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Memorandum 11-668

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART I, OCTOBER 29, 1948

To: 6345 Engineers

From: Jay W. Forrester

1.0 WHIRLWIND I COMPUTER ELEMENTS

1.1 Listed by Block Diagram Number

102 Program Counter

(K. E. McVicar)

Test specifications for the program counter panel are being written and should be ready for approval and distribution next week.

109 Clock Pulse Control

(J. A. O'Brien)

The layout of the clock pulse control panel has been received from Sylvania. The layout has been checked and approved with a few minor changes in the zero and one designations of the flip-flops to conform to the latest block diagram changes.

111 Synchronizer

(H. Kenosian)

Breadboard of the push-button circuits has been completed and is now undergoing tests.

202 Toggle Switch Storage

(H. Fahnestock)

The toggle switch storage layout has been approved with a few minor changes.

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203 Flip-Flop Storage

(A. K. Susskind)

A block schematic of flip-flop storage control has been made up showing the interconnections of the various RD types I & II involved and is now being finished in the drafting room. Drawing number is D-32106.

(R. H. Gould)

Writing of final specifications for the flip-flop storage register and flip-flop storage output panel will commence after some final tests on the prototype panels.

300 Arithmetic Control

(W. Papian and G. G. Hoberg)

Testing of the divide error and sign control panel and the ACO auxiliary panel has been completed. Drawings are being brought up to date.

Testing of the step counter has been postponed until after point-off control and divide control have been rechecked.

(G. G. Hoberg and C. A. Rowland)

Circuit schematics of all non-repetitive portions of the arithmetic element have been reviewed in light of Murch's layout of the video cabling for arithmetic control (SR40182). A list has been made of all circuit modifications which will be or might be necessary. Cable terminations and step-up transformers must be removed from a number of places, and terminations added in other places. In some cases external plug-in terminations will be used so that drawings and panels need not be modified. Where cabling is still arbitrary or doubtful for any reason, modifications will be withheld pending final information.

301 A-Register

(H. Fahnestock)

Sixteen tested A-register panels have been delivered to us by Sylvania. This completes the A-register except for the zero digit.

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302 Accumulator

(R. H. Gould)

The accumulator digits 1-14 test specifications have been typed in final form and are waiting for approval. Changes may be necessary in the trigger tube input to reduce feedback, but it was decided that some further experimentation is needed and any changes will be made at M.I.T. after delivery of the panels.

305 Step Counter Output

(J. A. O'Brien)

The construction of the step counter output panel is proceeding. This work is well head of schedule.

700 Operator's Console

(C. W. Watt)

Temporary video cabling for the preliminary testing period has been designed, and orders for about half have been given to the shop. The balance will be ordered next week. This cabling interconnects the standard test equipment used in the temporary console, and ties it to the arithmetic element. About 100 cables must be fabricated, and 50 more can be taken from standard lab stock cables.

1.2 System Engineering

(W. S. Rogers)

Installation - The following WWI installation projects were completed:

1. Installation of two power supplies (+120 volt and +90 volt).

The following work will be continued:

1. Installation of rack filter units. It was felt that new mounting brackets would permit easier removal of the units when balance of other panels are installed.
2. Sylvania - installation of overhead wireways awaiting material for completion. Sections which might be delayed by late delivery of mounting parts will be mounted by use of temporary brackets.

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1.2 System Engineering (continued)

3. The ground grid in the computer room is completed as far as overhead wireways permit.
4. Power wiring for available D.C. supplies has been completed but other units are expected.
5. Rack locating pins have been installed in arithmetic element racks and location data is expected on other racks.

The following will be started:

1. Lab power and service AC wiring in overhead wireways will be run as soon as wireways permit.

Personnel

A. Computer Room	8
B. Power Supply Room	2
C. Part-time students where needed	2

1.21 Power Control & Distribution

(R. E. Hunt)

Power Supply Remote Control Panel - has been manufactured and partially assembled. Final assembly awaits the delivery of a push-button station that will be delayed two more weeks.

Power Supply Control - is progressing satisfactorily. Drafting is now in its final stages.

Marginal Checking Control - has been manufactured and assembled and is now being wired. Installation will be made when the manpower is available.

Installation drawings are progressing well. We are trying to keep these drawings well ahead of installation rather than turn out finished drawings in any instance. In this way semi-finished drawings will be available for installation when needed.

Drawings for the arithmetic bay are practically complete.

Drawings for the arithmetic control (AX-7 & AX-8) and C-15 are underway.

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1.22 Power Cabling

(H. S. Lee)

The drafting and production of preformed cables is progressing satisfactorily. Present indications are that all preformed cables for the arithmetic elements and arithmetic control will be available when required for testing of the A-register.

1.23 Video Cabling

(C. W. Watt)

Further details of cable marking were decided upon, and memorandum M-664 outlines these. Spec S-7.504-3 will be revised to include them.

(R. H. Murch)

A drawing (SR-40182) showing all the video cabling for arithmetic control has been completed and checked. Cable numbers have been assigned and master video cabling schedules are about 50% complete for all cables shown on this drawing. Several basic forms for cable detail drawings will be completed next week.

1.24 Register Driver

(C. A. Rowland)

The prototype of register driver panel type II has been tested and approved for production.

1.3 Auxiliary Equipment1.31 Power Supplies

(J. J. Gano)

Designed heater load for testing power supplies; capacity, 10 KW; 115-230 volts; single phase or three phase. Parts are on order.

(J. J. Gano & C. R. Wieser)

Synchronous Motor Regulator - The breadboard regulator has been operating daily during the past week, maintaining the laboratory 115 V a-c power supplies within one volt.

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1.31 Power Supplies (continued)

Since there are no safety features in the circuit, it is shut off each evening. A permanent design incorporating safety features is underway.

(C. R. Wieser)

WNI Plate Power - The +150, +250, +90, and -150 volt supplies from Power Equipment Co. have been mounted and are about 90% wired in. The +150 volt supply has been operated satisfactorily at no load after repair of a short-circuited test-key.

(L. J. Nardone)

Variable-Voltage - The control circuits of the variable-voltage supply were modified to eliminate high frequency noise in the output. The low frequency noise (a ripple of approximately 0.5 cycles per second) was reduced to $\frac{1}{2}\%$ of the output by critical adjustment of the contacts of the Brown Converters. However, this does not eliminate the source of the 0.5 cps ripple.

A method has been devised for inserting the variable-voltage supply into a loaded circuit. Tests are being made on the transient response. When the variable-voltage output is zero volts and is inserted into a circuit carrying a 2 amp load, transients of less than 2 volts and .05 sec duration occur. However, the output of the variable-voltage supply changes its level from zero volts to approximately 2 volts.

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<u>VWV 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-32333-3
102 Program Counter	B-37062-4	B-32213-1	D-31516-4
103 Program Register	B-37067-2	B-39289-1	D-31276-8
104 Control Switch	B-37066-3	T60CS00-4-C	Z60CS00-A W60CS00-1-A Z60CS00-2-A
105 Operation Matrix		S600M00	Z600M00-1-C
Control-Pulse Output		H60CP00	S60CP00-1-B
106 Time-Pulse Distributor	B-37068-3	T60PD00-8-B	
106 Time-Pulse Distributor Counter		T60PD00-3-A	Y60PD00-C
106 Time-Pulse Distributor Output		T60PD00-4-B	Z60PD00-1-B
109 Clock-Pulse Control	B-39817-1	C-32642-2	R-31916-2
110 Frequency Divider	A-37154-1	B-32264-1	R-31729-1
111 Synchronizer	---	---	---
112 Restorer-Pulse Generator	A-37160	B-32209 -3	D-31909-6
200 Storage	C-37156-1		
201 Storage Switch	B-37121-1	B-32855 T60CS00-4-C	Z60CS00-A Z60CS00-2-A E-32830-1 R-32722-1
202 Toggle-Switch Storage	B-37122-2		E-32711
202 Toggle Switch Storage Output	C-37156-1	C-32080	E-32721-2
203 Flip-Flop Storage Output	B-37060-4	B-32269-1	E-31635-4
203 Flip-Flop Storage Register	B-37057-4	B-32268-1	E-31621-4
203 Flip-Flop Storage Control	A-37061-5	D-32108	

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<u>WWI Drawing List (Continued)</u>	<u>Block Diagram</u>	<u>Block Schematic</u>	<u>Circuit Schematic</u>
301 A-Register, Digits 1-15	B-37056-2	B-31211-3	D-31276-8
301 A-Register, Digit 0	B-37056-2 B-37072-7	B-31574	D-31573-2
302 Accumulator, Digits 1-14	B-37063-5	D-31213-3	R-31275-4
302 Accumulator, Digit 0	B-37096-5	D-32851	R-32850
302 Accumulator, Digit 0, Aux. Panel	B-37096-5	B-32492-2	D-32602
303 B-Register	B-37097-3 B-37069-8	B-31212-3	D-31277-4
304 Sign Control & 308 Divide-Error Control		C-31576-2	E-31619-1
305 Step Counter 305 Step Counter Output	B-37074-5	D-31828-1 A-32723-1	D-39764-1 D-32735-1
306 Multiply & 307 Shift Control		C-31532-3	E-31588-3
308 Divide Control		C-31552-2	R-31718-3
309 Special Add Memory & AOO Carry		C-31575-2	E-31632-1
310 Point-Off Control		C-31600-5	E-31717-3
403 In-Out Register	B-37119-2	B-32434-1	D-31277-4
404 Comparison Register	B-37120-2	B-32578	E-32576-1
601 Check Register	B-39816-2	B-32577	E-32576-1
601 Check Register Check		B-32018	E-32023
Bus Driver, Arithmetic Element		A-32297-1	D-31727-6
Bus Driver, Flip-Flop Storage		A-32296-1	D-31726-6
Register Driver, Type I		B-32207-1	E-32261-3
Register Driver, Type II		A-32691	D-32690-1
Fuse Indication Panel			W6QPP00-7-D
Voltage Variation Panel			W6QPP00-6-B
WWI Power-Connector Pin Connections			C-31955-4

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2.0 WHIRLWIND I RESEARCH2.2 Components2.23 Vacuum Tube Studies

(Ray L. Ellis)

The 36 6AG7 tubes on life test were retested at 2500 hours.

Six 832 tubes were tested to find the electrode voltages for concurrent maximum plate and screen dissipation. The halves were well balanced and emission very similar.

5687 tubes are coming in slowly. Tests indicate tubes of the last shipment will much better meet our requirements.

(H. B. Frost)

Study of the operation of deteriorated 7AD7's in buffer amplifiers is being handicapped somewhat by the lack of bad 7AD7's. Results to date show that deterioration does not result in a general scaling of the buffer-amplifier transfer characteristic, but distorts it, with very little change at signal levels of 25 volts, but about 10% loss below 20 volts input. The study is being continued.

2.24 Crystal Rectifiers

(E. S. Rich)

Standard tests made on 24 type 1N34 diodes which were removed from the deflection circuit generator after 1250 hours of operation showed that four of these diodes tend to drift and therefore are unsatisfactory. The remaining diodes pass the standard tests, and since initial data on them is not available no conclusions can be drawn as to their deterioration. Temperature measurements are being made for comparison with temperature data taken last summer on the five-digit multiplier.

Some 1N38 diodes taken from the G.E. counters are also being tested and operating temperature measurements will be made to see if deterioration has occurred in these units.

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2.24 Crystal Rectifiers (continued)

(Ray L. Ellis)

Voltage versus current curves have also been made on 1N21 B and D357 crystals and are available to those interested.

2.3 Systems2.31 Five-Digit Multiplier

(H. L. Ziegler)

Alterations and additions to the multiplier have been completed and the multiplier has been returned to normal operation. Temporary jumpers have been used to supply power to those circuits which will be controlled from the marginal checking panel. Wiring and installation of all marginal checking equipment should be completed during the coming week.

In returning the multiplier to operation, all supply leads were first checked with an ohmmeter for shorts and grounds. Voltages were then applied and each tube socket checked for proper voltages. After all tubes were installed, approximately one and one half days of trouble-shooting were required to obtain correct operation on all test problems.

The major cause of trouble was poor grounding of tube-socket rings. The original ground network was broken up during alterations to the multiplier and a new arrangement of ground leads showed these socket rings to be poorly grounded. These rings were then jumpered to the nearest good ground connection, the socket-ring mounting screws being inaccessible.

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3.0 SPECIAL CIRCUITS

3.2 Test Equipment

3.21 Standard Test Equipment

(C. A. Rowland)

Register Panel: A register panel incorporating a d-c coupled flip flop is being developed. This panel will be similar to the present register panel, but it will eliminate the necessity at restoration.

Delay Line Panel: A delay line panel is being developed. Delays in steps at 0.1 micro-sec. from 0.1 to 1.0 micro-sec. will be obtained by push button selection; provision will be made for adding additional external delay lines. A pulse standardizer will be included on the panel.

(H. Kenosian)

Gate and Delay Unit: Final design changes will be completed this week. Ten new units will be built incorporating these changes. Eventually, all units will be modified.

Pulse Standardizer: Several units from the shop were tested, and did not give rectangular envelopes on pulse chains. The first few pulses were found to be smaller than the following. Tests indicate that the trouble was due to the decrease of forward resistance of the bus driver crystals (D-359) with the first few pulses passing through these crystals. At least half of the crystals were rejected for this reason.

(R. W. Read)

Gate Inverter: Circuit design is underway on the gate inverter for use in storage tests. A larger amplitude than previously required is being generated. The negative gate will feed a capacitive load.

(R. L. Massard)

Video Amplifier for 'Scope: A second model 5 synchroscope with a modified Henry amplifier and probe have been sent to Sylvania to be used for testing WWI prototype panels.

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3.21 Standard Test Equipment (continued)

All four of the amplifiers received from Sylvania have been lined up. These amplifiers still broaden 0.1 μ s pulses and cut down their amplitude, even with the 15 mc. bandwidth. A much greater bandwidth is still needed.

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(J. M. Salzer)

The first stage of Block Diagram revisions has been nearly completed. All block diagrams on Control and Test Storage (Number series 100 & 200) have been changed. These changes are not major ones and have been transmitted to the interested designers in all cases. A great deal of work has also been made on all other block diagrams and on all timing diagrams; the corresponding changes, however, are not put in effect at this time because of the additional changes in sight. This is due to the present work of testing the Arithmetic Element and of consolidating the Operations.

Engineering Note, E-159, has been written on Whirlwind nomenclature. Several new terms are described and the use of several known terms discussed. Other memoranda concerning the Block Diagram revisions will be issued.

(R. P. Mayer)

Memorandum M-649 has been issued and describes "Some New Orders for WWI". Order ao, add one, is useful in increasing indices and other numbers by one, times 2⁻¹⁵. Order sp, subprogram, is an old order but has been modified to place the contents of PC in the AR. Uses of these orders are suggested in the Memo.

A Memorandum is about to be issued which describes "Standard Switch Positions for WWI". The switches referred to are those which determine the use of certain storage registers, and those which determine the contents of toggle-switch storage registers. Without Standard Settings of these switches, each program to be run on the computer would require the manually checking of all switches involved, and checking to make sure that all programs (library, test, main, and sub-programs) being run at the same time are coded for the same switch settings.

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