P. C. HEWITT.

METHOD OF MAKING REFRACTING AND DIFFUSING CONTAINERS FOR INCANDESCENT LIGHTS.

APPLICATION FILED JUNE 17, 1914.

1,177,326.

Patented Mar. 28, 1916.

Fig. 1

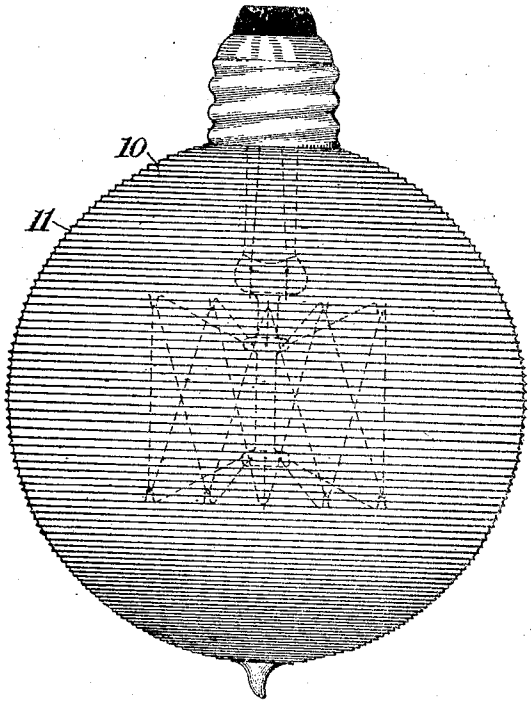


Fig. 2

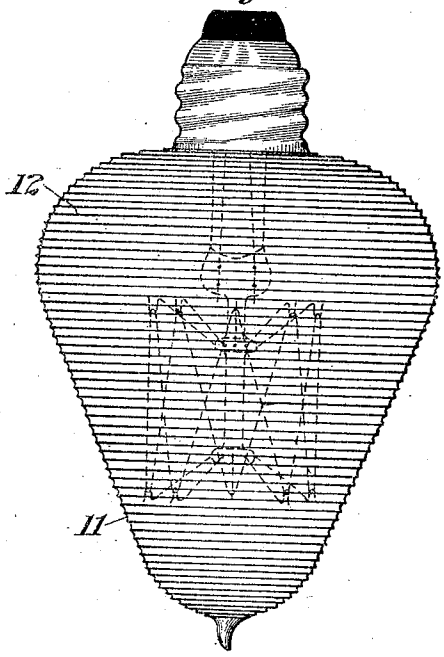


Fig. 3

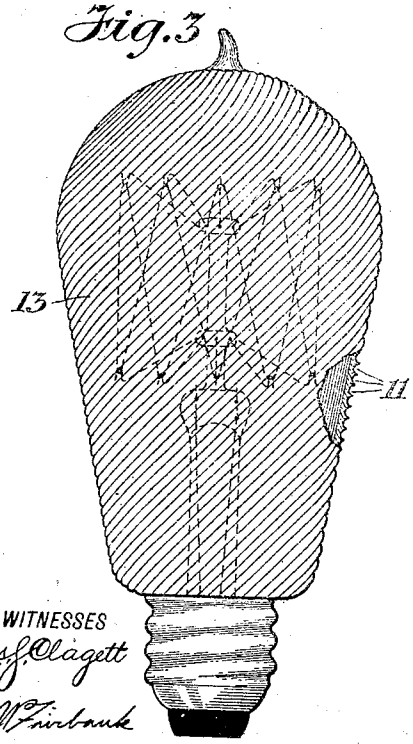
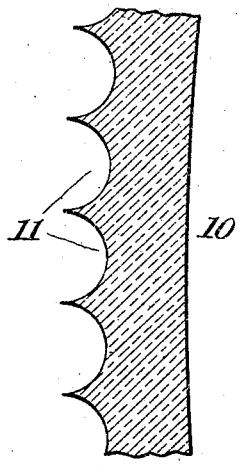


Fig. 4



WITNESSES

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METHOD OF MAKING REFRACTING AND DIFFUSING CONTAINERS FOR INCANDESCENT LIGHTS.

1,177,326. Specification of Letters Patent. Patented Mar. 28, 1916.

Application filed June 17, 1914. Serial No. 845,720.

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 Methods of Making Refracting and Diffusing Containers for Incandescent Lights, of which the following is a specification.

My invention is especially applicable for use in treating an incandescent lamp bulb so as to provide means for changing the direction of the light rays therefrom to permit the better illumination of objects in a desired direction from the lamps, and to secure by diffusion a softening of the light.

In my prior application, Serial No. 619,733, filed April 8, 1911, and my prior Patent No. 1,036,527 issued August 20, 1912, I have disclosed and claimed an invention of mine particularly applicable to the ordinary commercial tungsten filament and other incandescent lamps. In the preferred embodiment I disclose the use of etched groove-like markings on the bulb so narrow and so closely spaced that when viewed from ordinary distances, rays from any given length of filament, separately scattered laterally by each of a multiplicity of the groove-like markings, blend in the field of illumination, and cause said length of filament to have the optical appearance of a widened band, or transversely continuous surface of light, the width of which is practically independent of the diameter of the filament, but is dependent upon the shape, angle and spacing of the effectively contributing groove-like markings.

By arranging the markings at an angle to the general direction of the filaments and by properly proportioning the steepsidedness and close spacing of the grooves to the angle of the projected length of the grooves with the projected length of the filament, the ridges will act as refractors to direct the light to points deficient in luminosity. At the same time, the filament lengths are each apparently widened out so as to produce upon the eye of the observer, the effect of a single substantially continuous flame or cloud of light inside of the container, or the effect of a continuous light-giving surface, or both, although the distribution of light in the various parts of said flame cloud or surface may vary in intensity. The appearance thus given of a single continuous blaze of light emitted through a wide area may include the whole or a large portion of the surface of the bulb and the luminous cloud may appear as though filling the whole or a large part of the interior of the globe. The refraction may be in the direction desired. A softening of the intrinsic brilliancy of the source and a decreasing of the intensity, without loss of light, is thus secured not only by the lateral widening effect of the filament, but also by the directing of a portion of the light from what was otherwise the zone of maximum illumination to the dark spots or zones which in ordinary lamps are formed adjacent the projected longitudinal axis of the filaments and lamp.

I have discovered that by making the grooves sufficiently steep-sided and correspondingly closely spaced, the grooves may, in practice, be arranged diagonally or, owing to the curvature of the bulb and irregularity of the filament lengths, even at right angles to the general direction or common axis about which the lengths of filament are arranged. Even though a considerable portion of some one filament may appear ineffectively widened from certain view points, nevertheless, if the grooves are sufficiently steep-sided and sufficiently closely spaced, a large proportion of the total zig-zag filamentary lengths will be at such angles as to be effectively widened and productive of a practically continuous surface of light. This is attainable through practically polished groove-like markings closely spaced and arranged at right angles to the axis of the lamp, and hence not more than, say 10° to 25° from right angles to the projected length of some portions of some of the lengths of filament. The slight irregularities in cross sectional formation and lateral spacing of the grooves due to inaccuracies of the ruling or action of the acid, contribute to this same result. By the term "polished," I mean transparent in contradistinction to frosted or opaque. In other words, a surface in which there is no material loss of light by absorption or complete reflection.

My present invention involves a method which I have discovered whereby grooves may be etched with the required degree of precision and steep-sidedness necessary to secure extreme deflecting action which is required where the purpose is to deflect light

into a dark zone lying in the axis of the lamp. This required consideration of minute causes and effects to secure results not necessary in a case where the grooves and ridges are arranged approximately parallel with the axis of the lamp and with the filaments and the purpose is merely to deflect the light sufficiently to effect the desired widening of the light from each filament without attempting to deflect it out of the equatorial zone. By this, I do not mean that my present invention cannot be employed for making grooves parallel to the axis. It can be used for making grooves extending in any direction and on any suitable surface and for various other purposes than light refracting, but its greatest utility, so far as I am at present aware, is in the production of lamps of the character herein described.

In order to get approximately semi-circular grooves sufficiently near tangent to give sharp ridges with knife-like or cold-chisel edges affording the maximum lateral deflection required for the special purposes of my present invention, I have discovered that the grooving of the initial protective coating must be extremely regular and that the width of the exposed surface of the glass at the bottom of the groove should be small as compared with the distance between the grooves even in the cases where the total distance is only 1/100th inch or less. By pressing these grooves with an edge rather than attempting to plane them out with a chisel-like point, the width of the whole surface or 1/100th of an inch spacing may be approximately 1/5th of that distance or say 2/1000th of an inch. This expedient results in starting the action of the acid along the relatively thin line or axis so that if the corrosion is uniform the resulting groove should be a semicircle. I have further discovered that the action of the acid in eroding the glass in all directions from such an axial line results in causing an outwardly expanding mechanical forcing by the confined products of the reaction. This results in progressively pushing outward the overhanging edges of the wax and success in maintaining the desired semicircular or equal radius erosion of the glass requires that the coating be of such material and so applied that only the free or overhanging portion will bend or break outward under the expansive force of the reaction, and while the adhesion of the remaining portion of the coating to the original glass surface will remain so perfect that no fresh exterior surface of the glass will be exposed to the even action of the acid, the purpose and the result being that all erosion progresses uniformly from the original exposed line as an axis. In practice the acid may eat slightly more rapidly along a line directly opposite and lying at the bottom of the groove, but in general and within limits the result will be tangent semicircles with very sharp edges.

By employing my improved process and by employing the relative arrangement of grooves and filaments herein described, a large portion of the light from an incandescent lamp supported overhead with substantially vertical filaments may be directed downwardly, and at the same time may be softened by a very effective lateral component of the light-refracting effects of the grooves. By arranging the markings with each having a material component at right angles to the general direction of the filament, most of the light rays from any point on the source will be refracted so that they diverge in a plane at right angles to the groove-like markings or ridges on the surface of the container. If these extend around the container in a general direction at right angles to the series of filaments, the light may be given a strong downward component, such component depending on the steep sidedness of the refractors and the angle the interior surface makes with the filament, and made to shed light on the normal dark spots of the bulb.

If the bulb or other container be spherical or otherwise formed with equal portions of the vertical filament or other source of light above and below the plane of the maximum diameter of the container, and the defractors or prism-like bodies formed by the markings encircle the source of light either in concentric circles or concentric helixes, there will be a directive action due to the angle of the inner surface to the filament, toward both ends of the container, and the light rays emitted will be divided into two portions which will be refracted away from each other upon opposite sides of the plane of maximum diameter of the bulb. Thus objects at each end of the bulb or other container will be illuminated to a higher degree than they would were the surface plane.

It is not essential that the grooves be absolutely uniform as slight irregularities in the width, shape and depth of the grooves may be present without materially modifying the directive action of the prisms, and it may even add to the diffusing action. Furthermore, the shape of successive grooves may be intentionally varied so that the grooves adjacent to the ends of the bulbs may be of different refractive power than those opposite the center of the filament. Thus successive grooves or markings may be varied to secure a more effective distributing or directing action. Although the most effective directing action will be produced when the grooves lie in planes at right angles to the linear source of light, yet a very

effective and highly desirable directing action toward the ends of the bulb may be produced with the prisms disposed helically around the bulb. Under certain circumstances, it may be desirable to have the lines or markings running in different directions and different angles on different parts of the container, so as to accentuate or modify the directive action.

By etching the grooves extremely narrow, I am able to secure the desired steepsidedness without cutting the grooves to an objectionable depth. The narrower the grooves, the shallower may they be with the same steepsidedness, and the less will the wall of the bulb be weakened by the removal of material. Furthermore, the narrower and shallower the grooves, the less material will have to be removed and the quicker may the etching.

In the accompanying drawings, forming a part of this application, Figure 1 is a side elevation of an incandescent lamp of substantially spherical form and having the groove-like markings extending around the lamp substantially at right angles to the axis thereof; Fig. 2 is a side elevation of a lamp having the filaments disposed entirely at one side of the transverse plane of maximum diameter and marked similarly to the form shown in Fig. 1; and Fig. 3 is a side elevation of the ordinary pear-shaped incandescent light, having the markings helically disposed and with the major portion of the separate filamentary lengths below the plane of maximum diameter; and Fig. 4 is a section transversely of the grooves and on a greater enlarged scale.

In carrying out my invention, I preferably utilize the ordinary commercial incandescent electric lamp, but it is not limited to any particular form or type of construction. In the drawings, I have illustrated in Fig. 1, a lamp having a substantially spherical body of blown glass and of commercial thinness. Within the bulb is supported the light-emitting filament, which may be arranged in zig zag form and supported upon arms as in the ordinary tungsten lamp of commerce, or may be supported as in the ordinary carbon filament lamp. The form and arrangement of the filament does not involve any feature of my invention, except in so far as the relative positioning and direction of the filamentary lengths and the light-deflecting grooves or markings on the surface are concerned. The lamps illustrated have the filaments extending in the same general direction as the major or longitudinal axis of the bulb.

Upon the outer surface of the bulb, I provide minute ridges or grooves 11, which extend in the direction having a material component at right angles to the projected lengths of the filaments. These grooves or ridges are very minute and are closely spaced, and their sides are of such steepness as to give a material light-directing action at an angle to the general direction of the grooves. These grooves or ridges are preferably formed by coating the outer surface of the bulb with a fine skin of wax, asphaltum, or other similar acid-resisting material, and then cuting or scratching through the wax for the purpose of exposing the surface of the glass along lines properly spaced and of suitable width. The bulb may then be immersed in hydrofluoric acid, and in desired form, condition, dilution or admixture, for the proper length of time, or in place of hydrofluoric acid solution, the bulb may be exposed to hydrofluoric gas. Upon subjecting the bulb to the action of the chemical for the proper length of time and then cleaning off the remaining wax, the operation will be completed.

I make the grooving of the initial protective coating extremely regular and the width of the exposed surface of the glass at the bottom of the groove small as compared with the distance between the grooves even in the cases where the total distance is only 1/100th inch or less. By pressing these grooves with an edge rather than attempting to plane them out with a chisel-like point, the width of the exposed surface for 1/100th of an inch spacing may be approximately 1/5th of that distance or say 2/1000th of an inch. Thus the action of the acid starts along the relatively thin line or axis so that if the corrosion is uniform the resulting groove should be a semi-circle. The action of the acid in eroding the glass in all directions from such an axial line results in causing an outwardly expanding mechanical forcing by the confined products of the reaction. This results in progressively pushing outward the overhanging edges of the wax and success in maintaining the desired semicircular or equal-radius erosion of the glass requires that the coating be of such material and so applied that only the free or overhanging portion will bend or break outward under the expansive force of the reaction, and while the adhesion of the remaining portion of the coating to the original glass surface will remain so perfect that no fresh exterior surface of the glass will be exposed to the even action of the acid, the purpose and the result being that all erosion progresses uniformly from the original exposed line as an axis. In practice the acid may eat slightly more rapidly along a line directly opposite the line of exposed surface of glass and lying at the bottom of the groove, but in general and within limits the result will be tangent semicircles with very sharp edges.

I have discovered that the desired perfection of adhesion of the protective coating

and the desired narrowness of the grooves, and the desired approximation of perfect semicircular erosion may be attained on a commercial tungsten vacuum bulb lamp, as follows: I first dissolve 100 grams of Standard Oil 300° oxidized asphalt in 500 cublic centimeters of chloroform. I then dip the lamp in this solution, and upon removing it, heat to about 180° centigrade for a few minutes to cause the asphalt to adhere firmly to the glass. I then rule the asphalt with a tool making lines —1/100 of an inch apart. Etch with 48% commercial hydrofluoric acid slightly diluted and having added to it 20 cubic centimeters of hydrocholoric acid to the pound of commercial hydrofluoric acid, being about 4%. The etching is then continued from five to fifteen minutes depending on the temperature and freshness of the acid. I then wash carefully and dry. Grooves formed in this manner have knife-like or cold-chiseled edges as distinguished from the rounded edges disclosed in my prior patent above referred to. As previously explained, this is largely due to the fact that the adhesive coating does not chip off during the etching and that the etching progresses inwardly and laterally upon opposite sides of the ridges but cannot act upon the top of the ridge.

The grooves may be made as large as 1/30th of an inch or even larger, and as small as 1/250th of an inch or smaller, from center to center depending on the use designed for and practical reasons of economy and manufacture, and the steep sidedness may be varied dependent upon the permissible depth to which the glass may be etched, the degree of directing action which it is desired to secure, and the extent to which the projected lengths of the grooves and filaments approach the right-angular position. The action of the acid is so controlled that the surfaces of the grooves are substantially smooth or polished, so that there is practically none of the loss which occurs in the ordinary frosted bulb.

With the filaments extending in the same general direction as the major or longitudinal axis of the bulb, I may form the markings around the bulb at substantially right angles to the longitudinal axis, as is shown in Figs. 1 and 2. The small ridges of glass between adjacent grooves act as prisms and refract the light rays laterally from the outer angle or edge of the prism. Thus, each light ray in traveling outwardly at right angles to the filament will be bent toward either one end or the other of the bulb. With the bulb substantially spherical, as shown in Fig. 1, and with the filaments positioned opposite to the major diameter of the bulb, there will be an equal light-defecting action toward both ends of the bulb.

If it is desired to secure a larger light-directing action toward one end than toward the other, for instance, on a bulb which is to be supported overhead and illuminate objects beneath it, I may apply my process to a bulb 12 substantially conical in form, as shown in Fig. 2, and position the filaments entirely on one side of the plane of the major diameter. Thus, all of the bulb wall directly opposite to the filaments will be inclined toward an apex and a larger portion of the light rays traveling outwardly at right angles to the filaments will be directed in the general direction of the apex of the bulb than will be directed toward the flatter end or base.

Substantially the same results may be secured by employing a bulb 13 of the ordinary commercial form, as shown in Fig. 3. In this case, the major portion of the bulb walls are inclined inwardly toward the socket instead of toward the tip as in Fig. 2. In this form, I have illustrated the groove-like markings arranged helically, so that the angle between the grooves and the projected lengths of the filaments will be not quite as great as in the annular arrangement of markings shown in Figs. 1 and 2. The inclination or pitch of the grooves may be varied at will, but the greater the angle between the projected length of grooves and filaments, the greater will be the directing action in the general direction of the lengths of the filaments.

A variation in the angular arrangement of grooves and filaments may be counteracted by a variation in the steep sidedness of the grooves. As the filaments are ordinarily arranged in zig zag or other inclined positions in the bulb, it is evident that even with the grooves encircling the bulb in planes at right angles to the major axis, few, if any, of the grooves and projected lengths of filaments will be exactly at right angles, and thus by making the grooves with sufficient steep sidedness, the rays from any given length of filament will be separately scattered laterally by each of a multiplicity of groove-like markings and will blend in the field of illumination. Each length of filament will have not only the optical appearance of a widened band or transversely-continuous surface of light, but each of said bands may appear elongated substantially to the tip of the bulb, and the bulb when viewed from the end may present a substantially uniform field of illumination closely approximating the illumination at the sides of the bulb. If the filaments be arranged in some other form than in the general direction of the length of the bulb, it is evident that the direction of the groove-like markings may be correspondingly varied to secure the like results, and with other forms of light be modified accordingly.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. The herein described method of producing a light refracting surface which consists in coating a glass surface with an adhesive compound, ruling through said coating a series of substantially parallel narrow lines, and etching grooves in said surface along said lines, said grooves being materially wider than said lines in said coating, and the etching being continued until said grooves approximately meet beneath the portions of coating between said lines.

2. The herein described method which consists in etching depressions in a glass surface through apertures in a protecting coating, said apertures being narrower than the depressions to be formed, and the thickness character and adhesiveness of said coating being such that portions projecting over the formed depressions break away without exposing fresh surfaces of the glass.

3. The herein described process which consists in coating a glass surface with a thin adhesive layer, ruling through said layer a series of closely-spaced narrow lines, and etching grooves in the glass through said lines, the etching being continued until, said grooves approximately meet to leave knife edges there between.

4. The herein described process which consists in coating a glass surface with a thin adhesive layer, ruling through said layer a series of closely-spaced narrow lines, and etching semi-circular grooves in the glass through said lines and of greater width than said lines, the etching being continued until said grooves approximately meet to leave knife edges there between, and the said adhesive layer being of such thickness, composition, and adhesiveness, as to break away upon the continuing of the etching process beneath the layer, but without exposing additional glass surface.

5. The herein described process which consists in applying a thin adhesive coating to the outer surface of a glass electric light bulb of the incandescent type, ruling through said coating a series of closely spaced, narrow lines encircling the source of light and approximately at right angles to the major axis of said bulb, and etching grooves in the glass through said lines, the etching being continued until adjacent groves approximately meet to leave narrow ridges therebetween.

Signed at New York city in the county of New York and State of New York this 26th day of May, A. D. 1914.

PETER COOPER HEWITT.

Witnesses:

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C. W. FAIRBANK.