

6345
Memorandum M-509

Page 1 of 22

Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, JUNE 25, 1948

To: 6345 Engineers

From: Jay W. Forrester

5.0 MATHEMATICS

(P. Franklin)

Considered modifications of Newton's method of approximating roots which cut down the number of divisions needed.

(M. Daniloff)

Translation of M. Knoll's paper "Zum Mechanismus der Sekundäremission im Inneren von Ionenkristallen" (Z.F. Phys. 122, 137-162, (1944).

Some editing of Memorandum 395 was accomplished.

(Edgar Reich)

The last of Prof. Franklin's seminar lectures is being written up.

(G. W. Adams)

A study of conversion between teletype and binary form for input and output has been largely completed and will be summarized in a memorandum shortly.

(A. Orden)

Examined reports available on mathematical analysis for computer programming, and started consideration of the more common types of subprogram.

~~RESTRICTED~~
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6345
Memorandum M-509

Page 2

6.0 MATHEMATICS (cont)

(J.W. Carr)

A week-long study of coding, including flow diagrams and the Goldstine-Von Neumann report has enabled the writer to draw up a sample coding procedure for a second order non-linear ordinary differential equation using the Runge-Kutta numerical method. Further work is being done on the scale-factor problem and on coding some of the more complicated guided missile equations as reported in Reeves #73.

(Alan J. Perlis)

The numerical solution of integral equations by Fourier integral methods is being studied.

~~RESTRICTED~~

UNCLASSIFIED

~~UNCLASSIFIED~~
~~RESTRICTED~~

6345

Memorandum M-509

Page 3

7.0 INPUT AND OUTPUT

7.1 Eastman Kodak Recorders

(D.R. Brown)

The group at Eastman Kodak is providing for marginal checking of their units. At present about 20 different points are being brought out for insertion of marginal checking voltages. Because many of their circuits are very different from ours, marginal checking of the reader-recorder may require somewhat different techniques. Eastman is particularly concerned about noise on marginal-checking connections in their amplifier circuits. The present circuits in reader-recorders employ 6AG7's and 12AU7's. Changing the 6AG7's to 7AD7's would delay the reader-recorder program. Changing 12AU7's to 5687's would also delay the program. Both changes are probably desirable. No decision to make such a change has been made however. Closer liaison with Eastman should be maintained so that their circuits which can be the same as ours will be so.

(H. R. Boyd)

Recently, we have been concerned about the ability of the present group at Eastman to meet the delivery schedules required for reader-recorders. On June 24, a meeting was held at Eastman to discuss this problem. This conference is written up in M-510. Eastman has been making excellent progress during the last month on their film-drive which was causing considerable difficulty at an earlier date. Additional manpower is being added and they expect to deliver two units on January 1 and four units on March 1.

7.3 Binary to Analog Conversion

(E.W. Sard)

The peak-reading voltmeter idea mentioned in the last bi-weekly report was successful. The thesis report is now being written.

~~RESTRICTED~~

UNCLASSIFIED

6345
Memorandum M-509

Page 4

7.4 Magnetic Recording

(Gerald Cooper)

A gate generator and buffer amplifier to drive the recording amplifier was designed and constructed. When the input consists of triggers occurring at random intervals, the output pulse amplitude may vary because of the bias built up on the succeeding stage by the discharge of the coupling condenser. In an attempt to minimize this effect, neon bulbs were connected across the condenser to act as voltage regulators. The unit is now being tested.

UNCLASSIFIED
~~RESTRICTED~~

UNCLASSIFIED
RESTRICTED

6345
Memorandum M-509

Page 5

8.0 STORAGE TUBES

8.1 Tube Construction and Testing

8.1.1 Tube Construction and Processing

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

One storage tube (ST 32) with a beryllium mosaic had improved storage characteristics. An attempt was made to reproduce these results in another new storage tube (ST 32A-2). This tube was tested on the pumps and the results checked with the tests on ST 32. The tube had several mishaps after these tests and had to be reprocessed.

Another large evaporation tube to produce a beryllium mosaic was prepared and processed. The results were still unsatisfactory since the wire-mesh mask did not cast a well-defined shadow. Therefore under consideration is the use of a convex target to insure that the mask remains taut against the surface. Also under test and design is the use of resistance heaters instead of the bombarder for heating the evaporation cup. During a visit of Dr. Milo Wells of Kemet Labs, it was suggested that the application of 10,000 volts between target and evaporation cup might direct the vaporized material. Our experiments along these lines added new difficulties and showed no advantages.

The leakage resistance between the beryllium and aluminum thru the aluminum oxide is lower than our previous tests with silver paint indicated. Several experimental tubes and evaporation tubes were prepared and processed to study this leakage resistance and the effect of our processing cycle on the thin films of beryllium.

We are concerned whether any of the storage tubes develop gas. This may affect the storage characteristics of the storage surfaces. Therefore we have investigated and calibrated the 15E as an ionization tube. A 15E has been built into a cathode ray tube. This will enable us to study the aging of an oxide-coated cathode and the pressure within the cathode ray tube. Later these 15E's will be added

RESTRICTED
UNCLASSIFIED

6345
Memorandum M-509

Page 6

8.11 Tube Construction and Processing (continued)

to the storage tubes to study their pressure during test periods.

We have started an evening shift to keep the exhaust systems and processing under supervision for 16 hours of the day.

(R. Shaw)

Some of the erratic performance of evaporation tubes has been determined to be the result of warped parts, (See M-493). Inspection equipment has been ordered in order to detect and eliminate defective parts.

An evaporation tube with a convex target is being made. This will insure intimate contact between the target and mask.

Some time has been given to the design of an evaporation tube having a resistance heating element around the evaporation cup.

It is planned to install radiation shields around the furnaces in the tube processing laboratory. A draftsman will be available to make the necessary drawings early next week.

(E.S. Prohaska)

A research tube is to be built containing eight thermocouples, four at each end. The eight thermocouples will be all different types. The tube will be used only to study the technique of using thermocouples for temperature measurements inside the tube during processing.

(W.J. Nolan)

A resistance heated trough for beryllium evaporation has been constructed and tested in a vacuum tube. The results were satisfactory.

~~RESTRICTED~~
UNCLASSIFIED

~~RESTRICTED~~6345
Memorandum M-509

Page 7

8.12 Tube Testing

(S.H. Dodd)

The test set-up on benches 1 and 2 (which are used for testing the small sized storage tubes) has been modified to allow rack mounting of some of the equipment, and batteries, etc. have been mounted in boxes so that the equipment is easier to assemble and move. This should make it easier to bring equipment to the pump room for making tests during the processing.

Tests of ST 32A were made on the pumps and gave results similar to those of ST 32.

Tests are being continued on ST 32 to determine charge creepage and changes with time.

(J.S. Rochefort)

The memorandum on ST 28-1 was submitted for "hecto-ing" June 22nd. Its release has been delayed until today by an overload on the print room and intermittent operation of the print machine. The release of the memo was expedited by sending the majority of the drawings to print department of Building 32.

8.13 Storage Tube Demonstration

(J.S. Rochefort)

Storage tube ST 18A was re-installed in the Demonstrator and the unit checked out satisfactorily.

8.2 Storage Tube Research**8.21 Surface Material Characteristics**

(M.I. Florencourt)

Surface and front-to-back resistance tests have continued on anodized aluminum samples with various-shaped shadows of beryllium evaporated on their front faces. Front-to-back resistances continue to be considerably lower than originally

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8.21 Surface Material Characteristics (continued)

measured on typical samples using silver paint faces instead of beryllium faces. Surface resistance of the beryllium varies widely, depending on conditions. The tests are being continued with both beryllium and silver faces because it is felt that present evidence is not conclusive.

(W.J. Nolan)

The 931-A life tests have been completed and the curves plotted. The results indicate that considerable deterioration takes place during the first 50 or 100 hours but the emission is practically constant for the next 1900 hours. The final secondary emission curve has a first crossover at about 30 volts and a value of 2 at about 60 volts or less.

8.22 Anodizing

(R.L. Sisson)

The anodizing equipment was rewired in part, cleaned, and rearranged. 13 small, smooth discs were anodized.

8.23 Output System Circuits

(C.H.R. Campling)

Following a conference with S.H. Dodd on June 15, it was decided to construct an interim output circuit for use in storage tube tests at higher repetition frequencies than have been used up to the present time. Since the clamp circuit which has been studied already appeared to be the most suitable circuit available for the purpose, it was incorporated in the design. In addition, an impedance switch similar to that which has been used in the storage-tube demonstrator has been included. The output from the clamp circuit is coupled to a cathode follower which can be used to drive an oscilloscope amplifier. The amplitudes of spurious spikes in the output of the cathode follower are reduced by a crystal-diode dipper.

8.23 Output System Circuits (continued)

The circuit uses a total of 9 tubes and operates with standard WWI voltages. Tests on the bread-board model indicate that a read-out interval of 15 microseconds can be attained.

The circuit is under construction now in the electronics shop and should be completed and tested by July 2.

Attention is now directed to the design of an amplifier and pulse selector for use with the clamp circuit.

8.24 Holding Gun Studies

(H. Klemperer)

Tube RT 32, containing an experimental holding gun design was assembled, processed, and tested. With an accelerating voltage of 1000 volts the gun produces a wide angle beam of 1 ma intensity. The beam can be shut off with 40 volts negative on the control grid. The final aperture of the first anode appears to be too small and the lineup of the beam forming elements is not accurate enough. Another holding gun was designed and will be tested soon.

8.3 Unclassified

(M.I. Florencourt)

All drawings for storage tubes 11 thru 28 have been corrected and returned to the draftsman. Corrections should be completed within a short time. Checking prints of all research tubes drawn up so far have been received for checking. Randy Veinot has taken over drafting small storage tubes, research tubes and experimental tubes since Jeanne Antz's resignation from the work.

Issuing of a much-needed report by H.L. Heydt on Life Testing of Surfaces Suitable for Electrostatic Storage Tubes has been held up because of a

~~RESTRICTED~~6345
Memorandum M-309

Page 10

8.3 Unclassified (continued)

lack of dry-photo black paper to reproduce photographs attached to the report. A stock of the paper cannot be received for at least three weeks. A few copies of the report will be made up for the library with the few sheets of dry photo black paper available.

Input Resistance of "Boonton" Meters

(R.L. Sisson)

The d-c input resistance of two Measurements Corp. Model 62 meters was measured using the circuit described in M-434. The results presented in that memo were again obtained, and the reason for the input resistance falling off at high inputs is believed to be inherent in the meter.

8.4 Deflection Circuits

(L.J. Nardone)

The deflection-voltage generator has been operating successfully for the past two weeks. It has operated Monday thru Friday continuously from 8:30 A.M. to 5:30 P.M., except for short interval shut-downs to make minor changes in test equipment. All displays are performing properly.

All tubes in the vertical panel of the deflection-voltage generator were subjected to a 500 hour test, and all tubes in the horizontal panel were subjected to a 131 hour test. Only negligible changes in the characteristics resulted.

~~RESTRICTED~~

~~RESTRICTED~~

6345

Memorandum M-509

UNCLASSIFIED

Page 11

9.0 SERVOS AND SIMULATION

9.1 Cockpit

9.11 Structure

(E. S. Prohaska)

The report of the past year's work on the cockpit is still in the rough draft stage and will probably not be ready until some time in July.

Drafting is still going forward on the cockpit "breadboard".

9.13 Control Force Loading

(C.G. Eaton)

The report on the past year's work is nearing completion.

UNCLASSIFIED

~~RESTRICTED~~

6345
Memorandum M-509

Page 12

10.0 TRAINING

10.1 Seminar Series

(N. Blumenthal)

The second and third meetings of the new, informal seminar series were held June 16 and June 23 in the basement lecture room. Ron Mayer described his recent work on Electrostatic Storage Control, while Charles Adams discussed the problem of coding the conversion of teletype input data in binary pentad form to a form suitable for use by WWI.

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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

<u>No.</u>	<u>Title</u>	<u>No. of Pages</u>	<u>No. of Draws.</u>	<u>Date</u>	<u>Author</u>
E-127	Comparison of 7AD7 and 6AG7	1	1	6-15-48	H. Kenosian
E-128	Crystal Rectifiers for WWI	2	-	6-21-48	D. L. Brown
M-338	Flip-Flop Storage Output Prototype Drawing Author- ization	1	-	4-5-48	H. Fahnestock
M-469	Evaporation Tube ET45	1	-	6-11-48	R. Shaw
M-470	Bi-Weekly Report, Part I, June 11, 1948	16	-	6-11-48	
M-471	Bi-Weekly Report, Part II, June 11, 1948	18	-	6-11-48	
M-472	Filament Transformer, WWI	1	1	6-11-48	H. S. Lee
M-473	Proposal for Monitoring System of WWI Power Sup- plies	1	-	6-11-48	N. H. Taylor
M-475	Bus Driver Prototype Drawing Approval	2	-	6-14-48	H. Fahnestock
M-476	Frequency Divider Video Layout	1	-	6-14-48	H. Fahnestock
M-477	Proposed Register Panel	1	2	6-11-48	H. Kenosian
M-480	Restorer Pulse Generators; Revision	1	-	6-16-48	H. Fahnestock
M-481	ST 324	1	-	6-16-48	P. Youtz
M-482	Thermal Expansion of Al and Al ₂ O ₃ Layer	2	-	6-16-48	H. Klemperer
M-483	6345 Personnel- Barta Bldg.	3	-	6-15-48	E. Weil
M-484	Voltage Variation Panels	2	-	6-16-48	C. W. Watt
M-485	Input-Output and Comparison Registers	3	2	6-16-48	E. S. Rich
M-486	Program Register and A-Regis- ter Similarity	1	-	6-16-48	E. S. Rich
M-487	Toggle-Switch Storage; Switch Location	1	-	6-16-48	E. S. Rich

6345 Reports (cont'd.)

<u>No.</u>	<u>Title</u>	<u>No. of Pages</u>	<u>No. of Drvgs.</u>	<u>Date</u>	<u>Author</u>
M-490	In-Out Register, Omission of Manual Resets	1	-	6-17-48	R. R. Everett
M-491	Space for Storage Tube Group	1	-	6-17-48	R. R. Everett
M-492	Substitute for Delay Counter	2	-	6-17-48	R. P. Mayer
M-493	Warpage of Signal Plates	3	-	6-17-48	R. Shaw
M-494	7AK7 Tubes, Conference with E. W. Butler	1	-	6-18-48	H. Fahnestock
M-495	Fuse Indication Panel Production Drawing Approval	2	-	6-18-48	C. W. Watt
M-496	A-Register/Program Register Crystal Rectifiers	1	-	6-18-48	H. Fahnestock
M-497	Prototypes of WWI Panels	1	-	6-18-48	H. Fahnestock
M-498	Program Counter Prototype Drawing Authorization	1	-	6-18-48	H. Fahnestock
M-499	Discussion of 7AK7 Production, Emporium, Pa., June 15	2	-	6-18-48	D. R. Brown
M-500	Fabrication of Power Cables	1	-	6-21-48	H. S. Lee
M-502	Meetings of Electronics Group, June 4, 11 & 18, 1948	2	-	6-21-48	J. J. O'Brien
M-503	B-Register/In-Out Register, Production Release	1	-	6-23-48	H. Fahnestock
M-504	Painting 7" Channel	1	-	6-24-48	C. W. Watt
M-506	Changing Graded Drawings of WWI Units Built at MIT	1	-	6-24-48	H. Fahnestock
M-507	WWI Time Schedule Conference	2	-	6-24-48	H. Fahnestock

Translations

M-444	Continuous Self-Sustained Oscillations Occurring in a Multivibrator of the Abraham-Bloch Type - by K. F. Theodorich	5	1	6-14-48	E. I. Blumenthal M. Daniloff
M-464	The "Hard" Regime of Self-Excited Relaxation Oscillations of a Generator (or a Multivibrator of the Abraham-Bloch Type) - by V. V. Vitkevich	6	6	6-10-48	M. Daniloff E. I. Blumenthal
M-474	Study of the Occurrence of "Jumps" in Non-Linear Systems, by A. B. Netushil	18	5	6-14-48	M. Daniloff E. I. Blumenthal

6345
Memorandum M-509

Page 15

Library Files

73	Pre & Post Analyses, June 11, 1948 to June 17, 1948	Reeves Analysis & Computer Group
77	The Analysis and Synthesis of Linear Servomechanisms	A. C. Hall
78	Experimental and Analytical Studies on Oil Gears M3B1	Servomechanisms Laboratory
79	Dynamic Behavior and Design of Servomechanisms	(G. S. Brown (A. C. Hall
80	Fundamental Studies in Servomechanisms Rated Approximately 100 Watts, Vol. I and II	Servomechanisms Laboratory
81	Transient Behavior and Designs of Servomechanisms	G. S. Brown
81	Solution of the Cubic Equations and the Cubic Charts	L. W. Evans
81	Servomechanisms - Charts for Verifying Their Stability and for Finding the Roots of Their Third and Fourth Degree Characteristic Equations	
82	Electronic Control Co. Preliminary Report (UNIVAC) with Diagrams - 5 vols.	Y. J. Lin Electronic Control Co.
83	The Preliminary Design of an Automatic Digital Computing System with Diagrams	Raytheon Manufacturing Co.
--	Proceedings of the IRE, June 1948	

UNCLASSIFIED
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~~RESTRICTED~~6345
Memorandum M-509

Page 16

11.2 Standards Committee

(S. R. Abbott)

The following specifications have been approved and distributed:

6.043-1 Connector - Multipin, Power (female)
6.043-2 Connector - Multipin, Power (male)
6.132A Rectifiers, WWI, Crystal, Germanium
6.132B Rectifiers, Crystal, Germanium
6.172A Switches, Toggle
6.179B Switches, Miscellaneous (Non-Standard)

The following specifications have been approved:

6.193-5) Pulse Transformers (Revised)
6.193-6)
6.193-7)
6.193-8)
6.193-9)
6.193-10)

The following have been submitted for approval:

7.043 Connector - Multipin, Power
7.193 Pulse Transformers
S7.401-1 WWI Test and Use Specification, Crystal Rectifiers

11.3 Purchasing - Stock

(R. Fairbrother)

Rooms 014 and 024 have been vacated by the stock room, and the materials and supplies moved to Ft. Heath. An additional small stock room has been constructed near the basement lecture room.

Test equipment has now been constructed in Bob Murch's shop so that meters can be calibrated and adjusted here in the Barta Building. Only those actually in need of repair will be sent to Building 32. Meters that are in need of checking or calibration should be turned in to the stock room, not to Murch's shop.

(H. B. Morley)

Investigations are being made of competitive lines of standard stock items to determine comparative quality and

~~RESTRICTED~~

UNCLASSIFIED

~~RESTRICTED~~

6345

Memorandum M-509

Page 17

11.3 Purchasing - Stock (Continued)

whether cost savings can be effected through quantity orders.

A decision has been reached on the WVI D. C. Power Supply, and a requisition is being prepared for procurement action.

New material is being added to the file of test equipment instruction manuals, with a view to having copies available both with the equipment and in the Procurement Office.

A new line of high quality selector switches is being procured for a special job requiring a better switch than our standard stock. These switches are not to be carried in stock, but it is suggested that it might be suitable for some future requirements for a particularly rugged and high quality selector switch.

In a number of instances lately, personnel have removed catalogs, specifications, instruction books, or other material from the files without signing for them. This practice results in a definite handicap to the operation of the Procurement Office and it is requested that all publications borrowed be properly signed out. It is also requested that publications being held out which are not needed every day be returned to the files so they will be available for use by other personnel.

11.4 Electronic Construction

(A. Taylor)

One hundred twenty-five 7AD7 adapters have been completed and delivered to inspection.

Ten Variable Frequency Clock Pulse Generators have been completed and delivered to inspection.

Eight Gate and Delay units have been completed and a ninth one is 95% complete. Construction has stopped on the remaining units awaiting parts.

Eighteen Scope Synchronizers due to be delivered June 30 will be held up for modifications ordered June 24.

(R. H. March)

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

~~RESTRICTED~~
UNCLASSIFIED

11.4 Electronic Construction (Continued)

1. Ten DC Bench Outlet Boxes
 These units are completed except for relay to control +500 volts. Relays should be in next week.
2. Special Add Memory Prototype WVI
 This unit is about 85% complete.
3. Preformed Cable Boards for WVI
 At least 2 more weeks' work will be required to complete these.
4. Three Holding Gun Power Supplies
 These units are under construction but will not be completed for at least 2 weeks due to shortage of several parts.
5. Twenty-five DC Power Strips
 Some work has been done on these. Balance will be done as soon as sheet metal work is completed.
6. Point off Control Prototype WVI
 This unit is about 15% complete.
7. Multiply Shift Control Prototype WVI
 No work has been done on this.
8. Measure time-lag of fuses listed on standards sheet 6.061D.
9. Clamp Circuit Model 3
 This unit is under construction.
10. Clean and adjust several relays for WVI.

The work load in the Electronic Laboratory is as follows:

Two WVI Prototype technicians have work scheduled for 10 weeks.

One WVI Prototype technician has work scheduled for 7-1/2 weeks.

Five men have a work load of about 2 weeks.

(F. H. Caswell)

Anodising equipment has been taken apart and thoroughly cleaned.

One technician is on vacation for one week.

~~RESTRICTED~~6345
Memorandum M-509

Page 19

11.4 Electronic Construction (Continued)

An additional technician is now working in the filtered air room to supply the increasing number of tubes required for the vacuum systems and to create a backlog of tube parts.

Because of this increased tube program, a technician was borrowed from the Electronics Laboratory to rewind six transformers for three new holding gun power supplies of the type already in use.

Another storage tube test rack was constructed, making a total of four.

Work is progressing toward a flexible test setup and rack assembly of equipment used to test storage tubes.

The technician work load is quite heavy at present.

11.5 Drafting

(A. M. Falcione)

The work load on the drafting department is quite heavy at this time. It would be greatly appreciated if Engineers would give careful consideration to the priority of their work for this department, so that proper planning can be made for the best interests of the Project.

Memorandum M-479, "Production Drawings for WWI Units Constructed at MIT", will be issued in the next few days.

11.6 Unclassified

(R. H. Murch)

Test Equipment Maintenance. Due to the increasing amount of test equipment and a need for periodic checking of this equipment, Anthony Bille has been transferred from the Electro-Mechanical Laboratory to the Electronic Laboratory and assigned to work with Ernest Nickerson on test equipment maintenance.

A voltage source has been constructed for checking the calibration of meters. Only checking and calibration of meters will be done here. Meters that are found to be in need of repair will be sent to the instrument man at Building 32.

Engineers having meters in need of checking or repair should turn them in to the stockroom rather than the Electronic Laboratory. This is necessary because the stockroom is maintaining a record of the dates that a meter is checked or repaired.

~~RESTRICTED~~

UNCLASSIFIED

UNCLASSIFIED
~~RESTRICTED~~

6345
Memorandum M-509

Page 20

11.6 Unclassified (Continued)

Test equipment other than meters may be turned over directly to Ernest Nickerson in the Electronic Laboratory.

(J. C. Proctor)

Alternations to permit expansion in the basement are progressing satisfactorily. The new office area, Room 006, is completed. The sheet metal shop has been moved to the area at the rear of the lecture room, which will also be used to take care of the building maintenance group. The space thus vacated in the center of the basement will be converted to use as an engineering laboratory.

Room 024 has been vacated by the stockroom and is being prepared for use by the tube testing activity.

(A. Taylor)

Seventy-five per cent of available machine shop time is being devoted to storage tube work. The remaining time is being used for the manufacture of special parts.

If a delivery date is not specified on the work requests, it is assumed the job is to be completed as a routine order.

~~RESTRICTED~~
UNCLASSIFIED

6345
Memorandum M-509

Page 21

12.0 GENERAL

(J. W. Forrester)

New Staff Personnel

DIC Staff Members

John W. Carr has joined the laboratory and is working in the Mathematics Group under Professor Franklin. He received a Bachelor of Science Degree in Electrical Engineering from Duke University, and plans to receive a Masters from MIT in September. He was a Radar Officer in the Navy during the war.

Robert A. Nelson is working with Mr. Forrester on administrative problems. He received a M.S. in Business and Engineering Administration from MIT in June, and has attended Radar School at Harvard and MIT. He served in the Army as a Radar and Personnel Officer.

Alexander Orden is working in the Mathematics Group for Professor Franklin during the summer months. He will return to an appointment in the MIT Math Dept. in the fall. Mr. Orden worked for the Bureau of Standards for five years, some of this time being devoted to their computer program.

Alan J. Perlis is also a new member in the Mathematics Group under Professor Franklin. He received his B.S. from Carnegie Tech and his M.S. from Cal. Tech. He served as a Squadron Intelligence and Weather Officer in the Air Force.

Research Assistants

Gerald Cooper is continuing the magnetic wire recording work started by E. S. Rich. He received a B.S. from the College of the City of New York, and was an instructor there for the last term.

Charles L. Corderman is a new member of the storage tube group. He recently received his BEE from Rensselaer Polytechnic Institute. During the war he served as a radio technician in the Navy.

RESTRICTED

12.0 GENERAL (cont)

Research Assistants (cont)

John M. Salzer is working on block diagrams with R. Everett. He attended Case Institute of Technology where he received a Masters in Electrical Engineering. He has Army experience on instrument repair for ordnance and radar repair. Since then, he has had several part-time jobs including instructing in electrical engineering at Case, and consulting work for the Commercial Television Corp. of Cleveland.

Roger L. Sisson is working in the storage tube group. He is an MIT graduate in Electrical Engineering with an electronics option.

Alfred Sunkind is working for the Electronics group, and is a graduate of Brooklyn Polytechnic Inst.

New Non-Staff Personnel

John M. Blank is a graduate student at MIT who is working as a technician during the summer. He graduated from the College of Wooster, Ohio, and served for two years in the Army Air Forces.

Alice M. Griffin is a detailer working in the drafting room. She has had several years of drafting experience, both with Jackson & Moreland and Stevens Arnold Company.

Ghellis C. Lawrence is working for the Storage Tube Group as a temporary secretary. She recently graduated from Katherine Gibbs and in the fall will enter the University of Washington.

William E. Reardon is a cleaner working for the Maintenance Group. He served for three years in the Coast Guard and has worked for several companies, including Bethlehem Steel.

Terminations

Jacob Goldberg