Nov. 26, 1935. J. C. STIMSON 2,022,639

REFLECTING DEVICE FOR HIGHWAYS

Filed Oct. 6, 1933

Fig. 1.

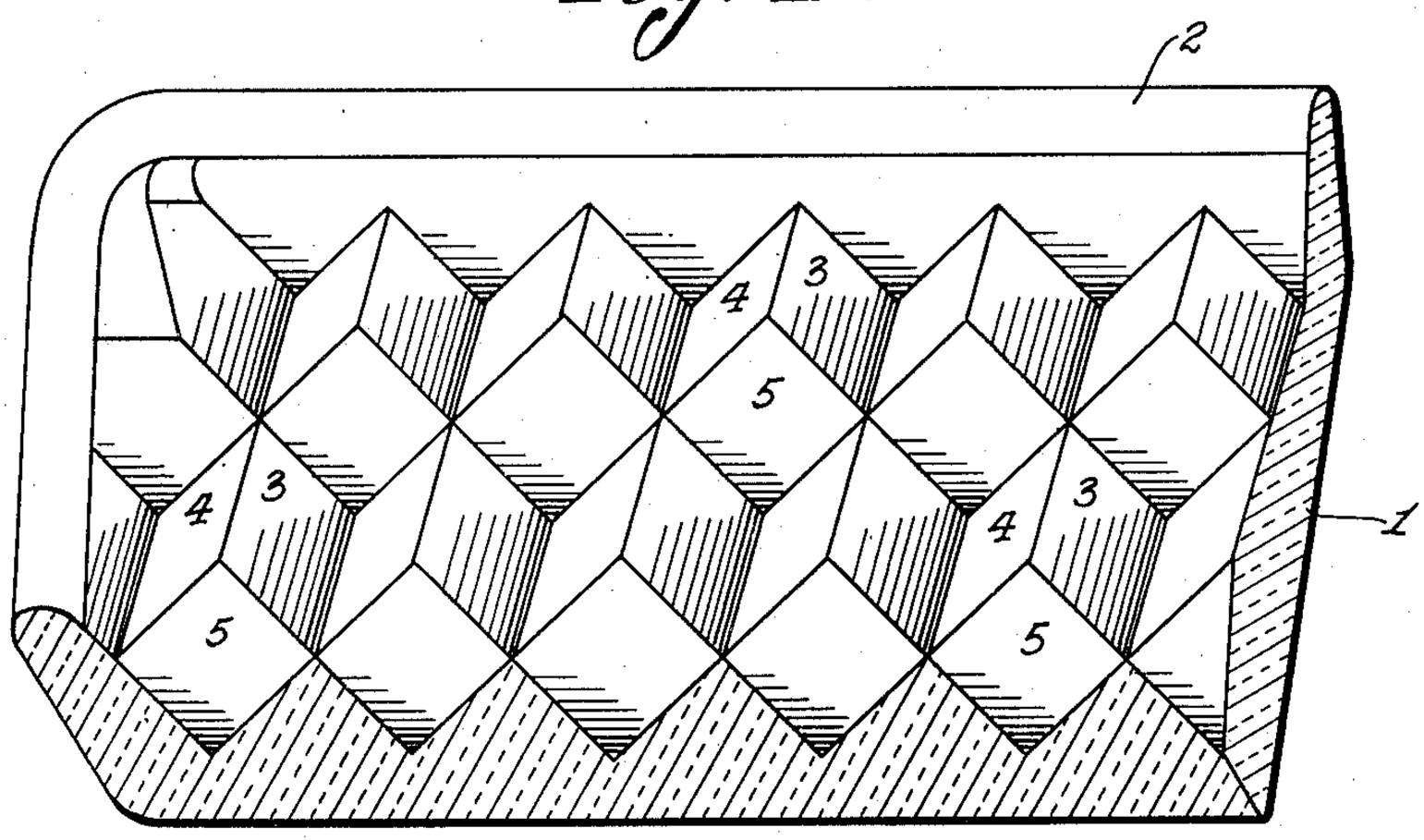


Fig. 2.

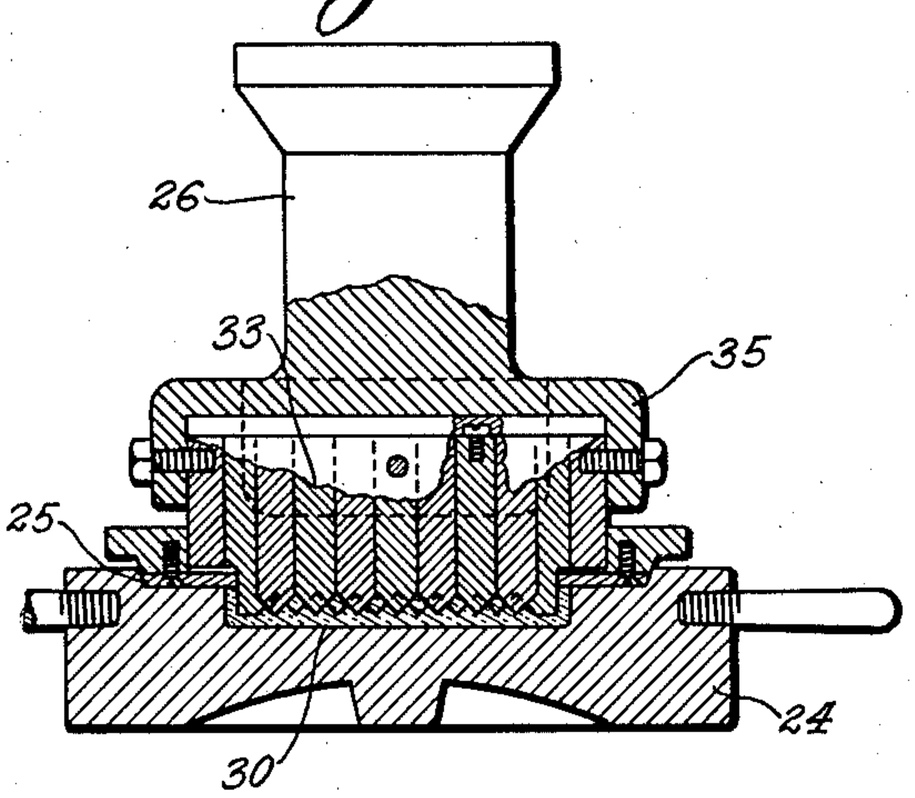


Fig. 3.

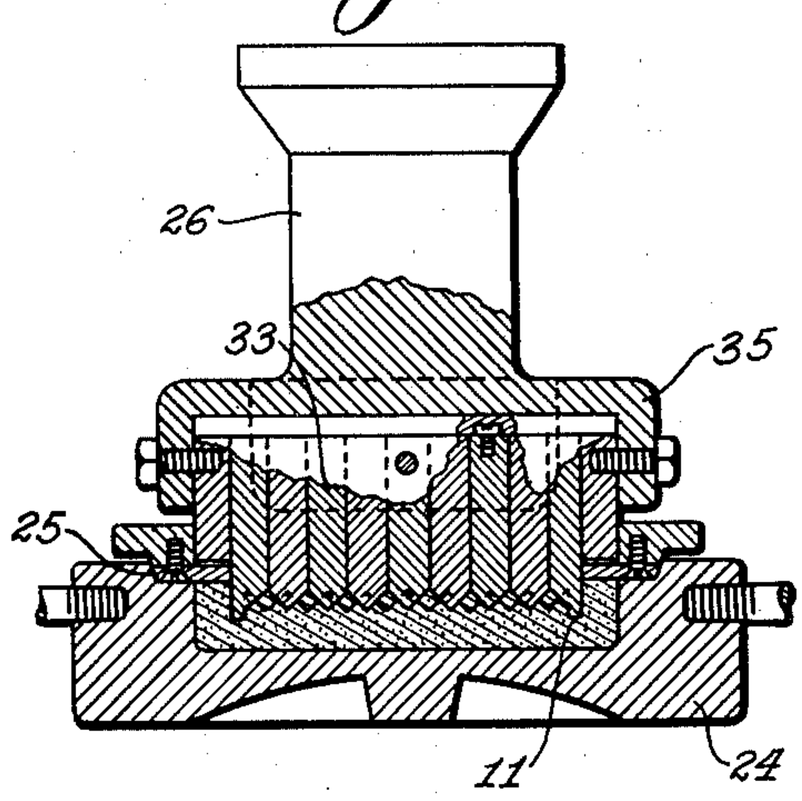
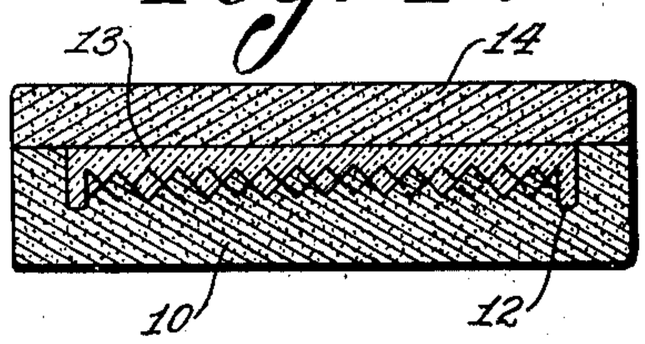


Fig. 4.



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Patented Nov. 26, 1935

2,022,639

UNITED STATES PATENT OFFICE

2,022,639

REFLECTING DEVICE FOR HIGHWAYS

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Application October 6, 1933, Serial No. 692,515

14 Claims. (Cl. 88—105)

This invention relates to reflecting devices and more particularly to devices for signaling traffic information to vehicles passing along highways. This application is a continuation in part of my application, Serial No. 210,473, filed August 4, 1927, as to subject matter common therewith.

A reflecting device of the character described must be constructed so as to reflect the light impinging thereon at varying angles to the horizontal and vertical back towards the light source. A device of that type is disclosed in my Patents No. 1,591,572, July 6th, 1926, No. 1,671,086, May 22, 1928 and No. 1,743,834, January 14, 1930. It comprises, generally stated, a molded structure having a series of reflecting units arranged in contiguous relation to form a reflecting aperture. In the reflector in one of the embodiments disclosed in said patents, the device comprises an integral prismatic glass plate having a series of total reflecting surfaces arranged relatively at right angles so as to provide a series of units each formed by reflecting surfaces arranged relatively at right angles and collectively around the axis thereof so as to form central triple reflectors. In another embodiment the units are formed hollow so as to operate by direct as distinguished from total reflection. In all of the embodiments of the above patents, the reflecting device embodies a series of mutually cooperating surfaces arranged in a circuit so that light impinging thereon from a variety of angles will be multiply reflected back toward the light source in the form of a slightly spreading beam.

In one of the embodiments of the process described in said Patent No. 1,591,572, the reflector is of glass and is formed by pressing the same to shape; the glass being deposited in the mold and the reflecting surfaces being formed by a suitably shaped matrix on a plunger which is moved into the mold. In the particular embodiments illustrated in that patent the mold has a series of mold elements arranged in mutual engagement, each element having forming faces in accurate relation to the locating faces thereof and adapted to form together the matrix required to produce the reflecting surfaces.

While glass reflectors of the character described in said patent have gone into wide commercial use and have been found to meet the requirements to a reasonable extent, nevertheless the reflector and the process of making the same have not completely met all of the conditions encountered. This is because glass although possessing the property of transparency and capability of forming total reflecting surfaces is, nevertheless, fragile and requires a good deal of care in the manipulation of the process in order to secure a good reflector. During the pressing operation the glass cannot remain in the mold and in contact with the reflector forming surfaces thereof until the material finally sets and accurately conforms thereto; for if this is done the reflecting surfaces become fragile and may crack so as to render the article useless for practical employment. Accordingly it is necessary to withdraw the figured plunger containing the reflector forming surfaces before the glass completely sets. While it is possible to control the operations so as to withdraw the plunger at the right time and still obtain sufficiently accurate reflecting surfaces in the required accurate angular relation, nevertheless, the procedure requires great care and close attention and is an essentially hand operation. This is for the reason that if the plunger is withdrawn too soon the surfaces are liable to "slump" and become deformed, while if the plunger remains in the mold too long the surfaces would become brittle and crack.

Now in a reflector of the chacter described, it is necessary for the reflecting surfaces to be accuratey formed in accordance with predetermined limits not only angularly but also planary. Thus in the reflectors of the patents referred to, after the limits have been established, the faces must not only be in accurate angular relation but the surfaces themselves must be substantially plane. Deviations from the required relations will cause wide deviations in effect, because the beam is reflected multiply from surface to surface and back towards the light source. Accordingly deviations of the surfaces will cause the errors to be multiplied progressively. In the reflectors of all of the patents referred to the reflected light is described as being directed back towards the source in the form of a spreading beam. This beam spread is secured in various ways as by diffusing means, generally in front of the reflector leaving the surfaces optically accurate, or by inaccuracies in angular relation or surfaces, or by various combinations of these factors. Where a spreading beam is secured by inaccuracies in angular relation of the surfaces combined with means to secure uniformity of beam, then where the greatest feasible distance visibility is required, the inaccuracies of the reflecting surfaces must be held within narrow limits not only angularly but also planary so as to confine the beam to a small angular spread.

A reflector of the character described when

made of glass has a definite angular range dependent upon the index of refraction of the material of which the reflector is made. While a prismatic glass reflector of the character described made of glass has a much greater range than a hollow reflector, due to the greater index of refraction of glass as compared with air, nevertheless, its range is not as much as desired but is limited on account of the character of the material used.

One of the objects of this invention, therefore, is to provide a reflecting device of the character described, in which the reflector structure is so constructed and of such a material as to meet the conditions encountered.

Another object is to provide a process whereby a reflector of the character described will have its reflecting surfaces formed with the required accuracy and in an effective manner.

One of the features of this invention resides in the fact that the structure of the reflecting device of the character described is composed of a plastic transparent material which finally sets and conforms accurately to the matrix surfaces without sinking or becoming fragile. Materials suitable for this purpose are plastic synthetic or artificial resins, which possess the above properties. Examples of these are the following: Cellulose acetate having a plasticizer one of which is known under the commercial name of "Tenite"; vinyl resins, such as polymerized vinyl alcohol, chloride or acetate, one of which is known under the commercial name of "Vinylite"; a nitrocellulose, such as pyroxyline, one of which is known under the commercial name of "Celluloid"; formaldehyde condensation products, such as the well known insoluble phenol-formaldehyde-condensation product known under the commercial name of "Bakelite"; carbamide-formaldehyde-condensation product, known under the commercial name of "Pollopas". The above materials are cold setting so that they will conform to the matrix surface without becoming fragile. Of the above cellulose acetate, the vinyl resins and pyroxyline are thermo-plastic; phenol condensation products are thermo-setting. In the case of carbamide-formaldehyde condensation products their indexes of refraction are substantially greater than that of ordinary glass.

Another feature of this invention resides in the fact that the material is permitted to remain in the mold and in contact with the reflector forming surfaces thereof until the material finally sets and accurately conforms to the matrix. In the case of the phenol-condensation products the mold is heated and pressed while hot into the material and the pressure is maintained until the material finally sets. In the case of cellulose acetate, vinyl resins and pyroxyline the mold and material are heated to the softening point of the resin, the matrix is pressed into the material and the mold is cooled to about room temperature while the pressure is maintained. In the case of the carbamide-formaldehyde condensation products the material is flowed into the mold as hereinafter described and allowed to set therein.

Further objects and features will appear from the detail description taken in connection with the accompanying drawing in which:

Figure 1 is a perspective view partly in section showing a reflector embodying this invention;

Figure 2 is a view similar to Figure 1 of Patent No. 1,591,572;

Figure 3 is a view similar to Figure 2, but showing a method of forming the matrix;

Figure 4 is a section of a mold or matrix in which the reflector can be formed.

Referring to the accompanying drawing and more particularly to Figure 1, the reflector there shown is substantially that illustrated in Patent No. 1,591,572 referred to. This reflector comprises an integral prismatic structure 1 which may be provided with flanges 2 to form a rim and which has formed on the back thereof units each providing total reflecting surfaces 3, 4 and 5, arranged relatively at right angles and collectively around the axis thereof. These units may be arranged in tiers as shown to provide a series of contiguous and merging reflecting apertures. Such a reflector when formed of glass in accordance with the process and by the apparatus as described in said patent, will operate to reflect light impinging thereon back towards its source, even though the impinging beam deviates from the axes of the units within limits, the minimum angle of deviation for glass being about 18 degrees. It will be understood, however, that the type of reflector shown is simply used for illustration.

In accordance with this invention, the reflector Figure 1, is formed of a plastic, and in this case, transparent material which finally sets and conforms accurately to the matrix surfaces without sinking or becoming fragile. All of the materials referred to have characteristics which render them particularly adaptable for making a reflecting device of the character described. They are not only plastic, but finally set and conform accurately to the matrix surfaces without sinking or becoming fragile for the reason that they are cold setting materials. The reflecting surfaces can, therefore, be accurately formed not only in the required angular relation but also to the required planes. Moreover, these materials take a high polish so that they form highly efficient total reflecting surfaces. Moreover, the material is such that it is not as fragile as glass and can be readily worked mechanically so as to permit drilling and machining in order to facilitate the fastening of the reflector to its base.

All of the materials mentioned (except "Pollopas") even in their transparent forms, can be pressed, as they soften under heat. Accordingly, the apparatus as shown in Figure 1 of Patent No. 1,591,572, reproduced at Figure 2 herein, can be used. It is only necessary to raise the material to the required temperature when the pressing operation can be performed. The plunger can, however, remain in position until the material has been fully pressed and sets and conforms to the matrix surfaces and this without becoming fragile. In the case of the thermoplastic products such as cellulose acetate, vinyl resins and pyroxyline the mold is suitably cooled.

In Figure 2 the parts are referred to by similar reference numerals as in the Patent No. 1,591,572 in which the mold 24 has a cavity 30 and a ring 25 while the plunger 26 has a box 35 to receive the mold elements 33. The elements, as described in the patent referred to, are machined or formed so that they can be assembled in accurate mutual relation while the ends of these mold elements are accurately machined and polished to provide a matrix for forming the reflecting surfaces. The mold may be designed to be heated and cooled and pressure applied in any

suitable manner as is common in the molding of phonograph records.

In the manufacture of reflectors from "Pollopas", it is necessary to introduce the material as a flowing colloid into the mold; it is then necessary to discard the dispersion agent; this can be accomplished in a mold of porous material impregnated with a membrane producer which is permeable to the departing agent but which is impermeable to the colloid itself. The procedure is illustrated in Figures 3 and 4. In Figure 3 the mold of Figure 2 has been modified so as to provide a recess for the formation of the mold body, the plunger being provided with an annular, downwardly extending part 11 in order to form the recess 12 for the rim 2 (Figure 1) of the reflector, while the figured plunger face forms the matrix 13 corresponding to the surfaces 3, 4 and 5 of the reflector. The mold 10 may be made of any suitable porous plastic material and impregnated with a suitable membrane producer. A cover 14 of similar material and similarly impregnated may also be provided. The fluid colloid is now poured into the mold (Figure 4) and allowed to set and harden therein, the liquid or dispersion agent passing through the pores of the mold while the colloid remains behind and forms the desired solid and transparent mass. Since the surfaces of the matrix are formed by the mold elements whose faces are suitably machined and which can be accurately formed, the material will take an accurate form and finish with the surfaces in their required accurate angular relation and with those surfaces taking the desired polish. While the matrix surfaces 13 are at the bottom and will, therefore, form smooth and polished reflecting surfaces, the top face of the reflector (Figure 4) may not be smooth; this can, however, be suitably smoothed and polished with any suitable tools or in any suitable manner since the material can be readily machined and worked as previously described.

While the invention is particularly applicable to the general type of reflector specifically shown and described, it will be understood that the invention is applicable in many cases to other forms and types of reflectors; thus while the materials described (all of which are transparent) are particularly suitable for the making of transparent reflectors operating by total reflection, this invention is applicable to hollow reflectors in which the reflecting area is formed by pressure and the hollow plated with a reflective metal such as silver by the usual process of mirroring. Furthermore, while several specific materials have been referred to as adaptable for this purpose, it is to be understood that other materials having the required characteristics and physical properties may be employed; thus it is not necessary that the material be transparent if the reflector forming area is hollow and silvered as above described. It will, furthermore, be understood that certain features, operations, structures, and subcombinations are of utility and may be employed without reference to other features, operations, structures and sub-combinations; that is contemplated by and is within the scope of the appended claims. It is further obvious that various changes may be made in details of construction and operation, within the scope of the appended claims, without departing from the spirit of this invention; it is, therefore, to be understood that this invention is not to be limited to the specific details of feature, structure, or operation shown and/or described.

Having thus described the invention, what is claimed is:

1. A reflecting device of the character described, comprising, a molded transparent prismatic structure having a series of totally reflecting units arranged in contiguous relation to form a reflecting aperture and composed of a non-metallic material characterized by the feature that it is transparent and finally sets and conforms accurately to the reflector forming surfaces of a matrix without sinking or becoming fragile.

2. A reflecting device of the character described, comprising, a molded transparent prismatic structure having a series of triple reflecting units arranged in contiguous relation to form a reflecting aperture, and composed of a material characterized by the feature that it finally sets and conforms accurately to the reflecting forming surfaces of a matrix.

3. A reflecting device of the character described, comprising, a molded transparent prismatic structure having a series of totally reflecting units arranged in contiguous relation to form a reflecting aperture and composed of a moldable hydrocarbon derivative which finally sets and conforms accurately to the reflector-forming surfaces of a matrix.

4. A reflecting device of the character described, comprising, a transparent prismatic structure composed of an artificial resin and having a series of mutually co-operating reflecting surfaces arranged in a circuit so that the light impinging thereon will be multiply reflected back towards the light source.

5. A reflecting device of the character described, comprising, a transparent prismatic structure composed of a formaldehyde-condensation product and having a series of mutually cooperating reflecting surfaces arranged in a circuit so that the light impinging thereon will be multiply reflected back towards the light source.

6. A reflecting device of the character described, comprising, a molded transparent prismatic structure composed of an artificial resin having the properties that it sets cold and conforms accurately to the matrix surfaces without becoming fragile, formed to have a series of mutually co-operating reflecting surfaces arranged in a circuit so that light impinging thereon will be multiply reflected back towards the light source.

7. A reflecting device of the character described, comprising, a molded transparent prismatic structure composed of a formaldehyde-condensation product having the properties that it sets cold and conforms accurately to the matrix surfaces without becoming fragile, formed to have a series of mutually cooperating reflecting surfaces arranged in a circuit so that light impinging thereon will be multiply reflected back towards the light source.

8. A reflecting device of the character described, comprising, a molded structure having a series of reflecting units arranged in contiguous relation to form a reflecting aperture and composed of a non-metallic material characterized by the feature that it finally sets and conforms accurately to the reflector forming surfaces of a matrix without sinking or becoming fragile.

9. A reflecting device of the character described, comprising, a molded structure having a series of reflecting units arranged in contiguous

relation to form a reflecting aperture and composed of a moldable artificial resin.

10. A reflecting device of the character described, comprising, a molded transparent prismatic structure having a series of totally reflecting units arranged in contiguous relation to form a reflecting aperture and composed of a moldable and transparent artificial resin.

11. In the art of making reflecting devices composed of a series of reflector-forming units arranged in contiguous relation to form a reflecting aperture, the process comprising, pressing a matrix of said units into a non-metallic material capable of finally setting and conforming accurately to the matrix units and maintaining the pressure until the material finally sets and conforms accurately to the reflector-forming surfaces of the matrix without sinking or becoming fragile.

12. In the art of making reflecting devices composed of a series of reflector-forming units arranged in contiguous relation to form a reflecting aperture, the process comprising, pressing a matrix of said units while heated into a non-metallic thermo-setting material which is capable of finally setting and conforming accurately to the matrix units and maintaining the pressure until the material finally sets and conforms accurately to the reflector-forming surfaces of the matrix without sinking or becoming fragile.

13. In the art of making reflecting devices composed of a series of reflector-forming units arranged in contiguous relation to form a reflecting aperture, the process comprising, pressing a heated matrix of said units into a thermo-plastic material capable of finally setting and conforming accurately to the matrix, and maintaining the pressure while the matrix is cooled until the material finally sets and conforms accurately to the reflector-forming surfaces of the matrix without sinking or becoming fragile.

14. A molded reflecting device of the character described, embodying a series of mutually cooperating reflecting surfaces arranged in a circuit so that light impinging thereon from a variety of angles will be multiply reflected back towards the light source in the form of a slightly spreading beam, characterized by the feature that it is composed of a non-metallic material, to-wit, a moldable artificial resin, which has the properties that it finally sets and conforms accurately to the reflector-forming surfaces of a matrix without sinking or becoming fragile.

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