

6345
Memorandum I.-1096

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, Project 6345, September 15, 1950

To: Jay W. Forrester

From: Project Whirlwind Staff

1.0 SYSTEMS TESTS

1.1 Whirlwind I System Test

(S.H. Dodd, R.R. Everett, N.H. Taylor, R. Read)

A large amount of progress has been made in obtaining a method of adjustment for storage tubes in ES Row. The original time of two weeks per tube has now been reduced to less than two days per tube. This saving in time has been accomplished by simplification of the test procedure and because the test personnel have become more familiar with the test methods. At present 4 tubes have passed the systems test and a fifth tube is under way.

In addition to resulting in a row of adjusted storage tubes the test schedule is expected to result in a final test procedure which will be easy and accurate to use. The past few weeks have evolved a fairly good test procedure and many of the methods can be used for further marginal checking work. A major recent modification of the test procedure is in the addition of the re-write cycle and a simplification of the method of adjustment in the high velocity gun gates. Some trouble has been found with gun current variation with duty factor and heater voltage. Investigation of these effects is being made in the reliability tester.

A cathode ray tube monitor is being added to the R.F. system so that accurate pulse and phase amplitude measurements may be made and a direct indication of phase angle by the use of "Lissajous Figures" may be obtained.

Consideration is being given to adjustment of some of the parameters in the storage tube mount before adding the tube to the computer. These adjustments will probably be made in the reliability tester. Of course, once ES Row is in final operating shape it will be desirable to make as many of these tests in the reliability tester as possible.

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1.1 Whirlwind I System Test (Continued)

As new test procedures suggest new marginal checking methods C. W. Watt is designing relay circuits and other means of facilitating these checking procedures. He is now working on a relay system for removing the high voltage supply for R.F. measurements.

The program will continue on a two shift basis allotting 12 hours each day to storage tube testing and 5 hours to marginal checking, maintenance and trouble location problems.

(N. Daggett)

During the past few weeks computer operation has been plagued by what is apparently trouble in the MS control counters. A new MSC alarm has been added which prevents the computer from remaining too long in an MS cycle. This eliminates the flip-flop stalling which otherwise occurs if MSC fails to produce an end carry because of improper counter action. Location of trouble in the counters has been helped greatly by the new alarm since it allows cyclic operation of MS control under conditions which would otherwise have been impossible because of flip-flop stalling. However, considerable time will still be needed to establish stable operating margins in MSC.

So much time has been diverted lately to the troubles in MSC that more routine maintenance has been scarcely holding its own. There have been very few opportunities to investigate low margins disclosed by marginal checking because time has had to be used for troubles already interfering with proper operation of the system.

(H. F. Mercer)

Component Failures in WI - The following failures of electrical components have been reported since September 1, 1950:

<u>Component</u>	<u>No. of Failures</u>	<u>Hours of Operation</u>	<u>Reason for Failure</u>
<u>Crystals</u>			
D-758	2	1000-1300	} Drift
	1	2437	
	4	3000-3500	
<u>Tubes</u>			
7AD7	2	3266	} Change in Characteristics, Low I_B
	2	4146	

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1.2 Five-Digit Multiplier

(M. A. Juditz)

During the period covered by this report the multiplier made errors on September 2, 6, 7, 8, 11, 12 and 14.

Trouble on September 7th and 8th caused the multiplier to fail completely. The breakdown was found to be caused by an intermittent filament connection in a power cable to control equipment.

Tapping the panels at this time revealed several tubes extremely sensitive to vibration.

It is interesting to note that no crystal failures have occurred since August 4th.

Tube failures during this period are as follows:

6AS6	5
7AK7	1
7AD7	11
6AG7	1

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

831 ST Mount

(W. J. Nolan)

The proposed modification to the ST mounts has been tested with 9 different combinations of storage tubes and mount boxes and has been found to consistently reduce the leakage signal to a level comparable with the noise, although some irregularities still remain. These data are believed sufficient to justify modification of additional mounts for use in WWI. These measurements were made on a bench setup and represent only the leakage within the mount. In a day or two tests will be made with the mounts in WWI to determine if there is additional leakage between cables, etc.

2.5 Tubes and Components

(F. E. Irish)

A circuit for life testing crystals under conditions similar to those found in a clamping circuit has been built. Four types of crystals with characteristics similar to those of the D-35E will be life tested in this circuit. At present these crystals are being given static tests prior to their installation in the life tester.

(H. B. Frost)

Test specifications and rejection conditions for all receiving type vacuum tubes commonly used on this project have been revised and brought up to date. Except where circuit conditions demand otherwise, the rejection points have been established to reject only abnormal tubes. This material will probably be incorporated into the WWI test specifications in the near future. In some cases changes in the test specifications have been made to either give more information about the tube or to simplify the testing procedure.

Samples of a new tube type, the 6BL7GT, have been received. This is a high-perveance double triode intended for TV vertical deflection amplifiers. A plate characteristic family has been run and is available as dwg. no. 40528.

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2.7 A Coincident-Current Magnetic Memory Unit

(W. N. Papien)

A breadboard containing one channel of the eight needed to make up the planned 2X2 Selector was received from the shop, tested and modified. From this the 2X2 Selector panel was designed and ordered from Production.

The single-channel breadboard will be cleaned up and used as the One-Zero Writer. It will be possible to rescue and use the prototype breadboard of the 10C Synchronizer, along with three or four pieces of standard test equipment, to complete the setup, so that only one major item (the 2X2 Selector) need be constructed at this time.

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3.0 STORAGE TUBES

3.1 Construction

(P. Youtz)

Four research tubes were processed this period. Three research tubes, RT165, RT166, and RT168, were identical with the 100 series storage tubes for WWI except the mosaics were lined up with the deflection plates and the mica spacer was redesigned to give uniform spacing between screen and mosaic surface. RT157 was a stubby research tube with a solid beryllium surface to investigate the secondary emission of beryllium and compare the behavior of an all beryllium surface with an all mica surface (RT155). One storage tube ST117-R1 was reprocessed satisfactorily.

(R. Shaw)

Since R.V.A. have not yet had the opportunity to acquire much experience in envelope construction, the incoming envelopes are still being individually inspected. A notebook record has been kept of all measurements and any discrepancies have been brought to the attention of T.F. Clough and J. O. Ely. In general, current envelopes are quite satisfactory. The inspection will be handled by J.C. Wilson in the future.

The jig for locating deflection plates has been redrawn to incorporate some suggestions from other members of the group.

Several high velocity guns from dissected ST's have been examined. The results will be turned over to the test group for possible correlation with the performance characteristics of these guns.

The list of ST drawings (M-987) is being brought up-to-date and expanded to include test equipment.

3.2 Test

(P. Youtz)

During this bi-weekly period, C. L. Corderman and M. I. Mann were on vacation. A. R. Tanguay was on vacation the second week of the period. Storage tubes were tested on the TV demonstration unit during the first week by A. R. Tanguay and the second week by H. J. Platt.

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3.2 Test (continued)

(H. J. Platt)

The first half of this period was spent in helping H. B. Frost to run a few tests on the storage tube reliability tester. Some time was also spent in learning to run the TV demonstrator and performing tests with it.

Three tubes were tested by me during this period - ST 103-R1, RT 165, and RT 166. ST 103-R1 was shown to be satisfactory. RT 165 and RT 166 both exhibited high leakage on the target surface. RT 165 also had a bad spot.

During the week the TV demonstrator was changed somewhat to allow certain sections of the procedure of M-1077-3 to be performed thereby facilitating and expediting some of the work of getting ES row into operation. Various difficulties encountered with new equipment recently installed in the TV demonstrator limited the amount of work accomplished.

(H. B. Frost)

Most of the past period the STRT has been used to obtain high velocity gun transfer characteristics on several storage tubes from WWI. In some tubes the high velocity beam current has been found to be greatly dependent upon the high velocity gun duty cycle and pulse current immediately before the measurement. The characteristics are similar to those presented in F-308. In one tube (ST159) a beam current range of about 4:1 was obtained depending upon the history of the cathode preceding the measurements. This seems to be an extreme case. Questions of some importance which remain to be answered are:

- 1) Do all cathodes as now used exhibit poisoning effects uniformly with advancing age?
 - 2) What mode of operation will allow the best use of tubes with these cathodes?
 - 3) Is there any way to delay cathode poisoning until the tube is otherwise unsatisfactory?
- 2

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4.0 INPUT-OUTPUT EQUIPMENT

4.1 Eastman Kodak Units

(D. Hageman)

Available computer time was spent making recordings which have a larger spot size, our experience with the reading mode having indicated that reliability might be thus improved. Several satisfactory films were prepared; more of other types need to be made for proper evaluation of the reading and recording functions with larger spot size.

4.3 Typewriter and Tape-Punching Equipment

(J. S. Hanson)

Relay mounting brackets and translator relay-retaining clips recently completed by the shops have been installed in their respective tape output units. A plug-in relay supported by the mounting bracket in the tape punch controls the stop-for-insert, feedout-hole reproduction, and recycling features of the equipment in both tape preparation and computer output applications. The retaining clips positively lock the tape reader translator relays in their sockets and prevent their being jarred loose by mechanical vibration.

The tape output relay cabinet is essentially complete and is undergoing wiring inspection. Wiring and inspection of the remote control unit will be complete sometime this coming week.

(R. E. Hunt)

The major part of the last fortnight has been spent going over these units studying their mechanical design and adjustment. At this point I feel that the basic design is good but the execution of the design is only fair.

It is felt that the only way these units could be made to be dependable enough for our purposes is by very careful adjustment and maintenance. The units as received were in poor adjustment.

At the present time a set of adjustment and maintenance specifications are being worked out.

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4.3 Typewriter and Tape-Punching Equipment (continued)

(C. W. Watt)

One short evening was spent in further test of this equipment with the computer. The normal and free running modes were both made to operate successfully. There is still one condition in which errors are produced, however, the source of which will need to be investigated when more computer time is available.

4.4 Input-Output Planning

(E. S. Rich)

Detailed planning for an integrated system of terminal equipment has been undertaken. This planning involves consideration of all types of terminal equipment that might be used with the computer so that specifications can be set for an in-out switch and for any necessary redesign of in-out control or in-out registers. Periodic meetings of interested persons will be held to report the progress of this work and to discuss questions that may be raised.

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5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control
(C. W. Watt)

Control of Hi Voltage Power Supply for ES:

1. A relay circuit to permit the high voltage to either banks A or B of ES to be turned on or off selectively has been developed and will be built shortly.
2. A relay circuit for cutting off the storage tube holding guns is being designed and will be built soon.

(J. J. Gano)

D-C Plate Supply Alternator: Sketches of the final circuit schematics and cabling for the four panels have been given to the drafting room. One of the panels requires but minor circuit revisions from its present operating status and the drawings for one of the other panels are already completed.

5.3 Video Cabling
(T. Leary)

Video-cabling activity has been reasonably brisk during the last two weeks, mainly because of the following system changes:

1. Reconnection of PR as a Program Register.
2. Modification of "PR Read to CB" in order to provide checking of the Program Counter input.
3. Transfer of the contents of the Accumulator to the Check Register via the main bus rather than the check bus (modification of operation "CK") in order to check the Accumulator output.

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4. Addition of "ES Cycle Alarm" (primarily to provide resumption of restoration in WWI if ES cycle is too long for any reason).
5. Addition of operation "qf".
6. Addition of "initiate write minus gate (Erase)" input to J3 of the Signal Plate Drivers.

Obsolete, superseded, and superfluous cables are being tagged and will be removed from WWI on Saturday mornings.

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6.0 BLOCK DIAGRAMS

(R. P. Mayer)

The recent changes in the computer--new order of, PR as PR, sp checks PC read-in, ES Cycle Alarm (occurs if SC counts "37" before ESC produces an end carry)--are shown on present "Up-to-the-minute" drawings.

Various groups of people now place programs into the computer. Some of these programs, and the procedures used with them, require changes in the positions of numerous switches and some cables. A check list would simplify the problem of checking these cables and switches whenever a new program is inserted. The second of two suggested check-list forms shows an outline of test control with provision for specifying all important switch positions, and provides space for listing cable connections, miscellaneous details, and toggle-switch storage settings. Any suggestions will be welcomed.

It was recently confirmed, by observation on the test control scope, that eleven low frequency clock pulses exist between each restorer interval, and that twenty-three high frequency clock pulses appear during the same interval--one before, and one after, the group of low frequency pulses.

(J. L. Salzer)

Work has been started on block diagrams for the use of various types of terminal equipment with the computer. This program is coordinated with Ed Rich's planning of input-output equipment.

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7.0 CHECKING METHODS

7.1 Test Problems

(G. Cooper)

ES Test Program Number X has been revised to meet the requirements of 1.-1077-3 and is available as SA-35983-1, with the variations appearing on SB-35985-2. Inasmuch as it is expected that the program requirements of MS testing will remain much as they are at present, M-359 is being completed.

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8.0 MATHEMATICS AND PROGRAMMING

(C. W. Adams)

I have attended both the International Congress of Mathematicians at Harvard and the meeting of the Association of Computing Machinery in Washington. Both were exceptionally stimulating meetings. Personal contacts made there have, in particular, (1) revived an interest in number-theoretical problems and (2) have encouraged work towards a practical, convenient, fully automatic means for handling coding details and computer set-up (cf. last Bi-Weekly Report). A note describing impressions of the ACM meeting will probably be issued soon in collaboration with D. Israel. Work on number-theory problems and on automatic set-up will be pursued further as time permits.

(F. C. Helwig & J. D. Porter)

We have continued to work on our report on the numerical analysis of the non-linear partial differential equation described in a previous Bi-Weekly Report (M-1071). We are also studying the round off and truncation errors and are continuing to compile information on other numerical methods for solving partial differential equations.

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9.0 FACILITIES AND CENTRAL SERVICES

9.1 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>Date</u>	<u>Author</u>
E-371	Splicing Nonex to Pyrex Glass to Form a Graded Seal	2	9-7-50	W. E. Pickett
E-373	18-Pin Stem Construction	3	9-7-50	W. E. Pickett
E-374	Beading of Tungsten Wire	2	9-7-50	W. E. Pickett
E-375	10-Pin Stem Construction	2	9-7-50	W. E. Pickett
E-379	A Coincident-Current Magnetic Memory Unit (Abstract of R-192, A Master's Thesis)	2	9-11-50	W. N. Papian
M-1092	Bi-Weekly Report, Project 6345, September 1, 1950	24	9-1-50	
M-1095	Electronic Computer Division Personnel	3	9-1-50	

9.2 Standards, Purchasing and Stock

(H. B. Morley)

Standards - No new Laboratory standards issued this period.

Procurement and Stock - It is apparent that the delivery time of many electronic components is steadily increasing. Radio Electron Tubes, for example, have become especially difficult to obtain on direct factory orders. General Electric, for instance, has advised us that direct Government orders have necessitated the allocation of a major portion of their production to these orders. Distributors are receiving an allocated portion of their factory orders. In consideration of this situation, it has been necessary to cancel orders 6AS7C and 6AN5 and several other types originally placed as direct orders. These have been ordered from a local distributor with either immediate or approximately thirty days delivery time. Some other approximations of deliveries to be expected are as follows:

Mica Capacitors	6 to 8 weeks
Paper capacitors metal cased	12 to 16 weeks
Electrolytic capacitors	8 to 10 weeks
X Type Resistors	4 to 8 weeks
Carbon resistors (AB)	25 to 56 weeks
Wire (especially vinyl or plastic)	Indefinite
Transformers (special)	12 to 16 weeks
Transformers (regular stock)	8 to 10 weeks
Transformers (pulse)	3 to 4 weeks-
	(small quantities)

Although Sylvania had informed us that D358 crystals were not to be readily available (see Bi-Weekly Report of 8/4/50), we were recently advised that a production run of 300 D358 was completed. Accordingly, a quantity of 100 of these were procured to alleviate the immediate shortage. They estimate that delivery of IN38A crystals should be at the rate of approximately 50 per week starting 9/18/50.

As we will probably have to vacate the Fort Heath storage area within the next few weeks, tentative plans are being made to move much of the material now stored in Room 045 to whatever space is to be assigned. This will provide a sub-stockroom in Room 045 for WWI spares and bulk storage. It is hoped that we will be able to secure more conveniently located facilities for this proposed move.

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9.3 Construction

(L. Prentice)

Machine Shop- The work load in this shop has been light. This has permitted routine maintenance as follows: Paint 2 lathes, paint 2 storage cabinets. Made 3 punch and die sets, replacements made for 1 turret tool post holder. Made new drill jig for support ring and repair to other fixtures. Work is now underway on parts for 12 storage tubes.

Sheet Metal Shop - The lucite shield was completed for Vacuum system # 1 and 2.

(R. A. Osborne)

Production Report - The following items have been completed and inspected since September 1, 1950:

- 1 Breadboard Modification
- 1 Breadboard (Channel of Magnetic Storage Tester.)
- 10 E. S. T. Output Panels modified
- 22 Video Cables
- 1 Tape Output Unit - Control Panel

9.4 Drafting

(A. M. Falcione)

1. VVI Rack Terminal Schedules - "P" reductions have been made for terminal schedules for C-Row and F-Row. We expect to obtain reductions for the balance of terminal schedules in the very near future. Any anticipated changes or revisions should be brought to our attention at the earliest possible moment.

2. Input Output Tape Units - Final circuit schematic drawings are now being made for these units incorporating all of the latest changes and revisions.

3. D.C. Plate Supply Alternator - Drawings for each unit of this power supply (Rack 11 Rm. 041) are now being made. It is expected that they will be completed before the next Bi-Weekly Report.

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10.0 GENERAL

(J. C. Proctor)

New Staff

Abraham Katz of Camden New Jersey, is a new Research Assistant. He received his Bachelor of Science in Electrical Engineering from MIT in June and has Engineering experience with General Electric plus three years electronic experience with the Navy.

Howard J. Kirshner, Research Assistant, is from New York City. He is an Army Air Forces veteran, has worked for Sperry Gyroscope Company as an assistant Project Engineer, and has a Bachelor of Electrical Engineering from New York University.

Kenneth H. Olsen, Research Assistant, received his Bachelor of Science in Electrical Engineering from MIT in June. Prior to his work at MIT, he spent two years as an Electronic Technician in the Navy and was a troubleshooter for General Electric. He spent this summer in Göteborg, Sweden as an exchange student worker. Mr. Olsen's home is in Stratford Connecticut.

Alexander M. Stein of Kew Gardens, New York, is also a new Research Assistant. He received his Bachelor of Science in Electrical Engineering from Union College, Schenectady, New York in June. His experience includes three years in the Navy and several engineering positions.

Non-Staff Terminations

Alice D. Monroe
Alfred W. Young