Sept. 14, 1943. W. J. HARSHAW 2,329,532

REFLECTOR

Filed April 30, 1941

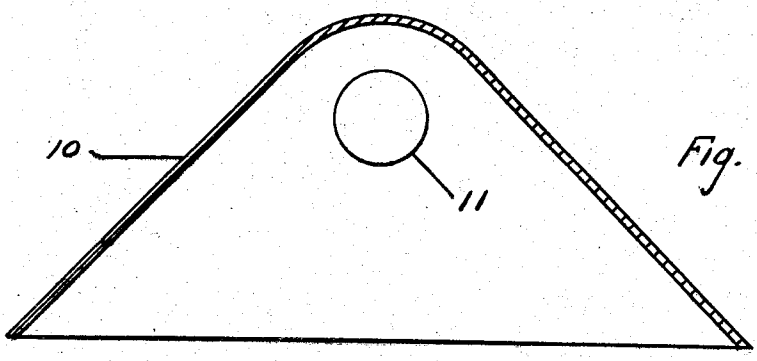


Fig. 1

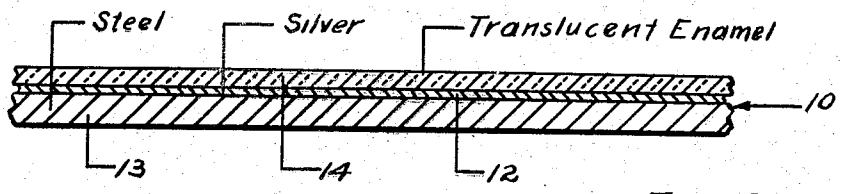


Fig. 2

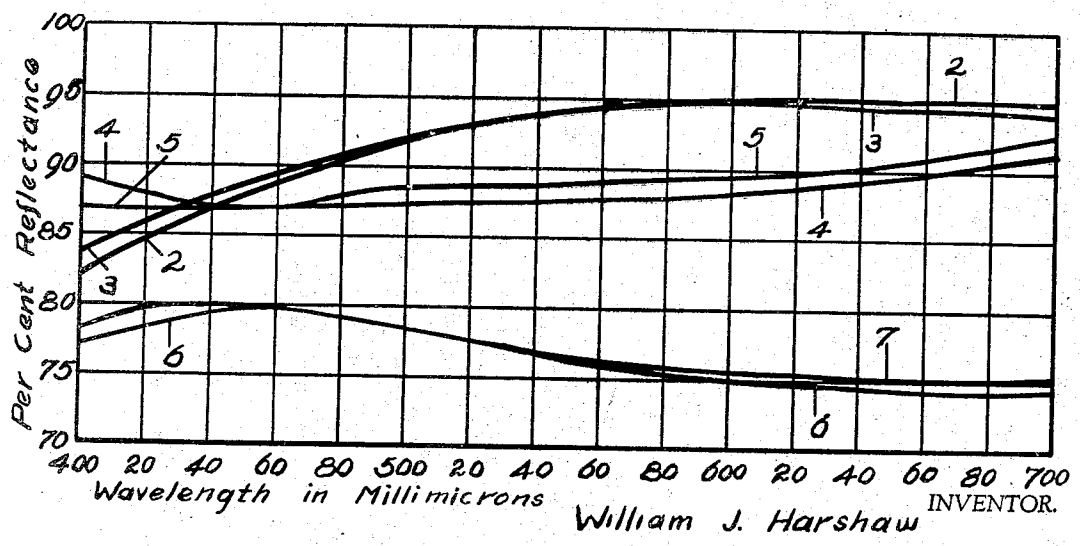


Fig. 3

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REFLECTOR

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2 Claims. (Cl. 88—105)

This invention relates to reflectors and particularly to reflectors of the type wherein relatively high diffuse reflectivity and low mirror or specular reflectivity, but together aggregating a high total reflectivity, are desired.

Prior to this invention, reflectors coated with opaque porcelain enamels have been used for obtaining diffuse reflectivity. They do reduce specular reflectivity to a small value, but the diffuse reflectivity and the total reflectivity obtainable are not as great as could be desired for a reflector.

An object of the present invention is to obtain the advantages of a silver reflector, however with an appearance of extreme whiteness and substantially without the metallic appearance of silver, and to overcome in a reflector the well-known tendency of silver to corrode and discolor when exposed to the atmosphere.

A further object is to provide an illuminating device including a reflector capable of giving a high diffuse reflectivity coupled with a high total and low specular reflectivity.

The present invention is primarily concerned with making available for purposes of illumination a reflector giving a high diffuse reflectivity and a high total reflectivity such reflector including a matte surfaced, (preferably electrodeposited) coating of silver and a coating of transparent vitreous enamel applied over such silver surface. Surprisingly, the metallic appearance of the silver surface is almost completely lost and the impression is one of extreme whiteness. Silver is by far the best metal for the purpose, being high in reflectivity both before and after the application of transparent enamel. However, copper and noble metals other than silver and alloys high in copper or noble metals or mixtures of one or more metals of the class consisting of copper and noble metals can be used with more or less good results. By the expression "noble metals," I mean silver, palladium, platinum and gold. Silver having a matte surface gives a far more pleasing appearance after enamel is applied than does highly polished silver, the appearance of whiteness being more pronounced and the residual metallic appearance being almost nil in the case of the matte surface while still being distinctly perceptible in the case of the polished surface. The reasons for these effects are obscure. If any film exists at the interface, it is so thin as not to be apparent upon separating the enamel from the metal surface. Such separation exhibits an apparently uncoated glass and restores the metallic appearance of the silver. The whiteness and loss of metallic appearance are not obtained by coating bright or matte silver with clear organic lacquers.

The foregoing objections are realized in and through the structures and procedures herein described and claimed and which structures are illustrated, insofar as practicable, in the accompanying drawing, in which Fig. 1 is a diagrammatic view representing a section of a lamp fixture comprising a reflector and source of light; Fig. 2 is an enlarged fragmentary section showing in detail the construction of the reflector; and Fig. 3 is a diagram showing approximately the curves traced by a Hardy recording spectrophotometer analyzing the color characteristics of reflecting surfaces according to the invention, matte silver surfaces and opaque vitreous enamel surfaces.

In the drawing, the numeral 10 indicates generally a sheet metal reflector element shown in section and associated with a source of light 11. The reflector element 10 may be elongated and the source of light 11 may be a fluorescent tube, for example, a hot cathode, argon-mercury filled tube interiorly coated with zinc-beryllium silicate. It is to be understood that suitable connections are provided for supplying suitable current to the source of light 11, all this being conventional and well known to persons skilled in the art of illumination.

In Fig. 2 I have shown an enlarged section of a fragment of the reflector 10. As will be clear from the drawing, the silver deposit 12 is applied over the steel base 13 and the clear enamel 14 overlies the silver deposit. It is to be understood that the translucent enamel is on the inner surface of the reflector so that the light from the source 11 will impinge thereon. The outside of the reflector 10 may be finished in the same way or may be painted, plated, or otherwise finished in any desired manner.

Reflector elements according to the invention may, as indicated, consist of a sheet, ferrous metal base such as steel which may be polished and silver plated on the polished surface or polished, then acid etched or lightly abraded with an abrasive which will leave a matte surface and then silver plated, after thorough cleaning in each case as is customary in plating practice. The ferrous metal base may be of any desired thickness. The silver plate need not be very thick. Good results may be had, for example, by the production of a deposit of a thickness not exceeding 0.00025 of an inch. If the silver deposit is very thin, e. g. below .0005 of an inch, it is well to deposit the same on a matte or satin

finish steel or other base metal. It is preferable to have from 0.001 to 0.005 of an inch of silver, however. The silver plating bath should be such as to produce a matte deposit, since otherwise it will be desirable (although not absolutely necessary) to etch or otherwise treat the deposit to form a matte finish. Such a procedure would result in loss of silver and require an extra operation. If the silver is deposited bright or buffed, the specular reflectivity is increased while the diffuse reflectivity is lowered. A polished silver deposit exhibits, before enameling, a low diffuse reflectivity and a high specular reflectivity, while after enameling it exhibits a high diffuse reflectivity but not as high as in the case of a matte surface. Also, in that case, the metallic appearance is not entirely lost.

It is possible, of course, to make use of a silver reflector element instead of a silver plated one. However, this is hardly to be considered a practical possibility except for very expensive fixtures in view of the cost of silver. Should sheet silver be used, the surface to be enameled should be lightly etched or otherwise treated to give the desired matte or satin finish.

The thickness of the transparent enamel or glaze is not critical. It should be thick enough to afford adequate protection of the silver against corrosion (to which silver is peculiarly susceptible when unprotected) and desirably may be from 0.005 to 0.010 of an inch in thickness.

The silver deposit may be produced from any conventional silver plating bath, such for example as the following:

$AgNO_3$	3.2 to 4.0 oz./gal.
NaCN	5 to 6 oz./gal.
KNO_3	15 oz./gal.
H_2O	To make one gallon
Current density	5 amps./sq. ft.

The enamel or glaze must be transparent or highly translucent and may be of various compositions. Suitable glaze compositions for the pactice of the invention are essentially low melting, lead-boro-silicates high in lead, low in boron, high in SiO_2 and containing alkali oxides in proportion of the order of 5% to 25%, suitably 10% to 15%. The following smelter batch for a glaze composition will be illustrative:

	Parts by weight
Borax	4.0
Quartz	29.0
Soda ash	4.7
$NaNO_3$	4.2
K_2CO_3	2.0
Red lead	42.0
As_2O_3	1.0
Sb_2O_3	1.0

These enamels are applied in accordance with usual practice, being melted on the metal base at a temperature approximating the minimum for melting to a homogeneous translucent coating.

Following the indicated procedure, I am able to produce reflectors characterized by an average diffuse reflectivity over the visible spectrum of the order of 80% to 90% (MgO=100%) and varying but little at the different wave lengths.

In Fig. 3 are shown some spectrophotometer charts illustrating the effects obtained. In connection with the curves shown in Fig. 3, it is to be noted that they are approximate copies of charts which were made on a Hardy recording spectrophotometer which rejects most of the specular reflection from the sample. All samples were done on the same machine. In the case of reflectors according to this invention and in the case of opaque porcelain enamels as well, the specular reflectance is only a few percent (probably not exceeding 5%) and does not greatly influence the comparison. In the curves, ordinates represent percentage reflectance (MgO=100%), a small part of the specular reflection being rejected by the instrument, and abscissae represent the wave length of the light in millimicrons.

The curve 2 was taken from a sample consisting of a matte silver deposit about .002 to .003 of an inch thick on polished steel, not yet enameled, while the curve 3 was taken from a sample consisting of a matte silver deposit on matte surfaced steel, not yet enameled.

The curve 5 was taken from a sample like 2 except that the matte silver surface was covered by transparent vitreous enamel. The curve 4 was taken from a sample like 3 except that the matte silver deposit was covered by transparent vitreous enamel.

The curve 7 was taken from a sample consisting of sheet steel coated by a white porcelain enamel prepared from a commercial "super-opaque" antimony frit opacified at the mill with 6% of tin oxide. The curve 6 was taken from a sample similar to 7 but opacified with a commercial tin oxide substitute sold under the trade name Uverite. Curves 6 and 7 are included merely for the purpose of comparing the reflectivity of reflectors according to the present invention with reflectors coated with highly opaque porcelain enamels. (These are very high reflectance opaque porcelain enamels.)

From the foregoing, it will be obvious that I have provided a reflector construction which is well adapted for its intended purpose and while I have shown and described the present preferred embodiment, other modifications and changes in the proportions and arrangement of the parts may be made by those skilled in the art without departing from the nature of the invention, within the scope of what is hereinafter claimed.

What is claimed is:

1. A reflector comprising a base, a silver coating on said base, the same having a thickness from .00025 and .005 of an inch and having a matte surface, and an adherent layer of translucent vitreous enamel covering said silver coating, said reflector being capable of exhibiting an average diffusive reflectance in excess of 80% as determined by the Hardy recording spectrophotometer, magnesium oxide being taken as 100%.

2. A reflector comprising a metallic base, a silver electrodeposit adherent to said base, having a thickness from .00025 to .005 of an inch and having a matte surface and a coating of translucent vitreous enamel covering said silver electrodeposit, said reflector being capable of exhibiting an average diffusive reflectance in excess of 80% as determined by the Hardy recording spectrophotometer, magnesium oxide being taken as 100%.

WILLIAM J. HARSHAW.