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Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Lexington 73, Massachusetts

SUBJECT: BIWEEKLY REPORT FOR JULY 2, 1954

To: Jay W. Forrester

From: Division 6 Staff

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SECTION I - CAPE COD SYSTEM

1.1 Group 61

1.10 General

(R.J. Horn, Jr.) (CONFIDENTIAL)

A major portion of the group effort continues to be spent on preparations for the 1954 Cape Cod System.

The estimates for intercept calculation times with XD-1 have been expanded to include switch interpretation, display make-up, and data-link programs. The resulting estimates are 10 milliseconds for final-turn intercepts and 7 milliseconds per interceptor without final-turn.

A program to analyze track-while-scan data and plot curves of some of the TWS counts as a function of time has been written.

The block diagrams for the manned-interception simulation program have been completed.

A new series of raid-size tests has been started at South Truro.

1.3 Group 65

1.31 Activities of Group 65

(P. Youtz) (UNCLASSIFIED)

I made a trip to the west coast with members of Groups 25 and 65 and IBM to study the progress of the Charactron and Typotron tubes. We visited Convair on 21 and 22 June 1954. Convair's new tube plant is progressing satisfactorily. Special equipment necessary to fabricate prototype and production tubes has been completed. Special techniques necessary for the construction of the final tubes are being refined, and personnel are being trained in the use of these techniques. MIT recommended an electron optical system for the three prototype tubes to be delivered to IBM 15 August 1954.

The new 19-inch Charactron bulbs from Corning Glass Works will be in Barta Building on 6 July 1954. It will be necessary to get an early evaluation of the Charactron electron optics and post accelerator in these final tubes.

Larry Steinhardt, who is in charge of the tube-production facilities at Convair, will visit us the week of 12 July 1954 to study our methods of applying helical dag, phosphor settling, aluminizing, and tube processing. Progress has been made by Convair in planning a test program and in designing test equipment to evaluate and inspect the production tubes. This work will be reviewed at our next joint meeting.

We visited Hughes Aircraft on 23 and 24 June 1954. There were discussions on a number of the Typotron specifications and the Typotron electron optics. Some of these points were not resolved at the meeting but must await further testing at Hughes Aircraft and MIT. We inspected the new Hughes tube-production facilities. These facilities were to be ready for occupancy on or about 1 July 1954.

On 24 June 1954, we visited Resitron in West Los Angeles. Members of the Resitron group had processed some of the early Charactron tubes and are interested in making display tubes for AN/FSQ-7. They want to make a dark-trace tube which could be used with the Charactron optics. This could be competitive with the Typotron tube.

We spent one day at the Willys Laboratory in Berkeley, California, discussing with Ross Aiken his new flat cathode-ray tube. This tube is only 3" thick. Aiken proposed combining this tube with the Charactron optics to make a flat Charactron only 3" thick. This proposal for a large Charactron tube and the possibility of a two- or three-color Charactron tube makes this family of tubes an attractive possibility.

IBM has been submitting tube specifications and scopes of work to tube companies to develop second sources for the Z-2177, SR-1782A, and Charactron tubes. One day was spent at Poughkeepsie on that program.

1.31 Activities of Group 65 (Continued)

(P. Youtz) (UNCLASSIFIED) (Continued)

Sylvania is still facing difficulties in producing any of the tubes in the 7AK7 family. There have been intensive investigations both at MIT and at Sylvania on this problem. These investigations will continue during the next period.

1.33 Research and Development

(P. C. Tandy) (UNCLASSIFIED)

One helical-dag tube, Cht-37, and one double-band tube, Cht-41, are being life tested. The cathode image shows that 50 per cent of the area on the helical-dag tube and 25 per cent of the area on the double-band tube had poor emission after 190 hours life test at 1-ma cathode current. The grid drive needed for the 1-ma cathode current has increased 13.5 per cent with the helical-dag tube, while it has remained about the same with the double-band tube.

Another helical-dag tube, Cht-36, completed 88 hours on life test with the cathode condition about 30 per cent poor at that time. Cht-36 was taken off life to make room for the deflection-sensitivity measurements of the double-band tube. The helical-dag tube appears to have about an 8-per cent advantage over the double-band tube in deflection sensitivity.

The 10-kv supply necessary for life testing more than two tubes at a time is being constructed.

(H. B. Frost) (UNCLASSIFIED)

During the past two weeks Al Zacharias and I have been studying intensively the SR-1782A tube. Sylvania has been having a great deal of trouble in producing this tube so far. We have studied both tubes believed to be defective and tubes believed to be good. Sylvania had believed that their trouble was caused by cathode poisoning from G_2.

We analyzed a lot of five defective tubes after life test. These tubes were characterized by low plate current and high, though not abnormal, screen currents. Examination of these tubes under pulsed conditions with both normal and low heater voltages revealed that the cathodes were fairly normal, with satisfactory emission. However, two of the tubes had screen grids somewhat misaligned, and three tubes had very high work functions for G_3, hence, a high contact potential on G_3. This abnormal contact potential for G_3 apparently was the cause of the high ratio of screen current to plate current. There is a residual reduction in plate current over normal tubes; this residue has not yet been accounted for.

1.33 Research and Development (Continued)

(H. B. Frost) (UNCLASSIFIED) (Continued)

Electrical analysis of new "good" SR-1782A tubes showed that the cathodes were somewhat unstable, a situation not unusual for new tubes. Some of these tubes are now being placed on life to see if the cathodes will stabilize and at what level they stabilize (if they do).

Thesis Research

During the past two weeks I have continued some experimental work to fill gaps in data previously obtained. I have continued to prepare drawings for drafting.

As a result of meeting with my thesis committee on Friday, 2 July, my experimental work has been accepted for writeup. I expect to finish the writeup within about a month.

(L. B. Martin) (UNCLASSIFIED)

The following is a list of Typotron tubes and their hours of operation in life test:

Tube No.	Hours
265	2826.6
280	2018.7
335	1201.7
366	499.9
390	499.9
392	499.9
389	416.1

These tubes are in satisfactory condition except for No. 265 which does not store information in the center. The area of poor storage is about 0.5" in diameter; the rest of the surface is still usable.

Convergence-coil currents were measured. For the six 11600T32 coils the currents ranged from 42.2 to 46.2 milliamperes. The seventh coil with no identification carried 70.0 milliamperes.

Leakage tests have been made on No. 268, and the results are included in a report on leakage for all tubes. This report should be completed by 9 July 1954. Comparing similar leakage tests of 17 June 1954 and 1 July 1954 on No. 268, currents were of the same order of magnitude for all elements except D_2, D_3, and D_{11}. The first two had increased and the latter decreased. Chronologically, D_2 varied from 0 to 9 microamperes,

1.33 Research and Development (Continued)

(L. B. Martin) (UNCLASSIFIED) (Continued)

D_3 from 0 to 11 microamperes, and D_{11} from 10 microamperes to 0.

Major leakages between high- and low-voltage electrodes were between HHK WG and HHK FG and HHK WG and D_2 (at 3.3 kilovolts). Major leakage among high-voltage electrodes was between WHHK and WG_1 (at 1 kilovolt). Major leakage among low-voltage electrodes was distributed from FG_1 to rest of low-voltage elements. Collector to contrast at 250 volts was 2.1 microamperes. Viewing screen to contrast at 3.3 kilovolts was about 1 microampere.

Work is progressing on the life-test expansion. The test equipment required by new logic has been received.

(S. Twicken) (UNCLASSIFIED)

For some time Sylvania has been having trouble producing the SR-1782A (improved 7AK7). After several hundred hours of life, the d-c plate current is quite low. The consensus was that the cathodes were being poisoned by some gas probably being evolved from the screen grid. A rather comprehensive series of tests conducted here indicates that the cathodes themselves are in fairly good condition and that the trouble may well lie elsewhere. The contact potential of the suppressor grid was found to be about 2 volts more negative that it should be, markedly reducing plate current on the d-c test where the suppressor-grid applied voltage is zero. The effect of this increased G_3 contact potential is much less at an applied suppressor voltage of + 10^3 volts (the pulse-test point and where actual circuit operation will be in XD-1) because of the curvature of the transfer characteristic of plate current vs. suppressor-grid voltage in this part of the positive region. For XD-1 operation, inability to meet the d-c test-spec limits is of no consequence if the pulse currents are up to par. Pulse currents in these tubes are somewhat low apparently because of a lower perveance, but this is easily rectified. Sylvania has been informed of our findings and has been working on this new approach to the problem. A meeting is scheduled at Emporium for 7 July to compare data and to determine whether our findings are peculiar to the small sample of tubes we had. If this shift in contact potential of the suppressor grid is the fundamental problem, the large stock of tubes new being held by Sylvania could become immediately available for XD-1.

Part of the Tube-Shop facilities have been moved to Building D in Lexington under the supervision of T. F. Clough. These facilities will service MTC and test equipment at that site.