, though it is preferred that it be separate and united by heat weld to the part 1.

A great advantage of course of my invention is the adaptability to selectively combine the color members 2 and 8 in many different combinations,

and a further advantage lies in the fact that the various laminae of the eye described by me may be made from sheet material stamped out with punched openings where required and formed to contour by pressure. The welded connection, so to speak, between the member 7 and the sclera member 2 may be such as to provide for the ready breaking of the weld should it be desired to change the iris unit because of the requirement for better eye-matching than may be originally obtained in the first assembly and welded combination of parts.

Exemplifying the advantage of my invention from the viewpoint of ability to carry reduced amount of stock of parts, I might note that where heretofore, because of the assembly or combining of the artificial eye structure into a unit before fitting, tremendous stocks of eyes or complete eyes were required to be kept on hand, my invention eliminates such requirement to a large extent. For instance, it is my object to keep the standard artificial eyeball comprising the parts 1 and 2 separate from the iris unit, also prefabricated, until the time of fitting the patient. Then the eyeball structure of the parts 1 and 2 may be selected, and, because plastic is used, it may be ground or cut away for fitting purposes with readiness. The eyeball sections, as I term them, could be made in about four sizes in rights and lefts for providing eight artificial eyes, which would fit most patients. The larger sizes can be cut down to intermediate or small sizes, and about four different sized holes may be formed in the sclera members for the iris, as readily evident. About six sclera colors for these members would usually suffice, and about five patterns of veins would be ample for the stock. Thus, a stock of about 960 eyes would be sufficient and from this stock a patient could be very readily fitted for size, shaped for adhesions, size of cornea, or iris, color of sclera and vein patterns. The iris could be made in about 72 colors and shades of colors which would usually match nearly all human eyes, and in four sizes, so that 288 irises might be used with four sizes of pupils, so that 1152 combination units of this character might be availed of. With approximately 960 eyeball members and 1152 iris units, substantially 1,105,000 different combinations may be obtained without cutting or grinding. This may be compared with the tremendous stock of eyes usually required to be kept at the producing or manufacturing place, ranging often up to 20,000 in number, which cannot possibly afford the eye matching combinations of the sclera and iris units obtainable in the practice of my invention. A very large percentage of artificial eyes of present known complete or finished constructions are required to be kept in stock by selling stores today.

In known types of artificial eyes there is no way of allowing for the variation of size of either the iris member or pupil member such as exists in the human eye. With my invention the iris member may be made of three or four sizes to accommodate for close matching of the human eye. Since the pupil usually varies in size with the size of the iris, my iris and pupil unit will obviously provide for this correspondence of variation in practice of manufacture.

Referring to Figure 12 of the drawing, it is notable that I illustrate therein a form of iris and pupil unit of modified construction, including the humor member 4*a*, that may all be made from glass, and properly shaped of course to con-

form with the inner portion of the bulbous part 1a of the cornea member as illustrated in Figure 2. In this modified construction, the humor member 4a is applied to a layer of plastic designated 10 which layer has peripheral edge portions arranged to overlap the inner surface of the sclera member 2 when the unit of Figure 12 is placed within the sclera and cornea unit which would be of the general construction illustrated in Figure 2.

The plastic member 10 enables the welding of the unit of Figure 12 within the sclera and cornea unit.

It is notable in reference to the practice of my invention, that, because of the welding of the sclera and cornea unit to the iris and pupil unit in the manner set forth hereinbefore, the naturalistic effects of the human eye are obtained to a degree not heretofore achieved in reference of the blending of the sclera with the iris member. This is true whether the iris and pupil unit is disposed on the posterior side of the body or ball of the eye or upon the anterior side, and the result is achieved very largely due to the fact that the iris member is disposed in an opening of the body or ball member, comprising of course the sclera and cornea, which opening is slightly larger than the iris member. Thus when the pressure and heat of the welding operation is performed, the blending action is obtained with a closeness of imitation of the human eye that has not been secured so far as I am aware in artificial eyes produced heretofore. Of course when the pupil member and the iris member are disposed in different planes as contemplated according to my invention, in many of its forms, when the artificial eye is actually viewed the pupil has the appearance of a real hole in the iris, as is the customary appearance in respect to the natural eye. The foregoing, in addition to the convexity of the pupil and iris unit, all tend to obtaining the desired obliqueness which enhances the desired objective of eliminating the appearance of stare in the fixed eye.

In Figure 13 there is provided a unit comprising the welded or connected plastic cornea and sclera members 25 and 26 respectively. This unit is formed with an approximately central hole or opening 27 to receive from the anterior side an iris, pupil, and humor unit, as seen in Figure 17, the iris being 28, the pupil 29, of black plastic, the transparent humor 30. The humor member 30 is extended somewhat at its peripheral edge to provide for overlapping and welding merging joinder to the cornea member 25. Or, the unit of Figure 16 may be inserted posteriorly in the unit of Figure 13, in which event this unit comprises the black plastic pupil member 31, the colored iris member 34, and the humor member 33. The member 31 in this form is extended at its periphery to be welded to the sclera 26, see Figure 13.

In the forms of both Figures 16 and 17 there is a plastic layer designated 32 and 35 in these figures, respectively, located between the pupil members and iris members, thus insetting the pupil member from the iris member.

I may employ a sclera member 36 alone as shown in Figure 14, that is, omitting the transparent covering hereinbefore called the cornea member. The units of Figures 16 and 17 may be applied and welded to that of Figure 14 as described in regard to the construction in Figure 13, as shown in Figure 15 in respect to the combination of the Figure 17 construction.

When either of the units of Figures 16 and 17 is assembled with the sclera 36 of Figure 14, the iris disc 34 or 28, as the case may be, will lie within the opening of the sclera 36 (see Figure 15 for example), and on final fusing together of the assembly under heat and pressure, will afford blending of the color areas of the iris and sclera.

In Figure 18 I show a combined fabricated cornea member 37, humor 38, iris member 41, transparent plastic uniting layer 40 (like 32 and 35 previously mentioned), and pupil member 39 of black plastic. This structure as a unit may readily be united to the sclera member 36 of Figure 14, or corresponding member 2 of Figure 5 constructions, and emplaceable anteriorly of such sclera members.

From the foregoing it will be apparent according to the various modifications of my invention, that variable matching of the iris units and sclera members or units is obtainable to the end of securing imitations of the human eye never heretofore available to my knowledge. And the advantages derived are largely due to the detachability and attachability of the units above referred to, with the additional advantage of accurate centering of the iris members derived from the provision of the centering openings in the sclera and/or cornea members.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. An artificial eye comprising, in combination, a plastic prefabricated sclera unit, provided with an opening, and a prefabricated iris and pupil unit including an iris disc of substantial thickness made of iris colored plastic material having the peripheral portion of its iris contacting the sclera at the wall of said opening, said iris and pupil unit being fused to the sclera unit in the opening thereof by heat and pressure, blending the color areas of the iris and sclera members after color matching.

2. In the art of artificial eye manufacture, the method which includes the insertion of a plastic circular completely prefabricated iris unit of substantial thickness into an opening at the anterior portion of a prefabricated sclera unit so the peripheral edge of the iris unit is in substantial contact with the peripheral portion of the said opening, and thereupon subjecting the two units so assembled to the action of heat and pressure sufficient to cause blending of the color areas of the two units at their contiguous portions adjacent to the periphery of the iris unit.

3. In the art of artificial eye manufacture, the method which includes the insertion of a plastic circular completely prefabricated iris unit into an opening at the anterior surface of a plastic prefabricated sclera unit, so that the peripheral edge of the iris unit is in substantial contact with the peripheral portion of said opening, applying to the posterior surface of the iris unit a transparent humor member, and fusing the combined iris unit, humor member and sclera unit into a single assembled artificial eye by heat and pressure sufficient to blend the color areas of the sclera and iris units adjacent the periphery of the iris unit.

4. In the art of manufacturing artificial eyes, the method which comprises the emplacement of a completely prefabricated circular iris unit composed of a plastic iris colored disc of substantial thickness covered by a transparent plastic and backed by a disc of transparent plastic, into a circular opening at the anterior portion of a pre-

fabricated sclera unit so that the periphery of the disc lies in contact with the wall of said opening, and thereupon applying to the unit so assembled sufficient pressure and heat to blend the color areas of the iris and sclera units together adjacent to the peripheral portion of the iris unit.

5. An artificial eye comprising in combination, a plastic prefabricated sclera unit provided with an opening in its anterior portion, and a plastic prefabricated iris unit having its peripheral portion contacting the sclera unit at the wall of said opening, said iris unit being fused to the sclera unit in the opening thereof, by heat and pressure blending the color areas of the iris and sclera units to faithfully duplicate the corresponding portions of the human eye.

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