P. C. HEWITT.

DIFFUSING CONTAINER FOR INCANDESCENT LIGHTS.

APPLICATION FILED JULY 20, 1911.

1,036,527. Patented Aug. 20, 1912.

Fig. 1

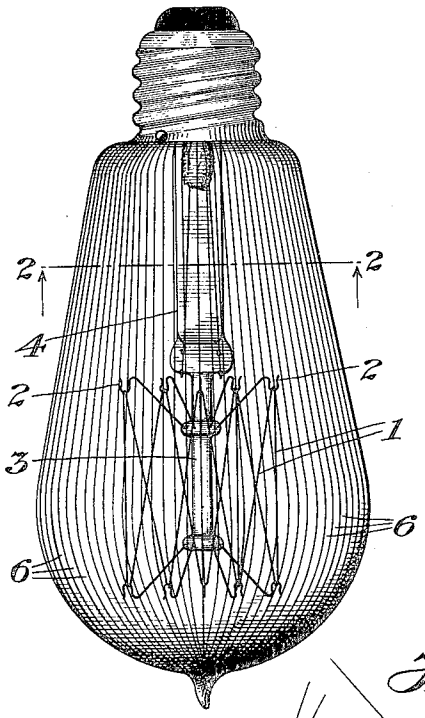


Fig. 2

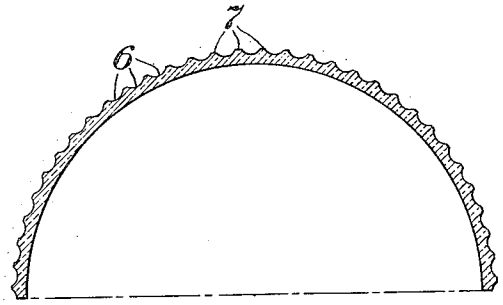
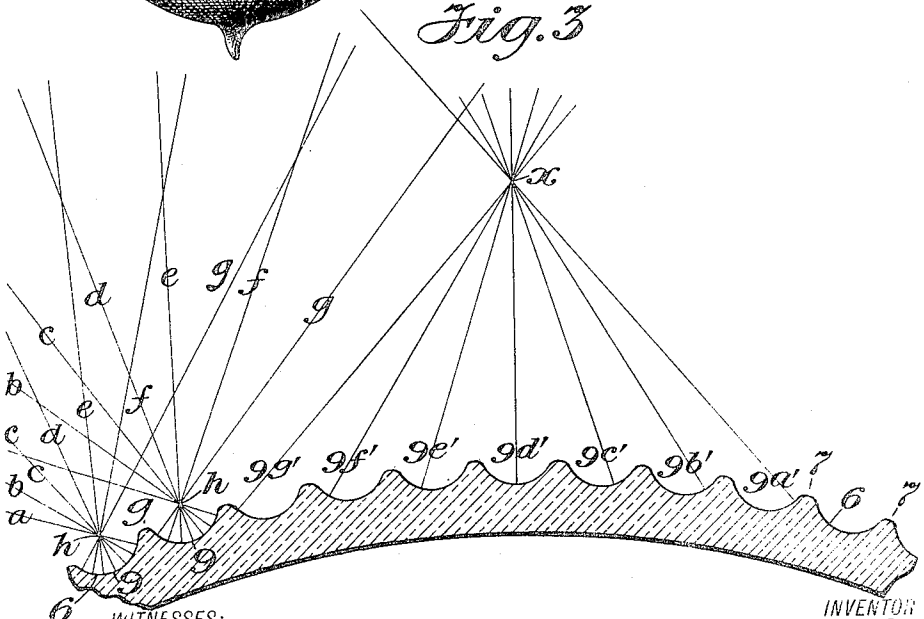


Fig. 3



WITNESSES:

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DIFFUSING-CONTAINER FOR INCANDESCENT LIGHTS.

1,036,527. Specification of Letters Patent. Patented Aug. 20, 1912.

Original application filed April 8, 1911, Serial No. 619,733. Divided and this application filed July 20, 1911. Serial No. 639,652.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and resident of Ringwood Manor, in the county of Passaic and State of New Jersey, have invented certain new and useful Improvements in Diffusing-Containers for Incandescent Lights, of which the following is a specification.

An object of this invention is to produce improved means for diffusing light from a linear source, such, for example, as an incandescent filament or glower.

In the ordinary incandescent lamp, the light emitted from the incandescent filament passes through the transparent wall of the vacuum container which is usually a blown glass bulb, without being appreciably deflected, since the inner and outer surfaces of the container are usually polished and parallel to each other.

My present invention contemplates shaping the external surface of the vacuum or the other container surrounding the light emitting filament so that the light emitted from the filament will be diffused in many directions and from a plurality of points or lines located on the external surface of the container; so that the apparent source of light is the external surface of the container or is diffused from a plurality of points or lines located on the external surface of the container. To this end I fashion all or a considerable portion of the surface of the container with a multiplicity of minute, closely spaced, but distinct, well defined elevations and depressions, preferably narrow grooves forming ridges constituting refractors or lens-forming surfaces, the refractors being formed so that rays from the source are separately scattered from a multiplicity of grooves, and blend in the field of illumination to cause the linear source to have the optical appearance of a widened band or transverse-continuous surface of light, the width of which is practically independent of the diameter of the filament but is dependent upon the number of effectively contributing grooves. The lens-forming surfaces or refracting elements are preferably narrow, for optical reasons, and also for the purpose of producing the desired refracting angles or surfaces on a container having thin walls. A large number of the elongated refracting elements are employed, so that they cover all or a determined portion of the surface of the container. There is no restriction as to the elongation of the refracting elements and in practice, the series of narrow grooves and ridges, may extend from one end to the other of the lamp bulb and are approximately uniform in cross section, uniformity, however, not being essential in carrying out my invention.

In the illustrated embodiment of my invention, I have provided a series of substantially parallel grooves which are formed on the external face of the vacuum container of an ordinary tungsten incandescent lamp. For the maximum diffusing effect, the grooves extend approximately parallel to the light emitting filament of the lamp, the glass wall of the treated portion of the container being in effect thereby formed into a plurality of linear concave and convex lenses or lens-like bodies which extend parallel to the longitudinal axis of the vacuum container.

One part of my invention which is extremely important both from a commercial and manufacturing standpoint, concerns the application of my invention to thin blown glass vacuum bulbs of incandescent lamps such as are now sold on the market, by minutely fashioning the surface of the lamp by chemical or abrasive action, preferably by hydrofluoric acid in desired form or condition or dilution or admixture, and, at the same time, preserving the surface practically smooth. I have discovered that it is possible on commercially thin bulbs to produce an efficient, and, at the same time, highly ornamental light-diffusing effect by causing light deflection or refraction by means of substantially smooth refractors of high light-transmitting efficiency. This I have been able to accomplish by making grooves narrow enough and close enough so that with a depth not exceeding that which is permissible and safe for such bulbs, the refracting surfaces will nevertheless be steep-sided enough and sharp enough to have the desired wide angle light-deflecting effect. The minuteness of width is chiefly controlled by practical optical conditions and the thickness of the wall of the bulb, and it is obvious that the smaller the depressions the less material will have to be removed and the neater may be the effect.

The etching by the acid may be conducted in such a manner as to leave the surfaces of the depressions and elevations substantially polished or of a vitreous or polished nature. The smooth surfaces of the grooves or ridges may be further polished if desired since the grooves or ridges extend in practically parallel directions. They do not materially lessen the transparency of the glass and do not have the relatively low emissive efficiency of frosted glass surfaces in which there are internal losses due to dirt reflection and refraction, and other losses due to dirt accumulation which cannot be easily removed.

With my invention, the diffusion of the light is accomplished almost entirely by refraction through the polished surfaces of the linear refracting elements and there is but little, if any, additional obstruction to the passage of light over that ordinarily encountered in a plain, unscreened, transparent container in which the inner and outer surfaces of the walls of the container are parallel to each other. The light transmitted from a linear filament through a container embodying my invention is subdivided and the image of the filament is so spread out laterally that it ceases to appear to be an incandescent filament but appears more like a wide band of light much less intense per unit of area than the incandescent filament.

In the drawings accompanying, and forming a part of this application, Figure 1 is an elevation of an ordinary tungsten incandescent lamp of commerce, embodying my invention. Fig. 2 is a fragmental sectional view along the line 2—2 of Fig. 1, and Fig. 3 is a fragmental cross section of a glass container illustrating diagrammatically the convergence and divergence of rays emanating from a single lens-forming surface or refracting element and the convergence of rays emanating from a plurality of such surfaces or elements located on the same container.

In Fig. 1, I have illustrated a well-known form of lamp provided with a linear source of light. The lamp illustrated, as has been said, is an ordinary commercial form of the tungsten incandescent lamp, and is provided with a light emitting filament suspended in zig-zag lengths 1, 1 by arms 2, 2 extending from an axially arranged insulated support 3, carried by standard 4, which contains leading-in wires connecting with the filament. The filament is inclosed within a highly evacuated glass bulb or envelop 5. The filaments of the lamp may be of any known or desired construction and may be composed of carbon, tungsten or tantalum or similar materials which become incandescent when subjected to electric current. In the lamp shown, the filament comprises portions which extend in the same general direction as the major or longitudinal axis of the bulb and consequently I provide ridges and grooves in the external surface of the bulb 5, which extend lengthwise of the bulb and constitute the refracting surfaces 6, 6.

The shape of the grooves and ridges constituting the refracting elements 6, 6, should be such as to facilitate light emission and substantially prevent losses by internal reflections. In practice the grooves need not be of a very great angle and may be relatively shallow as compared with their width. The refracting elements should also be so shaped and located that the filament or object, or both the filament and the object will be out of focus and it is therefore not essential that the refracting elements should be so formed as to have either a point or definite line of focal origin. These grooves, are preferably formed by coating the outer surface of the bulb 5 with a thin skin of wax or asphaltum, or some similar acid resisting material, then scratching through the wax, for the purpose of exposing the surface of the glass along lines of suitable width, and then immersing the bulb in hydrofluoric acid or submitting it to the action of hydrofluoric acid gas. The proper results may be obtained by subjecting the bulb to the action of the acid for about ten minutes. In an ordinary 25 watt tungsten lamp, the lines along which the bulb is etched, may be from 1/100 to 1/250 of an inch from center to center, according to the size and shape of the bulb, the thickness of the wall and the permissible depth to which it may be etched. With care, the lines may be spaced closer or farther apart than this, and may be smaller or larger in cross section. The size of the grooves may be determined by practical, rather than theoretical reasons, but the smaller cross section is advisable in practice. In the bulb illustrated, I have so formed the grooves, that the light emitting surface of each refracting element is concave and is curved so that its curved surface represents about 1/3 of the surface of a cylinder.

It will be understood that various methods may be employed in forming the refracting elements on the surface of the bulb, some of which will possibly form truer curved surfaces and more accurately spaced grooves, but in practice, it is not necessary to provide absolutely accurately formed nor accurately spaced refracting elements and the method described of etching the grooves is both cheap and practical. In the bulb illustrated, the concave grooves are separated one from the other by rounded ridges, 7, 7. The edges of the ridges are rounded by the action of the acid in forming the grooves. These ridges may vary in width to from

1/10 to 1/4 of the width of the grooves without affecting the optical effect of the concave light scattering surfaces of the bulb.

One distinct species of my invention, which is of great commercial value, involves the use of grooves, so narrow and so closely spaced, that when viewed from the ordinary distances of a few feet, the images produced by the individual refracting elements appear to blend in one practically uniform band of light. When this arrangement is applied to the ordinary commercial tungsten lamp above referred to, the superposed or over-lapping effect of the multiplicity of filament lengths each thus widens out, as to produce upon the eye of the observer the effect of an approximately uniform blaze of light emitted from the surface of the bulb over a wide area which may include a large portion of a surface of the bulb on the side toward the observer. The above referred to practically desirable form of lamp, has the ordinary thin light bulb, which is particularly desirable and commercially almost indispensable for a lamp to be sold in the open market. The grooves of the desired width, say less than 1/100 of an inch, very closely spaced, or if desired, separated by distances not greater than 1/10 of the width of a groove, may be formed on the exterior walls of the bulb after it is blown into shape by carefully etching to a depth preferably not greater than 1/3 the thickness of the thin wall of the bulb. The etching being by chemical reaction, avoids danger of producing or developing incipient fractures or internal stresses such as might render the bulb too fragile for commercial transportation and use.

It will be seen that the above specific embodiment of my invention involves three concurrent factors of great advantage in connection with the thin walled bulbs of commerce. First: The formation of the grooves by a chemical process, eliminates all danger of incipient fractures, which might result from molding. Second: By making the grooves narrow and closely spaced, their depth need not exceed 1/3 the thickness of the wall of the ordinary commercial bulb. Third: This same narrowness, shallowness and closeness in spacing, may be utilized to give the functional advantage of causing the optical effect of an approximately uniform blaze of light, originating over the entire or a large portion of the surface of the bulb. The above factors all have a special relation to the intensity of light produced by high efficiency, multiple length metallic filament lamps of the modern type, in so much as the uniform blaze of light which may be thus caused to originate with the apparent uniformity from practically all of the available surface of the bulb, is quite as intense as is agreeable when viewed directly by the human eye. The result from a consumer's view point is a tungsten or similar lamp with a bulb having the same or even less weight than the commercial bulb, together with all other advantages of current consumption economy and light producing efficiency.

In Fig. 3, I have shown diagrammatically the general effect of the elongated concave refracting surfaces or lenses 6, 6 upon the rays of light emitted from them. The portion of the bulb illustrated, is greatly enlarged and the grooves are more accurately formed and spaced than is necessary in actual practice. Each refracting element scatters the rays emitted by it, through a wide zone, as shown at 9, 9 in Fig. 3. Rays emitted from one of the grooves 6, 6 will be projected along straight lines, such, for example, as the lines a, b, c, d, e, f and g, which as shown, first converge and meet at a more or less well defined focal point, h, and then diverge through a wide angle, a, h, g and the amount of light emitted from one refracting element and received at any point such as a, b, c, d, e, f, or g will be diminished proportionately to the wideness of the angle. While each single groove 6, scatters the light transmitted through it, in the manner described, it will be apparent that each of the multiplicity of adjacent parallel grooves 6 will also emit light in a similar manner and that some of the rays from each adjacent groove on the same side of the bulb, will converge with the rays from other grooves as shown, for example, at x in Fig. 3. The grooves located at $9^{a\prime}$, $9^{b\prime}$, $9^{c\prime}$, $9^{d\prime}$, $9^{e\prime}$, $9^{f\prime}$, and $9^{g\prime}$, being each similar to the lens-forming surfaces located at 9, 9, will each emit rays which converge and then are scattered through a wide angle, as roughly indicated at 9, 9, but each such surface will emit rays which travel toward the point x along straight lines so that the object or the eye of an observer located at x receives light from a large number of secondary sources, each of which is dimmer than the original source, the incandescent filament, but the effect is that the total amount of light received at any point will roughly correspond to the amount which would have been received at that point directly from the intense source projecting rays through a transparent medium with plain, polished and parallel interior and exterior surfaces. It will be obvious that by distributing the apparent sources of light around the exterior of the bulb, globe or container, the same amount of light is delivered by the lamp or filament to the various objects but the contrasts are less marked, the light being more evenly distributed, and the effect is to produce the appearance of a uniform wide blaze of light,

much more grateful to the eyes than light direct from a filament.

The present application is a division of my co-pending application 619,733 filed April 8, 1911.

I claim—

1. A lamp comprising a linear source of light and a container therefor, said container being provided on its exterior surface with a multiplicity of shallow etched grooves having rounded edges and set relatively close together, whereby the individual images produced by each separate groove blend to produce the optical effect of a substantially uniform wide blaze of light.

2. A lamp comprising a linear source of light and a container therefor, said container having a multiplicity of parallel adjacent grooves, less than 1/100 of an inch in width, etched on its exterior surface in relatively close arrangement, whereby the individual images produced by the separate grooves blend to produce the optical effect of a substantially uniform wide blaze of light.

3. A lamp, comprising a linear source of light and an exhausted container therefor, provided on its external surface with a multiplicity of narrow, approximately parallel, shallow, groove-like, linear markings, which extend in the same general direction as the linear source of light and are closely spaced, whereby a multiplicity of the individual images of the source produced by each groove-like marking produce the optical effect of a substantially uniform wide blaze of light.

4. A lamp, comprising a linear source of light and a blown container bulb therefor, having one surface plain and the other surface provided with a multiplicity of narrow, relatively shallow etched grooves, which extend in the same general direction as the linear source of light.

5. A lamp, comprising a linear source of light, and a container bulb therefor, having one surface plain and the other surface provided with a multiplicity of approximately parallel, narrow, closely spaced grooves, which extend in the same general direction as the linear source of light, whereby the individual images of the linear source produced by the separate grooves, blend to produce the optical effect of a substantially uniform, wide blaze of light.

6. As an article of manufacture, a high efficiency metallic filament incandescent lamp, having the filament disposed mainly in lengths extending in the general direction of the length of the lamp and protected by an evacuated blown bulb of commercial thinness of wall, said bulb having a plain interior surface and having etched on the exterior surface thereof, a multiplicity of narrow, shallow, concave, adjacent, practically transparent grooves, the depth of said grooves being less than half the thickness of the wall of the bulb, whereby the individual images of the linear source of light produced by each groove blend and produce the optical effect of a substantially uniform wide blaze of light.

7. An incandescent lamp, comprising a linear source of light in combination with a blown glass container bulb, having a plain interior surface and an exterior surface, having a multiplicity of narrow, approximately parallel adjacent grooves etched thereon and extending in the same general direction as the linear source of light.

8. An incandescent lamp, comprising a linear source of light in combination with a blown glass container bulb for said source, having a plain interior surface and an exterior surface etched to form a multiplicity of shallow, narrow, concave, adjacent grooves with intervening convex curved ridges extending in the same general direction as the source of light and affording curved refracting surfaces.

9. An incandescent lamp, comprising a linear source of light in combination with an exhausted glass container, having a plain interior surface and provided on its exterior surface with a plurality of adjacent, elongated refracting grooves with substantially smooth surfaces, extending in the same general direction as the linear source of light and formed and spaced not more than one-fiftieth of an inch from center to center.

10. An incandescent lamp, comprising a linear source of light in combination with an exhausted glass container, having a plain interior surface and an exterior surface provided with a multiplicity of alternately arranged, narrow, elongated, concave and convex refracting surfaces of a polished nature, the concavities being not more than one-fiftieth of an inch from center to center.

11. An incandescent lamp, comprising a light emitting filament, in combination with a blown container bulb for the filament, having thin glass walls, a plain interior surface, and an exterior surface provided with a multiplicity of grooves, etched by means of hydrofluoric acid and extending in the same general direction as the filament.

12. An incandescent lamp comprising a light emitting filament, in combination with a blown container bulb for the filament, having thin glass walls, a plain interior surface, and an exterior surface provided with a multiplicity of grooves, etched by means of hydrofluoric acid and extending in the same general direction as the filament, the depth of the grooves being not greater than approximately one-third of the thickness of the glass walls.

13. A lamp, comprising a linear source of light and an exhausted container therefor,

provided on its external surface with a multiplicity of narrow, approximately parallel, shallow, groove-like, closely-spaced linear markings, having practically smooth surfaces and extending in the same general direction as the linear source of light, whereby the individual images of the source produced by each said groove-like marking, unite to produce the optical effect of a practically uniform wide blaze of light.

14. A lamp comprising a linear source of light and a container therefor, said container being provided on its exterior surface with a multiplicity of minute grooves set relatively close together, whereby rays received from the source are separately scattered laterally by a multiplicity of refracting surfaces and blend in the field of illumination to cause the linear source to have the optical appearance of a widened band or transversely continuous surface of light, the width of which is practically independent of the width of the source but is dependent upon the number of effectively contributing grooves.

15. An electric lamp comprising a filament and a glass container, a surface of the container being formed with a multiplicity of elongated refracting surfaces or lenses of a width less than the thickness of the wall of the container and all extending in the same general direction with each other and with the major portion of said filament.

16. In an incandescent electric lamp, a linear source of light, in combination with an evacuated inclosing bulb having at least a portion of its wall formed with a multiplicity of refractors comprising long narrow practically transparent, refracting surfaces, said refractors being formed so that the light received by each is refracted and emitted from the outer surface of each in a multiplicity of directions diverging laterally with respect to the linear source, so that diminished divergent rays from a multiplicity of said linear refractors will converge toward a multiplicity of points in the same field of illumination, the number of refractors emitting light toward the same given points in the field being in the aggregate approximately proportional to the light scattering power of the respective refractors, and the narrowness and spacing of said refractors being such as to constitute said bulb wall a diffusing medium emitting light from a wide zone distributed laterally with respect to the general direction of the linear source.

17. An incandescent filament electric lamp having a blown bulb of commercial thinness, having a smooth interior surface and having formed on its exterior surface a multiplicity of minute closely-spaced depressions and elevations having substantially smooth surfaces, the distances between the tops of adjacent elevations being so proportioned to the permissible depth of the depressions as to produce the degree of steep-sidedness necessary for effective light deflection.

Signed at New York city in the county of New York, and State of New York, this 18th day of July A. D. 1911.

PETER COOPER HEWITT.

Witnesses:
L. A. COLEMAN,
R. A. HEWITT.