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(54) Title: LENS SYSTEM FOR DIVER'S MASK

(57) Abstract

An underwater diving mask (10), including a preformed face piece (12) of suitable material so as to yieldably fit the contour of a wearer's face, and a strap (16) for holding the face piece (12) against the wearer's face. The mask (10) has a large opening (20) formed in the forward part thereof, and a rigid plate-like supporting structure (22) carried by the face piece closing the opening. A pair of lens systems (24) one for each eye of the user, are supported in side-by-side relationship by the supporting structure (22). Each lens system (24) consists of an individual equiconvex lens (26). So as to properly compensate for the foreshortening effect of the water, the magnifying power of the lens system is less than 1.75. Each lens may be integrally formed with the supporting structure (22), or a pair of equiconvex lenses may be affixed onto one surface of the supporting structure (22).

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LENS SYSTEM FOR DIVER'S MASK

Background of the Invention

This invention relates to lens systems for use in connection with providing vision through media having different indices of refraction, and in particular to lens or goggle systems for use in diving and providing vision under water.

While underwater face masks have been in use for some time, nevertheless entirely satisfactory results have not been obtained. Most commonly, divers use a face mask merely to keep the water away from the eyes. Such a mask has generally included a flexible face piece, preshaped to fit closely against the face of the wearer, positioned in front of the eyes, and usually also over the nose. A relatively large flat disk-like plate of transparent plastic or the like was held a in sight opening in the face piece to serve as a window therein. By this means the eyes are allowed to focus under the water, which they could not do were it not for the mask. Because water has a higher refractory index than air, however, a foreshortening effect occurs, making underwater objects appear closer and larger than they really are.

This foreshortening effect has been attacked in the past by making the lens system more complex,

such as that shown in Simpson, U.S. Patent No. 3,040,616. That patent shows a multiple lens system wherein water is permitted to enter behind a part of the system when the user is underwater. The purpose of this arrangement is to permit the user to see equally well when out of the water as when in. Since the diver usually takes his mask off when out of the water, however, such a structure is much more complex, and hence expensive, than necessary.

This invention relates to improvements to the structure indicated above and to solutions to the problems raised or not solved thereby.

Summary of the Invention

The invention relates to an underwater diving mask. In a preferred embodiment the mask includes a preformed face piece of suitable material so as to yieldably fit the contour of a wearer's face, and means for holding the face piece against the wearer's face. The mask has a large opening formed in the forward part thereof, and a rigid plate-like supporting structure carried by the face piece closing the opening. A pair of lens systems, one for each eye of the user, are supported in side-by-side relationship by the supporting structure. Each lens system consists of an individual equiconvex lens. So as to properly compensate for the foreshortening effect of the water, the magnifying power of the lens system is less than 1.75. Each lens may be integrally formed with the supporting structure. Alternatively, a pair of equiconvex lenses may be affixed onto one surface of the supporting structure.

Other objects and advantages of the invention will become apparent hereinafter.

Description of the Drawing

Fig. 1 is an isometric view of a diving mask

constructed according to a preferred embodiment of the invention.

Fig. 2 is a front view of a lens system to be used in the diving mask shown in Fig. 1, and constructed according to one embodiment of the invention.

Fig. 3 is a cross-sectional view of the lens system shown in Fig. 2, taken along line 3-3.

Fig. 4 is a front view of a lens system to be used in the diving mask shown in Fig. 1, and constructed according to an alternative embodiment of the invention.

Fig. 5 is a cross-sectional view of the lens system shown in Fig. 4, taken along line 5-5.

Description of the Preferred Embodiments

Referring now to Fig. 1, there is shown a diver's mask 10 constructed according to a preferred embodiment of the invention. As there shown, the mask 10 includes a face piece 12, the back portion 14 of which is of a relatively soft material, and is formed so as to yieldably fit the shape of a diver's face in the area of his nose and eyes. Means are provided for holding the face piece 12 against the diver's face. The preferred embodiment provides for a strap 16, each end of which is connected to the face piece 12, at the back portion 14, by attachment means 18. The material of the strap 16 is elastic in nature, so as to provide a snug fit of the back portion 14 against the diver's face. The length of the strap 16 may also be adjustable for the same purpose.

A large opening 20 is formed at the front of the face piece 12, making the face piece roughly cylindrical in shape. A lens supporting structure 22 is affixed within this opening 20, closing it. This structure 22 is shown in Figs. 2 through 5 as a transparent plate-like member which is substantially flat

and rigid. While the support structure 22 is shown in Figs. 2 and 4 to have an elliptical shape, the invention includes any shape suitable for use in a diver's mask. According to the invention the structure 22 supports a pair of lens systems 24 in side-by-side relation, one lens system for each eye of the diver. To counteract the foreshortening effect referred to above, the lens system 24 must have a magnifying effect. Applicant has determined that for optimum effect the magnifying power of the lens system 24 should be less than 1.75, that is, objects viewed through the lens system in air would appear less than 75% larger than they would without the lens system.

In the embodiment shown in Figs. 2 and 3, each lens system 24 is integrally formed with the supporting member 22. Each lens system 24 then consists entirely of a single lens 26. As shown in section in Fig. 3, in this embodiment the lens 26 is equiconvex. Such a system would be quite straightforward in manufacture, and thus quite inexpensive.

Figs. 4 and 5 show an alternative embodiment of the invention wherein a support member 22a, again transparent and substantially flat and rigid, supports a pair of lens systems 24a. In this embodiment each lens system 24a consists of a single discrete equiconvex lens attached to the surface of the support member 22 by means of an adhesive 28. In the preferred embodiment the adhesive 28 is also transparent, such as a transparent epoxy. Further, an area 30 in the center of the area of the lens 26 has no adhesive so as to ensure that vision is not clouded thereby. This embodiment provides substantial flexibility in choice of lenses and the ability to retrofit existing masks.

Thus the invention provides for a diver's mask which compensates for the foreshortening effect

of the water, and yet is simple and inexpensive to manufacture.

While the apparatus hereinbefore described is effectively adapted to fulfill the aforesaid objects, it is to be understood that the invention is not intended to be limited to the specific preferred embodiment of lens system for diver's mask set forth above. Rather, it is to be taken as including all reasonable equivalents within the scope of the following claims.

I claim:

1. An underwater diving mask comprising:

a preformed face piece of suitable material so as to yieldably fit the contour of a wearer's face and having a large opening formed in the forward part thereof;

means for holding said face piece against the wearer's face;

a rigid plate-like supporting structure carried by said face piece and closing said opening;

a pair of lens systems supported in side-by-side relationship by said structure, one said lens system for each eye of the wearer;

each said lens system constituted by an individual double convex lens.

2. An underwater diving mask as recited in claim 1 wherein said lens is an equiconvex magnifying lens.

3. An underwater diving mask as recited in claim 1 wherein the magnifying power of said lens system is less than 1.75.

4. An underwater diving mask as recited in claim 1 wherein each said double convex lens is integrally formed with said supporting structure.

5. An underwater diving mask as recited in claim 1 wherein each said lens system is formed by affixing a double convex lens onto one surface of said supporting structure.

6. A face plate for use in a diver's mask, comprising:

a rigid plate-like supporting structure;

a pair of lens systems supported in side-by-side relationship by said structure, one said lens system for each eye of the wearer;

each said lens system constituted by an in-

dividual double convex lens.

7. An underwater diving mask as recited in claim 6 wherein said lens is an equiconvex magnifying lens.

8. An underwater diving mask as recited in claim 6 wherein the magnifying power of said lens system is less than 1.75.

9. An underwater diving mask as recited in claim 6 wherein each said double convex lens is integrally formed with said supporting structure.

10. An underwater diving mask as recited in claim 6 wherein each said lens system is formed by affixing a double convex lens onto one surface of said supporting structure.

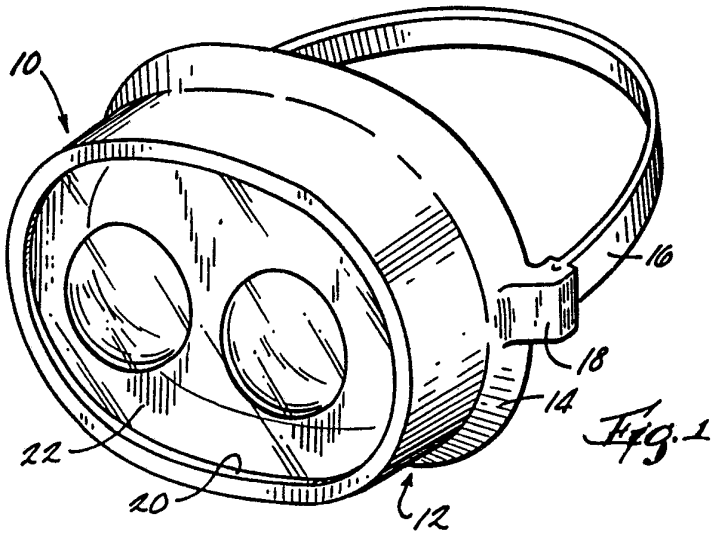

Fig. 1

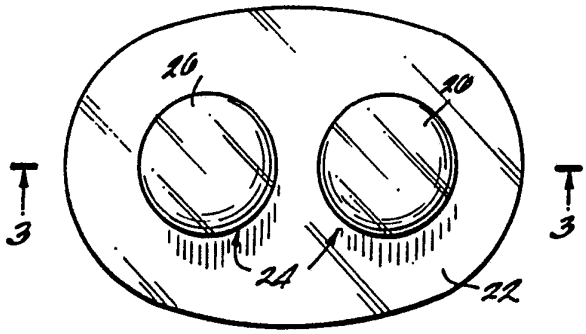

Fig. 2.

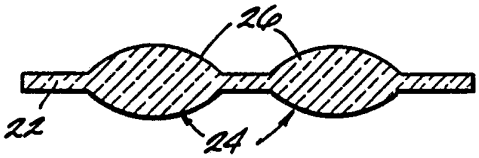

Fig. 3

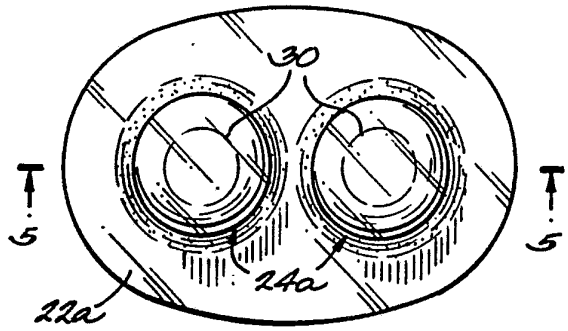

Fig. 4

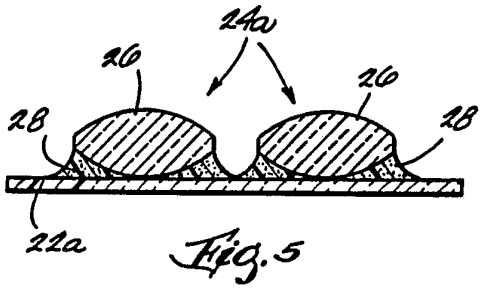

Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/03063

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5) ; G02C 1/00
US.CL. , 351/43, 2/14,441,442,445,

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	351/43 2/14

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	US, A 3,944,345 (DECORATO) 16 March 1976 See col. 2, lines 58-69 and cols. 3 and 4	1-10
Y	US, A 3,051,957 (CHAN) 4 September 1962 See Entire Document	1-10

* Special categories of cited documents: [10]

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
16 August 1991	09 SEP 1991
International Searching Authority	Signature of Authorized Officer
ISA/US	Paul M. Dzierzynski