

6345  
Memorandum M-764

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Project Whirlwind  
Servomechanisms Laboratory  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, January 21, 1949

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(P. Franklin)

Work continued on the coding of elementary functions and particular applications.

(M. Daniloff)

The problem of determining the position in the plane of a target from two receiving stations and one transmitter has been examined and solved. The answer depends upon the solution of a quadratic equation. This can be handled by Newton's method. A process has been devised for isolating the correct root. The solution is being coded to determine time and storage requirements.

(T. W. Hildebrandt)

Engineering Note E-170, "Codes for the Evaluation of  $e^{-x}$  and  $\ln x$ ", was issued.

(P. Rabinowitz and E. Reich)

The method of obtaining the position of a particle from information given only at grid points has been further studied. Modifications have been devised in order to make the method applicable to cases where the measuring apparatus introduces errors of known character.

Bieberback's method of conformally mapping a given plane region into a circle is being studied, and compared with other numerical methods for solving this problem.

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6.0 MATHEMATICS (cont)

(G.W. Adams)

"Intact Stability Study Programmed for a Digital Computer", a master's thesis, has been submitted to the Mathematics Department. Copies are in the library. An intact stability study is a numerical integration procedure which yields the stability characteristics of an intact ship. The calculations are carried out at present by machine-assisted hand calculation. The thesis gives a detailed program by which the calculations could be performed by WWI.

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7.0 INPUT AND OUTPUT

7.4 MAGNETIC RECORDING

(G. Cooper)

The driver for the static reading head has been designed and constructed. The pick-up amplifier has also been constructed and tested. It was found that spurious oscillations developed in this circuit. The causes and cures for these seem to have been found. In addition, the plate loads of the stages were reduced to increase the bandwidth, and a fourth stage added to compensate for the loss in gain. The revised unit is being built and it is expected that it will operate satisfactorily.

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8.0 STORAGE TUBES

8.1 Tube Construction and Testing

8.11 Tube Construction and Processing

(R. Shaw)

Beam analyzer tube, RT47, has been completed. A new tube is under consideration which will include minor modifications to give a stronger target and make the tube construction easier.

ST69, a tube with a calcium tungstate target for holding gun studies, has been completed. It is planned to make a duplicate, parts for which are already on hand.

Two evaporation tubes have been assembled for producing a beryllium "strip" pattern on a mica surface (ET115 and ET116).

The storage tube drafting group has been occupied chiefly with work on a polariscope, a tube-processing oven, and modifications of electron guns.

(M. I. Florencourt)

The construction and inspection sheets for tube parts and assemblies have been revised. The latest sheets have the same numbers as the originals, with a dash 1 added.

Memoranda have been issued on the construction and processing of the following tubes:

E-173	ST56
E-174	ST57
E-175	ST60
E-180	ST62
E-181	RT47
E-182	ST61

(J. S. Palermo)

The inventory of mechanical components for target assemblies remains well ahead of anticipated production schedule. The six modified frames for the new target design will be ready January 24, 1949. These frames together with the available supplementary components will constitute eighteen (18) target assemblies for the new design.

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8.11 Tube Construction and Processing (Cont'd)

Experiments conducted in dusting a Calcium Tungstate mosaic on nickel have proven successful. An improved technique, requiring more efficient equipment, has been planned. The purpose of this method will be to produce a more condensed and uniform mosaic.

Additional mica was received January 10, 1949. Our present stock now consists of twenty-three (23) sheets of good mica -- which is composed of both Canadian and India mica.

(W. E. Pickett)

The glass shop has on hand 4 - 12 pin stems for special gun mounting. There are 6 - 10 pin stems for regular gun mounting. There are 6-flat press stems. The above flat press stems should be enough for the 4 regular type large ET envelopes. The special ET112 envelope made from 6" dia nonex cylinders is also ready. The envelope for ET113 made from a 7" cathode ray tube blank is also ready and is in the FAR. At present there are 2 envelopes ready for mounting surfaces for ST tubes and only one 2 arm envelope ready for ST tubes. The planned work of very high priority concentrates on ET tubes and the above components should be ample to take care of the program, as close as a rough estimate can give.

(E. S. Prohaska)

The polarizer and analyzer for the polariscope are expected to be out of the shop by February 9th. The base will be ready for fabrication next week.

The new cylindrical oven is still in the layout stage. Heat balance estimates for it are being checked.

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

The eleventh and twelfth storage tubes (ST62, ST63) in the Be mosaic on mica series were processed satisfactorily and delivered to the test group. We will continue to build one tube a week in this series.

The Electron-Beam Analyzer tube (RT47) and a storage tube (ST69) with a mosaic of calcium tungstate on nickel to study properties of the electron guns were processed and turned over to the test group.

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8.11 Tube Construction and Processing (Cont'd)

(P. Youtz)

The Beam-Analyzer Tube (RT47) developed gas. This tube will be used to evaluate the test techniques. Another tube (RT50) was started as soon as RT47 became gassy.

A series of simplified Be strip tubes has been started. This series will be used for life, stability and contamination studies.

8.12 Tube Testing

(J. H. McCusker)

Tests have been started on RT47 to determine the velocity distribution and density of the holding beam and high velocity beam.

(C. L. Corderman)

The 10th and 11th of the Be on mica storage tubes have been given initial tests. ST61, the 10th in the series, has an unstable area occupying approximately 1/4 of the surface. When positive spots are written in this area, the surface between the spots is also switched positive. The 11th of the tubes, ST62, was specially constructed and has A<sub>2</sub> split into two sections. It as well as ST61 was made without the spacer bead. The surface of ST62 is exceptionally uniform and has good stability. No sustained oscillation of the collector has been noted; however, when the tube is lightly tapped, evidence that the collector is vibrating persists for about 5 seconds, a slightly longer period than for tubes with the collector to surface spacer bead.

E-178 has been issued which lists a set of standard tests to be performed on all storage tubes. These tests were designed to give information on the more important characteristics of the tubes, particularly those characteristics which might change during tube life. ST48, the 4th in the Be on mica series, now has been operated 400 hours, with no appreciable changes taking place.

A storage tube summary sheet has been drafted which lists general results on all ST's constructed and tested from ST40 to the present time. It is planned to issue this summary sheet weekly, with changes and additions as they occur.

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8.12 Tube Testing (Cont'd)

(A. H. Ballard)

Tests on ST56, the seventh Be-on-mica tube, have shown that positive spots can be written on a negative background by using a HV gun grid pulse as short as 1.5 microseconds. Reading out has been successful using a grid pulse of 0.5 microseconds. The output signals under these pulse conditions were about 100 mv for the negative background and 35 mv for a positive spot - a ratio of about 3. A ratio as high as 10 has been obtained by using read and write pulses of 4 microseconds duration.

The surface seems quite uniform in respect to writing positive and reading out. Detailed studies of the write negative operation will be made after the delivery of further test equipment.

ST56 is now being left on overnight for life test studies. The cumulative operating time at present is slightly in excess of 100 hours; no signs of deterioration have yet appeared.

The relay test position is being revised to provide more information on the storage tubes. Additions planned for the near future include a gate inverter for signal plate switching and a readout system comprising a Model 208 oscilloscope and associated sweep and video circuits. A power distribution system has been installed to make laboratory d-c power available to these new units.

(N. S. Zimbel)

High Speed Write-Read Unit. Tests with one of the old beryllium mosaic on  $Al_2O_3$  tubes, ST38, were made to check some of the results of M-747 and were then discontinued since the collector in this tube vibrates with signal plate switching.

ST57 (Be-on-mica) is now being tested in this unit. Tests with this tube have been impaired by some test equipment failures.

(J. S. Rochefort)

Testing of the video amplifier has commenced. When its operation is satisfactory, this amplifier will be used with a modified 208-B 'scope to view storage surfaces.

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### 8.13 Storage Tube Reliability Tester

(J. O. Ely, R. L. Sisson and L. J. Nardone)

Testing and adjustment of the system have been carried on during the past two weeks. The new video readout panel was checked out and tested. Although there is some improvement over the breadboard model, the circuits are still sensitive to changes in the shape and amplitude of the input gates. This panel has been operated with ST60, using both 8 x 8 and 16 x 16 stored patterns. Stability with 8 x 8 arrays was fair but satisfactory operation was not achieved with a 16 x 16 array.

Tests indicate that unsatisfactory operation is mostly caused by repetition-rate sensitivity throughout the system. This is particularly apparent when going from push-button to cyclic operation. Very bad regulation on the +150 volt, -150 volt, and -15 volt supplied seemed to contribute to the observed repetition-rate sensitivity, and steps have been taken to improve these supplies. It was noticed that the 256-B A/R scope used to supply clock-pulses is quite sensitive to small transients on the 115 volt a-c line, and it is felt that this condition will preclude use of the 256-B as a clock-pulse source for any extended runs.

During the past two weeks a number of flip-flop tubes (6AG7's) in the deflection circuit panels were retired because of sticking or stalling of the flip-flops in which they are used. All of these tubes have operated for approximately 2100 hours.

It has been decided to install r-f readout circuits in the present single-storage-tube system and try operation with these circuits before adding the remaining four storage-tube positions. The decision as to whether video or r-f readout circuits will be used in the five-tube setup will be made on the basis of the results obtained with the present video circuits and the r-f circuits being built now.

Tests on the reliability tester would be greatly facilitated by some sort of a TV display. Without such equipment questions concerning background polarity, spot size (focus), position and size of the array on the storage surface, and many other questions, can be answered only by indirect evidence.

Plans and the procurement of materials for the installation of four more storage tubes are proceeding as rapidly as seems wise in view of the present operating status of the single-tube system.

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**8.13 Storage Tube Reliability Tester (Cont'd)**

(J. A. DiGiorgio)

The 4 additional storage display mounts which will take care of the storage tubes to be added to the tester are about 20% completed, and the chassis are expected some time next week from the shop.

**8.2 Storage Tube Research****8.23 Output System Circuits**

(C. H. R. Campling)

Development of the phase-shifter mentioned in the last bi-weekly report is nearly complete. The range of phase shift available is about 120 degrees. With the output working into a terminated 90-ohm line the signal available is about 3.5 volts peak. The chief problems encountered have been the dependence of amplitude on phase shift (caused by the variable input impedance of the phase shifting circuit) and the presence of harmonics in output. Both of these faults have been corrected.

(W. J. Nolan)

An amplifier has been built for use in tracking down undesired 10 mc signals on power and video wiring and for detecting radiation leakage paths. This unit is considerably more sensitive than the type to be used for actual readout and in addition is entirely operated from self-contained batteries so that in use it will not introduce further undesired r-f coupling from its own power leads. Due to the high gain considerable difficulty was encountered in preventing instability, construction in a special copper chassis with barriers between stages being resorted to. Even with this type of construction trouble was experienced when the bottom cover was screwed in place. This was eventually traced to contact between certain points on the interstage barriers and the cover and was remedied by inserting insulation on the cover.

**8.24 Holding Gun Studies**

(H. Klemperer)

An investigation has been started into the influence of ions on concentration and intensity of the holding beam as well as on life of cathode and storage surface.

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8.25 Electrolytic Tank

(H. Rowe)

Work was started on a model of the high velocity gun which will be constructed in the near future. The fields and electron paths within the gun will be determined.

8.3 Unclassified

(M. I. Florencourt)

Visitors to the Storage Tube Lab. included: Capt. E.K. Walker and Dr. R.C.H. Wheeler of the U.S. Naval Academy; Mr. R. F. Clippinger of the Aberdeen Proving Grounds; Mr. J. W. Hinkley of Research Corporation, Mr. M. R. Jenney of DIC; Mr. Louis D. Smullin and Dr. L. J. Chu of MIT; Dr. A.V. Haeff of NRL; and Mr. Frank H. Wells of Aircraft Marine Products.

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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-14	Summary Report No. 14	17	-	11-48	
E-170	Codes for the Evaluation of $e^{-x}$ and $\ln x$	9	-	1-18-49	T.W. Hildebrandt
E-173	Storage Tube 56: Construction and Processing	2	-	12-21-48	M. Florencourt
E-174	Storage Tube 57: Construction and Processing	2	-	12-28-48	M. Florencourt
E-175	Storage Tube 60: Construction and Processing	2	-	12-28-48	M. Florencourt
E-176	Changes Required for Clearing Carrys on Divide	1	-	1-18-49	{J.M. Salzer R.P. Mayer
E-177	Change Required to Shift Zeros into BR15	2	-	1-18-49	{J.M. Salzer R.P. Mayer
E-178	Standard Tests for Reference in Storage Tube Evaluation	3	-	1-18-49	{S.H. Dodd C.L. Corderman
E-179	Quality Study of WWI Electron Tubes	3	2	1-18-49	R.L. Ellis
E-180	Storage Tube 62: Construction and Processing	2	-	1-20-49	M. Florencourt
M-703-1	Video Cabling Schedules, Forms and Drawing Numbers	1	-	12-6-48	C.W. Watt
M-740	Potential Fields and Electron Tra- jectories in the Holding Gun	6	6	12-20-48	H.E. Rowe
M-752	B1-Weekly Report, Part I, 1-7-49	12	-	1-7-49	
M-753	B1-Weekly Report, Part II, 1-7-49	14	-	1-7-49	
M-754	Holding Beam Trajectories and Potential Fields in the Storage Tube	3	4	1-7-49	H. Rowe
M-755	Progress Report: A Dual-Triode Capacitively-Coupled Flip-Flop	2	2	12-31-48	M.H. Hayes
M-756	Progress Report: Development of a Low-Speed Analogue for Flip-Flop Analysis	2	-	12-31-48	J.M. Hunt

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6345 Reports (Continued)

<u>No.</u>	<u>Title</u>	<u>No. of Pages</u>	<u>No. of Drwgs.</u>	<u>Date</u>	<u>Author</u>
M-757	WWI Panels, Turret Lug Marking	1	-	1-11-49	H. Fahnestock
M-758	Shop Orders	3	-	1-12-49	H. Fahnestock
M-759	WWI Power Plug Connections	1	-	1-13-49	H. Fahnestock
M-761	Progress Report: Development of a Low-Speed Analogue for Flip-Flop Analysis	2	-	1-15-49	J.M. Hunt
M-762	Pulse Transformers	1	-	1-20-49	H. Fahnestock
A-80	Standards Group Reorganization	2	-	1-7-49	H.B. Morley
A-81	Production Control	2	1	1-7-49	J.W. Forrester
C-83	The Process of Turning a Ship	16	2	12-22-48	M. Daniloff
C-84	Applications Group Working Notes, December 21 to 28	3	-	12-23-48	W.G. Welchman
C-85	Applications Study Group Working Notes, December 28 to January 4	2	-	12-29-48	W.G. Welchman
C-86-1	Applications Study Group Working Notes, January 4 to January 11	4	-	1-6-49	W.G. Welchman
C-87	Working Notes January 11 - 18	2	-	1-12-49	W.G. Welchman
C-88	Flow Diagram II, for Ship Control Problem	5	-	1-19-49	R.P. Mayer

Library Files

.004	European Scientific Notes, 1 December 1948				London ONR
47	Technical Information Pilot, Number U1927-1996				Lib. of Congress
52	Progress Report for WWI Electronic Digital Computer for Period January 1, 1949 - January 14, 1949				Sylvania
73	Pre- and Post-Analysis by Reeves Analysis and Computer Group: Dec. 2, Job No. 9-7.1; Dec. 1, Job No. 12-1.2; Dec. 3, Job No. 18-2.1; Dec. 18, Job. No. 18-3.1; Dec. 2, Job No. 25-1.1				{ Reeves Instrument Corporation
141	Planning and Coding of Problems for an Electronic Computing Instrument: by Goldstine and von Neumann; Part II, Volume III, 1948				{ Institute for Advanced Study
176	Metal Hydrides Progress Report for Period October 23 to December 23, 1948				{ Metal Hydrides Incorporated
180	Document Office Bulletin; January 5, 1949				{ MIT Electronic Research Lab.
198	Interim Engineering Report on Radio Control Receiver Model AN/ARW-55 and Radio Control Transmitter Model AN/ARW-56; 11-1-48 to 12-1-48				{ Collins Radio Company
210	New Advances in Printed Circuits: November 22, 1948				{ National Bureau of Standards

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Library Files (Continued)

<u>No.</u>	<u>Title</u>	<u>Author</u>
211	Traffic Control Requirements for Jet Transport Aircraft; for SAE National Aeronautic Meeting, 10-47	W.T. Dickinson
212	Hydraulic Servomechanism Developments; SM Thesis 1945	J.W. Forrester
213	Control of a High-Altitude Sounding Rocket; by Robert J. Parks (Report No. 4-50)	{ Jet Propulsion Laboratory
214A	Interim Progress Report on the Physical Realization of an Electronic Computing Instrument January 1, 1947: By Bigelow, J. H.; Pomerene, J. H.; Slutz, R. J.; Ware, W. H.	{ Institute for Advanced Study
214B	Second Interim Progress Report on the Physical Realization of an Electronic Computing Instrument, July 1, 1947, by Bigelow, J. H.; Hildebrandt, T. W.; Pomerene, J. H.; Snyder, R. L.; Slutz, R. J.; Ware, W. H.	{ Institute for Advanced Study
215	The Characteristics of a Hemispherical Air Bearing at High Rotational Speeds, by M. I. Edelstein	{ Curtiss-Wright Corp.
216	The EDVAC; A Preliminary Report on Logic and Design, February 16, 1948	{ Moore School, Univ. of Pa.
217	The Flight Signal Decoder, October, 1948	{ Cornell Aero. Laboratory
218A	Upper Atmosphere Research Report No. V	{ Naval Research Laboratory
218B	Upper Atmosphere Research Report No. VI: A Detector for the Dobson Ozone Spectrophotometer	{ Naval Research Laboratory

Books

Werkstoffkunde der Hochvakuumtechnik	{ W. Espe
	{ M. Knoll
Practical Analysis; Graphical and Numerical Methods	Dr. Fr. A. Willers

11.2 Standards Committee

(H. B. Morley)

Standards sheets have been written and will be distributed on:

- 6.074J Screws, self-tapping
- 6.154B Rheostats

New standards are under discussion on push-button switches, and additions are being prepared for tubes, fuses, coaxial cable, and relays.

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(H. B. Morley)

Manufacturers' representatives of two lines of equipment of interest to the laboratory have called recently to discuss their products. A local company has available a very complete line of shock mountings of all types and sizes, from 2 oz. to 3300 lbs. load capacity. Another company has started to manufacture under British patents a line of high stability carbon resistors, available in a wide range of resistances and close tolerances. They are of the carbon deposition type, 1% stability, 1% tolerance.

During the past few weeks the expenditures of the laboratory for material and services have shown a sharp rise. This may be partly due to anticipated WWI and test equipment construction. Personnel are urged to anticipate requirements whenever possible, but to exercise caution against over-estimating requirements or requesting items which will not be used. Standard stock should be used whenever possible.

The workload of the Procurement Office has increased considerably above recent weeks.

(R. Fairbrother)

The catalogue of purchased test equipment is now being typed in Mr. Morley's office.

The remainder of the stockroom time is being spent in supplying, receiving and inspecting parts.

**11.4 Electronic Construction**

(A. R. Curtiss)

Relays were changed in one D.C. control box.

Two Freed 13387 transformers were modified.

One high voltage power supply was serviced.

Additional work was done on a 10 mc amplifier.

One rack power control unit was modified. (Change notice 222 and 233).

A meter panel is being assembled and two power supplies are being worked on.

The work load remains heavy.

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11.4 Electronic Construction (Continued)

(A. Taylor)

About 150 cable terminators will be available Monday. A black anodized finish has been substituted for the polished aluminum finish originally supplied.

It is still not generally understood that all construction requisitions must pass through the Production Control Office, room 108.

11.5 Drafting

(A. M. Falcione)

Drawings on tube characteristics have been completed and a memorandum will be issued listing each drawing number with its respective tube type and characteristic.

The work load has been increasing on the drafting department. Drawings for the following have been received from Sylvania:

- a) Clock pulse control
- b) AR-O
- c) Restorer pulse generator
- d) Toggle switch storage

Changes and revisions are now being made on these drawings in accordance with our standards.

11.6 Unclassified

(L. Prentice)

Machine and metal shop. Some new equipment has been added namely, 1 set of expansion reamers and 1 last word 10/10000th indicator. New parts have been ordered for existing machines. All this has been necessary to obtain the required accuracy, and the increased demands on the machine shop. New stocks of bar stock and aluminum sheet have been procured. Three-quarters of machine shop time is now being devoted to production of parts for storage tube groups. The Curtiss Air Compressor has been repaired and is now ready for service.

The metal shop has a rather heavy backlog of work. It is requested that all personnel obtain permission from the foreman

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11.6 Unclassified(Continued)

before using this area or the equipment. This request is necessary for the following reasons:

1. The area is small and at present it is necessary to keep three men working there.
2. The equipment is in almost constant use.
3. Several of the punches have been seriously damaged by inexperienced persons and replacement takes 4-6 weeks.

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12.0 GENERAL

Non-Staff Terminations

George Fairbairn  
John Pellegrino  
Paul Windsor

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