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CHARACTERISTICS DEPENDANCE ON TEMPERATURE
FOR GRIDDED STREAMER DETECTOR

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ABSTRACT

Effect of temperature variation on the characteristics of gridded streamer detector is investigated. Relative detection efficiency is represented, which is very useful for practical use of gridded corona streamer counter.

INTRODUCTION

Temperature is an effective parameter on the efficiency of corona detectors[1-10]. No detailed investigation of the effect of temperature on spark detectors sensitivity has been made[1-5]. Recently an interesting study of characteristics dependance on temperature for wire-plane streamer detectors has been carried out.[6,8]

A trial is presented in this work to clarify the effect of temperature variation on the characteristics of gridded streamer counters.[7]

EXPEREMENT

The streamer counter system was described elsewhere[7] so that only a brief account may be given here.

The form of the gridded single-wire anode streamer detector and block diagram of electronic circuit are shown in Fig.(1). A highly polished stainless steel plate (82 mm effective length) served as cathode. Molybdenum anode and grid wires of diameter $\emptyset = 0.32$ mm were used. The following conditions were chosen: a spacing of 3 mm between grid wires, 17 mm grid-to-cathode spacing, 7 mm anode-to-cathode spacing, 5 MΩ anode load resistance and 10 MΩ grid load resistance.

Also a wide beam of alpha-particles emitted from 239 pu source (25 mm Ø) which was limited by passing through a rectangular plexiglass slit (25 mm length X 4.5 mm width x 8.3 mm thickness) was used.

The detector was operated inside an air-tight thermostat supplied with a temperature control to within ± 0.5°C. A steady stream of dry air free from carbon dioxide was possible to pass through this thermostat. A hygrometer and a thermometer were fixed inside the thermostat to show the relative humidity and temperature during the measuring of the experimental results

EXPERIMENTAL RESULTS

Fig.(2) shows the corrected counting characteristics for various temperatures extending from 10°C to 60°C keeping grid voltage constant at 2250 Volts. Variation in relative humidity (R.H.) due to change in temperature was removed by the possibility of introducing a stream of dry air inside the thermostat. Besides, curves of Fig.(2) were corrected for small deviations from 35% R.H. by using the relative efficiency vs R.H. curves[9]. The results indicate that the sensitivity of the gridded streamer detector is affected by temperature variation. Also it shows that the length of the plateau is somewhat decreased with increasing temperature.

However a small positive plateau slope is noticed at 10°C, while at 50°C and 60°C a small negative plateau slope is noticed.

The corona current characteristics are shown in Fig.(3). These curves show that the corona streamer current I_a increases non-linearly as the anode voltage V_a increases according to equation (1)

$$I_a = a + b\, V_a + C\, V_a^2 \quad \ldots\ldots\ldots \quad (1)$$

where a, b and c are constants.

Applying the least - squares fits to the present experimental results in Figure (3) , the values of a, b & c are calculated. The computed empirical formulae of current I_a are represented on fig (3) by continuous curves. These curves show good agreement with the experimental reseults which are shown in Fig.(3) by different types of dots.

Fig.(4) represents the relative efficiency "E_r" [$E_r = N(X°c)/N(10°c)$] i.e. the average plateau counting rate relative to the average plateau counting rate at temperature 10°c as a function of the temperature. Fig.(4) indicates that the relative efficiency of the gridded streamer detector increases gradually with the increase of temperature up to ∼30°c, after which it increases sharply.

It is clear from fig (3) that the gridded corona streamer detector is more temperature dependent than the wire-plane streamer detector.[6,7]

The internal resistance "r_d" can be determined as function of effective anode voltage "V_{ae}" for different values of temperature by equations (2) & (3)

$$r_d = \frac{V_{ae}}{I_t} \tag{2}$$

where

$$V_{ae} = V_a - I_a R_a - R_t I_t \tag{3}$$

Fig (5) shows the results. It is obvious that "r_d" decreases with the increase of the temperature and that

a small variation in "r_a" is observed with the change
in temperature at high values of "V_{ae}".

Fig.(6) represents the a.c. resistance "r_a" vs."V_{ae}"
for different values of temperatures i.e. 10, 20, 30,
40 & 50°c, as given by equ.(4).

$$r_a = \frac{dV_{ae}}{dI_t} \qquad (4)$$

It is clear that, "r_a" decreases with the increase
of temperature, while at large values of V_{ae} a smaller
variation in "r_a" is noticed.

Fig.(7) shows the threshold voltage "V_o" vs."T"
which is constructed from the curves in Fig.(1). It is
clear that as the temperature increases the threshold
voltage increases also.

ACKNOWLEDGEMENT

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توقف المنحنيات المميزه على درجة الحرارة

للكواثف الفيفية ذات الشبكه

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ملخص البحـــث

درس تأثير تفير درجة الحرارة على خصائص العدادات الهاليـــة الفيفيه ذات الشبكه ورسمت المنحنيات المختلفة التى تربـــط المتغيرات . حددت الكفاءة النسبية ، وهى ذات أهمية كبيـــرة لاستخدام الكواثف الهالية فى الاغراض العملية .
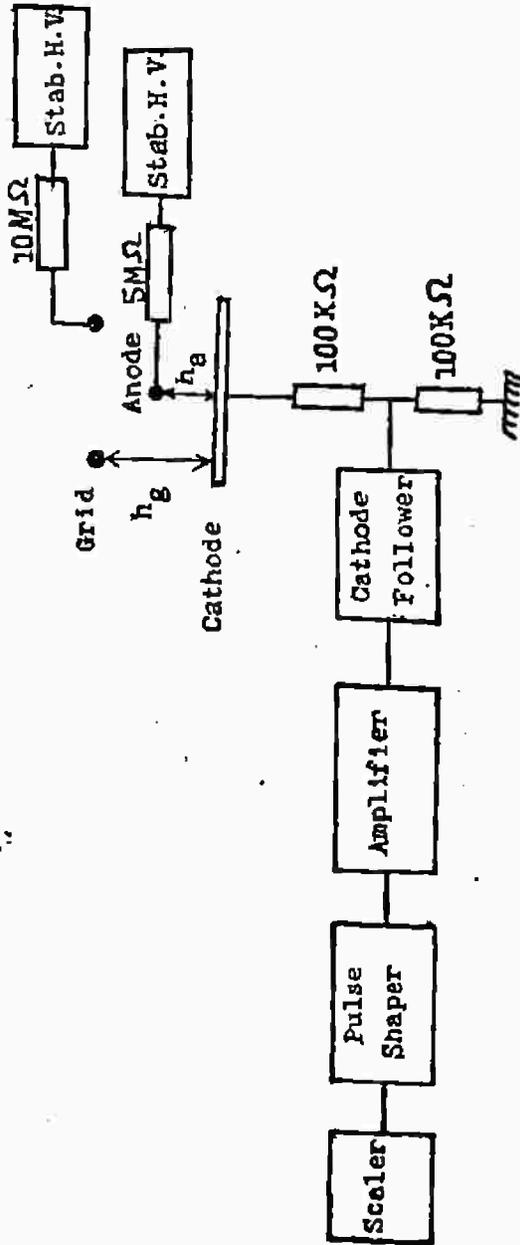
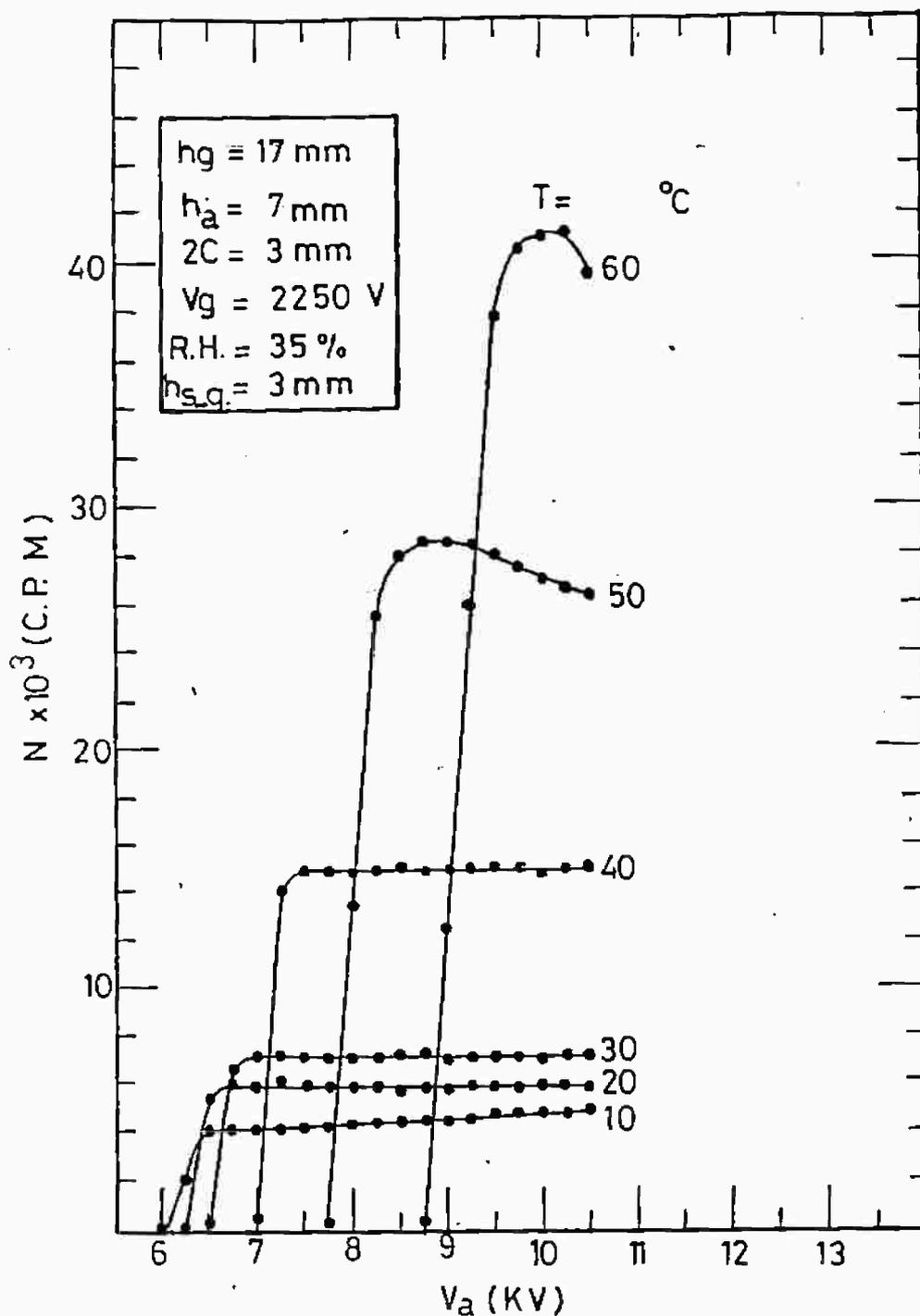FIG (1) THE CIRCUIT FOR PRODUCING AND RECORDING PULSES.
DUE TO INCIDENT ALPHA PATICLES.

FIG.(2) COUNTING CHARACTERISTICS FOR DIFFERENT
VALUES OF TEMPERATURE. -85-
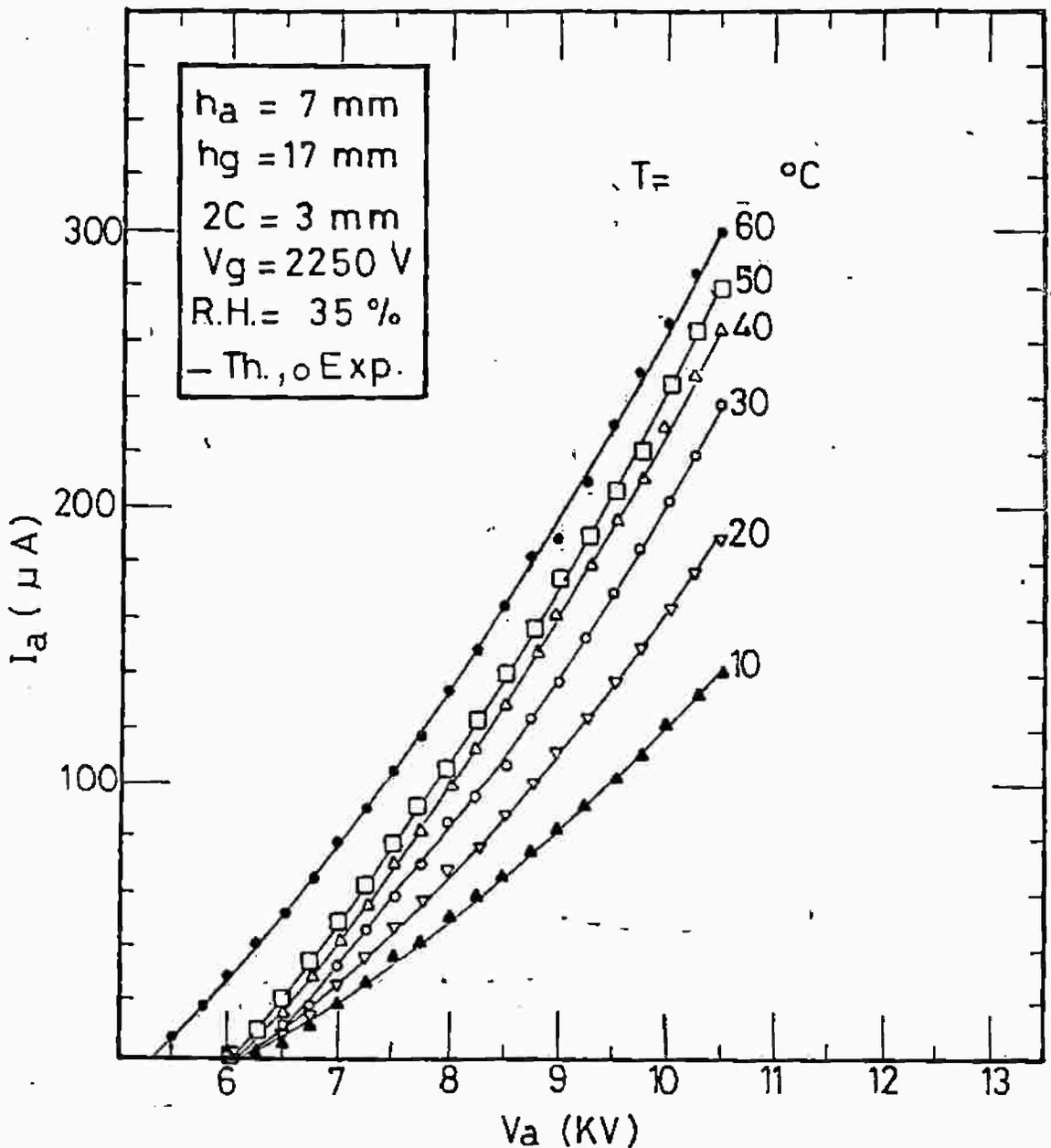
FIG. (3) CORONA CHARACTERISTICS FOR DIFFERENT
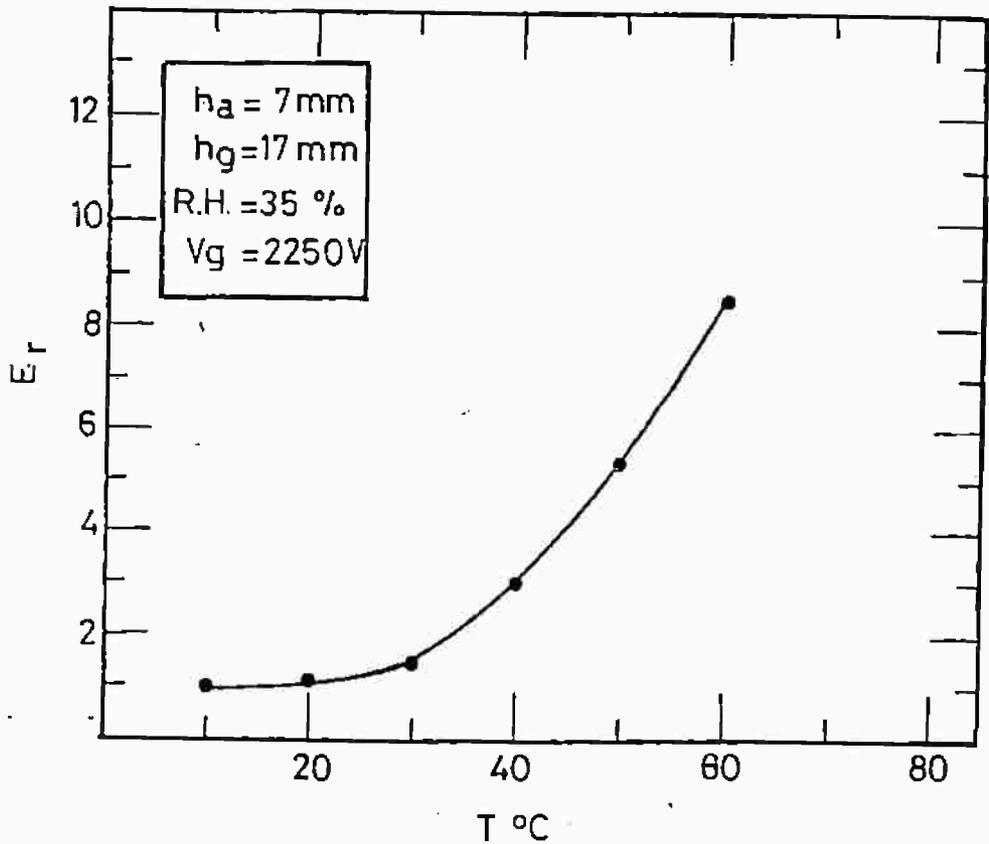VALUES OF TEMPERATURE.

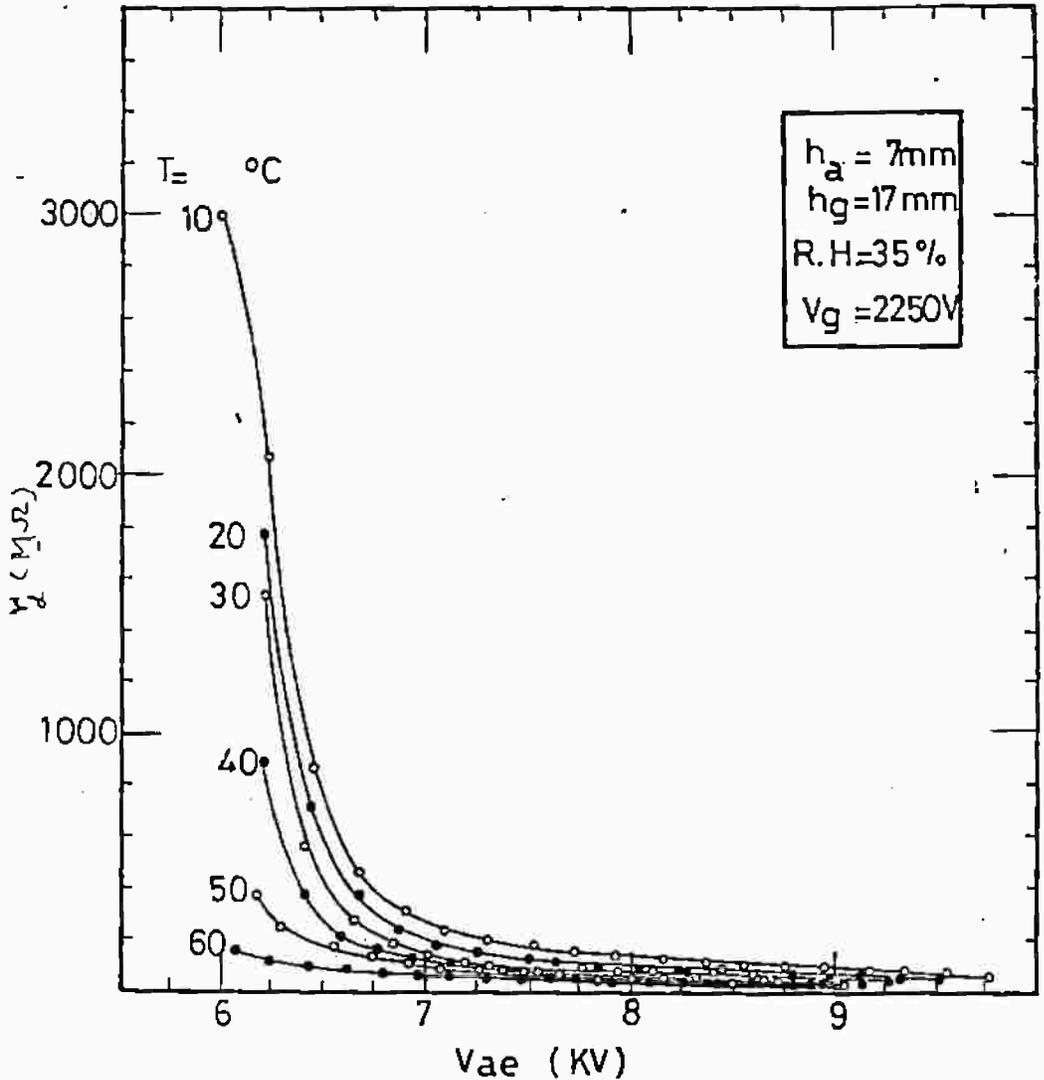FIG.(4): CALCULATED VALUES OF RELATIVE EFFICIENCY E_r vs. T.

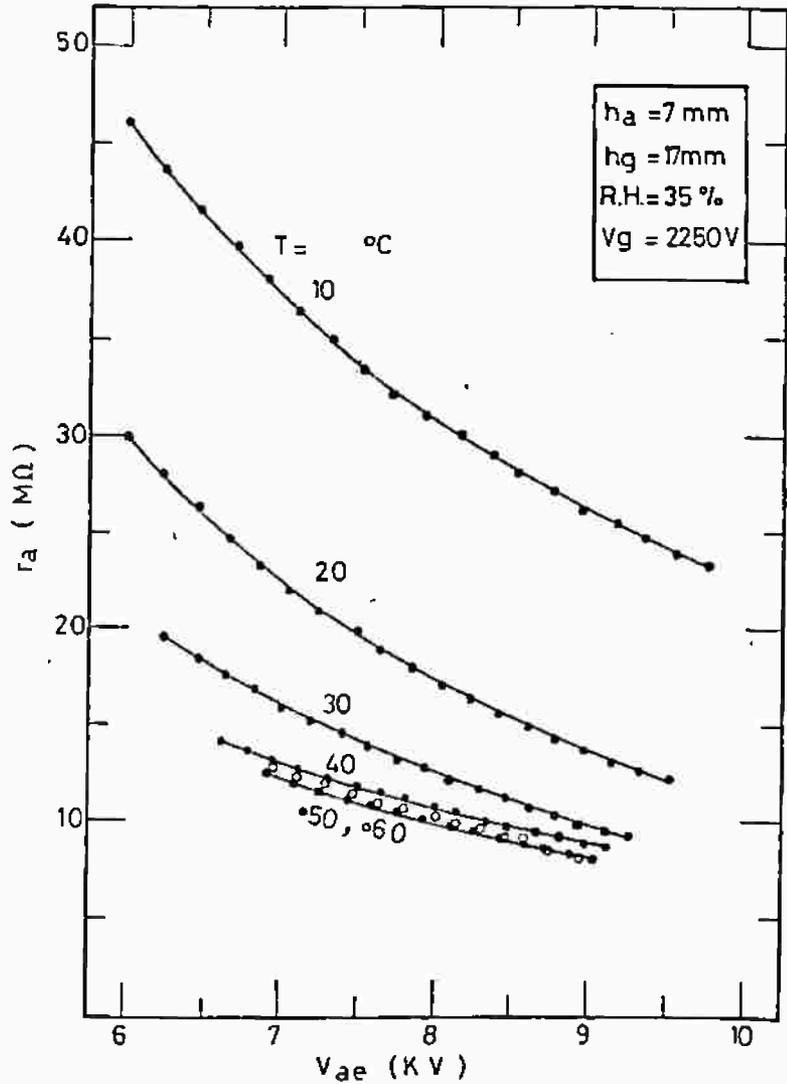FIG.(5) INTERNAL RESISTANCE r_d vs V_{ae} FOR DIFFERENT
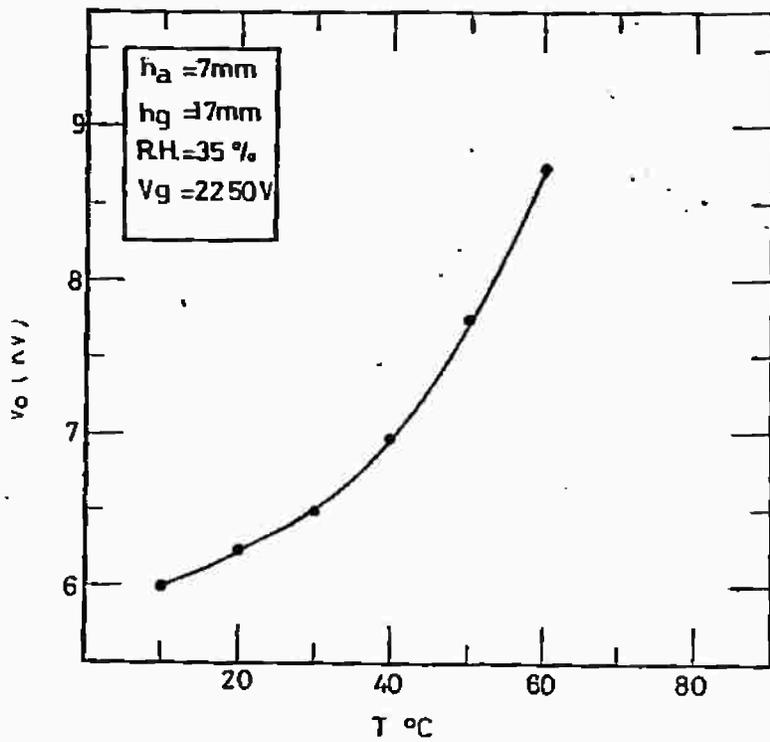VALUES OF T.

FIG.(6) r_a vs. V_{ae} FOR DIFFERENT VALUES OF T.

FIG.(7)   THRESHOLD   VOLTAGE V_o vs.   T.