Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, May 27, 1949

To: 6345 Engineers

From: Jay W. Forrester

1.0 SYSTEMS TESTS

1.1 Whirlwind I System Test

(N. H. Taylor)

The recent power shutdown has permitted the installation of more marginal checking equipment in the system. The added lines will allow more efficient use of marginal checking technique. During the last few days the use of simple trouble location sequences in conjunction with marginal checking have been the means of locating weak sections of the system. Considerable saving of time has been realized in these instances.

During the next two week period a second shift will begin testing the WWI System. This activity will permit us to collect considerable data which has been lagging behind the rapidly expanding system.

(G. C. Sumner)

System testing was resumed 23 May after a 10-day intermission to allow installation of power wiring in the control racks. Testing this week has mainly been routine in nature, such as setting signal amplitudes, etc.

A proposed modification in the shift left to BR-15 is being tested.

1.2 Storage Tube Reliability Tester

(R. Sisson)

Only two reliability runs of more than one hour were

1.2 Storage Tube Reliability Tester (continued)

tried. The first using ST94-1 ran 15 hours, apparently without a mistake. The second using ST96-2 ran 15 hours but made several mistakes, thought to be due to 60 cycle interference apparent in the readout system. ST96-? seems to be one of the best tubes we have had in this setup.

The system was used for storage tube testing. Using a revised cycle, the tests were run which measure the effect of writing minus on a nearby positive spot. These tests were run on both ST68 and ST94-1. In both tubes there was considerable interaction between spots. More of this sort of testing will be performed on ST96 to verify results and determine conditions for minimum interaction.

Some tests were run which were intended to check McCusker's results which showed that the current density may be higher and spot size smaller at a bias about ?0 volts below zero. The current density was checked indirectly by measuring the W- charging rate. The results are somewhat inconclusive since focus conditions were not properly controlled. Using the best focus conditions for various biases as determined on the TV setup, this test will be repeated.

(L. J. Nardone)

Installation of power preliminary to change over to the five-tube storage-tube reliability tester is in progress. All A. C. and D. C. distribution wiring to the power distribution racks has been completed. Relocation and rewiring of power supplies has been started. It is expected that the storage tube reliability tester will operate on the expanded power system within the next three weeks. Expansion of the storage tube reliability tester to contain five storage tube racks and one WWI prototype digit rack will start immediately after the power installation is completed.

(J. A. DiGiorgio)

The additional power regulators and amplifier section strips were completed.

The special transformers and coils were made up for the adapter to the tester.

1.3 Five Digit Multiplier

(E. S. Rich)

During the last two week period, random intermittent failures have prevented getting long periods of error-free operation in the Multiplier. These failures have been of a type to cause single error counts, about one per 24 hour period. It has been observed that when some tubes are tapped lightly they show a momentary blue flash within the bulb which causes an error in the system. In some cases this apparently does not damage the tube and subsequent tapping will not cause the failure to repeat. This trouble has been primarily in 6AS6's and four tubes have been retired for this cause. These were located on three different days. Also two clamp crystals developed low back resistances and were replaced because of the low margins which resulted. One defective adapter was discovered.

About 35 new tube adapters have been completed by the shop and will be installed next week. The remaining adapters will be replaced when they are available from the shop.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

102 Program Counter

(C. W. Watt)

Assembly of the 18 program counters has begun and is scheduled to be finished in three weeks.

105 Control Matrix

(J. A. O'Brien)

The testing of the control matrix has not started yet. Some of the control pulse output unit mounting panels were found to have faulty wiring and assembly, and these troubles have now been corrected. The interrack wiring of the panels in main control has been almost completed. The largest job remaining is connecting all of the crystals in the matrix. Drawings have been made up showing all of the connections and no trouble should be encountered in connecting the crystals. These crystals will be mounted so as to facilitate changing them.

109 Clock Pulse Control

(W. N. Papian)

Breadboard experiments indicate the feasibility of changing an S.A. panel for use as an auxiliary to C.P.C. to be called, in all probability, C.P.C. delay panel.

It will take the "62.5 kc to R.P.C. & Sync." pulse from C.P.C. and send it out as follows: with no delay, and of negative polarity, to the "Start Delay" jack on C.P.C.; after a 1.5 microsecond delay, to the R.P.C.; after a 4

109 Clock Pulse Control (continued)

microsecond delay, to the Synchronizer. It will also take the "E.S.C. Start" pulse from Storage Selection Control and send it out as above, with the exception of to the Synchronizer.

It is anticipated that four S.A. channels will take care of all of this, leaving one channel for other purposes. Experimental circuit details and amplitude limits are available from the writer or from J. A. O'Brien.

(R. H. Gould)

Due to too short a power shutdown last week the completion of the clock pulse control panel modifications was not carried out as expected. However, they will not be needed for some time so that they will be done at the next convenient time.

The redrawn block schematic of clock pulse control has been published and the redrawn circuit schematic is nearing completion.

Specifications for clock pulse control are being drawn up with the double purpose of specifying the operation of the panel and of providing an effective guide for rapid troubleshooting as a spare CPC panel will not be available.

202 Toggle Switch Storage Switch Panel

(C. W. Watt)

Assembly was delayed due to shift of the assembly technician to installation for 1 week. Should be finished next week.

404 Comparision Register Check

(H. S. Lee)

This panel has been completed, passed test and inspection and is now waiting final test by the Electronics Group.

404/601 Comparison Register/Check Register

(R.H. Gould)

Resistance and voltage measurements have been begun on the CO/CR panels that have been finished. Data sheets are being drawn up for the production testing of the panels.

404/601 Comparison Register/Check Register (continued)

Consideration is being given to the most efficient procedure and test set-up for the video testing of the panels so that testing will not fall too far behind production.

(C. W. Watt)

Sixteen check registers were completed Friday, May 27, and have gone to inspection. Video tests will be made by Nickerson. Balance of production will be delayed to permit program counters to be built.

410 In-Out Control

(J. A. O'Brien)

An engineering note, E-243, was written and distributed concerning the problem of double reading and recording as mentioned in the last bi-weekly report. The problem will be taken up at the next Input-Output Control Conference.

412 In-Out Synchronizer

(A. K. Susskind)

Tests have been conducted on a breadboard model of the in-out synchronizer. The orignal design was shown to be sound and minor circuit modifications have been made to obtain fully satisfactory performance. Sketches of the circuit and block schematics are now being drawn up and will shortly be given to the drafting room to be made into formal drawings.

602 Alarm Indication

(H. S. Lee)

The final assembly of this panel is 60% complete and progressing satisfactorily.

820 ES Deflection

(R. E. Hunt)

Two gate panels have returned from being silk screened. Assembly will start Tuesday, May 31, 1949.

Two decoder panels have been rescheduled. Sheet metal work will start May 31, 1949. The phenolic panels are about 25% complete.

820 ES Deflection (continued)

(H. Kenosian)

ESD Output - The amplifier for the storage tube deflection plates is being checked.

830 ES Digit Columns

(G. G. Hoberg)

Test System Using Breadboards -

Test equipment is being set up to run the breadboard panels of the signal-plate driver, gun driver, and read-gate generator as a small-scale test system to permit a better evaluation of the probable performance of final units in the computer.

831 Storage Tube Mount

(R. E. Hunt)

The STM Box complete this date and will be mounted in an E rack for further study.

(C. W. Watt)

Layout of the component panels for the ST Mount prototype is finished and the panels will be fabricated next week.

(G. G. Hoberg)

ST Mount Circuits (repetitive) - Drafting has been completed for the prototype phenolic assembly. Construction of the prototype will begin immediately and will require about two weeks.

832 ES Output

(W. J. Nolan)

The electrical design and mechanical layout have been completed on an RF amplifier for use on the ESO panel.

833 Signal Plate Driver

(C. W. Watt)

Drawings for a WWI prototype of the SPD have gone to the shop for fabrication of sheet metal. The assembly will

833 Signal Plate Driver (continued)

be done by Dan Mach next week and will require about two weeks.

834 Gun Driver

(C. W. Watt)

Layout will start Monday on the prototype gun driver panel. Hoberg is the design engineer, and Watt will follow the work for the production group.

(G. G. Hoberg)

Gun Driver (repetitive) - Drafting has been started for the prototype phenolic assembly. Construction will begin in about two weeks.

835 R-F Pulser

(C.H.R. Campling)

Development of the breadboard for the WWI pulser continues. The oscillator is crystal controlled and drives a pair of push-pull buffers. One buffer is used to drive a pair of 715 B's which provide the r-f pulse output; the other drives a phase-shift capacitor. This much of the circuit is complete and now appears to function satisfactorily. The design of the plate transformer for the 715 B's has caused some delay however. Several trials have been made and tested with the megasweep. The present version appears to satisfy the requirements and will shortly be subjected to test in the circuit.

(G. G. Hoberg)

Holding-Gate Generator (non-repetitive) - A breadboard has been tested and found satisfactory.

Read-Gate Generator (non-repetitive) - This unit is identical with the holding-gate generator (above).

2.3 Driver Circuits

(W. N. Papian)

Standardizer Amplifier - To the standard 100 ohm positive pulse inputs to each channel on this panel have been added two

2.3 Driver Circuits (continued)

so-called Hi-Z neg. input jacks. The impedance seen by negative input pulses at one of these jacks is the forward resistance of a crystal plus 180 ohms, in series with the parallel combination of the RLC peaker grid and 1000 ohms. This will allow a number of S.A. channels to be fed from one negative source without presenting too low a load impedance to the source. Breadboard tests indicate the following results for these inputs: no amplification for input amplitudes from 0 to 2½ volts; a marginal region for inputs from 2½ to 10 volts; the standardizing region from 10 volts on up; negligible p.r.f. sensitivity up to over 2 mc.

Some additional circuit changes were made on the panel resulting in improved overall performance and circuit simplification. Amplitude results remain substantially as previously reported.

2.5 Tubes and Components

(H. B. Frost)

Vacuum Tube Studies - A group of 5687 tubes of 3229-13 production have been life tested for 500 hours. At the end of this time, these tubes were not satisfactory for circuit applications if operated normally-off. 5687 tubes of 3228-52 production were in approximately the same condition after 1000 hours of operation. Tubes of both productions are fairly satisfactory if operated normally on; however, tubes of 3229-13 production slumps somewhat even under normally on conditions. A major part of the deterioration is the formation of an apparent cathode interface resistance.

A group of 9 special RCA 6AG7 tubes were tested after 500 hours with no plate potential applied and a filament voltage of 7.5 volts. These tubes had cathodes with various amounts of silicon - only those with 0.15-0.25% silicon showed apparent interface development. Other cathodes in the test were 220 alloy (less than 0.05% Si) and 499 alloy (less than 0.01% Si). These tests are not conclusive because of the small sample and short run; however, a larger sample of 45 is now being tested. Identical tubes are on life test by RCA.

Additional life tests have been started on 6AN5's and 6AS7's. A group of 6AN5 flip-flops is to be placed on life test as soon as construction and testing are complete.

2.5 Tubes and Components (continued)

Some pulse emission tests of 6AG7 tubes with and without apparent cathode interface show that emission of "bad" tubes is not seriously lower than the emission of normal tubes. Low emission does not seem to correlate with interface resistance measurements. This was done in connection with the work of John Waymouth.

(John Olivéri)

315 tubes for the check register/comparison register have been assigned. 144 tubes for the 16 check register panels have been delivered. The 171 tubes for the comparison register panels will be delivered pending the marking of circuit designations.

162 tubes for the program counters were marked and delivered. This includes tubes for the storage control and transfer digit order selection. A total of 180 7AD7's and 7AK7's were preburned during the last two weeks. 90 of these have been retested.

A total of 420 tubes (the majority being 7AD7, 7AK7's) were retested and placed in WWI Reserve.

150 cards were typed by additional help. This included 60 6AG7's, and 90 7AD7's.

The 3E29's placed in WWI by Sylvania were never tested or records kept, it was learned.

A quantity of 7AK7's were tested for oscillation and the majority do have oscillation irregardless of manufacturers type.

2.6 Test Equipment

(D. Hageman)

Gate and Delay Unit (Dwg. No. D-37148-2) - The output pulse amplitude decreases markedly as the delay thereof is increased. It has been suggested that this may be prevented by: (1) replacing the R-L-C peaker by a blocking oscillator having an R-L-C peaking circuit in its plate, (2) inserting an R-L-C peaking circuit in the plate of the cathode follower. Thus far, the writer has not been able to obtain good output pulse waveform together with proper action of the blocking oscillator.

WWI Drawing List	Block Diagram	Block Schematic	Circuit Schematic
System	B-37071-5		
Control	B-37098-4		
Master Clock	B-37159-3		
101 Pulse Generator	B-37155-3	B-32385	E-32333-4
102 Program Counter	B-37062-4	B-32213-1	D-31516-6
103 Program Register	B-37067-4	B-39289-2	D-33836
104 Control-Switch Matrix Panel	B-37066-3	C-33843-1	R-32722-3
104 Control-Switch Switch Panel	B-37066-3	B-34100	Z60CS00-2-E
104 Control-Switch Output Panel	B-37066-3	B-34101	Z60CS00-B
105 Operation Matrix Driver Panel		S600M00	Z600M00-1-E
105 Control-Pulse Output		R60CP00	S60CP00-1-B
106 Time-Pulse Distributor	B-37068-5	T60PD00-3-B T60PD00-4-C	
106 Time-Pulse-Distributor Counter		T60PD00-3-B	Y60PD00-D
106 Time-Pulse-Distributor Output		T60PD00-4-C	Z60PD00-1-F
109 Clock-Pulse Control	C-39817-3	C-32642-5	R-31916-7
110 Frequency Divider	B-37154-4	B-32264-1	R-31729-2
111 Synchronizer	B-37172-1	C-33485	R-33486-2
112 Restorer-Pulse Generator	B-37160-2	B-32209-4	D-31909-8
200 Test Storage	B-37156-2		
201 Test-Storage Amplifiers	B-37121-2	C-32855-3 C-33768	D-33706-1
201 Storage-Switch Matrix Panel	B-37121-2	C-32855-3	R-32722-3 D-33706-1
201 Storage-Switch Switch Panel	B-37121-2	B-34102	Z60CS00-2-E

WWI Drawing List (continued)	Block Diagram	Block Schematic	Circuit Schematic
201 Storage-Switch Output Panel	B-37121-2	B-34103	Z60CS00-B
202 Toggle-Switch Storage Switch Panel	B-37122-3	C-33768	D-33706-1 C-33707
202 Toggle-Switch-Storage Output Panel	B-37122-3		E-32721-4
203 Flip-Flop-Storage Output	B-37060-5	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	B-37061-7	D-32106-3	
301 A-Register, Digit 0	B-37056-3 B-37072-8	B-31574-1	D-31573-7
301 A-Register, Digits 1-15	B-37056-3	B-31211-3	D-31276-12
302 Accumulator, Digit 0	B-37173-1	D-32851	R-32850-3
302 Accumulator, Digit 0, Aux. Panel	B-37173-1	B-32492-2	D-32602-1
302 Accumulator, Digits 1-14	B-37173-1	D-31213-4	R-31275-10
302 Accumulator, Digit 15		D-33964	
303 B-Register	B-37097-5	B-31212-5	D-31277-7
304 Sign Control & 308 Divide-Error Control	B-37072-8	C-31576-3	E-31619-2
305 Step-Counter	B-37074-7	D-31828-1	D-39764-4
305 Step-Counter Output		A-32723-1	D-32735-2
306 Multiply & 307 Shift Control	B-37072-8	C-31532-3	E-31586-5
308 Divide Control	B-37072-8	C-31552-3	R-31718-5
309 Special Add Memory & Overflow	B-37072-8	C-31575-5	E-31632-5
310 Point-Off Control	B-37072-8	C-31600-6	E-31717-6
403 In-Out Register	D-37178	E-32434-2	D-31277-7
404 Comparison Register	D-37178	B-32578-2	E-32576-6
404 Comparison-Register Check		B-33488-1	E-33515-2

WWI Drawing List	Block Diagram	Block Schematic	Circuit Schematic
601 Check Register	B-39816-3	B-32577-1	E-32576-6
601 Check-Register Check	B-39816-3	B-32018-1	E-32023-3
602 Alarm-Indicator Control	B-37175	B-33603	E-33651-2
820 E.S. Deflection E.S.D. Gate Panel E.S.D. Decoder E.S.D. Output		A-34036	B-33876-1 E-33908-1 C-34182
831 ST Mount			SC-34040
833 Signal Plate Driver			SD-34029
834 Gun Driver			SD-34181
Standardizer Amplifier		A-33881	C-33880
Bus Driver, Arithmetic Element		A-32297-1	D-31727-7
Bus Driver, Flip-Flop Storage		A-32296-1	D-31726-7
Register Driver, Type I		B-32207-1	E-32261-7
Register Driver, Type II		B-32691-2	D-32690-2
Bus Connections	B-37124-3	C-37123-3	
Fuse-Indication Panel			W60PP00-7-D
Voltage-Variation Panel			W60PP00-6-C
WWI Power-Connector Pin Connections			B-31955-6
Digit-Interlock Panel			W60PP00-8-B
Fixed-Voltage Switching Panel			T-60PP00-11-B
Power-Interlock & Indication Panel			Z-60PP00-12-B
Power Supply Control		D-32017	D-33184 (cabling diagram)

3.0 STORAGE TUBES

3.1 Construction

(F. H. Caswell, T. F. Clough and P. Youtz)

Three storage tubes have been constructed and processed during the past bi-weekly period -- all within one week. One of these, ST96, has been operating satisfactorily in the reliability tester for about one week at this time.

All of these were constructed with precautions against lint. All glass work was done with an argon gas atmosphere. These later tubes have shown a distinct improvement over the earlier tubes as far as surface leakage is concerned.

Emphasis is continuing to be applied toward controlling this leakage as well as all phases of construction and processing to improve reproducibility.

(R. Shaw)

New tungsten springs have been made for the storage-tube target assembly. These have been made much more compact than the previous ones in order to reduce their influence on the electrostatic field in the neighborhood of the target. It is possible, however, that they are too rigid to perform their intended function of accommodating thermal expansion or other dimensional change of the storage assembly without allowing any great change in screen tension. A mock-up assembly is being made to test their effectiveness.

A new beam-analyzer tube, RT54, is under construction. The target aperture is to be much smaller than that in previous tubes and only one gun will be included in order that it may be mounted on the centerline. These changes are expected to permit more selective sampling of current density within the beam.

A sample of hard rolled Inconel has been received. This has been recommended as a more suitable material for springs and snubbers than Nichrome V which was previously tried.

(J. S. Palermo)

Mechanical Components - The tube construction program of the past two weeks has appreciably depleted our inventory of evaporation and storage-tube mechanical components. Immediate

3.1 Construction (Continued)

requisitions have been submitted for additional components. Shortage of components is not expected to interfere with tube-construction demands of the next fortnight.

The designing and procuring of assembly jigs and fixtures is proceeding satisfactorily. The reports on Washing and Coating Procedures have been started. The first of a series of reports will be completed shortly. Completion of the entire series is dependent on the construction program.

The two envelopes for RT51 and RT54 have been processed and are ready for construction assembly.

(W. E. Pickett)

Glass Components - This last bi-weekly period has been unusual in that within the first week we constructed three storage tubes in addition to several evaporating tubes. As this is the first time that three storage tubes have been constructed in one week, the inventory of glass components was exhausted. As a result the last half of this period was spent in building up an inventory of glass components for storage tubes.

Ten-pin stems were constructed and the supply of these stems on hand now should be ample for the next three bi-weekly periods. Envelopes for the storage tube were constructed. The quantity of envelopes on hand will take us through this next bi-weekly period. The memorandum on the construction and use of the polariscope has not been started because of the pressure of building storage tubes. An engineering memorandum has been written on the glass film observed in the glass necks of storage tubes and will be issued in this next period. All glass components used in the construction of evaporating tubes are sufficient for our needs in the next two periods. The series of engineering notes on glassworking procedures, describing in detail all glassworking techniques and procedures, have been started and when completed in the near future should prove to be of interest to all those interested in the building of our storage tube. The vacuum-firing and hydrogen-arcing bottle-stand has been completed and, if time permits, the glasswork for this new tool will be done in this coming period.

3.2 Test

(C. L. Corderman and A. H. Ballard)

Three new beryllium-on-mica tubes, ST96-2, ST97-1 and ST98

3.2 Test (Continued)

have been tested.

ST96-2 turned out to be the only completely satisfactory tube of the group. It had exceptionally uniform storage for a V_{HG} ranging from 50V to 350V, and very low surface leakage current. It has been operating in the reliability tester since completion of standard tests.

Initial observations on ST97-1 indicated a low resistance short between cathode and the first grid on the high-velocity gun. This short existed only when the heater was on and consequently was not noted during the normal series of resistance checks during processing. Efforts to remove the short were unsuccessful, culminating finally in a burned-out connection to the cathode inside the tube.

ST98 appeared at first to be a good tube and standard tests were started. However, it was noticed that the holding-gun cathode current was decreasing from its initial value of 3.6 milliamps, being down to 1.2 milliamps after the tube had been on for 10 hours. A visual check revealed a blue glow in the tube, concentrated along the center, indicative of a gassy tube. Getters were then flashed and a gas reading of 7.7×10^{-7} mm Hg was found immediately afterward. With continued operation, however, the tube went gassy again.

(J. S. Rochefort and N. S. Zimbel)

High-Speed Write-Read Unit - Restoring current tests with ST73 have now been run for spot potentials covering the complete range of V_{HG} from 0V to 125V. Measurement of the restoring current to a spot which is placed 1 to 5 volts above first crossover potential shows that the spot charges to its upper stable potential in 1300 to 1700 μs when V_{HG} = 125V. A plot of restoring current vs spot potential over this range shows that a smooth decrease in restoring current to the spot begins at a spot potential 25 volts below collector potential.

At the present time, the primary current to a spot which is placed above collector potential is under investigation. Two conditions will be studied. They are:

1. Surface background at collector potential and spot V_{HG} volts above this value.

2. Surface background at first crossover voltage (V_1) and spot V_1 volts above collector.

3.2 Test (Continued)

Life tests on ST63 have been terminated. The high-velocity gun grid was pulsed to zero bias at a 25 kc repetition rate with a 15 μs gate for a total of approximately 619 hours. At the completion of this life test, the zero bias, high-velocity, target current had decreased to 54% of its initial value while the holding-gun cathode current had decreased by only 10%.

(J. H. McCusker)

The potential field between the target and the faraday cage of the beam-analyzer tube has been determined by using the difference form of Laplace's equation in two-dimensional cylindrical coordinates.

The potential at the target aperture is affected less than 0.1% by the retarding potential of the cage.

All electrons which enter the target-cage region at normal incidence to the target and which have energies equal to or greater than the difference in potential between the target and the cage are collected by the cage.

Electrons which enter the target-cage region at some angle to the normal to the target surface may or may not be collected by the cage depending on the angle, the distance from the axis of symmetry of the target and cage, and the voltage difference between the target and cage.

If the beam, as in the case of the high-velocity beam, enters at an angle of 15°, electrons will begin to miss the cage when the potential of the cage is 6% of the target potential. If the beam, as in the worst case of the holding-gun beam, enters at an angle of 2°, all the electrons should be collected by the cage.

If the high-velocity beam reaches the target surface at a 15° angle with respect to the normal to the surface, the current density as determined by the current reaching the cage will be only 50% of the actual current density since 50% of the current strikes the walls of the aperture. However, the angle at which different sections of the holding-gun beam enter the aperture is small enough so that errors due to that angle are negligible. A tube is being made in which the high-velocity beam will be normal to the target so that the loss in collected current to the cage due to a 15° angle of incidence may be obviated.

3.2 Test (Continued)

(R. Sisson)

Testing on the Reliability Tester is described in section 1.2.

3.3 Research and Development

(H. Klemperer)

Stability conditions of the storage surface under the influence of leakage, field emission, gas ions and the holding beam were analyzed and reported in E-242.

Design of a 100 ma electron gun was started for experiments with a powerful holding beam.

(H. Rowe)

The rubber model built to study electron paths near the storage surface has been completed.

3.4 Unclassified

(H. Rowe)

A Master's thesis proposal entitled "Secondary Emission from Beryllium Surfaces at Low Incident Energies" is being written.

4.0 INPUT-OUTPUT EQUIPMENT

4.1 Eastman Kodak

(E.S.Rich)

At a discussion among Taylor, Rich, and Hageman some preliminary plans for testing the Eastman film units were considered. The main purpose was to determine what test equipment would be required to perform the functions of those parts of IO control which will not be completed by about July 15 and what is required to simulate the signals which normally will come from the computer control matrix. It appears that no serious problem exists in setting up the equipment for these tests.

4.3 Teletype

(E.S.Rich)

A layout of the equipment needed to record numbers on film from punched teletype tape has been worked out. This equipment consists of a WWI Synchronizer panel, standard test equipment, and a breadboard containing the teletype transmitter-distributor, an auxiliary relay and a gas tube circuit for operating this relay. It is estimated that this set-up will be required about August 1.

5.0 INSTALLATION AND POWER

5.1 Power Cabling and Distribution

(H.S.Lee)

Voltage Variation Panels - A. Taylor now has sufficient parts on hand to assemble the two panels that were delayed due to a scarcity of necessary parts.

While testing the wiring installed during the recent power shutdown two Variation panels were found to have a defective relay on each. These relays have been removed from the panels and returned to Sylvania for replacement.

Power Cabling - Drafting and Fabrication of all power cables for "P" Racks, "F" Racks, "A" Racks, and "C" Racks has been completed. Drafting of cables for the "E" Row will probably not start until July 1 approximately.

The installation effected during the recent power shutdown was quite successful. The installation phase was completed by the established target hour and the testing revealed only minor errors which were expeditously located and rectified. The computer was turned back to the Systems Group at 0300 hours May 23.

The internal wiring in all "C" Racks has been completed. The only wiring remaining to be done to make the entire "C" Row operative is the inter rack wiring between the Power Racks and Rack C4 for the Alarm Indicator Control Circuits.

5.2 Power Supplies and Control

(C.R.Wieser)

During the recent computer shut-down, motor driven timers were installed on all d-c supplies, the filament alternator regulator (and power supply) were installed with temporary front panels, and the entire power control system was connected with temporary cabling. Fully automatic remote control of the power supplies is now operating satisfactorily. Replacement of temporary construction will proceed as shutdown time permits.

On May 25 a meeting was held with Boyd, Fahnestock and Taylor to examine the status of WWI Power and Power Control. At that meeting the following points were decided upon.

5.2 Power Supplies and Control (cont)

1. The d-c voltage monitoring system will be deferred since there is no apparent need for it at present.

2. Work on marginal checking will be resumed. A new motor-generator will probably be used. Since marginal-checking performance requirements are not well-enough defined to specify a final system, the marginal checking equipment developed will probably be temporary. The temporary system planned will include automatic panel selection by means of the Voltage-Variation Panels and will include a regulator for the generator. The tentative output specification is ± 100 volts at ± 2 amperes. The system is essentially the one described in M-379.

(R.E.Hunt)

Automatic Control for Marginal Checking - is being laid out. Drafting should require about 2 more weeks.

(J.J.Gano)

115 Volt A-C Laboratory Supply Regulator - A breadboard assembly of the regulator similar to that used on the filament alternator regulator is ready to substitute for the present breadboard unit. The difference in the laboratory supply and filament alternator regulators is now only in the output voltage rectifiers and reference voltage circuits. The difference in the rectifiers is due to the fact that the laboratory supply regulator requires the rectification of the three phase output, while the filament alternator requires the rectification of the single phase output. The difference in the reference voltage circuit is due to the fact that the laboratory supply regulator has a fixed voltage while the filament alternator requires that the reference voltage be increased slowly in order to apply a gradually increasing voltage to the filaments of the MWI tubes. The power supplies for the two regulators are identical.

The final units for the regulator and power supply are now being assembled.

5.3 Video Cabling.

(R.H.Murch)

All video cabling that Sylvania was designing has been received from them.

All repetitive cabling has been installed in the arithmetic element row and Flip-Flop Storage row, except for the program counter, Check Register and Comparison Register.

5.3 Video Cabling (cont)

A video cabling block schematic (R-34186) of Flip-Flop storage has been issued.

5.4 Unclassified

(C.W.Watt)

Drawing D-33798, showing the location of panels in the storage tube Row, is being redrawn, using the new panel names from M-852-1 and locating panels to scale. Panel sizes are known for a number of the units, and the new edition of this drawing should be helpful in planning the installation as well as for general reference.

6.0 BLOCK DIAGRAMS

(R. P. Mayer)

The nomenclature for Electrostatic Storage is undergoing revision, and will be written up in the near future. These changes will affect the block diagram sketches for ES and ES Control etc., which are now being drawn up as a single block diagram showing all of the Electrostatic Storage Equipment.

Drawing SB-37190-1, Control Matrix Output Connections, shows all the necessary information for connecting up the Operation and Timing Matrices and the Control Pulse Output Units. The drawing is in the form of a list rather than a block diagram, and is primarily intended as an emergency measure to bring existing diagrams of the Control Matrix up to date. The information on the existing "Operation Matrix" drawings is obsolete, and these drawings will probably be redrawn in the near future.

(J. M. Salzer)

Revision of all timing diagrams has been undertaken in accordance with the wiring of the Control Matrix. This process will also serve as a check on the recently designed timing of orders.

7.0 CHECKING METHODS

(G. Cooper)

The investigation of programs for detecting faults in the step counter is continuing. The statement made in the previous bi-weekly report regarding the symptoms produced by these faults is a considerable oversimplification of the facts. In addition to counting an incorrect number of steps, there are faults which will result in numbers appearing on the bus at odd times, and others which will result in incorrect counting only in certain modes of operation. These are by no means undetectable - they merely require different schemes. Such schemes have been devised, as well as some rough codes for use with three of the eleven voltage variation lines to the step counter. These codes (with a little polishing) should detect all possible faults in the units affected by these lines.

(J. M. Salzer)

Although E-225 appears to be an exhaustive study of input-output checking, it is complete by no means. Additional problems and loopholes seem to sprout after every other question by interested inquirers (whose curiosity is solemnly encouraged). Some of these problems will be discussed briefly.

Block Identification - Words will be recorded on and read off the film in blocks of arbitrary number of words. It appears plausible to use the first word in a block to be a number identifying the block. WWI can then make the identification during reading, if it knows where a block starts and how many words each block contains. The latter information can be assumed to be available in WWI but the former cannot because after a slewing operation the film might stop any place. One remedy could be the recording of a plus zero (or any other unusual constant) as the last word in each block. The computer would then start reading until it reads a plus zero, upon which it will presume the end of a block and will consider the next number to be a block identification. To convince itself, the computer will count a block length, see if the new block also ends in plus zero, check if the next number is one greater than the previous block identification number and repeat the procedure several times before stopping the film reader after the reception of a plus zero. A search subprogram can easily be coded for such a procedure.

Alarm Indications - In the design of alarm circuits great care was exercised to get separate alarm indications for

7.0 CHECKING METHODS (continued)

three possible sources of error: faulty recording or reading (in-out alarm), faulty operation of the comparison register (COR alarm), and faulty coding of the program (program alarm). These are good distinctions but in the interpretation of alarm indicator lights good judgment will be necessary. Assuming one trouble at a time and normal high-speed operation, a faulty word (recorded or read) will invariably sound both the in-out and the COR alarm; it might also give a program alarm because the film unit might not have been stopped before the reading or recording of the next word starts and the alarmed computer will not supply the relevant program. If the fault is in COR, a COR alarm will appear, an in-out alarm might appear (since a sick COR cannot always compare properly), and the same remarks go for the program alarm as before. Finally an error in the program will give a unique indication of just a program alarm.

Missing Program Alarm - There is one condition under which no program alarm will occur although it should. On recording the program must supply an rf followed by several rc's. The program alarm should indicate if these orders are supplied too late so that recording has started before there was a word to record. Because rf prepares the Input-Output Element for reading, the late arrival of the first rc will not be detected. This should not be a great drawback, if it is realized by the coder; since the first number recorded after rf is to be the block identification number, it should be easy to follow rf by an rc immediately.

The Use of ri (read initially) - This order is used for the initial filling up of the computer and it is so designed that it will cause WWI to follow the program just read in, starting with the first word read in. This first word must, therefore, be an order. Since the conception and design of the ri operation it has also been (more or less) decided to make the first word a block identification number. The problem is under consideration.

8.0 MATHEMATICS

(P.Franklin)

The application of WWI to the computation of auto and cross correlation coefficients was considered and evaluated.

(E.Reich)

Engineering Note E-245 entitled, "Optimum Programming of Square-Matrix Multiplication with Insufficient Electrostatic Storage", is being issued. It shows how, in the case of high-order matrix multiplication, the computer may be instructed to work out its own optimum coordination method with the input-output equipment before proceeding to the main program.

(C.V.Adams)

In connection with a presentation of a programming procedure at the E.E.Staff Colloquium, considerable work was done toward preparing a program for the calculation of correlation functions. This work will be written up, together with a brief discussion of the procedures now used to calculate such functions, and will be issued as E-246, "Calculation of Correlation Functions by WWI".

9.0 FACILITIES AND CENTRAL SERVICE

9.1 Publications

(J. N. Ulman, Jr.)

The following material has been received in the Library, Room 217, and is available to 6345 Personnel.

6345 Reports

No.	Title	Classified	No. of Pages	Date	Author
R-163	A Trouble-Location Scheme for a Digital Electronic Computer (SM Thesis, Abstract in E-218)	-	120	4-21-49	G.G. Moberg E. Blumenthal
E-234	Programming Matrix Multiplication with Insufficient Electrostatic Storage	-	13	5-4-49	P. Rabinowitz E. Reich
E-235	Description of Whirlwind I Codes	-	16	5-6-49	J.M. Salzer C.W. Adams R.P. Mayer
E-238	Storage Tube ST94: Construction, Processing and Initial Testing	-	3	5-5-49	M. Florencourt
E-239	Function of the Revised Clock Pulse Control	-	6	5-12-49	J.M. Salzer
E-240	Storage Tube ST95: Construction, Processing and Initial Testing	-	3	5-16-49	M. Florencourt
E-241	Notes on Resistance Measurements of Storage Plates with an Electrometer Circuit	-	5	5-17-49	W.J. Nolan
E-242	Migration and Stabilization of Charges on Storage Surfaces	-	7	5-17-49	H. Klemperer
E-243	Double Reading and Recording Using Eastman Film Units	-	3	5-18-49	J.A. O'Brien
E-244	Storage Tube ST93: Construction, Processing and Initial Testing	-	3	5-19-49	M. Florencourt
M-836	Instructions for Filling out Progress Reports	-	1	4-22-49	H.R. Boyd
M-846	Constant-Frequency Restoration	-	2	5-11-49	J.M. Salzer
M-847	Thesis Proposal: Velocity and Current-Density Distribution in the Electron Beams of Holding Guns and High-Velocity Electron Guns at the Storage Surface of an Electrostatic Storage Tube	-	10	3-11-49	J.H. McCusker

6345 Reports (Continued)

No.	Title	Classified	No. of Pages	Date	Author
M-848	Electronic Computer Division Personnel	-	3	5-1-49	
M-849	Master's Thesis Research Proposal: Pentode Gate-Tube Circuits	-	4	5-13-49	C. Rowland
M-850	Bi-Weekly Report, Part I, 5-13-49	Restr.	26	5-13-49	
M-851	Bi-Weekly Report, Part II, 5-13-49	Restr.	10	5-13-49	
M-852-1	Panel Names for ES Row	-	2	5-20-49	S.H. Dodd
M-853	Conference at Eastman Kodak on May 3, 1949	-	4	5-19-49	(H.R. Boyd (E.S. Rich
M-854	Operation of Power-Supply Control System	-	4	5-24-49	C.W. Watt
C-105	Numerical Determination of Eigen-Values of Arbitrary Order for a Special Class of Differential Equations	-	7	4-18-49	M. Daniloff

Library Files

	Proceedings of the IRE, May, 1949	IRE
.004	European Scientific Notes, April 1, 1949	London ONR
47	Technical Information Pilots, Numbers U2821-3210	(ONR, Library of (Congress
52	Progress Report for WWI Electronic Digital Computer, Period April 23 - May 6, 1949	Sylvania
113	General Radio Experimenter, May, 1949	General Radio Co.
134	Eastman Kodak Monthly Progress Report No. 9	A.W. Tyler
180	Document Office Bulletin, May 10, 1949	RLE, MIT
198	Interim Engineering Report on Radio Control Transmitter Model AN/ARW-55 and Radio Control Receiver Model AN/ARW-56; Period April 1 - May 1, 1949	Collins Radio Co.
266	Interim Engineering Report on Airport Taxi Control System; June 30, 1947	Gilfillan Bros. Inc.
275	Economic Mobilization Course, 1947-1948	J. Steinhardt
276	The Automatic Sequence-Controlled Calculator, Reports I, II, and III; Harvard Computation Laboratory	(H.H. Aiken (G.M. Hopper
277	A Low-Speed Analogue for Analysis of Flip-Flops; SM Thesis, May 20, 1949	J.M. Hunt
278	A Dual-Triode Capacitively-Coupled Flip-Flop; SM Thesis, May 20, 1949	M.H. Hayes, Jr.
279	Electronic Calculating Punch; Principles of Operation	IBM
280	Digital Computer Newsletter, Issue I; Computer Branch, ONR	Albert E. Smith
281	Programming a Computer for Playing Chess; C. E. Shannon	Bell Tel. Labs.
282	A Logical Coding System Applied to the ENIAC; by R. F. Clippinger, September 29, 1948	(Ballistic (Research Lab

Library Files (Continued)

No.	Title	Author
283	On the Distribution of Short Discontinuities in DOVAP Records; by Dorrit Hoffleit, April 1949	(Ballistic (Research Lab
284	Analysis and Design of Sampled-Data Control Systems; DS Thesis, May 13, 1949	W.Linvill
285	The NAA Telemetering System; D. H. Jacobs, C. W. Chapman, November 19, 1947	(North American (Aviation, Inc.
519	Recommendations for Support and Insulation of Kinescope RCA - 16AP4 - Application Note May 2, 1949	RCA
559	Technical News Bulletin, May, 1949	Nat. Bur. of Stand.

Books

Components Handbook; Radiation Lab Series Vol. 17	J.F. Blackburn
Numerical Methods of Analysis in Engineering	L.E. Grinter
Advances in Electronics, Volume I	L. Marton

9.2 Standards, Purchasing and Stock

(H. B. Morley)

Standards - New or revised standards issued and/or assigned:

S7.411-12	Alarm Indicator Control, 602
S7.411-13	Check Register Check Panel
S7.411-14	Time Pulse Distributor, 106
S7.490-1	Test Specs., Coaxial Cables, Connectors & Assemblies
S7.503-1	Wiring Standards, Electronic Assemblies
S7.503-1	Wiring Standards, Video Cabling

Cancelled:

S7.503	Wiring Standards

Procurement - Hollow terminals used on WWI filament transformers will be made from Everdur on future orders, to minimize the possibility of their shearing off under strain.

As a result of comment on the apparent high cost of silk screening, a sample job was submitted to several vendors for estimates. The results indicate that our present vendor prices are considerably lower, and the quality of their work has been very satisfactory.

Delivery time on most makes of quality relays has steadily increased, average time now being about 6 to 8 weeks.

9.2 Standards, Purchasing and Stock (Continued)

New Products - Sprague Electric Company has announced a new line of high frequency non-inductive shielded capacitors (Hypass). Engineering data is available in the Procurement Office.

(R. Fairbrother)

During the past two weeks a considerable amount of equipment and material which was no longer useful on this project has been transferred to other Navy activities. There is at present a very adequate supply of test equipment.

Our last pulse transformer order is now nearly complete, giving us adequate stocks of those units.

BNC connectors on the shelves of the stock room have not been tested to WWI specifications, and should not be used in WWI until they have been inspected by Frank Hannon.

All material which remained at Sylvania at the completion of their contract has been shipped and received by us.

9.3 Construction

(H. F. Mercer)

Production Report - The following units have been completed here since May 13:

Comparison Register Check
Control Switch Output Panel
Storage Switch Matrix Panel
Storage Switch Output Panel

(A. Taylor)

WW construction is on schedule with the exception of the toggle-switch storage switch. This panel will be delivered about one month late.

(A. R. Curties)

Two Model 2 holding gun power supplies were mechanically checked then adjusted and checked for ripple and regulation.

Additional work was done on a 10 mc RF pulse generator.

Components received from J. A. DiGiorgio are now being assembled to complete 5 RF adapters for the storage tube reliability tester.

9.3 Construction (Continued)

The following units were breadboard constructed.

RF amplifier input stage.
Driver for unterminated line.
Gate generator and line driver for HGG and read signal plate gates.
100 - 200 volt regulated power-supply.

Additional work was done on the HVG and HGG driver panel.

(L. Prentice)

Machine Shop - Punch and die sets for Jones strips have been completed. Work for the past two week period consisted of parts for storage tubes, jigs and fixture for the storage tube group, and machined parts for the ESD transmission line.

Sheet Metal Shop - We are somewhat behind schedule and the work load is heavy. Four man-days were lost due to sicknesses and absentees during the past 2 weeks.

Duct work for storage tube has been completed, also storage tube mount box which was installed in rack for inspection.

9.4 Drafting

(A. M. Falcione)

Drawings for project 6673 - A block of drawing numbers have been assigned to this project starting with 45,000. All drawings for 6673 will be assigned to this group. In this manner a distinction can be readily made between drawings for different project numbers.

Work Load - The drafting room is keeping pace with present scheduled requirements. The work load is quite heavy.

Terminations - Mr. George H. Graff, design draftsman will terminate his services with Project Whirlwind as of May 28, 1949. Mr. Graff has done a fine job in his three years with this project.

Sylvania Drawings - Information has been received from Sylvania to the effect that all drawings in connection with this project have been delivered to MIT. Any open questions or missing drawings should be brought to their attention as soon as possible. Their files will be placed in permanent storage in the very near future.

9.5 Nomenclature

(J. M. Salzer)

At the initiation of Steve Dodd and Margaret Florencourt a glossary of ES terminology is being developed. It appears preferable to incorporate this into the WWI Glossary (R-138) rather than to make the ES Glossary a separate report. The revision of R-138 will probably be considered at the same time.

9.6 Time Schedules

(R. A. Osborne)

All time schedules are being posted through the month of May. Copies should be available by the end of next week.

10.0 GENERAL

Staff Terminations

John M. Hunt
Monson Hayes
Edgar Reich
Michael Daniloff

Non-Staff Terminations

Joan Kronick
Beverley Cox
Elise Weil
George Graff
Edward Szulewski

New Non-Staff:

Mrs. Lenore Freitag has replaced Marilyn Spurr who is on leave of absence. She is a graduate of the Pennsylvania State College. Her husband is a student at Harvard Graduate School of Business.

Mrs. Eleanore Galant is secretary to Mr. Forrester replacing Mrs. Cox. She is a graduate of the University of Illinois. Her husband is a graduate student in Government at Harvard.