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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART I, AUGUST 6, 1948

To: 6345 Engineers

From: Jay W. Forrester

1.0 WHIRLWIND I COMPUTER ELEMENTS1.1 Listed by Block Diagram Number104 Control Switch

(J. A. O'Brien)

The layout of the control switch output panel has been received from Sylvania and is being checked.

109 Clock Pulse Control

(H. Fahnestock)

Layout sketches and circuit schematic of the clock pulse control have been furnished to Sylvania. They can proceed with final layout.

111 Synchronizer

(J. A. O'Brien)

The breadboard testing of the synchronizer has been completed and plans for its layout and construction are under way. At this time it appears as though the unit will be built as a number of panels, the first of which will contain the delay multivibrator and blocking oscillator, the other panels will each contain two gas tube and five push-button output circuits. Enough panels of the second type can be used to provide any desired number of push-button circuits.

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201 Storage Switch

(M. Hayes)

A circuit schematic of the storage switch, and a physical sketch of the whole rack are now being drawn up by the drafting room. These will be found in drawings R-32722, and SB-40024 respectively.

202 Toggle Switch Storage

(M. Hayes)

A circuit schematic of the toggle switch storage panel, drawing E-32711, of which there will be four, has been completed. A drawing of the output amplifiers is still being drawn up and will be found in drawing E-32721. A physical sketch of this rack is being made and will be found in drawing SB-40033.

300 Arithmetic Control

(N. Daggett)

Testing of the divide control and the point-off control is nearly completed. Performance of the flip-flops on the divide control has been rather poor, apparently because of heavy loading.

(G. G. Hoberg)

Testing of the ACO carry and special add memory panel is proceeding after a one-week delay. Several changes in the circuit schematic will be necessary.

301/103 A-Register/Program Register

(R. H. Gould)

Test procedure and specifications for the A-register production panels have been drawn up in preliminary form. The final form cannot be decided upon until a conference is held between interested individuals from Sylvania and M.I.T. This is planned for the first of next week.

301 A-Register, Zero Digit

(H. Fahnestock)

It has been decided that Sylvania will complete the design and construction of the AR-0 panel.

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601 Check Register

(J. A. O'Brien)

The breadboard model of the check register check panel has been completed except for the installation of the required delay lines. The delay lines have been ordered and delivery is expected on or about Aug. 13.

1.2 System Engineering

1.21 Power Control and Distribution

(H. S. Lee) MMI Installation

A meeting of the installation group was held Aug. 6 in which the engineers outlined the present status of the various phases of the installation program and planned activity of the group for the next two weeks.

It should be noted that the installation time schedule, drawing C-32644, has been issued.

(R. Hunt)

Power Distribution Busses

These busses with their associated supports and covers should be completely designed in one week.

Construction for the most part will have to be done outside.

The time schedule should be met.

Panel Selection Rack

The panel selection rack is now better than 75% complete and better than 75% tested.

This means that we will be about a month ahead of schedule on this rack.

(H. S. Lee)

D-C Filter Panel

The prototype d-c filter panel has been completed and a study is now being made as to the best method of mounting the panel in the racks.

1.21 Power Control and Distribution (Continued)D-C Filter Panel (Continued)

Seventy-five of these units will be required and it is planned to utilize the facilities of A. Taylor's shop in the fabrication of these panels.

Rack Filament Power Panel -(H. S. Lee)

The prototype of this panel has been approved and A. Taylor's shop is presently engaged in fabricating seventy-five of these units.

Power Supply Control - (H. S. Lee)

A control circuit has been designed and approved. I am presently engaged in determining the circuit components. The orders for these components will be placed within the next few days.

1.22 Power Cabling

(H. S. Lee)

The drawings of the overhead cables and the cables for the arithmetic element racks have been completed and made Grade III. It is expected that the order for production of these cables will be placed in the next few days.

Work is progressing on the design of the cables for the flip-flop storage racks. When drawings are completed the production order will also be given to the same concern.

1.24 Driver Panels

(R. H. Gould)

Engineering Note E-136 on the testing of the bus driver prototype panel has been published. The instructions for the production testing procedure will be written directly in the specifications and not published first in an engineering note. The preliminary form of these instructions is finished and the final form will be written after a conference on the subject.

1.24 Driver Panels (Continued)

(C. A. Rowland)

Testing of the prototype of the register driver panel type I is near completion. Minor changes have been made on the schematic, and a few changes in the layout have been recommended.

1.25 Time Schedules

(R. A. Osborne)

All schedules are in the process of being posted through July 31.

Many revised schedules have been completed and a new Summary Schedule has been devised for the July Summary Report.

1.3 Auxiliary Equipment
1.31 Power Supplies

(E. S. Prohaska)

Design of the motor-alternator foundation has been started and the necessary material for fabrication ordered.

(J. J. Gano)

Secured the magnetization curve for the exciter to be used on the 75-KVA synchronous motor. A breadboard assembly of the amplifier circuit in the motor regulator has been prepared for connection to the exciter. The response of the system will be tested prior to incorporating the circuit into the regulator.

(C. R. Wieser)

Alignment of the plate supply motor-generator set has been completed. The motor reactors have been set in place and will be connected as soon as the pressure of other work permits.

The 50-KVA alternator for WWI heater supply has been delivered, and the drive motor has been ordered. The motor should be delivered, Wednesday, Aug. 11.

Heavy duty contactors for transfer of plate and heater loads from the alternators to emergency supplies have been ordered and should be delivered by October 1.

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1.31 Power Supplies (Continued)

(H. R. Boyd)

An installation and power supply meeting was held this week. The work is becoming much better coordinated and progressing favorably. It seems possible to have most of the power supply room equipment permanently installed prior to the arrival of the A-registers from Sylvania.

The 550 volt primary power to the lab will be reconnected this weekend to a 200-KVA open delta transformer bank in the court yard. Comments on the results will be helpful.

(L. J. Nardone)

Variable Voltage - Frequency response and phase measurements have been made on the variable voltage supply under various conditions. Curves of frequency response and phase shift are being compared for changes in compensating networks, amount of output filter capacitance, and cathode arrangement of the push-pull amplifiers. Tests will continue to be made to obtain the best frequency response and phase characteristics from various combinations of the above conditions.

1.33 Cabinets

(R. E. Hunt)

Power Bay - Sylvania now has complete information for the layout and installation of the power bay. Two of the racks P-5 (Power Junction) and P-12 (Panel Selection) plus the top brackets will require slight modification by us before assembly. We will have complete information on the modification required in the next week or two.

Power Supply Racks & Cabinets - Power supply racks have been laid out and approved along with their associated wireways. Details for preliminary construction should be ready in one week.

The time schedule on these racks will be met.

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<u>WWI Drawing List</u>	<u>Block Diagram</u>	<u>Block Schematic</u>	<u>Circuit Schematic</u>
System	B-37071-5		
Control	B-37098-4		
Master Clock	B-37159-1		
101 Pulse Generator	A-37155-1	B-32385	E-32333-2
102 Program Counter	B-37062-4	B-32213-1	D-31516-4
103 Program Register	B-37067-2	B-39289-1	D-31276-7
104 Control Switch	B-37066-3	T60CS00-4-A	Z60CS00 W60CS00-1 Z60CS00-2
105 Operation Matrix		S600M00	Z600M00-1-B
Control Pulse Output		R60CP00	S60CP00-1
106 Time Pulse Distributor	B-37068-3	T60PDC00-8-B	
106 Time Pulse Distributor Counter		T60PDC00-3-A	Y60PDC00-B
106 Time Pulse Distributor Output		T60PDC00-4-A	Z60PDC00-1-A
109 Clock Pulse Control	B-39817-1	C-32642	R-31916
110 Frequency Divider	A-37154-1	B-32264-1	R-31729-1
111 Synchronizer	---	---	---
112 Restorer Pulse Generator	A-37160	B-32209-2	D-31909-5
200 Storage	C-37156-1	B-31150	
201 Storage Switch	B-37121-1	C-31152	R-32722
202 Toggle Switch Storage			E-32711 E-32721
203 Flip-Flop Storage Output	B-37060-4	B-32269	E-31635-3
203 Flip-Flop Storage Register	B-37067-3	B-32268	E-31621-3
301 A-Register	B-37056-2	B-31211-3	D-31276-7
301 A-Register Zero Digit	B-37056-2 B-37072-7	B-31574	D-31573-2

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<u>WWI Drawing List</u>	<u>Block Diagram</u>	<u>Block Schematic</u>	<u>Circuit Schematic</u>
302 Accumulator	B-37063-5	D-31213-2	E-31275-3
302 ACC Zero Digit	B-37096-5		
302 ACC Zero Aux.	B-37096-5	B-32492-2	D-32602
303 B-Register	B-37097-3 B-37069-3	B-31212-3	D-31277-2
304 Sign Control & 308 Divide Error Control		C-31576-2	E-31619-1
305 Step Counter	B-37074-5	D-31828	D-39764
306 Multiply & 307 Shift Control		C-31532-3	E-31588-2
308 Divide Control		C-31552-2	R-31718-2
309 Special Add Memory & ACO Carry		C-31575-2	E-31632-1
310 Point Off Control		C-31600-4	E-31717-2
403 In-Out Register	B-37119-2	B-32434-1	D-31277-2
404 Comparison Register	B-37120-2	B-32578	E-32576
601 Check Register	B-39816-2	B-32577	E-32576
Bus Driver, Arithmetic Element		A-32297-1	D-31727-5
Bus Driver, Flip-Flop Storage		A-32296-1	D-31726-5
Register Driver, Type I		B-32207	E-32261-1
Register Driver, Type II		A-32691	D-32690
Fuse Indication Panel			W60PP00-7-B
Voltage Variation Panel			W60PP00-6
WWI Power Connector Pin Connections			C-31955-4

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WWI Installation Drawing List

(H. S. Lee)

The following cable drawings have been completed:

External Power Cables:

Accumulator	C-32573-3
Bus Driver	C-32655-1
A-Register	C-32659-1
Check Register	C-32660-1
Program Counter	C-32657-1
B-Register	C-32658-1
Program Register	C-32656-1

Overhead Cables:

D-C Cable WWI Rows A, E, F, Digits 8-15	B-32557-1
D-C Cable WWI Rows F-P, Digits 8-15	B-32558-1
D-C Cable WWI Rows A, E, F, Digits 0-7	B-32431-1
D-C Cable WWI Digits 0-7 to 8-15	B-32460-1

Arithmetic Element Racks:

Cable No. 1	B-32497-1
2	B-32498-1
3	B-32499-1
4	B-32500-2
5	B-32501-1
6	B-32502-1
7	B-32559-1
8	B-32623-1
9	B-32624-1
Filament Power Panel	C-32589
Filament Power Cir. Schematic	A-32663
Transformer Terminal Shield	
Sub Installation (2)	C-32443
(1)	B-32436
Power Supply & Control Room	D-37580
" " " "	
Side Elev.	D-37581

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2.0 WHIRLWIND I RESEARCH

2.1 Circuits

2.16 Basic Circuits

(J. M. Hunt)

Report E-137, describing tests of gate tube chain performance, and report M-566, describing simple modifications of the basic trigger tube circuit to increase input impedance and to eliminate parasitic oscillations, have been written and will be issued in the near future.

2.2 Components

2.23 Vacuum Tube Studies

(D. R. Brown)

7AK7

Measurements on the 82 7AK7's received July 22, tests C-6400 and C-6440, indicate an appreciable improvement over the earlier 7AK7's. Plate current and control-grid cutoff are satisfactory. Suppressor-grid cutoff is more negative than -9.5 volts in half of the tubes received. The vacuum is better than that in the earlier 7AK7's, but not as good as in the SR-1030, C-5245. The control-grid-to-plate transfer characteristic does not drop off as rapidly in the positive-grid region as it does in the earlier 7AK7's.

(A. Susskind)

Further measurements were made of the electrode currents of 7AK7's and SR-1030's as functions of control-grid and suppressor-grid voltages. Measurements with positive control and suppressor grid voltages were taken using pulse methods.

(R. L. Ellis)

The average leakage current for twenty-six 6L6 tubes RCA was found to be 64.5% of JAN maximum. Less than one percent were found above maximum. The average leakage current for ten 6L6 tubes, GE, however, was found to be 5.0% of JAN maximum.

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2.23 Vacuum Tube Studies (Continued)

(R. L. Ellis)

Curves on two more 7AD7 tubes causing FF troubles show characteristics similar to others causing FF troubles.

2.3 Systems2.31 Five-Digit Multiplier

(H. L. Ziegler)

During the past two weeks the stability of the multiplier has been greatly improved by changes made in the power input equipment.

The new belt-driven 150 volt generator was put into service at the beginning of this period and its operation has been very satisfactory.

Excellent filament voltage regulation has resulted from the installation of the Filament Voltage Regulator designed by J. J. Gano. Indications are that it has sufficient range to compensate for present line variations.

Some circuit changes were made in the multiplier to improve its timing; particularly, equalizing the overall delays of the Add and the Shift and Carry lines.

Several preliminary test runs of the multiplier under control of the Periodic Program Control and subject to checking by the Error Detector and Counter have shown an extremely small percentage of incorrect solutions. It is expected that the multiplier will be put on a continuous test of this type in the near future.

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3.0 SPECIAL CIRCUITS

3.2 Test Equipment

3.21 Standard

(R. L. Massard)

"Henry Amplifier":

The four amplifiers delivered by Sylvania are being corrected as far as wiring and layout faults are concerned and then being lined up. Frequency runs on all four amplifiers indicate no lining up had been done on the peaking circuits. Some of the variable chokes did not cover the proper range to include the value specified in the wiring diagram. The chokes were mounted with the iron core grounded in most instances which added excessive capacitance to ground, thus loading down the stages. Chokes which should have had the same Q's differed in Q, by a factor of 2.

Voltage Calibrator

(H. Kenosian)

Work on the prototype has been completed. This unit will be used to determine the deflection sensitivity of synchrosopes when connection to the deflection plates is made through an amplifier or network.

Push-Button Synchronizer

This unit was designed as part of the WWI synchronizer, but will find uses as test equipment.

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4.0 BLOCK DIAGRAMS

(E. Blumenthal, R. Mayer, J. Salzer)

All block diagrams have been edited and coordinated. Notation has been standardized throughout. After Everett's return, the drafting room will be able to begin work on the changes made.