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Memorandum M-744

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART II, December 24, 1948

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(P. Franklin)

Studied application of least squares and weighting factors to combined observations.

(H. Daniloff)

The equations of plane motion of a rigid body moving through a Newtonian fluid under the action of a deflected plane rudder have been set up in a form suitable for the direct application of the Kutta-Runge method of integration. These results are presented in Conference Note C-83, issued December 22, 1948.

(E. Reich and P. Rabinowitz)

Probability considerations related to observational error were studied.

The use of Poisson's integral as applied to the Dirichlet Problem in partial differential equations was investigated.

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7.0 INPUT AND OUTPUT

7.4 MAGNETIC RECORDING

(G. Cooper)

During the past two weeks considerable attention was given to the problem of designing a static reading head. Under consideration was a scheme which uses the amplitude of the second harmonic voltage generated by a non-linear inductance to indicate the value of the field on the tape. Preliminary investigation indicates that the design of a head that will work will require considerable analysis, while the design of an optimum head will require a good deal of experimentation in addition.

7.5 Unclassified

(J. A. O'Brien)

Some thought has been given to the problem of restoring the input-output flip-flops. A synchronizing circuit using d-c coupled flip-flops to control the flow of restorer pulses has been sketched and is under consideration.

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

Three storage tubes, the seventh, eighth and ninth in the Be mosaic on mica series, were satisfactorily processed and delivered to the test group. Three evaporation tubes were also processed to provide storage surfaces for tubes in the above series.

A supply of mechanical components is being prepared for storage, research and evaporation tubes. Our immediate objective is to increase the mechanical component stock as well as to improve our supply of glass components for the same purpose.

New envelopes will be prepared to contain the newly designed target assembly in an evaporation tube.

(M. I. Florencourt)

Memoranda are being prepared on the construction and processing of ST56, ST57 and ST60.

A memorandum, M-739, has been issued on the construction, processing and testing of ST54.

(R. Shaw)

The nickel screen flattened by rolling in the Metal Processing Laboratory was considered unsatisfactory because the rolling mill available there was too heavy to apply the very light, uniform pressure desired by H. Klemperer. Rolling by hand will be the process used in the next trials.

Two alternate designs are being prepared of an evaporation tube suitable for use with glass targets.

Work on demountable vacuum systems has been temporarily discontinued in order to expedite the design of assembly fixtures for holding guns.

(E. S. Prohaska)

The suction in the hood over the chemical bench in the

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8.11 Tube Construction and Processing (Cont'd)

inspection room has been improved to the point where it is satisfactory for removing noxious fumes from the area. This has been achieved by speeding up the fans in the ventilation system and blocking off all other dust intakes.

The polarizer for the polariscope is very nearly ready for the shop. The analyzer is under construction and should be completed around January 3rd.

8.12 Tube Testing

(A. H. Ballard)

A memo on the testing of ST45 has been completed and is being prepared for distribution.

A recent check on ST45 using the television equipment indicates that the primary cause of failure is an extremely weak holding gun -- high gas pressure having only a secondary influence.

I have also been assisting C. L. Corderman in testing the more recent mica tubes.

(C. L. Corderman)

Initial tests of stability limits and writing times have been run on three Be on mica tubes recently built -- the seventh, eighth and ninth in the series. The sixth in the series, ST54, was found to be gassy and is covered in M-739. The former three are listed below with short summaries of their test results.

ST56 was tested December 17th. Its upper stability point was above 400V -- lower at 50V. Optimum V_{HF} of 100V. Write + time of 4 μ sec and write - time of 6 μ sec with HV cathode at -1500V and HV grid pulsed to zero bias.

ST57 was tested December 21st. Upper stability was around 150V -- lower stability point was 45V. Writing times for HV cathode at -800V were 5 μ sec for writing +, 10 μ sec for writing -. $V_{HF} = 75V$.

ST60 was tested December 23rd. Upper stability point was 250V -- lower stability was 40V. With HV cathode at -1500V and a bias of -80V, plus spots could be written in 4 μ sec with 70V HV grid pulse and erased (written negative) with a 4 μ sec 80V HV grid pulse. Optimum $V_{HF} = 75V$.

ST56 has been placed in the reliability tester and further tests are being run on ST57 and ST60.

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8.12 Tube Testing (Cont'd)

A memo covering the initial tests on ST29 has been issued and another covering ST40 and ST48 is being prepared.

(J. S. Rochefort)

The video amplifier which was described in the last Bi-Weekly Report is now under construction. It has been designed for a 3 mc pass band and a gain of approximately 5000.

8.13 Storage Tube Reliability Tester

(J. O. Ely and R. L. Sisson)

Adjustments and refinements on the Storage Tube Reliability Tester were carried far enough so that a storage tube could be tried in it. ST29 was first used, but it has a weak high velocity gun and gave output signals too small to be useful. ST56 was then tried. Preliminary tests with it show that it is possible to read out signals from this tube with sufficient amplitude to operate the output circuits. Perfect surface stability has not yet been achieved with the storage tube but testing is in its early stages. Higher repetition rates are being used in this equipment which may require different operating conditions than in the storage tube test equipment. Further adjustments on the reliability test equipment still have to be made to get all the desired types of operation with a storage tube.

A new storage tube readout panel will be built incorporating new ideas developed during the past two week's testing.

(L. J. Nardone)

The past two weeks have been spent testing and adjusting the Storage Tube Reliability Tester. These tests will continue in order to obtain a stable system.

The power system also had to be further modified to suit the power requirements of the Storage Tube Reliability Tester.

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8.2 Storage Tube Research

8.21 High Repetition Rate Write-Read Equipment

(H. S. Zimbel)

Investigation of the d-c levels at the different electrodes of the storage tube showed that above 20 kc operation was not satisfactory. Further circuit modifications were made to cut down the d-c restoration time constant. In addition to this, it was found that the 2D21 gas tube used in the single pulse synchronizer has a relatively long deionization time. Consequently, these units were replaced by pulse standardizers.

Upon rechecking the d-c levels, satisfactory operation was obtained over the range of the scope synchronizer (0 to 33 kc). With ST18, it was found that the minimum write time is 10 μ s and minimum read time is 4 μ s.

A memo will be issued on the setting up of this equipment.

8.22 Anodizing

(E. S. Prohaska)

The current regulator circuit has been modified to give it more flexibility; an additional resistance network of 12 ohms shunted by a shorting switch was put in series with the present seven ohm resistor, the voltage drop across which has been used as a measurement of the current through the anodizing bath. The combination of the 7 ohm resistor and 12 ohm network are used to provide a voltage proportional to current for the regulator when attempting to regulate a small current (1 amp. or less) such as that through two spacers. This precludes the necessity of reducing the gain of the regulator to the point where "dead space" is excessive and regulation poor. The 12 ohm network is shorted out for such work as a signal plate, requiring a current of 2.8 amps.

8.23 Output System Circuits

(W. J. Nolan)

Application of the RF output circuit to the storage tube demonstrator equipment has shown the principle to be practicable for reading at a p.r.f. of about 3 kc without rewriting. The reading pulse was 4 μ s and the equipment showed rise times short enough to operate with 1.5 or 2 μ s pulses. The pulse amplitude was also larger than

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necessary, so it is apparent that a reading frequency of at least 12 kc is possible on a single spot without rewriting. The transients resulting from switching of the signal plate were short enough to permit operation with a gate of less than 20 μ s on the signal plate, corresponding to a reading rate of about 50 kc. The output signal had an amplitude of about 100 microvolts.

(C. H. R. Campling)

Tests on the r.f. pulser have continued. A detector circuit has been added to permit observation of the envelope of the r.f. pulse on the scope. Amplitudes up to about 50 volts are obtainable. Ringing on the top of the pulse has been eliminated. Rise time is $\frac{1}{2}$ microsecond, fall time $\frac{1}{4}$ microsecond. There is still some dependence of pulse amplitude on duty cycle.

8.24 Holding Gun Studies

(H. Rowe)

Testing has been completed on ST41, the tube constructed for holding gun studies. A memo, M-742, has been written summarizing the results obtained.

Equipotentials have been plotted in the electrolytic tank using a $2\frac{1}{2}$ to 1 model of the storage tube. The electron paths for various applied voltages will be determined.

8.3 Unclassified

(M. I. Florencourt)

An effort is being made to standardize the location of the various construction and processing entries in the storage tube lab notebooks.

There were several visitors who came to the lab to discuss storage tubes: Prof. H.J. Zimmerman of M.I.T., Mr. G.S. Smith of Melpar Inc., and R.J. Bergemann of the Boston office of ONR.

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11.0 FACILITIES AND CENTRAL SERVICE11.1 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 Drwgs.</u>	<u>Date</u>	<u>Author</u>
R-134	The Five-Digit Multiplier, Vol. 1	48	-	12-3-48	N.H. Taylor
R-134	The Five-Digit Multiplier, Vol. 2	-	27	12-3-48	N.H. Taylor
R-145	The Register Panel	12	9	12-7-48	R.R. Rathbone
E-161	Code for Solution of Simultaneous Equations by Elimination	32	1	11-4-48	A. Orden
E-168	D-C Coupled Flip-Flops	4	3	12-17-48	C.A. Rowland
M-347-1	Receptionists and Guard Duties	2	-	12-7-48	J.C. Proctor
M-725	Sylvania Tracings, Delivery to MIT	1	-	12-7-48	H. Fahnestock
M-730	Bi-Weekly Report, Part I, 12-10-48	14	-	12-10-48	
M-731	Bi-Weekly Report, Part II, 12-10-48	17	-	12-10-48	
M-732	Tolerances for Video Cable Lengths	1	-	12-14-48	R.H. Murch
M-733	Meeting at Eastman Kodak Company	2	-	12-13-48	J.A. O'Brien
M-734	PR: A Dual-Triode Capacitively Coupled Flip-Flop	2	2	12-10-48	M.H. Hayes
M-735	Contract Costs Correspondence, MIT to Sylvania	2	-	12-16-48	H. Fahnestock
M-736	Christmas and New Years Guard Schedule	2	-	12-17-48	F. Cowie
A-55-1	Security and Classification	5	-	12-10-48	{J.W. Forrester {H.R. Boyd
A-76	Laboratory Hours	1	-	12-14-48	{J.W. Forrester {H.R. Boyd
A-77	Visitors	1	-	12-21-48	J.W. Forrester
C-74-1	Code for the Square Root	3	-	12-3-48	P. Franklin
C-77	Codes for the Square Root II	6	-	12-6-48	P. Franklin
C-80	Ship Control Problem	3	-	12-10-48	W. Welchman
C-82	Problem for December 21, 1948	1	-	12-15-48	W. Welchman

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<u>No.</u>	<u>Title</u>	<u>Author</u>
- - -	Proceedings of the IRE, December, 1948	
.004	European Scientific Notes, 15 November 1948	London ONR
47	Technical Information Pilot, Number UI510-1848	Lib. of Congress
73	Pre- and Post-Analysis by Reeves Analysis and Computer Group, October 8, 1948, Job No. 22-4.1; October 8, 1948, Jobs No. 22-1.2, 22-2.2, 22-4.2; October 14, 1948, Job No. 7-3.3; October 29, 1948, Job No. 9-4	{ Reeves { Instrument Corp.
113	General Radio Experimenter, December, 1948, "The Interpolating Frequency Standard"	{ General Radio { Company
134	Eastman Kodak Monthly Progress Report no. 5, Photographic Digital Reader-Recorder, December 10, 1948	{ R.D. O'Neal { A.W. Tyler
180	Document Office Bulletins; November 26 and December 9, 1948	{ MIT Electronics { Research Lab
196	Mechanical Switch (Commutator) Development for Time Division Telemetry, Technical Report No. 38, 29 November 1948	{ US Naval Air { Missile Test { Center
197	Chopper Type of Direct Current Amplifier, by John J. Wedel, July 27, 1948	{ Jet Propulsion { Lab, Calif. { Inst. of Tech.
198	Interim Engineering Report on Radio Control Receiver Model AN/ARW-55 and Radio Control Transmitter Model AN/ARW-56 for Period May 7, 1948 to November 1, 1948	{ Collins Radio { Company
199	Office of Naval Research, A Statement of Policy and Organization, December 1946	{ US Navy { Department
200	Power Supply Circuit Description	{ Power { Equipment Co.
201	Type RV2 High Precision Potentiometer	{ Technology { Instrument Corp.
202	Miniature Motor Products, October 15, 1948	{ Globe Industries

11.3 Purchasing and Stock

(H. B. Morley)

Samples of pulse transformers have been received from Amertran. Instead of Flexseal coating, they are treated with Permaseal, a JAN approved process. Preliminary tests indicate satisfactory performance.

The stockroom inventory has been received and posted to the Kardex file. This makes available consumption data for a period of approximately nine months. This information

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11.3 Purchasing and Stock (Continued)

is being coordinated with anticipated requirements to prepare revised minimum stock levels for standard stock items.

(R. Fairbrother)

Work still continues on the list of purchased test equipment, a brief description of its purpose, characteristics etc.

In the past two weeks a considerable quantity of material for which individuals had no further use has been returned to the stock room. This procedure should be followed as much as possible, as it then returns the material to the spot where it is available for the use of all.

11.4 Electronic Construction

(A. R. Curtiss)

Repairs were made to two holding gun and two high voltage power supplies.

A 10 mc pulsed oscillator was worked on.

A sweep adapter was breadboard assembled and a signal plate gate amplifier was chassis constructed.

Construction of a video amplifier was started this date.

The work load remains heavy.

(A. Taylor)

Construction on console equipment is still underway. Ninety per cent of the co-ax cable for the console has been completed.

There has been some misunderstanding about electronic equipment deliveries. With the exception of breadboards and other things in that class, all completed equipment must be delivered by us to inspection. All deliveries to final destinations are made by the inspection department or the testing department. The construction group does no inspecting or testing.

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11.5 Drafting

(A. M. Falcione)

Miss Pat Wolfe, a draftsman, was transferred to Bldg. 32 to work on a special project. Miss Wolfe is planning to re-enter Tech in February '49 to complete her freshman year studies.

The Mechanical Standards Book is complete, however due to the excessive load on the Print room the remaining sections have not been run off as yet. It is expected that this will be completed during the coming week.

The work load on the drafting department is quite heavy at this time. This, together with the anticipated thesis work, will no doubt cause some work to be delayed. It is suggested to engineers that in order to help alleviate the condition, greater use should be made of rough sketches. In many cases the drawings are only experimental and subject to numerous changes before the final form is reached.

11.6 Unclassified

(A. Taylor)

Eighty per cent of machine shop time is being utilized by the storage tube group. The past two weeks of sheetmetal shop time has been devoted to manufacture of console equipment.

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12.0 GENERAL

Staff termination: Samuel R. Abbott

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