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Memorandum M-470

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART I, JUNE 11, 1948

To: 6345 Engineers

From: Jay W. Forrester

1.0 WHIRLWIND I COMPUTER ELEMENTS

1.1 Listed by Block Diagram Number

102 Program Counter

(H. Fahnestock)

Video layout of program counter has been received from Sylvania and is being checked.

106 Time Pulse Distributor

(H. Fahnestock)

Video layout of the time pulse distributor counter panel has been received from Sylvania and approved subject to replacement of 6AG7's by 7AD7's for which recommendations were made.

107 Operation Matrix

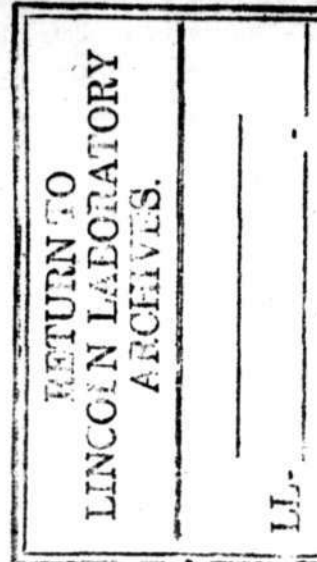
(H. Fahnestock)

Production drawings of control pulse output units have been received from Sylvania and approved for construction of prototype.

109 Clock Pulse Control

(R. L. Massard)

A push-button gate tube starter has been added in order that the clock pulse control may be started after the power is turned on. Testing has been completed and corrected drawings have been sent to the drafting room for completion. The control is its own source of restorer pulses; consequently the loop had to be broken and pulses fed in to start it. The



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109 Clock Pulse Control (Continued)

(R. L. Massard)

starter gate tube feeds the restorer pulse generator and at the same time sets the flip-flops in the position (alarm) to feed pulses to the restorer pulse generator. The matrix switch rise time has been decreased to $0.5\mu\text{s}$.

110 Frequency Divider

(H. Fahnestock)

Video layout of frequency divider has been received from Sylvania and is being returned with suggestions for further consideration. There is a possibility of noise, picked up by a long lead to the indicator tube, getting back into a gate tube.

111 Synchronizer

(H. Kenosian)

A breadboard for the remote-control delay multivibrator for the WWI synchronizer is being constructed. Procurement for appropriate relays for the push-button circuits is proceeding on a sample basis.

112 Restorer Pulse Generator

(H. Fahnestock)

Video layout of restorer pulse generator has been returned to Sylvania for correction. Along with minor changes, two output transformers are to be added necessitating rather drastic revision.

202 Toggle Switch Storage

(J. A. O'Brien)

An investigation is being made of the various ways in which toggle switch storage may be connected to determine the manner which will result in the best signal to noise ratio.

300 Arithmetic Control

(N. Daggett)

Layout and cabling drawings have been completed for the multiply-shift control.

301 A-Register

(R. H. Gould)

Testing of the A-register prototype panel has been completed. Data are now being consolidated preparatory to drawing up specifications for production testing of the panels.

301/103 A-Register - Program Register

(N. H. Taylor)

Modifications have been made to the A-register in order to achieve the dual function of A-register - Program register which was proposed recently.

Testing of the A-register is practically completed and indicates that satisfactory performance may be obtained using the design in its present state. These tests were made with the 7AD7 tube used in place of 6AG7's. The design has been released for production of 35 panels.

302 Accumulator

(N. H. Taylor)

The prototype accumulator has been shipped to Sylvania in order that they may proceed with the problems of production drawings and the manufacture of the mechanical details. Further testing on this unit will be made as soon as they have completed this work. These tests will include circuits of 7AD7's in the 6AG7 circuits and more work with the Henry amplifier and probe. In general, the performance was as expected. A few minor changes have been included in the latest circuit schematic which Sylvania will use for production drawings.

303/403 B-Register - In-Out Register

(N. H. Taylor)

The necessary design changes which were needed to modify the B-register to make it useable as an In-Out register have been completed, and drawings will be submitted to Sylvania within the next few days.

Testing of the prototype B-register has started and will continue for the next week or so.

700 Operators Console & Control Room

(E. S. Rich)

A study is being made of the various indicators and controls that will be required for operation of WWI. Following this study, sketches will be worked out showing proposed arrangements of these controls on panels which can be incorporated into the operator's console or suitable racks in the control room.

A proposed control-panel layout for the marginal checking equipment has been worked out and a pictorial sketch of this panel will be done in the drafting room. This sketch should be ready about June 17.

1.2 System Engineering1.21 Power Control and Distribution

(W. S. Rogers)

The Sorenson regulator for installation of the lab power supplies have not arrived since they are not standard and required special manufacture.

The power wiring raceways from the computer to the power supplies have been installed. One of the raceways is being immediately put to service to bring laboratory power to the computer room for testing.

The 100 volt bias MG set for the five-digit multiplier is being completely repaired after a break down. Improper commutator cutting, probably done prior to our acquisition, is the cause of the failure.

(C. W. Watt)

Progress on the power distribution system continued.

Physical layout of the marginal checking panel selection equipment is almost done, and cabling design is beginning.

A satisfactory layout of the voltage variation panel was received from Sylvania June 11 and will be approved shortly.

Production drawings of the fuse indication panels are expected from Sylvania next week.

A number of details of the Sylvania panels were decided on. See M-459.

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1.21 Power Control and Distribution

(R. E. Hunt)

Progress made on the power distribution racks to date is as follows:

Voltage Variation Racks - turned over to Sylvania for detailed development.

Power Junction Rack - Should be ready for approval in another week or two, depending on whether the voltage comparison system (as described in M-422) will be used, and if used if it will be housed in this rack.

Panel Selection Rack - This rack has been detailed and will be checked this week and sent to the shop for mechanical construction. The circuitry is being worked out along with complete wiring schedules. We should be ready to build the wiring harness by the end of the month.

1.22 Power Cabling

(H. S. Lee)

The fabrication of the prototype inter-rack cables has been completed by E. Holmes. In addition he has completed a cable board for fabrication of these cables.

Drafting and fabrication of intra-rack cabling is progressing satisfactorily. A prototype cable for the accumulator power input has been completed.

It has been decided to install a switch in the racks that will disconnect the a-c filament voltage while maintenance is being performed on a rack. (See M-459). This switch will also energize a lamp in the rack indicating the alternating current is disconnected. Engineering of this installation is underway at the present time.

It is estimated that within two weeks mass production of cables may be initiated.

1.23 Video Cabling

(C. W. Watt)

Sylvania memos 60-26 and 60-32 were received, proposing a method of video cabling for the repetitive portions of WWI. The proposed method had been mocked-up at Sylvania, along with the mockup of the rack and power cabling, and appeared

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1.23 Video Cabling (Continued)

(C. W. Watt) (Continued)

satisfactory. Therefore memo M-461 was written June 9 approving the video cabling method proposed. During the next two weeks, it is expected that some work will be done on a method of running video cabling to the register driver racks.

1.24 Driver Panels

(H. Fahnestock)

A) Register Driver

Sylvania has been furnished the circuit schematic of the type I register driver from which they will make video layouts.

B) Bus Driver

Production drawings of the bus driver panels have been received from Sylvania and are being approved for construction of prototype.

1.25 Time Schedules

(R. A. Osborne)

All time schedules have been posted to the end of May. Prints will be distributed today to those concerned.

It is requested that all persons working on scheduled operations review them with a view to rescheduling in the light of any changes that have taken place since the original estimates were made.

It has not yet been possible to make a good approximation of the effect of combining certain registers and changing from 6AG7 tubes to 7AD7.

1.3 Auxiliary Equipment

1.31 Power Supplies

(H. R. Boyd)

Price estimates and delivery schedules have been received from Power Equipment Co. Similar information will be available from Raytheon and Federal by June 15. At that time, the manufacturer will be selected and the supplies ordered.

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1.31 Power Supplies (Continued)

(J. J. Gano)

Marginal Checking

Most of the components for the mechanical drives of the control potentiometers have been ordered or, are being machined.

(C. R. Wieser)

Reactors for the 75HP motor have been ordered from Raytheon. The estimated delivery date is July 1.

(E. S. Prohaska)

The foundation for the 31 KVA alternator and its motor has been designed. The shop in Bldg. 32 is processing the steel parts and should finish them by June 23. Mr. Proctor is negotiating with C. A. Dodge Co. for the excavation and concrete work in the generator room. The installation drawings are D-35571 and D-35572.

(M. S. Rogers)

The Cambridge Electric Light Co. is planning to install a hole and transformer bank adequate for our power requirements. Changes in our circuits are being planned accordingly.

(H. S. Lee)

Filament Transformers

United Transformer Co. has furnished us with a sample expanded metal case for the filament transformers which we have approved.

UTC could not provide a special terminal, that we desired, in sufficient time to meet partial delivery date of 30 June, hence we have agreed to supply the terminals to UTC. Cambridge Thermionic Co. is manufacturing these terminals for us and 12 day delivery has been promised.

The order for the transformers has gone to the Navy for approval and to date has not been returned.

1.33 Racks & Cabinets

(C. W. Watt)

A meeting was held Friday, June 4, at which Sylvania

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1.33 Racks & Cabinets (Continued)

(C. J. Watt)(Continued)

presented their drawings of the racks for discussion. Based on the results of that meeting they submitted Memorandum 6737 and a set of drawings for approval. Approval of all but six of the drawings was given in Memorandum M-466 of June 9. Raw material is on hand at Sylvania for about 65 complete racks, and the large 7" base channels have all been fabricated. A decision must soon be reached on the paint specifications for the racks and cabinets.

1.4 Tube Type Changes

(H. Fahnestock)

The twin triodes used as indicator tubes throughout the computer have been changed from 5692 to 6SN7. It appears that 5692 tubes will not be available in time for use in WWI. This change involves no delay in production.

It has been decided to replace all 6AG7 tubes in WWI with 7AD7's. Investigations carried out over a period of several months show that the 6AG7 has inherent limitations when used in a normally off condition which are not present in the 7AD7. These investigations are fully reported in R-139 by D. R. Brown, soon to be issued. The necessary procedures for the substitution are given in M-454. The tubes have different basing but are otherwise interchangeable although some resistor and voltage values may be changed as a modification at a later date. At the present, the cost of the change is almost exclusively in drafting time. No firm estimate has yet been made of the delay involved but it should in no case exceed two weeks.

(J. C. Proctor) Sprinkler System Alterations

The sprinkler system in the WWI area has been rearranged and all pipes put as close to the ceiling as practicable. The control valve has been installed in the basement, and the remote control system will be completed in a few days.

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2.0 WHIRLWIND I RESEARCH2.1 Circuits2.10 Pulse Standardizing Circuit

(H. Kenosian)

Work is proceeding to improve the recovery time of the pulse standardizing circuit (SA 39877). Tests will also be made to check the relative outputs of 6AG7's and 7AD7's for the output circuits.

2.11 Flip-Flop Design and Stability

(R.L. Best)

A flip-flop is being tested which uses a 250 volt plate and screen supply, 1200 ohm plate resistors, and which triggers on the cathode. Some difficulty in triggering may be due to overshoot on the incoming pulses.

(J.J.O'Brien)

Basic circuit, FF-1, is being modified to use 7AD7 tubes. Work so far has been on the d-c relationships of the modified circuit. Three possible modifications are available to date.

A. With no changes in the circuit, it is stable but the screen dissipation of the 7AD7 is 1.17 times its max. rated value. The operating point is about half way down on the knee of the I_B vs E_B characteristic.

B. With plate voltage of 200 and screen voltage of 150 and a cathode resistor of 1200 ohms, the screen dissipation is reduced to 76% of its max. rating. The circuit is stable. The cathode resistor dissipates 1.6 watts.

C. With plate voltage of 250 and screen voltage of 150 and a cathode resistor of 1600 ohms, the circuit is stable and the screen dissipation has dropped to 64% of max. rated values. The cathode resistor dissipates 2.0 watts and the plate resistor, 5.7 watts.

In all three circuits there is a bias on the control grid of the nonconducting tube that is at least twice the cut-off voltage.

2.2 Components

2.22 Pulse Transformers

(N.H.Taylor)

Work by Hoberg and Rowland indicates that a new pulse transformer can be obtained which when used in place of the present models will widen the pulses which it produces. The present circuit tends to make pulses more narrow and causes considerable trouble in some circuits. A decision on the use of this new design will be made as soon as more rigorous tests can be made on the advantages of using this wider pulse output in certain applications.

(R.A.Rowland)

Some tests on coreless transformers have been carried out. The results indicate that there is a possibility of developing a coreless interstage transformer or possibly a transformer using only a powdered iron core. Greater delays would have to be tolerated and it is questionable if the prf sensitivity would be as good. The principal advantage would be in ease construction and cost as well as eliminating the bottleneck of core procurement.

2.23 Vacuum Tube Studies

(J.J.O'Brien)

With 7AK7 tubes set up as ionization gauges the gas current was measured. Recently delivered, unused, 7AK7 tubes had a gas current 15 times greater than these same 7AK7 tubes after they had been "preaged", operated at full plate and screen dissipation for some 100 hours. These new unpreaged 7AK7 tubes have a gas current about 30 times greater than the earlier version of the 7AK7, the SR-1030.

This gas current gives a relative measure of the gas pressure.

(D.R.Brown)

Plate current of 7AK7's decreases rapidly to about 75 percent of the original current when the tube is operated at full dissipation. This decrease is believed to be caused by the release of gas during operation and a consequent poisoning of the cathode.

R.S.Fallows of Boston Sylvania, T.F. Clough and myself are going to the Sylvania Emporium plant where the tubes are manufactured to discuss processing methods with them.

2.23 Vacuum Tube Studies (cont)

(R.L.Ellis)

Retests have been made on the first nine 7AK7 tubes preaged for 100 hours. These results show the average plate current decreased 33%; the control grid current, 100%; the screen current, 19%; the suppressor current 100%. The average suppressor cut-off decreased 20%; the control grid cut-off, 10%.

Results from retesting 90 6AG7 tubes that had been preaged 100 hours show that both the plate and screen currents decreased in 57 tubes. These currents increased in 19 tubes. Thirteen tubes remained unchanged. One tube failed completely.

The average decrease in plate and screen currents for the 89 tubes was less than one percent. Likewise, the average decrease in control grid cut-off was less than one percent.

An examination of a 6SJ7 new tube failure proved its internal structure to be a 6J5.

The supply of 7AK7 tubes is still good.

2.24 Crystal Rectifiers

(D.R.Brown)

Three types of crystal rectifiers have been decided upon for Whirlwind I. Type D-357 is to be used for most applications. Type D-358 is to be used for applications demanding low forward resistance, high back resistance, or high back voltage. Type D-359 is for bus drivers and applications demanding very high forward current. Specifications will be issued shortly.

2.3 Systems

2.31 Five-Digit Multiplier

(N.H.Taylor)

It has been decided to install 7AD7 tubes in the Five-Digit Multiplier to replace the 6AG7 now in use.

A new test set which will count the errors made during repetitive programming of the Five-Digit Multiplier will allow us to put this unit on life test in the near future.

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2.31 Five-Digit Multiplier (cont)

This test will be much more realistic than tests made in the past as each error will register on a counter.

(H.L.Ziegler)

Substitution of WWI type Whiffle-Tree gate-tube Shift and carry switches for the original crystal-matrix switches has been completed in all digit panels. Performance to date has been satisfactory and relatively free of trouble.

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3.0 SPECIAL CIRCUITS

3.2 Test Equipment

(R. R. Everett)

In the past two weeks requests for purchase of the following equipment have been received:

Model 22A Ferris Signal Generator.
WWI Equipment Trucks
2 Model 5 Synchrosopes

These items have been approved and assigned to N. Taylor as responsible committee member.

The following priorities have been given to Al Taylor for the construction of test equipment items released to his shop.

1. Completion of prototypes has the highest priority. They should be finished in the following order:

Register Panel
Trigger Mixer
Coder

2. The following items which are under construction should be finished as soon as possible:

10 Variable-frequency clocks.
4 Gate and Delay Units
1 Tube Tester

3. 18 scope synchronizers can be built in one run as soon as approved.
4. 15 gate and delay units still on order can fill in if delays occur. Orders and priorities will be given for register panels, coders and trigger mixers as soon as prototypes are approved.

In addition to the above, Sylvania is completing 10 rack power control units and 25 d-c power strips have been sent out for sheet metal fabrication.

3.21 Standard Test Equipment

(R. L. Best)

A prototype of the scope synchronizer has been completed and tested. It will synchronize to a pulse of from

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3.21 Standard Test Equipment (Continued)

500 cycles to 6 megacycles prf, and put out a pulse of from 500 cycles to 50 kc prf. The output pulse is variable up to 175 volts, and is a half sine wave of .5 microsecond width.

(N. H. Taylor)

The Henry amplifier which seems to work satisfactorily with the Model 5 synchroscope is available from Sylvania under the name of Model 202 Video strip. Ten of these have been ordered and will be installed in the Model 5 scopes which we now have.

Work is progressing on testing the cathode-follower probe with the Henry amplifier in order to establish optimum conditions for use of these two units together.

(H. Kenosian)

Voltare Calibrator (SB-3981A-1). Breadboard work on this unit is complete. Drawings are being made preparatory to the construction of this unit.

Register Panel (SC-3975A-1). This unit will be completed in the shop by June 18. It is expected that the unit will go into production about a week or so later.

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4.0 BLOCK DIAGRAMS

(E. Blumenthal)

Revisions to R-127 are underway. At present, work involves clarifying the block diagrams of the new master clock; including the pulse generator, frequency divider, synchronizer, clock pulse control (matrix type as described in E-125), time pulse distributor, delay counter and restorer pulse generator. Block diagrams of these components of the master clock are currently being drawn.

(R. P. Mayer)

Progress is being made on the EST control problem.

Two systems of controlling the storage tubes are proposed. In one system, a check is made on every read and write by means of a three-way flip-flop as described in M-135 "Block Diagrams, Electrostatic Storage." In the other system, which is much more simple, no check is made of the read and write, and standard flip-flops are used. It is difficult at this early stage of storage-tube design to decide which of the two control systems should be used in WWI.

The connections between main control and EST control are nearly identical for each of the two proposals. It is therefore possible at this time to design the modified main control and to decide later which EST control will be used.

Three methods are proposed for determining whether EST or Test Storage will be used: (1) Plug in the connections to either EST or Test; (2) Switch from one to the other (probably by means of relays); (3) Automatic flip-flop control depending on which storage register is selected, with manual selection also possible.

A memorandum explaining these various systems in more detail will be issued soon.

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5.0 CHECKING METHODS

(G. C. Sumner)

A study of trouble location for NWI has been started. A proposal for thesis research on this subject will be made in the near future.

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