

~~RESTRICTED~~6345
Memorandum M-707

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Page 1 of 19

Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, November 26, 1948

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(P. Franklin)

The mathematics group has studied some specific simple coding problems, as that for the sine and cosine in Note C-70 and a sorting problem in Notes C-71 and C-72. Work was started on some pulse analyses of use in tests. Work on storage tube problems and on partial differential equations continues.

(M. Daniloff)

It was noted, with some measure of satisfaction, that the behavior of a film of beryllium deposited by sublimation upon glass in vacuo did in fact follow the pattern discussed in Memorandum M-596 "The Critical Temperature of Condensation of Atomic Metallic Vapours". Observed facts give additional weight to the contention of that note, namely, that the beryllium should be condensed on a plate kept at low temperature, preferably at the temperature of liquid air.

Eng. Note E-164 "Natural Frequency of Vibration of the Circular Grid with Central Support of E.S. Storage Tube" was prepared and duly distributed.

(E. Reich)

I have been joined by Philip Rabinowitz in the work on partial differential equations. At present I am studying the paper by Wiener and Phillips on "Nets and the Dirichlet Problem".

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6345
Memorandum M-707

UNCLASSIFIED

Page 2

6.0 MATHEMATICS (cont)

In general, it can be said that while storage facilities will be adequate for the solution of problems of the hyperbolic type, where one merely proceeds from one point to the next, they might not prove sufficient for problems of the elliptic type except for rather rough nets.

(T.W. Hilderbrandt)

Work was continued on sorting problems and on evaluation of usually tabulated functions.

(P.Rabinowitz)

Several codes for sorting numbers were drawn up. In collaboration with T. W. Hilderbrandt.

E-162 "Extension of Runge-Kutta Method to Differential Equations of Order n , Where n is Greater than 4" was issued and distributed to the Mathematics Group.

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7.0 INPUT AND OUTPUT7.1 Eastman Reader-Recorder

(H. R. Boyd)

A conference was held at Rochester on November 23. Doersam and Thaler of Special Devices Center, Bishop, Tyler, O'Neal, Cochran, and Seymour of Eastman, and Forrester, Everett, O'Brien, and Boyd of M.I.T. attended the conference. The purpose of the meeting was to discuss the final design of the film units. The design seems satisfactory and construction will be pushed to obtain two final units by March 15. The prototype film drive handles the film smoothly. The optics are satisfactory, the electrical layouts are partly completed and the wiring of two final panels has begun. The Dahlstrom Company is designing the final cabinet.

A picture of the final cabinet and assembly drawings of the film drive are available in Watt's office. O'Brien is expecting circuit schematics from Eastman next week and they will be available in his office.

7.4 Magnetic Recording

(G. Cooper)

A revised version of the pick-up amplifier has been built using the Sylvania 1273 tube. This seems to have a sufficiently low inherent noise level, is not affected by sound, but does exhibit unsatisfactory characteristics with respect to vibration. It is hoped that shock mounting will improve this.

The playback synchronizer, as initially designed, could not be made to operate in the desired manner, since too many of the factors involved in the adjustment were interdependent. A new design, using a different (and much simpler) principle is being constructed. It should not prove difficult to adjust.

Final preparations for the actual testing of the tape are now being made. The testing will probably begin in about four or five weeks.

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8.0 STORAGE TUBES8.1 Tube Construction and Testing8.11 Tube Construction and Processing

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

The fourth and fifth large storage tubes with a beryllium mosaic on mica storage surface were processed and turned over to the test group. The construction and processing of the fourth tube is described in M-695. The fifth tube's construction and processing was almost identical to that of the fourth tube. Any changes will be reported in a forthcoming memo next week. A beryllium mosaic on mica surface was prepared and will be put in a sixth tube next week.

The large storage tube with a calcium tungstate on aluminum storage surface was processed and turned over to H. Klemperer. This tube was constructed in order to study the holding beam distribution within the tube. The construction and processing of this tube are described in M-701. Components for a second tube in this series were fabricated. Final construction and processing of this tube will await the results on the first tube.

The first new beryllium strip tube for stability studies, which utilizes only mechanical pressure to maintain contact between the beryllium surface and the leads, has been processed and turned over to the test group. The second tube in this series is under construction. We will attempt in this second tube to reduce all leakage paths as much as possible.

(M. I. Florencourt)

The following memoranda have been issued: M-692 "RT41"; M-701 "ST41: Objective, Construction and Processing"; and M-695 "ST48 Construction and Processing." A memorandum on the construction and processing of ST53 will be issued as soon as processing is completed.

(R. Shaw)

Drawings of storage and evaporation tubes are being systematically revised in order to incorporate various design changes which have become necessary.

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8.11 Tube Construction and Processing (Cont'd)

The "beryllium strip" research tube has been completely redesigned. Two sets of parts of the new design are being made.

With the drafting personnel now available to the storage tube group, it should be possible to complete drawings of all tubes on schedule. In the future, therefore, a new print of the assembly will be furnished to each interested person for each tube to be constructed. Prints of unusual details will also be included. All those receiving these prints are requested to advise R. Shaw of any revisions that are considered necessary in order that prints of future tubes may be up to date.

(E. S. Prohaska)

All drawings are completed and all materials have been received for the new filtered air room. Construction is going according to schedule and completion is expected 12/1/48.

Drawings of the headpiece (analyzer) of the polariscope have been completed and checked. Procurement of the parts will begin 12/1/48.

8.12 Tube Testing

(C. L. Corderman)

Tests on ST48 showed that spots of either polarity were stable between V_{HG} of 50V and 500V. There seems to be no difference between storage in the center and outside areas, a substantial improvement over ST45. Writing times were in the vicinity of 5-10 μ sec. Signal outputs were also comparatively good. For a 1.5 μ sec read pulse, a negative spot gave 80 mv output across 5,600 ohms, and a positive spot gave 15 mv. Two photographs were obtained, one showing 121 positive spots on a negative background, the other showing 121 negative spots on a positive background.

(A. H. Ballard)

Minimum write time on ST29 (an early Be on Al_2O_3 tube) shows considerable variation with spot position, being 5 microseconds at best and more than 150 microseconds at worst. The explanation could be non-uniform surface-to-signal plate capacity, non-uniform secondary emission ratio, or possibly inclination of the high velocity

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8.12 Tube Testing (Cont'd)

gun. Similar tests on other tubes have not shown this wide variation in write time.

The stable range of holding gun velocity seems to be reasonably constant for all parts of the surface.

During the past week I have been working with ST45, a 5-inch tube with mica dielectric. Since the surface does not fluoresce, spots cannot be observed visually with the standard test equipment. Consequently curves of deflection voltage and optimum focus voltage for various accelerating voltages have been taken, using the TV setup.

This difficulty has given rise to the suggestion that a TV receiver or equivalent be incorporated into each of the storage tube test positions.

(J. S. Rochefort)

Tests are planned to obtain minimum write-pulse, and surface stability, vs spot position on ST45. Preliminary tests have been run to obtain the proper deflection plate voltages for various values of HV gun accelerating voltage. Portable TV units, or similar equipment, would be a help in tests of this nature.

A Browning CRO (Model OL-15A) was connected in place of the TV picture tube and produced satisfactory results. The TV sweep voltages were applied through the X and Y axis amplifiers. A double image was obtained because of phase shift, and failure to blank-out the horizontal return trace.

SHD has suggested modification of Dumont 208 scopes. Under these modifications, the signal would be applied to the control grid, and a Y-axis sweep generator and amplifier would have to be constructed. The internal X-axis sweep generator contains return-trace blanking; and the fly-back could be differentiated to obtain vertical sync. pulses. Horizontal-return blanking would eliminate the double image; but vertical-return blanking might be necessary. It is hoped the resolution of this type of scope will be comparable to that of the TV picture tube.

(N. S. Zimbel)

The automatic read-write unit has given satisfactory push-button operation. The read (-) signal is approximately

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twice the read (+) signal, and is about .04 volts in amplitude with ST18.

Operation at high repetition rates has been possible at about 1 kc with a writing spot of about 3/16" diameter. At the present time, consideration is being given to the coupling between units in order to improve performance at high repetition rates.

8.13 Reliability Tester

(J. O. Ely)

Progress in the assembly of the storage-tube reliability tester has been rapid during the past two weeks, although the present state of development is not as advanced as was predicted two weeks ago. It now appears that preliminary system testing will begin about December 1st, with assembly of the system completed about December 6th. A number of factors have contributed to the delay, the major factors being:

1. A considerable amount of time has been diverted to the design and test of a new storage-tube output system.
2. Entirely inadequate allowance was made in earlier time estimates for the layout and construction of the storage-tube mount (with its associated circuits), the display 'scope mount, and the main control panel.
3. Early consideration of the power-supply question was superficial and failed to reveal the magnitude of the problem.

All required items of test equipment are either on hand or available when needed, although some of the equipment is on loan from other groups.

It now appears that we will be ready to start tests with a storage-tube about Monday, December 6th.

(R. Sisson)

After a consideration of possible designs, an output circuit for the storage tube reliability tester was decided upon. The circuit is simple and uses a minimum of tubes.

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8.13 Reliability Tester (Cont'd)

The circuit was constructed in breadboard form and tested under conditions simulating actual operation. These tests indicate that this output circuit will be satisfactory for use in this test setup. If storage tubes similar to ST45 and ST48 are available, it should be possible to read out signals about 15 microseconds after switching the signal plate.

A complete signal plate driver and output circuit panel was designed and is being built. This panel supplies the negative gate to cut off the holding gun; it makes possible the reduction of the amplitude of the signal plate switching gate on "read"; it has the necessary clamp circuits and impedance switches; and it includes a video amplifier and gate tube so that the output is approximately in the form of a standard pulse.

(L. J. Nardone)

An estimate of the total power requirements for the storage tube reliability tester, including the deflection-voltage generators, has been made. Special supplies are being provided to meet the power requirements where necessary. A Western Electric Power Supply has been modified to supply regulated plus or minus 350 volts at 500 ma.

8.2 Storage Tube Research

8.21 Surface Material Characteristics

(J. H. McCusker)

Stability tests are being run on RT41, a beryllium strip tube. The potential and the restoring current of the test strip in this tube are affected by changes in the potentials of the dees and adjacent strip, but they are not affected as much as in RT38.

The surface triggers from collector to cathode potential when the collector is 50 to 60 volts above cathode potential. The first crossover is approximately 30 volts above cathode potential.

8.22 Anodizing

(E. S. Prohaska)

J. Palermo is writing an outline of the procedure for anodizing for the guidance of the night crew. This

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8.22 Anodizing (Cont'd)

outline together with several days of personal supervision and instruction should make them capable of producing good anodized surfaces.

A study of the method of anodizing parts at constant voltage indicates that the voltage across the sample was not kept constant, but varied over a range of 20 volts because the drop through external resistances was included in the meter reading. In the future, the meter connections will be changed so that the voltage across the sample will actually be kept constant.

8.23 Output System Circuits

(C. H. R. Campling)

A 10 mc pulsed oscillator with two stages of balanced amplification and gate amplifier to drive the last stage has been sketched in layout form and construction will begin immediately. While this work proceeds, the design of suitable tuned circuits for the unit will be carried out.

8.24 Holding Gun Studies

(H. Klemperer)

A new design was sketched for a tube that will allow the measurement of velocity and intensity distribution of electrons in the holding beam and the high velocity beam of the 5" storage tube. Drafting of the tube has been started.

(H. Rowe)

Using potential plots obtained in the electrolytic tank, studies of the electron paths in the region of the cathode, grid, and first anode of the holding gun have been made for various applied potentials. The electron paths were plotted using the circle method.

A $2\frac{1}{2}$ to 1 model of the entire storage tube has been constructed, and the equipotentials and the electron paths throughout the rest of the tube will be determined.

ST41, the 5" storage tube constructed for holding gun studies, is now being tested.

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8.3 Unclassified

(J. S. Rochefort)

The Secondary Emission Life-Test Rack contained six low voltage, and six high voltage, tube bases. Three of each of these bases, and associated circuits, have been modified to accommodate the low and high velocity guns of storage tubes. The voltages available for the electron guns are the same as those found in the EST Tube-Mount. Jacks have been provided so that heater voltages and cathode currents may be measured. As yet, provision has not been made to supply deflection-plate voltages.

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10.0 TRAINING

10.1 Seminar Series

(J.M.Salzer)

The following Block Diagram Seminars were held:

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|---------|-----------------------------------|-------------|
| Nov. 17 | Operation of the Reader-Recorder. | J.A.O'Brien |
| Nov. 24 | Clock Pulse Control. | R.P.Mayer |

10.2 Electronics Meetings

(N.H.Taylor)

The following Electronics Meetings were held:

- | | | |
|---------|---|-------------|
| Nov. 19 | A discussion of Tube Marking procedures and their importance to WWI. | R. Ellis |
| | A History of a-c Coupling as used in WWI and the future trends towards the use of a-c Flip-flops. | N.H.Taylor |
| Nov. 26 | Probe Design for High Frequency Video work emphasizing the practical problems of constructing these units with conventional resistors and condensers. | H. Kenosian |

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(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>
SR-12	Summary Report, Number 12	15	-	9-48	
E-143	Numerical Solution of Linear Integral Equations	48	-	9-16-48	A.J. Perlis
E-160	Report No. 164-RÖ/E, "The Influ- ence of the Resistance of the Oxide Layer upon the Damping of the Vacuum Tube LG11" (Translation)	4	4	11-1-48	M. Daniloff
E-162	Extension of Runge-Kutta Method to Differential Equations of Order n, where n is Greater than 4	10	-	11-15-48	P. Rabinowit
E-163	Aged 7AD7 Tubes	6	2	11-12-48	J.J. O'Brien
E-164	Natural Frequencies of Vibration of the Circular Grid with Central Support of E. S. Storage Tube	4	-	11-18-48	M. Daniloff
M-665	Standard Switch Settings for WWI	4	-	11-8-48	(C.W. Adams R.P. Mayer)
M-683	Bi-Weekly Report, Part I, 11-12-48	11	-	11-12-48	
M-684	Bi-Weekly Report, Part II, 11-12-48	18	-	11-12-48	
M-685	Program Counter Production Release	1	-	11-12-48	H. Fahnesto
M-686	Deviation from Specifications: Fuse Strip; Register Driver, Type I; Control Switch; Frequency Divider; Time Pulse Distributor Counter	1	-	11-12-48	H. Fahnesto
M-687	Storage Group Organization	3	1	11-18-48	R.R. Everet
M-688	Priorities for Tube Construction	3	-	11-16-48	P. Youtz

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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-689	The Effect of Non-Uniform Holding Beam Velocity on Signal Stability	8	8	11-5-48	W.J. Nolan
M-690	Auxiliary and Bias Interlock Panel	1	-	11-17-48	H.S. Lee
M-691	Master's Thesis Proposal: A Dual-Triode Capacitively-Coupled Flip-Flop	7	5	11-15-48	M.H. Hayes
M-692	RT 41	2	1	11-17-48	{W.J. Nolan {M.I. Florencourt
M-693	Video Busses	2	-	11-17-48	C.W. Watt
M-694	Redirection of Test Equipment Forms	1	-	11-18-48	R.R. Everett
M-695	ST 48 Construction and Processing	2	-	11-17-48	M. Florencourt
M-696	RG-58/U Cable Fittings	1	-	11-18-48	C.W. Watt
M-697	WWI Cabinet Allocation Revisions	1	-	11-18-48	H. Fahnestock
M-698	Proposal for New Orders	5	2	11-22-48	{R.P. Mayer {J.M. Salzer
M-699	Conference on Operator's Console	1	-	11-23-48	C.W. Watt
M-700	Vacuum-Tube Studies and Flip-Flop Circuits	6	-	11-23-48	J.J. O'Brien
M-701	ST41: Objective, Construction and Processing	3	1	11-23-48	M. Florencourt
M-702	Measurement of Velocity and Intensity Distribution of Electrons in the High Velocity and Holding Beam of the Storage Tube	2	2	11-22-48	H. Klemperer
A-74	Terminology	1	-	11-9-48	R.R. Everett
C-65	Hints for Problem, November 9 to 16	5	-	11-12-48	{J.M. Salzer {R.P. Mayer
C-66	Standardization of Coding Abbreviations	3	1	11-12-48	{R.P. Mayer {J.M. Salzer
C-67	A Solution of Problem, November 9 to 16	11	-	11-15-48	{J.M. Salzer {R.P. Mayer {C.W. Adams
C-68	Problem for November 16 to 23	2	-	11-16-48	{T.W. Hildebrandt {P. Rabinowitz
C-69	Interpolation, A Solution to the Problem in C-63	3	1	11-17-48	J.W. Forrester
C-70	Codes for the Sine and Cosine	5	-	11-22-48	P. Franklin
C-71	Hints for Problem, November 16 to 23	1	-	11-19-48	{T. Hildebrandt {P. Rabinowitz
C-72	Solutions of Problems in C-68	7	-	11-22-48	{T. Hildebrandt {P. Rabinowitz
C-73	Problem for November 23 to 30	1	-	11-23-48	P. Rabinowitz

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Reports and Publications (Continued)

<u>No.</u>	<u>Title</u>	<u>Author</u>
<u>Library Files</u>		
52	Progress Report for WWI Electronic Digital Computer for Period October 23 - November 5, 1948	Sylvania
113	<u>General Radio Experimenter</u> , November, 1948: "A Compact Radio-Frequency Capacitance Measuring Instrument"	W.F. Byers
134	Eastman Kodak Monthly Progress Report No. 4, Photographic Digital Reader-Recorder	{ R.D. O'Neal A.W. Tyler
173	Report No. 55243 on Project Hermes; Hermes A-1 Simulators	{ General Electric Company
178	Mathematical Tables and Other Aids to Computation; Quarterly Journal, National Research Council; Numbers 21, 22, 23, 24, for 1948	{ R.C. Archibald D.H. Lehmer
179	The Influence of the Resistance of the Oxide Layer upon the Damping of the Vacuum Tube LG11 (In German)	{ Illegible Author's Signature
180	Document Office Bulletin; October 27, 1948	{ MIT Electronic Research Lab.
181	<u>Pegasus</u> , March, 1948; "Teloran: An Integrated System for Air Navigation"	Hugh H. Spencer
182	G. M. Giannini and Company, Inc. Book Two: Reaction Power Plants, Automatic Flight Equipment	G.M. Giannini Co., Inc.
183	Proportional Displacement Remote Control Study and Development Progress Report, Period May 1, 1948 to May 31, 1948	{ Air Associates, Incorporated
184	Instrumentation Development and Investigation of Pulsating Jet Engine Cycle, Period February 14, 1947, through August 14, 1948	{ Aerojet Engineering Corporation
185	Free-Flight Investigation at Transonic and Supersonic Speeds of the Rolling Effectiveness of a Thin, Unswept Wing having Partial-Span Ailerons, by C. A. Sandahl	{ National Advisory Committee for Aeronautics
186	The Effects of High-Lift Devices on the Low-Speed Stability Characteristics of a Tapered 37.5 Sweptback Wing of Aspect Ratio 3 in Straight and Rolling Flow, by M. J. Queijo and Jacob H. Lichtenstein	{ National Advisory Committee for Aeronautics
187	Longitudinal Stability and Control Characteristics of a Semispan Model of a Supersonic Airplane Configuration at Transonic Speeds from Tests by the NACA Wing-Flow Method, by Norman S. Silsby and James M. McKay	{ National Advisory Committee for Aeronautics
188	Effect of Taper Ratio on the Low-Speed Rolling Stability Derivatives of Swept and Unswept Wings of Aspect Ratio 2.61 by Jack D. Brewer and Lewis R. Fisher	{ National Advisory Committee for Aeronautics

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Reports and Publications (Continued)

<u>No.</u>	<u>Title</u>	<u>Author</u>
189	Effect of Airfoil Profile of Symmetrical Sections on the Low-Speed Static-Stability and Yawing Derivatives of 45 Sweptback Wing Models of Aspect Ratio 2.61 by William Letko and Byron M. Jaquet	{ National Advisory Committee for Aeronautics (General Electric Company
190	Report No. 55429 on Thumper Project; Angular Reference Systems	
554	Project Cyclone Progress Reports: No. 2 for December, 1946; No. 3 for March, 1947; No. 4 for June, 1947	{ Reeves Instrument Corporation (National Bureau of Standards
559	Technical News Bulletin, November, 1948	
- - -	Proceedings of the I.R.E., November 1948	

11.2 Standards Committee

(S. R. Abbott)

The following specifications have been approved and distributed:

- 6.300A Drafting Supplies
- S7.421-4 Digit Interlock Panel
- S7.421-3 Voltage Variation Panel
- S7.410-3 302 Accumulator Digits 1-14

11.3 Purchasing and Stock

(H. B. Morley)

A revision of the Office Memorandum covering Work Order procedures is being prepared, covering the present system of originating and processing Work Orders.

Recent additions to the Laboratory Standards List have made it necessary to secure additional filing space for the Kardex cross-reference index.

New data, specifications and manufacturing methods for I.R.C. fixed composition resistors were discussed by a factory representative last week at Building 32, at a meeting attended by interested personnel from several

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11.3 Purchasing and Stock (Continued)

M.I.T. Labs. This information and a few sample resistors are available for inspection in the Procurement Office.

(R. Fairbrother)

The inventory is now about 95% complete in counting and recording.

The next project which is now underway is the preparation of a commercially manufactured test equipment list, items owned by the laboratory, which will give the uses and pertinent characteristics of each item of equipment. This list is being prepared in cooperation with Mr. Abbott.

11.4 Electronic Construction

(A. Taylor)

About two-thirds of the equipment required for the Temporary Console will be available December first. The balance is being held up for material, design changes, etc.

(A. R. Curtiss)

The following units were assembled:

- A 300 volt, 250 ma power supply (breadboard)
- An R. F. amplifier
- One pulse generator (breadboard)
- Electrodes (aluminum) to simulate the holding gun configuration, scaled 2-1/2:1 for use in the electrolytic tank.

Sweep speed changes were made to one TS-34/AP scope, data recorded in the instrument change book.

Repairs were made to one trigger generator and two W. E. power supplies.

Construction of a second "Protect-O-Vac" unit approximately 85% complete.

A circuit diagram was made of the W. E. power supplies in use in the storage tube section, drawing no. SC-40362.

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11.5 Drafting

(A. M. Falcione)

Tube Characteristics - For the past two years the drafting room has accumulated a quantity of tube characteristic curves for various and sundry types. No drawing numbers were assigned to these tube characteristic curves, making it quite difficult for some engineers to find any particular curve desired with a minimum amount of delay. For the past several weeks we have reviewed all the tube curves and assigned drawing numbers to each curve sheet. The numbers for tube characteristic curves will start with A-50000.

It was found that some of the important characteristic curves for WWI tubes were lacking. However, with the cooperation of N. H. Taylor, H. Kenosian, and Ray Ellis these characteristic curves are now being added to the group. A memo will be written covering the subject as soon as the drawings are completed, together with a table listing each drawing number and its title. A complete set of prints on tube characteristics will be added to the three master files for reference.

Mechanical Drafting Standards Book, Class 2.00 - The section of the standards book entitled, "Drafting Standards" is nearly complete and will be issued next week.

Change in Drawings - There have been several instances in the past weeks which indicate that the drafting room is not being informed of changes made on existing drawings. It is of prime importance that any changes or deviations from existing drawings be brought to our attention immediately. This is especially true for test equipment and WWI installation groups. It is the purpose of the Drafting group to keep an up-to-date record of all work being done for the project, and unless we are notified of changes made, our records will be of no value. The cooperation of all groups in this matter is requested.

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11.6 Unclassified

(A. Taylor)

More machine work is now being done by the Building 32 shop but there is still no open time in our own shop. The sheetmetal shop is still running through a heavy backlog of work for test equipment.

The mechanical unit has been instructed to do no work without a work order.

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12.0 GENERAL

New Non-Staff Personnel:

Bayard R. Lincoln is a student technician in the Storage Tube Lab under Theodore Clough. As a cooperative student at Northeastern University he will alternately work at the Laboratory and attend school. He served in the Navy for two years.

Terminations

John J. O'Brien

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