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Engineering Report
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VA-158 KLYSTRON OSCILLATOR
DEVELOPMENT PROGRAM

Progress Report for
2 June - 31 July 1954

Prepared for: Bureau of Ships
Navy Department

On: Contract No. NObSr-52503
Index No. NE-110420

By: Peter H. Kafitz

Approved: SF Varian
Sigurd F. Varian
Vice-President for Engineering

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PURPOSE

The original purpose of the program covered by BuShips Contract No. NObsr-52503 was to develop a rugged local oscillator to comply with the Bureau of Ships Contract Specification SHIPS-O-419, dated 15 March 1951, which was subsequently modified at a conference held at the Bureau of Ordnance, Washington, D. C. on 20-21 May 1952 and later at a conference held at Varian Associates on 29-30 September 1952. The tube was to be a reflex klystron operating in the frequency range from approximately 8.5 to 9.6 kmc, and its performance was to be similar to the 2K25 except for severe restrictions on frequency drift with temperature, frequency change due to shock, and FM noise due to vibration.

An amendment to Contract No. NObsr-52503 executed on 10 July 1953 changed the scope of this contract to incorporate additional development work, as follows:

I. Additional design work in connection with the prototype tube meeting the "1000-Tube Production Refinement Order Specification."

II. Long-range extended development including:

- A. Broadband matching to load: Elimination of the matching screw in the output iris to simplify the use of the tube.
- B. An investigation to improve repeller or modulation sensitivity and reduce sensitivity variations over the frequency range and from tube to tube.
- C. Elimination of undesirable modes.
- D. An increase in mechanical tuning range from 8.8 - 9.6 kmc to 8.5 - 9.6 kmc.

The product of the extended development program was designated the VA-158, to differentiate it from the V-52 developed on the original contract.

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The latest amendment to Contract No. NObsr-52503 was executed on 2 June 1954 and calls for still further electronic and mechanical improvements in VA-158. To meet the extended development requirements, the electronic tuning range must be substantially increased. The variation in reflector voltage sensitivity over the tuning range, and from tube to tube, must be reduced. Electronic performance should also be improved to increase the production yield in other respects, including power output and hysteresis. Other factors requiring study include variation of performance with gas pressure in the tube and filament voltage stability.

To accomplish all of the needed electronic improvements, it appears that a substantial redesign of the electron optical system is required. Such a design is being developed for other klystrons, and information obtained from that work can be adapted to improve the VA-158. The resulting performance should be significantly superior.

After the completion of the above electronic improvement program, work will be directed toward further simplification and ease of tuning.

At the conclusion of this program, six (6) sample tubes will be delivered representative of the engineering progress.

PROGRESS

Work was resumed on this program with the receipt of the extension to BuShips Contract No. NObsr-52503 on 2 June 1954. This report covers the first period, from 2 June to 31 July 1954. Future reports will be submitted at regular monthly and quarterly intervals.

As outlined in the Purpose section of this report, the major objective of this extended program is to improve the electron optics of the VA-158. This phase of the development will be carried on, as before, in close cooperation with the VA-116 advance development (Johns Hopkins University P.O. No. 44469) which has essentially the same objectives. As a matter of

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convenience it was decided to attack the VA-116 problem first. The design of a new electron gun has been calculated and most of the details have been worked out in the electrolytic tank. Once the first models of the new VA-116 cathode have been built and tested, the design will be adapted to the VA-158. This appears to be a more efficient procedure than trying to carry on both developments simultaneously.

A second objective of this program is to increase the ease of tuning. Previous VA-158's were equipped with a spring-loaded tuning screw which eliminated the need for a locknut. This arrangement was quite successful in giving a simple, smooth frequency adjustment; however, later tests showed that the mechanism would not withstand the specified shock. A simplified version of this tuner was applied to V-52's made on the refinement program (BuShips Contract No. NObs-5358) with good results both in ease of tuning and ruggedness; however, this device has a limited life.

In view of the decision to direct the effort in cathode development toward the VA-116 first, it was decided that this would be an opportune time to redesign the tuning mechanism of the VA-158. The problem turned out to be somewhat more difficult than anticipated. A number of different schemes were tried. The most promising of these is shown in Figure 1. The tuning screw has been replaced by a smooth shaft which is positioned by an external screw thread. The shaft is split into quarters which are spread apart. In this way good contact between the shaft and the hole through which it protrudes is assured. The same principle is applied to the male threads to eliminate backlash and any possible motion during vibration or shock.

This device gives a very smooth tuning action and vibration tests show it to be free of microphonics. Some work is still needed to increase the life beyond several hundred cycles.

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PROGRAM FOR NEXT INTERVAL

During the next month work will continue on both the cathode design for the VA-116 and the tuner design for the VA-158.

Estimated expenditures from 2 June to 31 July 1954: \$2,687.00

Estimated man-hours from 2 June to 31 July 1954: 234

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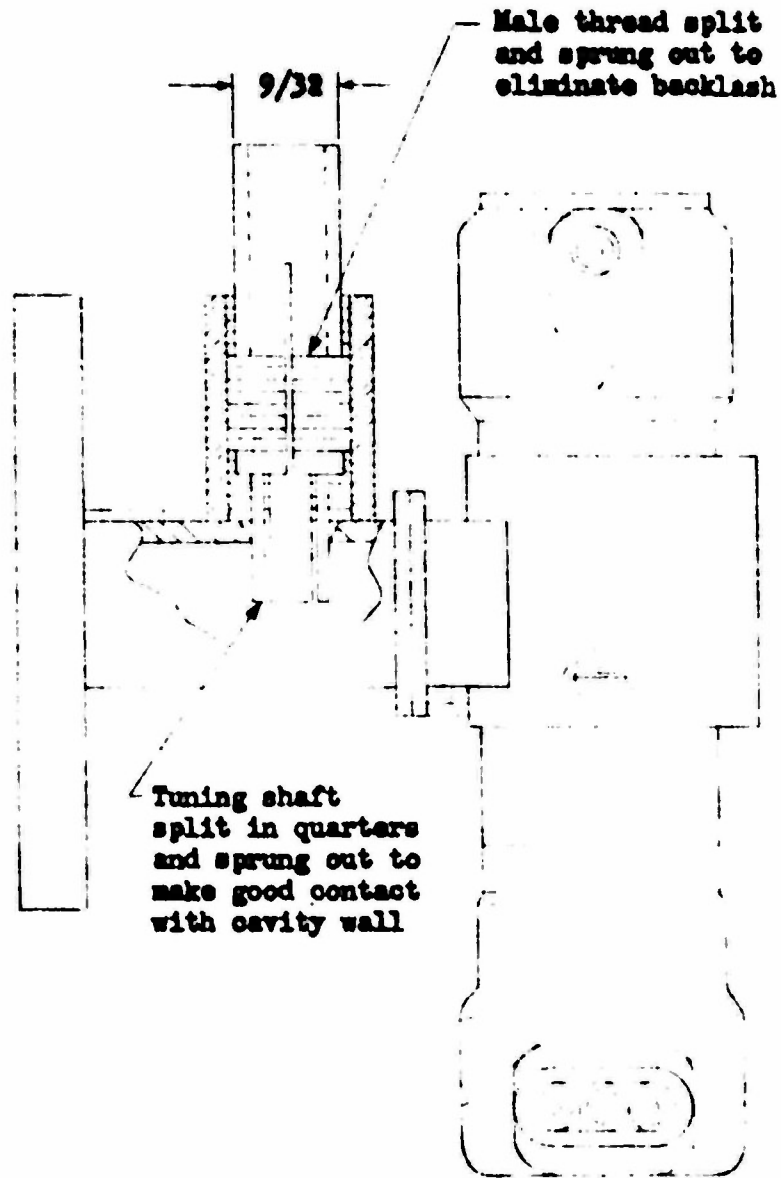


FIGURE 1
VA-158 TUNING MECHANISM

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