Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II

To: 6345 Engineers

From: Jay W. Forrester

Date: October 15, 1948

6.0 MATHEMATICS

(P. Franklin)

Studied methods of interpolation and numerical differentiation.

(M. Daniloff)

The mathematical study of the problem of the speed of condensation of metallic vapours was continued. It was found that the latter can be expressed in terms of two material parameters; to wit:

a) the energy of extraction of an atom(heat of sublimation),
b) the period of normal vibrations of the same.

Further study must, therefore, concern itself with either:

A) an examination of the special literature to determine whether the parameters listed under a) and b) are already known for the berylium-glass and berylium-mica combinations.
B) further reduction of the equations, so as to express the speed of sublimation in terms of physical constants which are more readily available.

Calculations of the "natural frequency" of the grid of the E.S. Storage Tube ($f=3500\ sec^{-1}$ for fundamental mode of vibration).

Engineering Note E-152 "Review of the Work of L.V. Kantorovich and V.I. Krylov on the Methods of Approximate Solution of Partial Differential Equations" was issued to the members of the mathematics group.

6.0 MATHEMATICS (cont)

(P. Rabinowitz)

Codes for solution of differential equations of second and fourth orders were brought into semi-final form.

An investigation has been started into the application of the computer to non-arithmetical problems.

(E. Reich)

I am continuing the investigation of numerical methods for the solution of partial differential equations, and am at present studying Southwell's book on "Relaxation Methods in Theoretical Physics".

7.0 INPUT AND OUTPUT

7.1 Eastman Reader-Recorders

(H.R.Boyd)

The Eastman Progress Report #3 was received this week. One copy is available in the library, a second copy is circulated and I retained the third copy. These reports which are now issued monthly are very brief and include one or two pages of comments on the current status of different parts of the film units and a copy of our film Reader-Recorder Schedule C-31678. Report #1 issued in June is approximately 20 pages in length and gives the best and most complete information currently available on the theory and design details of the film units.

7.4 Magnetic Recording

(G. Cooper)

The parts for the pick-up amplifier have been received and the unit has been constructed. It has not yet been tested.

The design of the erasing amplifier is complete. It too has been constructed, but remains to be tested.

The recording amplifier still continues to give trouble. A form of intermittent operation of the multivibrator portion has developed - its response to chains of triggers is extremely erratic. The source of this difficulty defies location - so far. A possible solution, which is receiving consideration, is a complete redesign of the unit, using a different operating principle.

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 fourth five-inch storage tube with a beryllium mosaic on aluminum oxide, ST 38, was processed and tested on the exhaust system. Later it was based and turned over to the test group. We will not construct any more five-inch tubes with a beryllium mosaic on aluminum oxide until the test results on these four tubes have been analyzed.

During this bi-weekly period components were constructed for a new series of storage tubes. Two storage surfaces of beryllium mosaic on mica were prepared. One was selected for the storage tube, ST 40. This tube was constructed and put on the exhaust system. The tube should be ready for the test group 20 October 1948.

We obtained large thin glass disks to be used as storage surfaces. Beryllium mosaics will be evaporated on two disks and one will be selected for a storage tube.

Several experiments were performed to study methods of reducing the vibrations of the screen assembly. We adopted the temporary expedient of putting a pyrex washer between the screen and the storage surface. The pyrex washer will hold the mica dielectric against the surface of the nickel signal plate. This will reduce the effective storage area and intensify the "edge effect" problem. Work has been started and will be intensified to produce an assembly which does not vibrate.

Work on the new beryllium strip tube for stability studies, which utilizes only mechanical pressure to maintain contact between the beryllium surface and the leads, has been progressing. One and possibly two tubes of this series will be constructed this next fortnight.

A large five-inch tube with a calcium tungstate surface and which simulates the storage assembly, will be constructed for Dr. Klemperer's holding gun studies.

8.11 Tube Construction and Processing (Cont'd)

Our new and improved holding gun has not been checked in a holding gun tube with a fluorescent surface and storage tube geometry.

(R. Shaw)

Two storage surfaces, consisting of a beryllium mosaic on mica, have been prepared.

Several experimental screen-and-storage-surface sub-assemblies have been constructed for mechanical test. The most satisfactory of these is being assembled into a tube, using one of the surfaces mentioned previously.

A "mock-up" of the signal plate assembly of the new beryllium strip tube was made to test contact resistance and mechanical strength of the proposed contact arrangement. A second "mock-up" for leakage resistance tests is being made. In the meantime, work is continuing on parts for the final tube.

Production of tube components has been delayed by difficulties in obtaining a smooth machined finish on nickel parts.

(E. S. Prohaska)

Work on the new anodizing layout has been interrupted in order to layout facilities for the expansion of the filtered-air-room. Work has been begun on this room, which will provide facilities for simple chemical analysis, inspection of tube parts, assembly and "dagging", and glass work. The new room will receive its air supply from the exhaust of the present room. The installation of a "monel" sink, gas, and air facilities is expected to be the only work requiring outside help.

(H. Klemperer)

Attention and advice were given towards obtaining mechanically improved screen plate structure for 5" storage tubes.

8.11 Tube Construction and Processing (Cont'd)

Report was written on final design of beryllium evaporation tube with special attention given to beam forming heat shields and an evaporation cup heated by radiation from a filament.

8.12 Tube Testing

(R. Sisson)

ST 38, a 5" Be tube, was tested on the pumps. It was noted that the center of the storage surface switched from negative to positive potential at 240V., which severely limits the range over which operation could be obtained.

The collector of this tube was found to oscillate mechanically whenever VHG was greater than 240V. This causes an electrical output also. Further, it was found that even below 240V. the collector would move when the S.P. was switched.

Tests made on storage assemblies out of tubes indicate that the collector can be made to vibrate rather easily. A glass bead between surface and collector seemed to eliminate the possibility of forced vibrations almost entirely. The cause of the oscillation in the tube is not understood yet.

(C. L. Corderman)

Further tests on ST 39, a five-inch tube with an aluminum oxide surface, have shown that positive spots may be written on a negative background only on a certain portion of the target. These positive areas are not "held" completely by the holding gun, and either expand or contract slowly depending upon the holding beam velocity. Tests are now being run to determine the holding gun characteristics in an effort to investigate the rate of creepage of the potential barrier between positive and negative areas as a function of current density and holding beam velocity.

(J. S. Rochefort)

Work has been re-commenced on the memorandum covering the tests performed on ST 32 between July 12 and Aug. 20.

8.13 Storage Tube Demonstration

(J. O. Ely)

Tentative block diagrams have been drawn up for a storage-tube control utilizing standard test equipment in so far as possible. Some planning of control sequencing for demonstration and reliability testing has been done.

8.14 Television Setup

(R. Sisson)

The setup was used to study ST 38 on the pumps. It was then moved back to the storage tube lab. The sweep adapter and video amplifier were mounted in panels and put in the rack. Changes were made in the TV set to improve synchronization of vertical sweep.

The setup is complete except for a new video amplifier which is in the design stage, and a preamplifier, which is nearly ready for use.

8.2 Storage Tube Research

8.21 Surface Material Characteristics

(J. H. McCusker)

A memo on storage stability in RT 38, a beryllium strip tube, is being prepared.

(N. Zimbel)

Further tests on RT 39 indicate that a heavy beryllium oxide coating exists and that the silver contacts are connected to this oxide rather than beryllium metal. A pulse technique would be necessary for the required tests of this tube.

The memorandum for RT 36 is being typed.

8.22 Anodizing

(E. S. Prohaska)

The recording potentiometer on the anodizing equipment is not working properly and will be inspected Monday by Mr. Scott of Brown Instrument Company. Considerable trouble was experienced last Monday (10-11) with

8.22 Anodizing (Cont'd)

loose and broken wires and burnt out resistors in the anodizing equipment. This equipment is in need of a general overhaul.

8.23 Output System Circuits
(C. H. R. Campling)

A two-stage video amplifier has been built which will amplify the clamp circuit output sufficiently to make it possible to drive the suppressor grid of one of the gate tubes in the standard gate panel. Thus, the signal pulse can be used to gate a standard 0.1-microsecond pulse. The amplifier is so designed that the spike transients in the clamp circuit output do not overdrive it. With the setup driven by a free running scope synchronizer, operation is satisfactory up to something more than 15 kc. The difficulty in operation at higher frequencies seems to be in the method used for gating, because the clamp circuit will operate at the upper frequency limit of the scope synchronizer - i.e., at 30 kc.

Only initial tests have been made on the signal-plate driver. It became evident immediately, however, that the amplitudes of the two gates obtained from the unit could not be controlled independently.

A 30-megacycle crystal-controlled pulsed oscillator is being assembled for use in the RF read-out system.

8.24 Holding Gun Studies
(H. Klemperer)

Interactions between holding beam current and vacuum in 5" storage tubes were observed and studied. It appears that the high intensity holding beam liberates gas from the target surface, which in turn affects the emission from the holding gun cathode. This may explain gas current, short life, and cathode fatigue at positive grid voltage in previously reported holding gun life test tubes.

8.3 Unclassified

(W. J. Nolan)

Additional study of the effect of non-uniform holding beam velocity has shown that with materials

8.3 Unclassified (Cont'd)

having a low secondary emission ratio (max. 1.3 to 2) as little as 30% of the holding beam electrons, when slowed by the proper amount, may cause instability. The particular values of velocity required are not likely to occur with the voltages now used in storage tubes. It appears that if the condition did occur, however, a small change in the voltage of the holding gun cathode would eliminate a large part of the difficulty.

(H. Klemperer)

The circuit design of one power supply requested by the Test Equipment Committee was completed. Design of two more power supplies was started.

8.4 Deflection Circuits

(J. O. Ely)

Considerable time has been spent during the past two weeks in attempting to track down intermittent operating difficulties in the deflection-circuit demonstrator. Most of the troubles have been traced to the control circuits, being caused mainly by unstable operation of the single-pulse generator and the gate-and-delay units used for timing. Some tendency toward sticking has been observed in several flip-flops. Difficulty in triggering the flip-flops on their cathodes seems to be caused by a combination of the long interval between restorer pairs (50 μ sec) used in this equipment and decrease of the back resistance of IN 34 diodes used in the d-c restoring circuits on the flip-flop outputs.

All tubes in the unit were tested at a clock reading of approximately 1100 hours. These tests have not yet been analyzed in detail, but no obviously bad tubes were found.

A slight variation in horizontal spacing which appeared after about 700 hours of operation seems to be caused by lowered back resistance of crystal diodes used in the increment switches. Since no IN 38 crystal diodes are at present available for replacement purposes, tests of crystal resistances have not been made because of the danger of damaging a diode when removing it from the circuit or resoldering it into place.

10.0 TRAINING

10.1 Seminar Series

(J. M. Salzer)

The regular Block Diagram Seminars were held on Oct. 6 and 13. On Oct. 6, G. C. Sumner talked on Trouble Location, while on Oct. 13, J. M. Salzer discussed Program Timing.

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
E-148	The Solution of Systems of Linear Algebraic Equations by Successive Approximation	36	-	9-29-48	E. Reich
E-149	History of Storage Tube Program	5	-	9-30-48	(S.H. Dodd (M.I. Florencourt
E-150	Filament Voltage Regulator for Five Digit Multipliers	2	-	10-5-48	J.J. Gano
E-151	Voltage Regulation of Laboratory Central D-C Power Supplies	2	-	10-5-48	C.R. Wieser
E-153	Flip-Flop Operation in WWI Circuits	2	1	10-11-48	R.L. Best
M-625	6345 Personnel	3	-	10-1-48	
M-626	Staff Indoctrination Program	6	-	9-29-48	J.C. Proctor
M-630	Bi-Weekly Report, Part I, 10-1-48	11	-	10-1-48	J.W. Forrester
M-631	Bi-Weekly Report, Part II, 10-1-48	17	-	10-1-48	J.W. Forrester
M-634	Eastman Conference on September 29, 1948	4	1	10-1-48	J.A. O'Brien
M-635	Tests on A-Register Digit Panel Serial no. 14	1	-	10-4-48	R.H. Gould
M-636	Accumulator, Deviation from Specification	1	-	10-5-48	H. Fahnestock
M-637	B-Register/In-Out Register, Deviation from Specification	1	-	10-6-48	H. Fahnestock
M-638	Flip-Flop Storage Register Production Release	1	-	10-7-48	H. Fahnestock
M-639	Flip-Flop Storage Output Production Release	1	-	10-7-48	H. Fahnestock
M-640	Block Diagrams	2	-	10-8-48	A.M. Falcione

PB Reports

74363	Grid Controlled Tubes under Pulse Conditions (In German)	7	4	11-1-43	L. Ratheiser

PB Reports (Continued)

No.	Title	No. of Pages	No. of Drwgs.	Date	Author
83339	A Method and Setup for the Production of Image Points of Defined Form in a Cathode Ray Tube (In German)	3	-	12-19-32	(D.S. Lowe (K. Schlesinger

Library Files

.004	European Scientific Notes, 15 July, 1948	ONR London
47	Technical Information Pilot, U1260 - 1318, U1319 - 1380, and U1381 - 1444	(ONR, and (Library of (Congress)
52	Progress Report for WWI Electronic Digital Computer, for Periods Sept. 11 - Sept. 24 and Sept. 25 - Oct. 8, 1948	Sylvania
134	Eastman-Kodak Monthly Progress Report no. 3, Photographic Digital Reader-Recorder	(R.D. O'Neal (A.W. Tyler
163	A New Type of Differential Analyzer; Reprint from Journal of the Franklin Institute, October, 1945	(V. Bush (S.H. Caldwell
164	Policies and Procedures, MIT	MIT
165	A Survey of Large Scale Computers and Computer Projects, August, 1948	ONR, Wash.,DC
166	Interim Engineering Report on the Thermionic Emission of Various Materials; Periods October 1 to October 31, Nov. 1 to Nov. 30, and Dec. 1 to Dec. 31, 1947	(Battelle (Memorial (Institute
167	Project Typhoon Summary Progress Report No. 1, Nov. 12, 1946 to Nov. 12, 1947	RCA and ONR
168	A Skin Temperature Gage for use with the Jet Propulsion Laboratory Telemetering System Memorandum No. 4-36, August 5, 1948	(Jet Propulsion (Lab, Calif. (Inst. of Tech.
168	Effect of Tilt on the Polarization of the Three-Phase Sergeant Antenna Memorandum No. 4-37, July 14, 1948	(Jet Propulsion (Lab, Calif. (Inst. of Tech.
---	Proceedings of the IRE, August, 1948	

Book

Crystal Rectifiers, Volume 15 of Radiation Laboratory Series	Torrey Whitmer

11.2 Standards Committee

(S. R. Abbott)

The following specifications have been approved and distributed:

11.2 Standards Committee (S. R. Abbott)

S7.410-1	301/103 A Register/Program Register (Revision)
S7.504-1	Records and Markings, WWI Panels (Revision)
S7.504-3	Records and Markings, Video Cables
S7.421-2	Fuse Indication Panel
6.043-5	Connector, Female, 10 Pin Power
6.043-6	Connector, Male, 10 Pin Power
6.043A	Connectors, Multi-Conductor (Revision)

11.3 Purchasing and Stock

(H. B. Morley)

The I.P.C. ten-pin power connector sample has been received. Inspection revealed that the case sections were soft-soldered together and could be easily pulled apart. It was recommended to I.P.C. that these parts be silver soldered.

The Erie Resistor Corporation now has a local factory representative, which will facilitate obtaining information on their line of ceramic capacitors, resistors, etc. A set of samples of Erie carbon resistors is available for inspection and examination in this office.

N.E.T. informs us that approximately 1000 pulse transformers are completed, except for Flexsealing. Delivery of these units will relieve the pressure of current demand for pulse transformers.

This laboratory was visited by Mr. K. A. Waldron and Mr. F. W. Tietsworth, tube application engineers from General Electric Company. They have offered their services to assist us in any problems concerning application and use of vacuum tubes, and quoted favorable net prices and delivery schedules for G. E. tubes.

The catalog and reference files in this office have been accumulated over a period of years at considerable expense in time and effort. These files serve a valuable purpose, primarily to provide procurement information for use by this office, and further as a fairly complete reference file for use by all laboratory personnel. In the past, file material has been available for loan to personnel for laboratory and personal use on a rather lenient basis, the individual being relied upon to sign for material and to return it promptly when finished with it. However, it has been

11.3 Purchasing and Stock (Continued)

noted recently that numerous catalogs are missing from the files, and have not been signed out. It, therefore, becomes necessary to insist that personnel sign out all catalogs, instruction books and other data which are removed from this office. Periodic checks will be made of the sign-out register, and persons keeping material out of the files for extended periods will be required to justify their continued possession of it.

(R. Fairbrother)

For better control of tools and equipment, it has been decided that all equipment and tools identified by a number, except small hand tools issued on a permanent tool list, will be approved by the stock room before being taken from the Barta building, for any reason. They should also be checked into the stockroom upon return.

11.4 Electronic Construction

(N. H. Taylor)

Sylvania is being held up in testing because of test equipment breakdown and lack of a second test position. Every effort is being made to settle this problem, however, it may delay some testing at MIT in order to resolve the matter.

(F. H. Caswell)

The electrolytic tank has been moved from the basement to room 219, tank and bench being refinished and a rack for storing electrodes built.

The T.V. sweep adapter, video amplifier and pre-amplifier have been rack mounted.

Work is progressing on two vacuum system protective circuit chassis.

A rubber mat model has been constructed for use in studying storage surface current densities.

(A. Taylor)

Orders have been received for the construction of five

11.4 Electronic Construction (Continued)

Rack Power Control Units and fifteen more Coders. The Filter Panels are now under construction. There are also a number of non-repetitive units under construction.

11.5 Drafting

(A. M. Falcione)

Storage Tube Drafting. We have had considerable difficulty in the past year in keeping draftsmen on Storage Tube work. This is due to the characteristics of Storage Tube drawings which are small and have a concentrated amount of detail involved, which results in a heavy eye strain on draftsmen. In order to alleviate this condition, it has been suggested to the group that small parts and assemblies be drawn as large as possible, and, if necessary, tracings could be sent out for reduction on vellum. This would not only relieve eyestrain, but insure a more accurate drawing.

11.6 Unclassified

(A. Taylor)

Seventy-five per cent of the current machine shop work consists of storage tube parts manufacture. The backlog has been reduced to sixteen man hours.

The sheetmetal shop has been making panels and chassis for test equipment and copper bus bar for the WWI installation. The backlog is about 22 man-hours.

12.0 General

New Non-Staff Personnel:

Ernest J. Druan, Jr. is a Senior Detailer working in the Drafting Group under the supervision of Mr. Falcione. He graduated from Boston Technical High School, and now attends evening courses at Northeastern University. He served in the United States Navy for three years, and has had a number of years drafting experience with the Chelsea Clock Company.