Oct. 17, 1944. G. T. SCHMIDLING 2,360,516

PHOSPHORESCENT DEVICE

Filed Nov. 18, 1941

Fig. 1

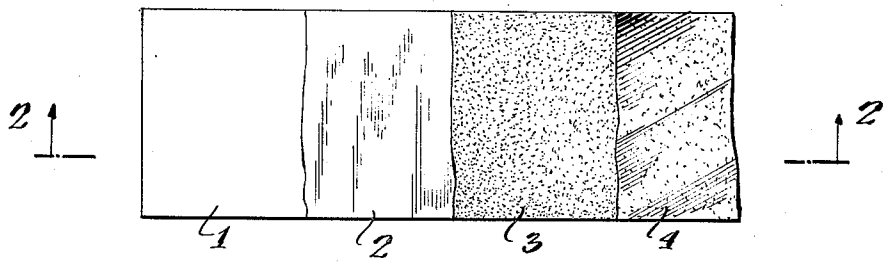


Fig. 2

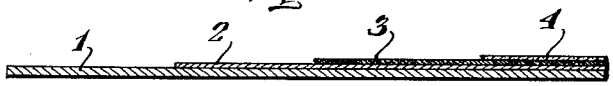


Fig. 4



Fig. 5

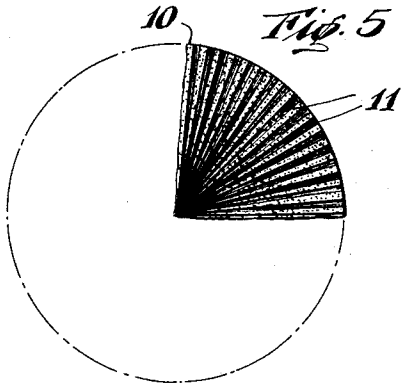


Fig. 3

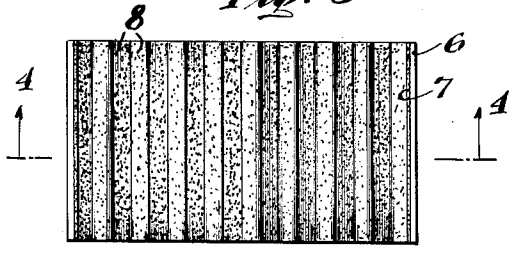


Fig. 6

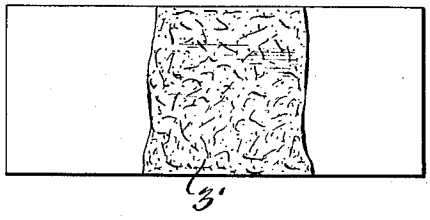
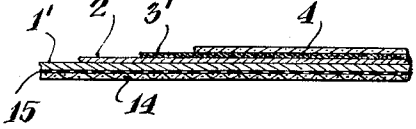


Fig. 7



INVENTOR.

Gilbert T. Schmidling

BY

Norman A. Holland

ATTORNEY

Patented Oct. 17, 1944

2,360,516

UNITED STATES PATENT OFFICE

2,360,516

PHOSPHORESCENT DEVICE

Gilbert T. Schmidling, New York, N. Y.

Application November 18, 1941, Serial No. 419,521

19 Claims. (Cl. 250—80)

The present invention relates generally to phosphorescent devices and more particularly to an improved phosphorescent surface and coating therefor.

The value of phosphorescent lighting in protecting against hazards and in preventing accidents and injuries is being appreciated more and more. Cars and trucks are stopped on roadways and streets without lights, and hallways, garages, steps and other places are left unlighted for substantial periods of time, generally at night. The number of accidents and injuries resulting from unlighted objects and unlighted passageways are enormous. In war time, such accidents are greatly increased due to blackout periods and elimination of ordinary lights to prevent being seen by the enemy flying over in planes. Phosphorescent lighting surfaces are clearly visible at short distances but not at substantial distances; hence, they may be made to serve the purpose of making obstacles visible without being seen from planes.

The general principle of phosphorescent lighting is the provision of a surface adapted to absorb light while exposed to it and to glow or emit light after the energizing light is extinguished. Some phosphorescent materials will glow for a few seconds and others for a few hours after being energized. Likewise, the intensity varies with different materials and decreases somewhat rapidly during the afterglow period. There are no materials known which have sufficient light intensity or sufficient afterglow periods to be entirely satisfactory for all requirements. Constant effort, particularly during the present war period, is being made to improve phosphorescent materials and surfaces in this respect.

The present invention aims to overcome the above difficulties and to provide an improved phosphorescent surface which will give a greater luminous intensity and a longer afterglow with a given phosphorescent material. In addition, the invention provides an improved phosphorescent coating having high efficiency and durability.

An object of the present invention is to provide an improved phosphorescent surface.

Another object of the invention is to provide an improved phosphorescent coating,

Another object of the invention is to provide a phosphorescent surface which has a longer afterglow and a higher luminous intensity.

Another object of the invention is to increase the period of afterglow and the luminous intensity obtained with a given phosphorescent material.

Another object of the invention is to provide a phosphorescent surface having greater permanence and durability.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawing, forming a part of the specification, wherein

Fig. 1 is a top plan view of a surface of a sheet or article having the present coating applied thereto, the upper coatings being broken away to show the lower ones and the surface of the article;

Fig. 2 is a sectional view along the line 2—2 of Fig. 1, the thickness of the coatings being greatly exaggerated;

Fig. 3 is a top plan view of an improved surface adapted to increase the intensity and afterglow of a phosphorescent coating;

Fig. 4 is a sectional view along the line 4—4 of Fig. 3;

Fig. 5 is a top plan view of a disk-shaped device having the improved surface of Figs. 3 and 4;

Fig. 6 is a top plan view of the surface of an article illustrating an alternate embodiment of the improved phosphorescent surface; and

Fig. 7 is a sectional view of another embodiment of the invention.

Referring again to the drawing and more particularly to Figs. 1 and 2, there is shown an improved phosphorescent coating for surfaces to be lighted. The base 1 is intended to illustrate, as an example, a sheet metal plate for the front or back of a car or truck. It could be used equally well to light any other obstacle or hazard. It is also to be understood that the coating shown on the plate may be applied directly to the surface of any article or object where a phosphorescent coating is desired. In the preferred embodiment; three coatings are applied to the surface of the article 1; first the coating 2, then a second coating 3 of phosphorescent material and a third protective coating 4. I have found that by applying the three coatings consecutively and by baking each one on before applying the succeeding coating, improved re-

sults are obtained; hence, I prefer to follow such procedure, although it is not essential in all cases. The temperature and period of baking may be varied to a considerable extent. However, as an example, good results may be obtained by baking the respective coatings for a period of about fifteen minutes at a temperature of about 160° centigrade.

Both the constituents and the proportions thereof in the composition of the coatings may be varied but the following examples give excellent results. For the first coating 2 I prefer to use:

	Parts
(A) Melamine	80
(B) Dibutyl phthalate	15
(C) Toluol (enough to thin)	5
(D) Titanium oxide (enough to give white color)	20
(E) Aluminum stearate	5

For the second coating 3 I prefer to use:

	Parts
(A) Melamine	80
(B) Dibutyl phthalate	15
(C) Toluol (enough to thin)	5
(D) Strontium hydroxide or a proper proportion of another suitable phosphorescent material	35
(E) Aluminum stearate or other suitable stabilizer	3

For the third coating 4 I prefer to use:

	Parts
(A) Melamine	80
(B) Dibutyl phthalate	15
(C) Toluol (enough to thin)	5
(D) Dewaxed dammar	15

The first coating 2 gives a base on which a coating of phosphorescent material may be securely adhered and in addition gives a light background which cooperates with the phosphorescent coating to obtain a maximum absorption and emission of light. The coating 3 is more particularly a phosphorescent material in a substantially transparent carrier. Strontium hydroxide is given as the phosphorescent material but it is to be understood that any other phosphorescent material may be substituted therefor. The aluminum stearate is an important but not an essential element. It renders the solution alkaline, which prevents or minimizes the effect of attack by moisture on the coating due to exposure to weather and normal atmospheric conditions. Acids are formed when the coating is attacked by moisture and the presence of an alkaline stabilizer neutralizes and prevents the acid from damaging the phosphorescent coating, thus preserving the effectiveness of the coating. Other suitable stabilizers are calcium borate, glycerol monostearate and calcium stearate. The aluminum stearate also acts as a suspending medium for the other constituents of the first and second coatings. The baking of the coating increases hardness, permanence and resistance to moisture.

The coating 4 is a substantially transparent coating which further protects the phosphorescent coating against moisture, abrasions, wear and other impairment of its effectiveness and durability. The dewaxed dammar assists in the waterproofing features of the coating 4.

The dibutyl phthalate of each of the coatings acts as a plasticizer, i. e., it acts to keep the coatings somewhat pliable. With its use, brittleness and cracking of the coatings are minimized.

As an alternative for the coating 4 disclosed above, a thin sheet of material such as Cellophane, polystyrene, methyl methacrylate, or n-buty methacrylate may be utilized with excellent results. The sheet or coating is preferably applied under heat and pressure over the phosphorescent coating.

An important object of the invention is to increase the period of afterglow and the luminous intensity during the afterglow of phosphorescent surfaces. This is achieved in part by the combination of coatings described above and also by the constructions illustrated in Figs. 3, 4 and 5 of the drawing where a sheet of metal 6 is shown in Figs. 3 and 4 with a phosphorescent coating 7 thereon, preferably though not necessarily the coatings illustrated and described with reference to Figs. 1 and 2. A sheet of metal 6 is pleated or folded as shown in Figs. 3 and 4 so that the phosphorescent coating is on a series of joined V-shaped or trough-like surfaces 8. The sides of the V-shaped surfaces should be at a comparatively small angle with respect to each other to obtain the best results. Excellent results may be obtained with angles from five to fifteen degrees. The purpose of the small angles is to have some of the rays from one surface impinge on the adjacent surface and vice-versa. In this way the surfaces are continually excited by each other and the afterglow continues for a longer period. The intensity is also much greater. The incident rays as well as the emitted rays increase the brightness of the surface. In one way, the operation may be compared to flashlights with their beams crossing. There is a decided increase in intensity at the point where the beams cross. Likewise, if the two flashlight beams are directed against a wall, the intensity is greater with both beams on the same spot than with one. By having the joined V-shaped surfaces, both effects are achieved by the numerous phosphorescent particles acting more or less like tiny flashlights, as shown by the arrows at 9 with reference to a single particle. Thus both the intensity and the period of the afterglow are greatly increased. If desired, the pleated sheet may be expanded during exposure to light to facilitate absorption thereof and rapid energization. While trough-like creases and depressions are shown in Figs. 3 and 4, the same general effect could be obtained by other protuberances and depressions; for example, protuberances and depressions like the surface of a waffle iron.

In Fig. 5, a round disk 10 is shown with pleats 11 radiating from the center thereof. The principle and operation of the surface are the same as disclosed with reference to Figs. 3 and 4.

Another embodiment for obtaining a result similar to that in Figs. 3 to 5 is shown in Fig. 6, by forming cracks in the coating 3' of phosphorescent material. This may be achieved by including with the constituents thereof solvents that dry at different rates. By including one solvent that dries several times faster than another, the two contract at different rates of speed and give a crackle surface. The fine cracks disperse the light laterally and hence increase the intensity and the period of the afterglow. The device of Fig. 6 may be coated in advance and quickly secured by adhesive, nailing or otherwise to any kind of surface. In certain instances it might be difficult to apply adhesive to the fluted or corrugated material of Figs. 3 and 5 and then to apply it by

means of the adhesive to a surface. The device of Fig. 6 provides a result similar to Figs. 3 and 5 but in an easily attachable flat surface. If desired, the device of Fig. 6 may be fluted as shown in Fig. 4.

Considerable time and trouble are involved in applying the several coatings of the present invention to obstacles such as steps in garages, walls, parts of battleships, et cetera. In order to facilitate such applications and to increase the general application of the invention, an alternative embodiment is illustrated in Fig. 7. A base material 1', preferably of thin aluminum, is provided and the coatings 2, 3' and 4 applied thereto as described with reference to Figs. 1 and 2. Thereafter, a sheet of fabric or other suitable material 14 is adhered to the opposite side thereof by an adhesive 15. The composite sheets may be stored without adhering to each other and may be quickly applied to any surface by removing the cloth to expose the tacky bottom surface of the base 1' which is ready for adherence to the surface requiring a phosphorescent material. The crackle coating 3' of Fig. 7 operates similarly to the coating 3' described in connection with Fig. 6 and disperses the light laterally and increases the afterglow period.

In the manufacture of the device, the coatings 2, 3 and 4 are applied and baked consecutively on the surface of an article 1. The resulting article may be used in the form shown in Fig. 1 or as shown in the preferred embodiment, the sheet 1 may then be corrugated or bent into a series of connected V-shaped or trough-like surfaces as shown in Fig. 4. Preferably, the sides of the V have a small angle with respect to each other. The device is then ready for attachment to the back or front of cars or trucks and to any other surface requiring illumination while the ordinary illumination thereof is discontinued or ineffective. In the embodiment of Fig. 7, a cloth or other flexible material 14 is adhered to the bottom of the base 1' to facilitate attachment to surfaces.

It will be seen that the present invention provides an improved phosphorescent device which affords a longer period of afterglow at a higher intensity than devices known heretofore. The co-mingled rays from the adjoining V-shaped surfaces increase the intensity and the periods of afterglow. The improved coatings increase the efficiency and durability of the phosphorescent material. The devices are simple in construction, inexpensive to manufacture and fully capable of withstanding the rough usage to which they may be subjected.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In a phosphorescent device, the combination of a surface having a coating thereon comprising melamine, dibutyl phthalate, toluol, titanium oxide and aluminum stearate, and a coating of phosphorescent material on said first coating.

2. In a phosphorescent device, the combination of a surface having a coating thereon comprising melamine, dibutyl phthalate, toluol and titanium oxide, a coating of phosphorescent material over said first coating and a protective coating over said phosphorescent coating.

3. In a phosphorescent device, the combination of a surface having a phosphorescent coating thereon and a protective coating extending over said phosphorescent coating comprising melamine, dibutyl phthalate and toluol.

4. In a phosphorescent device, the combination of a surface having a coating of phosphorescent material extending over said surface comprising melamine, dibutyl phthalate and strontium hydroxide, said phosphorescent coating being baked for a substantial period to provide a hard permanent surface.

5. In a phosphorescent device, the combination of a surface having a coating thereon and a phosphorescent coating comprising melamine, dibutyl phthalate, toluol and strontium hydroxide extending over said first coating, said phosphorescent coating being baked on.

6. In a device of the class described, the combination of a surface having a coating thereon, a phosphorescent coating extending over said first coating and a protective coating extending over said phosphorescent coating, said protective coating comprising melamine and dibutyl phthalate.

7. A phosphorescent device, having a surface with a coating thereon, a phosphorescent coating extending over said first coating and baked thereon and a protective coating comprising melamine and dibutyl phthalate extending over said phosphorescent coating and baked thereon.

8. In a device of the class described, the combination of a surface having a coating baked thereon, a phosphorescent coating comprising melamine, dibutyl phthalate, and strontium hydroxide extending over said first coating and baked thereon and a protective coating baked on said phosphorescent coating.

9. A phosphorescent device having a surface and a phosphorescent coating thereon, said surface having alternate protuberances and depressions to increase the period and intensity of the afterglow, the coating being substantially uniform in thickness on both said protuberances and depressions.

10. A phosphorescent device comprising a sheet of material bent into a plurality of flutes, the adjacent sides of said flutes being at acute angles to each other and a phosphorescent coating thereon having a substantially uniform thickness.

11. A phosphorescent device having a surface with alternate depressions and protuberances thereon, a coating on said surface having a substantially uniform thickness and a phosphorescent coating extending over said first coating having a substantially uniform thickness.

12. A phosphorescent device comprising a sheet of material bent to provide a fluted surface, with a coating thereon having a substantially uniform thickness and a phosphorescent coating having a substantially uniform thickness extending over said first coating, the adjacent surfaces of said fluted portion being at an acute angle to each other.

13. A phosphorescent device comprising a sheet of material bent to provide a fluted surface, a coating thereon, a phosphorescent coating extending over said first coating and a protective coating extending over said phosphorescent coating, said coatings being of substantially uniform thickness on said fluted surface.

14. A phosphorescent device having a fluted surface with a coating thereon, a phosphorescent coating extending over said first coating and a protective coating extending over said phospho-

rescent coating, certain of said coatings being baked on and all of said coatings having a substantially uniform thickness.

15. A phosphorescent device comprising a sheet of material bent to provide a fluted surface, a coating thereon, a phosphorescent coating extending over said first coating, and a protective coating extending over said phosphorescent coating, all of said coatings being baked on and having a substantially uniform thickness.

16. A phosphorescent device having a surface with a coating thereon comprising melamine, dibutyl phthalate, toluol, titanium oxide and aluminum stearate; a phosphorescent coating on said first coating comprising melamine, dibutyl phthalate, toluol, and strontium hydroxide; and a coating comprising melamine, dibutyl phthalate and toluol on said phosphorescent coating.

17. A phosphorescent device having a fluted surface with a coating thereon comprising melamine, dibutyl phthalate, toluol, titanium oxide and aluminum stearate; a phosphorescent coating on said first coating comprising melamine, dibutyl phthalate, toluol, and strontium hydroxide; and a coating comprising melamine, dibutyl phthalate and toluol on said phosphorescent coating; all of said coatings being baked on.

18. A phosphorescent device having a surface with a phosphorescent coating thereon, said coating having a crackled finish to increase the period and intensity of the afterglow.

19. A phosphorescent device comprising, in combination, a member having a phosphorescent crackle finish coating at one side thereof, an adhesive at another side thereof, and a covering material extending over said adhesive.

GILBERT T. SCHMIDLING.