Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, July 22, 1949

To: 6345 Engineers

From: J. W. Forrester

1.0 SYSTEMS TESTS

1.1 Whirlwind I System Test

(G. C. Sumner)

At a meeting on July 15 the plans of system tests for the immediate future were slightly changed. It was previously intended that the next phase of system tests would be to shift from test control to WWI control order by order. However, to allow time for installation and testing of improvements to the control matrix, it was decided that the next phase should be the "switch check" described in M-863 using test control. In this check, test storage is set up so that any register n contains the binary number n + 1. The program counter is operated as in WWI to select each register in turn. The contents of the program counter (just after receiving an add pulse) are compared with the contents of the selected storage register in the check register. This test was set up July 20 and correct operation by push button obtained. Stable automatic operation has not yet been obtained. However, since this represents the addition of a large amount of equipment to the operating system, it is to be expected that new problems are to be encountered. For example, since the program for "switch check" requires about 320 microseconds, whereas the longest program previously attempted required less than 60 microseconds, means had to be provided for delaying synchroscope sweeps to be able to observe operation.

The check register is now operating satisfactorily with two more minor modifications. Five digits of the program counter have been received from the shop after having been modified as reported in the last Bi-weekly Report.

1.1 Whirlwind I System Test (Continued)

Four more crystal rectifiers were removed from the check register, all with low back resistance, three of which exhibited extreme drift. This makes a total of eight crystal rectifiers which have been removed from the check register in preliminary system tests. This seems to indicate that a more rigorous crystal test should be applied just before the crystals are installed in WWI panels. It is hereby proposed that test specifications be changed to include a drift test of perhaps 30 seconds duration. Even if the manufacturer will not perform this test, it could be very economically made in our own laboratory.

(H. F. Mercer)

The following failures of electrical components have been found since July 8, 1949:

TUBES	QUANTITY	COMMENTS
7AD7	4	Tube removed from Clock Pulse Control Panel, Serial #1. Tube Test Group tested tube and found it unmatched for flip-flop operations. Total hours on tube; Filament hours 517.2 Plate hours 475.9
		Two tubes removed from Storage Switch Switch Panel, Serial #2. Emission low for flip-flop operation. (Found because flip-flop stalled) Total hours on tubes: Filament hours 395.9 Plate hours 365.0
		Tube was removed from Operation Matrix Driver, Serial #1. Low plate current. 22.5 ma. Total hours on tube: Filament hours 383.1 Plate hours 355.2
7AK7	3	Removed 1 Gate Tube, Digit 0, Program Register Serial #32. Tube passed pulses from flip-flop waveform on grid. Test on tube tester showed high leakage current

1.1 Whirlwind I System Test (Continued)

TUBES	QUANTITY	COMMENTS
		on control grid (gas test). After flash, on tamping tube, test showed normal. Suspected trouble - lint. Total hours on tube: Filament hours 543. Plate hours 379
		Removed 1 Gate Tube, Digit 12, Program Counter Serial #2. Trouble not definitely known but tube showed plate short when tapped. Tube had a small crack near the top of the bulb but its operation was not affected by the crack. Total hours on tube: Filament hours 71.7 Plate hours 69
		Tube removed from B-register Serial #7. Tube blew +150 V GT fuse in Rack A7 and burned up plate decoupling resistor. Total hours on tube: Filament hours 1150.4; Plate 962.0
6Y6G	1	Tube was a Buffer Amplifier in flip-flop storage output Digit 1. Tube developed a control grid to screen short during marginal checking of +150V Total hours: Filament hours 326.8 Plate hours 304.2
3E29	1	Tube in Operation Matrix Driver Panel #1. Became gassy - had no output. Total hours: Filament hours 364.5 Plate hours 336.7

CRYSTAL RECTIFIERS	QUANTITY	COMMENTS
D-357	4	These four crystals were in use in the Check Register and were found to

1.1 Whirlwind I System Test (Continued)

CRYSTAL RECTIFIERS	QUANTITY	COMMENTS
		have little or no back resistance. It is believed that these crystals fell below required specifications prior to their use in WWI.
D-358	4	These four crystals had low back resistance and drift. They were in use in the Check Register. Believe the crystal fell below required specifications prior to their use in WWI.
RESISTORS		
220 ohm plate decoupling resistor		Resistor in B-register Serial #7 Resistor burned up due to a gassy gate tube. Fuse in Rack #A7 (+150 V GT line) blew but not until resistor had burned up.

1.2 Storage Tube Reliability Tester

(R. Sisson)

ST 103-2 has been tested in the reliability tester. Its operation is at least as satisfactory as that of ST 96-2. There is no evidence of any "leaky area" on the surface of ST 103 such as was mentioned in the initial tests on that tube.

A reliability run with ST 103 was attempted over the weekend of July 16-17, which was not successful. The cause of the failure of the pattern to cycle properly seemed to be that at the end of the run, the tube required a V_{HG} of at least 125 V to operate satisfactorily, while at the beginning of the run, it was operating very well at V_{HG} = 110 V (the value used during the run.) Why the tube should require a different V_{HG} is still a mystery; however, this tube (103) had been operated only 13 hours before this run began. Thus this shift in required V_{HG} may be

1.2 Storage Tube Reliability Tester (Continued)

an aging effect. The effect has never been observed on tubes with more than 30 hours of operation. Studies should be made of the range of V_{HG} within which good operation is obtained.

The reliability tester is being set up so that two storage tubes will operate in it. By running two tubes, it is hoped that we can isolate some more of the causes of errors. Cycling a pattern through two tubes will also give information on the problems of multi-tube operation.

1.3 Five Digit Multiplier

(E. S. Rich)

The life run on the multiplier was resumed on July 15th after a shutdown during which the tubes were tested and some work done on the circuits to correct deficiencies previously noted. About 45 tubes were retired on the basis of the test results. Operating margins in general were greater after the replacements were made. Since the start of this run two errors have been recorded, one at 3:10 AM on July 21 for an unknown cause and one at 10:30 AM on the same day because of a blown fuse. Three tubes which were sensitive to tapping were discovered and replaced on that day. The extremely hot weather probably has been detrimental to crystals since six crystals have had to be replaced during the week.

2.0 Circuits and Components

2.1 Circuits by System Number

102 Program Counter

(R. H. Gould)

All of the program counter panels have been modified, tested, checked for proper soldering and returned to the computer room. Five are now being used in the system test of the storage switch.

104/201 Control Switch/Test Storage Switch

(R. H. Gould)

The "matrix choppers" that drive the extra line added to the control switch matrix and the storage switch matrix for the purpose of chopping the selected output so that a-c coupling may be used have been modified. They have been made quite insensitive to restorer amplitude and their natural period has been reduced to approximately 1.5 microseconds so that in the event of a missed restorer pulse or the occurrence of a complement pulse the chopper will switch over and back in a manner so like normal restoration that the computer action may not be affected. Operation with the storage switch is satisfactory. The operation matrix has been shut down so that its chopper has not been used.

105 Operation Matrix Drivers

(J. A. O'Brien)

Difficulty was experienced because of unequal outputs from the operation matrix drivers causing radically unequal outputs from the CPO units. The coupling condensers in the circuits charged up to different voltages when energized by different operations and this acted as a change of bias cutting off the smaller signals. The whole circuit has been revised and d-c coupling is used most everywhere to eliminate the condensers. The circuits should be ready for test next week.

106 Time Pulse Distributor

(K. McVicar)

The time pulse distributor has been placed back in operation in the computer after extensive changes involving

106 Time Pulse Distributor (continued)

conversion to a circuit similar to that in clock pulse control for the matrix connections, replacement of the trigger tubes by buffer amplifiers, insertion of delay lines between the buffer amplifiers and flip-flop cathodes, and removal of one buffer amplifier used to feed the output panel and conversion of the remaining buffer to a limiter-amplifier. Preliminary checks seem to indicate that it is now operating satisfactorily though a detailed test is yet to be made.

109 Clock Pulse Control

(W. Papian)

CPC Delay Panel - This panel has been installed and put into operation in WWI. Operation seems satisfactory.

201/202 Test Storage Switch Matrix Panel & Toggle Switch Storage Switch Panel

(W. Papian)

The outputs from the 32 amplifiers on these two panels were found to be marginal and different in amplitudes. Pulses to the busses from the output panels varied from 1 or 2 volts to 25 volts, and selection of FF storage registers was shaky. The remedy was found in reducing the bias on the 6Y6 tubes in the amplifiers from 30 to 15 volts.

It would now be possible to reduce the dissipation of the 2C51 tubes in these amplifiers (which is now slightly high), but it would be at the expense of transit time through the amplifiers; further testing and operation will help to determine which factor is the more important.

410 In-Out Control Synchronizer

(H. S. Lee)

The layout of this panel is approximately 70% complete.

602 Alarm Indication

(A. K. Susskind)

When the alarm-indicator control was connected into the system, unreliable alarm indication was observed. Proper indication resulted when an error was first put into the system, but the alarm failed to register the presence of

602 Alarm Indication (continued)

of the error if the source of error was not removed before the computer was restarted. The result was that after an error had been put into the system, CPC was stopped and the alarm lights turned on. When next the computer was restarted, the computer resumed operating until that step was reached which revealed the error. At that point CPC was stopped once again, but the alarm lights failed to go on again. This trouble has been traced to chatter of the restart push-button.

This situation must be remedied. It is unlikely that switches with better operating characteristics can be found. It is therefore recommended that the alarm-indicator tubes be disconnected from the restart push-button and be permanently connected to a +120 volt source. Operation of the synchronizer and alarm-indicator control are not affected by this change, except that the restart button will now no longer clear the alarm indication. Instead, a separate clearing switch, now in existence on the control panel, must be used.

The above scheme has successfully operated for the past few days.

603 Comparison Register Check

(K. McVicar)

The comparison register check panel has been checked and alterations similar to those made in the check register check completed. Since precise information regarding pulse amplitudes available at the various jacks is lacking at the present time, final balancing of the circuits will be done when the panel is installed and operating. Test specifications have been written for the panel and are about to be typed.

810 ES Control

(R. W. Read)

Modifications on all panels in ES control were completed July 15. Block schematics, circuit schematics, and assembly drawings on all panels should be available soon. Panel inspection and video tests remain to be done.

A block schematic of the complete ES control should be available within the week. Video and power cabling is progressing satisfactorily. The system should be ready for preliminary tests by about August 8th.

820 ES Deflection

(R. E. Hunt)

ESD Transmission Line - The line sections are being manufactured at the present time. All design and layout work is complete.

The transmission line elbows are being manufactured and are about 80% complete.

All castings have been ordered and should be available within one week.

ESD Termination Panel - Has been laid out but held up pending decisions on decoupling and output wave monitoring which would affect this panel.

830 ES Digit Sections

(C. W. Watt)

A block schematic of the complete ES digit was prepared in sketch form for discussion purposes, and has been graded Grade I. The number is SD-34476.

831 ST Mount

(W. J. Nolan)

A memo M-880 has been written comparing the aluminum and mu-metal mount boxes for r-f and magnetic properties. Test results indicate that either material would be satisfactory.

833 Signal-Plate Driver

(G. G. Hoberg)

After completion of a number of minor changes the prototype has been found satisfactory. Test specifications exist in notebook form.

(C. W. Watt)

Drafting will begin Monday, July 25 on production drawings for this unit. Some layout modification will be needed and the schematic must be drawn in final form. Production on 18 of these panels is scheduled to begin August 15.

834 Gun Driver

(G. G. Hoberg)

Testing of the prototype is in progress.

835 RF Pulse Generator

(H. Kenosian)

The phase reference output coil was revised to allow for the power dissipation in the output circuit. Specifications for all the coils in this unit have been drawn up.

2.2	WWI Drawing List	Block Diagram	Block Schematic	Circuit Schematic
	System	**B-37071-5**		
	Control	**B-37098-5**		
	Master Clock	**B-37159-4**		
101	**Pulse Generator**	**B-37155-3**	**B-32385**	**E-32333-4**
102	**Program Counter**	**B-37062-5**	**B-32213-1**	**D-31516-8**
103	Program Register	B-37067-4	B-39289-2	D-33836-1
104	Control Switch			
	Input Panel	B-37066-4	B-34321	
	Matrix Panel	B-37066-4	C-33843-1	R-32722-3
	Switch Panel	B-37066-4	B-34100	Z60CS00-2-E
	Output Panel	B-37066-4	B-34101	Z60CS00-C
105	Operation-Matrix Driver Panel		S60CM00-A	Z600M00-1-F
105	Control-Pulse Output		S60CP00	S60CP00-1-B
106	Time-Pulse Distributor			
	Counter Panel	B-3706805	T60PD00-3-C	T60PD00-D
	Output Panel	B-37068-5	T60PD00-4-C	T60PD00-1-F
109	Clock-Pulse Control	B-39817-4	C-32642-5	E-31916-8
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-33763	D-33706-2
201	Storage Switch			
	Input Panel	B-37121-2	B-34322	
	Matrix Panel	B-37121-2	C-32855-3	R-32722-3 D-33706-2
	Switch Panel	B-37121-2	B-34103	Z60CS00-2-E
	Output Panel	B-37121-2	B-34103	Z60CS00-C

2.2 WWI Drawing List (continued)	Block Diagram	Block Schematic	Circuit Schematic
202 Toggle Switch Storage			
Switch Panel	B-37122-3	C-33768	D-33706-2
Output Panel	B-37122-3		C-33707 E-32721-4
203 Flip-Flop Storage			
Output Panel	B-37060-5	B-32269-1	E-31635-6
Register Panel	B-37057-4	B-32268-1	E-31621-6
Control	B-37061-7	D-32106-3	
301 A-Register, Digit 0	B-37056-3 B-37072-9	B-31574-1	D-31573-8
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
Digit 0, Auxiliary Panel	B-37173-1	B-32492-2	D-32602-1
Digits 1-14	B-37173-1	D-31213-4	R-31275-10
Digit 15		D-33964	
303 B-Register	B-37097-6	B-31212-5	D-31277-8
304 Sign Control & 308 Divide-Error Control	B-37072-9	C-31576-3	E-31619-2
305 Step Counter	B-37074-7	D-31828-2	D-39764-4
305 Step-Counter Output		A-32723-1	D-32735-2
306 Multiply & 307 Shift Control	B-37072-9	C-31532-3	E-31588-5
308 Divide Control	B-37072-9	C-31552-3	R-31718-5
309 Overflow & Special Add Memory	B-37072-9	C-31575-5	E-31632-6
310 Point-Off Control	B-37072-9	C-31600-6	E-31717-6
400 Input-Output	B-37178-1		
403 In-Out Register	B-37178-1	B-32434-2	D-31277-8
404 Comparison Register	B-37178-1	B-32578-3	E-32576-8
404 Comparison-Register Check	B-37178-1	B-33488-1	E-33515-2
601 Check Register	B-39816-3	B-32577-1	E-32576-8
602 Check-Register Check	B-39816-3	B-32018-1	E-32023-3

2.2 WWI Drawing List(Continued)	Block Diagram	Block Schematic	Circuit Schematic
602 Alarm-Indicator Control	B-37175-1	B-33603	E-33651-3
820 ES Deflection			
ESD Gate Panel	B-37220	A-34036	B-33876-1
ESD Decoder	B-37220		E-33908-2
ESD Output	B-37220		C-34182-1
831 ST Mount	B-37220		SC-34040-2
832 EST Output			
R-F Amplifier	B-37220		D-34315
Gate Tubes	B-37220		C-34251
833 Signal-Plate Driver	B-37220		SD-34029-2
834 Gun Driver	B-37220		SD-34181
835 Holding-Gate Generator	B-37220	A-34354	C-34060-1
835 Read-Gate Generator	B-37220	A-34355	C-34324-1
Standardizer Amplifier		A-33881-1	C-33880-2
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-32261-10
Register Driver, Type II		B-32691-2	D-32690-2
Bus Connections	B-37124-3	C-37123-3	
Fuse-Indication Panel			W60PP00-7-B
Voltage-Variation Panel			T60PP00-6-D
WWI Power-Connector Pin Connections			B-31955-6
Digit-Interlock Panel			W60PP00-8-B
Fixed-Voltage Switching Panel			T60PP00-11-B
Power-Interlock & Indication Panel			Z60PP00-12-B
Power-Supply Control		D-32017-5	D-33184-4 (cabling diagram)

2.5 Tubes and Components

(H. B. Frost)

Vacuum Tube Studies - As a result of our complaint made to Tungsol concerning poor 5687 tubes of 3229-13 production, the cathodes of their new production have been changed to 499 alloy. This alloy has proven very satisfactory in life tests of other tube types here. Four of the new 5687 tubes are now on life test. All 7AD7 and 6AG7 tubes in the life test racks have been tested during this last week by pulse and d-c methods. This data will be analyzed as soon as possible.

Tests of the 5-digit multiplier tubes performed a week ago were quite favorable. 7AD7 and 7AK7 tubes are standing up very well, with a large number of original 7AK7 tubes still in service after 7000 hours. 49 tubes were replaced as a result of these tests.

A modification of tube shop records is contemplated to simplify and speed up procedure, as records are behind considerably.

(John Olivieri)

In the last bi-weekly, it was stated that of 20 6AS7's tested, four were found to be usable. It has been pointed out by W. Nolan that this was highly misleading since the tubes were improperly used. The four tubes conformed to JAN specs. Of the 20 6AS7's, 5 have been retired. This is explained in detail in this report by W. Nolan.

The multiplier tube complement has been completely retested and the data sheets completed. 48 tubes were replaced. They comprised 13-7AD7's, 5-7AK7's, 2-2C51, 3-5687's, 2-6Y6's, 10-6AG7's, 11-6AS6's, and 2-6J6's.

The number of 7AD7 and 7AK7's on hand for WWI replacements total 980 tubes. 531 are 7AD7's, 429 are 7AK7's. 45 7AK7's and 45 7AD7's are being prepared for burning.

The tube complements have been issued for the following panels:

Control Switch Chopper Panel
Storage Switch Chopper Panel
ES Write Rewrite Timer

ISA remarked for use in CPC DE.

Tubes from AC19 were remarked for use in ES pulse distributor panel. 18 tubes for the 2nd panel were issued from reserve.

2.5 Tubes and Components (continued)

Tubes from BR prototype were remarked for use in ES SS control. A total of 225 7AD7's have been retested in two weeks.

The following tubes have been retested for B. Frost from the life test racks:

45	6AC7's	having 1286 hours
11	7AD7's	(F8B) with 3540 hours
9	7AD7's	(L7P) having 4262 hours
9	7AD7's	(F8B) with 3132 hours
47	7AD7's	(L7P) having 3540 hrs. (C7P)

(W. J. Nolan)

In the last bi-weekly report it was stated that out of 20 6AS7 tubes tested after 18 months of service in a regulator circuit, only 4 were serviceable. Although it is true that only 4 of the tubes would meet the usual tests for new tubes, the statement is grossly misleading. Fourteen of them have been returned to service.

The circumstances attending the operation of these tubes and the characteristics which are significant to their operation should first be understood. They operate in parallel in a regulator rated at 5 amperes and supplied by a compound wound generator with a normal output of 380 volts. Overload protection is provided by the line fuses of the driving motor and by a fusetron in the generator output line. The estimated short-circuit current of the system is about 30 amperes or 1.5 amperes per tube. Due to unequal division of current between tubes, some of them might pass as much as 3 amperes, which is believed to be sufficient to burn off the cathode leads in the tubes. Short circuits and severe overloads have occurred on the system a number of times. Considering the 20 double triodes as 40 sections, 18 were found to have the cathode leads burned off, effectively stopping any further significant testing. This, however, should not be taken as a reason to condemn the tube construction, but merely as an indication that more effective overload protection should be provided.

Of the remaining 22 sections, 7 showed a decrease to less than 3/4 of normal current for new tubes under standard test conditions but only 2 were as low as 2/3 of normal. All of them were returned to service.

2.5 Tubes and Components (continued)

Practically all of the tube envelopes showed heavy coatings of material evaporated from the heaters and cathodes. The deposit of this material on the insulation in the tube is believed to be the reason for the abnormally low leakage resistance observed in many of them. Unless it becomes practically a short circuit, this does not impair the usefulness of the tube in a regulator.

This regulator has probably been in operation about 8000 hours. Part of the time it operated 24 hours a day but with very light loading for about 18 hours out of the 24. The maximum normal load has rarely exceeded about 60% of the rating. This has been supplied, however, with only 55% of the tube complement operating. Discounting those sections which were probably destroyed by preventable overloading, it is apparent that practically all of the tubes are still in a usable condition and none of them have deteriorated sufficiently to cause failure of the regulator.

(W. Papian)

Cased Delay Lines - I visited the James Millen Co. last week with O'Brien to discuss cased lines and delay line crosstalk. They had apparently not recognized the effect, partly because they test with pulses appreciably longer than our 0.1 μsec standard.

We obtained a sample 4 μsec cased line (5 loops in a case approx. 7-1/2 x 4-3/4 x 7/8 inches), and have made some photographs of the effect which will be sent to them. Except for this crosstalk effect, caused by the looping of the line, the steel case does not affect the characteristics of the line much. Where physical configurations can be found which avoid looping of the line, cased units might be of use to us.

2.6 Test Equipment

(H. Kanosian)

The 2:1 - 4:1 frequency dividers are being modified to allow operation down to zero frequency. A memorandum on the changes will be issued.

2.7 Unclassified

(K. McVicar)

Report on a Crystal Limiter Circuit - Slight modifications on a crystal gate circuit which is used at the University of Pennsylvania resulted in a rather good crystal limiter, capable of producing a constant output over an input range greater than

2.7 Unclassified (continued)

two to one it can be installed in the conventional buffer amplifier circuit by the addition of one or two extra components.

One immediate application has been in the counter panel for the time pulse distributor. This panel contained a buffer amplifier which was used to drive eight gate tubes on the output panel. Since it was desired to standardize the input to these gate tubes a crystal limiter of the type mentioned above was installed.

An E-note has been written describing the limiter in more detail and will be issued shortly.

3.0 STORAGE TUBES

3.1 Construction

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

The production of storage tubes in July proceeded as scheduled and reported in the last bi-weekly report. See section 3.2 for the detailed test results of these tubes. Two more storage tubes are scheduled for next week. At the end of next week our tube construction facilities will be shut down for our two-week vacation. During our absence mechanical components and nonex stems can be manufactured for us. We have requested some painting in the basement assembly rooms during this period.

The July production run has proved valuable assistance in evaluating the present reliability of our production techniques. We were seriously handicapped during the run by the heat and high-relative humidity. A few problems arose during the processing of the electron guns. J. G. McMullin of the M.I.T. Metallography Department cooperated with us in taking X-ray pictures of our electron guns. The present model of the electron guns (5UP) may be adequate for our present needs, but their flimsy structure makes their processing hazardous.

We have been spraying silver paint on the back of the mica surface for a signal plate. This process is difficult to control for reproducibility. Therefore we are planning to evaporate a heavy film of silver on the mica. We will use a modified evaporation tube for the first few surfaces. Later we will adapt the vacuum firing system to this process.

(W. E. Pickett)

Glass Components - During this last bi-weekly period, the activity has centered on making tubes, which has nearly exhausted the supply of glass components. If time and the proposed schedule permit for the next week, it is hoped to have a supply of glass components that will allow the construction schedule to start up after the vacation period. Ten-pin stems are being made by the local vendor who makes our flat-press stems. The vendor has promised us some ten-pin stems while we are out on vacation. If this goes as is planned we should have a supply of ten-pin stems on hand

3.1 Construction (Continued)

after vacation. Envelopes for the storage tube and evaporating tubes will be made this next week if time and schedule permit.

A new evaporating tube for evaporating silver on mica for the storage tube has been proposed. This tube will evaporate silver on the back of the mica where at present we are spraying silver paste. Components are in process for this tube.

(J. S. Palermo)

Mechanical Components - The construction schedule of the July 15 - July 29, 1949 period will nearly exhaust our present inventory of most mechanical components for tube target assemblies. However, procurement of twenty-four (24) units is already in process for delivery before August 15, 1949.

A cathodic cleaning technique has been set up and is now in operation in the Inspection Room. In addition, we have a Detrex machine to degrease screens prior to cathodic cleaning. The results to date are encouraging.

Splitting of mica to get a virgin surface after spraying and baking has produced satisfactory surfaces. The relative merit of this operation compared to simple cleaning is presently under consideration.

(R. Shaw)

series of specifications are being prepared covering all the materials used in tube construction. Several of these are already complete. Another series covering the manufacture of components is also planned. These specifications, in conjunction with a new record-keeping procedure, will provide reasonably complete information on every component of every tube. A memorandum describing the new procedure will be issued in the near future.

Drawings have been almost completed for the proposed storage assembly mentioned in the last report. One of its novel features is the fact that the mica storage surface is the last part to be inserted in the assembly. This could greatly reduce the time during which the surface need be exposed to air and possible contamination.

3.1 Construction (Continued)

Graphs and illustrations are being prepared for a report on beam-analyzer tubes.

3.2 Tubes

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

Recent testing with the TV demonstrator unit has been closely coordinated with the construction group to aid them in establishing a reliable production technique. New tubes are being received at the rate of two per week. Initial test results of the last four tubes are summarized below.

ST104 - Extremely weak emission from holding gun. The trouble has been traced to the fact that after activation of both guns, the tube was opened to replace the HV gun. Test results on this tube show that in such a case, both guns must be replaced.

In addition, this tube had low output signal and would not write negative. The reason, as confirmed by a capacitance check was a break in the signal-plate lead.

ST105 - A crescent-shaped area near the center of the storage surface behaves as if there were high conductivity between mosaic squares. Although normal writing and erasing is possible on the rest of the surface, the area on the concave side of the crescent exhibits high leakage currents with the holding beam off. Improper trajectories during evaporation of beryllium are suspected.

ST106 - Excellent storage surface characteristics. Gun currents are satisfactory although emission from HV gun is less than usual.

ST107 - Direct short between A_2 and DJ_2 of HV gun. To obtain reasonable deflection sensitivity during testing, accelerating voltage was reduced to 800V.

Uniform storage and erasure is possible over the entire surface, but leakage currents are high in the absence of the holding beam. The configuration of surface leakage is akin to that in ST105. As yet it has not been established whether such behavior would disqualify a tube for computer operation.

3.2 Test (Continued)

As mentioned in the last bi-weekly report, ST101-1 was opened to ascertain, if possible, the cause of a 5/8" bad area on the surface. Close observation of the collector and mosaic surface in the region of this area revealed no defects; however, on the back of the silver paint, a shiny circular area, correctly oriented with the bad area as shown on the TV photographs, was present. This brighter area was thought to be caused by closer contact or pressure to the backing plate over this area, possibly due to a raised portion in the silver. A microscopic examination of a cross section taken from this area showed a dark region, perhaps 1 to 2 mils in thickness, between silver and mica. It was thus concluded that a small space due to a contamination or irregularity of some kind between silver and mica was the most likely cause of the bad area.

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

High Speed Write-Read Unit - The rough draft of the interim report for this unit is in the process of being written. Consequently no new tests have been run during the past two week period.

(J. H. McCusker)

Work has been started on writing up the results obtained from the beam-analyzer tubes.

(H. Rowe)

Tests continue on RT51, the secondary emission tube. The cathode current of this tube is low because low voltages must be used on the gun. Therefore a magnetic focussing coil has been added to the tube. With this coil it is possible to increase the primary current striking the target by a factor of about 1.5.

3.3 Research and Development

(H. Rowe)

The new electrolytic tank has been operated and found to be entirely satisfactory. A detailed description will be forthcoming.

4.0 INPUT-OUTPUT EQUIPMENT

4.2 Display

(E. S. Rich)

Circuit schematic and assembly drawings of an ESD unit showing the modifications required for the special-display decoder have been prepared and furnished to Osborne for use by the shop.

The control features desired have been decided on so the amount of equipment needed could be determined. It will be arranged so that the cyclic program can be stopped at any step in the program to allow indicator lights to show the contents of all registers at that step.

A breadboard of the intensifier gate circuit has been built and will be tested soon with the oscilloscope to be used.

4.3 Teletype

(E. S. Rich)

A wiring diagram for the teletype-reading and transmitter-distributor-control circuits has been made. Bob Hunt is working on the mounting for the transmitter-distributor and the control circuit assembly. This represents all of the construction required for the initial teletype-reader unit aside from the teletype synchronizer which is already being built.

(R. E. Hunt)

Teletype Reader and Control - This is being designed at the present time. About one more week will be required to complete the design.

The unit will be constructed from sketches as a prototype model.

5.0 INSTALLATION AND POWER

5.1 Power Cabling and Distribution

(H. S. Lee)

The fabrication of external power cables for the panels in Racks EX3, EX4, EX5 and EX6 is approximately 50% complete. The installation of internal rack wiring and hardware in these same racks is 75% complete.

Drafting of cables (low voltage) for the ES digit prototype has been started and is approximately 40% complete. A decision must be made on marginal checking of the ES digits before drafting can be completed. Some consideration has been given to the design of high voltage distribution for ES. It is believed that a rack junction box of special design will be necessary for the HV.

Preliminary wiring layouts of the ESD and ED racks have been made and drafting of cables will start on completion of the drafting for the special display.

A construction requisition has been forwarded to the shop for an experimental panel on which are mounted 1000 ohm and 2000 ohm resistors which are to be connected respectively to the load side of the -15 and -30 volt power relays. The theory being tested is that: when current is constantly flowing through relay contacts the possibility of a high resistance contact is precluded. A large percentage of bias failures has been due to high relay contact resistance. It is hoped that this experiment will validate the theory and thus solve the problem of obviating future failures of this type.

The following panels are in the construction stage indicated:

2.	Digit Interlock	- Fabrication and painting complete. Now being silk screened.
10.	Voltage Variation	- Fabrication complete; being painted.
10.	Fixed Voltage	- Same comment.
10.	DC Filter	- Assembly, 25% completed.

The design of the power wiring for special display will be initiated within the next week.

The shop is testing the WWI 26 volt filament transformers which were received within the last week.

5.2 Power Supplies and Control

(J. J. Gano)

Marginal Checking - A 750 watt amplidyne was tested for gain and frequency response. The results were not as favorable as those of the 500 watt amplidyne tested last fall. The time constants and the gain were on the high side for easy use in a regulated power supply. The exciters used in the Filament Alternator Regulator and the 115 volt A-c Laboratory Supply Regulator have too small a gain and would require too many tubes in the output stage of the amplifier. A further investigation will be made to determine the availability of a machine with characteristics intermediate between the two.

5.3 Video Cabling

(C. W. Watt)

An abbreviation list has been prepared covering all abbreviations used in WWI video cabling, tube workings, and block diagrams. This has been discussed by Salzer, Murch, Fairbrother, and Watt, and will soon be issued. When new units are designed into the system the block diagram abbreviations given to them should be checked against this list so that duplications do not occur. Ray Fairbrother will keep the list up to date, and he should be consulted whenever questions arise.

(R. H. Murch)

The video cabling for electrostatic storage control has been designed, and is being measured. Information for their construction should be ready for the shop by the last of next week.

5.4 Unclassified

(H. S. Lee)

Installation and Power - The installation of the Synchronizer Pulse and Interphone systems has been completed and the systems have operated satisfactorily. Several minor additions will be effected in the near future.

6.0 BLOCK DIAGRAMS

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

E-260 was written to discuss a few cases where the timing of computer operation appears critical. In general, the difficulties lie in the proper coordination with various types of auxiliary controls (such as ES, AE) and with the constant-frequency restoration. The purpose of the note is to collect the cases for which timing is suspected to be critical in order to facilitate further investigation by testing. It is emphasized that only testing can decide if corrective measures are necessary. E-260 will be issued next week.

All timing diagrams are issued with drawing numbers B-37195 through B-37219. These refer to all operations discussed in E-235. For these operations the so-called traffic schedules were also completed and issued with drawing numbers running from SA-37224 through SA-37248. Traffic schedules are space-time sketches of the operations, and they prove to be handy for the design and check of operations. R. P. Mayer is preparing an explanatory note for timing of operations.

The complete control matrix block diagram was drawn up in three drawings (D-37192 to D-37194). The drawings follow the layout of the actual equipment so that they may prove handy references.

An Engineering Note is being issued on "Time Saved by Simultaneous Operation of AE and ES". This note includes a discussion of the method of analyzing coded problems with respect to the number of times certain orders are performed. It is interesting to note that in the code for Power Networks (E-169) by Phyllis Fox, the recently adopted ao order occupies from 33 to 40% of computer operating time (not including time for solution of simultaneous equations nor for film input or output).

7.0 CHECKING METHODS

(C. W. Adams)

A procedure for checking electrostatic storage after it is installed in the Whirlwind racks and before it is integrated with the system is being worked out. It seems likely that ES can be tested independently of the rest of the system by using only a few panels of test equipment and a little special cabling. It will be necessary (according to the plans being worked out) to use PR for testing ES. The rest of the system can get along without PR very simply by giving up part of the transfer check and using CR to replace PR.

(G. Cooper)

A memorandum (M-877) has been written detailing the approach being used in developing the test sequences. The sequence for the Arithmetic Control flip-flops is given. Comments from those interested are earnestly invited.

Work is continuing on the sequences for the CPO units.

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-150	The Pulse Mixer	-	12	6-28-49	R. R. Rathbone
E-259	Classified Bibliography on Conversion Between Analogue Quantities and Binary Numbers	Conf.	2	7-14-49	A. K. Susskind
M-788-1	Suggestions for Mental or Manual Binary Conversion	-	3	7-1-49	C. W. Adams
M-873	MS Thesis Proposal: Secondary Emission from Beryllium Surfaces at Low Incident Electron Energies	-	8	6-13-49	H. E. Rowe
M-875	Bi-Weekly Report, July 8, 1949	Restr.	32	7-8-49	
M-876	Progress Report: Study of Non-Linear Servomechanisms with an Automatic Digital Computer	-	2	7-11-49	J. E. Pierson
M-878	Construction of MWI Repetitive Units	-	1	7-21-49	Production Control

Library Files

	Proceedings of the IRE, July 1949	IRE
.004	European Scientific Notes, May 1 and 15, 1949	London ONR
47	Technical Information Pilots, U3341 - 3990	ONR, Library of Congress
134	Eastman Kodak Monthly Progress Report No. 11, Photographic Digital Reader-Recorder	A. W. Tyler
315	Boeing Magazine, February, 1949	Boeing
316	A Method for Designing Pulse Transformers: TP 49 - 198	AIEE
317	An Improved A-C Network Analyzer: TP 49 - 164	AIEE
318	A New Fourier Coefficient Harmonic Analyzer: TP 49 - 163	AIEE
319	Automatic Range-Adjusting Radiosonde Recorder: TP 49 - 152	AIEE

9.2 Standards, Purchasing and Stock

(H. B. Morley)

Standards - New standards issued and/or assigned:

S7.411-12 Test Specs. - Alarm Indicator Control 7-13-49

Specifications for the high voltage multi-pin connectors were submitted to the drafting room for preparation.

Procurement - Approximately 60 type 5687 Tung-Sol tubes from the last production run were found to be unsatisfactory for our use. Arrangements were made through Purchasing to exchange these with the factory for tubes from the current production run, at no charge.

Additional filing space has been provided in the Procurement Office for expansion of catalog reference files and Kardex cross-reference file.

Summer vacation schedules have occasioned some delays in deliveries from vendors; however critical items have been expedited without undue delay.

Samples are being ordered in an effort to find a better quality latching type relay than that presently listed in the Standards Book.

9.3 Construction

(R. A. Osborne)

Production Report - The following units have been completed since July 8th:

13	Program Counters modified
1	Teletype Synchronizer
10	Power Cables
48	Video Cables

(L. Prentice)

Machine Shop - We have finished the machine work pertaining to the water circulator and motor.

The work load in this shop will be heavy for the next month due to the vacation schedules and receipt of castings which are part of the DVG line.

9.3 Construction (Continued)

Work is now in progress on all parts of the DVG line except the castings. Work is nearly complete on parts for the supporting members of the storage tube mount.

Sheet Metal Shop - Work completed during the last period:

3	Special tool boxes and tool trays for storage tube
2	Digit interlock panels
10	Voltage variation panels
10	Fixed voltage switch panels
2	Rework 2 panels to fit WWI racks
1	Line holding oven.

Work in progress:

15	Rack fuse boards
6	Standardizer amplifier panels
1	Modify P5 scope case.

(A. Taylor)

Whirlwind construction is now proceeding on schedule.

(A. R. Curtiss)

Assembly work on the WWI RF pulser is now in progress.

A checking circuit and a gate generator were breadboard assembled, while work continued on a control panel for the portable vacuum system.

The electrolytic tank was completely assembled and checked for water tightness.

9.4 Drafting

(A. M. Falcione)

Roger Emerson is now working for the drafting department on power circuit schematics. Emerson was previously working as a technician. This transfer will assist the drafting department during the present very busy period.

Van Dyke drawings have been received from Power Equipment Company for the power supplies. MIT drawing numbers will be added to each drawing and prints issued to C. R. Wieser, John O'Rourke and files for maintenance and service records.

9.4 Drafting (Continued)

The drawings for the 10C Synchronizer will be delayed due to vacation schedules. We expect to have all the drawings completed by 1 August 49.

9.6 Time Schedules

(R. A. Osborne)

The following new time schedules have been completed.

C-34500	Summary - WWI Schedules
C-33455-1	Drafting
C-33456-2	Sheet Metal Shop
C-33457-2	Assembly Shop Time
C-31674-3	Power Cables - Drafting - Fabricate - Install
C-34503	6 Standardizer Amplifier
C-33629	2 Digit Interlock
C-33502	10 Voltage Variation
C-34504	10 Fixed Voltage Switching
C-33593-1	System Testing
C-31672-3	WWI Power Supplies
C-34501	In-Out Control Synchronizer
C-33590-1	Special Display Unit

10.0 GENERAL

(J. C. Proctor)

An oil burner is being installed in our boiler with a 4000 gallon oil storage tank in the old coal room. This will leave an area of about 500 square feet which will be used for storage. Lights have been installed, and the area will be cleaned and painted as soon as the tank is complete.

(H. R. Boyd)

Miss Ardis J. Gabbe has begun work as receptionist to replace Mrs. Shirley Ray who will be leaving August 31st. Miss Gabbe is a graduate of Bay City Junior College and has worked as a receptionist for two years in Michigan before coming to Massachusetts this month.

William H. Smith, Jr. has left Project Whirlwind to transfer to another project, DIC 6149 at the Hood Building.