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OPTICAL ELEMENT

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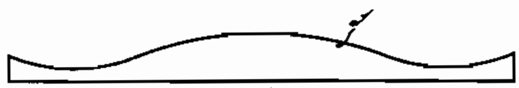

Fig. 1

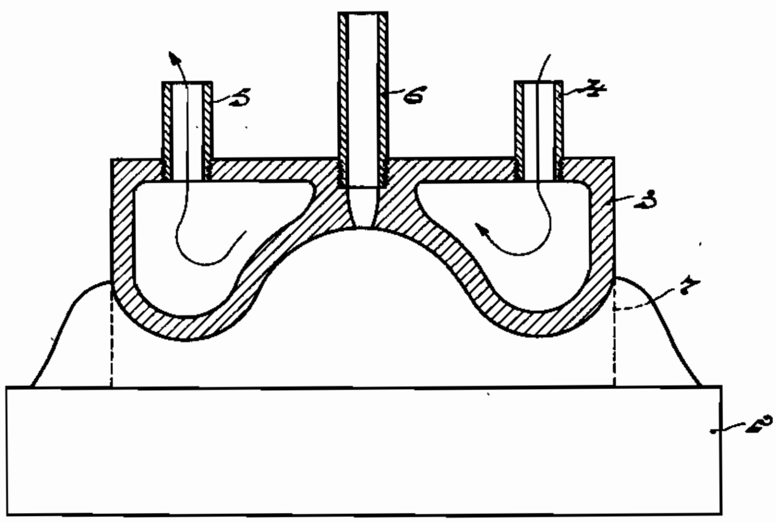

Fig. 2

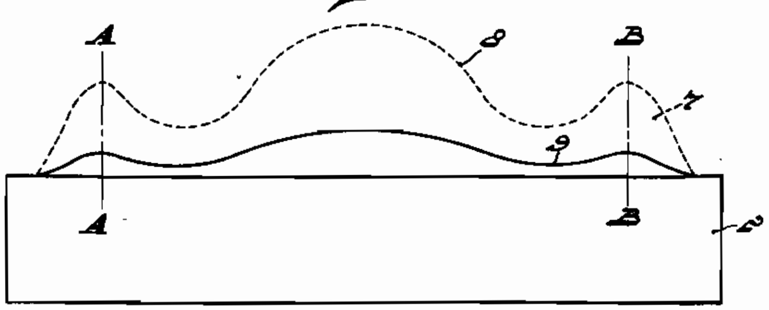

Fig. 3

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ALIEN PROPERTY CUSTODIAN

OPTICAL ELEMENT

Herre Rinia, Eindhoven, Holland; vested in the Alien Property Custodian

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Optical elements, such as lenses, have practically always been manufactured hitherto from glass of from quartz. For this purpose a plate must be ground to the desired shape, which is very expensive, particularly with surfaces which are not plane or spherical. It has also been suggested already to manufacture such elements from moulding materials, for which purpose, however, a very accurately finished matrice must be at one's disposal in which all the changes of profile existing on the surface of the lens to be manufactured must be present with perfect accuracy and with exactly the dimensions prescribed. It has not been decided hitherto to use this kind of lenses, at least not on a large scale.

The present patent application relates to an optical element such as a lens, consisting of a material which is gelatinisable in solution.

The term "gelatinisable materials" has to be understood in this connection to mean those materials which can be colloidally distributed in solution and can be separated from this colloidal solution to form a gel. Subsequently this gel can desiccate, if desired. The term "gel" means a solid material exhibiting rigidity combined with elasticity.

Materials suitable for this purpose and gelatinisable in solution may contain organic components, such as gelatine, agar-agar and pectine. It is also possible that these materials contain inorganic components, such as silicates or aluminium oxide, whether or not together with glycerine, to contribute to the optical homogeneity of the optical element concerned. The solvent serving to obtain a solution which is gelatinisable is chosen independently of the material. For gelatine, for example, water may be chosen as a solvent.

It has been mentioned before that the gel formed from the solution can desiccate. During this desiccation contraction of the material occurs. Use is made of the latter phenomenon with the optical element according to the invention. In fact, it has been found by Applicant that, independently of the concentration of the gelatinisable material in the solvent, the extent of the contraction in a definite case can be accurately determined beforehand. This contraction may be located between factors of the order of magnitude **3** and of the order of magnitude **50**. It has been found by Applicant that the contraction factor may be successfully chosen of the order of magnitude of **8**. Due to this contraction, the matrice used for the manufacture of the optical element in question can exhibit dimensions which are far larger than the dimensions of the element to be ultimately manufactured. It is evident that this means a great advantage. If, for example, differences of thickness of, say, 0.3 mm occur in a definite element, the matrice or mould wherein the element is to be manufactured, when assuming an 8-fold contraction, exhibits a difference of leven of 2.4 mm in the points where these differences of thickness are produced in the optical element. The matrice which consequently exhibits the profile to be manufactured on a greatly enlarged scale, may be manufactured mechanically with very great accuracy and may serve for the manufacture of a theoretically unlimited number of optical elements according to the invention. If for some reason it is undesirable that contraction occurs in a definite direction, for example in the direction normal to the optical axis, the mould may be made to co-operate, for example, with a metal plate as a substratum, to which the gelatinisable material slightly adheres. After drying-up, in the direction in which the occurrence of contraction is thus prevented, the gelatinated material exhibits the dimensions which the material has in this direction prior to gelatinising and drying-up.

The element obtained from the mould is preferably hardened during or after desiccation, which results in the element concerned no longer being soluble in a solvent.

One advantageous practical example of the element according to the invention, wherein one or two refracting surfaces have an aspherical or, if desired, a rotation-symmetric shape, exhibits in particular advantages. It is difficult to make such surfaces of glass on the machine so that the manufacture of glass lenses shaped in this manner is extraordinarily expensive. Another practical example of an element according to the invention wherein the occurring differences of thickness in the element are of the order of magnitude of 2 mms at most, has the additional advantage that the material is very homogenous due to the small differences of thickness.

It has been found by Applicant that the optical element according to the invention is very satisfactory as a correcting element for the occuring spherical aberration in an optical system, more particularly in the optical system of Schmidt, as described in the "Zentralzeitung für Mechanik und Optik" Volume 52, 1932, number 2, in which design the element according to the invention exhibits an aspherically refracting surface.

As has already been mentioned briefly the optical element according to the invention may be manufactured by bringing a solution of a material which is gelatinisable in solution into a mould of such shape that the material exhibits the desired shape after being gelatinated from this solution and desiccated. In this case it is advantageous to remove the mould after the material is gelatinated from the solution.

In order that the invention may be more clearly understood and readily carried into effect, it will be explained more fully by reference to the accompanying drawing.

Fig. 1 illustrates a cross-section across the optical axis of one practical example of the optical element according to the invention in the form of a lens. From the Figure ensues that the profile of the lens differs from the spherical shape; a ring-shaped embedded region is located between the elevated central portion and the elevated edge. The element shown is destined to be used in an optical system to correct therein the spherical aberration.

Fig. 2 shows the device in which the element of Fig. 1 can be made. 2 designates a plane metal plate whose top surface is placed exactly horizontally. This plate prevents contraction of the element during desiccation in the direction normal to the optical axis. A metal mould 3 which is made hollow is located above this plate at the correct distance. The interior of the mould is provided with two conductors 4 and 5 which serve for the supply and discharge of water with which the mould can be maintained at a definite temperature. The centre of the mould 3 has fixed in it a tube 6 which constitutes part of a channel traversing the mould from its top side to its bottom side. This enables the mould to be supplied with the material from which the optical element is manufactured. This is, for example, hot water in which gelatine is dissolved in a definite concentration. The mould 3 and the metal plate 2 are now maintained at such temperature that the gelatine just remains in solution. Due to this, a mass 7 of dissolved gelatine is formed between the mould 3 and the metal plate 2. By gradually reducing the temperature of the mould and of the metal plate the solution 7 is gelatinated and a gel is formed which exhibits rigidity combined with a certain elasticity. The mould 3 can now be removed and on the metal plate 2 remains the gelatinated mass 7 whose top surface 8 is indicated in Fig. 3 in dotted line. If now this mass is dried the gelatinated mass 7 contracts to form pure gelatine 8, the latter surface having the desired shape. This gelatine layer may then be removed from the metal plate and is ready for use after the extreme edge located outside the lines A—A and B—B has been removed. If desired, the element may still be hardened by treating it, for example, with formaline.

Particularly in view of contraction tensions it is desirable that the element should be made as thin as possible and with as uniform a thickness as possible.

For obtaining a more uniform thickness it is also possible to give the refracting surface of the element such a shape that, in addition to containing the fourth-power, sixth-power and eighth-power parabolas and, if desired, higher-power parabolas which serve for correction, it contains a second-power parabola. This results in the focal distance of the optical system using the element being slightly changed. At the same time, however, the result is obtained that the thickness of the element is more uniform while in some cases the aberrations which still result outside the axis are reduced.

In the description of the drawing we have described an example of an optical element which must serve as a correcting element; it is evident, however, that any desired lens profile, that is to say also the spherical profile, may be obtained in the same manner.

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