PRISMATIC GLOBES AND REFLECTORS.*

By Van Rensselaer Lansingh, *Member*.

The use of the principles of refraction and reflection for changing the direction of rays of light is, of course, one of the oldest branches of modern physics, and to-day the sciences of optics, astronomy, etc., are based on these fundamental principles. The application of these principles, however, to the use of artificial light is more recent. Numerous experimenters have tried to use either one or the other principle in their efforts to re-direct the rays of artificial light, but it remained for Blondel and Psaroudaki to combine both principles into compound prisms and thus lay the foundation of the modern science and art of prismatic glassware for artificial lighting. The principles in their invention were announced in this country in 1897 by the award by the Franklin Institute of the John Scott Legacy Medal to the inventors. Since that time, however, no statement has been made of the numerous and varied advances that have been made, and it is the object of this paper to point out some of the more important steps made in the past ten years.

PRINCIPLES.

The prismatic globe, as originally designed, consists of a set of vertical internal diffusing prisms, showns in Figs. 1 and 2.

The function of the internal prisms is simply to break up or diffuse the light rays; the method by which this is accomplished is clearly shown in Figs. 1 and 2. It will be seen from Fig. 2, showing an enlarged section, that a ray of light A impinging at B will be broken up into two or more diverging rays, so that the eye, following back each ray will no longer be able to see the light source and we say that the light is diffused.

The external horizontal prisms are in general compound, that is, consist of both refracting and reflecting faces, as shown in Fig. 4. It is evident that rays of light coming from the right direction and impinging on the surface c′ a′ will be simply refrac-

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ted or bent from their original course. Owing to the fact that rays of light can be bent or refracted only a given amount, advantage is taken of the critical angle or the angle of total reflection, so that where it is desired to bend the rays of light more than is possible by refraction, the face of the prism is designed to reflect

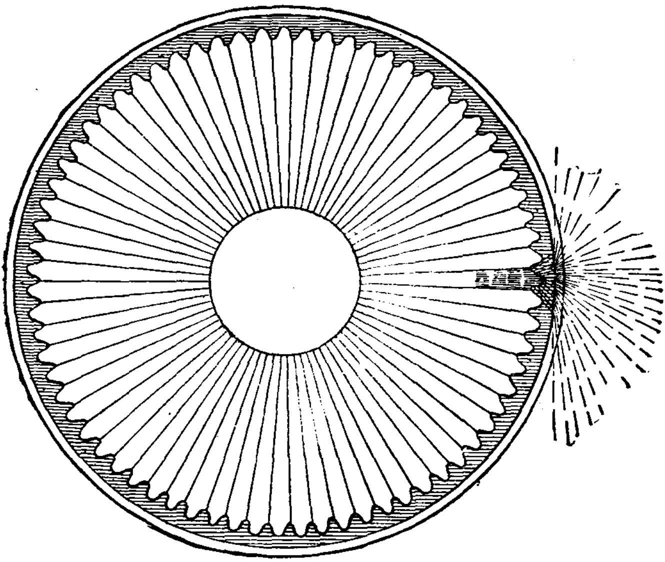


Fig. 1.—Cross Section, Looking at Top of Prismatic Globe, Showing Internal Prisms Breaking up the Light Rays.

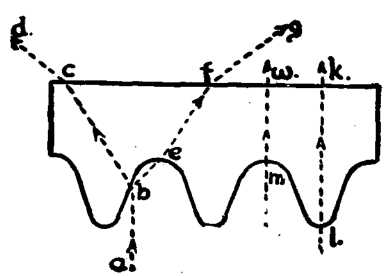


Fig. 2. — Showing Enlarged View of Internal Prisms and How the Rays of Light are Broken up into two or more Components.

the ray to the lower surface of the prism where it is again bent by refraction to the desired angle. It will thus be seen that it is possible, by correctly designing the surfaces of each prism, to obtain almost any desired distribution. In this connection it should first be noticed that the prisms are in a definite position, as shown in Fig. 3, and that if the position of the source of light is changed, the light rays may no longer impinge on the surface

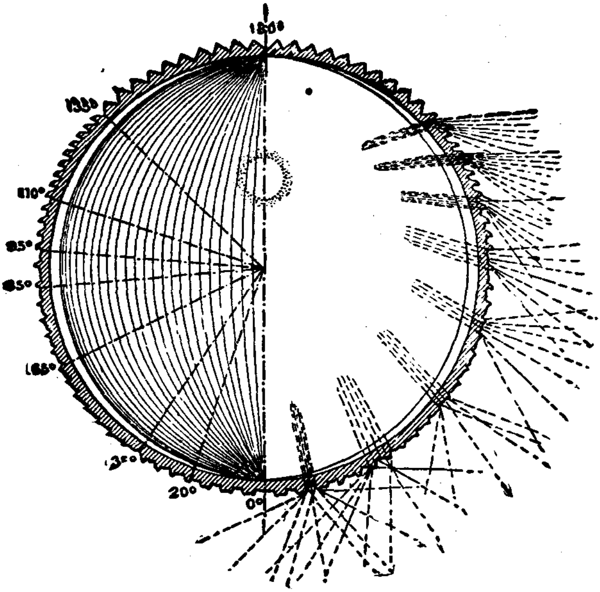


Fig. 3. — Vertical Section of Prismatic Globe Showing Method of Redirecting the Rays of Light.

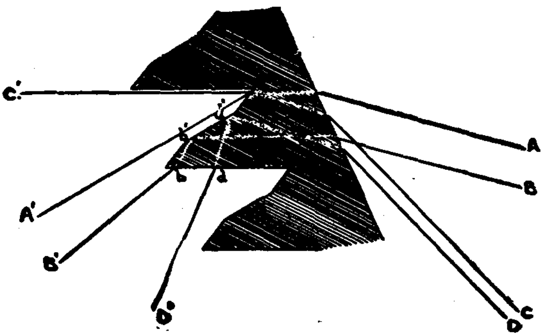


Fig. 4. — Enlarged View of External Prisms, Showing Refracting and Reflecting Surfaces.

of the prisms at the angle for which they were calculated, with the result that some of the rays may be thrown back into the globe and thereby largely lost. For this reason each globe is designed for a given size and shape of the source of light. Thus if a ten candle power electric lamp were used with the standard socket and holder and around it were placed an eight inch prismatic ball, designed primarily for a 32 candle power lamp, the results would not be satisfactory for two reasons: first, the light rays would not impinge on the prisms at the correct angles, and second, because such a small amount of light diffused over the large surface would appear dim. If it were desirable to use a small lamp in such a globe, it would be necessary to extend the socket so that the filament of the lamp occupied the same position as the filament of a 32 candle power lamp with standard socket and holder.

EFFECT OF DUST.

It should also be borne in mind that the surface b′ d′ acts by total reflection, and since a reflecting surface is unaffected by any substance resting on it but not in optical contact, such for example as dust, the effect of the same is far less than might be imagined. Undoubtedly the numerous prisms tend to collect the dust, but, peculiarly, the effect of dust on a correctly designed pris-

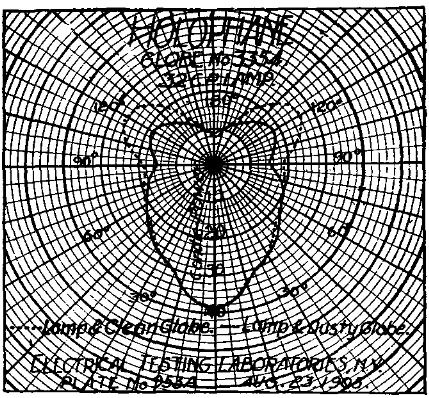


Fig. 5.—Photometric Curve, Showing Effect of Dust on Prismatic Globe.

matic globe is less than with an ordinary smooth surfaced globe. In a certain test where a globe was hung pendant for several months in a dusty place, allowing a heavy coating of dust to accumulate upon its outer surface but with its opening covered to keep the dust from getting upon the inner surface, the loss of light due to the dust was only thirteen per cent, almost all of which was in the light going above the horizontal. This is shown graphically in the photometric curves given in Fig. 5, the dotted line being the curve when clean and the full line when dusty.

LOSS BY ABSORPTION.

As is well known, every time a ray of light is changed in its course, either by refraction or reflection, there is a resultant loss.

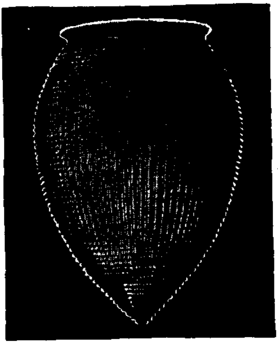


Fig. 6. -- Globe for General Distribution of Light.

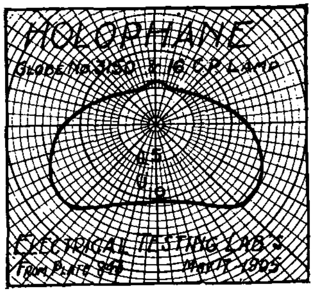
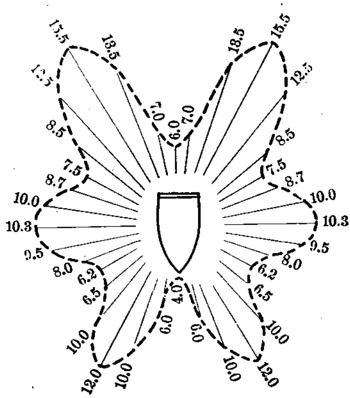


Fig. 7. — Curve of Globe Designed for General Distribution.

Fig. 8. — Uncalculated Prismatic Globe.



Candle Power.

Fig. 9. — Curve of Uncalculated Prismatic Globe.

In a correctly designed enclosing globe this loss may be as low as ten per cent, while if not so designed the loss may run anywhere from 30 to 40 per cent, owing to the fact that the prisms may throw the light back into the globe instead of out. Perhaps the most elaborate and thorough tests on this subject were made at the Massachusetts Institute of Technology,* where the mean of the tests on prismatic globes showed a loss of 12.3 per cent, while another prismatic globe having the same general appearance, but with incorrectly designed prisms, showed a loss of 34 per cent.

Fig. 6 shows a prismatic stalactite designed for general illumination and Fig. 7 its photometric curve. This should be compared with Figs. 8 and 9 showing a similar, but uncalculated, prismatic stalactite and its curve of light distribution.

It will be seen from the foregoing that not every prismatic globe is correctly designed, and without a photometric curve, or its equivalent, one is working in the dark as far as knowing what it actually accomplishes.

DISTRIBUTION CURVES.

As before noted, it is possible to get practically any distribution of light desired by correctly shaping the prisms, but in practice it has been found that three general types are sufficient for most purposes. These may be designated as Class A, designed

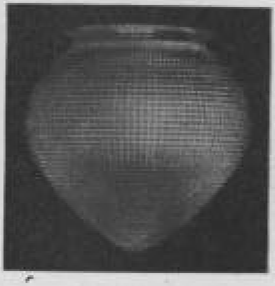


Fig. 10. — Class A Stalactite.

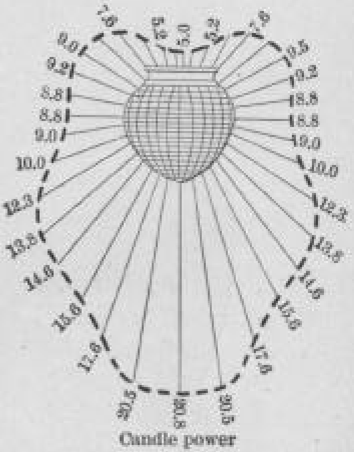


Fig. 11. — Curve of Class A Stalactite.

to throw the strongest light directly downward; Class B, to throw the light in all directions below the horizontal, and Class C, to throw the strongest light at about fifteen degrees below the horizontal in order to light a large area. These three classes are

* Technology, Quarterly, March, 1902.

illustrated in Figs. 10 to 15. Figs. 10 and 11 show a Class A stalactite for electric light and its photometric curve.

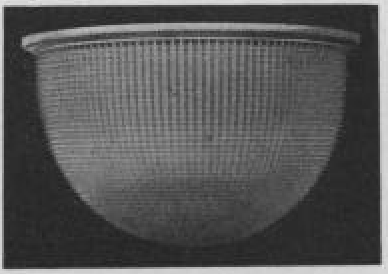
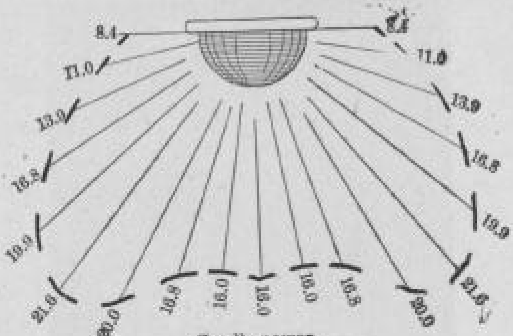


Fig. 12. — Class B Hemisphere.



Candle power

Fig. 13. — Curve of Class B Hemisphere.

Figs. 12 and 13 show a Class B hemisphere and its photometric curve.

Fig. 14. — Class C Mantle Burner Globe.

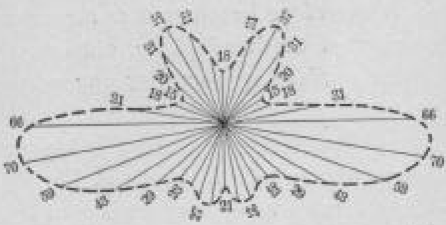


Fig. 15. — Curve of Class C, Mantle Burner Globe.

Figs. 14 and 15 show a Class C mantle burner globe and its photometric curve.

That the above principles can be carried into the design of globes for almost any form of artificial light is self-evident, and to-day it is possible to procure globes of the above three classes for the electric arc, the incandescent electric lamp whether it be carbon, tantalum or tungsten filament, the mercury vapor lamp, mantle burners both upright and inverted, acetylene, gasolene, etc.

MODIFICATIONS.

It is also evident that many modifications can be introduced in the design of different globes. Thus in the case of the hemisphere shown in Fig. 16 it is evident that any prisms placed on or

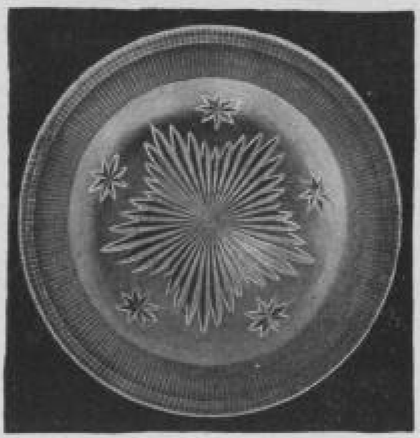


Fig. 16. — Hemisphere with Cut Glass Bottom.

near the bottom will be useless as far as throwing the light downward is concerned, and can only be utilized for diffusing the light. It therefore becomes possible to omit the external prisms on this part of the hemisphere, obtaining the diffusion by sand-blasting the surface and cutting any pattern which is desirable, without sacrificing much efficiency.

Another modification is shown in Fig. 17, the pohtometric curve of which is shown in Fig. 18.

Here a banded effect is procured by omitting some of the vertical internal diffusing prisms. This destroys to some extent the diffusing qualities of the globe, but increases its power of directing the light directly downward.

In the use of hemispheres, which are usually placed on or near the ceiling, it is sometimes difficult to clean them with a brush, and it is therefore desirable to use such as can be cleaned with a cloth.

Fig. 17. — Banded Ball.

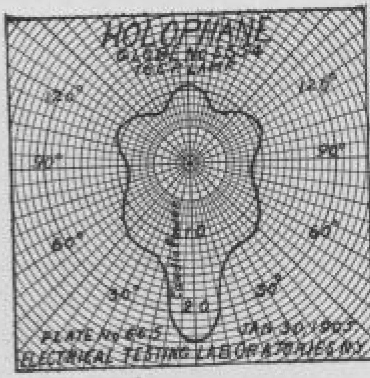


Fig. 18. — Curve of Banded Ball.

Fig. 19 shows a hemisphere which has the usual diffusing prisms on the inside but where the external prisms have been made so shallow as to be easily cleaned with a cloth. Their use is therefore simply to aid in the diffusion, the directing powers of the combination being effected by the prismatic reflector placed

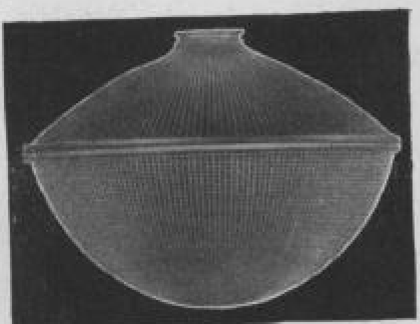


Fig. 19. — Combination Hemisphere and Reflector.

directly on top, so designed as to accomplish the purposes intended. The results are seen in the curve shown in Fig. 20.

In bracket lighting we are usually confronted with the difficulty that one-half of the light from the source used strikes the

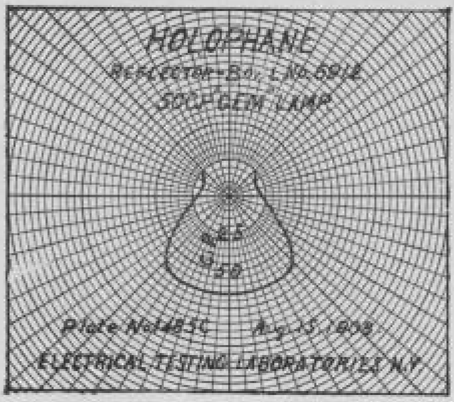


Fig. 20. — Curve of Combination Hemisphere and Reflector.

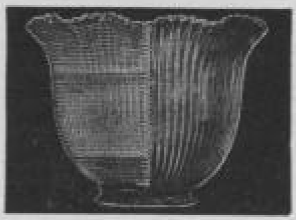


Fig. 21. Wall Bracket Globe.

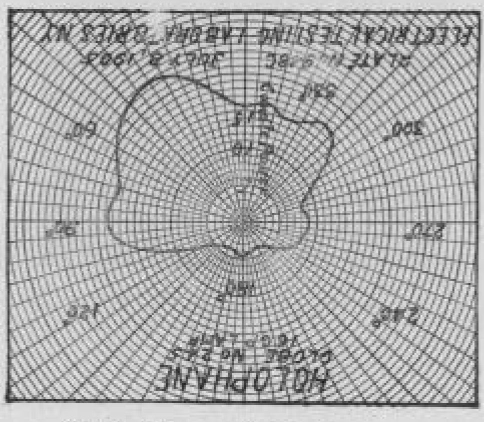


Fig. 22. — Curve of Wall Bracket Globe.

walls and is largely lost by absorption. For this reason bracket lighting is, generally speaking, much less efficient than chandelier lighting, where the light is radiated in all directions. In order to overcome this difficulty, prismatic globes have been designed so as to reflect a larger part of the light directly into the room before it strikes the wall. An example of such a globe is shown in Fig. 21 and its photometric curve in Fig. 22.

The side of the globe facing into the room is designed in the usual manner, but the side next to the wall consists of reflecting prisms similar to those described below under prismatic reflectors. The curve shows how successfully the results have been attained, no less than 62 per cent of the light below the horizontal being thrown into the room as compared with 38 per cent against the wall, while the amount of light thrown into the room below the horizontal is increased 47 per cent with the bare lamp, neglecting, of course, the effect of the reflection of the walls which may or may not be large.

STREET LIGHTING.

In street lighting we have two propositions to contend with as far as the distribution of light is concerned: first, to take the rays which would naturally be above the horizontal and bend them so that they will lie between the horizontal and fifteen degrees below, and second, to throw the largest part of the light up and down the street rather than equally in all directions. In other words we must redistribute the light rays in both the horizontal and vertical planes. We have already seen how the vertical redistribution is brought about, *viz.*, by compound prisms. The horizontal distribution is accomplished by so changing the shape of the internal prisms as to throw the maximum light in the directions desired. Fig. 23 shows such a globe, while Figs. 24 and 25 show, respectively, the vertical curve and the horizontal curve, taken in the plane of the horizontal.

We see that with a 32 candle power lamp we have increased the light up and down the street at the desired angles to 51 candle power, at the expense of the side light which has decreased to 22 candle power. It is evident that this principle can be carried out in the design of all kinds of globes where an uneven horizontal distribution is desired, such as for halls, corridors, etc.

The chief objection to such a globe for street lighting would be the effects of dust, so that it would probably be necessary to enclose it in some form of lantern. Attempts are being made, however, to design this globe with both inside and outside perfectly smooth, the prisms both diffusing and redirecting being

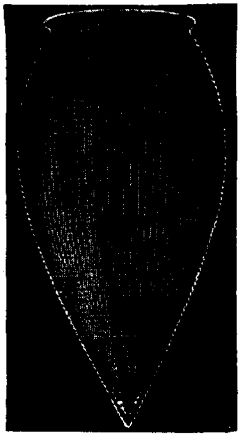


Fig. 23. — Globe for both Vertical and Horizontal Redistribution.

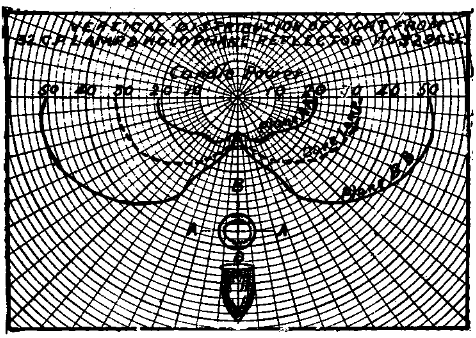


Fig. 24. — Vertical Distribution Curves of Fig. 23.

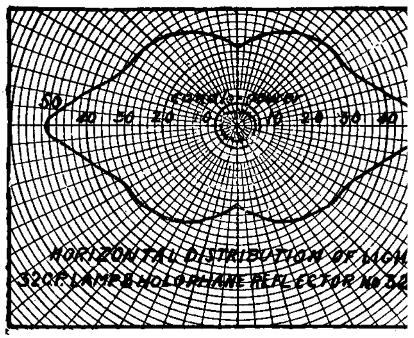


Fig. 25. — Horizontal Distribution Curve of

inside of the glass. If this can be done it will mark an important step in modern methods of street lighting.

PRISMATIC REFLECTORS.

The principles of the prismatic reflector are entirely different from those embodied in the globes. Generally speaking, the interior surface of such reflectors is perfectly smooth, while the outer surface consists of right-angled prisms designed totally to reflect the light. Fig. 26 shows the principles of the same.

It is evident from this figure that a ray A B will be doubly reflected from the right-angled prisms, but that rays D E and F G, which strike at right angles to the surface, will pass directly through the glass, so that a reflector will not appear totally dark but will allow enough light to pass through so as not to cast shadows on the ceiling. This effect alone, namely, of being able to make an efficient reflector without casting a shadow on the ceiling, marks a valuable step in advance over ordinary reflectors, but when combined with this it is possible to re-direct the rays of light in any directions desired by properly shaping the reflector and prisms, a most valuable adjunct is placed in the hands of the illuminating engineer.

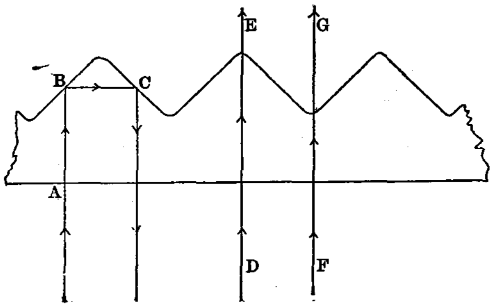


Fig. 26. — Showing Principle of Primatic Reflector.

Inasmuch as this portion of the prismatic system has advanced more rapidly than the older type, the matter will be gone into with considerable detail to explain the principles and applications.

Generally speaking, the reflectors are designed to throw the light in three directions similarly to the globes. Thus we have the concentrating (or C type), the distributing (or D type), and the bowl (or B type), the latter being designed so as to give approximately uniform illumination over an area whose diameter is twice the height of the lamp above the plane illuminated.

Fig. 27 shows a common form of concentrating reflector, showing also one form of holder. It is extremely important that the position of the reflector, with reference to the source of light, be exactly as was originally designed, otherwise entirely different results may be obtained. For this reason it is a good policy, in many cases, to put out special holders with the reflectors so as to bring the lamp in what might be termed the focus of the reflector.

As seen in Fig. 27 a reflector is made of perfectly clear, transparent glass, on the outside of which are a number of right angle prisms, the inside being perfectly smooth. These prisms are naturally larger at the top and smaller at the bottom. Where the prisms become so small near the top of the reflector as to lose their efficiency, and where also owing to the angle at which the rays of light strike that they would lose their efficiency as far as directly the light is concerned, advantage is taken of the principles of the prismatic globe proper, and a neck or collar is

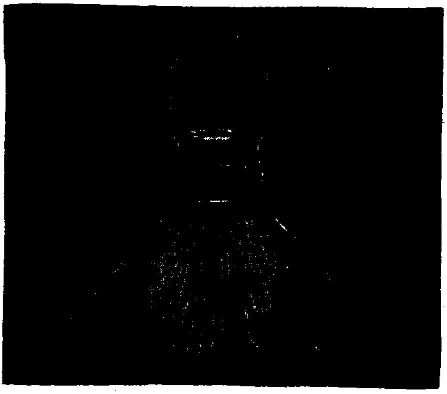


Fig. 27. – Typical Reflector and Holder.

formed in the glass, as illustrated in Fig. 28, having both internal and external prisms which allow the light to pass through the glass and from there throw it at a predetermined angle. In this way additional efficiency is obtained.

It is interesting to note the effect of dust on such reflectors. It is essential, of course, to keep the inside of the same clean, the same as with any reflector, which, however, owing to its perfectly smooth surface is an easy matter. The external surface naturally forms a place for dust to collect, but does not decrease its reflecting power as it simply cuts off some of the light which would otherwise pass through the reflector to the ceiling. This is due to the fact that the prisms act by total reflection, and that, inasmuch as each particle of dust is surrounded with a minute covering of air, the dust does not come in optical contact with the surface of the glass, so that we still have the difference in density between glass and air, the critical angle being unchanged. This applies only, of course, when dust does not come in optical contact with the glass. While such a reflector forms a better place for the collection of dust than a smooth opal reflector, its effect is less noticeable, and for this reason such reflectors are often used in very dusty places, rather than opal, owing to their superior looks when dirty. The fact that they can be easily cleaned with a brush by simply brushing in the direction of the prisms, makes it an easy matter to keep them clean. In case any substance actually comes in optical contact with the glass, we then have a change in the index of refraction and the amount of light reflected is more or less changed. This is true providing the source of light is so designed that the

Fig. 28. – Concentrating Reflector with Special Neck.

rays of light will strike the prisms correctly and that the prisms are total reflecting. If, on the other hand, a large reflector were used, taking say a cluster of four sixteen candle power lamps, and the reflector were originally designed for one large unit, the rays of light would no longer strike at the critical angle for which the reflector was originally designed and it might be possible considerably to increase the reflecting power of the reflector by enamelling or other processes as noted later in the diffusing type.

Another example of a similar change would be where the prisms were originally designed for 90 degrees, but after the reflector has left the mold it is flared out, thus destroying the accuracy of original design and allowing more light to pass through than formerly. In such cases increased efficiency may be obtained by properly coating the reflector.

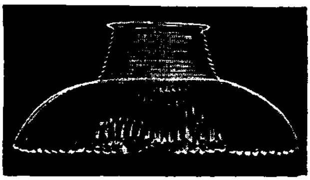


Fig. 29. — Shallow Concentrating Reflector.

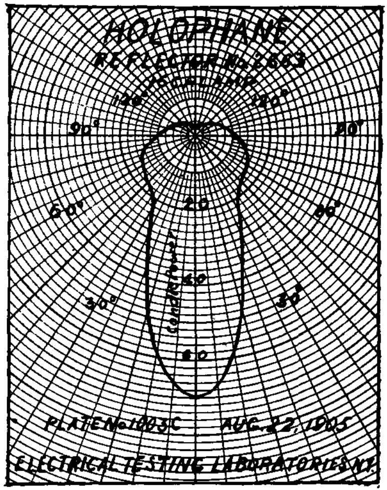


Fig. 30. — Curve of Fig. 29.

That it is practically impossible to tell off-hand what sort of distribution of light a reflector will give, attention is called to Figs. 29 to 32.

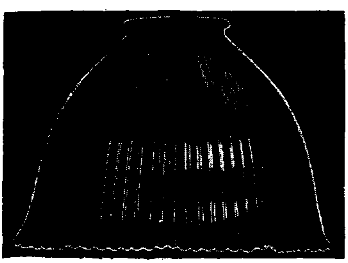


Fig. 31. — Wide Distributing Reflector.

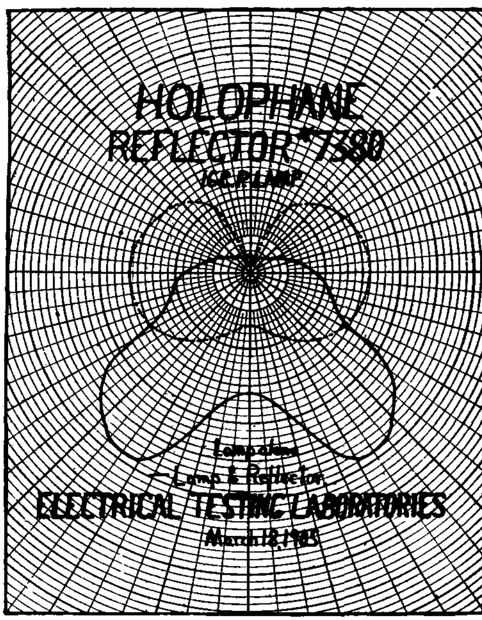


Fig. 32. — Curve of Fig. 31.

Fig. 29 shows a shallow type of reflector, which would ordinarily be supposed to give rather a broad distribution of light, while Fig. 31 shows a deep form of reflector, which would naturally be supposed to concentrate the light. As a matter of fact we have the exact opposite results, Fig. 30 showing the concentrated type of illumination received from the reflector shown in Fig. 29, and Fig. 32 showing the photometric curve of a very broad type of distribution from the reflector shown in Fig. 31. We thus see that unless one has a photometric curve of the reflector which it is desired to use, or else its equivalent, one is working absolutely in the dark. The selection of a reflector should always

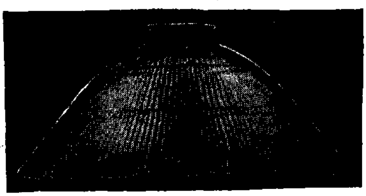


Fig. 33.
Concentrating Equal Prism Reflector.

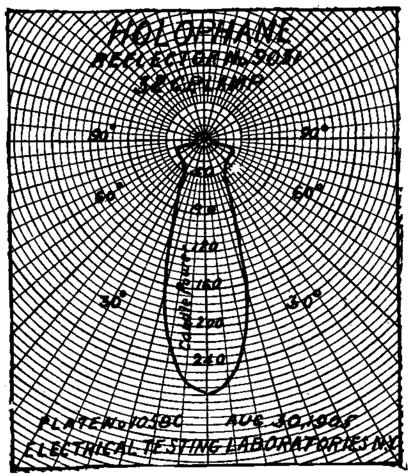


Fig. 34.
Curve of Fig. 33.

be governed not by the shape or looks, but by its photometric curve.

Figs. 33 and 34 show a reflector and its photometric curve, giving an extreme case of concentration, the reflector giving no less than 270 candle power directly downward from a 32 candle power lamp, as shown in Fig. 34.

It will be noticed in this case that there are apparently two horizontal ridges in this reflector. The explanation of this is as follows: In the case of a large reflector like this, if we start with a comparatively small prism at the bottom, by the time we reach the top of the reflector the prisms would be so fine as to be of little use. The surface of the reflector is, therefore, divided into three bands, the second having a smaller number of prisms than the first and the top having still fewer. By this means it is possible to keep the same size prisms throughout the entire surface of the reflector and thus materially increase its efficiency.

Figs. 35 and 36 show a wide distributing reflector and its photometric curve. This should be compared with the photometric curves shown in Figs. 32 and 34, and show very clearly how

Fig. 35. — Broad Distributing Reflector.

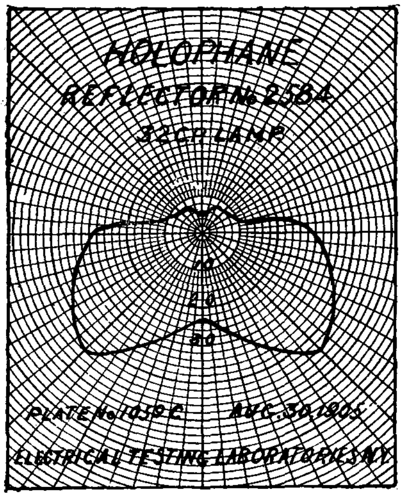


Fig. 36. — Curve of Fig. 35.

it is possible to get almost any desired distribution of light by proper design.

Figs. 37 and 38 show a large reflector designed for clusters of lamps and its photometric curve. On examining this photometric curve, it will be noticed that much more light passes upward through this reflector than with other photometric curves here shown, which is due to the cause already explained, namely, that the light from the lamps no longer strike in every case at

Fig. 37. — Large Reflector for Cluster of Lamps.

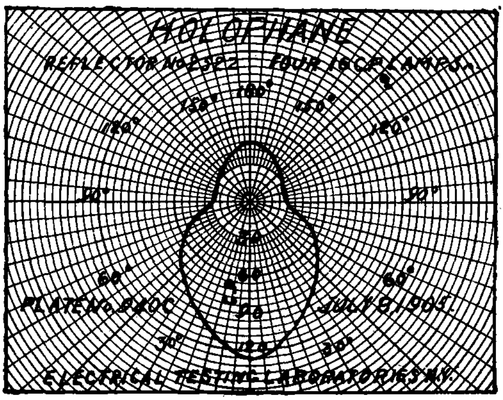


Fig. 37. — Curve of Fig. 37.

the correct angle, so that considerable of the light passes through the reflector. This is sometimes a distinct advantage where it is desired to get rid entirely of all shadows on the ceiling, and for this reason this cluster has been adopted instead of white porcelain in many important installations.

Fig. 39.
Side View of Horizontal Reflector.

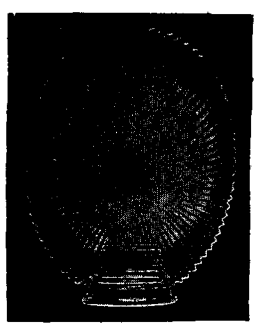


Fig. 40.
End View of Horizontal Reflector.

Figs. 39 and 40 show, respectively, side and end view of a reflector designed for lamps which are placed horizontally or in such a position that the side of the lamp must face the observer.

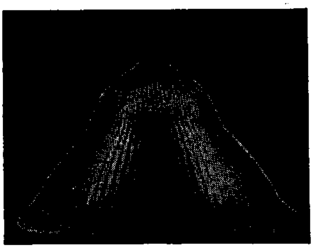


Fig. 41.
Reflector for Upright Lamps.

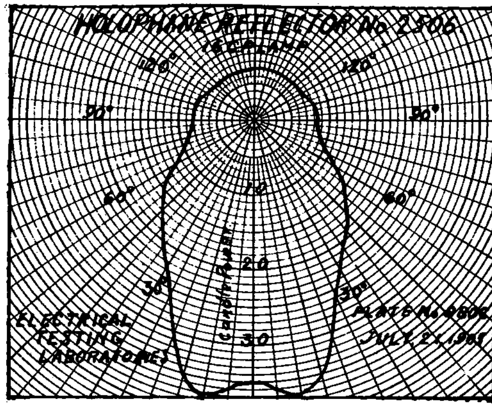


Fig. 42.
Curve of Fig. 41

Unfortunately the photometric curve of this reflector is not yet available.

Figs. 41 and 42 show a reflector and its photometric curve

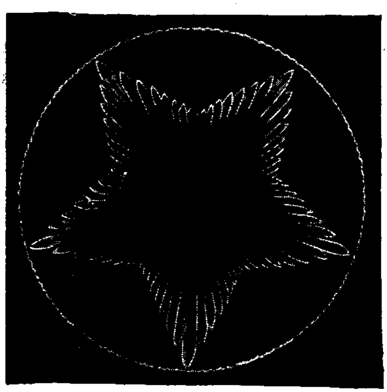


Fig. 43.
Side View of Ornamental Reflector.

Fig. 44.
End View of Ornamental Reflector.

adapted for use on upright lamps where it is desired to throw a strong light directly downward. This reflector rests on the lamp and is so shaped as to conform to the ordinary standard bulb, a small hole being left in the top to admit of the tip of the lamp. As seen by its photometric curve, it very materially increases the downward light.

Figs. 43 and 44 show a side and end view of a rather ornamental type of reflector, in which the star portion proper is composed of reflecting prisms while the surface outside is of plain

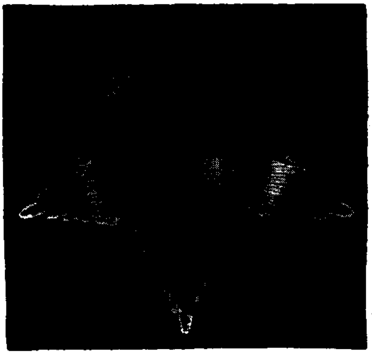


Fig. 45. — Star Reflector, End View.

Fig. 46. — Reflector for Inverted Gas Burner.

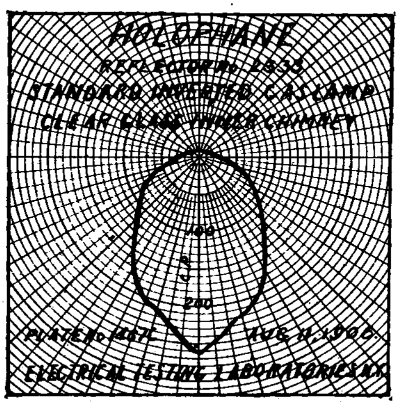


Fig. 47. — Curve of Fig. 46.

glass frosted, producing an ornamental yet effective reflector. Of course such a reflector is not as efficient as if the prisms were carried out to the edge of the reflector.

Fig. 45 shows another application of a reflector designed for decorative purposes which will combine both efficiency and artistic appearance. It is designed primarily for use with a small round frosted lamp.

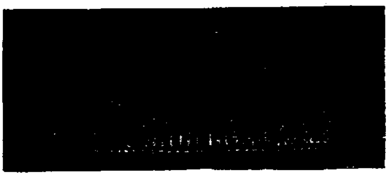


Fig. 48. — Desk Lighting Reflector.

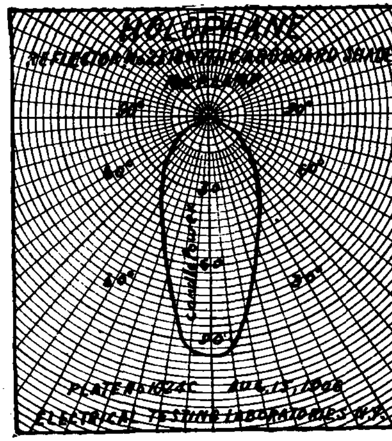


Fig. 49. — Curve of Fig. 48.

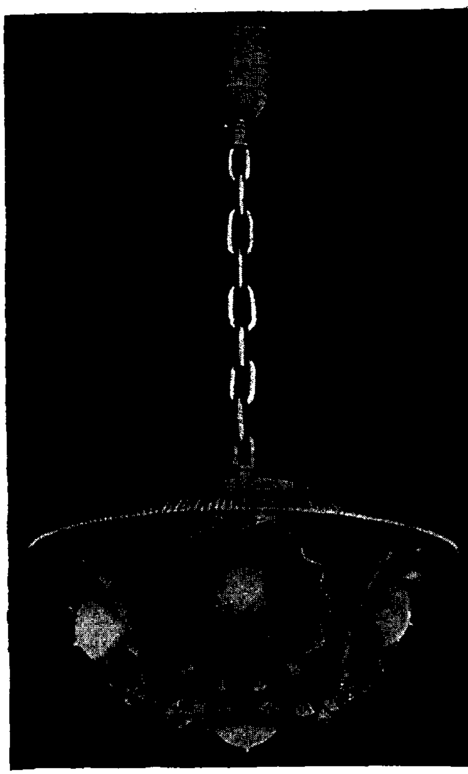


Fig. 50. — Reflecting Arc.

Fig 46 shows a type of reflector adapted for the inverted gas burner, and Fig. 47 shows its photometric curve.

Figs. 48 and 49 show a reflector and its photometric curve which is designed primarily for desk lighting. Inasmuch as in many cases even the small percentage of light which would shine through the reflector is objectionable when it strikes the eyes, this reflector is designed to be covered with either a card-board cover, white on the inside and dark green on the outside, or else with a thin green celluloid cover which allows a little of the light to shine through, making a pleasing contrast to the reflected light.

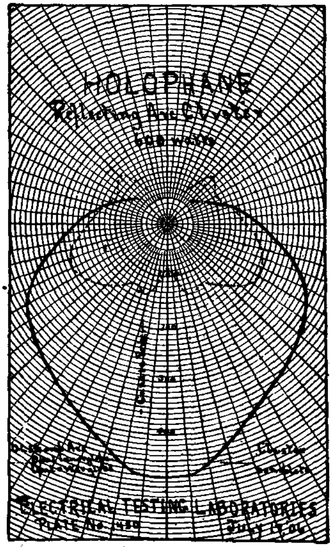


Fig. 51. — Direct Current Arc with Opal Inner and Opal Outer

Fig. 50 shows an application of prismatic reflectors in the design of a cluster for 40 candle power 100 watt lamps, and the three photometric curves shown in Figs. 51, 52 and 53 make an interesting comparison with an arc lamp, consuming the same amount of energy, equipped however with different forms of glassware.

The foregoing reflectors were designed primarily for standard forms of lamps. Several years ago, however, there appeared on the market two light distributing units which were designed to give certain distributions of light. Originally, the first form was designed to obtain an even illumination over a certain definite area. This was achieved by using a filament of a certain size and shape in a definite position in a round bulb, the upper part which was of clear glass covered with a metallic reflector of such shape as would, when the incandescent coil within was in proper relationship, throw the light back through the opposite side of the bulb. This distribution of light, however, was obtained with a marked shortening of the life of the lamp, so that for this metal reflector, there was substituted a prismatic reflector which would

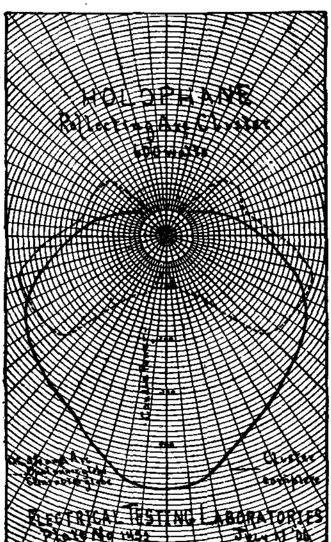


Fig. 52. — Direct Current Arc with Opal Inner and Clear Outer.

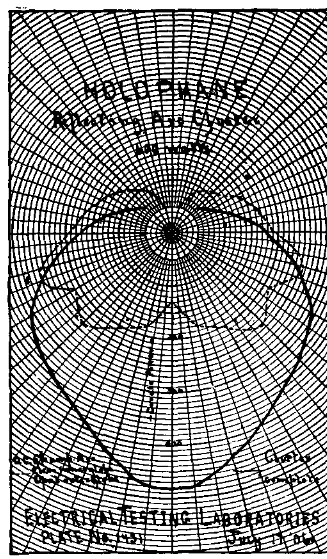


Fig. 53. — Direct Current Arc with Clear Inner and Opal Outer.

give the same light distribution allowing, however, the light rays to pass through the top of the bulb out sideways rather than back through the bulb.

Fig. 54 shows the original style of prismatic reflector designed for this type of lamp, and Fig. 55 its distribution curve.

Figs. 56 and 57 show the latest type of reflector designed for this lamp and its distribution curve. It will be noted that the latest form of reflector gives a considerabl wider and better distribution than formerly.

This was the beginning of the design of a number of special reflectors made especially to fit different lamps which have since been placed on the market. In all of these the position of the reflector and the filament of the lamp have been carefully consid-

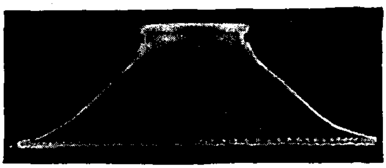


Fig. 54.
Reflector for Meridian Lamp, Old Style

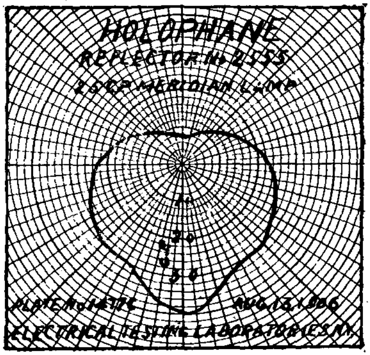


Fig. 55.
Curve of Fig. 54.

ered and the result has been that it is now possible with such a unit to obtain different distributions of light as desired.

When dealing with high candle power lamps, it became necessary to cut down as much as possible the size of the reflector, as

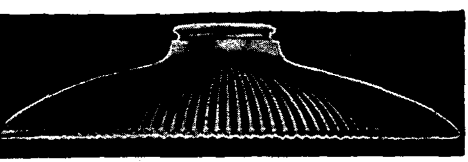


Fig. 56. — Reflector for Meridian Lamp, New Style.

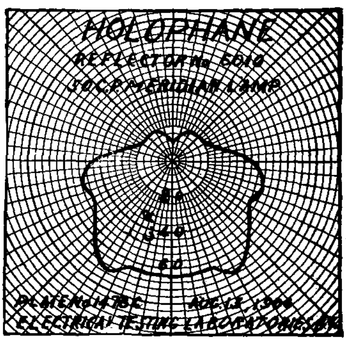


Fig. 57. — Curve of Fig. 56.

this rapidly increased in weight and cost. In order to do this, the main part of the reflector is made to start very slightly above the top of the filament, this body part being connected with the ordinary holder by a tall, narrow glass collar which is part of the reflector. Owing to the shape of the collar part being necessarily steep, it ceases to have any reflecting value, and therefore is designed to be a light transmitting part, the light being allowed

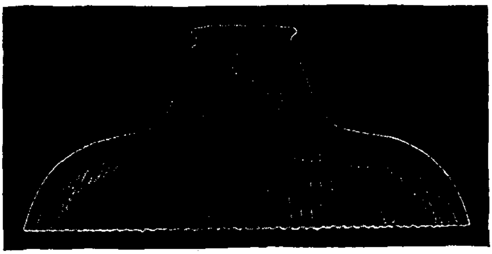


Fig. 58. — Concentrating Reflector for "Gem" Lamp.

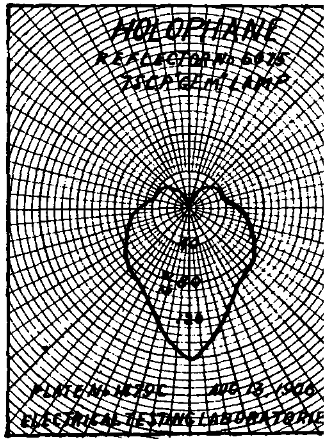


Fig. 59. — Curve of Fig. 58.

to pass through and reflected from prisms on the outside.

Fig. 58 shows such a reflector of the "C" or concentrating type, and Fig. 59 its distribution curve.

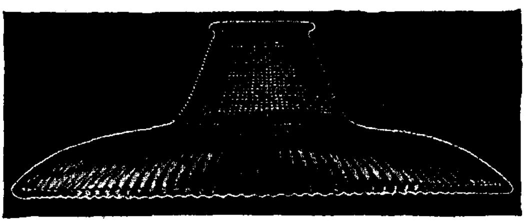


Fig. 60. — Distributing Reflector for "Gem" Lamp.

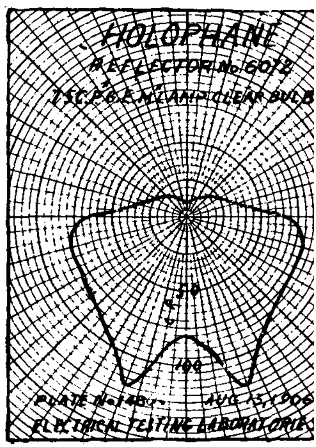


Fig. 61. — Curve of Fig. 60.

Fig. 60 shows a "D" or distributing type of reflector for a similar lamp, and Fig. 61 its curve.

Fig. 62 shows a bowl or "B" type of reflector, and Fig. 63 its distribution curve.

It will be noted in the case of this latter curve that it is pos-

Fig. 62.
erted Bowl Reflector for "Gem" Lamp.

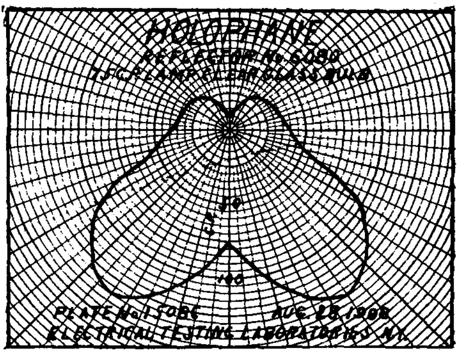


Fig. 63.
Curve of Fig. 62.

sible to obtain a deep reflector completely hiding the bare filament of the lamp and still getting a broad distribution of light, so that such a unit placed ten feet above the floor will light the same practically uniformly throughout a diameter of twenty feet.

Fig. 64.
Concentrating Reflector with Tantalum Lamp.

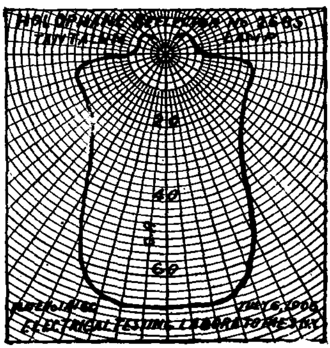


Fig. 65.
Curve of Fig. 64.

Figs. 64 and 66 show the concentrating and distributing types of reflectors for 22 candle power tantalum lamps, and Figs. 65 and 67 show respectively their distribution curves. It will be noticed that although the two reflectors look very similar indeed, the distribution curves are entirely different, showing again the necessity of selecting the unit from its photometric curve rather than from its appearance.

In addition to these reflectors for special purposes described here, it might be mentioned that reflectors are now being designed for Nernst, tungsten and other forms of lamps, inasmuch as the principles here enunciated can be applied to practically any source of light.

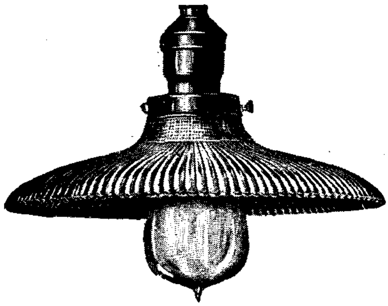


Fig. 66.
Distributing Reflector with Tantalum Lamp.

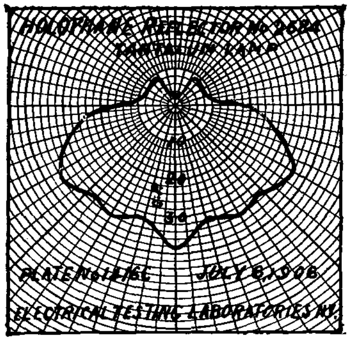


Fig. 67.
Curve of Fig. 66.

ENAMELED REFLECTOR.

This type of prismatic reflector consists of the regular style of clear prismatic reflector which, however, is enamelled with a thin coat of white enamel which cuts down materially the intrinsic brilliancy of the light which passes through the reflector, so that when hung in the field of vision, the result is much softer and easier on the eyes than the standard form of prismatic reflector. The further result of such enamelling is to broaden out the distribution curve so that such reflectors can be used to light large areas advantageously, especially where lamps are apt to hang low or in the field of vision.

Still another type of reflector is one in which the interior surface of a clear prismatic reflector is sand blasted so that the light which passes through is very much softened, although not so much as in the case of the preceding type. This also has a tendency to broaden out the distribution curve. Its disadvantage is that the frosted interior surface when dirty has to be cleaned, which is more difficult than with the other type.

Another type lately devised is one in which a special white milk glass of high reflecting quality is used, the interior surface of which is depolished, the result being a brilliant white but matte surface, absolutely devoid of any glitter or shine whatever, so that no matter how intense the source of light placed under such a reflector, none of the dazzling qualities are reflected back by the inside surface. Moreover, the light which passes through is extremely soft and easy on the eyes.

In addition to these new forms of reflectors, I would mention the fact that reflectors are now being designed for street lighting which will throw the maximum light up and down the street, cutting off to a large extent the light thrown to the sides, and at the same time throwing the maximum light at the critical angles for street lighting, namely, from the horizontal to fifteen degrees below, so that we may hope when the experiments with such types of reflectors are brought to a satisfactory conclusion, that we can obtain nearly double the efficiency in the lighting of our streets that it is possible to obtain to-day.