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LONG LIFE X-RAY TUBES FOR AN/TAQ-2 SYSTEM.(U)

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LONG LIFE X-RAY TUBE FOR AN/TAQ-2 SYSTEM

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January, 1978

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Design work on a long life x-ray tube for the AN/TAQ-2 System is discussed. Both a glass and ceramic envelope tube are to be built. The principal feature of the tubes is to be a single crystal tungsten anode.

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I. FOREWORD

This report covers work done during the period 15 April 1977 to 14 August 1977 on Contract DAAB07-77-C-2657 to develop a long-life x-ray tube for the AN/TAQ-2 x-ray system. The work is being performed by the ITT Electron Tube Division in Easton, Pennsylvania for the U. S. Army Electronics Command, Ft. Monmouth, New Jersey.

II. OBJECT

The object of the work is to develop an x-ray tube for use in the AN/TAQ-2 Portable X-Ray Generator System according to the requirements of Beam, Plasma and Display Technical Area Guidelines entitled: "Long-Life X-Ray Tube for AN/TAQ-2 System," dated 1 June 1976.

III. BACKGROUND

In work performed 1 June 1975 to 31 May 1976 under Contract DAAB07-75-C-1334, the ITT Electron Tube Division was able to improve the tube life for the then existing x-ray tube for the AN/TAQ-2 system by a factor of three at 100 KV operation and approaching a factor of two at 150 KV operation. An alternate approach which accepted a slightly lower x-ray output extended the life five to six times that of the previous standard tube.

The principal change which affected life was the reduction in the number of crystal boundaries on the anode surface which could be eroded by the bombarding electrons necessary to x-ray generation. The approach to the present task will be to continue anode metallurgical changes and to effect other changes in parallel which should contribute to longer tube life.

IV. PROGRESS DURING THE REPORT PERIOD

1. Anode Material

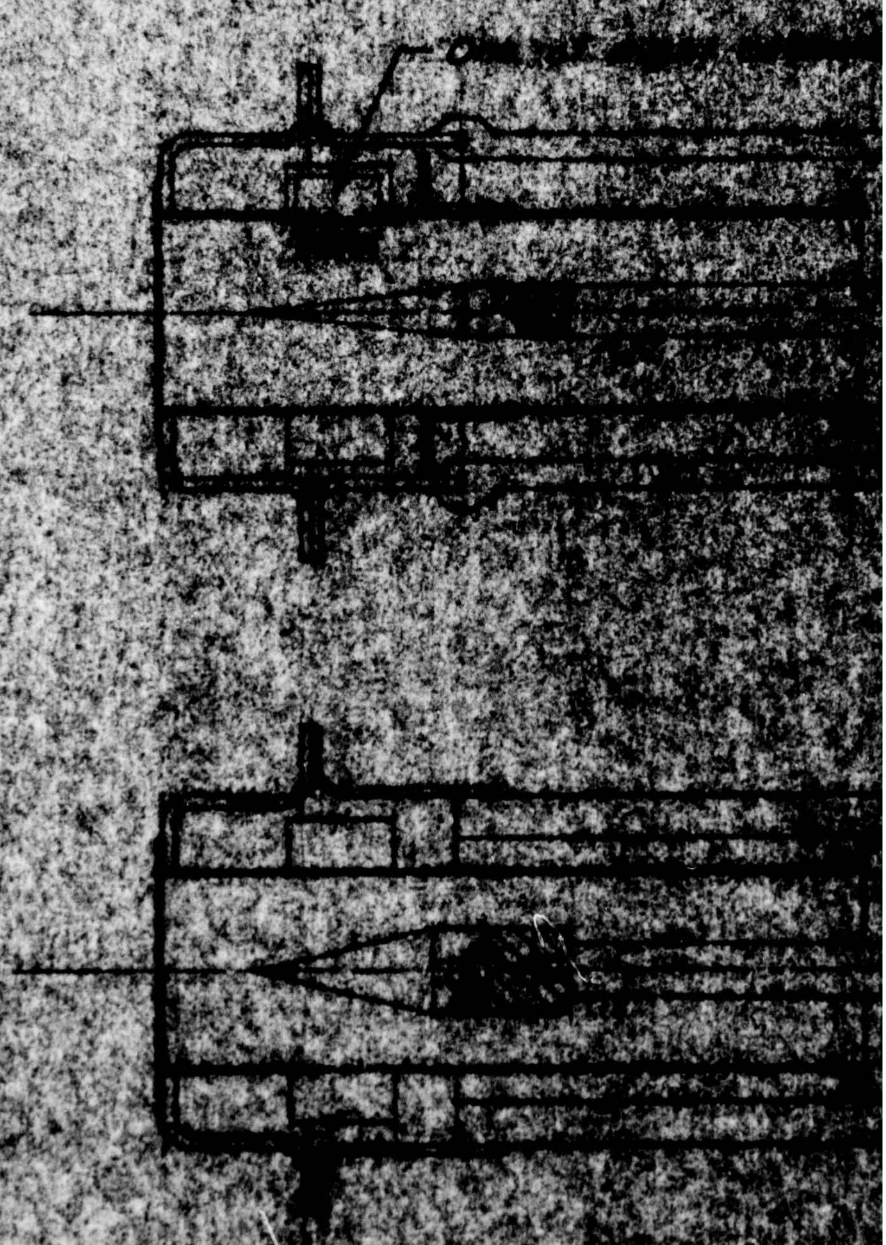
The key change during the previous investigation was the reduction in the number of exposed crystal boundaries on the anode. This was effected by local heating of the anode tip in an arc. This heating was difficult to control, but it was considered possible to develop equipment that would do a better job than was being done.

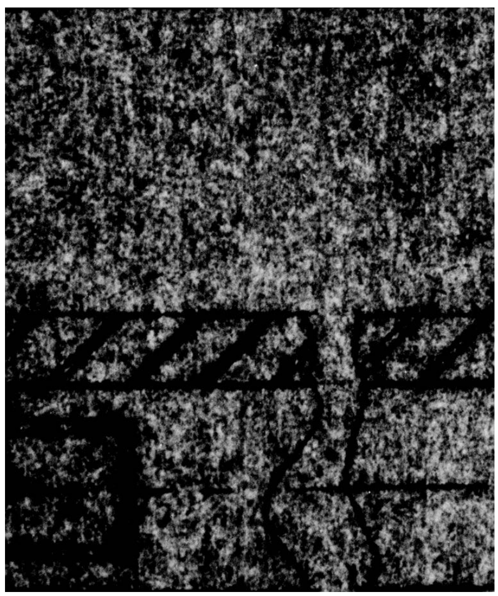
To determine the tube life if this approach was carried to its ultimate, single crystal anodes, is the principal experiment planned for this investigation.

Anode tips in the two sizes used in the previous investigation have been ordered in single crystal tungsten. Crystal orientation is also being obtained in two ways for each size: random and axial for maximum thermal conductivity.

2. Ceramic Tube Design

The higher processing temperatures of ceramic envelope tubes as compared to glass tubes should allow some life improvement. Figure 1 shows a ceramic tube design labeled as Type 707. Parts for both the glass 706 and the ceramic 707 have been ordered. The cathode is





essentially common to both tubes; the anode supporting structure of the ceramic tube is more complicated than the glass tube because of the field problems posed by the confined cavity for the tube in the x-ray generator. The figure shows differing anode sizes in the two tubes; the parts designs are such that either anode may be used in each tube.

3. Particle Trapping

A principal failure mode for previous tubes was puncturing at the glass-to-metal seal at the cathode. This appeared to be aggravated by a metallic film sputtered onto the glass in this area. Reference to Figure 1 will show that the cathode sleeves are being carried to almost twice the previous length and, in the case of the glass tube, a baffle just to the rear of the cathode location will shield the glass-metal junction from material which may exit the slots in the cathode sleeve through which the cathode elements are inserted.

4. Getters

Flashless getters will be fastened to the brackets shown in Figure 1 at the base of the anodes. Our previous experiments at ITT with getters in the tubes were inconclusive; however, tubes whose life test was continued at Ft. Monmouth show improved performance when the getter is incorporated.

5. Cathodes

We plan to use the same cathodes used in the previous tubes, at least in the beginning of the investigation. They performed well in the previous tubes.

6. Tube Assembly

No tubes have been assembled during this period. The procurement of the single crystal tungsten anodes has been a problem, as has been the ceramic envelopes.

7. Procurement

All parts, with the exception of the anode tips and the ceramic envelopes are in house at the end of the report period. One vendor has agreed to work on the envelopes. The manufacturer of the anode tips is having difficulty holding the proper angle on the anodes, and while there was no delay in growing the tungsten crystals, there has been considerable delay in fabricating the tips. Delivery is now promised for one size and one orientation sometime in the latter part of September. The fabrication is by a spark machining process similar to, but not exactly like, the Elox process. If the delay continues beyond the present schedule, we will consider a chemical milling operation to shape the tips and effect a redesign to a different means of attaching the tips to the copper rods supporting them.

V. PLANNED WORK FOR THE NEXT PERIOD

As soon as anodes are available, glass envelope tubes will be constructed and put on life test. Several glass tubes will be constructed before a ceramic tube is built. Our data on previous glass tubes will make a judgement of initial tests more meaningful if the complications which might be introduced by the ceramic tube are not a factor.

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