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6345
Memorandum M-647

Page 1 of 13

Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART I, OCTOBER 15, 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)

The prototype model of the program counter has been subjected to preliminary resistance measurements of the type indicated by Sylvania in their recommendations accompanying the unit.

A versatile test panel to effect a complete check of the operation, including tolerances on parts affecting reliability, is near completion.

202 Toggle-Switch Storage

(J. A. O'Brien)

The complete layout of the toggle switch storage rack has been received from Sylvania. The general layout has been verbally approved and a few changes in the circuit schematics are being made to incorporate the improvements suggested by Sylvania. The details of the layout are now being checked.

203 Flip-Flop Storage

(H. Fahnestock)

Sylvania has been given a production release on the flip-flop storage register and output panels.

~~UNCLASSIFIED~~
~~RESTRICTED~~

RESTRICTED

6345
Memorandum M-647

Page 2

300 Arithmetic Control

(G. G. Hoberg)

Rewiring and retesting of the ACO carry and special add memory panel has been completed, and associated drawings are being brought up to date. This panel is now ready for use.

The divide error and sign control panel has been modified in accordance with the results of preliminary tests and is now being retested.

The step counter will be finished and testing started early this week.

301 A-Register

(N. H. Taylor)

Five A-register panels have been tested at Sylvania and the data scrutinized for spread in readings. Most readings are within $\pm 10\%$ of a mean value and seem to indicate a satisfactory production condition. Three readings show a somewhat abnormal level and must be studied more carefully.

It seems desirable to test all 16 of these panels before setting rigorous test limits. A study of variations between panels and tubes is being initiated wherever the readings fall outside a normal distribution pattern.

302 Accumulator

(R. H. Gould)

Test specifications for the accumulator panel digits 1 to 14 are being written up. They should be ready for approval and distribution next week.

305 Step Counter Output

(J. A. O'Brien)

Work on the construction of the step-counter output panel is underway. The aluminum panel has been punched and is out being painted. The phenolic panel has been cut and is ready to be punched. It is expected that the phenolic

RESTRICTED

RESTRICTED

6345
Memorandum M-647

Page 3

305 Step Counter Output (continued)

panel will receive more work next week when the work on the step counter is completed.

601 Check Register Check

(J. A. O'Brien)

The drafting has been completed on the check register check circuit schematic and the print is being checked. The layout of this unit will be started next week.

700 Operator's Console

(C. W. Watt)

Temporary - Design of video cabling for the temporary operator's console is nearly complete, and fabrication will begin during the next two weeks.

Permanent - The Karp Metal Products Corp. was contacted about design of an operator's console. Their suggested procedure is for M.I.T. to supply rough sketches showing overall size, panel, and operating space. Karp will then make preliminary drawings as a basis for discussion. Such drawings would not obligate M.I.T. in any way.

1.2 System Engineering1.21 Power Control and Distribution

(C. W. Watt)

Installation - The following scheduled projects were completed:

1. Wiring of surface ducts and convenience outlet strips on racks.
2. Installation of AC maintenance switches where possible.
3. Overhead busses except for minor changes.

The following work will be continued:

1. Mounting filament transformers and brackets - 10% completed.
2. Main connections to external ground are installed. Bonding to lab power supply ground and 3" water main is being completed.

RESTRICTED

UNCLASSIFIED
RESTRICTED6345
Memorandum M-647

Page 4

1.21 Power Control and Distribution (continued)

3. Four WWI power supplies are being installed. The +150 volt supply nearly ready for testing.

The following work will be started:

1. Sylvania will begin to install overhead wireways October 18.
2. D.C. rack filter panel installation will begin.

Personnel

- A. Computer Room - 8
- B. Power Supply Room - 3.
- C. Two part-time students where needed.

(H. S. Lee)

Laboratory Power Supply & 115 Volt Distribution, Computer Racks. The installation of the "Surface Duct" on the 7" channel and the wiring therefor is practically completed. Installation of the "Plug In" strip on the 3" channels is progressing satisfactorily. The overhead wiring is waiting installation of the wireways by Sylvania.

Rack Filament Power Panel - Installation of these units has been started and is progressing satisfactorily.

Filament Transformers - Testing of the transformers is continuing. To date 300 transformers have been tested and 20 have been found to have either mechanical or electrical defects. Assembly of the transformers with the terminal shields and transformer brackets is progressing rapidly and installation of the units in the racks has commenced.

D.C. Filter Panel - Our shop is presently engaged in assembling these units. The panels can be installed in the racks as fast as they are completed by the shop. It is anticipated that production will soon be suspended pending delivery of the remainder of the 1.0 microfarad can capacitors. To date only 200 of these capacitors have been received. This quantity is only sufficient for 14 panels. An effort is being made to expedite delivery of the capacitors.

Ground Matrix - The shop is presently fabricating the component parts of ground matrix. It is expected that installation can proceed as soon as the overhead wireways are installed.

RESTRICTED

UNCLASSIFIED
RESTRICTED

6345
Memorandum M-6345

Page 5

1.21 Power Control and Distribution (continued)

(R. E. Hunt)

Progress of components to date are:

Common Tie Panel - Complete & installed.
Power Distribution Busses - Are about 80% installed.
Additional spacers have been designed for the bus runs over the doorway. Drafting on the duct covers is about 90% complete. These covers will be manufactured in the near future.

Power Control Panel - All components have now been fixed, and an interconnecting system plan worked out. Drafting is now being revised - about two more weeks will be required.
Laboratory Power Distribution Panel - Complete, and will be installed as soon as overhead wireways are ready.

1.22 Power Cabling

(H. S. Lee)

Gavitt Mfg. Co. has made two deliveries of preformed cables to date. The two lots consisted of the three types of cables for the overhead distribution plus five types for AE racks.

The shop has completed fabrication of the preformed cables for the arithmetic register driver and the preformed cables for the temporary distribution system, see Dwg. SD-40157.

Wiring schedules are being drawn up for installation and interconnection of the indicator and alarm systems. Design of cables for arithmetic control will start Tuesday October 19.

1.23 Video Cabling

(C. W. Watt)

A meeting was held October 15 between representatives of M.I.T. and Sylvania to decide on the best method of dividing the video cable work load, and to standardize on the form of video cable drawings to be used by both organizations. A full report on this meeting is contained in Memorandum M-646, soon to be issued.

UNCLASSIFIED
RESTRICTED

UNCLASSIFIED
RESTRICTED6345
Memorandum M-647

Page 6

1.25 Time Schedules

(R. A. Osborne)

All time schedules have been posted through September and prints have been distributed to interested parties.

1.3 Auxiliary Equipment1.31 Power Supplies

(C. R. Wieser)

WWI Filament Power - Delivery of the filament alternator drive motor is still held up. The normal-emergency throw-over contactor (300 amp) has been delivered. If necessary, WWI filament power can be supplied temporarily from the laboratory 115-volt 3 phase system, which will be regulated soon.

WWI Plate Power - The normal-emergency throw-over contactor (90 amp) for the plate alternator has been delivered and is being installed.

The +150, +250, +90, and -150 volt supplies from Power Equipment Co. have been delivered. The +150 is being wired in for test and may be used temporarily as a +150 volt central laboratory supply.

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

Synchronous Motor Regulator - The gain of the regulator was more than doubled by revising the first stage of the amplifier. A tendency of the last stage to oscillate due to rearrangement of leads seems to have been overcome by shielding of leads. The transient behavior was found satisfactory upon the application of the highest load available in the laboratory, the starting of the elevator. A sudden 6KW load did not appear in the error voltage. It is hoped to set the breadboard regulator in continuous operation next week while a permanent assembly is being constructed.

UNCLASSIFIED
RESTRICTED

UNCLASSIFIED
RESTRICTED

6345
Memorandum M-647

Page 7

1.31 Power Supplies (continued)

(L. J. Nardone)

Variable Voltage - The control circuits of the variable voltage supply were modified to eliminate noise and also to increase the stability of the system.

A low frequency ripple, in the order of 0.5 cps, exists in the output of the variable voltage supply. The probable source of this ripple is in the magnetic coupling in the common frame of the induction motor and the generator section of the amplidyne. The ripple, about 2% of the output, is undesirable and must be eliminated. A decrease in transient voltage and a faster response of the system must also be obtained.

UNCLASSIFIED
RESTRICTED

6345
 Memorandum M-647

<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	T60PD00-8-B	
106 Time-Pulse Distributor Counter		T60PD00-3-A	Y60PD00-C
106 Time-Pulse Distributor Output		T60PD00-4-B	Z60PD00-1-A
109 Clock-Pulse Control	B-39817-1	C-32642-1	R-31916-1
110 Frequency Divider	A-37184-1	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 R-32722
202 Toggle-Switch Storage	B-37122-2		E-32711 E-32721-1
203 Flip-Flop Storage Output	B-37060-4	B-32269	E-31635-4
203 Flip-Flop Storage Register	B-37057-4	B-32268	E-31621-4
203 Flip-Flop Storage Control	A-37061-5		

6345

Memorandum M- 647

Page 9

<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-37069-3	B-31212-3	D-31277-4
304 Sign Control & 308 Divide-Error Control		C-31576-2	E-31619-1
305 Step Counter	B-37074-5	D-31828-1	D-39764-1
305 Step Counter Output		A-32723-1	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 & ACO 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
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	E-32261-3
Register Driver, Type II		A-32691	D-32690
Fuse Indication Panel			W60PP00-7-D
Voltage Variation Panel			W60PP00-6-B
WWI Power-Connector Pin Connections			C-31955-4

RESTRICTED

6345
Memorandum M-647

Page 10

2.0 WHIRLWIND I RESEARCH2.1 Circuits2.16 Basic Circuits

(A. K. Susskind)

The trigger-tube investigation has been completed. The results will be published in Engineering Note E-155 now in preparation.

2.2 Components2.23 Vacuum Tube Studies

(J. J. O'Brien)

The 7AD7 tubes used in the Five-Digit Multiplier were from two production lots. The L7P lot made at Emporium, Pennsylvania dropped an average of 5 per cent in plate current after 2500 hours of operation in the circuit type found to be the most destructive on tubes. The B8B lot, made elsewhere, dropped an average of 42 per cent after 1600 hours of operation in the same type circuit.

A pulse test of the poorer tubes of this aged B8B lot shows a peaking of the plate current similar to that found in the deteriorated 6AG7 tubes.

(R. L. Ellis)

A high percentage of the 3E29 army surplus tubes exhibit slow leakage. From a lot of 78 tubes tested recently, 31.0 per cent were found to have sufficient gas to prevent the filaments from reaching normal temperature.

Test records and summaries have been completed on 108 7AD7 tubes used in the multiplier 1600 hours. Similar information is now available on 18 7AD7 tubes used 2500 hours.

Sample tests on new shipments of 7AD7 and 7AK7 tubes have shown no appreciable changes from the previous lots.

Standard tests have been established, with the help of H. Kenosian for Tung-Sol 5687 tubes.

RESTRICTED

6345

Memorandum M-647

Page 11

2.23 Vacuum Tube Studies (continued)

Comparative data on RCA 5692 tubes and Sylvania 6SN7 GT tubes is available. It gives the average plate characteristics of each triode unit for samples of four tubes of each kind.

(H. B. Frost)

Initial results indicate that 7AD7's with cathode interfaces operate rather satisfactorily in buffer amplifiers. Tubes with very low D.C. test characteristics give normal signals. The study is being continued.

2.3 Systems

2.31 Five-Digit Multiplier

(H. L. Ziegler)

Alterations to the multiplier are progressing satisfactorily and should be completed during the coming week.

Delivery date for the marginal-checking control has been set for October 25. Several days will be required for cabling the system together and testing it.

The multiplier probably will not be returned to continuous operation before November 1.

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3.0 SPECIAL CIRCUITS

3.2 Test Equipment

3.21 Standard Test Equipment

(H. Kenosian)

Gate and Delay Unit: Work is under way to attempt to stabilize the low frequency jitter. A circuit has been developed which will eliminate the variation of amplitude with delay.

Push-Button Pulse Synchronizer: A new circuit which uses no relays is being constructed in breadboard form.

(R. L. Massard)

Video Amplifier for 'Scope: One model 5 Synchroscope with a modified Henry Amplifier and a probe have been sent to Sylvania to be used in testing W/I prototype panels.

Work is being done on the improvement of the probe attenuators as far as input capacity and ability to attenuate without distortion.

The breadboard model of a newly designed amplifier has been completed and is in the process of test. It is expected to be a very great improvement over the modified Henry Amplifier both as regarding bandwidth and gain.

(R. W. Read)

Design is underway on a gate inverter-amplifier to be used in conjunction with the GATE DELAY UNIT for storage test purpose. An 100-volt "negative gate" is required, to work into a capacitive load.

RESTRICTED

4.0 BLOCK DIAGRAMS

(R. P. Mayer)

Equipment and orders for the control of In-Out devices are being worked out.

The command "Set Storage Switch" is being removed from Program Timing. (This is one of the many recent changes affecting MS equipment described in M-521, 2, and 3 - which will not be issued until all these changes have been coordinated.)

The command "add to PC" on TP 3 will probably be moved to TP 6 or 7, which will also require moving the commands in "sp".

The numbering of WWI operation codes is to be changed according to the list in M-644. This list will be frozen on October 21; any suggestions or objections should be presented by that time.

A proposal for several new operations is soon to be issued.

(J. M. Salzer)

Revision of all block diagrams is continuing. Significant changes arising through this process are being communicated by memoranda. Memoranda M-640 and M-642 have been issued.

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