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Memorandum M-731

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, December 10, 1948

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(P. Franklin)

Codes for the square root and one for the solution of simultaneous linear equations have been completed by the mathematics group and issued as C-74, C-77, and E-161. Work on partial differential equations and on least square fitting of curves by polynomials continues.

(M. Daniloff)

Attention was drawn by Prof. P. Franklin to a paper by Ray T. Birge, "Least-squares fitting," (Rev. of Modern Physics, 19, (1947), 298-360). This is being studied to determine whether some of the material contained therein could be used to advantage for function simulation for/by WWI.

The process of revolution of a ship (power driven) is being studied in connection with the control problem of sea-borne traffic approaching a harbor through a bent channel in a sand bank.

(E. Reich)

Codes for numerical integration and solutions of linear systems by iteration were studied.

(P. Rabinowitz)

Collaboration with E. Reich on partial differential equations has been started. Use of difference equations methods for solving the Dirichlet problem is the first subject being studied.

(T. W. Hildebrandt)

A memorandum is being prepared with codes for evaluation of e^{-x} and $\log x$, for x lying within the capacity of WWI.

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7.0 INPUT AND OUTPUT

7.4 Magnetic Recording

(G. Cooper)

The revised playback synchronizer operates satisfactorily. A pick-up amplifier to drive the synchronizer has been designed and is awaiting construction. This unit will amplify the output of the pick-up preamplifier. The pick-up preamplifier is having some mechanical work done on it to reduce its sensitivity to vibration. Four recording heads have been completed, and several electrical measurements have been made on them.

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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)

Only one storage tube, the sixth in the series of tubes with a Be mosaic on mica was processed. This tube was broken while it was being based. The tube was repaired and given a special processing. This processing gave satisfactory electron gun currents but the tube became gassy over one weekend. The pressure rose from 1×10^{-6} mm Hg to 10^{-3} mm Hg.

Our poor production record during this period was due to the mica. Our original supply of mica produced satisfactory virgin surfaces. The next supply of mica could not be split without rupturing the surface. This problem is now under control. We have surfaces which should produce satisfactory targets in evaporation tubes.

An inspection and assembly room next to the filtered air room has been completed enough for use. All of our chemical work will be done in this room. These additional facilities enable us to coordinate our efforts and produce a smoother flow of mechanical components for storage tubes.

Our immediate objective for the rest of this year is to produce three good storage tubes. One will be a replacement for the storage tube in the TV test unit. The second will be assigned to the reliability test unit in the basement. The third will be used in the automatic read and write test unit. A secondary objective will be to test the newly designed storage assembly in a storage tube.

(R. Shaw)

Drawings of a beam-velocity measuring tube are almost complete.

Several proposals have been layed out of means to increase the effective storage surface area within the present storage tube envelope.

Drawings have been made of existing holding guns and some proposed modifications.

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8.11 Tube Construction and Processing (Cont'd)

With the assistance of the Metal Processing Laboratory (Bldg. 35), we are attempting to improve the flatness of the collector screen by rolling. While the first two samples could not be considered successful, the method has possibilities which have not yet been fully investigated.

Drawings of the D.P.I. air-cooled diffusion pump are being prepared to aid in the maintenance and repair of this equipment.

Layouts of several proposed demountable vacuum systems are being made.

(H. Klemperer)

The new target assembly was given a vibration test in air. No resonance points appeared with the screen properly stretched. The plate capacity is 195 μf without the back shield and 210 μf totally enclosed. Silver painted mica was used as a target plate.

(M. I. Florencourt)

Memorandum M-714 has been issued on the construction and processing of ST 53. Memorandum M-727 has been issued on ST 47.

A memorandum is in process which will describe the tube processing procedure used by the Storage Tube Group.

Tube component construction and inspection sheet blanks have been distributed to all construction and inspection personnel. A tube may not now be accepted for the next stage in its construction and processing until those sheets have been properly filled out. By double checking all construction, it is hoped that shrinkage of tubes due to even minor faults in construction may be avoided.

(E. S. Prohaska)

The tube parts inspection room has been completed with the exception of air ducts to exhaust the chemical bench hood and the room.

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8.11 Tube Construction and Processing (Cont'd)

Some difficulty has been experienced in procuring stock for the construction of the polariscope headpiece. This will probably delay its completion for a month. Detailing of the polarizer should be completed by 12/21. However, no great difficulty is anticipated in procuring stock for its manufacture.

Layouts have been started on a new cylindrical oven for baking out storage tubes.

8.12 Tube Testing

(A. H. Ballard)

Studies of write time and output signal magnitude have been made on ST 45, a 5" tube with mica dielectric. Both of these characteristics are good in a concentric circular area comprising roughly 2/3 of the surface, but storage is poor if not impossible at the outer edge. This configuration has not appeared in other tubes.

Similar to other mica tubes, ST 45 operates at its best when the accelerating voltage of the read-write gun is in the range of 800 - 1000 volts. From the standpoint of output signal for this tube, holding gun voltage should be not less than 150 volts, although portions of the surface will store with V_{H} as low as 75 volts.

At 150 volts, the center area referred to will store a 15 μ sec. write pulse easily. Using a 10 μ sec. read pulse, output amplitudes are of the order of 175 mv for a negative spot and 10 mv for a positive spot (using the tube as a pulse or no pulse device).

On December 9, after 90 hours of operation, ST 45 became too gassy to make any further tests. A memo is being prepared on the testing of ST 45 and will be issued in the near future.

(C. L. Corderman)

Initial tests on ST 53 showed that both vertical deflection plates were shorted to A_2 . However, storage along the horizontal line available should have been possible if the surface was satisfactory. Electrode voltages were varied between wide limits but storage was not possible. Consequently the tube was dissected, and resistance measurements made on the mosaic. The surface resistance of the mosaic from ST 53 was significantly

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8.12 Tube Testing (Cont'd)

lower than that of two other mosaics available for comparison. It is assumed that this lower surface resistance accounted for the inability to store successfully.

St 48 has continued to operate in a gratifying manner. Numerous arrays have been stored for periods up to 6 hours with no observable change in spot size. However, an "after storage" has been noticed when any area is left positive more than 5 - 10 minutes. Tests are being run at present to investigate possible changes in stability, writing times, etc. on these areas from that of areas left negative.

Modifications have been made on the TV test unit to reduce the time between TV presentation and the writing of spots.

(M. I. Florencourt)

Memorandum M-724 has been issued on the test results of ST 53.

(J. J. Rochefort)

Memorandum M-726, "The Dispersion Action of the Collector", has been issued. This memo was issued to draw the attention of the group to material in Spangenberg, "Vacuum Tubes", which tends to confirm an assumption made in M-611, "The Dispersion Action of the Holding Gun Beam within the Collector to Target-Surface Field".

Two Dumont 208 scopes were used to simulate the operation of the TV equipment. One scope was used solely to generate the vertical sweep. The other was used to provide horizontal sweep, signal amplifier, and picture tube. A satisfactory picture of the surface of ST 45 was obtained. Resolution was good when low sweep frequencies were used. Plans have been made to use a modified 208-B scope in place of an additional TV set. The tests indicated above have shown that the following equipment should be constructed:

- (1) Sweep Generator: Linear sweep rates up to 300 per sec.
- (2) Sweep adapter: Minimum amount of phase shift and variable output.
- (3) Video amplifier: Flat freq. response from 30 cps to 3 MC. Maximum gain of 5000 (74 d.b.).

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8.12 Tube Testing (Cont'd)

(N. S. Zimbel)

By the use of d-c restoration in various units of the automatic write-read equipment, satisfactory operation up to a 10 kc "rep" rate has been accomplished with ST 18. The limitation on the maximum "rep" rate is the fact that, at a certain frequency, under the action of the read beam, a spot at cathode potential switches to collector potential. If the read pulse length is decreased, the maximum operating frequency is slightly increased. The minimum read pulse length of about 4 μ s is due to the fact that Mod 18 gives a small read signal at or below this pulse length.

A write pulse length of 20 μ s is being used, while the read pulse is 5 μ s long. The write (-) schedule which is the longest of the three schedules (W+, J-, R) takes 45 μ s. It appears that the limitations on the maximum "rep" rate using ST 18 are the characteristics of the calcium tungstate surface in this tube.

Tests are being conducted on the d-c levels at the various electrodes of the storage tube as the frequency is varied.

(H. Klemperer)

ST 41 was connected to the TV set to check its performance as a storage tube. The phosphor on aluminum (unoxidized) target appeared to be able to store points in the way ordinary phosphor tubes do, but unfortunately it turned gassy before details could be evaluated. It was decided to repeat these experiments with a tube that uses nickel or stainless steel as signal plate instead of the aluminum.

8.13 Storage Tube Reliability Tester

(J. O. Ely)

Construction of all special circuits for the initial operation of the reliability tester with one storage tube has been completed. All test equipment has been mounted in the racks and power and video cabling is virtually complete. The storage tube mount is complete and ready for installation of a storage tube as soon as tests on the control show satisfactory operation of the control equipment.

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8.13 Storage Tube Reliability Tester (Cont'd)

The main control panel has been checked for proper operation and found apparently satisfactory. A portion (about 1/3) of the standard test equipment in the control chain has been operated, and, while some pulse-amplitude-control settings and delay unit stability control settings are extremely critical, it appears that satisfactory operation can be achieved by selection of tubes and close regulation of critical power supply voltages. The deflection circuits have been operated and apparently were not damaged during moving and re-installation.

During the next two weeks adjustments and tests will be made on the complete system with one storage tube. Planning and procurement of materials for installation of four more storage tube racks with teletype input facilities will be begun immediately.

(L. J. Nardone)

Power supplies have been provided to meet the power requirements of the storage tube reliability tester when testing one storage tube only. All mounting and wiring of power units has been completed. However, many of the power supplies are being used temporarily to meet present needs, and will have to be replaced, or modified, in the assembling of a final adequate power system.

(R. Sisson)

The breadboard model of the output panel was completed and tested. After some experimentation, all parts of this panel were made to operate satisfactorily. A read-out pulse was obtained that was big enough to trigger a pulse standardizer, the readout occurring about 15 microseconds after the signal plate is switched. These tests were made by simulating the storage tube with an RC network. It is felt that an actual storage tube may give better results. Work was suspended on the panel until other parts of the tester are ready to be used.

A chassis to support the storage tube and the necessary components to supply power and signals to the guns of the storage tube was designed and built.

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8.13 Storage Tube Reliability Tester (Cont'd)

(J. A. DiGiorgio)

The preliminary construction work on this tester has been completed. The racks, test equipment, power supply, and deflection voltage generators have been set up in Rm. 026.

The pressing need this week was to have the main control panel installed. This panel contains the binary converter switches and main operation selector switch. Also included is the 5" deflection display scope with its controls. The scope tube is a 5CP2A. All input jacks are connected to operation selection switch through 90 ohm coax cable in back of the panel. Indicators are also included on main panel.

The Push-Button Synchronizer was completed.

The deflection voltage generators were in operation and the pattern obtained on the operation display scope.

For the next two weeks I shall be concerned with the testing and adjustments.

8.2 Storage Tube Research8.21 Surface Material Characteristics

(J. H. McCusker)

A memo on the beryllium strip tubes is being written.

8.23 Output System Circuits

(W. J. Nolan)

A storage tube mount has been modified for use in experiments with the RF output circuit and construction has been started on an RF amplifier. The latter has been delayed by loss of technician time. Meanwhile, measurements made with an amplifier obtained from the acoustics laboratory have shown that with some care in the construction of the tube mount it will be possible to reduce the direct coupling between the grid and the signal plate to a point where the interference will not exceed 10% of the expected output signal. Work on coupling circuits between the signal plate and the amplifier has shown that the output signal will be well above amplifier

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8.23 Output System Circuits (Cont'd)

noise level. However, no measurements have been made on the noise introduced by the signal plate gate amplifier. This may be much larger than the other sources.

(C. H. R. Campling)

Construction of 10 MC pulsed oscillator has been completed including all tuned circuits. The circuit consists of a tuned-plate-tuned-grid oscillator which uses a 6AS6, and two stages of push-pull amplification - a neutralized 6SN7 stage and a 3E29. Video gate pulses will be applied to the grids of the 3E29. Tests on the circuit have begun. No difficulties have occurred so far.

8.24 Holding Gun Studies

(H. Rowe)

Testing continues on ST 41, the tube constructed for holding gun studies.

A memo has been written summarizing results obtained from the electrolytic tank for the cathode-grid-first anode region of the holding gun. Studies will continue on the fields and electron trajectories in the rest of the tube.

8.3 Unclassified

(J. S. Rochefort)

The first draft of a report on the E.S.T. Demonstrator was completed in April, 1948. The original demonstrator is no longer in existence for it was modified to accommodate the TV set during July, 1948. Therefore, the classification has been changed from Report to Engineering Note and will be issued soon.

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10.0 TRAINING

10.1 Seminar Series

(J. M. Salzer)

As of December 1, 1948, the Block Diagram Seminars were discontinued temporarily. Their resumption, probably in January or February 1949, will be duly announced.

10.2 Electronics Circuits Course

(H. Kenosian)

A brief course has been started for technicians, designed to give a more complete understanding of pulse circuits as applied to all phases of Project Whirlwind. The course utilizes "Radar Electronic Fundamentals" as a text, supplemented by lectures. At least one home problem per week is assigned to stimulate thinking and interest.

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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 Drwgs.</u>	<u>Date</u>	<u>Author</u>
E-165	Summary of Tube Information on Plate Current Deterioration	2	-	11-30-48	N.H. Taylor
E-167	A-C Power in WWI	2	-	12-8-48	C.W. Watt
M-703-1	Video Cabling Schedules, Forms and Drawing Numbers	1	-	12-6-48	C.W. Watt
M-704	Thyratron Control of A. C. Spot Welder for Storage Tube Assembly	2	1	11-23-48	H. Klemperer
M-705	End Carry for Point Off	1	-	11-24-48	(R.P. Mayer G.G. Hoberg)
M-706	Bi-weekly Report, Part I, 11-26-48	13	-	11-26-48	
M-707	Bi-Weekly Report, Part II, 11-26-48	19	-	11-26-48	
M-708	Barta Building Security Alarm System	3	-	11-24-48	J.C. Proctor
M-709	Master's Thesis Research Proposal: A Low-Speed Analogue for Analysis of Flip-Flops	5	2	11-29-48	J.M. Hunt
M-710	New Orders in WWI; Effect on Construction	1	-	11-26-48	H. Fahnestock
M-711	Storage Tube Group Editor	2	-	11-15-48	S.H. Dodd
M-712	Storage Tube Publications	2	-	11-26-48	S.H. Dodd
M-713	Pulse Transformers on Whirlwind Panels	1	-	11-29-48	G.G. Hoberg
M-714	ST 53: Construction and Processing	2	-	11-29-48	M. Florencourt
M-715	Check Register/Comparison Register, Production Release	1	-	11-29-48	H. Fahnestock
M-716	Video Cable Drawings	1	-	11-30-48	C.W. Watt
M-717	6345 Personnel	3	-	12-1-48	
M-718	GTCB Check Register	1	-	12-1-48	J.M. Salzer
M-719	Video Cable Drawings, WWI	1	-	12-1-48	A.M. Falcione
M-720	Synchronisation with the Synchronizer	3	1	12-2-48	J.M. Salzer

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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-721	Materials Control Group Procurement Office Procedures	6	-	12-2-48	H.B. Morley
M-722	Special Clear and Computer Complement	2	-	12-2-48	J.M. Salzer
M-723	Deviations of Arithmetic Element Video Cabling	3	1	12-7-48	R.H. Murch
M-724	ST 53: Test Results	3	-	12-2-48	M. Florencourt
M-725	Sylvania Tracings, Delivery to MIT	1	-	12-7-48	H. Fahnestock
M-726	The Dispersion Action of the Collector	1	-	12-6-48	J.S. Rochefort
M-727	ST 47	1	-	12-7-48	M. Florencourt
M-728	Power Panels, Marking of	1	-	12-7-48	H. Fahnestock
A-75	Procurement of Mechanical Parts	2	-	11-30-48	(H.R. Boyd (J.C. Proctor
C-74-1	Code for the Square Root	3	-	12-3-48	P. Franklin
C-75	Meeting on December 7; Conference Note C-74	2	-	12-2-48	W.G. Welchman
C-76	Solution of Problems in Conference Note C-73	3	-	12-2-48	W.G. Welchman
C-78	Problems for December 7 to 13	3	-	12-7-48	E. Reich
C-79	Ship Control Problem	2	-	12-7-48	W.G. Welchman

Library Files

.004	European Scientific Notes 15 October and 1 November, 1948				ONR, London
52	Progress Reports for WWI Electronic Digital Computer for Periods November 6, 1948 - November 19, 1948 and November 20, 1948 - December 3, 1948				Sylvania
173	Project Hermes Report No. 55273: Report on Special Test A4 (V-2) Launched 20 November 1947				(General (Electric Compa
180	Document Office Bulletin; November 9, 1948				(MIT Electronic (Research Lab
183	Proportional Displacement Remote Control Study and Development Progress Report, Period June 1, 1948, to June 30, 1948				(Air Associates (Incorporated
191	Investigation of a Thin Wing of Aspect Ratio 4 in the Ames 12-Foot Pressure Wind Tunnel. III - The Effectiveness of a Constant - Chord Aileron; by B. H. Johnson and F. A. Demele				(National Adviso (Committee for
192	Data Handling Systems				Teleregister
193	The Flight Signal Decoder: Interim Engineering Report for September 1948				(Cornell (Aeronautical L

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Library Files (Continued)

<u>No.</u>	<u>Title</u>	<u>Author</u>
194	Electronic Digital Computers (Reprint from <u>Nature</u> , Sept. 25, 1948)	(F.C. Williams T. Kilburn)
195	<u>The Institution of Electrical Engineers</u> ; "A Storage System for Use with Binary-Digital Computing Machines"	(F.C. Williams T. Kilburn)

11.2 Standards Committee

(S. R. Abbott)

Test specification, register driver type I, S7.413-2 dated 10-19-48 has been revised by the addition of a paragraph on voltage variation and will soon be issued.

The next scheduled meeting of the Standards Group will be on January 4th. However, a meeting, prior to that scheduled, may be called if required.

11.3 Purchasing and Stock

(H. B. Morley)

An additional set of JAN tube manuals has been obtained for use by the tube testing lab.

Price increases in all types of material are being received almost daily. The most recent notification is on Allen-Bradley fixed resistors, an increase of approximately 10% in 10% tolerance and 25% in 5% tolerance, on quantity orders.

Present outstanding orders for pulse transformers from N.E.T. have been nearly completed, and a survey of future requirements will be necessary before placing another order. An adequate supply of Hipersil cores is on hand.

(R. Fairbrother)

The stockroom inventory is now completed, and is being recorded in Mr. Morley's office.

In the interests of saving money, before ordering non-standard or special items, possibly the stockroom has the article you desire or an acceptable substitute. It would pay to inquire of Frank Hannon or Bob Pugliese.

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11.4 Electronic Construction

(A. Taylor)

Work orders for equipment due for delivery on December 15 are accumulating. The present backlog for this equipment is not expected to be cleaned up before January 27.

Drafting by the construction group is now reduced to one man half time, and will be eliminated as soon as the test equipment layouts are complete.

WVI units are now coming in for modifications. In each case the priority is being determined in respect to the temporary console equipment.

No test equipment is now planned after the needs of the temporary console are met until WVI modifications are brought up to date and WVI units are delivered.

(A. R. Curtiss)

Repairs were made to one holding gun power supply.

A Galvin IF strip was modified.

A tank coil for a 10 mc oscillator was wound.

An RF amplifier and detector, and a 10 mc oscillator were worked on.

The annealing oven has been rewired, using a pair of Nichrome bus feeders from each side of the line.

The work load remains heavy.

11.5 Drafting

(A. M. Falcione)

Tube Characteristics - For the information of all concerned the drawing numbers on tube characteristic have been changed to start with number 40,400 instead of 50,000. Additional drawings are being made up where necessary. It is expected that a memo will be issued on this matter in the near future.

Mechanical Drafting Standards Book - Due to the heavy

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11.5 Drafting (Continued)

influx of work on the drafting department recently the completion of these standards have been delayed.

On November 29, 1948 Miss F. Brunswick was transferred to work at Building 32 for a period of two months on a special work order for Building 32.

11.6 Unclassified

(A. Taylor)

The mechanical unit of the construction group is now scheduling work to improve machine loading. This means orders are not being scheduled by delivery date alone but by a combination of due date and machine considerations. This will in some cases result in slight delays on certain orders but should increase the volume of work that can be put through.

At present in the construction group there is a duplication of effort in the case of requests for outside mechanical procurement. To eliminate this all requests for outside procurement should be made directly to the purchasing department as prescribed by their memo. The construction group will receive only orders for work in our own shop. However, all requests for mechanical procurement should be discussed with us and placed outside only if we are not able to do it.

About 90% of available machine shop time is devoted to storage tube work. About 80% of sheetmetal shop time is being spent on test equipment construction.

A 5 x 5 notching shear has been added in the sheetmetal shop. This will permit faster production on any chassis up to 4-1/2" deep. All chassis are now being welded unless another method is specified.

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12.0 GENERAL

Terminations:

Andrew Lofgren
Robert Blanchette

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