Raytheon
TECHNICAL BULLETIN

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Useful facts about the *Raytheon Kino Lamp*

By D. E. REPLOGLE

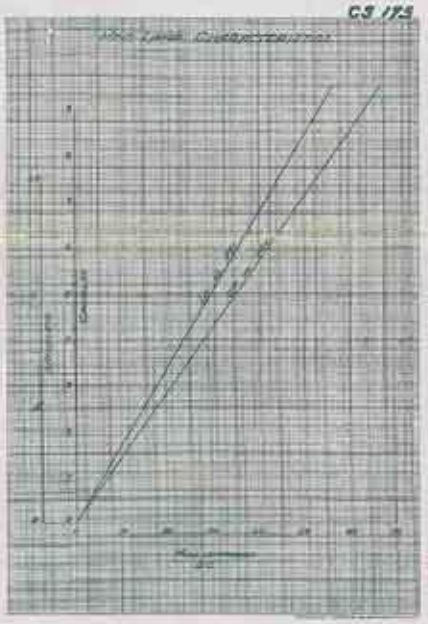
THE RAYTHEON KINO-LAMP as a variable source of light in the output circuit of a television receiver has required, up to date, much "cut and try" experimental work in ascertaining the correct power tube to use and the correct current to pass through the lamp to give the optimum brilliancy of the image.

After a fashion such experimental results are satisfactory, but before a purposeful analysis of what happens is made with a view of determining in what ways results can be bettered, there are some essential characteristics of the Kino-Lamp that must be known. These characteristics can best be put in the form of curves. This bulletin is written to give these characteristics in a clear and understandable manner.

Units

In these characteristic curves the units are Candle Power, Lumens and Lamberts. The total amount of light can be measured in Candle Power or Lumens. The surface brightness is best measured in Lamberts.

1. The unit Candle Power is well known and is the luminous intensity given by a standard candle as determined by the Bureau of Standards.
2. One standard candle gives out 4π Lumens of light flux from a source that radiates uniformly in all directions. When a flat plate is considered, as in the Kino-Lamp, one candle power will radiate approximately π Lumens, as one side only is used.
3. The Lambert is the measure of surface brightness and is the surface brightness that will give one Lumen per square centimeter or gives a luminous intensity of .32 Candle Power per square centimeter of projected area. For comparison, the frosted bulb of an incandescent light has a surface brightness of approximately three Lamberts.



CS-175

RELATION OF LIGHT OUTPUT AND BRIGHTNESS TO D. C. CURRENT THRU RAYTHEON KINO-LAMP.

With these definitions in mind use can be made of the following data:—

Candle Power and Surface Brightness

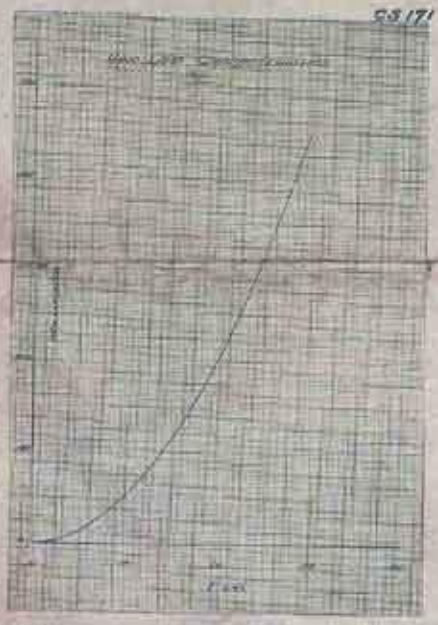
Plate CS-175 shows the variation in apparent Candle Power as viewed in the direction normal to the cathode surface and also the surface brightness measured in Lamberts as the current through the tube is varied. It is readily seen that both the apparent Candle Power and surface brightness are directly proportional to the current and the proportionality factor or slope of the curve is respectively .14 candles per milliampere of current through the tube and .03 Lamberts per milliampere through the tube. These factors have been found constant within a very few per cent for all standard Kino-Lamps, though the voltage drop in different tubes has been varied as much as 100 volts in operating. For best results in a television receiver the slope of these lines is particularly important as it is the variation between maximum and minimum brightness with maximum and minimum current that gives definition to the

age supply of approximately 180 volts. The average variation of voltage drop in a lamp with varying current is shown in CS-176. This is also approximately a straight line, the slope corresponding to approximately five hundred ohms. This represents a resistance offered by the lamp to changes in current within the operating range and can be considered its internal impedance.

Series Resistance Values

As gas discharge tubes are inherently unstable, that is, have a very pronounced negative resistance characteristic, it is always necessary to operate them with a series resistor to prevent the current from rising to an excessive value.

The second curve on plate CS-176 shows the approximate value of resistance required to hold the current in the Kino-Lamp to any desired value when operating on 180 volts direct current. Both the curves in this set show average values and are given only as an aid to set design. Individual tubes will show variation from values indicated in these curves and in practice the series resistance should be adjustable to compensate for variations in the lamps.



CS-171

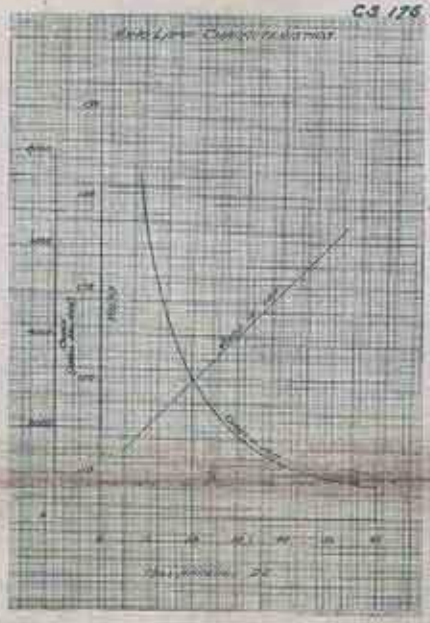
RELATION OF CURRENT OUTPUT TO POWER INPUT.

When a series resistance is used other than the amplifier tube itself or the coupling resistors, it should be shunted by a large bypass condenser so that the impedance to the AC component of current will be low.

The curve on plate CS-171 is based on the value of lamp resistance shown by the curves on plate CS-176 and represents average values. As stated previously, it is obvious that the greatest contrast is obtainable by operating the Kino-Lamp so as to give the lowest possible instantaneous value of current and the highest possible value of current, the contrast being determined by the values of the fluctuation of current in the lamp itself. The value of the fluctuating component of current in turn depends on the amplitude of the signal received and the degree of amplification in the receiving set. The amplitude of the AC component that the Kino-Lamp will handle and the corresponding image brightness and the contrast obtainable with strong signals are limited by the average or DC component of current that can be safely passed through the lamp. Good contrast can be obtained by a steady DC current of ten milliamperes and it is recommended that the DC current be not allowed to exceed twenty milliamperes. Operation at higher value of current, while making the image brighter, is not needed as the contrast of minimum to maximum intensity does not increase rapidly with higher values of steady DC component of current. An excessive DC current through the lamp will result in a proportional reduction in its life which will be manifested by a gradual increase in operating voltage and resistance of the lamp and a gradual blackening of the bulb.

Description

The construction of the Raytheon Kino-Lamp is such that there are two plates, either of which may be used so that if the glass before the plate in use becomes darkened, the terminals and the tube may be reversed and the other plate used for a considerably longer time.



CS-176

VALUE OF CURRENT LIMITING RESISTANCE AND INTERNAL IMPEDANCE OF KINO-LAMP.

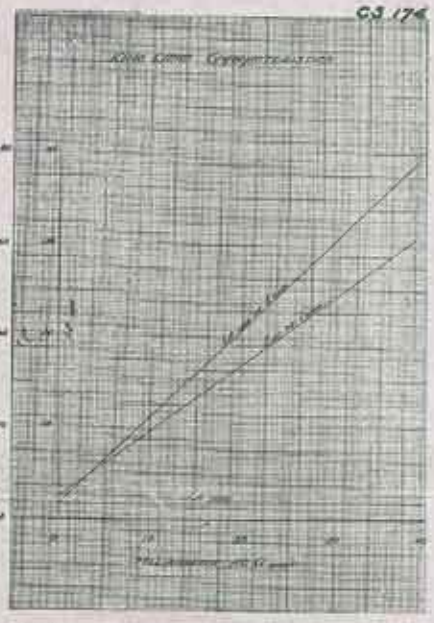
The Raytheon Kino-Lamp is a current operated device and consequently a circuit adjustment to obtain a maximum current change in the plate circuit of a power tube in which the Kino-Lamp is connected is desirable.

While the impedance of the Kino-Lamp is five hundred ohms it can be used directly in the plate circuit of power tubes such as 171 or 210 without any effort made to match the impedance of the tube used. When so used, the undistorted output in wattage will be less than if the impedance were matched, yet the response of the tube will be satisfactory.

Other Uses

While primarily designed for television reception, the Raytheon Kino-Lamp has characteristics which make it applicable for other uses.

One of the most obvious uses is as an oscillator. When connected across a capacitance of approximately two microfarads and the combination connected in series with a variable resistance across a high voltage source, a wide range of frequencies have been easily produced in the tube-condenser circuit. Coupling to this circuit can be made inductively.



CS-174

RELATION OF I_{AV} TO I_{MIN} AND OF BRIGHTNESS TO I_{MIN}

received image. In designing the Kino-Lamp this slope was made as steep as possible and it is an excellent index of the performance of the tube.

Direct current of a minimum value is passed through the Kino-Lamp at all times, this current being either the plate current of the power tube or supplied from an external battery. An AC voltage, which is the output from the power tube as the result of the received television signal, is then impressed on the Kino-Lamp. This voltage causes a varying current to flow. If a black background is desired in the received image the amount of AC variation should be such that the lamp ceases to glow at the minimum value and should glow intensely as possible with the maximum impressed voltage.

In the ordinary use of the Kino-Lamp for television reception it is desired to obtain the greatest possible contrast between the light and dark portions of the image as viewed, in other words between the brightness of the lamp at maximum and minimum value of current. This is determined largely by the amplitude of the AC current which is supplied to the lamp by the receiving set. The minimum steady current at which the glow covers the surface uniformly is approximately five milliamperes. If the current is reduced below this, the glow first fails to cover the entire surface leaving dark areas on the plate, and later the lamp goes out entirely.

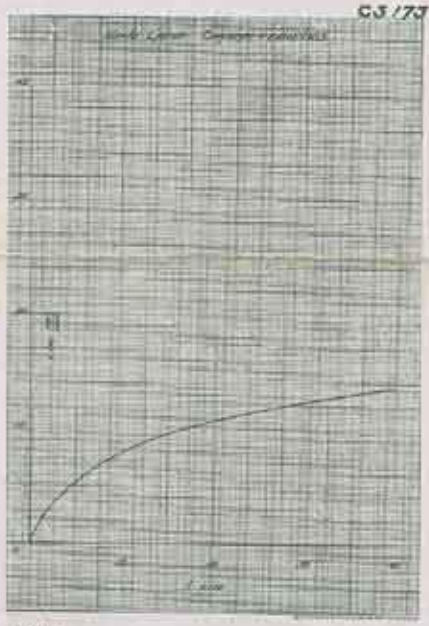
Maximum and Minimum Brightness

The curves on the plate CS-174 are based on the operation of the Kino-Lamp so that the total current falls to a value approximately five milliamperes. They show first, the value of surface brightness in Lamberts corresponding to this minimum value of current; second, the brightness corresponding to the average current, namely, five milliamperes DC, plus the average of the AC component; third, they give the corresponding value of maximum brightness in Lamberts for a given impressed AC current.

It is readily seen that the difference between the maximum brightness and minimum brightness increases in direct proportion to the amount of impressed AC.

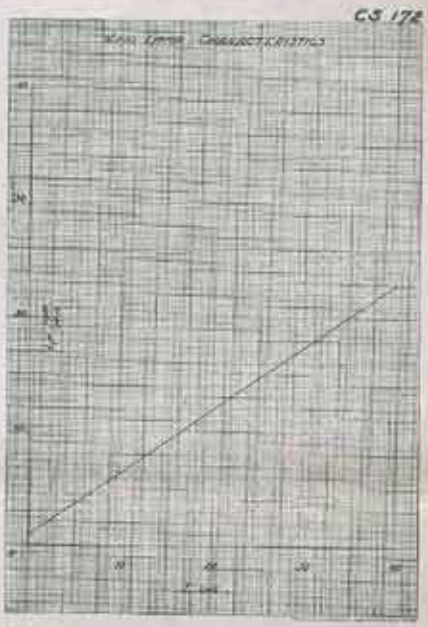
Brightness Ratio

The curve on plate CS-172 shows



CS-173

VISUAL CONTRAST CURVE



CS-172

BRIGHTNESS VARIATION WITH A. C. CURRENT CHANGE

the corresponding ratios of maximum to minimum brightness and gives an indication of the relative brightness of light and dark portions of the picture as received with various values of AC current through the tube. Since the smallest change in brightness that the eye can detect is directly proportional to the instantaneous brightness, the visual contrast between two intensities of light having different values of brightness is best expressed in terms of the logarithm of the ratio of the two brightness values. Thus, the curve on plate CS-173 gives the logarithm of the brightness ratio shown on plate CS-172 and the ordinance of this curve may be taken as a measure of the relative visual contrast between the bright and dark surfaces under the conditions previously stated.

Power Required

To obtain best results from the Kino-Lamp, a suitable power tube should be used with a suitable resistance in series with the lamp, and a proper voltage to obtain best performance.

On plate CS 171 the curve shows the relation between the AC current output and the milliwatts required to supply it. Kino-Lamps should be operated from a DC volt-

Another excellent use of the Kino-Lamp is to connect it in this oscillating circuit and use the light of the tube to watch machinery or objects in motion. By varying the frequencies of the impulses of light sent out by the tube, the object may be made to apparently stand still so that it can be readily seen or the motion apparently slowed down. This is particularly applicable for the studying of knitting needles, or another use would be to note the wave motion over the surface of a loud speaker cone. This has been made use of in commercial stroboscopes.

RAYTHEON KINO-LAMP

It may also be used in series with a resistance to hold a constant voltage across a DC source. This tube is manufactured and sold by the Raytheon Manufacturing Company of Cambridge and is produced as the result of experience gained in the use of gases in gaseous rectifiers.

RAYTHEON KINO LAMP $7.50

For use in television receivers. Price ~~$12.50~~

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Raytheon Kino Lamp, price ~~$12.50~~ $7.50

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