Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, November 12, 1948

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(P. Franklin)

The mathematics group has completed a study of numerical solutions of integral equations, issued as E-143. A general method of simplifying the coding of problems involving a scale factor by using two registers is described in M-659.

(E.Reich)

It has been possible to prove that symmetry and positive definiteness of the system matrix is a sufficient condition for convergence of the Seidel method directly from Picone's necessary and sufficient condition, without recourse to the indirect method of showing that the iterations provides a minimal sequence to the "energy function" of the system.

In connection with the work on partial differential equations, conformal mapping is being studied.

(M. Daniloff)

Eng. Note E-160 "The Influence of the Resistance of the Oxyde Layer upon the Damping of an Electron Tube" was prepared and distributed to the members of the Storage Tube Group.

The preparation of a report on the "Simulation of Empirical Functions" was begun. The actual work has been completed several months ago but was not put in the form of a Report because of pressure of current requests.

(P.Rabinowitz)

Most codes for solving differential equations were revised in light of the proposed ao order. In the standard code, a saving of

6.0 MATHEMATICS (cont)

at least 13 storage registers and 34(N-1) orders resulted. Similar savings occurred in the case of the other more specialized codes.

(T.W. Hildebrandt)

Further work was done on the coding of an aircraft control problem described in reports from the Reeves group. Investigation was begun to determine whether calculation from series expressions or interpolation between stored values is preferable in finding values of usually tabulated functions.

7.0 INPUT AND OUTPUT

7.4 Magnetic Recording

(G. Cooper)

The search for a non-microphonic tube is continuing. Preliminary tests on the Sylvania 1273 indicate that it is somewhat less microphonic than the other tubes tested. However, we are waiting for the set of characteristic curves for the tube before passing judgment.

The erasing amplifier, after a few minor changes, is now operating satisfactorily.

The design of a playback synchronizer, to synchronize the scope with the playback signal, has been started. This unit will utilize a crystal gate circuit, among its components.

8.0 STORAGE TUBES

8.1 Tube Construction and Testing

8.11 Tube Construction and Processing

(F. H. Caswell, T. F. Clough and P. Youtz)

The second and third large storage tubes with a beryllium mosaic on mica storage surface were processed. The third tube cracked when it was being removed from the exhaust system. A fourth tube in this series was immediately started and will be processed this next week. The storage surface of these tubes is a mica plate which is .007 inches thick. One side of the plate is coated with silver paint and baked thoroughly to remove binder and volatile substances. Then a virgin surface is obtained on the other side by removing a thin outer layer of mica. Care is taken not to rupture the surface. This surface is made the target for the beryllium mosaic in an evaporation tube.

In preparing calcium tungstate surfaces for holding gun studies we found electrostatic precipitation of the surface required more refinements than we wanted to develop at this time. Therefore we prepared several surfaces by using familiar cathode-ray-tube techniques. We put a binder on the surface and dusted on a surface in a cloud chamber. One and maybe two tubes for holding gun studies will be processed this next fortnight. These tubes simulate as much as possible the regular large storage tubes, but the storage surface is a fluorescent screen in order to study the behavior of the holding gun.

A new beryllium strip tube for stability studies, which utilizes only mechanical pressure to maintain contact between the beryllium surface and the leads, has been constructed and will be processed next week.

(E. S. Prohaska)

The electrical wiring of the new filtered air room will be completed this week. The benches and other equipment are about 50% completed. The piping for compressed air, gas and plumbing have not been started. The sink and trap have been shipped by Kohler and should be here this

8.11 Tube Construction and Processing (Cont'd)

month. It still appears that the room will be ready by December 1.

The analyzer section of the polariscope has been designed and will be detailed as soon as drafting time is available. The analyzer consisted of a portable headpiece, a fixed-position polarizing medium (polaroid) protected by crown glass lenses, and a movable pair of retardation plates (565 µm-wavelength) so that a specimen may be viewed either through the plates or not. The layout of the polarizer has been started.

(R. Shaw)

Since considerable difficulty was experienced in assembling the last beryllium strip tube, modifications are being studied which will facilitate assembly.

Tools have been designed for production of 12-lead nonex stems.

Drawings are being prepared, and material ordered for the tubes listed in Memorandum M-672.

(H. Klemperer)

New storage tube target design was completed and is ready for construction.

8.12 Tube Testing

(A. H. Ballard)

Further tests are being performed on ST 29 in order to compare its behavior with that of the later 5" tubes. The main objectives of these tests are:

1. Further study of collector vibration.
2. Determining minimum writing pulse length as a function of spot position.
3. Determining the stable range of holding gun velocity as a function of spot position.

These tests have been hampered somewhat by the fact that the Be surface in ST 29 is beginning to show signs of fatigue. After about 90 hours of tube operation it was found impossible to store spots at the end of the day. After

8.12 Tube Testing (Cont'd)

about 128 hours it was found that storage was unreliable some 2 hours after electrode voltages were applied. The tube seems to restore itself when left inactive overnight.

(C. L. Corderman and R. Sisson)

A few further tests were performed on ST 40. These indicated that it was possible to read both positive and negative signals out of the tube under proper conditions, but that the signal read out was very small (20 to 30 mv.). Also there was a tendency for the read pulse to switch negative spots positive.

Tests were started to determine the effect on neighboring spots of writing a spot; that is, the extent to which "crosstalk" was important. Changes will have to be made in the circuits, however, before these tests can be considered conclusive. At present it seems that crosstalk is not negligible.

On Nov. 3, ST 45 was made available for testing. It is a five inch tube with a Be mosaic evaporated on mica, and a silver backing on the mica. A summary of its characteristics follow:

Spots of either polarity seem to be stable on a negative background as V_{HG} varies from 50 to 200 volts for the lower limit to an upper limit of above 500 volts. The center portions are stable for V_{HG} down to 50 volts, but this lower limit increases as one tries to write further out on the surface and is 200 volts near the edge. This variation in the lower stability limit seems to be unaffected by electrode voltages, but may depend on the life of the tube.

In the center portion of the target the characteristics resemble those of ST 40. With V_{HG} about 75 volts writing times of the order of 10 to 20 microsecs. are possible.

Signals have been read out of spots near the center of the surface using the charge method (that is reading out across a capacitive load.) When the signal plate is not switched and V_{HG} is about 75 volts, negative spots read out about .06 volts and positive spots about .03 volts.

8.12 Tube Testing (Cont'd)

The reason for the large signal from positive surfaces is not understood, but will be investigated. It seems possible that positive spots are being stored at a potential considerably below that of the collector.

The physical and processing differences between ST 40 and ST 45 were examined to determine what caused the differing results obtained from the two tubes. Another tube is under construction which will have physical characteristics thought to be best.

(N. S. Zimbel)

The automatic read-write unit has been in operation. However, at the present time, the amplifier-limiter unit is inoperative.

The reading schedule is set up in such a way that reading a positively written spot should give no signal, while reading a negatively written spot gives a signal. It was found that a signal was obtained in both instances with the negatively written spot giving the greater signal. A good part of the read signal consists of feed-through or pickup of the read pulse to the high velocity grid by the output system. This has not been corrected as yet.

(H. Klemperer)

Regulated power supplies for 500V and 1000V were designed and test of first samples was completed. All three supplies are ready now for the shop.

(H. Rowe)

Power Supply Tests. Testing was completed on the breadboard of the T-50 500V power supply.

8.13 Storage Tube Reliability Tester

(J. O. Ely)

Materials for the storage tube reliability tester are arriving about as needed, although some items have taken longer in delivery than expected. Relay racks have been received and mounting of test equipment for the control

8.13 Storage Tube Reliability Tester (Cont'd)

is under way. Special panels for control and for display 'scopes have been manufactured and sent out for painting.

It is expected that the main control panel and the display panel will be completed and installed, along with as much of the control as can be assembled from standard test equipment available, and tests will be started within the next two weeks.

Design of the storage-tube mount and output circuits will be taken up within the next two weeks.

Critical points in the program at the present time are:

1. Procurement of 6 dual gate-and-delay units.
2. Procurement of 1 rack power control
3. Installation of power supplies
4. Development of suitable output circuits.

Unless regulators are installed on the +250, +120 and +90 volt laboratory supplies it will be necessary to provide some special supplies for the reliability tester.

(L. J. Nardone)

Test equipment and circuits for the Storage Tube Reliability Tester are being assembled. A Single-Pulse Synchronizer and a Gate-Mixer Amplifier have been breadboarded and made to operate properly.

The mounting of test equipment on the control racks has been started.

8.2 Storage Tube Research

8.21 Surface Material Characteristics

(J. H. McCusker)

Further reverse curves were run on RT 38, a beryllium strip tube. The beryllium surface was connected to a high impedance voltmeter. Then the beryllium was stabilized at collector potential. The voltage of the collector was decreased from 500 volts positive with respect to the cathode

8.21 Surface Material Characteristics (Cont'd)

to the voltage at which the beryllium triggered to cathode potential. The beryllium was about 4 volts positive with respect to the collector at 500 volts. With the collector at 68 volts, the beryllium was at the same potential as the collector. As the collector potential was decreased further, the beryllium became approximately 10 to perhaps 15 volts negative with respect to the collector before the beryllium triggered to cathode potential. If the third anode was at ground potential, 200 volts above cathode potential, triggering occurred at 52 volts while if the third anode was at collector potential the triggering occurred at 43 volts.

In this tube the secondary electron current from the third anode to the surface was equal to the primary beam current when the surface and the collector were positive with respect to the third anode. When the collector was positive with respect to the third anode, the floating potential of the beryllium was several volts lower than when the third anode was at the same potential as the collector. If a poor secondary emitter such as aluminum oxide were used in place of the beryllium, the floating potential of the surface might be near third anode potential rather than collector potential when the collector is positive with respect to the third anode.

8.23 Output System Circuits

(C. H. R. Campling)

It has been decided to reduce the operating frequency for the RF output system from 30 megacycles to 10. An oscillator circuit has been built up on a suitable chassis but there has been some difficulty because oscillation in the plate circuit of the pentagrid tube does not cease when plate current is cut off. This is caused presumably by capacitive coupling between the screen (which oscillates continuously) and the plate. It is hoped that the difficulty can be overcome by changing the circuit so that the screen potential is held fixed while RF appears only on the cathode and first grid. This method will give much better shielding between the portion of the circuit which oscillates continuously and the plate circuit which should not oscillate when plate current is cut off.

8.23 Output System Circuits (Cont'd)

(W. J. Nolan)

The RF output circuit project breaks down into four basic problems:

1. Development of a satisfactory pulsed RF source to drive the HV gun control grid.

2. Shielding of the signal plate and associated circuits from the RF source and the HV gun grid.

3. Construction of a satisfactory RF amplifier or modification of an available one.

4. Possible development of a satisfactory gate amplifier to drive the signal plate. This may not be necessary if present equipment has satisfactory RF characteristics.

If no unexpected troubles develop, there will be considerable information on the practicability of these circuits in about 3 weeks but there will be very little data before that time.

8.24 Holding Gun Studies

(H. Klemperer)

Studies with electrolytic tank were continued.

8.3 Unclassified

(J. S. Rochefort)

The Secondary Emission Life-Test Rack is being modified to allow life tests to be run on storage tubes. These tests will be conducted on the older tubes with 3/4 inch targets. It is hoped these tests will give helpful information on gun-life and surface deterioration.

(M. I. Florencourt)

A glossary of terms peculiar to the storage tube group's literature is being prepared. This work is being done to familiarize others with the particular meanings

8.3 Unclassified (Cont'd)

the group has for certain words and to encourage the group itself to standardize on various terms being used with the same meaning.

8.4 Deflection Circuits

(J. O. Ely)

The deflection-voltage generator and control have operated continuously without failure of any kind during the past two weeks.

It is expected that the present deflection demonstrator will be torn down and moved to Room 026 for inclusion in the storage tube reliability tester within the next two weeks.

10.0 TRAINING

10.1 Seminar Series

(J. M. Salzer)

The following Block Diagram Seminars were held:

November 3,	Master Clock	R. P. Mayer
November 12,	Temporary System for Testing the Arithmetic Element.	J. M. Salzer

11.0 FACILITIES AND CENTRAL SERVICE

11.1 Publications

(J. N. Ulman, Jr.)

The following material has been received in the Library, Room 217, and is available to 6345 Personnel.

6345 Reports

No.	Title	No. of Pages	No. of Drwgs.	Date	Author
SR-11	Summary Report No. 11	19	-	8-48	
R-152	Binary Counter Application of the Whirlwind Flip-Flop	8	9	10-20-48	H. Kenosian
E-155	Trigger-Tube Circuits	3	4	10-21-48	A.K. Susskind
E-158	Binary Counter Application of the Whirlwind Flip-Flop (Abstract of Report R-152)	1	-	10-20-48	H. Kenosian
E-159	Block Diagram Revision - Nomenclature	6	-	10-28-48	J.M. Salzer
M-658	Storage Holding Stability Tests on RT36	5	15	9-29-48	N.S. Zimbel
M-659	The Problem of Scale Factor as Applied to Non-simulator Problems	12	-	10-20-48	J.W. Carr, II
M-660	Time Pulse Distributor Output; Deviation from Specification	1	-	10-21-48	H. Fahnestock
M-667	Summary of Storage Tube Testing, May 1 - Oct. 26, 1948	2	2	10-28-48	C.L. Corderman, J.S. Rochefort, R.L. Sisson
M-668	Bi-Weekly Report, Part I, 10-29-48	13	-	10-29-48	
M-669	Bi-Weekly Report, Part II, 10-29-48	17	-	10-29-48	
M-670	6345 Personnel	3	-	11-1-48	
M-671	Clock Pulse Control; Layout Approval	2	-	11-1-48	J.A. O'Brien
M-672	Priority for Tube Construction	2	-	11-2-48	P. Youtz
M-674	Panel Engraving Drawings	2	2	11-4-48	A.M. Falcione
M-677	Drawings for Reports, Memos, Etc.	1	-	11-3-48	A.M. Falcione
M-678	Inspection of Material	1	-	11-5-48	H. Fahnestock
M-680	Barta Building Parking Facilities	1	-	11-5-48	J.C. Proctor

6345 Reports (Continued)

No.	Title	No. of Pages	No. of Drwgs.	Date	Author
M-681	Approval of Test Specifications for Digit Interlock and Voltage Variation Panels	1	-	11-5-48	C.W. Watt
M-682	Partial List of Wiring Installation, Computer Room	2	-	11-9-48	C.W. Watt
C-62	Applications Study Group	2	-	11-1-48	J.W. Forrester
C-63	Applications Study Group	2	-	11-9-48	J.W. Forrester
C-64	Coding the Evaluation of Sin X (Problem Assigned in C-62)	5	-	11-10-48	J.W. Forrester

Library Files

.004	European Scientific Notes, Vol. 2, No. 19, 1 October 1948	ONR London
47	Technical Information Pilot Number U1510-1576	(ONR & Lib. of Congress
51	Tracerlog, October, 1948	Tracerlab, Inc
113	General Radio Experimenter, October 1948, "A Radically New Coaxial Connector for the Laboratory"	(General Radio Company
131	Abstracts Listed Under Fire Control in the Index to Bibliography of Scientific and Industrial Reports, Vol. 1, January 11 to June 28, 1946 and Vol. 2, July 5 to September 27, 1946	P. Travers
175	The Expected Performance of the Edvac on Some Astronomical Problems, Reprint No. 73 from the Flower Observatory of the University of Pennsylvania	John B. Irwin
176	Metal Hydrides Progress Report, for Period August 18 - October 23, 1948	(Metal Hydrides Incorporated
177	Mechanical Drafting Standards Book Class 2.00	(J. Aitken & (A.M. Falcione

Book

	Tables of Functions with Formulae and Curves	Jahnke & Emde

11.2 Standards Committee

(S. R. Abbott)

The following specifications have been approved and distributed:

11.2 Standards Committee (Continued)

S7.504-2	Records and Markings WWI Tubes
S7.413-2	Register Driver Type I Preliminary Tests
6.183A	Terminal Lugs - Turret (Revision)
7.161A	Sockets, Tube (Revision)
6.240	Raw Metal Stock
6.310A	Tools Issued
6.310B	Tools Available for Temporary Issue
6.161A	Sockets, Tube (Revision)

11.3 Purchasing and Stock

(H. B. Morley)

Many of our suppliers have reported that they are receiving increased orders, with the result that delays in deliveries from the manufacturers are to be expected.

A complete set of General Electric Tube Manuals, Receiving, Transmitting and Industrial, is now available in the Procurement Office.

To obtain more efficient overall laboratory operation, an effort is being made to reduce inventories and stock replacement orders on items which will not continue to be used in large quantities.

Difficulty has been experienced in obtaining tube sockets with beryllium copper silver-plated contacts from Cinch Mfg. Company. We have obtained proper ordering numbers from Cinch, and in addition will continue to specify contact material on future orders. Also, arrangements are being made for analysis of samples at M.I.T. Chemistry Department.

A series of office instructions has been compiled and will be issued as a manual of internal office procedure for the Procurement Office.

The work load of this office continues at a high level. Investigations in search of specialized components and/or material consumes much of the time of staff and administrative personnel. Files and Kardex cross-reference system have overflowed previous space estimates, and require constant revision.

11.3 Purchasing and Stock (Continued)

(R. Fairbrother)

About 95% of the stockroom material has been counted, and we are now in the process of recording the count. This should be completed by the 19th.

Again it is urged that more care be used in meter operation, particularly Simpson Model 260 volt-ohm-milliammeters. There are at present eight Simpsons in the repair shop, and four have been returned from repair since November 1st.

11.4 Electronic Construction

(F. H. Caswell)

Heater element repairs to the annealing oven were made.

Two new holding gun power supplies were checked and current regulators adjusted.

The following units were assembled:

A two-tube video amplifier.
50 - 500 volt, 10 ma, regulated power supply.
A 10 Mc oscillator.

Rewired switch panel and installed relay box on Vac system no. 1 to permit operation of protective circuit. These protective devices will be known as "Protect-O-Vac".

(A. Taylor)

Priority is presently being given to the construction of test equipment required for the temporary console.

Very little test equipment will be available for general stock until these needs are satisfied. The equipment is being "earmarked" for the console before being sent to inspection.

11.5 Drafting

(A. M. Falcione)

Change Notices - Many change notices received from Engineers for changes in graded drawings are not explicit and clear

11.5 Drafting (Continued)

as to the intent. This necessitates a considerable amount of lost time both for the engineer and drafting room. It is estimated that 50% of all change notices received require rewriting into clear, concise wording. It would be greatly appreciated if engineers would cooperate in this matter. The change notice is not complete unless it fully describes the changes, such as:

a. Remove R71.
b. Change R71 from 2200 ohms to 500 ohms.
c. Add 2500 ohm resistor between control grid of V1 and ground.
d. Change jack designation of J11 from "Pulse Output" to "new designation".
e. Etc...

Mechanical Drafting Standards Book, Class 2.00 - The first section entitled "Drafting Practice", Class 2.01 through 2.13, was issued recently. Copies may be seen in the library.

Memorandum M-674 on Panel Engraving Drawings was issued November 4, 1948. Recent developments in the method of engraving panels may require a revision of this memorandum. The matter is being investigated.

11.6 Unclassified

(A. Taylor)

All mechanical technicians of the Construction Group are now in one group to be known as the mechanical unit. This simplifies the organization of the Construction Group and allows a more flexible application of mechanical talents. Loren Prentice is directing the activities of the mechanical unit for Al Taylor.

The storage tube work is now taking about three-fourths of the available machine shop time. Light gas welding equipment has been added in the sheetmetal shop. This will considerably extend our sheetmetal operations by permitting aluminum welding.

12.0 GENERAL

Non-Staff Terminations: Albert Elliott