Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, SEPTEMBER 3, 1948

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(C. W. Adams)

I am waiting for information from the Bureau of Ships describing their calculational problems and the procedures which they now use. This information will provide a basis for my thesis on coding a complete solution of their problem. At present I am investigating possible input-output procedures (in collaboration with R. Mayer) since I hope to include input-output in my thesis problem.

(M. Daniloff)

Memorandum M-596 entitled "The Critical Temperature of Condensation of Atomic Metallic Vapours" was finished and distributed to the members of the Storage Tube Group.

Consideration was given to the question of the speed of sublimation of beryllium. A first examination showed that difficulties of a mathematical nature could be obviated by a proper choice of the form of certain thermodynamic functions entering into the situation. The question remains, however, whether the thermodynamic properties of beryllium are sufficiently well known to construct trustworthy empirical functions for the required thermodynamic properties.

The purpose of this query is to ascertain the conditions for the maximum speed of sublimation of beryllium.

(Edgar Reich)

On August 31, N. Rochester and D. L. Stevens of Sylvania, and I visited the David Taylor Model Basin near Washington, D.C. We discussed the computing requirements of the Basin with the

6.0 MATHEMATICS (Cont.)

(Edgar Reich) (Cont.)

heads of the various sections and considered the possibility of the solution of their numerical problems on Whirlwind. We were also given a tour of their aerodynamical, hydromechanical and computing installations.

Work on the numerical solution of partial differential equation is being continued. The method of characteristics is being studied at present.

(P. Rabinowitz)

In the Runge-Kutta method for solving differential equations of high order ($n \geq 5$), it was found that full use was not made of initial data. Results were only of 4th order accuracy whereas it was possible to get nth order accuracy by introducing a slight modification in the method. A new code is necessary and is being drawn up for this purpose.

(Alan J. Perlis)

An application of iterative methods to integral equations of the first kind reveals that the steepest-descent and back-substitution methods will provide adequate numerical solutions in those cases where the kernel has a complete set of eigen-functions. However the most general equation of the first kind, since it may possess none or many solutions, is best given individual treatment, perhaps as a variational problem. A detailed analysis of the errors in a numerical solution proves to be of the same scope as the original problem; however rather weak bounds on the errors can be obtained easily.

(A. Orden)

The code for solution of simultaneous equations by elimination was put in final form. A code for checking the calculation was drawn up. The arithmetic questions were presented to the Math group as a seminar discussion. Preparation of a memorandum describing the code was started.

(J.W. Carr)

The use of automatic subprograms to aid in matrix and other multi-element operations was studied. Coding of such a problem will now be investigated.

7.0 INPUT AND OUTPUT

7.4 Magnetic Recording

(Gerald Cooper)

The Gated Multivibrator was altered by adding a peaker. It has been found to operate quite satisfactorily. It has been used in conjunction with the recording amplifier and the operation of the system meets all specifications. There is no noticeable jitter in the output.

Some consideration was given to the specifications for the amplifier to be used with the reading head. The problem is quite nebulous because the output to be expected from the reading head is not known. However, very conservative specifications have been set and the design of the amplifier has been started.

(Edwin S. Rich)

Lamination stampings for constructing magnetic heads have been received and will be sent out for heat treatment. Methods for cutting gaps of the order of 2 to 4 mils in length are being studied so that ring type cores with single air gaps may be used.

7.6 Output Printers

(F. A. Foss)

The engineering note E-141 on the teletype input-output demonstrator is completed. This teletype input-output demonstrator is now being tested in conjunction with an automatic input tape checking system. The occurrence of perforation errors in the input tape stops the input process so that manual correction may take place.

A modification in the design of the output circuits of the demonstrator is being considered.

8.0 STORAGE TUBES

8.1 Tube Construction and Testing

8.11 Tube Construction and Processing

(R. Shaw)

Drawings are near completion for storage tubes ST 30 and ST 36.

A tube having several concentric anodes is required for studies of holding-beam current-density distribution. Sketches have been made of two alternate designs.

An evaporation tube having a resistance-heated crucible enclosed in heat-insulating material has been assembled and is ready for sealing.

A holding gun research tube with third and fourth anode connections is also in the design stage.

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

A second five inch storage tube with a beryllium mosaic, ST 30, has been constructed and processed. The tube is now ready to be tested. The five inch storage tube with a calcium tungstate surface, which was scheduled for this period, was not constructed. Our present methods of putting calcium tungstate on large surfaces of aluminum oxide are unsatisfactory. We plan to improve these methods.

An evaporation tube designed to give thicker coatings of beryllium mosaics has been constructed. Microscope slides have been placed by the evaporation target so that we can study and record the thickness of each coating. Our major attention during the next bi-weekly period will be devoted to producing beryllium mosaics with thicker coatings and putting one of these surfaces in a five inch storage tube.

Tests of the temperatures on the storage surface during the glassworking stage indicate they are much lower than the tube processing temperatures. We will

8.11 Tube Processing and Construction (Cont'd)

continue to study the effects of the tube processing and glassworking temperatures on the beryllium mosaic. Toward that end we are constructing more beryllium strip tubes.

Also beryllium strip tubes will be constructed with coatings treated similarly to the coatings in the storage tubes. This will enable the test groups to correlate their results.

One research tube, RT 39, which is similar to RT 36, was constructed for N. Zimbel. This will be used to check his recent tests on a solid beryllium surface.

8.12 Tube Testing

(J. S. Rochefort)

A memorandum covering tests performed on ST 32 between July 12 and August 20 has been started.

A more detailed discussion of the dispersion of the holding beam in the collector-to-target-surface field has been issued as a notebook memorandum. This paper was issued to supplement the typed report of the conference of August 17 on ST 32.

Positive and negative spots have been successfully stored on the surface of ST 29. An array of 121 spots has been maintained within a 2x2 inch area for 30 minutes. A positive 121 spot array was stored on a negative background, and a negative array on a positive background. Storage has been obtained at an accelerating voltage of 700 volts. This higher voltage seems to be determined by the reverse curve obtained on this tube. The thickness of the layer of beryllium seems to be the cause of the higher triggering voltage of the reverse curve.

(C. L. Corderman)

ST 29, a 5" Be. mosaic tube with a new holding gun, was tested during the past two weeks. Although satisfactory storage was obtained, collector voltages higher than for other tubes were required. Also, when running

8.12 Tube Testing (Cont'd)

a reverse curve, the surface returns to cathode potential in the vicinity of 200 volts, instead of near 60 volts as with previous Be. tubes.

With a holding velocity of 700 volts, the center portion of the surface switches from cathode to collector potential, accompanied by an audible pinging sound from within the tube. It seems as if the collector is vibrating when suddenly released from the electrostatic force of attraction to the negative surface. There is reason to believe that this deflection of the collector causes the switching of the center portion of the surface, although tests to substantiate this have not as yet been run.

(S. H. Dodd)

Simplified block diagrams for automatic read-write equipment have been made. These diagrams are required because enough equipment is not available to set up the system outlined in SD-40038. Some of the required equipment is not part of the standard line and test equipment request forms have been made out for a Rack Current Surge Suppressor, a Gate Inverter, Power Supplies, and a shielded switching panel.

8.13 Electrostatic Storage Tube Demonstrator

(R. Sisson)

The demonstrator was modified so that it operates entirely with electronic switching, that is, there are no relays. This allows much faster operation.

A new switching unit, pulse mixing unit, and a new control box were installed. The switching unit also contains a trigger generator which may be used to pulse any one of the three operations (write minus, write plus, or read) at rates up to about 200 operations per second. A new type of deflection system for the high velocity gun was installed. Part of it is in the switching unit and part in the new control box.

8.13 Electrostatic Storage Tube Demonstrator (Cont'd)

The circuits are so arranged that either polarity write operation may be performed at any time even while reading at a high repetition rate. The read operation is automatically blocked for 1000 microseconds while the write operation occurs.

It is hoped that this setup will be completely tested and ready to use with the 5" tubes, early next week.

The television setup has not been used while the changes were being made in the demonstrator. The video amplifier for the TV setup was modified to increase its frequency response to about 4 megacycles. A memo describing the TV setup will appear next week.

8.2 Storage Tube Research

8.21 Surface Material Characteristics

(N. S. Zimbel)

Tests on RT 36 have been completed. The purpose of this tube was to supplement stability tests run on RT 21. The tests were essentially the same as those run on RT 21, as described in Memorandum M-434. A memorandum for RT 36 is being written.

It was found that triggering of the beryllium surface from cathode to collector occurred at a different value of bias voltage for each collector to cathode voltage when tests were made with the bias negatively greater than a bias of -42V. This was attributable to the fact that leakage from A_3 to Be. surface was high; the resistance from A_3 to Be. being of order of magnitude $10^{9}\Omega$. Leakage measurements from A_3 to Be. surface showed a leakage current of .055 μa at triggering voltages; this was in good agreement with the optimum I_s-I_p current of .05 μa at bias setting of -40V. Triggering of Be. surface from collector to cathode did not occur over a range of collector to cathode voltage from 0 to 500V. In these tests A_3 and Be. surface were at the same potential. No appreciable time effects were noticed at crossover. Further stability studies will be continued on RT 39.

8.21 Surface Material Characteristics (Cont'd)

(J. H. McCusker)

Tests are still being made for storage stability on RT 38, a beryllium strip tube. From present data, it seems that the floating strip triggers from cathode to collector potential or vice versa when the restoring current equals the leakage current.

The potentials of the adjacent "D" and strip affect the potential of the floating strip. If either the adjacent "D" or strip is at cathode potential when the floating strip is above the crossover potential, the floating strip's potential is only slightly reduced from its stable value. However, if both the adjacent strip and "D" are at cathode potential, the floating strip's voltage decreases by about 15 volts. The restoring current also decreases.

When the strip is floating below crossover, its potential remains about the same either when one or both of the adjacent "D" and strip are at collector potential. In the latter case, the restoring current also decreases.

The mutual resistances between adjacent strips or adjacent strip and "D" have remained approximately the same, 10^{10} ohms or greater, during approximately 100 hours of testing.

8.22 Anodizing

(M. I. Florencourt)

A constant current control servo has been designed and built by J. B. Pickel for the anodizing equipment. The circuit has been tested and works well, maintaining constant current within 1% between 2.0 amps and 3.5 amps. It is being built into a chassis now and will be ready for final testing and use next week.

A York refrigeration engineer has been consulted concerning our electrolyte temperature control problem. He is to submit an estimate next week on the equipment and cost involved.

8.22 Anodizing (Cont'd)

A laboratory notebook has been assigned to contain all anodizing information. It has been brought up to date with regard to all anodizing conditions used now; control circuits are being added.

8.23 Output System Circuits

(C. H. R. Campling)

Completed preliminary design for signal-plate driver. The purpose of this unit is to provide gates at a common output for the "write minus" and "read" operations. These gates should be independently adjustable in amplitude and variable up to say 300 volts for write minus and 150 volts for read. A layout for the unit is now being made.

The design is based in part upon the gate amplifier which has been used for output-circuit testing. This latter unit has been improved during the past fortnight and will now give output gates from about 0.75 microseconds duration to 2500 microseconds or somewhat more. Rise and fall times are less than 0.5 microseconds. Amplitude is variable from zero to more than 350 volts and is independent of duty cycle.

8.24 Holding Gun Studies

(H. Klemperer)

Holding Gun Life Test. After 800 hours the cathode emission is limited to the edges of the cathode while the center, comprising about 50% of the active surface, is exhausted. The tube shows a gas current of 2 microamps at the third anode, with that electrode 45 volts negative with respect to the cathode.

8.3 Unclassified

(W. J. Nolan)

A protective circuit for the vacuum systems has been designed. This provides for sensing of the type of break or leak which has occurred and selection of the more satisfactory of two possible shut-down cycles.

8.3 Unclassified (Cont'd)

Adjustment is provided to take into account the probable conditions in the system when processing different tubes.

(M. I. Florencourt)

Corrections on old research tube drawings have almost been completed.

Much information on tube construction and processing is being recorded on audograph records. These records are transcribed if they are of fairly general interest; if not, they are kept in the notebook of the tube referred to. Using records, a lot more information on a tube or operation will be kept than if written records had to be kept.

8.4 Deflection Circuits

(L. J. Nardone)

The deflection-voltage generator was shut down for several days in the past two weeks due to power supply trouble in the P-4 Synchroscope used for display purposes. All displays operate properly except "single pulse operate", which is erratic. Work is continuing on the deflection-voltage generator to eliminate this trouble and other minor defects which occur.

An over-voltage relay was installed on the 115V. 400 cycle line supply for protection of the deflection circuits against power supply failures.

10.0 TRAINING

10.1 Seminar Series

(J. M. Salzer)

The regular Block Diagram seminars were held on August 25 and September 1. Carry and shift operations, and the process of division were the subjects discussed.

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-9	Summary Report No. 9	16		6-48	
R-141	Rectifier Networks for Multi-Position Switching	5	9	8-31-48	(D.R. Brown (N. Rochester
E-139	7AK7 Characteristics	7	7	8-25-48	(J.M. Hunt (A.K. Susskind
E-140	Gas-Discharge Gaps for Data Storage in Electronic Computers	2	-	7-21-48	R.F. Markel
M-564-1	Rack Modification for Power Bay	2	-	8-4-48	R.E. Hunt
M-581	Location of D. C. Filter Panel	1	1	8-20-48	H.S. Lee
M-584	Progress Report: Trouble Location in a Large Scale Electronic Digital Computer	2	1	8-10-48	G.C. Sumner
M-585	Bi-Weekly Report, Part I, 8-20-48	14		8-20-48	
M-586	Bi-Weekly Report, Part II, 8-20-48	17		8-20-48	
M-587	Pulse Generator, Layout Approval	1	-	8-23-48	J.A. O'Brien
M-588	The Divide Control	3	1	8-23-48	N.L. Daggett
M-589	Fixed Voltage Switching Panels, Production Testing	1	-	8-24-48	C.W. Watt
M-590	Control Switch and Storage Switch Drawing	1	-	8-24-48	J.A. O'Brien
M-591	Restorer Pulse Generator Change	1	-	8-24-48	J.A. O'Brien
M-592	Sylvania - M.I.T. August 25, 1948	2	-	8-26-48	C.W. Watt
M-593	Progress Report: Trouble Location in a Large Scale Electronic Digital Computer	2	-	8-20-48	G.C. Sumner
M-594	The Multiplier Error Detector	2	1	8-26-48	N.L. Daggett
M-595	Register Driver Type I Layout Approval	1	-	8-27-48	N.H. Taylor
M-596	Critical Temperature of Condensation of Atomic Metallic Vapors	5	1	8-30-48	M. Daniloff

No.	Title	No. of Pages	No. of Drwgs.	Date	Author
M-598	Circuit Research, Present and Future Work	5	-	8-27-48	D.R. Brown
M-599	6345 Personnel	3	-	9-1-48	
M-600	Mounting Holes for D.C. Filter Panel Bracket	1	1	9-1-48	H.S. Lee
M-601	Revision of Control Switch Block Schematic, T60CS00-4	1	-	9-2-48	J.A. O'Brien
C-58	Meetings of the Mathematics Group: The Solution of Systems of Linear Algebraic Equations by Successive Approximation	4	-	7-29-48 8-3-48 8-6-48	E. Reich

PB Reports

91529	Fiat Evaluation Report no. 235	1	-	8-31-45	
74821	Der Impulstrans Formator	57	44	3-7-48	Dr. Grasl
74385	Uber Einfluss des Widerstandes der Oxydschicht auf die Aampfung der LG 11	16	5	4-44	
73614	Abhandlungen der PreuBischen Akademie der Wissenschaften	10	-	1-42	Prof.K. Popoff

Library Files

73	Pre and PostAnalysis by Reeves Analysis and Computer Group. July 6 Job no.3-3, July 8 Job no. 3-3, Aug.10 Job no. 18-1.1, Aug. 12 Job no. 18-11, Aug. 12 Job no. 17-1	Reeves Instrument Corporation
52	Progress Report for WWI Electronic Digital Computer August 1-13, 1948	Sylvania
140	The Physical Review March 15, 1936 July 1, 1936	
141	Planning and Coding of Problems for an Electronic Computing Instrument Part II, Volume II	H.H. Goldstine J. vonNeumann
142	The Pulse Transformer (Translation of PB 74821	Dr. Grasl
143	Design and Testing of an Electrostatic Storage Tube	W.J. Nolan, Jr.

No.	Title	No. of Pages	No. of Drwgs.	Date	Author
144	The Transistor, A Semi-Conductor Triode				J. Bardeen- W.H. Brattain Bell Tel. Lab.
145	Eckert-Mauchly Computer Corp Summary Report Chaps 1-4				
146	The Application of a Moving Block System to RCA Teleran Dec. 2, 1947				W.W. Felton
147	Mechanism of Secondary Emission from the Inside of Ionic Crystals				M. Knoll- O. Hachenberg- J. Handmer
148	A Federal Program in Applied Mathematics				J.H. Curtis
149	National Aviation Policy, Report of the Congressional Aviation Policy Board Congress of the U. S.				U.S. Gov't Printing Office
150	Fundamental Research on Raw Material used for Electron Emissivity on Indirectly treated Cathodes - (Raytheon Report)				J. Cardell

11.2 Standards Committee

(S. R. Abbott)

The following specifications have been approved and distributed:

S7.507 WWI Finishes
S7.400-3 WWI Test Specs. 6Y6 Tubes
Pre-burning Setup for 6Y6.
S7.400-4 WWI Test Specs. 6SN7 Tubes.
Pre-burning setup for 6SN7.
6.175A Lever Switch, Multi-conductor.
6.199 Misc. Non-Standard Transformers (Revision)
6.091A Lamps, Pilot. (Revision)
6.212D Single Conductor Wire, Cotton Braid (Revision)
6.214A Delay Lines (Revision)

A revised introduction outlining the policy of the Standards Book has been issued.

In connection with purchases of special items by engineers and technicians it is suggested that Kardex in Material Control office and stockroom listings of existing non-standard items be checked for acceptable useage and desirable information.

11.3 Purchasing - Stock

(H. B. Morley)

Sample orders for silk screening have been placed with a different company in an effort to secure better and more uniform results.

Rejections on pulse transformers received from our present source of supply are running so high that consideration is being given to placing orders elsewhere as soon as a sufficient supply of cores is received. One quotation received is very favorable in price.

Westinghouse has advised that the maximum limit of their production schedules that can be arranged would allocate us an additional 1000 Hipersil cores this year if required, provided the order is placed within the next few weeks. Inasmuch as we have outstanding orders for over 2000 cores, it is not believed that this additional quantity will be required.

Continued delays are being encountered on deliveries of almost all items. Even in cases where the vendor is contacted for delivery information, we find that they are unable to meet the dates promised. Therefore, it is again requested that requirements be anticipated as far in advance as possible, particularly on items requiring special order or submission of samples for approval.

(R. Fairbrother)

The list of replacement tubes used in test equipment has now been completed. Because of the large number of types necessary for a complete stock, it was decided to keep on hand in quantity only those which are not available from sources in or near the City of Boston. Those tubes have been ordered.

11.4 Electronic Construction

(R. H. March)

The following jobs and units are in the Electronic Laboratory for construction.

1. Divide error and sign control WWI. This unit is about 95% complete.

2. Two holding gun power supplies. These units are about 25% complete.

3. Step counter WWI. This unit is about 15% complete.

11.4 Electronic Construction (Continued)

4. Gated Multivibrator.

5. Input tape checking circuit.

6. Ten d-c bench outlet boxes.

The work load in the Electronic Laboratory is as follows:

2 WWI Prototype technicians have a work load of 5 weeks.
6 Technicians have a work load of 2 weeks.

11.5 Drafting.

(A. Falcione)

Class 2. Mechanical Drafting Standards Book. The first section of the standards book has been completed. A copy of the initial draft has been run off for approval by J. Aitken and the writer prior to final release. A meeting will be held on Saturday 11 September 1948 for this purpose. At that time Section 2, Drafting Standards, will be discussed. Mr. Lofgren will continue to work for 6345 on a part time basis until the standard book has been completed.

Work Load. The work load is fairly steady on the drafting department. It is expected that the work load will increase in the next few months. Mr. Richard Dickie, a technician who worked for Walter Rogers, has transferred to the Drafting Dept. for a trial period to replace Jean McHugh who has terminated.

12.0 GENERAL

(H. R. Boyd)

NEW NON-STAFF PERSONNEL

MRS. JANE CAMERON recently became secretary to Mr. Ulman. She is a graduate of the University of Southern California, where she majored in English and Psychology. Her husband is a student at Harvard School of Business Administration.

ANN CONNOR is a secretary in the Procurement Section. She was graduated from Newton High and since her graduation was secretary to the Registrar at Boston University College of Music.

SAMUEL GLADSTONE is a student technician working under Pat Youtz. He attends Northeastern University and was formerly employed as a cooperative student at Boston Edison Co.

GEORGE KAPLAN is a mechanical technician who was transferred to this building from Building 32. He graduated from Malden High and attended Brown University for evening courses. He has had a number of years of technical experience, including four years with Polaroid.

SOL MALKIEL is a temporary detailer working for Chan Watt. He was transferred to this project from another DIC assignment, and will continue until the fall term opens.

MYRON MARGOLIN is a student technician working for Pat Youtz in the Storage Tube Group. He is studying electrical engineering at Northeastern University, and also attended the University of New Hampshire and University of Connecticut.

HELEN O'CONNOR is a secretary working for the Storage Tube Group. She graduated from Jeremiah E. Burke High School and has recently been a secretary at Little, Brown & Co.

TERMINATIONS

Stanley Fay
Chellis Lawrence
Wilfred Lefkovich
Katherine Nicol
Nagel Ruppenthal