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Memorandum H-683

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Project Whirlwind  
Servomechanisms Laboratory  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART I, NOVEMBER 12, 1948  
To: 6345 Engineers  
From: Jay W. Forrester

1.0 WHIRLWIND I COMPUTER ELEMENTS

1.1 Listed by Block Diagram Number  
(H. F. Mercer)

We have received from Sylvania the following WWI panels  
(Production Units).

- 19 301/103 A-Register, Digits 1-15 / Program Register  
Digits 0-15
- 10 303/403 B-Register / In-Out Register
- 1 301 A-Register, Digit 0
- 8 Fixed Voltage Switching Panels

102 Program Counter  
(J. A. O'Brien)

The final draft of the test specifications on the  
program counter are now being typewritten.

111 Synchronizer  
(J. A. O'Brien)

The latest model of the synchronizer push-button cir-  
cuit shows cross-talk and spurious pulse trouble. This  
unit is quite a bit behind on the time schedules; and Al  
Susskind has been assigned to full time work on the unit.  
He will try a new approach to the problem and will also use  
the results of the work on the problems of the WWI Alarm  
Indicators.

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203 Flip-Flop Storage

(R. H. Gould)

The test specifications for the flip-flop storage register panels and the flip-flop storage output panels are being written together because of the similarity of the parts of the different panels. They will be ready for approval next week. Additional tests on the output panel show that a cathode resistor may be needed in the read-in buffer amplifier to prevent overdriving the register input gate tubes.

300 Arithmetic Control

(G. G. Hoberg &amp; W. Papien)

All testing of WWI arithmetic control panels has been completed except:

- 1) retesting of divide control
- 2) testing, modification, and retesting of the step counter.

601 Check Register

(J. A. O'Brien)

The prototype of the check register panel has been received from Sylvania and the initial tests on the panel have begun.

700 Operator's Console

(R. E. Hunt)

Some work is being done to prepare a preliminary proposal for the Operator's Console WWI.

A scale model of a proposed console is being built. Sketches of console components, drawn to scale will be pasted in place. It is felt that a model of this type will greatly help to crystalize the general conception of the operator's console.

(A. K. Susskind)

Consideration is being given to the design of the alarm-signal mixing and indicating circuit. As a first design approach thyratron circuits seem suitable. The main problem consists of designing the alarm circuit in

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700 Operator's Console (continued)

such a manner that when the computer is restarted, the alarm circuit will be cleared and made ready to receive a new alarm before the actual restart pulse goes to the computer.

1.2 System Engineering

(W. S. Rogers)

WWI System Installation -

- A. The following work was completed during the past week:
1. Overhead wireway installation - except for a few minor pieces not yet delivered.
  2. Ground grid installation.
  3. Rack locating pins in all racks - where assigned and temporary installation in other racks for rack alignment testing.
  4. Installation of preformed d-c cabling in overhead wireways.
- B. The following work will be continued:
1. Fuse strips have been received and turret lugs are being wired for installation.
  2. Installation of video cable troughs.
  3. Installation of air-in ducts by Arlex awaiting delivery.
  4. Installation of wireway lighting circuits if time is available.
  5. Installation of video cables for A-register.
- C. The following work is expected to be started:
1. Installation of filament power wiring.
  2. Interlock relay cabling in overhead wireways.
  3. Temporary power wiring of racks, P1, P2, P4 and P3 in this order.

(C. W. Watt)

Installation - A memorandum was written listing available installation drawings, and outlining a priority for the several phases of installing wiring in WWI. This was memorandum M-682.

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1.2 System Engineering (continued)

(R. E. Hunt)

Installation Drawings - These drawings are progressing satisfactorily and are now well ahead of delivery of components.

The following drawings are available in a usable but semi-finished state.

1.	AO-A15	Installation	E-32135
2.	AD	"	E-32134
3.	C-14	"	
4.	C-15	"	
5.	AX-7	"	E-32137
6.	AX-8	"	E-32136
7.	P1	"	
8.	P2	"	
9.	Master Installation		R-32129

Installation of the power bay will be completed next, followed by the installation of the flip-flop storage bay.

1.23 Video Cabling

(R. H. Murch)

The lengths of the video cables required for arithmetic control are being measured. A-register cables have been received from Sylvania.

1.25 Time Schedules

(R. A. Osborne)

All time schedules have been posted through October 31, prints have been made and distributed to interested parties.

1.3 Auxiliary Equipment1.31 Power Supplies

(C. R. Wieser)

WWI Plate Power - The +150 and +250 volt supplies have been operated satisfactorily with load.

At present there is a large voltage overshoot when anode voltage is applied to the rectifiers. This can probably be remedied by minor circuit changes in the regulator amplifier.

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1.31 Power Supplies (continued)

WWI Filament Power - The alternator drive motor has not yet been delivered. The motor starter and control panel have arrived and will be installed as soon as manpower is available.

Variable-Voltage Supply - Work on the regulated variable-voltage generator for marginal checking has been temporarily discontinued because of lack of manpower.

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

Synchronous Motor Regulator - The breadboard unit continues to be operated during the working day only. The design of the permanent regulator continues. Protective relays, including overvoltage, undervoltage, and under-current relays, have been ordered. Due to the four month delivery date on these, the protective circuit may be set up temporarily with stock relays on the breadboard unit.

1.32 Air Conditioning

(J. C. Proctor)

Most of the duct work has been installed and can be completed soon after the air ducts on the ends of the bays are installed by the Arlex Company. The power wiring has been completed and the control wiring is under way. It is planned to supply heating air to the WWI area next week if the weather remains cold. The refrigeration piping will be tested next week, and the system filled with refrigerant. Another two weeks should be sufficient to complete all but some of the final testing.

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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-32333-3
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		R60CP00	S60CP00-1-B
106 Time-Pulse Distributor	B-37068-3	T60PDOO-8-B	
106 Time-Pulse Distributor Counter		T60PDOO-3-A	Y60PDOO-C
106 Time-Pulse Distributor Output		T60PDOO-4-B	Z60PDOO-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-S-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-32106	

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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-32602-1
303 B-Register	B-37097-3 B-37069-3	B-31212-3	D-31277-5
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-31588-4
308 Divide Control		C-31552-2	R-31718-3
309 Special Add Memory & ACO Carry		C-31575-3	E-31632-1
310 Point-Off Control		C-31600-5	E-31717-3
403 In-Out Register	B-37119-2	B-32434-1	D-31277-5
404 Comparison Register	B-37120-2	B-32578-1	E-32576-2
601 Check Register	B-39816-2	B-32577-1	E-32576-2
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-32691-2	D-32690-2
Fuse Indication Panel			W6OPPOO-7-D
Voltage Variation Panel			W6OPPOO-6-B
WWI Power-Connector Pin Connections			B-31955-4

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## 2.0 WHIRLWIND I RESEARCH

### 2.1 Circuits

#### 2.11 Flip-Flop Design and Stability

(M. Hayes, Jr.)

A thesis proposal titled, "A Dual-Triode Capacitively-Coupled Flip-Flop", has been completed and will be turned over to the Institute today. Work has already begun on the flip-flop.

The initial design of the flip-flop has proven to be very encouraging. It triggers very easily, using (10 volt) negative pulses. Both the top and bottom of the waveforms are flat. The rise and fall times are good, and it will operate at 4 megacycles.

(R. L. Best)

Preliminary measurements indicate that the starting and stalling characteristics of a flip-flop, as the interval between restorers is increased, are a good measure of the back resistance of the crystals used in the clamping circuits, and a poor measure of the state of the tubes in the flip-flop. Marginal checking of these diodes could be done by supplying the flip-flops with restorer pairs of the order of 80 microseconds apart, and observing which flip-flops are stalled.

### 2.2 Components

#### 2.23 Vacuum Tube Studies

(J. J. O'Brien)

The pulse tests of deteriorated 7AD7 tubes have supplied the additional information that first, the apparent resistance found in the cathodes of these tubes has a negative temperature coefficient and second that all these tubes have deteriorated in the same fashion.

An examination of L7P lot 7AD7 tubes operated for 2500 hours in the Vacuum Tube Life Test Racks shows only a 10 per cent drop in plate current on d-c measurements.

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### 2.23 Vacuum Tube Studies (continued)

No apparent cathode resistance was found in a pulse test.

These tubes are described in Engineering Notes E-163.

After 2200 hours of operation in the Five Digit Multiplier, 7AK7 tubes of lot D&F showed an average increase of 6 per cent in plate current.

(R. L. Ellis)

Distribution curves from data taken on 600 7AD7 tubes after 100 hours preburning are completed. Distribution curves from initial test data on these tubes will be finished soon.

Retests were made on 48 7AK7 tubes from the multiplier. Most of the tubes showed but small changes.

Fifty 5687's received last week have been tested. These results showed close range distribution and the two units well balanced.

Tubes in the WWI A and B-register panels have been marked with circuit numbers. The records are not complete.

Tube tester voltmeters for measuring grid cut-off have had a more appropriate range added and are now re-installed.

Our record keeping on tubes is presented with serious problems because of the inavailability of completed cards or data on tubes now being assigned to WWI.

## 2.3 Systems

### 2.31 Five Digit Multiplier

(H. L. Ziegler)

All cabling of the multiplier and its marginal-checking equipment has been completed. The circuits have been energized and are being checked for correct operation. Following this, a study will be made of the marginal-checking method and its effectiveness.

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3.0 SPECIAL CIRCUITS

3.2 Test Equipment

3.21 Standard Test Equipment

(R.L. Massard)  
Video Amplifier

An amplifier using newer type tubes and quite different from the modified Henry amplifier is in the process of being tested and 'de-bugged'. Four of these amplifiers, or ones of a similar nature, should be ready by December 1.

(H. Kenosian)

Gate and Delay Unit

Final design changes have been completed. A unit is being built incorporating these changes.

(R.W. Read)

Final design is underway on the gate inverter for the Storage Tube Section. The circuit consists of a d-c amplifier which drives a 4D32. A cathode follower output may be incorporated to provide either positive or negative output.

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4.0 BLOCK DIAGRAMS.

(J. M. Salzer and R. P. Mayer)

The first set of revised block diagrams has been dispatched to the drafting room.

Conference Note C-65, an aid to the solution of this week's problem by the Applications Study Group, has been issued.

Another Conference Note on Coding symbolism is in preparation.

It seems that a recently-discovered omission from clock-pulse control can easily be corrected. This problem is discussed in a forthcoming memorandum.