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Memorandum M-797

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, March 4, 1949

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(P. Franklin)

The mathematics group has been organizing various problems on applications to ship control, ballistics, and eigenvalues or critical speeds.

Some codes and solutions have been worked out.

(E. Reich and P. Rabinowitz)

The code for the ship location problem has been completed. The maximum amount of time required to compute the positions of all ships in the channel will be less than 0.1 seconds. The total storage requirement will be about 625 registers.

A Note is being prepared explaining the code and will be issued shortly.

(T. W. Hildebrandt)

I have written conference note C-98, "Ballistic Problem. Simplified Flow Diagram for Runge-Kutta Method", and I have been working on applications of the Runge-Kutta method to simple problems in an effort to make the process clear to all interested personnel.

(M. Daniloff)

The ballistic problem was examined in some detail and it was found possible to throw the equations of motion into a form such that the Kutta-Runge method need be applied to not more than two equations simultaneously. (The remaining quantities are then obtained by simple quadratures).

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6.0 MATHEMATICS (cont)

For the case of direct fire, the number of equations to be treated by Kutta-Runge's method reduces to one only, the remaining quantities being again obtained by simple quadratures.

Work on the machine calculation of eigen-values was continued and a tentative memorandum prepared and circulated privately.

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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)

Two storage tubes using the new target assembly were processed and turned over to the test group. One tube (ST73) was in the Be mosaic-on-mica series with a glass spacer in the center between the screen and storage surface. The second tube (ST65) was the second in the Be mosaic-on-glass series. However, in this tube the mosaic did not go to the edge of the surface as it did in the first tube.

A third tube in the Be mosaic-on-mica series with a glass center spacer is on the exhaust system and ready to be processed next week.

The nickel support ring in the new storage assembly becomes magnetized and distorts the holding beam. We will attempt to spin rings out of stainless steel. This will give us a complete assembly which is non-magnetic.

Renewed intensive interest in the upper limit of holding gun voltage has pointed the immediate need for some new types of tubes. The 40 mesh collector screen will be replaced by 100 mesh screen to get better control in the collector-storage surface region.

We have been producing thick mosaics of beryllium. This increased evaporation time increases the hazard of leakage between mosaic squares. Therefore we will prepare a series of evaporation tubes with thinner mosaics.

(M. I. Florencourt)

Engineering notes have been issued on the construction, processing and initial testing of ST65 and ST73: E-209 and E-208 respectively.

Data has been gathered to try to correlate storage stability with evaporation and processing techniques.

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8.11 Tube Construction and Processing (Cont'd)

(R. Shaw)

All existing storage tubes have now been shatter-proofed by coating with electrical Scotch tape.

Tests on the signal plate assembly indicate that stress in the wires of the screen is roughly half the yield point stress. This tension is reduced somewhat by baking at 540° C., but this is not considered serious since the usual bakeout temperature is 450° C. These results are given more fully in an engineering note now being typed.

A study is being made of various materials suitable for screens and associated parts. The results are being tabulated for future reference.

The storage tube drafting group has been preparing charts, designing special tools, laying out storage tube racks for WWI and facilities for the safe storage of tubes.

(W. E. Pickett)

Glass components - During this last period, construction of storage tube envelopes was carried on as planned. There are enough storage tube envelopes on hand to take care of the scheduled construction of storage tubes for the next period.

Several large 7" CRT evaporating envelopes were also constructed. We now have enough of these large evaporating tube envelopes on hand to change over completely to the new target assembly.

The difficulty which was encountered on the ten-pin stems has been cleared up. There is a low inventory of ten-pin stems which will necessitate all spare time activity on this item. No unnecessary delay will be encountered on this item as parts for this stem are on hand and do not have to be fabricated.

During the last period, glass spacers were made for spacing the screen grid from the storage surface. These were made from a solid glass rod which is a departure from

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8.11 Tube Construction and Processing (Cont'd)

using glass tubing for this purpose.

Two evaporating tubes were constructed from the local vender's flat-press stems and no difficulty was observed in using these stems. In the future these stems will be used for all the evaporating tubes to be constructed.

(J. S. Palermo)

Mechanical components - Revisions in specifications, and results from our present series of Be-on-glass storage tubes, have necessitated the requisitioning of many components for storage tube target assemblies. The procurement of these components is not expected to delay the present production schedule of storage tubes since our present inventory is more than ample to cope with the demands of the next three (3) weeks.

The mica needed for mica spacers and mica targets has been received this week. There are at present five complete sets of storage tube envelopes, to be cleaned and dagged, in the Inspection Room.

8.12 Tube Testing

(H. Klemperer)

Construction work - During this period construction work on the life-test rack as well as on the automatic readwrite unit has moved ahead. The life-test rack is nearing completion while the automatic read-write unit is undergoing first testing.

Tube Testing - With construction work nearing completion the main interest is returning to tube testing. Experimental work with the beam analyzer tube was resumed and the electrolytic tank was readjusted to start measuring static fields of the storage assembly. "Upper Stability", which connotes the complex of problems related to switching of the storage surface from holding beam cathode to collector potential, received foremost attention, and in the course of this work there were indications that a third stable level does exist.

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8.12 Tube Testing (Cont'd)

(A. H. Ballard)

Two more storage tubes have been received from the construction group and have been given initial tests. ST73 has a Be-on-mica surface and ST65, Be-on-glass. Both tubes are equipped with the new storage assembly.

It appears that some of the differences observed between the mica and glass tubes and reported in the previous bi-weekly report may possibly be traced to the type of target assembly used. Both ST73 and ST65 use the new target assembly and have areas which do not stabilize at collector potential below $V_{HG} = 150$ volts, compared to 75 volts for the previous mica tubes. The shape of this unstable area is a concentric ring at the outside of the surface.

The first tests on ST73 showed the upper limit of holding gun voltage to be 175 volts, thus the usable range was only 25 volts wide. Observations of the holding beam pattern indicated that the reason might be distortion of the beam arising from permanent magnetism in the target assembly. Demagnetizing the target raised the upper limit of V_{HG} to 370 volts. Storage performance is now very satisfactory at intermediate holding gun voltages.

Several voids and scratches were observed on the mosaic in ST65 before sealing the tube; these areas appear dark on a television presentation indicating little or no output signal. Positive spots written near these areas spread and become irregular in shape. Otherwise storage is satisfactory, although $V_{HG} = 200$ volts is required to write over the entire surface.

(C. L. Corderman)

Further work has been done on assembling and testing the units to be used in the life-test rack. All of the mu-metal tube shields have been received and are being installed in the tube mounts. A partial shipment of meters arrived. Initial life tests using two tubes should be underway the latter part of next week.

Present tests on storage tubes are being directed towards determining the reason for switching on the forward curve and accounting for the presence of unstable spots on the surface.

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8.12 Tube Testing (Cont'd)

(J. S. Rochefort)

Engineering note E-169, "Electrostatic Storage Tube Demonstrator", has been issued.

208TV - The sweep generator and adapter panel for the life-test rack have been constructed. This unit has checked out satisfactorily. The life-test television-readout equipment built around a standard Dumont 208 scope is now complete.

(H. Rowe)

A control panel for the storage tube life-test rack was constructed and wired.

(J. S. Rochefort and N. S. Zimbel)

High Repetition Rate Write-Read Unit - This unit has been assembled in accordance with a revised block diagram. This will allow the cycle R, W- followed by R, W+, to be accomplished at high repetition rates. By recabling and using the same amount of equipment, the cycles W+, W-, R and W-, W+, R may be obtained.

The unit is now cabled for the first cycle mentioned above. Satisfactory operation has been accomplished at repetition rates up to 20 kc.

8.13 Storage Tube Reliability Tester

(J. O. Ely and R. Sisson)

Testing on the system using a single storage tube has been continued. Control connections were changed so that a read, write(+), read, write (-) cycle at a variable p.r.f. could be used on a single spot of the storage surface. This type of operation allows point-by-point investigation of the switching properties of the surface as a function of various operating conditions. Equipment for a TV presentation of the storage surface has been installed and operated.

Observations of focus, spot size, surface condition, position and size of the stored pattern, etc., may be made by means of this equipment.

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8.13 Storage Tube Reliability Tester (Cont'd)

Investigation showed that 60 cps magnetic fields picked up by the storage tube were interfering with deflection and hence with operation in general. Removal of an adjacent filament transformer, and further magnetic shielding has apparently reduced this pickup to a level which gives improved operation. Further reduction of the effect of pickup was gained by operating at a frequency such that the frame rate is a multiple of the pickup frequency; thus the spots appear to be stationary in spite of the pickup.

After reducing deflection pickup and as a result of tests with the TV system, operation of the tester was improved considerably. Patterns of spots may now be written on the surface and read out both as a static display or as a cycling display; frequent errors during cycling, however, render this display relatively unstable. These errors may be due to transients picked up through the power supplies or by radiation, or they may actually be errors made within the storage tube or readout equipment.

Work on the problem of determining the nature of errors will continue as well as more basic studies to determine why conditions for stable operation are more critical than expected. Further work on magnetic and electric shielding will be done. Installation of the additional four storage tube positions will be deferred until more satisfactory operation with one tube has been obtained.

(J. A. DiGiorgio)

The video amplifier for the TV presentation was completed.

Assembly of the equipment for the additional storage tubes has begun.

At present a sweep generator (designed by J. S. Rochefort) for the TV setup is under construction.

8.2 Storage Tube Research

8.23 Output System Circuits

(W. J. Nolan)

Operating experience with the r-f output system on the storage tube reliability tester has indicated the desirability

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8.23 Output System Circuits (Cont'd)

of a number of changes in the amplifier. A new amplifier incorporating these changes has been designed and will probably be operated in the reliability tester before production is started on additional amplifiers for a 5-tube setup.

(C. H. R. Campling)

Construction of the second r-f pulser is nearly complete and testing of this unit should begin within the next week.

8.24 Holding Gun Studies

(H. Klemperer)

The electrolytic tank was moved into the basement to provide space upstairs for setting up the storage tube life-test rack. In the new location the tank was cleaned and adjusted, and electrodes were prepared to measure the field distribution between collector and storage surface of current storage tubes.

8.4 Deflection Circuits

(L. J. Nardone)

The complete schematic diagrams of the deflection-voltage generators have been drawn except for the output amplifier and minor details on the increment schematics which are dependent upon the output amplifier design.

A two-wire shielded transmission line has been designed to feed the deflection voltage to the storage tubes. The mechanical design of the line, including its supporting brackets, is being carried out at present. RG22/U Cable will be used in going over the center aisle.

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11.0 FACILITIES AND CENTRAL SERVICE11.1 Publications

(J. N. Ulman, Jr.)

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

6345 Reports

<u>No.</u>	<u>Title</u>	<u>No. of Pages</u>	<u>No. of Drwgs.</u>	<u>Date</u>	<u>Author</u>
SR-15	Summary Report No. 15	25	-	12-48	
R-154	Outlook for Electronic Digital Computers-The Scope of the Engineering Involved (Abstract in M-201)	7	-	2-16-49	J.W. Forrester
E-169	Electrostatic Storage Tube Demonstrator	23	2	2-49	J.S. Rochefort
E-195	Status of Research on Magnetic Recording	8	11	2-14-49	G. Cooper
E-196	Storage Tube 71: Construction, Processing and Initial Testing	3	-	2-14-49	M. Florencourt
E-197	An Investigation of Basic Circuit BA-2	3	5	2-16-49	H.B. Frost
E-198	Storage Tube 64: Construction, Processing and Initial Testing	3	-	2-16-49	M. Florencourt
E-199	Storage Tube 51: Construction, Processing and Initial Testing	3	-	2-18-49	M. Florencourt
E-200	Electrostatic Storage Tubes for Digital Computers and Other Information Processing Systems (Abstract of Report R-153)	1	-	2-24-49	J.W. Forrester
M-774-1	Tube Conferences - January 31, 1949	2	-	2-7-49	E. S. Rich
M-782	Return of Templates and Jigs	1	-	3-1-49	H. Fahnestock
M-788	Suggestions for Mental or Manual Binary Conversion	3	1	2-16-49	C.W. Adams
M-789	Bi-Weekly Report, Part I, 2-18-49	18	-	2-18-49	
M-790	Bi-Weekly Report, Part II, 2-18-49	18	-	2-18-49	
M-791	Tube-Life Investigations	2	-	2-21-49	E.S. Rich

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<u>No.</u>	<u>Title</u>	<u>No. of Pages</u>	<u>No. of Drwgs.</u>	<u>Date</u>	<u>Author</u>
M-793	Production Meetings	1	-	2-23-49	H. Fahnestock
M-794	Conference on Vacuum-Tube Problems - February 17, 1949	2	-	2-24-49	E.S. Rich
M-795	6345 Personnel	3	-	3-2-49	
C-97	Applications Study Group Working Notes, February 15-29	2	-	2-17-49	W.G. Welchman
C-98	Ballistic Problem, Simplified Flow Diagram for Runge-Kutta Method	4	-	2-18-49	T.W. Hildebrandt

Library Files

40	Experiments and Reference Notes on Digital Computer Laboratory Work, MIT				F.M. Verzuh
47	Technical Information Pilot, Number 2158-2220				{ ONE & Lib. of Congress
52	Progress Reports for WWI Electronic Digital Computer for Periods December 4-December 17, 1948 and February 12- February 25, 1949				Sylvania
113	General Radio Experimenter, February 1949				Gen. Radio Co.
150	Fundamental Research on Raw Materials used for Electron Emissivity on Indirectly Heated Cathodes; by James Cardell, Quarterly Report 12-1-48 to 3-1-49				Raytheon
173	Project Hermes Report No. 49A0500: Report on A4 (V-2) Missile No. 39				General Elec. Co.
173	Project Hermes Report No. 55287: A Pulsed S-Band Signal Generator for Testing the Hermes A-1 Command Unit				General Elec. Co.
190	Report No. 55381 on Thumper Project; Acquisition Radar Smoothing				General Elec. Co.
198	Interim Development Report on Radio Control Model AN/ARW -55 and Radio Control Receiver Model AN/ARW-56; January 1, 1949 to February 1, 1949				Collins Radio Co.
239	Detection of Overheated Transmission Line Joints by Means of a Bolometer; AIEE 49-9, December, 1948				{ J.R. Leslie J.R. Wait
240	An Electro-Optical Shutter for Photographic Purposes; AIEE 49-24, January, 1949				{ A.M. Zarem F.R. Marshall F.L. Poole
241	The Distinction Between Effective and Circuit Bandwidths; AIEE 49-26, January, 1949				W.J. Kessler
242	Electrical Noise at the Sliding Contact; AIEE 49-30, December, 1948				{ V.P. Hessler M.C. Cottom
243	Some Fundamentals of D-C Controlled Reactors with Resistive Load; AIEE 49-55, December, 1948				H.F. Storm
244	Damper Stabilized Instrument Servomechanisms; AIEE 49-79, December 1948				A.C. Hall

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Library Files (Continued)

<u>No.</u>	<u>Title</u>	<u>Author</u>
245	Transconductance as a Criterion of Electron Tube Performance; AIEE 49-106, December 1948	T. Slonczewski
246	Bibliography of Scientific and Industrial Reports, Jan. 1949	{ U.S. Department of Commerce
247	Aerodynamic Characteristics of a Wing with Quarter-Chord Line Swept Back 45°, Aspect Ratio 4, Taper Ratio 0.6, and NACA 65A006 Airfoil Section; J. Weil & K. Goodson	NACA
559	Technical News Bulletin, February 1949	{ National Bureau of Standards

Books

Numerical Calculus	W.E. Milne
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11.2 Standards Committee

(H. B. Morley)

At the meeting of the Standards Committee, H. Kenosian presented a report and comments on recent experience with breakdown of mica capacitors. If further failures are noted, it is possible that voltage breakdown tests should be conducted before units are placed in service.

Revised standards issued:

6.015A - Knobs and Dials
6.193-1 - Pulse Transformer Cores

11.3 Purchasing and Stock

(H. B. Morley)

In several instances recently, difficulty has been encountered in silk screening of panels because of layout changes in the panels which are not indicated on the drawings. This has made it impossible for the silk screen vendor to completely prepare screens in advance of receipt of the panels, since the legends sometimes appear too close to or even over panel holes. Engineers are requested to make every effort to insure that drawings accurately indicate the actual layout of the panels which will be supplied. The same precaution applies to repeat orders on panel types which have been silk screened previously.

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11.3 Purchasing and Stock (Continued)

Navy Property Record Cards for capital equipment procured with Navy funds must now be prepared by this office for submission to the Navy Contracting Officer.

(R. Fairbrother)

The specification book listing all numbered, commercially manufactured test equipment belonging to the project is now completed. The copies will be distributed one to the stockroom, one to the library, one to the test equipment group and one to the storage tube group. This book contains a separate sheet for each different item of equipment giving its uses, range, accuracy and pertinent electrical characteristics. As new instruments are purchased these books will be brought up to date.

All except 43 relays have now been received for the completion of the remaining 63 voltage variation panels.

A parts list is now being prepared from the circuit schematic of the WWI Synchronizer.

11.4 Electronic Construction

(A. P. Curtiss)

Two power supplies were serviced.

A 10 mc. oscillator and one RF pulse generator were breadboard assembled.

A second holding gun power supply was modified. D-33559.

A TV sweep generator and adapter was constructed.

A deflection circuit and an RF amplifier are being constructed.

Additional work was done on the storage tube life test racks.

11.5 Drafting

(A. N. Falcione)

Mr. Henry Austin reported for temporary work on this date. Mr. Austin is an Electronic draftsman on loan from Bldg 32, and will assist in completing thesis drawings.

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11.5 Drafting (Continued)

The work load on the drafting department is full and heavy and is expected to remain so for some time to come. To date we have kept pace with WWI schedules and expect to continue to meet requirements.

A ditto master is being typed at this time listing all mechanical parts required on WWI Panel Assembly Parts List. This form will assist drafting personnel in the making up of mechanical parts list, and the construction shop on assembly.

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(1. Prentice)

Machine Shop - Overhaul of the 13" South Bend lathe has proceeded far enough so the lathe is back in service. Additional parts are now on order to replace worn gears to increase precision and reduce noise level. Some repair work has been done on the small Burke miller and a faster motor has been added to machine the phenolic material now in process in the shop.

Parts are on order to make a turret lug staking machine to be air operated and controlled by a foot valve.

Parts have been received to make a collet fixture to facilitate moving work from lathes to the Bridgeport miller.

We have completed an experimental cutter and holder for cutting 1-3/4" holes in phenolic panels. Additional cutters are being made.

Sheet Metal Shop - A primary survey has been made toward getting more space to accommodate additional equipment and personnel.

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