A GAS MASK WAFER FOR PRESBYOPIA*

BY

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WHEN officers over forty are required to wear a respirator they frequently feel the need for some device to assist near vision which will yet not interfere with the vision for distance.

It is manifestly impossible to adjust reading glasses whenever they may be needed in the middle of a gas attack, and some method to overcome this difficulty had to be devised. There are four possible solutions: (1) A pair of respirator lenses may be made of the bifocal type. (2) A lens may be held either inside or outside the respirator eye-piece by mechanical means. (3) A lens surface may be worked on the glass of the respirator eye-piece itself. (4) A lens wafer may be cemented to the respirator eye-piece.

The first method is unsuitable because in many cases the bifocal part of the lens would be hidden by the nose-piece of the respirator. It would also be expensive and troublesome to make, and would require the application of "anti-dim" before adjustment of the mask. In large scale application expense and man-hours are of very great importance. The second method has already been described in this journal (1941); it is open to the difficulties of a mechanical method and is troublesome to anti-dim. The third method is impossibly expensive and raises difficulties in supply.

The last method was developed at a Military Hospital in Scotland during the summer of 1941. For security reasons this work could not be disclosed before. The honour chiefly belongs to Sgt. R. Freeman, R.A.M.C., sergeant optician to the eye centre at that hospital, and to Messrs. Scott and Madill, manufacturing opticians, who co-operated whole-heartedly.

The problem to be overcome was the method of fixation of the correcting wafer. It will be remembered that the respirator lens is made of laminated safety glass, and hence if heat is applied there will be splitting of the laminations. Yet to fix glass to glass with Canada Balsam requires the application of heat in the process of "baking." Other adhesives have optical and other defects which preclude their use. A substance known as "British Balsam" which has the optical qualities of Canada Balsam but requires less heat in its use was brought to our attention by the manufacturing opticians, and it was found that by careful pre-heating and slow cooling the wafer could be affixed without separation of the laminae. It is probable that success lies in the care

* Received for publication, June 7, 1944.

with which this is carried out, since, as can be seen in the photograph of the device in use, three years have not shown any deterioration in the wafers or the adhesive. Whereas, although the device has been officially adopted, it is understood that the adhesive has not proved entirely satisfactory in general use.

Optical Problems Involved

The method of determining the required reading addition is best solved by trial and error in view of the great variation in axial distance of the eye-piece from the eye in different individuals. The trial lenses are held against the outside of the eye-piece until the most suitable is found. If a distance correction is also required, the Mk. III respirator spectacles are worn inside the gas mask. For the purposes of reading in the relatively short periods during which a respirator must be worn, it is sufficient to use one eye alone. In fact, the width of the nose-piece is such that binocular vision is hardly possible at reading distance (depending on the exact relationship between p.d. and facial width). Thus the wafer is fixed to one eye-piece only. Normally the left is chosen to leave the right entirely free for shooting, unless the wafer is needed to see the foresight—a complicated manoeuvre! The size of the reading wafer need be no more than 12×20 mm., which gives a field of about 48×80 mm. at comfortable reading distance. Most of the field of the respirator eye-piece is therefore still available for distance vision and the part within the wafer area is still covered by the right eye working monocularly. It is arranged that the wafer is attached below the line of vision with the head in the normal attitude so that binocular vision is still present in the most essential part of the field.

The weight of the addition is negligible, and since it is affixed to the outside of the respirator, no problem arises from dimming due to the condensation of the breath. If it is necessary to alter the lens, or if a respirator has been heavily contaminated, the wafer can be readily removed. The cost is low (two or three shillings) and no hesitation need be felt in its discard.

Use in Ametropia

The wafer can be used in ametropia, and has certain advantages over the ordinary Mk. III glasses, such as, that it is always available when the respirator is adjusted. As an experiment the author's own respirator was so fitted, and the photograph shows it in use. The refraction was: Rt.—2.50 D.Sph. —1.75 D.Cyl. 110° , 6/5. L.—2.50 D.Sph. —1.75 D.Cyl. 85° , 6/5.

The use of cylinders would, however, introduce many difficulties

in testing and fitting, as well as greatly increasing the cost. Both spherical and cylindrical corrections would have to be ground on the same surface if the wafer was to be applied to the flat surface of the eye-piece. The inclination of the eye-pieces also contributed a variable and difficult factor to calculate. If spherical lenses are rotated round an axis at right angles to the visual axis,

Photograph showing respirator with special large wafers for correction of ametropia.

then an astigmatic effect is produced, corresponding to the introduction of a cylindrical lens whose axis coincides with the axis of rotation. In the case under consideration it will be noted that the refraction shows a cylindrical error which is approximately vertical and of the same sign as the spherical element. Since the respirator eye-pieces make an angle with each other of between 15° - 30° on a vertical axis, it will be seen that minus spheres lying flat on the eye-pieces will actually have a partial cylindrical effect of minus sign and axis 90° in straightforward gaze. This had the effect

of enhancing the visual acuity even without separate correction of the astigmatism. The V.A. was R. 6/18, L. 6/18, together 6/12, wearing -3.00 D.Sph. R. and L.

Had the astigmatism required a cylinder of similar sign to the sphere, at a horizontal axis, it would, of course, have been artificially exaggerated. The problem does not arise in the wafer for reading only, since only one eye is in use and the visual axis can be normal to the surface of the wafer.

Field of vision while using the wafer for ametropia

The object in the correction of ametropia by this method is to secure as large a field of vision as possible, consistent with lightness, simplicity, and cheapness. Accordingly a larger wafer than is used for reading only was applied to each eye-piece. They measured 25 × 30 mm. and were so placed as to occupy as much as possible of the available binocular field. The fields of fixation were measured on a recording perimeter and were found to extend 38 deg. on each side of the fixation point, 20 deg. above, and 30 deg. below it while looking through the wafers.

This is illustrated in diagram III. For comparison, the field of fixation through the respirator eye-pieces alone is also shown, diagram I, and also the field through Mk. III respirator glasses

DIAGRAM I.

DIAGRAM II.

DIAGRAM III.

while wearing the respirator, diagram II. In each case the extent of the binocular overlap is shown, and in diagrams II and III the respirator field alone is included for ease of comparison. It will be noted that this field is slightly larger on the left side than the right, and this is due to the fact that a constant slight tilt of this particular respirator brought the left eye-piece nearer to the left eye.

The prismatic effect of a flat lens looked through obliquely causes an apparent shift in the position of the test object, and since the correcting lenses are concave, the test object could be seen through the lens as a sharp, clear image while a blurred one was still visible through the respirator eye-piece outside the correcting lens. This extension is indicated by a hatched line in diagram II: it extends almost 50 deg. beyond the actual edge of the Mk. III lenses and thus means an appreciable increase in the field covered. With convex lenses the converse is found.

Summary

A method of correction of presbyopia for use on respirators with or without additional correction for ametropia is described. The optical problems are considered. The device has the advantages of cheapness, lightness, absence of mechanical parts, freedom from dimming, and ease of testing and fitting.

Acknowledgments are due to Brigadier Sir Stewart Duke-Elder, Consultant in Ophthalmology to H.M. Army, for encouragement and permission to publish the findings of this study, and to Lt.-Col. C. J. Stocker, M.C., I.M.S., O.C. a military hospital.

ANNOTATION

On the diagnosis of choroidal sarcoma

The diagnosis between choroidal sarcoma and a cyst of the peripheral retina is often a matter of great difficulty, especially in the early stage of a true growth. It is now many years since the writer heard the late Mr. Richardson Cross confess, at a meeting of the Ophthalmological Society, that he could recall at least four instances in which he had excised an eye for supposed choroidal sarcoma and no growth was present when the eye was examined by the pathologist.

We are inclined to the belief that with true growth in fairly early stages there will generally be a fluid detachment of the retina either