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[redacted]

12 May 1966

[redacted]

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Enclosed are three copies of Technical Report No. 7 on the above-referenced contract.

[redacted]

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WB:aq

Enclosures: Technical Report No. 7 (3 copies)

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cc: [redacted]
Successor Contracting Officer

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Technical Report No. 7

Government Contract [redacted]

a. Current Status of Work

The following areas have been worked on during this period.

1. The influence of limiting the target to 15 bars was further investigated.

Consider an infinite number of transparent bars of width w spaced w apart and having a transmission $b_o + b_1$, which are superimposed on a background having a transmission $b_o - b_1$. (Fig. 1)

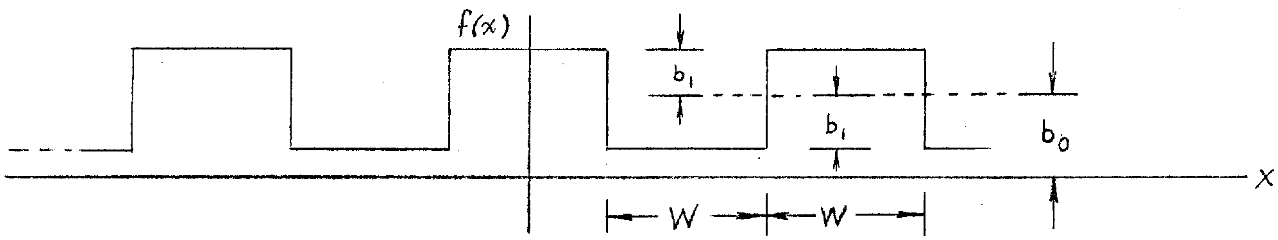

Fig. 1

The visability of this target is

$$V_T = \frac{(b_o + b_1) - (b_o - b_1)}{(b_o + b_1) + (b_o - b_1)} = \frac{b_1}{b_o}$$

The Cosine Fourier Series representation of the above target is

$$f(x) = b_o + \frac{4}{\pi} b_1 \cos\left(\frac{\pi x}{w}\right) - \frac{4}{3\pi} b_1 \cos\left(\frac{3\pi x}{w}\right) + \ldots$$

If harmonics higher than the first are neglected, then the visability of the approximate "infinite" target is

$$V_f = \frac{(b_o + 4b_1/\pi) - (b_o - 4b_1/\pi)}{(b_o + 4b_1/\pi) - (b_o - 4b_1/\pi)} = \frac{4}{\pi} \frac{b_1}{b_o} = \frac{4}{\pi} V_T.$$

Consider now an odd number, N, of similar bars. The Exponential Fourier Integral representation of this "finite" target is

$$F(x) = (b_o - b_1) + \int_{-\infty}^{\infty} d\nu \, e^{i2\pi\nu x} \, G(\nu)$$

where

$$G(\nu) = 2Nwb_1 \frac{\sin(2N\pi w\nu)}{2N\pi w\nu \cos(\pi w\nu)} .$$

As the number of bars increases, the Spectrum Density, $G(\nu)$ becomes more sharply peaked at points which approach the values $\pm$ 1/2w, $\pm$ 3/2w, . . . Thus, if a sufficient number of bars is considered, the above function is approximately

$$F(x) \simeq (b_o - b_1) + b_1 + 2b_1 G(\nu_o) \cos\left(\frac{\pi x}{w}\right)$$

where $G(\nu_o)$ is the maximum of $G(\nu)$ closest to $\nu = 1/2w$.

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The visability of this approximate "finite" target is

$$V_F = 2G(\nu_o) \frac{b_1}{b_o} = 2G(\nu_o) \ V_T.$$

In particular for N = 15, the Exponential Spectral Density has been calculated and has yielded for the approximate finite target (Fig. 2):

$$V_F = 1.27376 \ V_T \quad \text{for} \quad \nu = 0.4997w.$$

For the approximate infinite target one has

$$V_f = 1.27324 \ V_T \quad \text{for} \quad \nu = 0.5000w.$$

In Fig. 3 we show the Fourier transform of a target with an infinite number of bars.

2. During the investigation of the instrument we performed the following experiment. The value of the transfer coefficient τ for one frequency was measured using filters of different modulation in the eyepiece. Using green light, the instrument gave the same value for τ ; however, repeating this measurement with red light showed that for different visibilities of the filters different values for τ were measured.

First, the $\lambda/_4$ plate was suspected. However, after measurements in different wavelengths were made, the error in birefringency was found to be neglibible and therefore could not be the cause.

The cause was found to be a property of the polarizers. This will be discussed in Section 3.

3. Properties of Polarizers

First it was thought that the transmission of the polarizers was not given by $\cos^2 \varphi$ (where φ is the angle between the polarizers) for all wavelengths. The results are shown in Table 1. The polarizers are adequate in all wavelength regions.

These measurements were made with a [redacted] spectrometer. 25X1A
It turns out that the light beam in this instrument is partially polarized and it is therefore impossible to get absolute values for the transmittance of the polarizers at various wavelengths. We will, therefore, use the values as published by [redacted] and shown in 25X1A
Fig. 4.

If, for example, the two beams are properly adjusted in the green (500 mμ), we have for the transmission in the target bundle 39%. In the flooding beam we have $2(.39)^2 \cos \varphi = 1/2 \times .39$; or $\cos \varphi = .6414$. For red light (750 mμ) in the target bundle we have a transmission of .42 and in the flooding bundle .226. Instead of a 2:1 ratio we have a 1.858:1 ratio or an error of over 14%. This can lead to an error of 28%

in the measurement of the transfer function.
There are two ways to correct this situation. The first one is to place two polarizers in each beam; in the target beam with an angle zero, in the flooding beam with the appropriate angle. The second one is to find another way to adjust the flooding beam.
The first method will automatically be adjusted for wavelength, but will result in a light loss. The second method will not result in a light loss, but might be much more difficult to accomplish.

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TABLE I

φ in °	$\cos^2\varphi$	500 mμ	550 mμ	600 mμ	650 mμ	700 mμ
3.5	99.6	99.5	99.5	99.0	99.5	99.2
8.5	97.8	98.1	98.1	98.5	97.2	97.7
13.5	94.6	95.2	94.8	95.0	94.0	94.0
18.5	89.9	90.5	90.5	90.5	89.5	89.5
23.5	84.1	84.8	84.8	85.1	83.9	83.5
28.5	77.2	77.1	77.1	76.1	77.1	77.1
33.5	69.5	69.0	70.5	70.6	68.8	69.5
38.5	61.2	61.0	61.9	61.7	61.0	60.9
43.5	52.6	52.4	52.4	53.2	51.8	52.3
48.5	43.9	44.8	44.3	44.3	43.6	44.0
53.5	35.4	35.7	35.7	34.3	33.0	35.3
58.5	27.3	27.6	27.6	27.4	27.5	27.3
63.5	19.9	20.5	20.0	20.4	19.7	19.9
68.5	13.4	13.8	13.8	13.4	13.8	13.4
73.5	8.1	8.3	8.1	8.5	8.3	8.3
78.5	4.0	4.5	4.0	3.7	4.2	4.1
83.5	1.3	1.4	1.0	1.2	1.4	1.1
88.5	0.1	0.5	0.0	0.0	0.0	0.0

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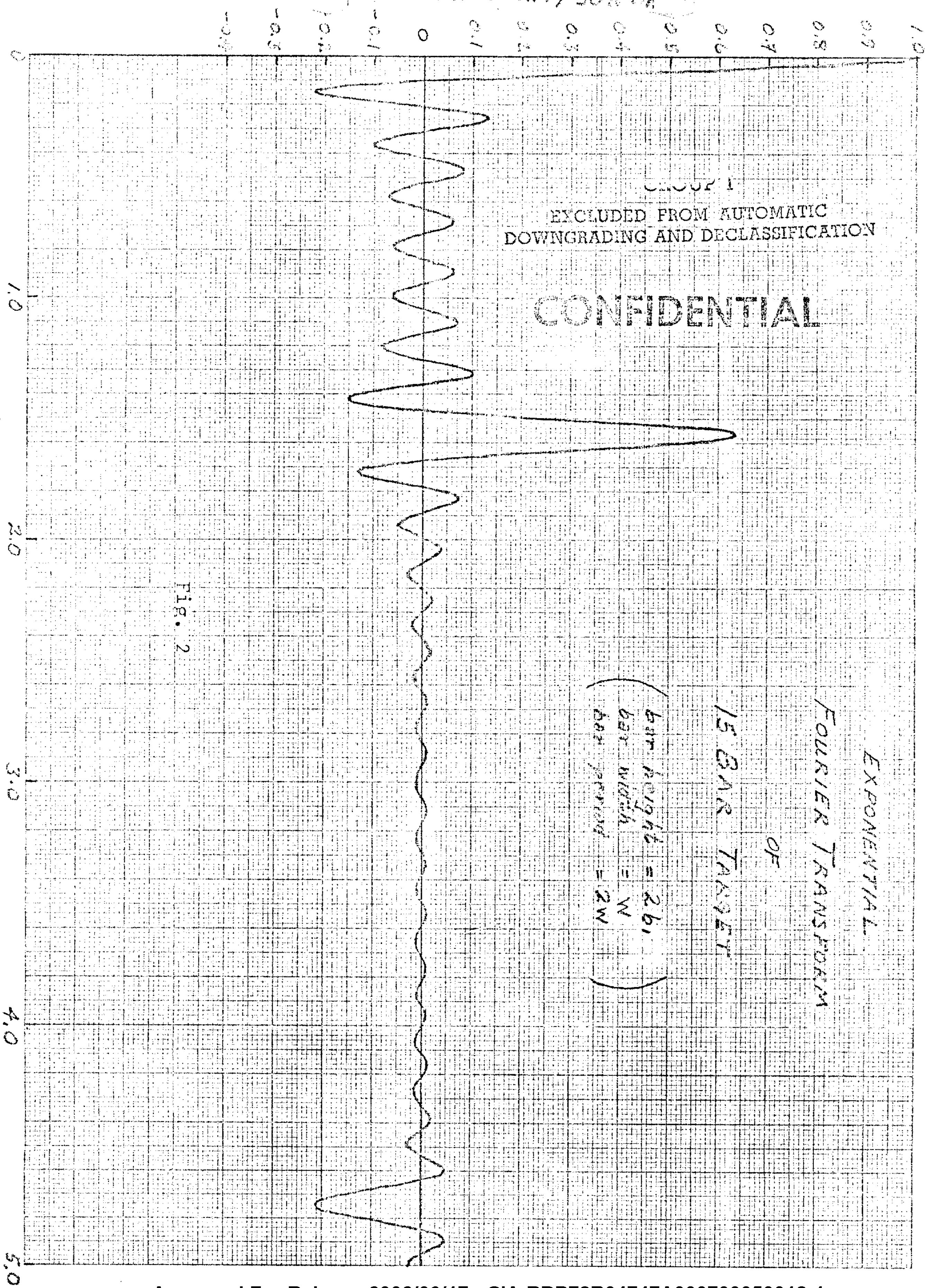

Fig. 2

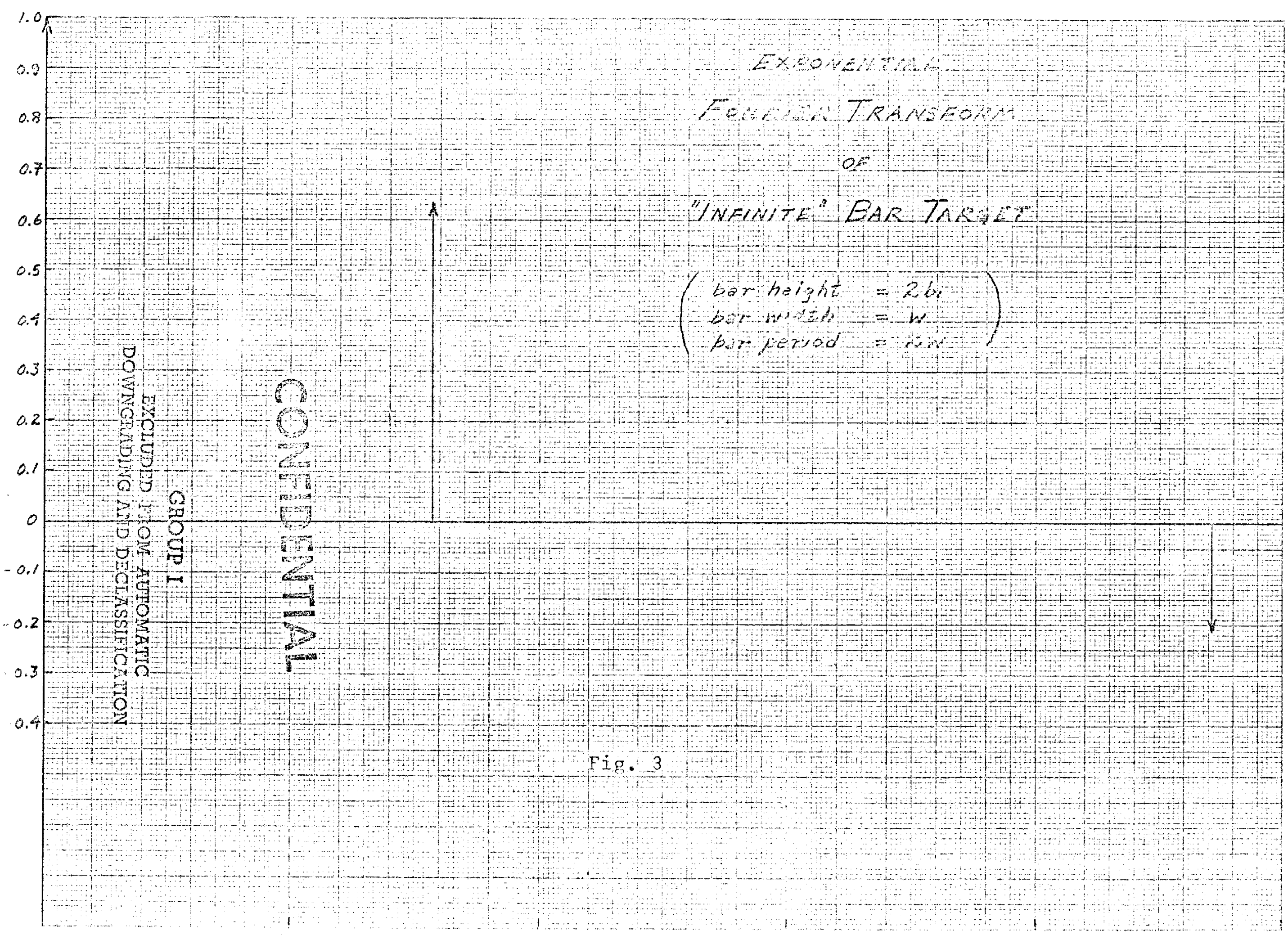

Fig. 3

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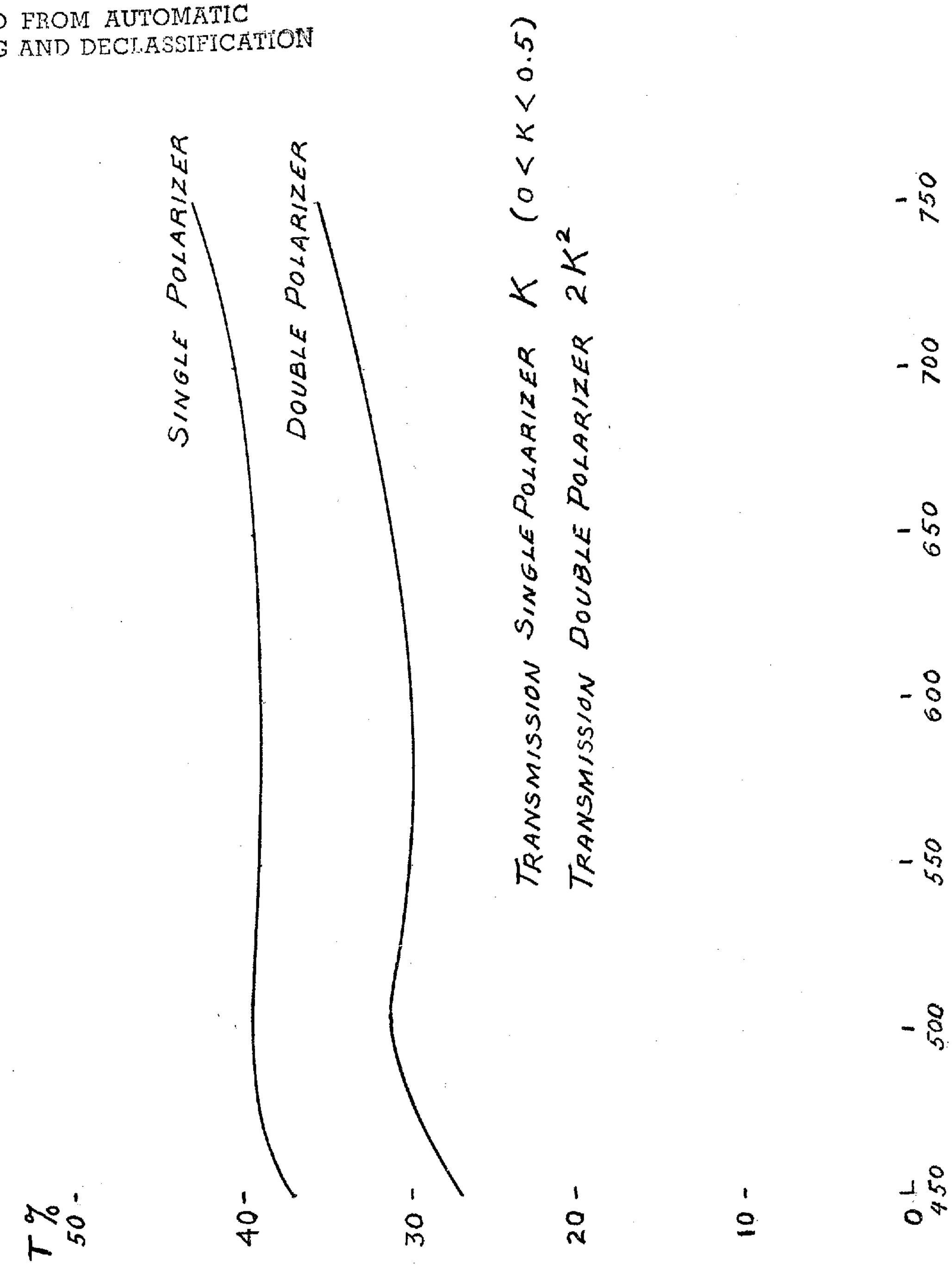

FIG. 4

b. Problem Areas Encountered

Problem areas have been discussed in Section a.

c. Projected Work for Next Monthly Period

1. Work will continue in the areas described in Section a: 1, 2, and 3.
2. When we are satisfied that all problems are solved, work on the second model will be started.

d. Status of Funds Expended

From the period of February 1, 1966 to April 30, 1966 the sum of [redacted] was spent on subject contract. This figure includes direct labor, materials, overhead and G & A, and fixed fee.

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e. Documentation of any verbal committments and/or agreements with the Technical Representatives of the Contracting Officer during the reporting period.

No verbal agreements or committments were made.

f. Request

The delivery date in our contract extension dated 18 March 1966 (Amendment No. 1) cannot be met. The delay in receiving the contract extention resulted in serious scheduling problems.

We therefore request an extension of the delivery date to December 31, 1966. (This refers to the "deliverable items" - two prototype Field Sine Wave Test Devices.)

In discussions with your project personnel it was stated that the first model of this equipment could be used later on this year and we agreed that we would make available a workable, although not final piece of equipment for your use for a period of time, since it would be to our mutual advantage to find any improvements that might be suggested by actual field use.

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Submitted by [redacted]

12 May 1966

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