CERAMIC STREET LAMP REFLECTOR

By DAVID WELCH

REDESIGN CONSIDERATIONS

ONE type of product which offers excellent possibilities for redesigning in ceramics is the opaque light reflector usually made from porcelain-enameled steel. If ceramics are to be substituted for metal, an application must be found where the reflector is not subjected to sudden shocks and continued handling. The street lamp reflector suggests itself as a logical application, partly because glass refractors have long been used in this type of lighting without excessive breakage, and partly because a great deal of attention was being given to black-out lighting restrictions when this problem was first considered. It was interesting to observe in a number of blacked-out areas where the light sources had been partially covered and the degree of illumination materially reduced, that actual visibility seemed to have improved. This observation suggests that a reflector designed to replace the existing residential street lighting unit and to comply with black-out regulations might even give better lighting conditions than before. In addition to functional improvements in the reflector itself, the initial cost and maintenance cost must compare favorably with those of existing competitive reflectors to insure a good postwar market.

Before the actual design work was started considerable research was done on the general subject of street and highway illumination to get a broader view and a better understanding of the problems involved. A number of sources listed in the "Industrial Arts Index" and the "Reader's Guide" were investigated. General Electric and Westinghouse publications, bulletins on black-out lighting, catalogues, and the "Patent Gazette" all provided interesting information on the subject. Finally the Society of Illuminating Engineers and the Los Angeles Bureau of Power and Light were consulted. With the general aspects of street lighting investigated, the next step was to collect data on residential street lighting. A brief investigation showed that very little advancement had been made in this particular branch of public lighting. The Pasadena Light and Power Department supplied information concerning the local potential market for this type of reflector and prices on competitive reflectors.

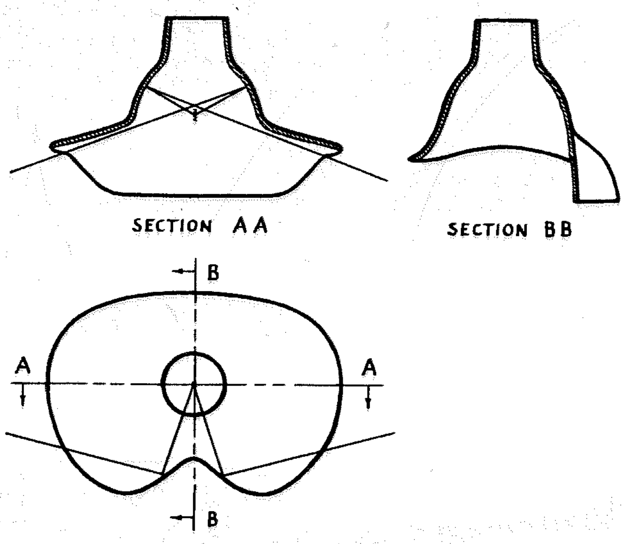

FIG. 1—Ray diagram illustrating the redirection of light to areas of weakest illumination.

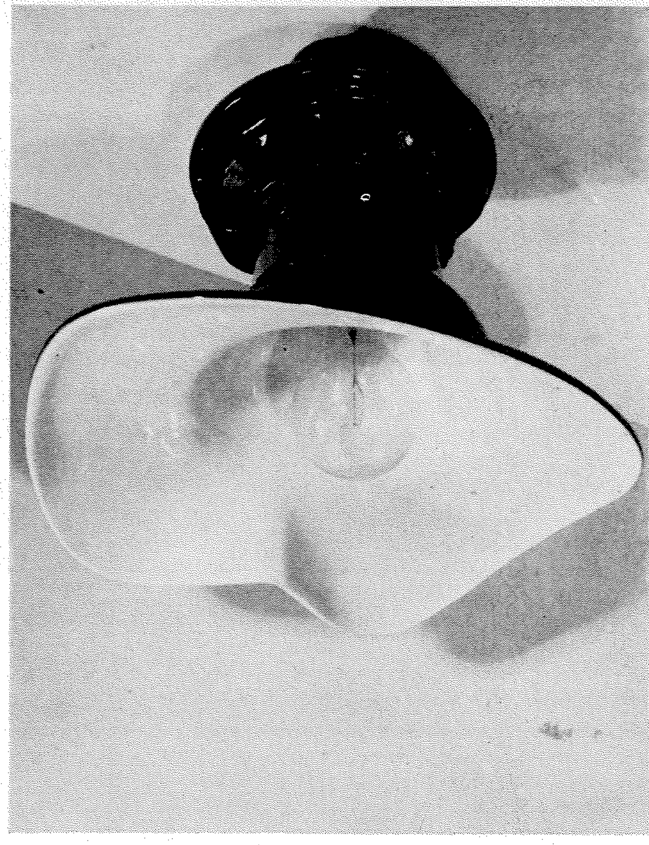

FIG. 2—Ceramic street light reflector.

The design of any new ceramic product requires that the designer have a working knowledge of the material and various processes used in the production of ceramic ware. Glazed ceramics present certain advantages as a material for light reflectors, such as excellent light-reflecting characteristics, resistance to weathering, and cheapness. On the other hand the low shock resistance of ceramics is a disadvantage.

A study of specific conditions affecting visibility along lighted thoroughfares, considering both the driver of a moving vehicle and the pedestrian, has shown that the elimination of intensely bright spots and the production of a more uniform distribution of light are the most important aspects to be considered in improving the visibility. In the past the degree or intensity of illumination has been determined for the most part by economic factors. Recommended intensity levels for better visibility under fixed conditions have been raised as lamp efficiencies have increased and the cost of electric power decreased. Exposed light sources or other bright spots are most detrimental to good visibility because they offer such a powerful contrast to dimly lighted surrounding objects that perception in the vicinity becomes very difficult. By eliminating these bright spots the visibility can be greatly increased at even lower levels of illumination. Data on present residential street-lighting practice were obtained through the assistance of the Bureau of Light and Power and samples of standard lamps, sockets, adapter bases and reflectors were secured.

LIGHT DISTRIBUTION

The radial wave reflectors used in the past have been designed to distribute light in a circular pattern. The reflector bowl tends to concentrate the rays in a small area below the reflector, instead of redirecting them up and down the thoroughfare, and there is no provision made for shielding house windows from direct rays. The lamp bulbs themselves are exposed to varying degrees, depending on the size of bulb and type of reflector. This presents a series of bright spots down the thoroughfare which counteracts some of the benefits gained through better illumination by offering such intense contrast with the surroundings that actual visibility is decreased. Emphasis in the design of the radial wave reflector seems to have been placed on obtaining an apparently efficient illumination curve with little consideration of visibility or of uniformly distributing the light up and down the street.

This analysis has led to several obvious improvements which should be incorporated into a new design. The light ordinarily directed downward by the bowl of the reflector and that ordinarily passing into house windows directly behind the lamp should be redirected up and down the road. The cut-off angles on the reflector should cut off direct rays from the filament at a greater angle with the horizontal and a backdrop should be provided to redirect those rays which would ordinarily shine into adjacent house windows. The preliminary designing was begun at this stage with the general objective of redirecting upward rays from the lamp filament and rays which would ordinarily shine into windows of adjacent houses out to areas where the illumination is weakest.

THE DESIGN

Rough sketches were made through various sections of the reflector to help develop the general form. A clay model was then made as an aid in visualizing the transitions between sections and the form as a whole. As a rough approximation of the reflector the model was now considered in relation to the manufacturing process. A slip casting in a one piece mold with a small amount of hand finishing was the obvious method for producing the reflector. As the reflector consisted of two halves which were mirror images of each other and whose axial plane was perpendicular to the thoroughfare, an accurate model had to be made and production molds taken off this.

With the general form of the reflector determined, a full scale drawing was next made, showing several sections through the center. First a full-scale section drawing was made of the standard base adapter into which the neck of the reflector must fit. Then the removable lamp socket and lamp were drawn in position and the position of the filament carefully located. The neck of the reflector was designed to fit the standard clamp adapters in the base and to distribute the stress over as large an area as possible. The neck of the reflector was tapered out from the base to the bowl of the reflector so as to provide sufficient clearance around the bulb for the tongs used by repair men in replacing bulbs. The shape of the reflecting surfaces was determined graphically, using the center of the filament as the light source. The bowl of the reflector was designed as illustrated in *Fig. No. 1*, to redirect the upward rays to areas between adjacent lamps on the street where the light intensity is weakest, instead of directing these rays straight down. The backdrop and aprons were developed in a similar manner with the same objective of redirecting as much light as possible to distant points, again illustrated in *Fig. No. 1.* Additional means of more efficiently distributing the light, such as by louvres in the neck of the reflector and a reflecting surface directly under the bulb, were considered, but eliminated because of production costs and difficulties in servicing.

PRODUCTION AND TRIAL

The working drawings were submitted to a manufacturer of ceramic products and discussed in regard to production and costs. Materials and glazes were suggested and slight revisions were made on the neck of the reflector to eliminate as much hand trimming as possible. A drawing was next made to shrink scale for the mold shop. From this drawing a plaster model was made and then a one piece mold was cast around the model. In the finished mold the first piece was slip cast. A pottery body was used, because of its low cost and relatively high shock resistance. After trimming and drying, the piece was fired and glazed. Clear glaze was used on the reflecting surfaces and green glaze to match the adapter was used on the outside. The reflection characteristics of the less expensive clear glaze over the light cream pottery body compared so favorably with a white glaze that it was finally selected for the inside surface.

The finished reflector was mounted in a standard base adapter, provided with a standard bulb, and given a check test in the photometric laboratory. Distribution curves showed too great a concentration of rays directly below the reflector, dictating a slight modification of the reflecting surfaces. The suggested revisions were sent to the mold shop, where the original model was altered to the new specifications. A new mold was cast around the revised model and several reflectors were cast. These were fired, glazed, and tested again. A sample unit was installed by the Pasadena Light and Power Department (see *Fig. No. 2*). Initial tests have indicated a great improvement in the general light distribution and visibility in the vicinity of the reflector as compared with that of comparable standard reflectors now in use.

C. I. T. NEWS

A CAMPUS TALE

By R. W. SORENSEN

THREE inducements caused me to answer, way back in 1910, a request from Cal Tech, then Throop Polytechnic Institute, that I consider joining its staff as the Electrical Engineering faculty. These were Dr. George E. Hale, as a member of the Board of Trustees, Dr. James A. B. Scherer, as President of the Institute, and the declared college policy of making the humanities, as they are taught at C.I.T., a large part of the entire four-year undergraduate curricula. Reminiscences concerning these arguments were brought to the fore a short time ago, when during some of my east coast rovings, I had dinner with a group of Cal Tech alumni in Washington, D.C. The group was small and the meeting took on the nature of an old-acquaintance get-together for a few of the many C.I.T. graduates who are now in Washington. Each one who partook of the excellent steak dinner was stimulated to the point of contributing some tale relating to the good old days when he was a student on the campus at 1201 East California Street. When my turn came, I told the tale of how Cal Tech got James A. B. Scherer for its president. Those present seemed keenly interested so I venture to tell the same tale to all alumni who read these pages, hoping that at least those who were students and knew Dr. Scherer during his presidency will find the tale as interesting as did those who heard it at our Washington meeting.

My first knowledge of Throop and Dr. Scherer was obtained when I considered joining the faculty being formed at the time Throop Hall, the first building on the present campus, was opened. Naturally, not knowing Dr. Scherer, I endeavored to learn something of his biography and discovered immediately that before going to Pasadena he had been president of Newbury College in