3 NEW

GENERAL ELECTRIC GERMICIDAL LAMPS

FOR KILLING HARMFUL BACTERIA

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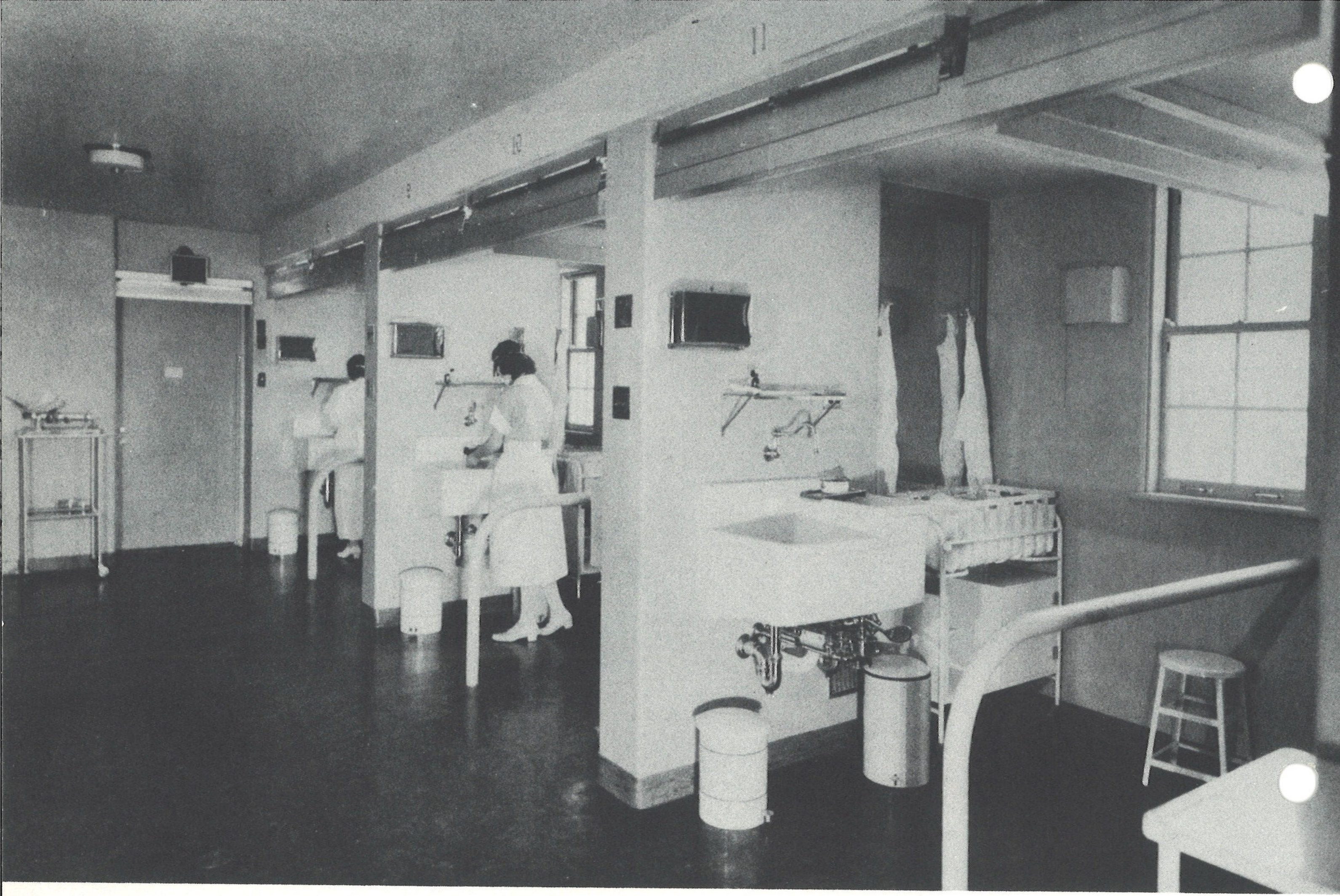


● *Scientific research has proved that Germicidal Lamps, installed as shown here at the Cradle, famed foundling home in Evanston, Ill., will substantially reduce the bacteria carried in air. While final results of the research are not yet available, it is believed that a curtain of ultraviolet energy across the entrance to each room or cubicle will aid in preventing the spread of disease by air-borne bacteria.*

ESSENTIAL FEATURES

The elimination of germs and bacteria detrimental to health has been steadily pursued by science for many years. Various methods of sterilization are employed. One convenient form, offering a great diversity of applications, is ultraviolet energy.

Germicidal Lamps derive their name from their ability to produce energy which under certain conditions will destroy bacteria. At the present time, the benefits of ultraviolet energy most widely enjoyed are the constructive benefits obtained from the use of sunlamps—the prevention and curing of rickets in children and the building of stronger bones and teeth in both children and adults. Most of the energy obtained from Germicidal Lamps differs from that provided by sunlamps in that it is of wave lengths not reaching the earth from the sun.

Three Forms of Radiant Energy

The difference in wave lengths of the energy obtained from Germicidal Lamps and other sources radiating ultraviolet energy can best be explained by a brief description of what ultraviolet is, where it comes from, and certain of its characteristics.

In general the radiation of the sun can be divided into three parts: (1) Visible energy or light; (2) Infrared energy which is invisible but produces heat, as does other radiant energy when it is absorbed; (3) Ultraviolet energy which is invisible and cannot be directly detected by any of our senses, although some of its effects can be. These forms of radiant energy differ only in the lengths of their waves. The infrared waves are the longest, the visible light waves are shorter, and the ultraviolet waves are the shortest. Wave lengths of radiant energy are measured in terms of Angstrom units. An Angstrom unit, generally designated by the letters "Å" or "AU," is a length of one ten-millionth of a millimeter or four-billionths of an inch. The range of wave lengths of infrared, visible light and ultraviolet are given in Diagram 1.

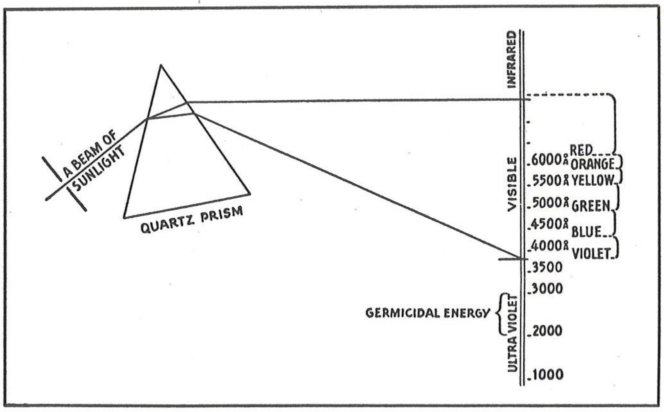


Diagram 1

Range of wave lengths of infrared, visible light and ultraviolet energy.

The Ultraviolet Spectrum

Visible energy or light is subdivided into colors of the spectrum produced by the energy of different wave lengths. All that is necessary in order to separate the different portions of the spectrum is to pass a beam of light through a suitable prism.

Ultraviolet is also made up of energy of different wave lengths of an approximate range from 4000 to 1000 Å. It can be subdivided along with visible and infrared energy by passing a beam through a quartz prism (Diagram 1).

The following table indicates how the ultraviolet spectrum may be divided *approximately* into four parts according to one or more principal effects or uses of ultraviolet energy:

1. Up to 2000 Å —production of ozone.
2. 2000 to 2800 Å—sterilization by killing bacteria.
3. 2800 to 3200 Å—supplied by sunlamps for health purposes.
4. 3200 to 4000 Å —photographic and fluorescent display range.

The divisions actually overlap considerably.

In another common breakdown the energy is referred to as:

1. Far ultraviolet (1000 to 2000 Å).
2. Middle ultraviolet (2000 to 3000 Å)
3. Near ultraviolet (3000 to 4000 Å).

Sunlamps vs. Germicidal Lamps

Ultraviolet energy has certain other characteristics which should be considered. Only the longest ultraviolet waves will pass through ordinary glass. Short waves of approximately 1700 Å will pass through quartz but shorter ones are absorbed by air in the production of ozone. This is of vital importance in the manufacture of artificial sources of ultraviolet. For instance, the special glass used in sunlamp bulbs, transmits practically no radiation shorter than 2800 Å. On the other hand, a very special glass is used in making Germicidal Lamps so that energy of wave lengths shorter than 2800 Å can readily pass through it.

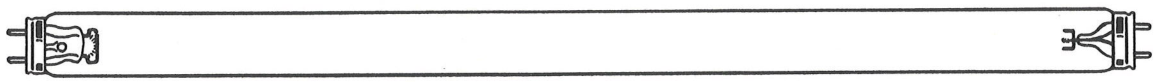
Sunlamps radiate waves from 2800 to 3200 Å in length and supply no appreciable ultraviolet energy of wave lengths not found in sunlight. Germicidal Lamps radiate energy of wave lengths from 2000 to 2800 Å. Most of these waves are 2537 Å in length, which is the point at which the energy is most effective in destroying bacteria.

HOW THE GERMICIDAL LAMP OPERATES

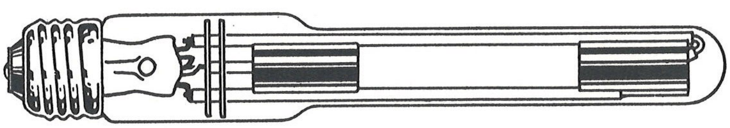
The Germicidal Lamp is almost identical in its operation with the fluorescent lamp, the only difference being the lack of fluorescent powder in the Lamp. Current flows from electrode to electrode through mercury vapor, producing very little visible light and crowding most of its energy into ultraviolet energy at the 2537 Å line. Instead of activating fluorescent powder on the inside of the Lamp, the ultraviolet passes through the special glass used in the Germicidal Lamp.

Auxiliary Equipment

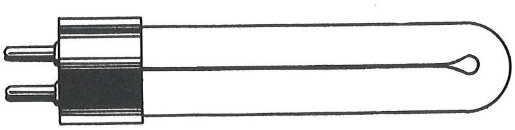
In common with all electrical discharge sources, the Germicidal Lamp requires auxiliary control equipment. (See Table A)



Fifteen-watt Lamp, the largest Germicidal Lamp now available. Requires auxiliary control equipment, (1) iron-core choke coil (2) starting switch.



Five-watt Lamp, for applications where smaller amounts of ultraviolet are desired. No auxiliary equipment needed.



Three-watt Lamp. Produces more ultraviolet than five-watt Lamp. Requires Z-11202 reactor for operation.

OPERATING DATA ON GERMICIDAL LAMPS

There are several factors affecting the operation of Germicidal Lamps which should be pointed out to anyone selling or using them.

Humidity

The amount of humidity has a marked effect on the ability of ultraviolet at 2537 Angstrom units to kill air-borne bacteria. If it is assumed that humidities of less than 60 per cent are low, and greater than 80 per cent are high, we can state roughly that at ordinary room temperatures it requires several times as much radiation to kill germs at high humidity as at low humidity.

Volume of Air per Lamp

Tests with Colon Bacilli* indicate that at medium humidity, one 15-watt Lamp in a duct made of non-reflecting material can sterilize 200 cubic feet of air per minute. This is independent of the size of the duct—within reasonable limits—because while large ducts conduct some of the air at greater distances from the Lamp, they also provide slower air movement and therefore longer exposures, offsetting the lower intensity of ultraviolet.

If the duct is made of a material which is a good reflector of 2537 radiation (See Table B), the ultraviolet intensity is increased considerably, expanding correspondingly the volume of air that can be sterilized by the Lamp. In order to maintain the intensity of radiation, the Lamp and duct should be regularly and thoroughly cleaned.

Lethel Dosage

Since Colon Bacilli are frequently used in experiments to test the strength of an antiseptic, they were used in measuring the killing power of the Germicidal Lamp. The lethal dosage has been found to be approximately 6600 micro-watt seconds** of 2537 energy per square centimeter of area covered. It seems to make little difference whether a long exposure of low intensity or a short exposure of high intensity is used. Exposures ranging in lengths from a few seconds close to the Lamp to many minutes at distances of several feet have been found necessary with a single Lamp without reflector.

Considerably longer exposures than are needed for killing Colon Bacilli are required for eliminating molds.

Depreciation

Tests to date indicate that the ultraviolet output of the 15-watt Lamp is approximately 80 per cent of the initial output after burning 1000 hours.

Temperature

Apparently Colon Bacilli are killed as readily at 100° F as at 52° F. However, the ultraviolet output of the Lamp is materially reduced by low temperatures. In still air it will be approximately 60 per cent of normal at freezing and 30 per cent at zero.

Production of Ozone

Germicidal Lamps generate an extremely small amount of ozone, which is helpful in killing bacteria and reducing mold. Ozone can be tolerated by human beings only in very limited amounts, without becoming irritating to the nose and throat. Under ordinary conditions of use, the ozone generated by a Germicidal Lamp is not enough to be objectionable.

Effect of 2537 Radiation on Eyes

Exposure of the eyes to the energy from a Germicidal Lamp will cause severe conjunctivitis†. Where the Lamps are mounted above the normal line of vision and several feet away, there is little danger from short exposures. However, glasses or a celluloid eye shade should be worn as an added protection.

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* Bacteria normally inhabiting the colon or lower intestine.

† Inflammation of the conjunctiva, the outer covering of the eyeball and the eyelids.

** A micro-watt is a millionth of a watt. Therefore 6600 micro-watt seconds means 6600 millionths of a watt for one second, 3300 millionths of a watt for two seconds, etc.

TECHNICAL DESCRIPTION

Table A

	15-watt (Same as Fluorescent)	5-watt	3-watt
Overall length	$17\frac{25}{32}$ in.	7⅝ in.	5⅜ in.
Diameter	1 in.	1¼ in.	½ in.***
Operating voltages	110-125 v., 60 cycles	110-125 v., 50-60 cycles	110-125 v., 60 cycles
Nominal lamp amperes	.27	.048	.050
Watts incl. reactor	19	5	4
Life	1500 hrs.	1500 hrs.	1000 hrs.****
U.V. output	15-20 micro-watts per CM^2 of 2537 Å at one meter	1 micro-watt per CM^2 at one meter	3 to 4 micro-watts per CM^2 at one meter
Base	FA-1 cap	Medium screw	Radio No. 4108
Operating auxiliary	Same as for 15-watt T-8 fluorescent lamp	None required	Z-11202 reactor
Burning position	Any	Any	Any
Price	$5.75	$5.00	$4.75
Bulb	T-8	T-10	T-4*****
Standard Package Quantity	24	24	12

*** The General Electric Company can also supply two other types of sterilizing units. The one generally known as the cold cathode type is available in the 10 in., 20 in. and 30 in. sizes, the rating being approximately 6 to 10 watts.
The Uviarc is available in sizes from 250 to 1200 watts. These are the quartz mercury arcs generally used in the medical profession, and in commercial devices for the sterilization of water, the vitaminization of food products, and a variety of photochemical reactions.
These units require special sockets and auxiliary devices. Information on these two types of sterilizing units and their auxiliary equipment can be obtained from the Lamp Department, General Electric Company, Nela Park, Cleveland, Ohio.

**** A conservative estimate. Tests not yet completed.

***** Bent-tube or "closed hairpin" construction makes lamp approximately one-inch wide.

Reflection Factors Of Five Materials At Three Wave Lengths

Table B

Material	Per Cent Reflection-Factor at		
	2537 Å	2967 Å	3660 Å
Smoked magnesium oxide	93	95	96
Vaporized aluminum deposit on glass	87	90	91
Polished and electrolytically brightened aluminum	82	84	87
Chemically etched aluminum	76	80	83
Chromium plated metal	50	59	64

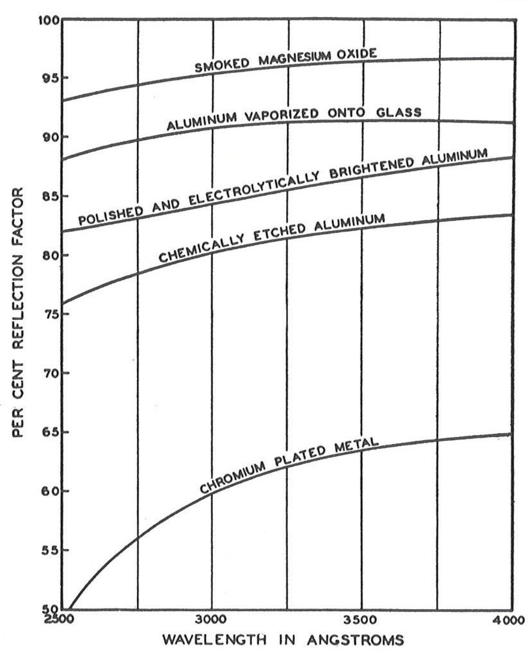
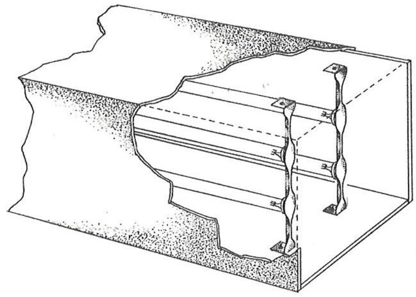


Diagram 2

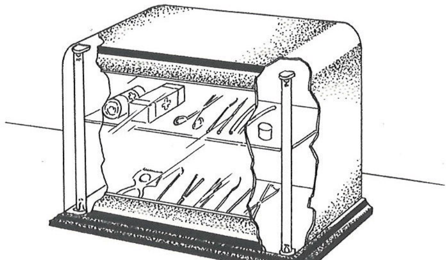
APPLICATIONS FOR GERMICIDAL LAMPS

● Germicidal Lamps have been used successfully for sterilizing air in air ducts and killing air-borne bacteria in hospitals, and are being tried for sterilization in cosmetics manufacture, and in food industries, particularly in meat storage, bakeries, and in canning. Since the Lamps are of small size, they are particularly suited for installation in places where space is limited to cabinet or cupboard areas. There are wide opportunities for application in doctors' and dentists' offices and in hospitals for keeping sterile articles that have been sterilized. To a limited extent the Germicidal Lamp can be used in the home for keeping sterile such articles as nursery equipment, dishes, silverware, and tumblers which have previously been sterilized.

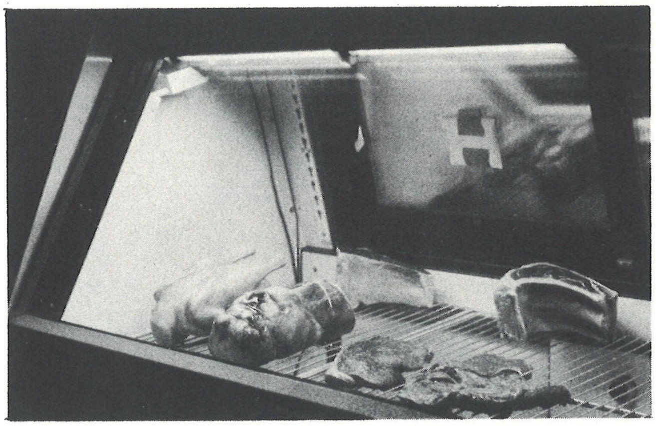
It should be noted that the Germicidal Lamps can be fully effective only when the bacteria can be reached by the direct rays of the ultraviolet and when humidity and temperature conditions are satisfactory.



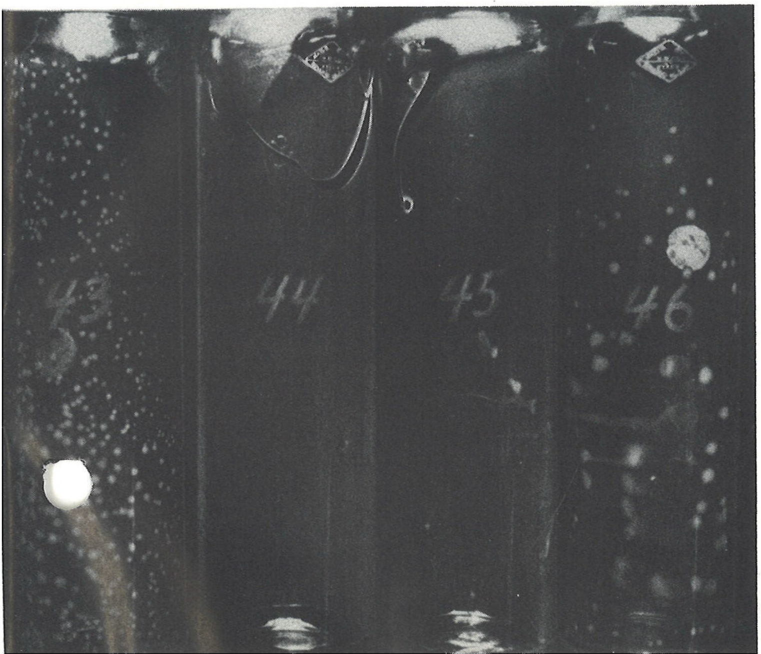
● *Germicidal Lamps properly installed and in sufficient quantities can make air delivered from air ducts practically free of bacteria.*



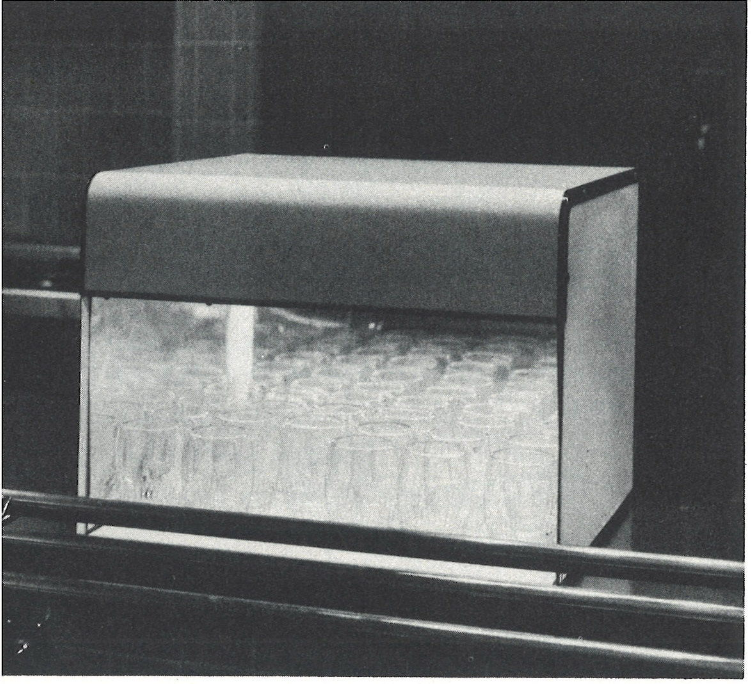
● *Sterilized instruments, bandages, and other articles can be kept sterile by the energy from Germicidal Lamps installed at the opening of the cabinet or container.*



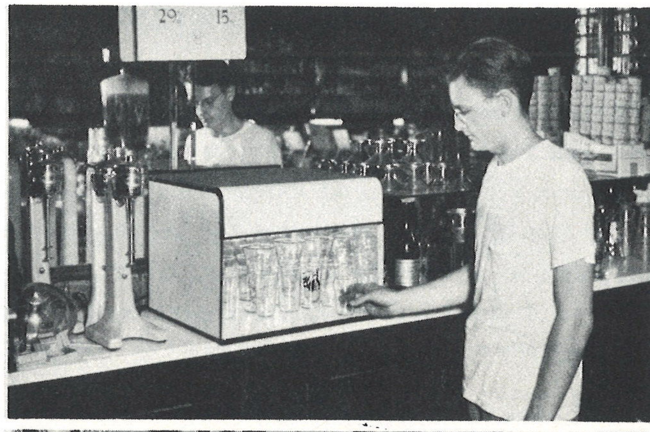
▲ *The use of Germicidal Lamps in walk-in coolers and refrigerated display cases is being tested with a view to retarding growth of molds and bacteria.*

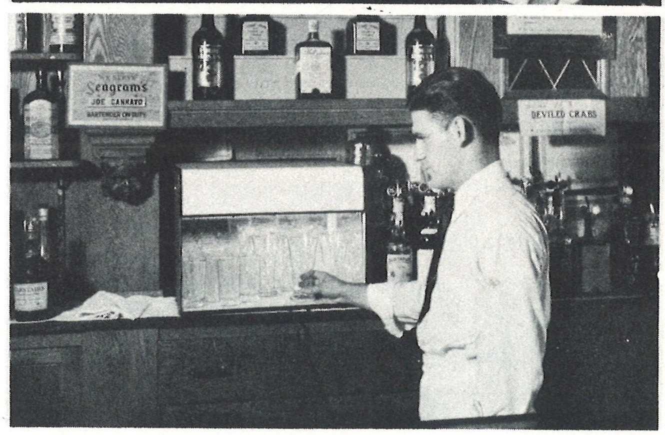


◄ *The four glass containers show the effect of irradiation by Germicidal Lamps of colon bacilli suspended in air. Container 43 shows the number of bacteria collected from a sample of air which was not irradiated. The second tube (No. 44) is completely sterile, showing that no bacteria were present in a sample of air irradiated for 10 seconds. The third container (No. 45) shows a few bacteria remaining in a sample of air which was irradiated for five seconds, while the tube at the right (No. 46) shows incomplete sterilization after irradiation for one second.*



● *Long recognized as a potential source of infection, the drinking glass offers a great opportunity for application of Germicidal Lamps. Properly installed in cabinets such as shown here, the Lamp can supplement present sterilization methods in providing the patrons of restaurants, drugstores, or bars with glasses as free as possible from pathogenic bacteria.*





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