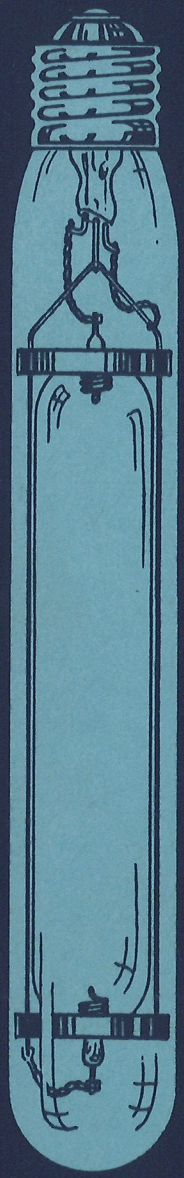

IMPROVED LIGHTING EFFICIENCY

WITH 400 WATT

HIGH INTENSITY MERCURY VAPOR LAMPS

AND

COMBINATION UNITS

IMPROVED LIGHTING EFFICIENCY

with 400-Watt

GENERAL ELECTRIC

High Intensity

MERCURY VAPOR LAMPS

and

COMBINATION UNITS

NELA PARK ENGINEERING DEPARTMENT

GENERAL ELECTRIC COMPANY

CLEVELAND

The automobile industry, always leaders in improved lighting and other efficient production aids, has been among the first to install the new High Intensity Mercury Vapor Lamp. Proper seeing conditions are so inseparably related to time saving, high efficiency, and safety in industrial production, that any improvement in lighting proves to be an economy in over-all operation.

A New Step In Lighting Progress

MAN has wanted more light ever since he first withdrew from under the open sky and brought his work indoors. Whether the source was a blazing pine knot, an oil lamp, a gas flame, or an electric light, man has never been fully satisfied. And quite naturally. Instinctively his eyes crave as much light as nature intended them to have, for they were developed for out-of-door daylight seeing. Even today, with all our scientific knowledge and up-to-date equipment, the best lighted interiors are illuminated to but a small fraction of outdoor daylight values. And so human eyes are still unsatisfied, and the search for better light sources continues.

Gradually man is becoming aware of the value of light, and whereas formerly his need for more light may have been instinctive and unconscious, it is now becoming a recognized and deliberate desire.

As the result of continuous experimentation and research by the General Electric Company there now appears a new light source which represents one more forward step in the efficiency of light production—a step that brings man a little closer to the realization of the sort of lighting he desires. This source is the High Intensity Mercury Vapor Lamp.

HIGH EFFICIENCY AND ADAPTABILITY

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THE new General Electric 400-watt High Intensity Mercury Vapor Lamp is a light source that has an efficiency of 35 lumens per watt, which is about double that of an incandescent lamp, and of former vapor sources suitable for general use. It produces as much light as is delivered by one 750-watt incandescent lamp, and this unusually high efficiency has aroused widespread interest in the lamp. The new lamp differs considerably from the familiar mercury vapor tube; in general appearance it is not unlike a tubular MAZDA lamp. It is fitted with a Mogul screw base, a feature which makes it readily adaptable for use in many luminaires already on the market.

A special transformer or reactor is required for each individual lamp.

This large craneway, 360 feet long, 67 feet wide, housing a battery of lofty 750-ton presses, is lighted by a combination of 400-watt High Intensity Mercury Vapor Lamps and 750-watt MAZDA Lamps. The lamps are mounted 41 feet from the floor in spun aluminum high bay reflectors. The spacing is approximately 12½ feet between rows, 20 feet lengthwise, the arrangements providing for two MAZDA incandescent lamps and three mercury vapor lamps in each bay; the two outside rows and the center row are mercury vapor lamp units. The result is 20 footcandles of well-blended, high quality illumination.

Workers in this modern radio factory enjoy 80 footcandles of light on their work. This splendid illumination is supplied by alternate units of High Intensity Mercury Lamps and 500-watt MAZDA lamps in Glassteel Diffusers spaced on 8′ x 8′ centers and mounted 9 feet above the floor.

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APPLICATIONS

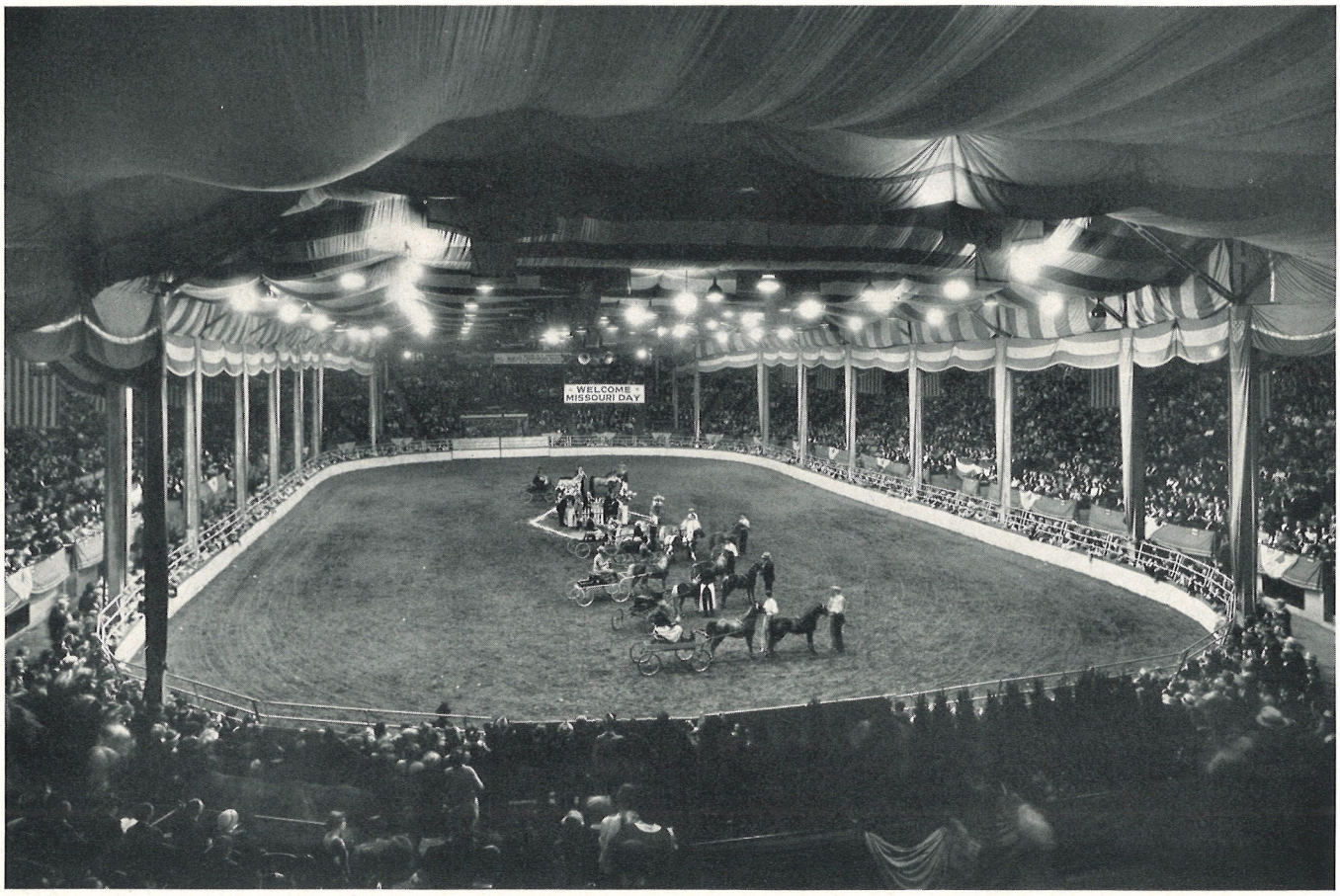
THE accompanying pictures show typical installations of the new high intensity vapor lamp used either alone or in combination with MAZDA lamps. While the appearance of the mercury vapor light is whiter than that of a MAZDA lamp, it has the characteristic mercury vapor line spectrum in contrast to the continuous spectrum of the MAZDA lamp. This means that all the light from the mercury is represented by only a few bands which produce yellow, green, and blue light. Red is practically absent. The result is that although the light itself has a bluish-white cast, some colors such as the reds are not recognized, while yellows and greens are emphasized. Combined with continuous spectrum MAZDA lamps

which are rich in red, the resultant light is a synthetic white, although by no means could it be considered a "color-matching" white because of the emphasis it gives yellows. However, the mercury-vapor–MAZDA lamp combination gives a cool white light which mixes well with natural daylight, and is very pleasant for factory, office, school and all similar applications where no occasion for accurate color discrimination of materials is presented.

The installations of High Intensity Mercury Vapor Lamps now in use are quite varied in character and only suggest the wide application of this new light source. In addition to interior lighting these lamps have also been applied to exterior floodlighting and to street lighting.

It is in the industrial field that the High Intensity Mercury Vapor Lamp finds its most important applications. For lighting factories and machine shops particularly where there are high bays and high-ceilinged areas, this lamp has already proved to be a satisfactory and economical light source, used either alone or in combination with MAZDA lamps.

The High Intensity Mercury Vapor Lamp is not limited to industrial application. The commercial units in this office contain a combination of one High Intensity Mercury Vapor Lamp and four 200-watt MAZDA lamps. This installation gave an initial illumination level of 63 footcandles.



Lighting an arena with High Intensity Mercury Vapor Lamps combined with MAZDA lamps. Here mercury vapor units were alternated with 1000-watt MAZDA lamp units. The units were mounted 35 feet above the floor and lighted the arena to over 40 footcandles.

Lighting plays such an important part in the economics of factory production and administration that it justifies a much larger proportion of the cost of production than the fraction of one per cent commonly allotted to it. So great is the need and so sound the logic of raising industrial lighting standards, with benefits accruing both to the employer and employee, that practical developments in light sources should challenge the interest of every business executive. The High Intensity Mercury Vapor Lamp, doubling light production efficiency in a single step, is a remarkable achievement. It is noteworthy commercially not because of any decrease in present lighting costs afforded, but because of its high efficiency, it offers an opportunity to break from traditionally meager lighting conditions and faulty lighting so invariably encountered in existing factory lighting installations. Artificial lighting is so inherently and distinctly a part of practically every manufacturing operation that there is wisdom in suggesting that every factory get first-hand experience with at least a small installation of these new and efficient light sources. In many cases they will have an added advantage in being able to provide an increase in illumination where present wiring is inadequate to carry additional wattage.

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Four combination units of the totally indirect type produce a high level of illumination in this conference room. Each unit contains one mercury vapor lamp, two 250-watt and two 150-watt MAZDA lamps.

COMBINATIONS OF MERCURY VAPOR AND MAZDA LAMPS

MERCURY vapor and MAZDA lamps may be combined in a number of different ways. For certain classes of installations they are combined in the same unit in a specially designed reflector such as the modified Glassteel Diffuser unit shown on page 8, or the commercial type unit used in the conference room installation shown above or the office installation on page 5.

Combination units offer considerable flexibility and choice as to the relative proportion of incandescent and mercury light. An equal number of lumens from mercury vapor and MAZDA lamps combined gives perhaps the closest approximation of daylight whiteness.

If equal lumens of mercury vapor and MAZDA light are desired, the combination might be one 400-

watt mercury vapor lamp and four 200-watt MAZDA lamps. Since the mercury vapor lamp does not attain full brilliancy immediately, one advantage of combination units is that the MAZDA lamps will supply considerable light the moment the switch is snapped on. Another point in favor of combination units is suggested by the fact that the mercury vapor lamp will not re-light after it has been turned out until it has cooled enough to reduce the pressure of mercury vapor considerably. Normally, when it is the only lamp in the reflector, this requires from five to fifteen minutes. In a combination unit, of course, the MAZDA lamps will re-light the moment the current is re-established. However, in a combination unit, after a current interruption, the heat from the MAZDA lamps will delay the restarting of the mercury vapor lamp. A practical solution to this difficulty is to install alternate units of mercury vapor and MAZDA lamps. If this is done in buildings in which the units are mounted high above the floor, the two types of light will overlap and mix by the time they reach the work area, and hence the actual illumination will be well blended.

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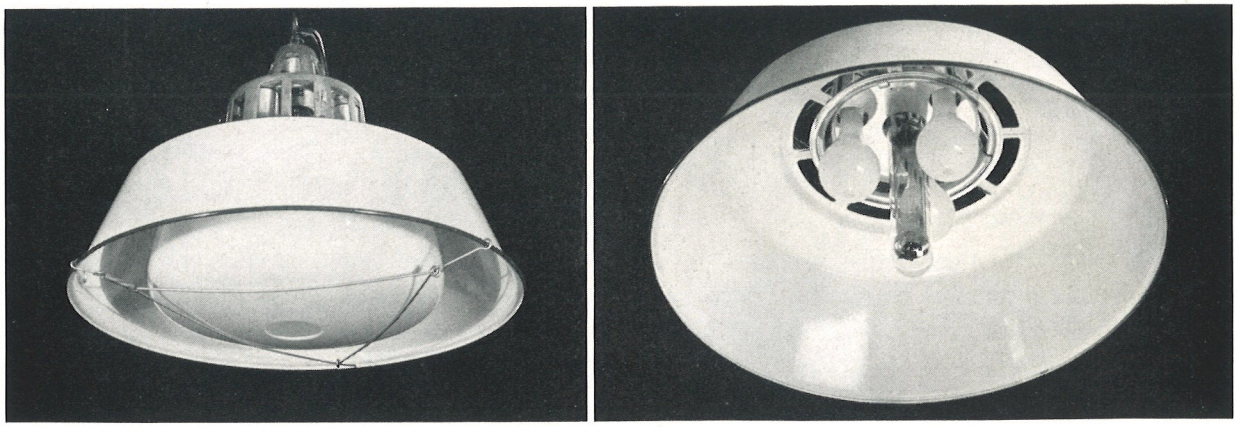
REFLECTING EQUIPMENT

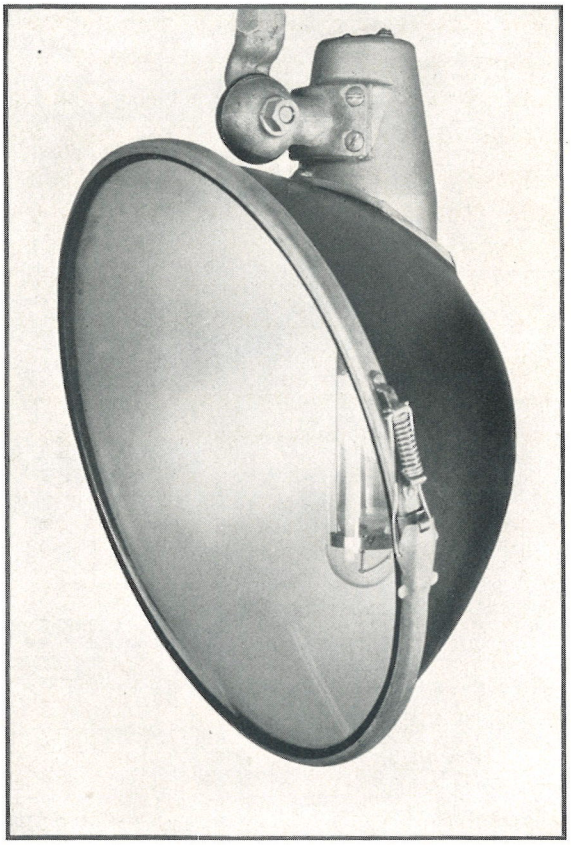
FORTUNATELY, the light-center length as well as the size and shape of the new 400-watt mercury vapor lamp permit it to be used in reflector equipment designed to accommodate 750-watt and 1000-watt incandescent lamps. In order to avoid concentration of high temperature at the upper electrode and base, it is necessary that reflectors be designed so that temperature limits are not exceeded.

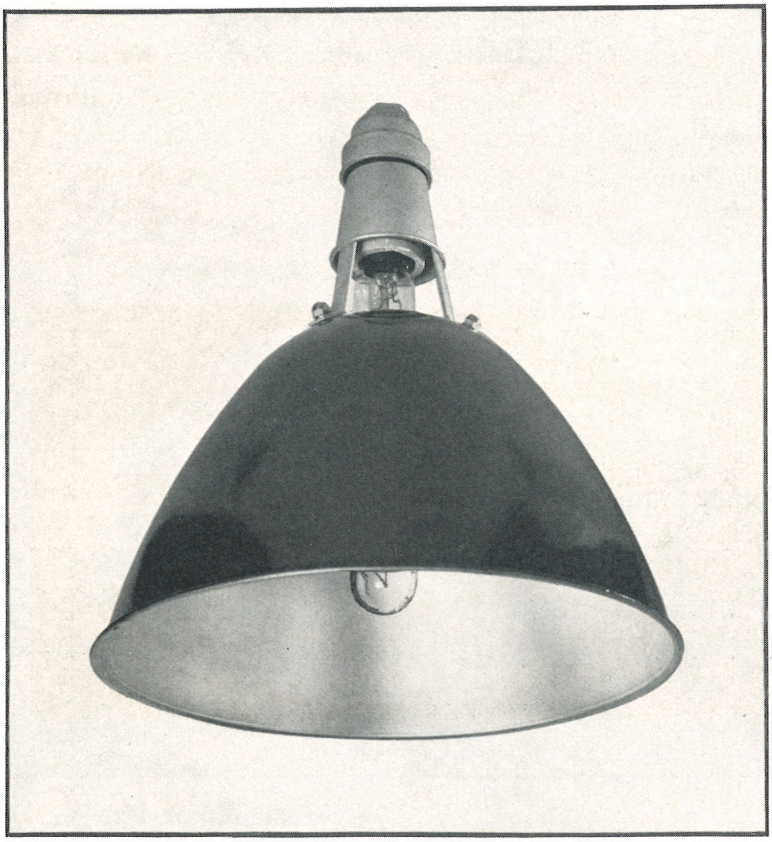
Typical industrial reflectors are shown in the accompanying illustrations.



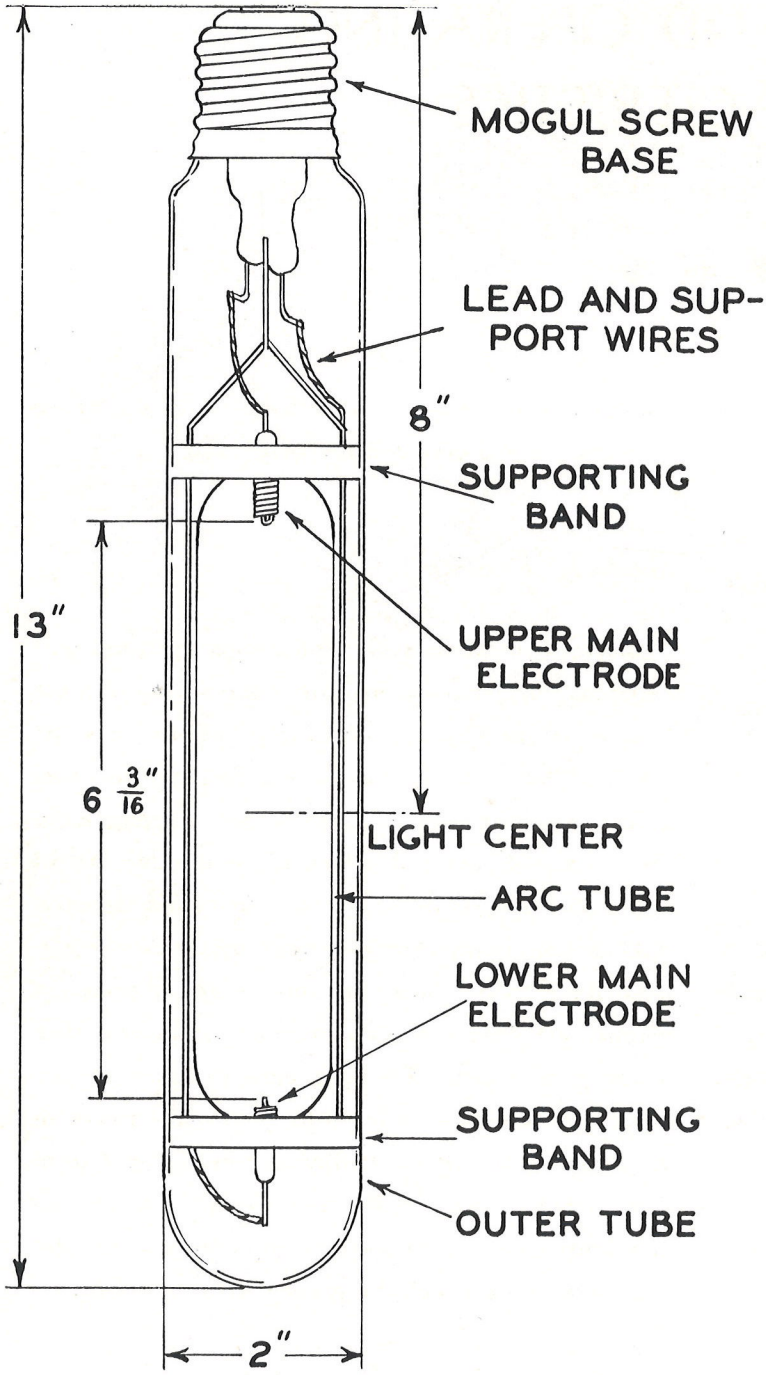
The High Intensity Mercury Vapor Lamp combined with three 150-watt MAZDA lamps in an open-neck Glassteel Diffuser. The left-hand view shows the complete unit; the hole in the bottom of the diffusing globe is for ventilation. In the view on the right the globe has been removed, showing the arrangement of the lamps.

The High Intensity Mercury Vapor Lamp may be used in many conventional types of reflector equipment, although provision must be made for keeping below assigned temperature limits if satisfactory lamp performance is to be assured. Angle reflectors of this general type are used for illuminating vertical surfaces in the automobile body line shown in the illustration on page 2.





The new lamp is well adapted to use in reflectors of the high bay type. This unit is similar to those used in the high bay installation shown on page 3.



Lamp Data

Watts	400
Volts	Approx. 150 (115- or 230-v. circuits)
Amperes	2.9
Bulb	T-16
Base	Mogul Screw
Finish	Clear
Maximum Over-all Length	13 Inches
Maximum Diameter	2 Inches
Light-Center Length	8 Inches
Length of Light Source	6 Inches
Approximate Lumens	14,000
Rated Lumens per Watt	35
Average Life	1500 Hours
Frequency	60 Cycles
Burning Position	Vertical, Base Up
Standard Package Quantity	6

Auxiliary Equipment

	Approximate Power Factor	Total Watts Lamp and Auxiliary
115-Volt Circuits		
Transformer	65%	430–460
Transformer-Condenser	90–95%	430–460
230-Volt Circuits		
Reactor	65%	420–430
Transformer-Condenser or Reactor-Condenser	90–95%	420–430

PHYSICAL AND OPERATING CHARACTERISTICS

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THE High Intensity Mercury Vapor Lamp utilizes the principle of the mercury vapor arc. It consists, essentially, of two main electrodes located at opposite ends of the 7½-inch glass tube in which the mercury that maintains the arc is vaporized. These electrodes are of tungsten wire, coiled and covered with barium-strontium-oxide which makes it possible for them to function satisfactorily at a correct temperature and for a long useful life.

Starting

The arc tube contains a small amount of pure argon gas which is used as a conducting medium to facilitate the starting of the arc before the mercury is vaporized. Near the upper end of the tube is a starting electrode which is electrically connected to the lower electrode, and hence when current is applied, an electric field is set up between the starting electrode and the upper main electrode, causing an emission of electrons from the active surface of the main electrode. This imparts energy to the gas in the arc tube so that it becomes conducting.

The quantity of mercury in the arc tube is very carefully measured so as to maintain quite an exact vapor pressure, which incidentally, is about normal atmospheric pressure.

The 400-watt arc tube is enclosed in a larger tubular bulb which makes the lamp less subject to the effect of surrounding temperature. About half an atmosphere of nitrogen is introduced in the space between the arc tube and the outer bulb.

Burning Position

Because in most of its applications the lamp will be burned in a base-up position, the majority of these lamps are designed accordingly. They may be obtained, however, for base-down burning, the chief difference being that in a base-down burning lamp the arc tube is reversed so that the sealing tip is still at the top in order not to pocket any of the mercury, since this might interfere with its complete vaporizing. If all the mercury does not vaporize, the pressure of the mercury vapor will be less than normal, resulting in lower efficiency. The lamp must be operated in a vertical position in order to keep the arc stream in the center of the tube. If the lamp is deviated from vertical more than ten degrees, the arc stream will bow until it touches the side of the tube and its 400 watts will quickly melt the glass and ruin the lamp.

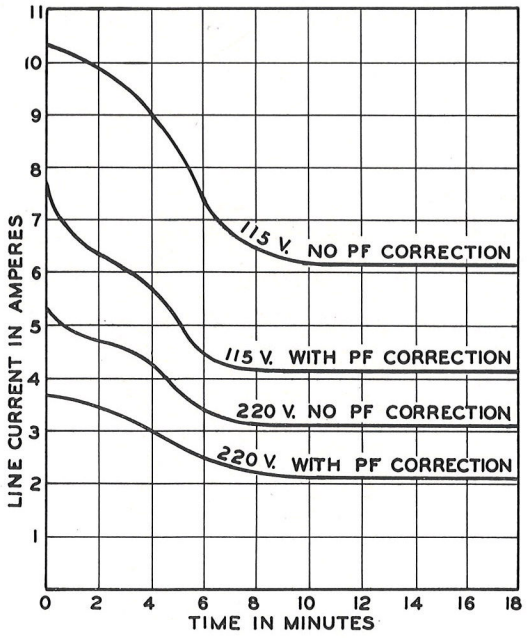
Auxiliary Equipment for 115- and 230-Volt Circuits

In the 400-watt size the lamp requires a starting voltage, under ordinary temperatures, within the range of 130 to 160 volts, and after coming to full brilliance operates at about 150 volts. To produce this starting and operating voltage either from 115- or 230-volt circuits requires auxiliary transformer or

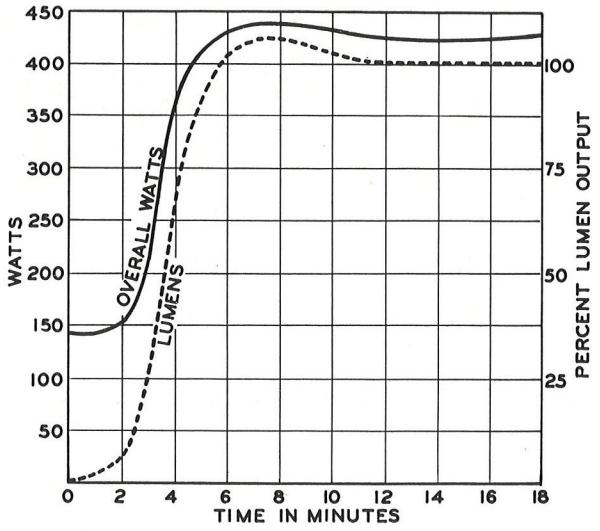
reactor equipment illustrated on page 13. In common with all arc sources, the High Intensity Mercury Vapor Lamp requires a ballast resistance or reactance to limit the current, in order to prevent the arc from "running away with itself" and burning out the lead wires. The transformer or reactor furnishes the ballast necessary for controlling the current.

On the 115-volt circuits, a transformer, or a transformer-condenser, provides the necessary voltage and ballast. Without the condenser the over-all power factor is 60–65 per cent. A transformer with a built-in condenser will result in a power factor of about 92 per cent, and in general is to be recommended, but this is not essential in installations where consideration of the power factor is unimportant or where other means of general power factor correction are in use.

On 230-volt circuits the simplest auxiliary is an iron-core reactor connected in series with the lamp, which likewise gives a resultant power factor of 60–65 per cent. Where the power factor is to be corrected, a transformer-condenser combination or a reactor-condenser combination will give a resultant power factor of 90–95 per cent.



This chart indicates graphically the line current characteristics during the period in which the lamp is coming up to full normal operation. Note the differences in line current on 115-volt and 220-volt lines, with and without power factor correction. The lamp requires 10 or 12 minutes to reach a stable operating condition.



For the first 2 minutes after the lamp is started the over-all wattage and the lumen output are of relatively low value, increasing slowly. Both increase rapidly during the next 4 minutes, reach a maximum at about 7 or 8 minutes, and become stable after about 12 minutes.

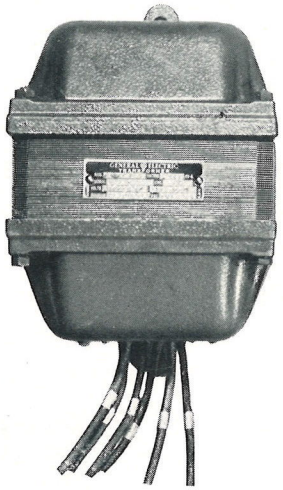
The auxiliary equipment is designed to be adaptable to all usual conditions, and hence the transformers for 115-volt circuits are tapped at 107, 115, or 123 volts; the 230-volt equipment is provided with taps for circuits having voltages of 208, 220, 230 and 240.

A separate transformer or reactor must be provided for each lamp. This equipment may be mounted near each individual lamp, or if more convenient, grouped in one or more banks and located at a distance from the lamps.

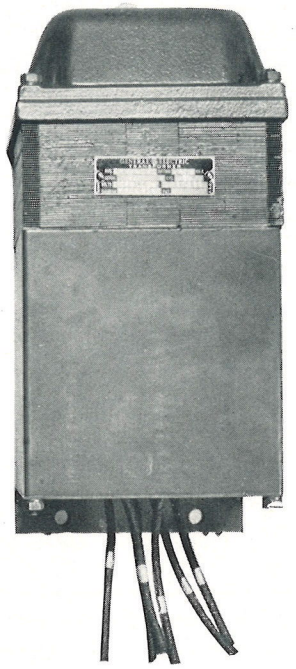
Auxiliary reactor and transformer equipment is available through jobbers handling General Electric equipment. Listed on the following page are the several types of reactors and transformers, including General Electric catalog numbers, weights, and list prices.

REACTORS AND TRANSFORMERS
for
400-WATT HIGH INTENSITY MERCURY VAPOR LAMPS

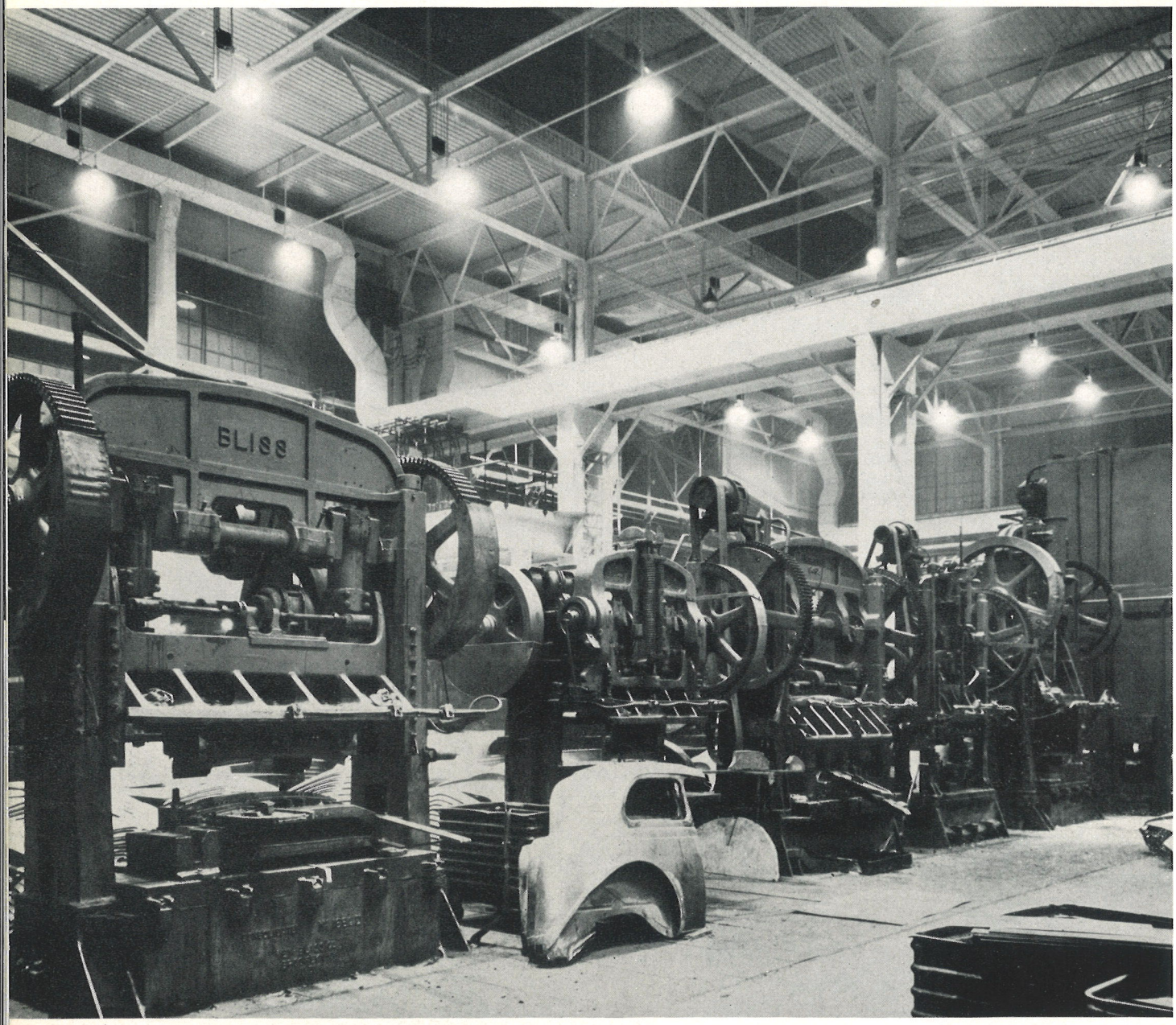
Item No.	Catalog No.	Description	Approximate Weights Net	Shipping	List Price f.o.b. Fort Wayne
		Reactors and Transformers for 230-Volt, 60-Cycle Circuits			
1	9XD336A	Core and Coils Only	13.5 lbs.	16 lbs.	$ 6.75
2	9XM199A	Weatherproof	19 lbs.	29 lbs.	8.75
3	9TMX49A	Weatherproof, High Power Factor Type	36 lbs.	50 lbs.	15.00
		Transformers for 115-Volt, 60-Cycle Circuits			
4	9TDX258E	Core and Coils Only	22.5 lbs.	26 lbs.	8.50
5	9TMX47A	Weatherproof	28.5 lbs.	38 lbs.	11.00
6	9TMX48A	Weatherproof, High Power Factor Type	36 lbs.	50 lbs.	15.00



A regulating transformer for use on 115-volt lines where power factor correction is not important. The transformer shown is enclosed in a weatherproof housing, over-all dimensions $6\frac{1}{4}''$ x $6\frac{5}{16}''$ x $9\frac{3}{8}''$. For 230-volt line operation there is available a reactor of the same general appearance, the over-all dimensions of which are $5\frac{1}{2}''$ x $4\frac{7}{16}''$ x $7\frac{3}{4}''$. This equipment may be mounted on a column or beam near the lamp or on a panel board with several other transformers in a central location.



On 115-volt circuits where power factor correction is desired, the use of a transformer with built-in condenser of the type shown here will result in a power factor of 92–95%. The over-all dimensions of this piece of equipment are $6\frac{1}{4}''$ x $6\frac{5}{16}''$ x $13\frac{1}{2}''$. For power factor correction on 230-volt lines, a transformer-condenser which may be used is very similar in appearance and has the same over-all dimensions.



The High Intensity Mercury Vapor Lamp is particularly well adapted for use in high bays. Here we see another automobile plant, where an installation of high bay units provides a high level of illumination at minimum current cost.

OPERATION

As soon as the arc has struck, the lamp takes about 20 volts, 5 amperes. When the current flows, the argon arc is seen for about two minutes as a bluish glow that fills the entire arc tube. After a few minutes the voltage rapidly increases until the lamp reaches a stable operating condition in about 10 or 12 minutes, at which time all of the mercury is completely vaporized. The lamp now operates at about 150 volts, 2.9 amperes. At this stage the arc no longer fills the tube but is concentrated to a pencil-like arc stream of high intensity. At full brilliance the lamp produces approximately 14,000 lumens.

The lamps have a very satisfactory performance as far as light output during life is concerned. At the end of rated life their output in percentage of initial is at least comparable with that of corresponding incandescent lamps.

If the current is interrupted while the lamp is in operation, the lamp cannot be re-lighted until it has cooled enough to reduce the mercury vapor pressure sufficiently to allow the arc to strike again, which will occur automatically if the current is on. This may require from five to fifteen minutes, depending on the conditions of operation. This characteristic of the lamp in some applications is likely to be a disadvantage, for example, in a photographic studio or other intermittent service where lamps are often switched on and off. However, where lamps are used continuously for extended periods, as they are in industrial interiors, no inconvenience because of this characteristic has been reported from the many installations already in service.

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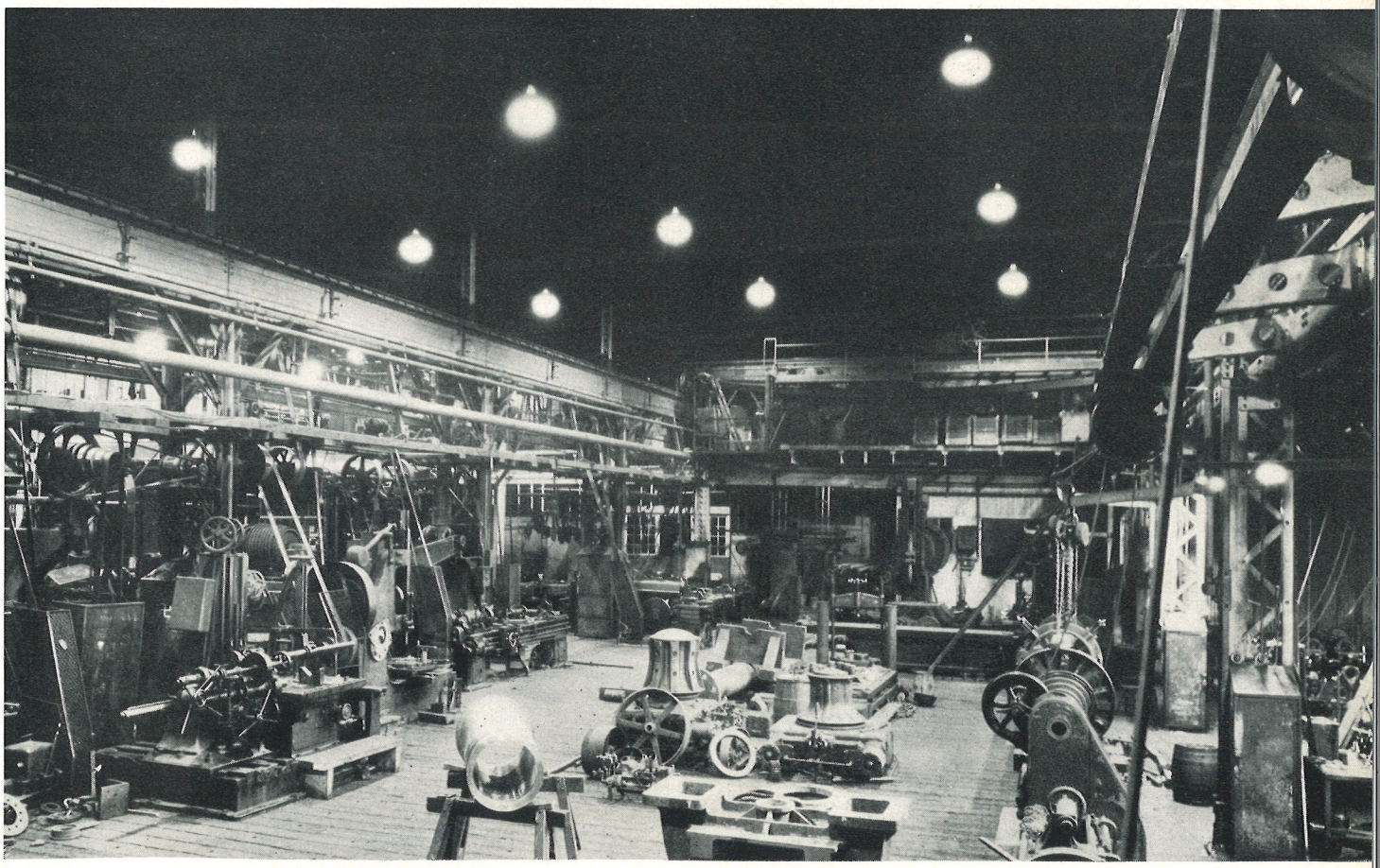
Industrial interiors with high bays where there is no need for color discrimination may be well lighted by an installation of High Intensity Mercury Vapor lighting.

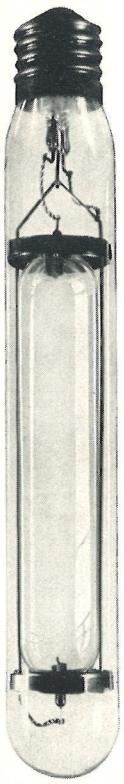


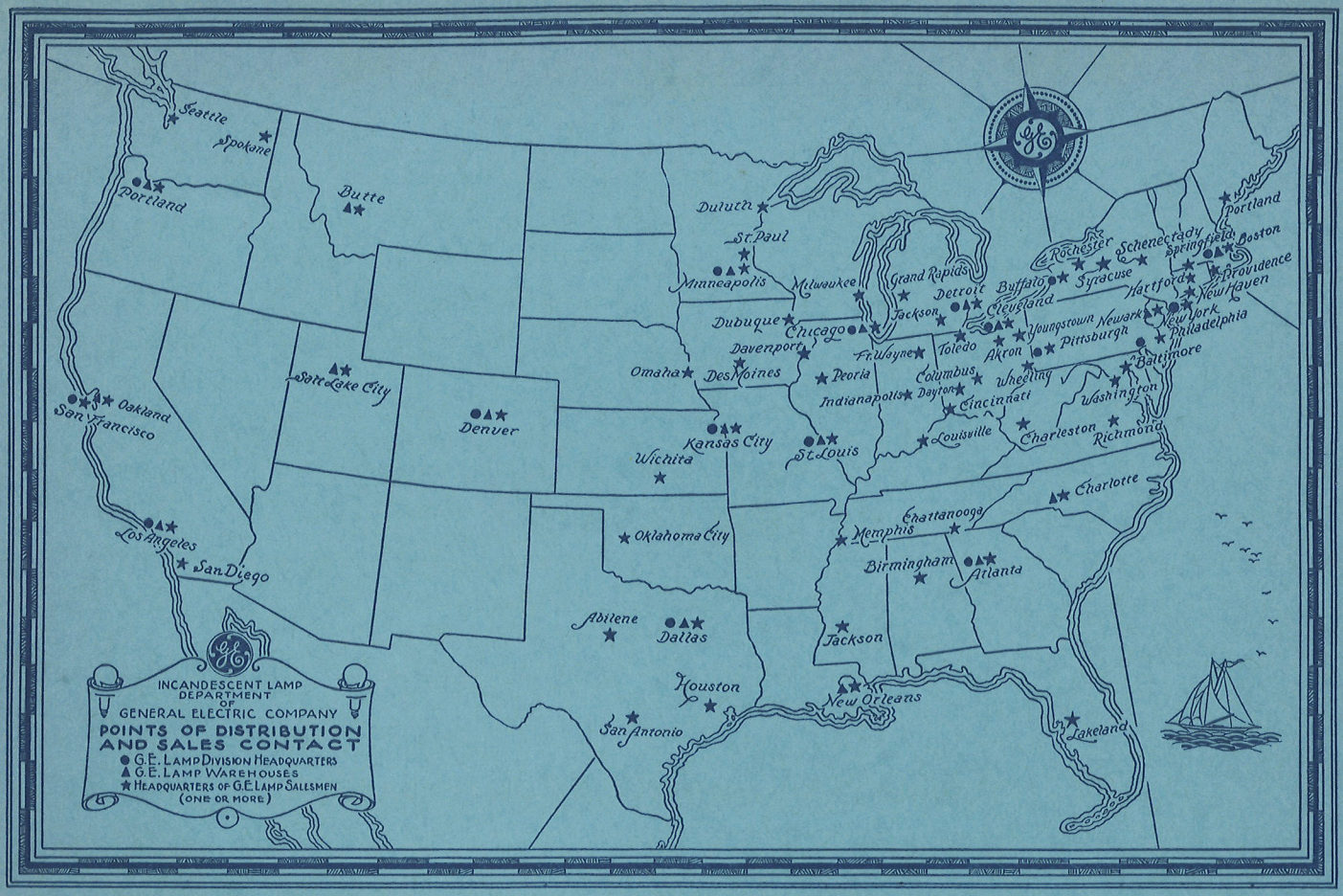
SALES INFORMATION

THE New High Intensity Mercury Vapor Lamps are available through the seventeen Sales Divisions of the Incandescent Lamp Department of General Electric Company. These Sales Divisions, listed on the following page, are equipped to render complete engineering service in connection with the application of High Intensity Mercury Vapor Lamps and in the design of lighting installations.

The list price of the 400-watt High Intensity Mercury Vapor Lamp is $12.50 and the following discounts apply to consumers purchasing only for their own requirement.

Quantity	*Discount*
Less than Standard Package of Six Lamps .	0%
Standard Packages	15%
10 or More Standard Packages	20%





DIRECTORY

SALES DIVISIONS

ATLANTA
Southeastern Division
Incandescent Lamp Dept. of G.E. Co.
Red Rock Building, 187 Spring St., N. W.
Atlanta, Georgia.

BOSTON
New England Division
Incandescent Lamp Dept. of G.E. Co.
United Shoe Machinery Building
50 High Street, Boston, Mass.

BUFFALO
Empire Division
Incandescent Lamp Dept. of G.E. Co.
Genesee Building, 1 West Genesee St.
Buffalo, N.Y.

CHICAGO
Midland Division
Incandescent Lamp Dept. of G.E. Co.
Continental Illinois Bank Bldg.
230 South Clark St., Chicago, Illinois.

CLEVELAND
Buckeye Division
Incandescent Lamp Dept. of G.E. Co.
Terminal Tower, Cleveland, Ohio.

DALLAS
Southwestern Division
Incandescent Lamp Dept. of G.E. Co.
General Electric Building
1801 North Lamar St., Dallas, Texas.

DENVER
Rocky Mountain Division
Incandescent Lamp Dept. of G.E. Co.
650 Seventeenth St., Denver, Colo.

DETROIT
Michigan Division
Incandescent Lamp Dept. of G.E. Co.
1249 Washington Blvd., Detroit, Mich.

KANSAS CITY
Midwest Division
Incandescent Lamp Dept. of G.E. Co.
Power and Light Building, 106 W. 14th St.
Kansas City, Missouri.

LOS ANGELES
South Pacific Division
Incandescent Lamp Dept. of G.E. Co.
Edison Building
601 West Fifth St., Los Angeles, Calif.

MINNEAPOLIS
Northern Division
Incandescent Lamp Dept. of G.E. Co.
523 Marquette Ave., Minneapolis, Minn.

NEW YORK
Atlantic Division
Incandescent Lamp Dept. of G.E. Co.
General Electric Building, 570 Lexington Ave.
New York, N.Y.

PHILADELPHIA
Continental Division
Incandescent Lamp Dept. of G.E. Co.
Mitten Building, 1405 Locust Street
Philadelphia, Pa.

PITTSBURGH
Allegheny Division
Incandescent Lamp Dept. of G.E. Co.
Koppers Building, 436 Seventh Ave.,
Pittsburgh, Pa.

PORTLAND
North Pacific Division
Incandescent Lamp Dept. of G.E. Co.
Terminal Sales Building
1220 S. W. Morrison Street
Portland, Oregon.

SAN FRANCISCO
Pacific Division
Incandescent Lamp Dept. of G.E. Co.
Russ Building, 235 Montgomery Street
San Francisco, Calif.

ST. LOUIS
Mississippi Valley Division
Incandescent Lamp Dept. of G.E. Co.
Landreth Building, 320 North 4th Street
St. Louis, Missouri.

WAREHOUSES

Atlanta Lamp Warehouse
490 Glenn St., S.W., Atlanta, Georgia.

Chicago Lamp Warehouse
3636 S. Iron Street, Chicago, Illinois.

Cleveland Lamp Warehouse
1133 East 152nd Street, Cleveland, Ohio

Dallas Lamp Warehouse
703 McKinney Avenue, Dallas, Texas.

Denver Lamp Warehouse
1863 Wazee Street, Denver, Colorado

Detroit Lamp Warehouse
700 Antoinette Street, Detroit, Mich.

East Boston Lamp Warehouse
156 Porter Street, East Boston, Mass.

Kansas City Lamp Warehouse
819 E. Nineteenth St., Kansas City, Mo.

Los Angeles Lamp Warehouse
5205 Santa Fe Ave., Los Angeles, Calif

Minneapolis Lamp Warehouse
410 Third Ave., No., Minneapolis, Minn

Newark Lamp Warehouse
133 Boyd Street, Newark, New Jersey.

Oakland Lamp Warehouse
1648 Sixteenth Street, Oakland, Calif.

Portland Lamp Warehouse
1239 N.W. Glisan Street, Portland, Oregon.

St. Louis Lamp Warehouse
4142 N. Union Blvd., St. Louis, Missouri.

FACTORY

G-E Mercury Vapor Lamp Co.
Hoboken, N. J.

■ *Sales Division headquarters of the Incandescent Lamp Department of General Electric are located in seventeen leading cities throughout the United States, with branch sales offices in other important centers. Complete warehousing facilities guarantee 24-hour distribution anywhere in the country.*

Lamps bearing the famous General Electric monogram assure you of good light at low cost. Look for this monogram on every lamp you buy.

August, 1935

Form LS-1012