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PROGRESS REPORT

DESIGN AND DEVELOPMENT OF KLYSTRON OSCILLATORS V-39 AND V-40

For Period: 1 October to 31 October 1953

Prepared for

Bureau of Ships Navy Department

on

BUSHIPS CONTRACT NObsr-52105
Index No. NE 110244

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PURPOSE

The purpose of the program engaged under BuShips Contract No. NObsr-52105 is to design and develop two wide-range klystron oscillators, V-39 and V-40, which will comply with the specifications outlined in this contract.

The two oscillators will cover the frequency band from 10 to 21 kmc. One tube will tune over the lower half of the band from 10 to 15.5 kmc, and the other will cover the band from 15 to 21 kmc. Preliminary design tubes of each type, complete with electrical test and characteristic data, will be furnished. In addition, five tubes embodying the final design of each type will be supplied, along with electrical characteristics and test data, final proposed specifications, and manufacturing drawings.

PROGRESS

During the past month one V-40 tube (tube No. 54) was tested and passed contract specifications. In addition, four V-39 tubes (tubes No. 14, 18, 20, and 21) were tested and performed satisfactorily except for low power output at about 10 kmc. The performance data for the V-40 tube are given in Table I. Table II shows typical data for the V-39, as exemplified by V-39 tube No. 20. Figures 1 and 2 are tuning curves for V-40 tube No. 54 and V-39 tube No. 20, respectively. Measurements of all five tubes tested this month were witnessed by the local Inspector of Naval Material.

TABLE I

Performance Data of V-40 Tube No. 54

Heater Voltage = 6.3 v
Heater Current = 1.2 a

Frequency (kmc)	Beam Voltage (vdc)	Beam Current (madc)	Reflector Voltage (vdc)	Power Output Matched Load (mw)	Power Output Optimum Load (mw)	Tuning Resetability (%)
21.0	750	32	-300	71	115	0.020
20.5	750	35	-285	94	144	0.020
20.0	750	36	-260	83	167	0.008
20.0	750	35	-530	91	111	0.020
19.0	750	34	-460	120	157	0.008
18.0	750	35	-400	137	181	0.020
17.0[1]	750	36	-340	132	255	0.040
17.0[2]	750	36	-340	105	170	0.040
16.0	750	36	-270	116	240	0.010
15.0	750	36	-240	111	200	0.010

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1 K-Band Waveguide
2 K_u-Band Waveguide

TABLE II

Performance Data of V-39 Tube No. 20

Heater Voltage = 6.3 v
Heater Current = 1.2 a

Frequency (kmc)	Beam Voltage (vdc)	Beam Current (madc)	Reflector Voltage (vdc)	Power Output Matched Load (mw)	Power Output Optimum Load (mw)	Tuning Resetability (%)
15.5	750	33	-315	58.5	155	0.006
15.0	750	33	-300	176	210	0.030
14.0	750	32	-250	109	128	0.000
14.0	750	35	-450	292	292	0.000
13.0	750	35	-380	187	243	0.020
12.0	750	35	-300	160	239	0.005
11.0	750	35	-240	76	181	0.005
10.0	750	31	-170	25	110	0.000

An improved technique was used to measure the noise. This consisted essentially of utilizing a Pound Microwave Discriminator, and resulted in a much greater sensitivity than obtained heretofore. It was found that the V-39 FM beam noise, measured with battery voltages applied to all electrodes of the tube, was of the order of 3 kc; the measured noise was approximately doubled when a-c was applied to the heater of the tube.

The modulation sensitivity of the V-39 tubes, measured at 12 kmc, was approximately 0.18 mc/volt.

Two of the V-39 tubes required shorting screws to the tube body since the ring spacing was at the extreme limits of tolerance.

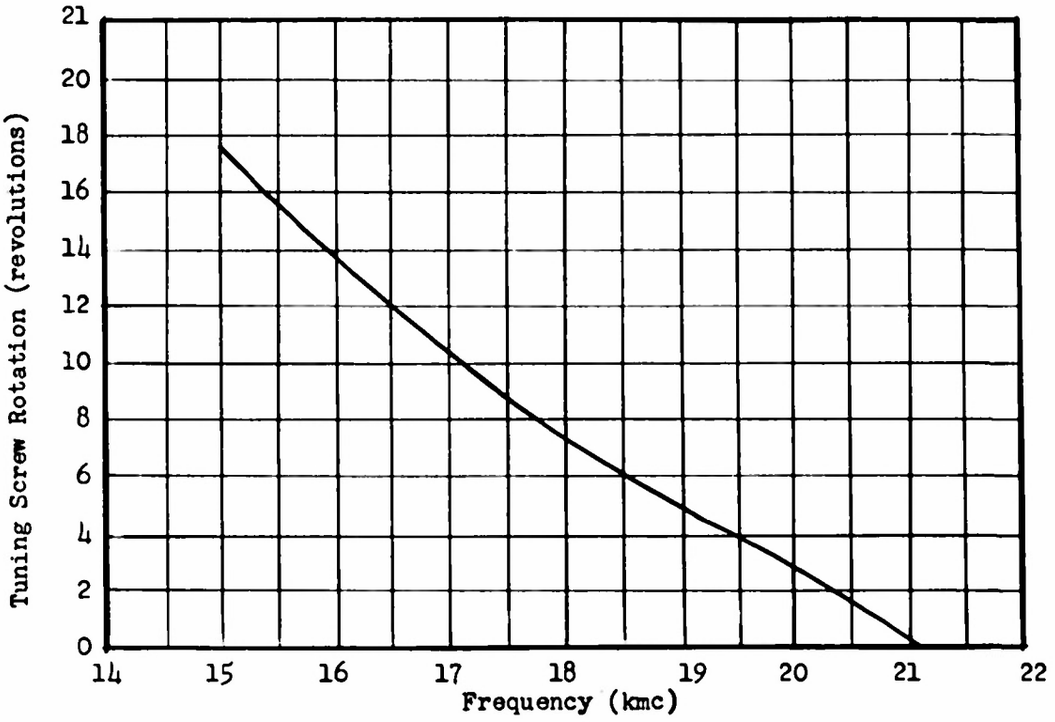
PROGRAM FOR NEXT INTERVAL

A change in design of the V-40 tube will be made which will reduce the amount of pretuning required. Pretuning, with the present design, has resulted in a bowed header, causing special, undesired trimming of the mica windows. Another change will eliminate the need for shorting screws to the tube body, and will relax the close tolerances needed for the ring spacing.

After successful operation of this new V-40, a V-39 will be designed by scaling from the V-40 in an attempt to: (1) reduce the number of mode suppressors, (2) bring the suppressor alongside the main cavity, and (3) increase the power at the 10 kmc end of the tuning range.

Estimated expenditures during October 1953: $3,012.00

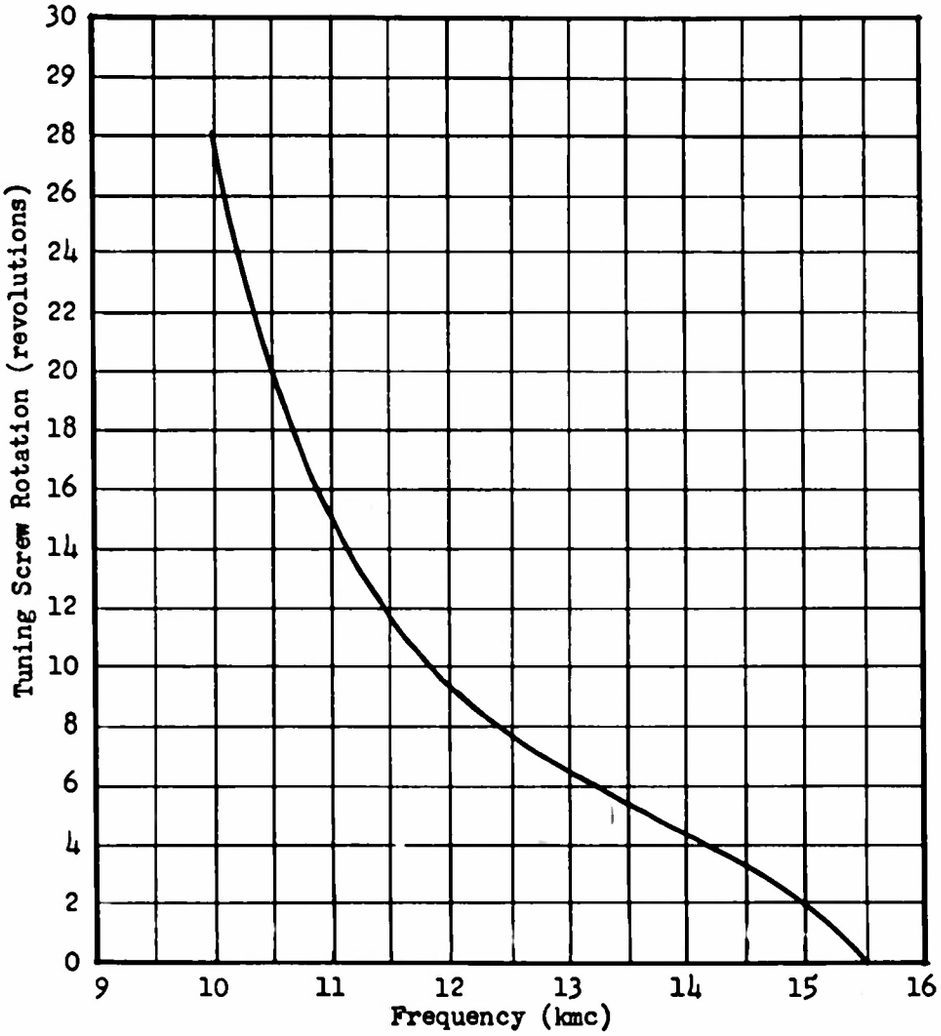
Estimated man-hours during October 1953: 360



Reflector Mod. Sens. = 0.19 mc/volt @ 17 kmc
FM Noise (battery voltage on tube) ≈ 2 kc
FM Noise (a-c voltage on heater) = 30 kc

FIGURE 1

TUNING CURVE FOR V-40 TUBE NO. 54



Reflector Mod. Sens. = 0.17 mc/volt @ 12 kmc
FM Noise (battery voltage on tube) < 1 kc
FM Noise (a-c voltage on heater) < 2 kc

FIGURE 2

TUNING CURVE FOR V-39 TUBE NO. 20