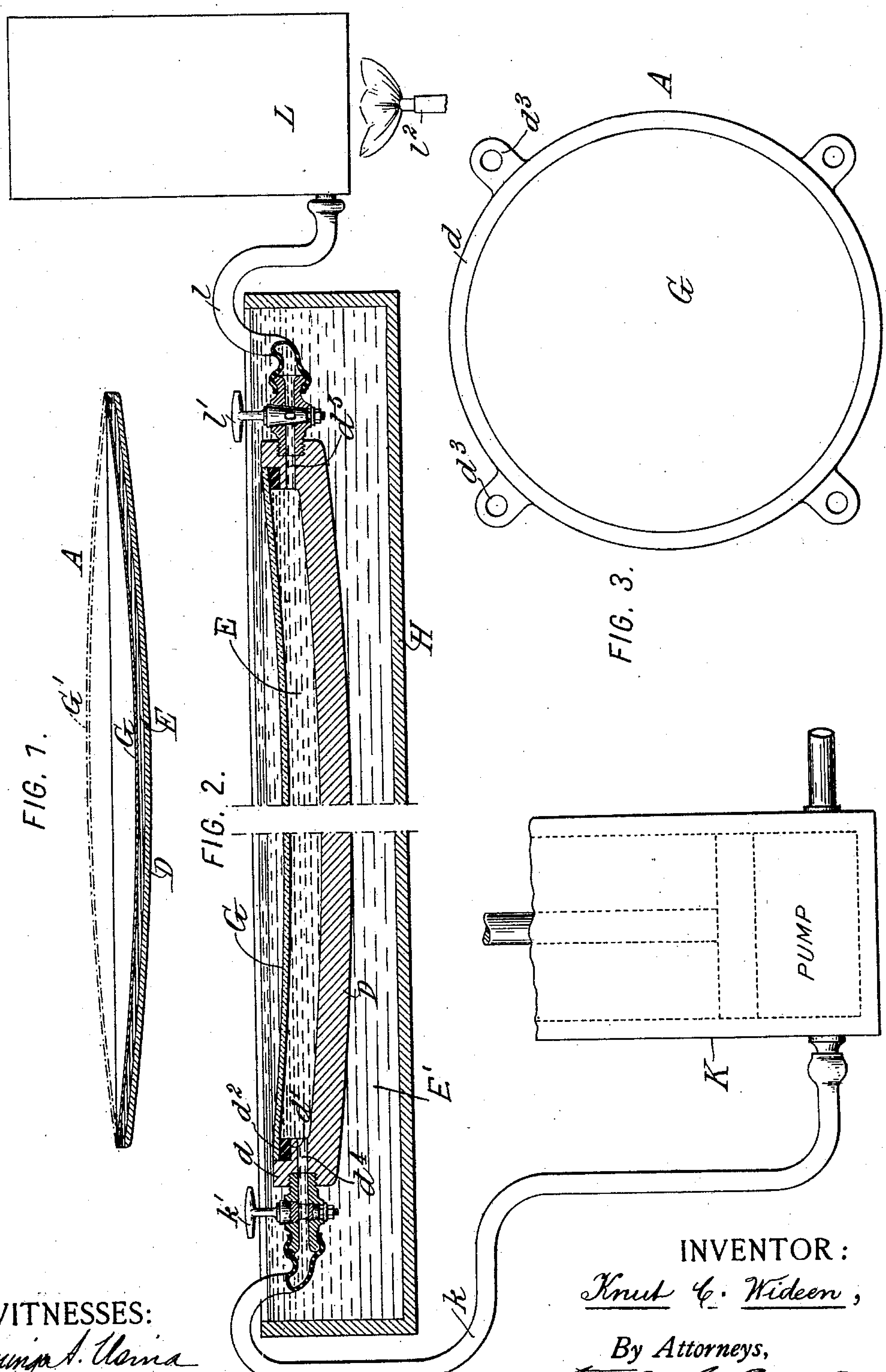
No. 683,163. Patented Sept. 24, 1901.

K. C. WIDEEN.

PROCESS OF MAKING CURVED MIRRORS.

(Application filed June 12, 1900.)

(No Model.)



WITNESSES:

Dominga A. Uaina

Fred White

INVENTOR:

Knut C. Wideen,

By Attorneys,

Arthur C. Fraser & Co

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

KNUT C. WIDEEN, OF NEW YORK, N. Y.

PROCESS OF MAKING CURVED MIRRORS.

SPECIFICATION forming part of Letters Patent No. 683,163, dated September 24, 1901.

Original application filed April 27, 1900, Serial No. 14,638. Divided and this application filed June 12, 1900. Serial No. 20,087. (No specimens.)

To all whom it may concern:

Be it known that I, KNUT C. WIDEEN, a subject of the King of Sweden and Norway, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Processes of Making Curved Mirrors, of which the following is a specification.

My invention provides a process whereby curved mirrors of great strength, rigidity, and regularity of curvature may be made cheaply and of unusually large size.

My invention provides also a process for making a curved mirror which is especially suitable for use in the system for collecting and utilizing solar heat described in my application for Letters Patent, Serial No. 14,638, filed April 27, 1900, of which the present application is a division.

It provides also various other improvements, all of which will be set forth in detail in the following specification.

In the accompanying drawings, illustrating one embodiment of my invention, Figure 1 is a section of one of my concave mirrors, a similar convex mirror being shown in dotted lines. Fig. 2 is a view similar to Fig. 1, but on a larger scale, and showing the process for manufacturing one of my improved mirrors. Fig. 3 is a plan of one of my improved mirrors in its frame.

The mirror is supported at its edges and subjected at its central portion to differing pressures of a fluid on the face and a fluid on the back thereof, the fluid at one side being preferably the atmosphere. By varying the difference of pressure on the opposite sides the degree and direction of curvature are varied, and by using for one of the fluids a material which is subsequently hardened I obtain a stiff backing, molded on the back of the mirror and fitting the same closely. By "pressure" I mean absolute pressure, whether greater or less than that of the atmosphere. For example, if the fluid-pressure on the face of the mirror—that is, the atmospheric pressure—be greater than that on the back (which must therefore be the pressure of a partial vacuum, any pressure less than that of the atmosphere) the curvature is concave, but if the pressure at the back be greater than that of the atmosphere the curvature is convex.

For the purpose of cheaply constructing my system of collecting and utilizing solar heat above referred to it is obviously advantageous to use curved mirrors of considerable size. By the method herein described I produce cheaply and expeditiously mirrors of accurately-determined concavity or convexity and evenness and of considerable size—say, for example, ten to twelve feet in diameter. It is to be understood, however, that my process may be used in making smaller curved mirrors.

Referring to the drawings, D is a casing having a body portion circular in outline and depressed at the center, so as to form the segment of a sphere, and having a rim d projecting upward all around such center portion, forming a chamber E. The inner edge of the rim d is rabbeted, as shown at d', and carries an annular washer d^2 of yielding material. On the outside of the rim are formed a series of perforated lugs d^3, used in attaching the mirror to its supports or in handling the castings in the process of manufacturing the mirror.

G is the plate of reflecting material—such as silvered glass, celluloid, or polished metal—which forms the reflector proper. At two points of the casting D shown diametrically opposite, are perforations d^4 d^5. My process is best carried out with the mirror and casting in a substantially horizontal position, as shown in Figs. 1 and 2, and the perforations d^4 d^5 are best placed at the highest possible points of the casting when it is in such horizontal position.

H is a vessel of any convenient form and size, in which the mirror and casting are to be submerged in hot water in the process of curving the mirror. Connected to the orifices d^4 and d^5 are respectively an air-pump K and a vessel L for stearin, rosin, lead, or the like. The pump K is connected by means of a tube k, having a cock k'. The vessel L is connected by means of a tube l, in which is a cock l'. Under the vessel L, wherein the material which is kept molten by heat is stored, is a heater typified by a gas-burner l^2.

The manner of carrying out my process with this apparatus is as follows: The tubes

k and l being attached to the casting and to the pump K and the vessel L and a plane mirror being set tightly on the packing or washer d^2, the whole is immersed, as shown, in a bath of water or other liquid in the vessel H at about 80° centigrade, where it is heated uniformly to this temperature, so as not to chill the molten backing material. Both cocks k' and l' are then opened and the air-pump K set in operation, the stearin, rosin, or lead, when one of these materials is used, being maintained in a liquid condition by the heater. As the air is withdrawn the stearin or the like takes its place until the entire chamber E is filled. The connection of the air-pump being at the highest point of the chamber possible in the position shown, when the air of the chamber is entirely exhausted and not before the air-pump will suck stearin. At this point the cock l' is closed and the operation of the pump continued to withdraw a portion of the fluid backing in the chamber E to form a partial vacuum therein. As the stearin is now withdrawn a portion of the pressure on the back of the mirror is removed and the atmosphere pressing on the face of the mirror presses the same inwardly. The atmospheric pressure being fluid and the glass being elastic and having a fluid backing, the effective pressure is the same at all points and in all directions, and the mirror is bent into a true spherical shape. When the desired degree of curvature is obtained, the pump is stopped and the connection k' closed. The whole is then returned slowly, with the bath E', Fig. 2, to atmospheric temperature, the stearin hardening to a compact mass. It is obvious that a great variety of materials may be used instead of the stearin, rosin, or lead referred to, the principal desideratum being that it shall enter the chamber E in liquid form and shall subsequently become quite hard, so as to give a firm backing to the mirror and stiffen the whole as much as possible. Stearin is especially useful because of its slight expansion under heat and also its slight contraction in solidifying and because it melts at a comparatively low temperature, (77° centigrade,) and is about as hard when cold as wood of average hardness. To avoid cracking of the stearin, where stearin is used, I cool the finished mirror very slowly. I have found a rate of 1° centigrade every two minutes satisfactory.

It will be understood that there is a constant atmospheric pressure on one side of the glass and another fluid-pressure on the inner side the latter being greater or less than the atmospheric and being such that the difference between it and the atmospheric pressure produces the direction and degree of curvature desired. Where a concave reflector is desired, the pressure within the chamber is less than the atmospheric pressure. By means of the apparatus shown the degree of curvature is controlled directly by the pump K, which sucks out the fluid and with it the pressure from the chamber until the reflector is observed to have the desired curvature.

In making a convex reflector the same apparatus may be used. In such case the air is drawn out of the chamber and the backing material substituted therefor, as before. Then, instead of withdrawing such material, the outlet is closed and an excess of filling material forced into the chamber. The filling material, being in a liquid condition, of course forces the reflector G', Fig. 1, outward at the center, (the same being held down at the edges in any suitable manner,) with an equal pressure at all points and in all directions, and therefore into a true spherical shape.

Though I have described with great particularity of detail one embodiment of my invention, yet it will be apparent that many modifications of the same, both in the general arrangement and in the individual features thereof, are possible to those skilled in this art without sacrificing all the advantages of my invention and without departing from the spirit thereof.

I do not in this application claim the improved mirror disclosed, the same being claimed in my pending application, Serial No. 27,143, filed August 17, 1900.

What I claim, therefore, and desire to secure by Letters Patent, is a process for making curved mirrors having the following-defined novel features, each substantially as described:

1. The process of making a curved mirror having a hard backing which consists in supporting a mirror at its edges, submitting said mirror to differing pressures of a fluid on the face and a fluid on the back thereof to curve said mirror, and then hardening the fluid on the back to form a hard backing.

2. The process of making a curved mirror having a stearin backing which consists in supporting a mirror at its edges, submitting said mirror to the pressure of the atmosphere on its face, and to the pressure of fluid stearin on the back thereof, said pressures differing so as to curve said mirror, and solidifying said stearin.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

KNUT C. WIDEEN.

Witnesses:
D. A. USINA,
FRED WHITE.