Theater Engineering Conference

Lighting

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Lighting Ideas Offering New Opportunities in the Theater*

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Summary—Long the leaders in prompt utilization of advanced resources of the lighting art, motion picture theaters yielded this place as a result of wartime restrictions and early postwar conditions. Many now find themselves in marked need of rehabilitation in this respect.

Some of the newer forms of light sources produced during the war and since, offer ways to expand the techniques of lighting. New materials and old ones in new forms are becoming available for modernizing the theater. Combinations of these sources and materials increase the scope of lighting treatments available to serve the special purposes of the motion picture exhibitor.

In this paper, the authors present some of the new types of lighting elements and suggest applications to marquee, lobby, foyer, standee space, and public rooms.

MOTION PICTURE THEATER operators and their designers long set the pace in the use of light for gaining attention and for creating atmosphere, mood, and distinction. They were motivated to a large extent by keen competition and by the very nature of a mass-recreational business. However, in the past few years, crowded houses were the rule, and less need was felt for quickly applying every new resource of the art. To be sure, restrictions on new building and modernization programs limited the opportunity to apply new techniques. But, by contrast in the field of retail merchandising, where competition is keen and growing keener, merchants, architects, and designers have been making rapid strides in finding ways to apply the newer forms of light sources for more profitable store operation. As their conditions change the theater people will step to the front again, giving attention to the many houses that need modernizing and to new projects.

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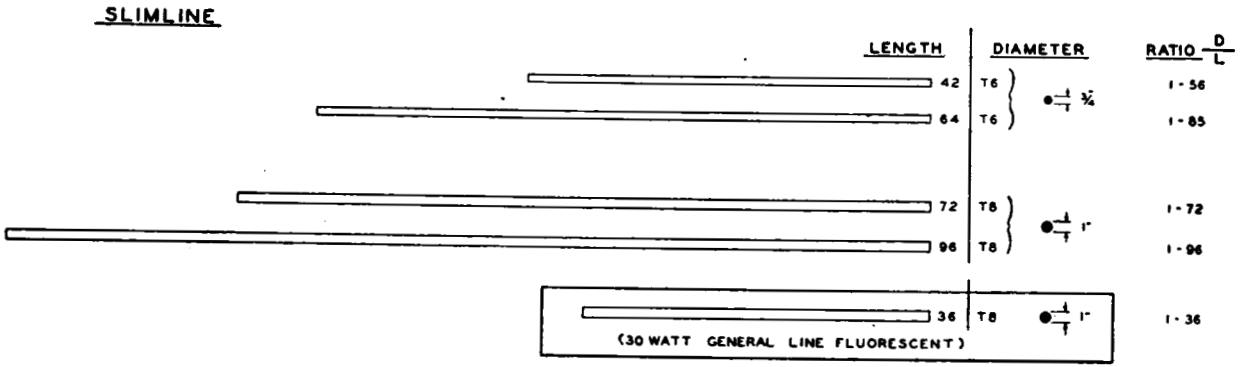


Fig. 1—Lengths and diameters of fluorescent lamps.

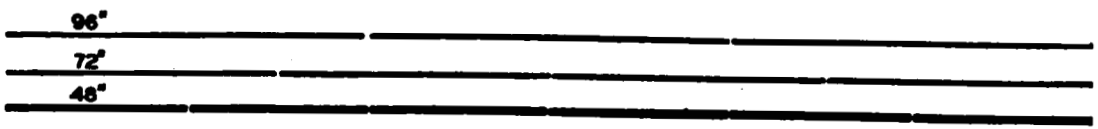


Fig. 4—Long lamps give fewer socket interruptions in continuous rows.

What are some of the new sources and materials of illumination and how are they to be used in the theater?

SLIMLINE FLUORESCENT LAMPS

The Slimline fluorescent lamp is rapidly entering the field of store, restaurant, and display lighting because it combines several new lamp

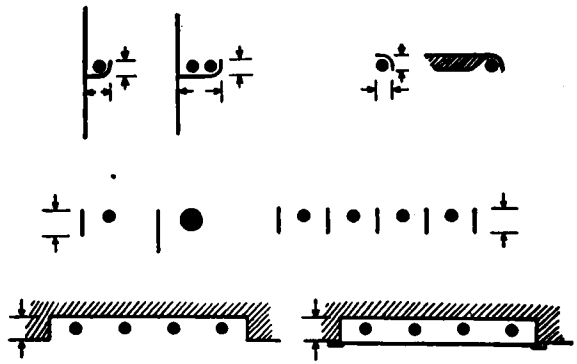


Fig. 2—Small-diameter lamps make possible small cross sections for coves, narrow bands, and other lighting elements.

features, notably instant-start operation and longer unbroken lines of light with minimum dark areas in continuous lines. In the theater, too, the Slimline offers many opportunities to solve old lighting problems and suggests new treatments.

First, examine Slimline dimensions. Four sizes of lamps are available (Fig. 1). Until its introduction, the greatest ratio of length to diameter was 1 to 36 in standard fluorescent lamps produced in quantities. Now the ratio is increased 1 to 96 in the 8-foot lamp. These dimensions serve to give new proportions for luminaires; the small diameter permits small cross sections in lighting elements (Fig. 2), and in reflectors for control of light (Fig. 3). Long lamps cause fewer interruptions in continuous

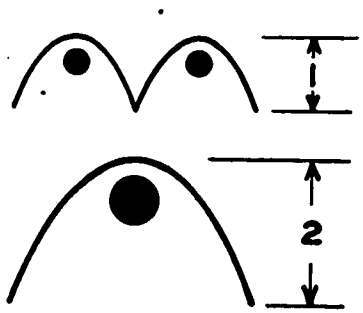


Fig. 3—For the same control reflector size is in proportion to diameter of the lamp. In many cases the shallow reflector may be fitted into structure more easily.

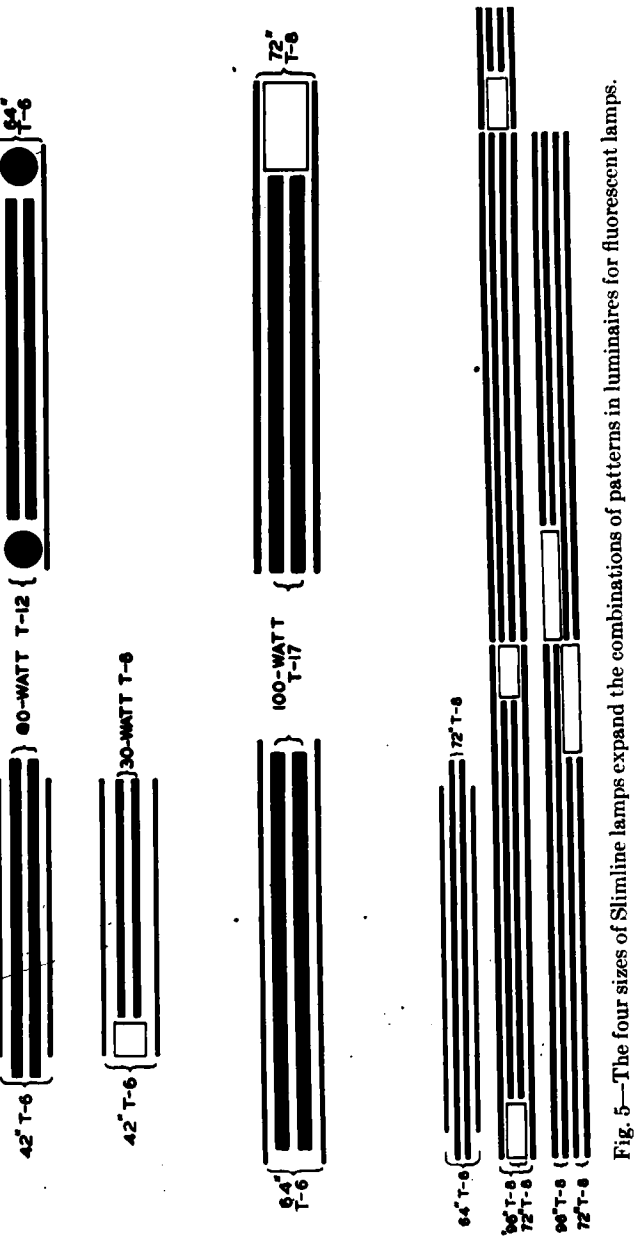


Fig. 5—The four sizes of Slimline lamps expand the combinations of patterns in luminaires for fluorescent lamps.

lines of light than shorter ones (Fig. 4). Then, too, the different lengths make possible numerous combinations with other lamps for variety and flexibility in design (Fig. 5). Moreover, the shorter lamps were designed to fit in typical "4- and 6-foot" spaces.

Second, as to electrical characteristics. Each lamp may be operated over a range of currents or watts, thus providing a choice of lamp brightness and light output. Ballasts are available to supply 100, 120, 200, or 300 milliamperes. The resulting values of light output, brightness, wattage, and luminous efficiency are given in Table I.

TABLE I

APPROXIMATE TECHNICAL DATA

4500-Degree White Slimline Lamps

Lamp	Milli-amperes	Lamp Watts	Initial Lumens	Initial Lumens per Watt	Lamp Brightness (Foot-Lamberts)	Recommended Minimum Starting Voltage
F96T8/45W	100	29	1800	62	1000	
	120	34	2100	62	1200	750
	200	51	3050	60	1650	
	300	69	3950	57	2150	
F72T8/45W	100	22	1340	61	1000	
	120	26	1590	61	1200	600
	200	38	2250	59	1650	
	300	51	2850	56	2150	
F64T6/45W	100	24	1370	57	1600	
	120	27.5	1570	57	1800	600
	200	39	2150	55	2450	
	300	51	2600	51	3000	
F42T6/45W	100	16	880	55	1600	
	120	18	990	55	1800	450
	200	25	1320	53	2450	
	300	33	1620	49	3000	

For example, this type of fluorescent lamp gives the opportunity to step down from high brightnesses (300 milliamperes) under the marquee, through the lobby at medium brightness (200 milliamperes) into the foyer at still lower levels (100 milliamperes) without changing the character of luminaires or luminous pattern.

The Slimline fluorescent lamps start instantly. The longer lamps provide this feature with greatest economy because the ratio of starting voltage to operating voltage is about 2 to 1. Thus, under operating condition, the lamp and ballast have nearly the same voltage drop, providing good regulation over the range of line voltages normally encountered.

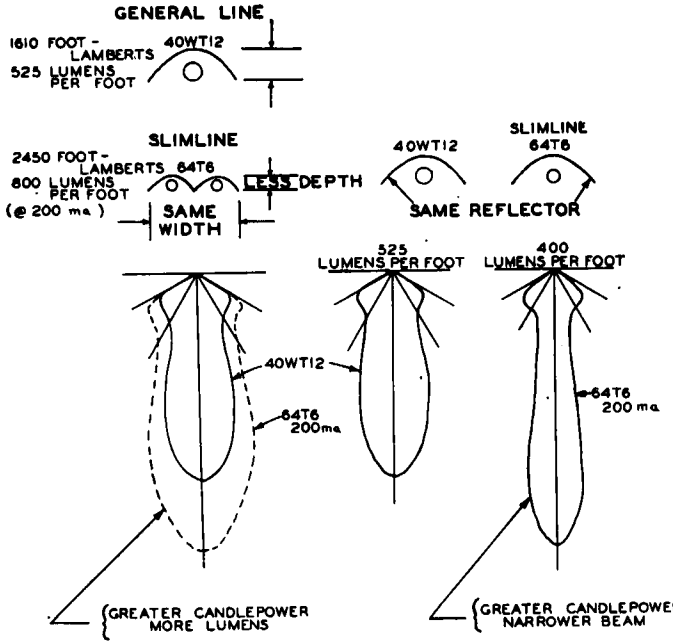


Fig. 6—In spaces of the same width and less depth, the Slimline lamp operated at 200 milliamperes will produce greater candle power and more lumens as compared with the 40-watt T12 lamp. In the same size reflector the beam will be narrower and of greater candle power.

By comparison, the familiar 40-watt fluorescent lamp because of its shorter length (4 feet) and larger diameter (T12) has a ratio of cold-starting voltage to operating voltage of about 4 to 1. Hence instant-start operation of this lamp results in greater losses than obtained in the more usual circuit in which starters are used to preheat the cathodes and thus to bring the hot-starting voltage down to twice the operating voltage.

The longest Slimline also offers the highest efficiency of any of the

standard fluorescent lamps made to date. One of the principal factors is that in long lamps the wattage lost at the cathode becomes a smaller proportion of total lamp watts.

Third, optical control. Light from fluorescent lamps can be controlled in a plane perpendicular to the axis of the tubes, and the width of reflector required is proportional to tube diameter. This means that more rows of Slimline lamps can be put in a given space for the same control than with lamps having larger diameters, as shown in Fig. 6. The light-distribution curves are based on an accurate parabolic reflector having a specular surface. Tests have shown that a

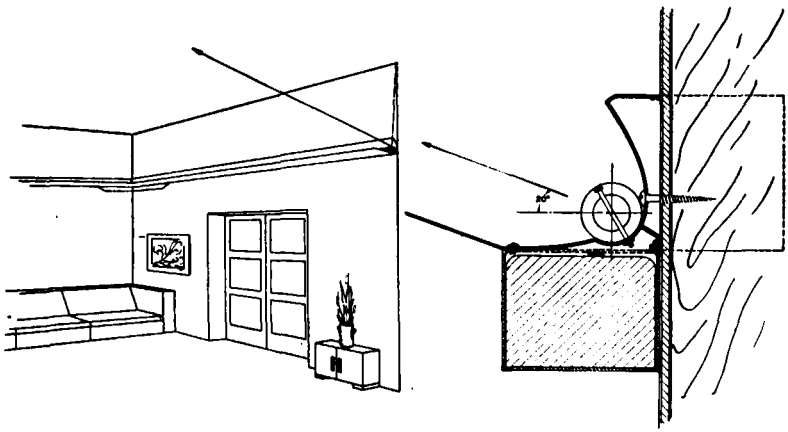
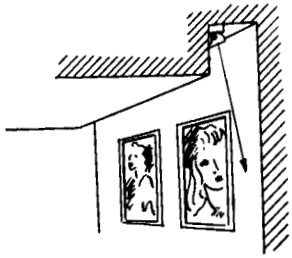


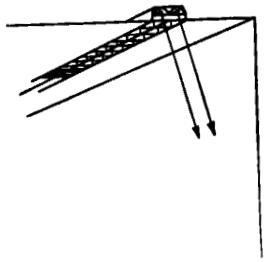
Fig. 7—Cove lighting from elements of small cross section has been something designers have wanted for a long time. Reflectors are required for effective utilization of the light. The section for an attached or built-in cove illustrates a method of providing a luminous band as well as lighting for the ceiling.

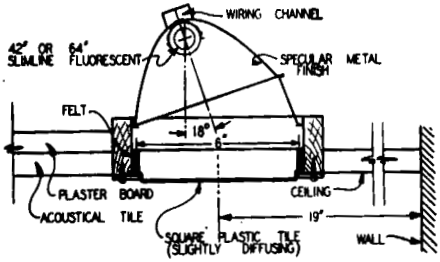
satisfactory degree of control for most purposes can be achieved where the reflector width is at least four times the lamp diameter. Thus a T6 ($^3/_4$-inch) diameter Slimline with a 3-inch reflector becomes an effective lighting device for it can provide higher utilization of light and more effective appearance in such places as:

1. *Cove Lighting.* Where a uniformly lighted ceiling is desirable from an unobtrusive lighting element, the small diameter and long lengths are advantageous (Fig. 7).

2. *Wall Lighting.* One of the most effective means of creating a cheerful, stimulating appearance in a room is to light the perimeter areas. Optical control is necessary if the light is to cover the surface

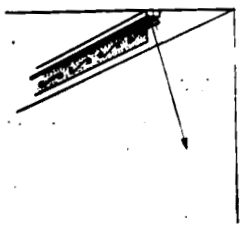






(*a*) For wall lighting in new installations recesses may be left between ceiling and wall for the lighting or a recess may be provided in the ceiling. Lightly diffusing glass or plastic will give good appearance and will only slightly spread the wedge of light.

(*b*) A valence may be attached to ceiling to conceal reflectors. The lamps and reflectors may be shielded from endwise view by louvers.



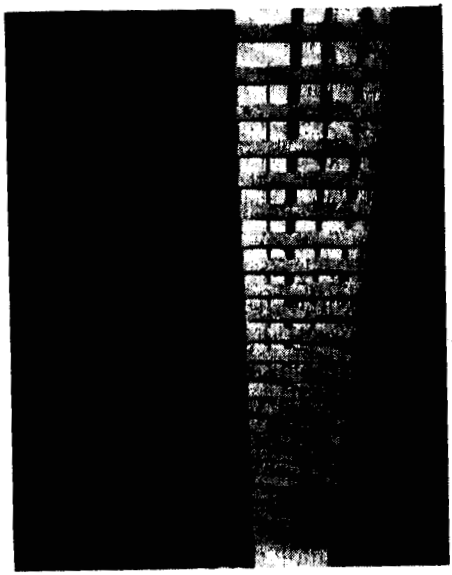
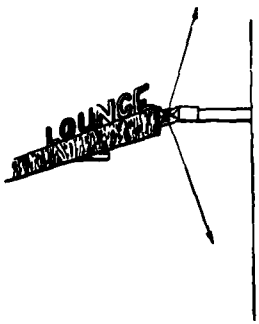


Fig. 8



(c) Another method is an architectural frame or valence attached to wall having a concentrating type of reflector.

Fig. 8 (*continued*)

fairly uniformly without too great a brightness difference between the top and bottom of the wall (Fig. 8).

3. *Poster Panels.* Often exposed lamps or lamps with inadequate shielding are used around the panel and while this may have some attention value, the result is distracting and the patron's reaction may

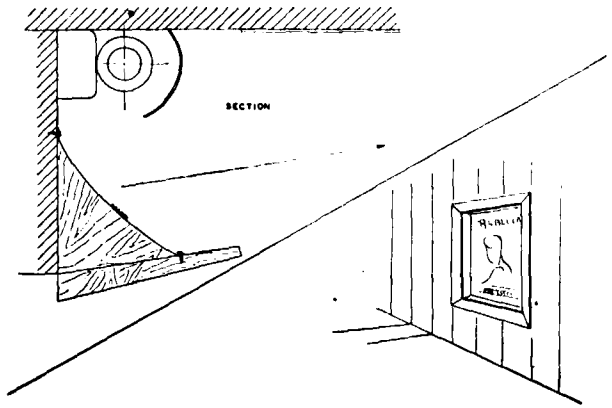
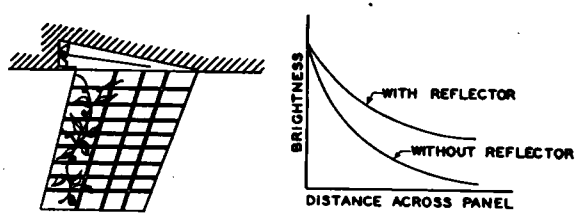
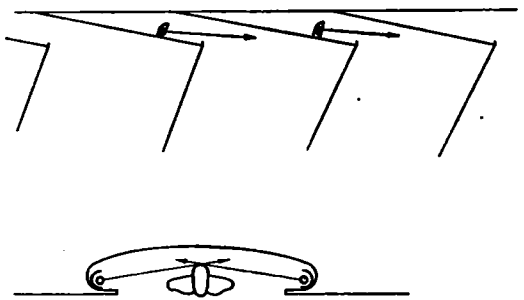
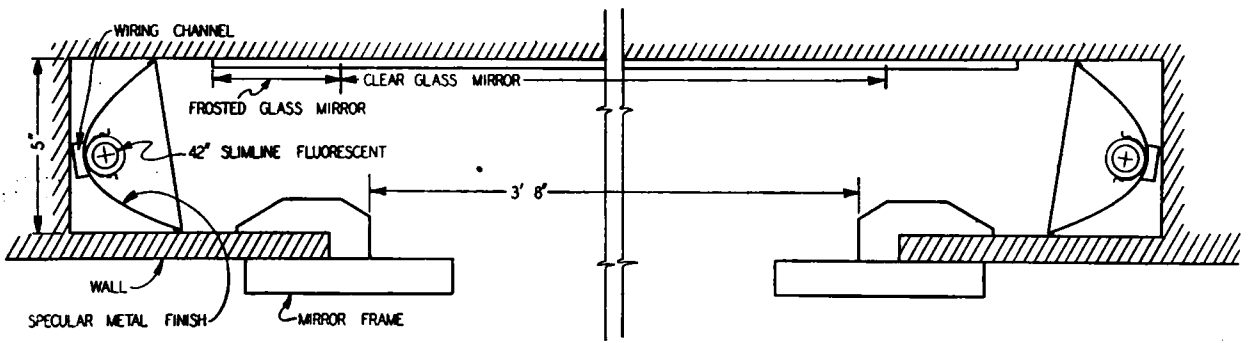


Fig. 9—A new technique for lighting poster panels is suggested here. The lamp is entirely concealed and still the light from both sides of the frame will be well distributed over the poster.



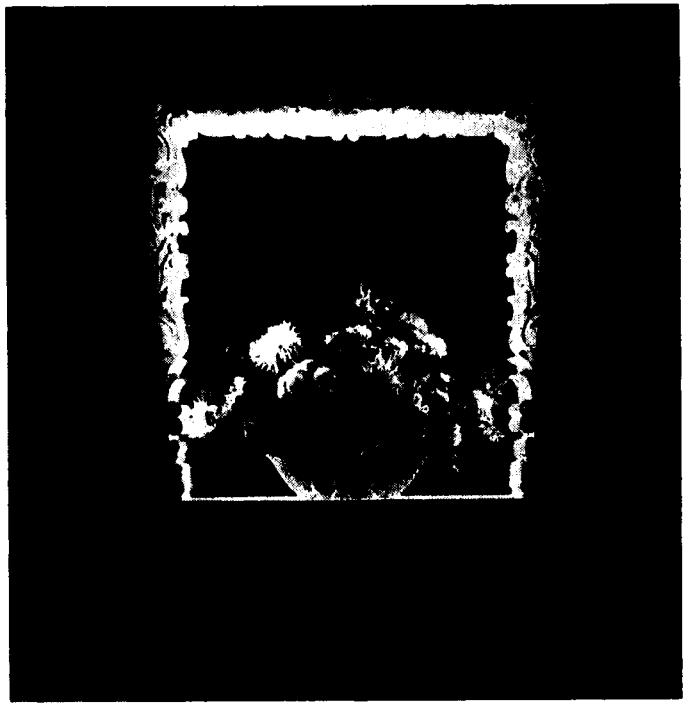


(*a*) In some architectural elements a sheet or wedge of light is required. Where space for the lighting is restricted, the Slimline in narrow beam reflectors is very useful.

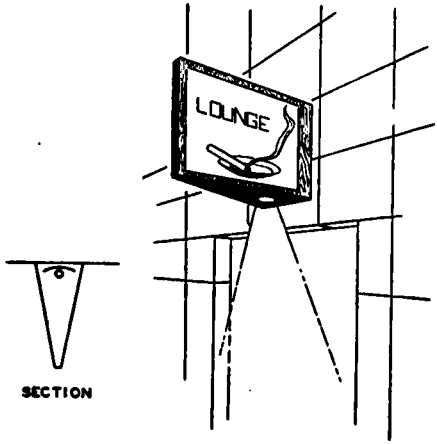


(*b*) In shallow space around a mirror with a center display, the narrow units may be easily concealed.

Fig. 10



(*b*)



(*c*) Uniform lighting of the wedge-shaped sign requires the control so easily obtained with Slimline in reflectors. Illumination of surface behind letters may be done with a minimum depth of shield for the lighting units.

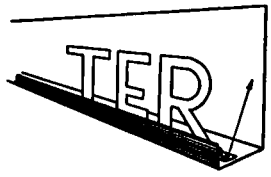


Fig. 10 (*continued*)

be to look away immediately because of uncomfortable brightness. The method shown in Fig. 9 assures complete shielding of the lamps and will provide nearly uniform brightness across the panel for good appearance and far better composition.

4. *Architectural Elements.* Some of the elements for decoration and illumination take a form which requires control of light distribution for adequate uniformity on a reflecting or transmitting surface (Fig. 10).

In all of the above examples, the range of available light-output values in each of the Slimlines increases the scope of application.

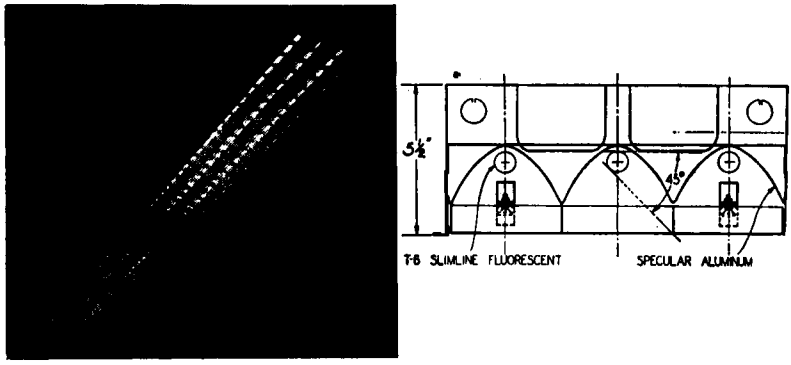
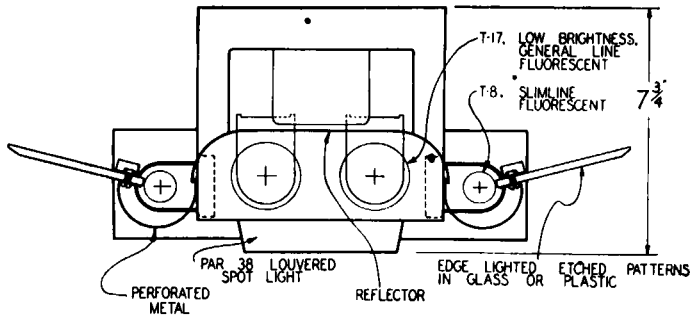


Fig. 11—Example of a shallow recessed fixture with good control.

Control of light is also an important consideration in many types of luminaires. Fig. 11 is an example. The proportions of the lamps make possible designs having an appearance of minimum bulk because the sides of such luminaires may be narrower for the same degree of shielding as compared with the large-diameter fluorescent lamps. This means the dimensions of the projected view may be small in relation to the length. While those shown in Fig. 12 were not designed particularly for the theater, they may suggest some possibilities. Some designs may combine Slimline lamps with other sizes of fluorescent lamps and, in some cases, with filament sources.

An idea for creating versatility in effect with simple standard types of luminaire chassis is illustrated in Fig. 13. The chassis houses the ballast, the sockets, and wiring, but may have a character which is adaptable to many variations in treatment with accessories

(*a*) Patterns produced with suspended small "V" section housing Slimline. The system is combined with flush panel units. In theaters different colors might be used in each system.



(*b*) Narrow side view with Slimline lamps shielded by perforated metal. Lamp set at edge of plastic for lighting etched pattern. Compact projector lamps integrated in the design for lighting wall displays.

Fig. 12

of various kinds of materials, varying in texture, finish, color, brightness, and form. Then, too, the units may be arranged in numerous ways to give greater versatility in pattern (Fig. 14).

While the small diameter of Slimline lamps is advantageous in providing good optical control, the same characteristics of small

(*c*) A suspended luminaire with slender lines made possible with Slimline lamps. It has a "lightweight" appearance and either bent glass or extruded plastic of light diffusion may be used.

(*d*) The proportions of the Slimline lamps give architects and designers opportunity for creating many types of luminaires. In this example, 72-inch lamps are employed. The slot in the bottom is finished in another color to conform to the color scheme.

Fig. 12 (*continued*)

diameter plus their range of light output make them very useful in built-in luminous or attached lighting elements. It is especially true where spaces for recesses are limited or when cross sections of small dimensions are required for appearance reasons (Fig. 15).

The design of luminous panels often becomes a problem where depth for a recess is at a minimum and the effect desired on the face is uniform brightness. This is due to the fact that uniformity is a function of the spacing between lamps and the distance from the diffusing face, and the brightness is a function of the light output of the lamp and the light-reflecting efficiency of the cavity. Here the choice of light output available in Slimline lamps gives flexibility in obtaining in a small space uniformity at desired brightness value (Fig. 16).

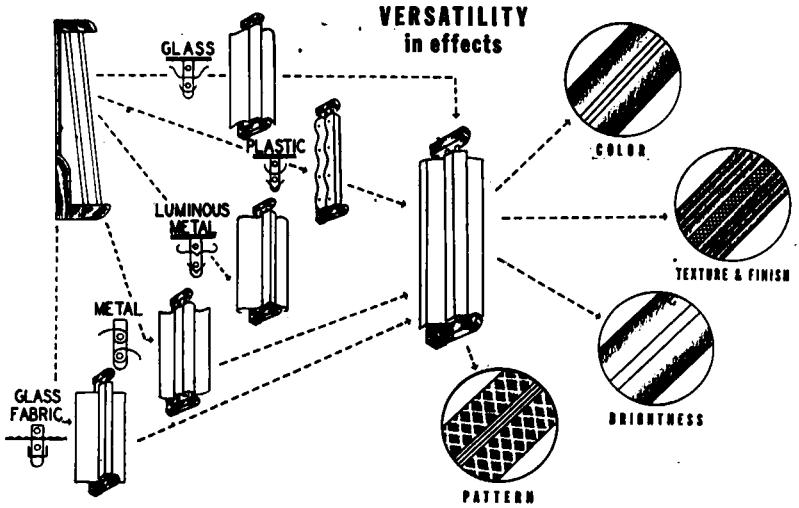


Fig. 13—A few of the many types of decorative diffusing shields which may be fitted to a basic fixture unit. Differences in shape, surface, finish, color, and texture of shields expand the variety of effect.

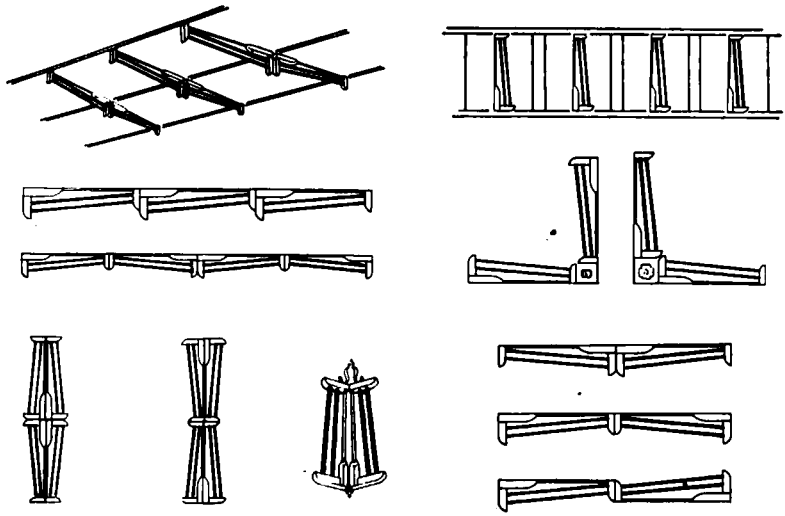
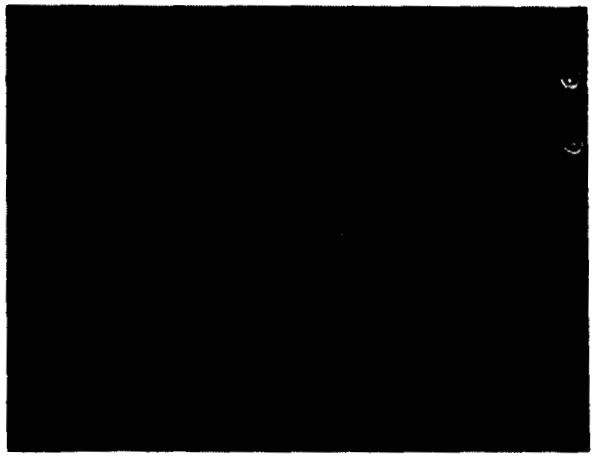


Fig. 14—Some of the ways the standard units may be combined to create a variety of patterns.

Slimline lamps may be combined with incandescent lamps for additional attention value. One example is the attraction panel for the marquee also shown in Fig. 16.



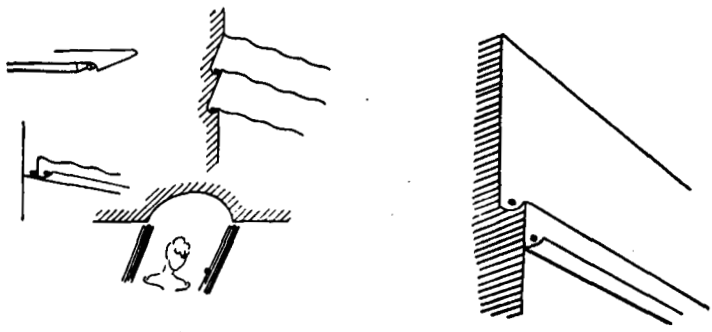
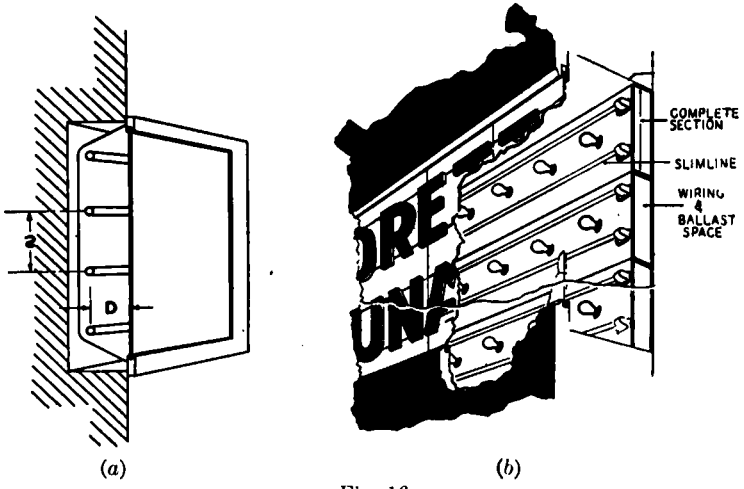


Fig. 15—Small diameter is useful in edge lighting and for fitting lamps into small spaces for decorative effects. The several values of light output from Slimline lamps give a choice of brightness.

CIRCLINE FLUORESCENT LAMPS

Another example of a new form of fluorescent lamp is the Circline. Originally designed to meet the demand for fluorescent sources in portable lamps, it has many other applications in decoration and display, as well as some uses for purely illumination purposes.

The first size available is 12 inches in outside diameter. An $8^1/_4$-inch size has been announced to be followed later by one about 16 inches in diameter. These two will become available as manufacturing facilities permit. Such standard shapes expand the number of designs that may be developed for decorative elements in the



(*a*) (*b*)

Fig. 16

(*a*) Small-diameter fluorescent lamps of several light outputs are ideal for shallow recess. The ratio of *S* to *D* should be about $1^1/_2$ to 1 where good diffusing material is used for the panel.

(*b*) A combination of incandescent lamps and Slimline gives attraction panels greater attention value when the incandescent lamps are flashed or dimmed for color and brightness changes.

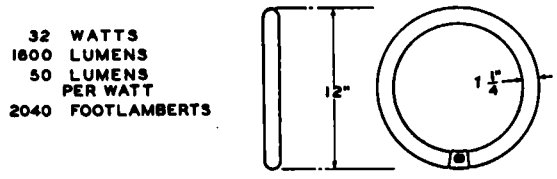


Fig. 17—Circline fluorescent lamp.

theater. Obviously, they may be combined with the linear fluorescent lamps and also with incandescent lamps for an unlimited range of effects.

First, examine this lamp as to dimensions and electrical characteristics (Fig. 17). It is operated on a conventional preheat circuit with a glow-type starter. With this circuit, a minimum starting

voltage is required. The two cathodes are close together, which gives a minimum unlighted section in a circle. The 4-pin connector is adjustable through a small angle to facilitate installation of the lamp.

The brightness of the 12-inch lamp is 2040 foot-lamberts (considerably more than that of the 40-watt straight lamp) and should be, in general, shielded from direct view in the interest of greater comfort and better appearance. The shields may be of several types and can provide a decorative form as well as serve as signs, directional markers, and the like (Fig. 18).

These luminous forms may be utilized as part of a pattern and also

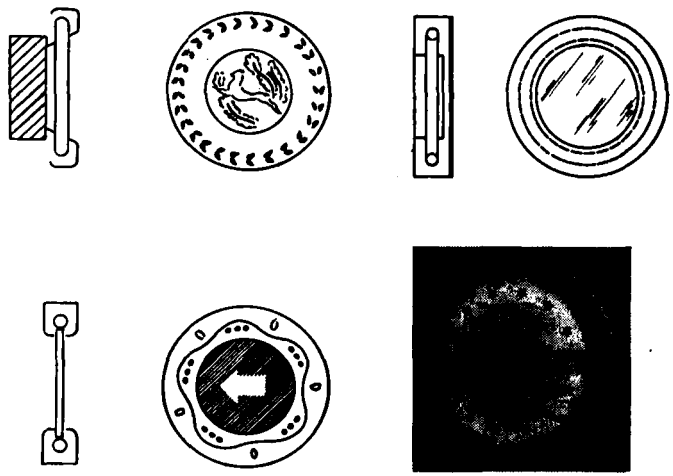


Fig. 18—A few of the ways Circline lamps may be incorporated in plaques or medallions for decoration or markers.

serve as a shield for the housing incorporating the ballast when used in conjunction with other fluorescent lamps (Fig. 19), such as the Slimline applied in bands. In other patterns the Circline lamp may introduce another form combined with a difference in color quality of light. Circline is a logical shape to use around a reflector or projector lamp particularly when the housings for such lamps are attached to the ceiling. The Circline will provide light on the ceiling to lower contrast between the projector lamps and their surroundings.

Many of the newer designs of portable floor and table lamps embody the Circline (Fig. 20). These lamps may be employed in lounges and

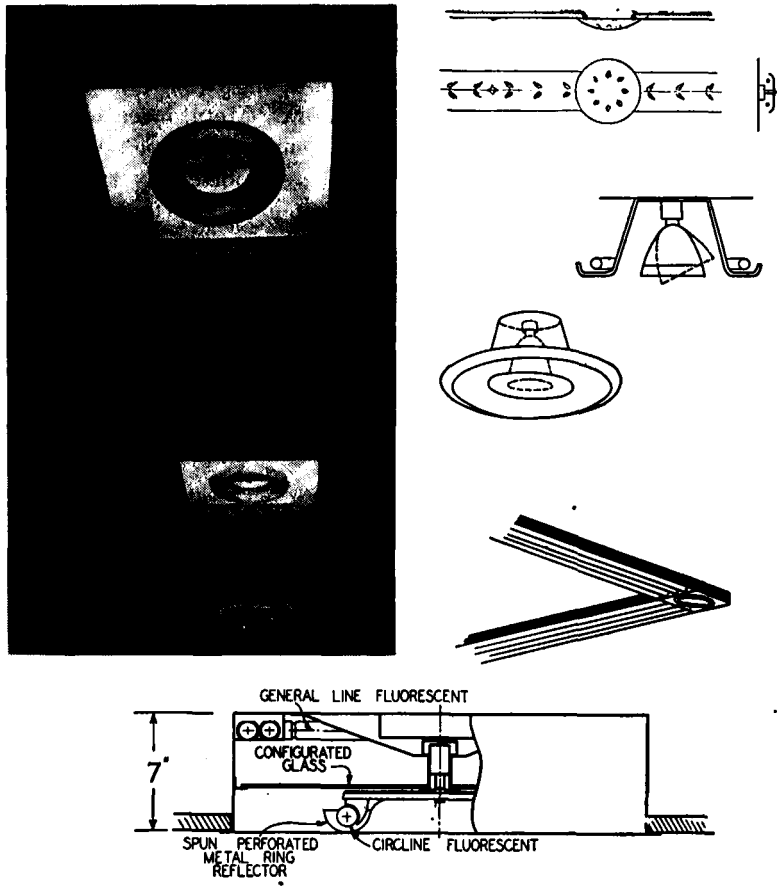


Fig. 19—Decorative bands offer many possibilities for ceiling and wall treatments. Here are some of the ways the Circline may be utilized in parts of pattern in luminaires or to provide upward light around the housing of downlights.

rest-room areas to afford good lighting with a clean, fresh, color appearance.

PROJECTOR AND REFLECTOR LAMPS

Lamps with integral reflectors are coming into wide use largely because of the results produced with their convenience and simplicity in application. Sealed inside the bulb, the reflector does not deteriorate due to dust and dirt, and when the lamp is replaced, initial efficiency is automatically restored without further cleaning of equipment.

The molded-glass type, known as PAR-38, has an accurately formed heat-resistant glass reflector bulb and is made for spot or flood distribution of light. It may be used out of doors without danger from thermal shock caused by rain and snow. Metal accessories for holding color roundels or shields (Fig. 21*a*) may be clipped directly to the rim of the bulb. This lamp may be supported by the rim as shown in Fig. 21*d*. A recent PAR-38 lamp in 150 watts is the "compact" projector. As the name implies, it requires less space than the standard screw-base type. It is well suited for mounting in a gimbal

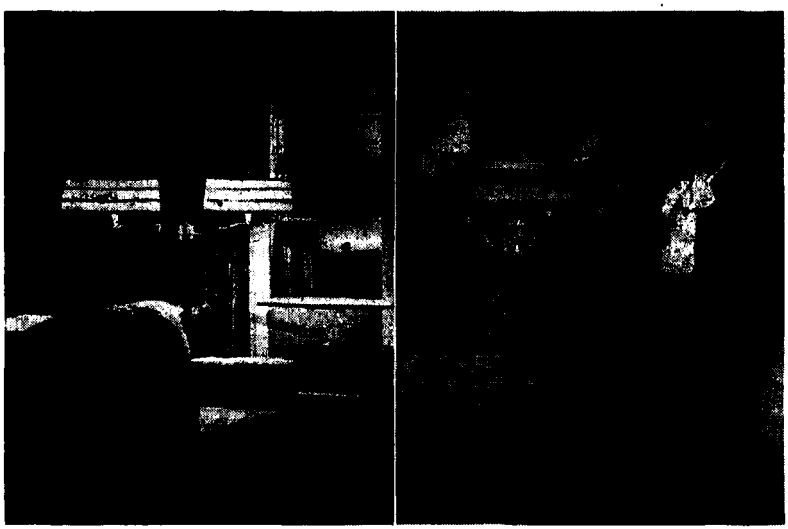


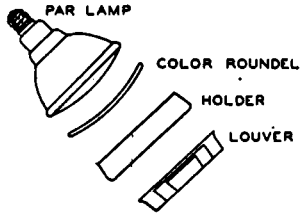
Fig. 20—New designs in floor lamps incorporating the Circline.

as in Fig. 21*c* and can be recessed in a space less than 5 inches high either in the ceiling or luminaires.

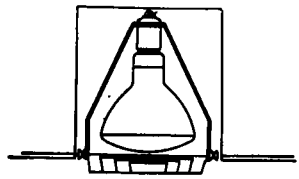
The most common blown-bulb reflector type is designated as the R-40. A blown bulb is inherently somewhat less accurate in contour than the molded type. In soft glass it is more susceptible to thermal shock and, therefore, not suitable for outdoor use exposed to rain and snow. While it is lighter in weight than molded PAR lamps, it should always be supported by the screw base (Fig. 21*b*). Shields and color accessories touching the bulb may result in unsatisfactory performance and, therefore, are not generally recommended. Such accessories for best results should be incorporated in a housing or in open-frame supports.

The line of lamps is shown in Fig. 22.

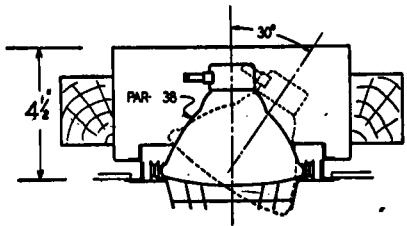
Lighting of displays is a prime function for these sources. In many cases flexibility in aiming is required and numerous mountings and housings are manufactured to achieve this purpose. One of the newer ones is the gimbal which permits aiming in any direction up to 30 degrees from the vertical. Wherever a patron in the theater is likely to look into the beam of light from the lamp it is best to use



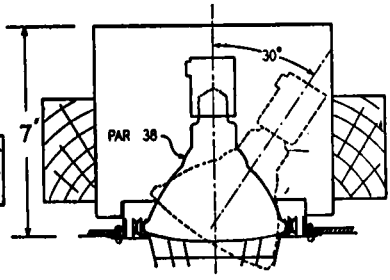
(*a*) Projector lamps are recommended where accessories are to be attached directly to the lamp.



(*b*) In most installations metal enclosures should be used for reflector or projector recessed in ceiling. The reflector lamps are supported by the base.



(*c*) The compact projector saves space.



(*d*) The projector lamp may be supported by the rim.

Fig. 21

louvers or shields. If color or shielding accessories are to be clamped to the lamp, the PAR types are preferred.

Units are available for mounting in the ceiling, attached to the ceiling, and suspended. In addition, there is a trend to incorporate the lamp in fluorescent-lamp luminaires, particularly in stores, thereby keeping the number of wiring outlets to a minimum. In lobbies and foyers of the theater, this technique offers similar possibilities (Fig. 12*c*).

Reflector lamps are handy units for installation in the soffit of

marquees to project light on the sidewalk and pedestrian traffic. The PAR type is generally selected when the lens is to give an appearance of being on the same plane as the soffit surface. The R-40 reflector type should be used only when protected from rain. If it is mounted to extend a half inch or so below the surface it presents

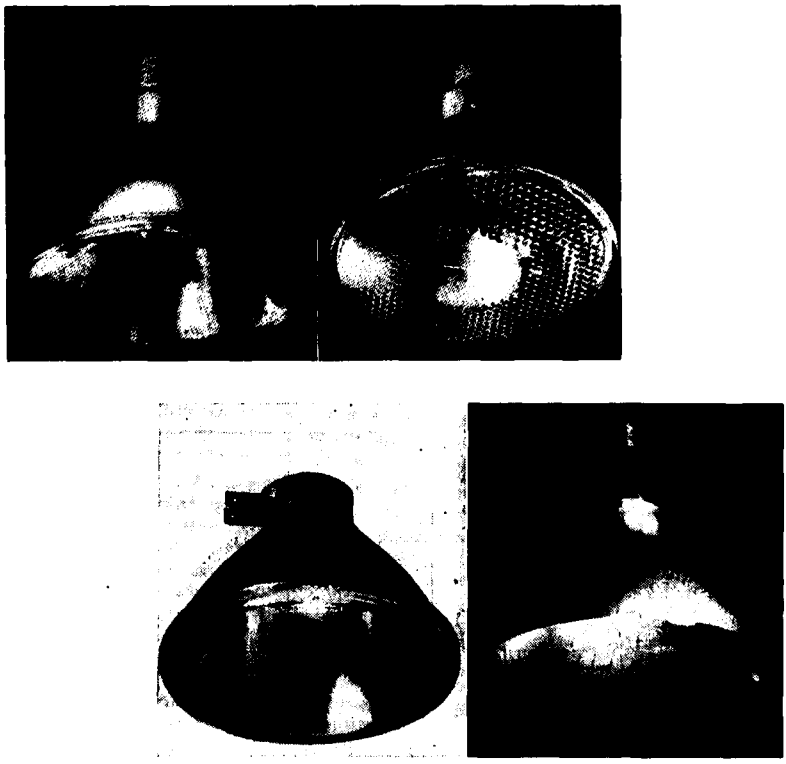


Fig. 22—Reflector and projector spot and floodlamps are useful tools for many jobs in the theater.

greater brightness than does the edge of the PAR unit at normal angles of view and thus imparts greater life and sparkle.

There has been no intention to make this discussion comprehensive but rather to suggest some of the ways newer light sources fit into many of the lighting applications posed by the theater and thus to help the theater designer and owner in their never-ending quest for new and better solutions.