Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, February 17, 1950

To: 6345 Engineers

From: Jay W. Forrester

1.0 SYSTEMS TESTS

1.1 Whirlwind I System Test

(N. H. Taylor)

The ES Storage Row is making slow steady progress. A number of circuit troubles continue to obscure the main problem of storage tube reliability, but last week several periods of cycling were obtained using ST 120 with final central control circuits. Marginal checking will be used to measure operating margins in these circuits.

An attempt to simplify the operation of storage tubes from the Test Control Room is being considered.

WWI with Test Storage is running along well. Several new people from other parts of the project are to join this group to learn the problems of systems testing firsthand.

The In-Out testing using the EK Recorder with the WW In-Out register has reached a stage where the recording of fixed numbers is satisfactory. The problem of generating and recording random numbers has just begun. This test is being made using the shifting ability of the In-Out register as a method of generating the random numbers.

After these tests are complete, the next step will be to test the EK unit as a reader.

1.1 Whirlwind I System Test (Continued)

(G. C. Sumner)

Work has continued toward the extension of voltage variation margins in WWI, with notable improvements being made in gate tube screen-grid margins. Small modifications are being made to the bus drivers to change the method of limiting and to equalize pulse amplitudes in the bus at 20 volts. The new circuit utilizes plate limiting in the 6Y6 bus drivers rather than the 7AD7 buffer amplifiers. Experience with the register drivers has shown that the 6Y6 is a much more satisfactory tube for plate-saturation limiting.

(C. Rowland and R. Read)

Operation of the first digit of Electrostatic Storage is improving steadily. Some cycling has been accomplished, but much improvement is necessary for suitable reliability. Most of the equipment in ES Row are production models, but the high-voltage power supplies are laboratory equipment. The storage tube mount is a prototype; a few changes in the mount have improved reading and writing.

There is still some 60 cycle fluctuation on the deflection transmission lines. About 1 volt fluctuation was traced to a poor contact, due to the lack of spring clips in the tube sockets, in the cathode circuit of a 715 deflection amplifier.

Marginal checking of the flip-flops in ES Control and in the ESD Decoders indicates that they are satisfactory. Further checking of the GT's and BA's awaits reliable cycling operations, which will be used for detecting failures.

(H. F. Mercer)

The following failures of electrical components have been reported since February 3, 1950:

CRYSTAL RECTIFIER	QUANTITY	COMMENTS
D-357	2	1 grid crystal in "B" Register serial number 15 replaced after 2237 hours because of excessive drift.

1.1 Whirlwind I System Test (Continued)

CRYSTAL RECTIFIER	QUANTITY	COMMENTS
		1 clamp crystal in Flip-Flop Storage Register serial number 6 replaced after 1787 hours because of excessive drift.
D-358	8	2 -- both were "one" side clamp crystals in Flip-Flop Storage Register panels serial numbers 24 and 32. The crystals were replaced after 1757 hours because of excessive drift.
		2 clamp crystals in Check Register serial number 9 replaced after 1555 hours because of excessive drift.
		4 clamping crystals in ESD Decoder serial number 1: One replaced after 282 hours because of excessive drift. Two after 519 hours: One because of excessive drift and one because it was shorted; the other after 531 hours because of excessive drift.
D-359	1	Bus driver crystal in Arithmetic Element Bus Driver serial number 12 replaced after 2329 hours because it was open circuited.
RELAY		
Allied Control Co. Type BJUX-17	1	In Power Bay Fuse Indication Panel replaced after about 200 hours because of fused contacts. For further details see WWI Log Feb. 14, 1950.

1.1 Whirlwind I System Test (Continued)

RESISTORS (Carbon)	QUANTITY	COMMENTS
220 ohms 1 watt	1	Plate decoupling resistor in Arithmetic Element Bus Driver serial number 12 replaced after 2270 hours because it burned out. Believe caused by varying +250 plate supply during Marginal Checking.
680 ohms 1 watt	3	Plate resistors in three Flip-Flop Storage Output panels serial numbers 1, 2, and 9. Replaced after 1768 hours because they showed effects of overheating. The resistors were later changed to 2 watts. For further details see WWI Log Feb. 10, 1950.
5000 ohms 8 watt (Wire-wound)	1	Crossover resistor in Flip-Flop Storage Register serial number 12 replaced after 1786 hours because it fell below the specified ± 1% tolerance.
TUBES		
7AD7	16	All 16 were flip-flop tubes -- 1 in Comparison Register serial No. 20 replaced after 680 hours due to change in characteristics. 1 in Accumulator serial No. 4 replaced after 2555 hours due to change in characteristics. 1 in B-Register serial No. 8 replaced after 2630 hours due to change in characteristics. 2 in A-Register serial No. 4 replaced after 2630 hours: one due to change in characteristics and the other because of control grid to cathode leakage.

1.1 Whirlwind I System Test (Continued)

TUBES	QUANTITY	COMMENTS
		1 in Flip-Flop Storage Register serial number 24, FFS4 digit 8, replaced after 1835 hours because of change in characteristics, low plate current.
		1 in Flip-Flop Storage Register serial number 32, FFS5 digit 0, replaced after 1835 hours because of change in characteristics, low plate current.
		2 in Accumulator serial number 10 replaced after 2585 hours. One because of control grid to cathode tap short and the other because of change in characteristics, low plate current.
		2 in B-Register serial number 10 replaced after 2639 hours because of change in characteristics, low plate current.
		2 in Flip-Flop Storage Register serial number 12, replaced after 1853 hours because of change in characteristics, low plate current.
		1 in Accumulator serial number 10 replaced after 2598 hours because of change in characteristics, low plate current.
		1 in Program Register serial number 29 replaced after 2442 hours because of change in characteristics, low plate current.
		1 in Accumulator serial number 6 replaced after 2629 hours because of change in characteristics, low plate current, and control grid to cathode tap short.

1.1 Whirlwind I System Test (Continued)

TUBES	QUANTITY	COMMENTS
7AK7	1	Gate tube in Flip-Flop Storage Register serial number 6 replaced after 1883 hours because of change in characteristics. Dynamic suppressor characteristics such that low margins existed with this tube on Marginal Checking.

All tube failures and all crystal rectifier failures, with the exception of those crystals which failed in ESDD, were found through Marginal Checking.

1.2 Storage Tube Reliability Tester

(H. B. Frost)

During the last period activity of the STRT was confined to the first week. During the latter week the author was engaged in preparation of a report on vacuum tubes. RT 113, RT 120, RT 122, and RT 105 were operated at various times, all during the first week of the period.

The research tubes mentioned above were constructed in an effort to determine the optimum mosaic mesh for use with high storage densities. All of these tubes are "stubby" 8-inch throw types. RT 105 contains the standard 40 mesh mosaic, RT 113 contains both 60 and 100 mesh mosaic (split mosaic), RT 120 contains a 100 mesh mosaic, and RT 122 contains a 60 mesh mosaic. The storage surface in RT 113 is not entirely uniform on either side, and results on this tube were inconclusive.

It was found possible to operate RT 120 in limited cycling tests with a 32 x 32 array under conditions which were very favorable for the storage tube. Under more rigid conditions, RT 120 and none of the other tubes would operate with this array density.

A method was devised and installed in which alternate spots in both horizontal and vertical rows may be written positive. This is believed to be a relatively rigid test of the storage surface. It was found possible to cycle this array for limited periods of time using RT 120 and RT 122 with a 16 x 16 array. No extended tests were attempted.

1.2 Storage Tube Reliability Tester (Continued)

Using the above array, operating limits of most of the critical parameters were measured for RT 120, RT 122, and RT 105. No definite conclusions could be drawn immediately as a result of these tests. More intensive work is planned during the next period which should provide some clarification.

1.3 Five-Digit Multiplier

(E. S. Rich)

The last error in operation of the Five-Digit Multiplier occurred on January 18. This represents the longest error-free run that has been obtained since the start of the reliability test. Since the marginal checking data has shown no significant changes in the past two-week period, no servicing work has been done.

The 15-volt bias regulator panel has been completed and given static tests to determine that the design values of the components used are correct. Inasmuch as the bias generator presently in use has stabilized somewhat, it was decided not to make any change in the system for a few weeks unless an error occurs or the generator shows signs of further deterioration.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

831 ST Mount

(R. E. Hunt)

Certain modifications to the ST Mount have been decided on, as follows: (Drawing changes should be made in about one week.)

1. The "Dzus" fasteners will be changed to a larger type "Cam-Lock" fastener.
2. Two handles will be added to each cover.
3. Longer feet to clear cover handles will be added on the back.
4. The mounting panel will be modified to incorporate a shorter tube.
5. The split shield has been modified to incorporate the shorter tube.

These modifications will be made on the sixteen under construction. Some of the completed 24 mounts may be modified at a later date.

2.2	WWI Drawing List	Block Diagram	Block Schematic	Circuit Schematic
	Block Diagram Symbols	B-37001-5		
	System Numbers	B-37250		
	System	D-37071-6		
100	Central Control	B-37098-6		
	Master Clock	C-37159-5		
101	Pulse Generator	B-37155-4	B-32385-1	E-32333-6
102	Program Counter	B-37062-6	B-32213-1	D-31516-9
103	Program Register	B-37067-4	B-39289-3	D-33836-4
104	Control Switch			
	Input Panel	B-37066-5	B-34321-1	
	Matrix Panel	B-37066-5	C-33843-3	R-32722-7
	Switch Panel	B-37066-5	B-34100	Z60CS00-2-J
	Output Panel	B-37066-5	B-34101	Z60CS00-F
105	Operation-Matrix Driver Panel		S600M00-B	Z600M00-1-J
105	Control-Matrix			
	(1-40), Rack C-9	D-37192		
	(41-80), Rack C-10	D-37193		
	(81-120), Rack C-11	D-37194		
105	Control-Pulse Output Unit		R60CP00	S60CP00-1-C
106	Time-Pulse Distributor			
	Counter Panel	B-37068-6	T60PD00-3-D	Y60PD00-F
	Output Panel	B-37068-6	T60PD00-4-C	Z60PD00-1-H
108	Storage Selection Control	D-37220-1	B-34230	D-34236
109	Clock-Pulse Control	C-39817-5	C-32642-5	E-31916-9
	Clock-Pulse Control	C-37159-5	A-34446	D-34416-1
110	Frequency Divider	B-37154-4	B-32264-1	R-31729-4
111	Synchronizer	B-37172-2	C-33485-1	R-33486-3
112	Restorer-Pulse Generator	B-37160-3	B-32209-4	D-31909-10

2.2	WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
200	Test Storage	B-37156-3		
201	Test-Storage Amplifiers		C-32855-5 C-33768-1	D-33706-4
201	Storage Switch			
	Input Panel	C-37121-3	B-34322-1	
	Matrix Panel	C-37121-3	C-32855-5	R-32722-7 D-33706-4
	Switch Panel	C-37121-3	B-34102	Z60CS00-2-J
	Output Panel	C-37121-3	B-34103	Z60CS00-F
202	Toggle Switch Storage			
	Switch Panel	B-37122-4	C-33768-1	D-33706-4 C-33707-1
	Output Panel (Main Bus)	B-37122-4	C-32080-1	E-32721-5
	Output Panel (Check Bus)	B-37122-4	C-32080-1	E-35019
203	Flip-Flop Storage			
	Output Panel	C-37060-6	B-32269-1	E-31635-9
	Register Panel	B-37057-5	B-32268-1	E-31621-8
	Control	B-37061-8	D-32106-3	
300	Arithmetic Element	D-37072-10		
301	A-Register, Digit 0	C-37056-4	B-31574-1	D-31573-8
301	A-Register, Digits 1-15	C-37056-4	B-31211-3	D-31276-12
302	Accumulator			
	Digit 0	D-37173-2	D-32851-1	R-32850-5
	Digit 0, Auxiliary Panel	D-37173-2	B-32492-2	D-32602-1
	Digits 1-14	D-37173-2	D-31213-4	R-31275-10
	Digit 15	D-37173-2	D-33964	
303	B-Register	C-37097-6	B-31212-5	D-31277-12
304	Sign Control & Divide-Error Control	D-37072-10	C-31576-3	E-31619-2
305	Step Counter	B-37074-8	D-31828-2	D-35049 Thru D-35057

2.2	WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
305	Step-Counter Output		A-32723-1	D-32735-2
306 307	Multiply & Shift Control	D-37072-10	C-31532-3	E-31588-6
308	Divide Control	D-37072-10	C-31552-4	R-31718-6
309	Overflow & Special Add Memory	B-37174-2	C-31575-5	E-31632-5
310	Point-Off Control	D-37072-10	C-31600-6	E-31717-6
400	Input-Output	D-37178-2	R-34866	
403	In-Out Register	D-37178-2	B-32434-3	D-31277-12
	IOR Auxiliary	D-37178-2	B-34860	E-34833
404	Comparison Register	D-37178-2	B-32578-4	E-32576-10
	Comparison Register Check	D-37178-2	B-33488-1	E-33515-3
410	Input-Output Control	D-37178-2	R-34866	
	IOC Synchronizer	D-37178-2	A-34320	D-34338-1
	IOC Program Alarm	D-37178-2	B-34834	D-34831
	IOC Read-Record Memory	D-37178-2	B-34859	D-34830
	IOC Interlock	D-37178-2	B-34835	D-34832
601	Check Register	B-39816-4	B-32577-1	E-32576-10
601	Check-Register Check	B-39816-4	B-32018-1	E-32023-4
602	Alarm-Indicator Control	B-37175-2	B-33603-1	E-33651-4
811	Write-Rewrite Timer	D-37220-1	B-34282	D-34283
	ES Control Counter	D-37220-1	B-34359	D-34360
812	ES Pulse Distributor	D-37220-1	D-34229	R-34266
813	ESTD Selector	D-37220-1	B-34231	D-34237
820	ES Deflection	D-37220-1	E-34770-2	
	ESD Gate Panel	D-37220-1	A-34036-2 E-34770-2	B-33876-3
	ESD Decoder	D-37220-1	E-34770-2	E-33908-3
	ESD Output	D-37220-1	E-34770-2	C-34182-1
	ESD Bank Selector	D-37220-1	B-34232 E-34770-2	D-34238
	Storage Selection Mixer	D-37220-1	E-34770-2	C-34311
	ESD Termination			B-34628-2

2.2 WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
831 ST Mount	D-37220-1		E-34040-4
832 EST Output			
RF Amplifier	D-37220-1		D-34315-3
Gate tubes	D-37220-1		C-34251-2
833 Signal-Plate Driver	D-37220-1	A-34711-1	D-34029-4
834 Gun Driver	D-37220-1	B-34712-2	D-34181-2
835 Holding-Gate Generator	D-37220-1	A-34354-1	C-34060-5
835 Read-Gate Generator	D-37220-1	A-34355-1	C-34324-5
835 RF Pulser	D-37220-1		E-34549-2
Standardizer Amplifier		A-33881-1	C-33880-3
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-32261-14
Register Driver, Type II		B-32691-3	D-32690-6
Bus Connections	C-37124-4	C-37123-3	
Fuse-Indication Panel			T60PP00-7-F
Voltage-Variation Panel			T60PP00-6-E
WWI Power-Connector Pin Connection (29 Pin)			C-31955-6
Digit-Interlock Panel			T60PP00-8-C
Fixed-Voltage Switching Panel			S60PP00-11-C
Power-Interlock & Indication Panel			Z60PP00-12-B
Power-Bay Fuse-Indication Panel			C-34473-2
Power-Supply Control		D-32017-5	D-33184-5
ESD Monitor			B-34756
LV Floating Power Supply			C-34652-5
500V Regulator			D-35031

2.2 WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
HG Anode Supply			D-34824-2
HV Cathode Supply			D-34977-2
600 Volt Rectifier			C-34909
Teletype Synchronizer			R-35189
Filament Voltage Control Panel			D-33098-2
Panel Selection Rack			R-39911
ES Power Supply Control Panel			D-35171
Filament Power Panel			C-32589
Regulator Video Probe Power			B-35184

2.5 Tubes and Components

(H. B. Frost)

During the last week continuous effort has been expended on the R-Report Vacuum Tube Life. This report, while not yet complete in draft form, is very nearly so. Work during the last period has included obtaining data for all illustrations and in preparing these illustrations for the drafting room.

During the last period shop time has been largely absorbed by testing and marking new tubes. In addition, a large number of interim tubes have been prepared and marked for WWI. These tubes are used in circuit testing when tubes are suspected of malfunction. A method of rolling tube-marking-paint on with a rubber stamp has been developed by K. Grinnell. This appears to be a faster and more satisfactory way of applying tube serial numbers. It does not appear to be entirely satisfactory for tube circuit numbers, however.

Additional pulse tests have been made on the Sylvania tubes SR 1407. An accelerated life test was checked for interface using test C 9002. (HBF notebook II p. 43) Only two of ten tubes showed slight interface development. From previous tests (M969) this is a good showing, and it appears that the cathode material being used is satisfactory. Previous tests had shown low pulse currents making them unsatisfactory for buffer amplifier use; however, two new tests C 9186 and C 9188 (HBF notebook II p. 52) show satisfactory pulse current. A third new test using beam-forming plates is expected during the next week. Small adjustments in plate current and cutoff appear to be required before this type is entirely satisfactory.

3.0 STORAGE TUBES

3.1 Construction

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

Three storage tubes with 40 mesh mosaics (ST145, ST146, ST147) for use in WWI were processed. We had not made any storage tubes in this 100-series with the long beam throw since 23 December 49. We have been making research tubes with the 60 and 100 mesh mosaic sizes and a reduced beam length.

Six storage tubes in the 200-series for WWI were made previous to this period. The 200-series are storage tubes with 40 mesh mosaics and reduced beam lengths. The storage tube test group felt that tubes in this series were not adequate for a 32 x 32 array. The E. S. Row group felt that the deflection sensitivities of the 200-series were different enough from the 100-series so that they would prefer a full complement of 16 tubes in the 100-series. Therefore we scheduled 6 tubes in the 100-series to complete the complement and have a few spares.

Three research tubes (RT122, RT123, RT125), similar to the storage tubes in the 200-series, with the exception of the target mosaic size, were processed. These tubes are being used to study the effects of beryllium mosaic size and the screen-to-mosaic spacing on stability when the density of storage elements is increased. RT122 had a 60 mesh mosaic and RT123 had a 100 mesh mosaic. The previous period we had given the test group RT120, which has a 100 mesh mosaic. RT125 had a 100 mesh mosaic target and a screen-to-surface spacing which varied from .002" to .014".

At present we have available two 100 mesh mosaics and one 60 mesh mosaic for other mosaic studies.

The complement of tubes for the study of storage tube cathode deterioration under standby conditions was completed this period.

A storage tube with both guns in one neck is ready for the glass shop and exhaust room.

(W. E. Pickett)

Glass Components - The final stage of construction of the much postponed 18-pin stem was completed during this last period. Four stems were made on the new single-head stem machine, with the result of three completed stems and one broken stem. As a first attempt in constructing this stem, three good stems out of four represents an exceptional yield for the first trial run. In this final construction of the 18-pin stem several small

3.1 Construction (continued)

difficulties were encountered which will be corrected before any more stems are made. In general, the construction of this stem was not too difficult after the application and direction of heat was solved.

The second glass lathe has been set up in the glass room. Because of this it has been possible to budget better the construction time of the storage tubes and evaporation tubes. At present the gas manifolds of the lathe and the crossfires have been connected and work well. As soon as a gas economizer is received and installed on the second lathe the efficiency of the lathe will be increased. Until such time as this gas econimizer is received, the lathe will be operated for the construction of the smaller assembly units which go into the final assembly of a storage tube envelope.

The supply of storage tube envelopes still remains in excellent condition. Although during this last period time out was taken for the construction of the 18-pin stem, the supply of storage tube envelopes on hand should take us through the next four weeks.

The supply of evaporation tube envelopes still remains as reported in the last bi-weekly. Although still low, the supply on hand will not cause any slow-down of the proposed evaporation tube construction program.

(J. S. Palermo)

Mechanical Components - Most of the mechanical components necessary for the 24 storage tube target assemblies have been received. The units will be completely assembled for WWI storage tube mounts as soon as expedient.

Inventory of all other components for silver and beryllium mosaics to target construction remains well ahead of schedule.

(J. O. Ely)

Three research tubes (RT117, 118, 119) were processed for use by Dana Collier in his study of deactivation of cathodes under standby conditions. These three tubes have normal cathode coatings but the cathode base metal is a passive alloy (DH 499). This completes the complement of tubes for Collier's work.

Planning for construction, processing, and testing of RT124, a storage tube having both guns mounted in a single neck, has been continued. All sub-assemblies for this tube are now on

3.1 Construction (continued)

hand, and construction is scheduled for Feb. 21 and 23, with processing scheduled for Feb. 24.

Three silvered surfaces on mica have been produced in vacuum system #4. Two of these surfaces have been inspected and found suitable for use in storage tubes. The third surface has not yet been inspected. In all three evaporations actual evaporating time was thirty minutes or less and at no time did pressure in the system rise above 2×10^{-5} mm of mercury. It appears that we will be able to produce silver surfaces on an average processing cycle of approximately 90 minutes.

Work on improving fixtures for evaporating silver and beryllium on system #4 has been continued. Major difficulty so far has been sagging of the tungsten heater at the high power inputs required for rapid evaporation. This difficulty has been eliminated by improved heater mounting clamps, redesign of the heater coils, and by coating the heater coils with a standard insulating coating such as is used on receiving tube heaters. It appears that the improved heater construction will allow from three to five evaporations before the heater will need replacement. This will result in a substantial saving in materials, labor, and setup time.

(R. Shaw)

Drawings of RT124 are in process. In this tube, a 3RP gun and a holding gun are mounted in the same neck.

Some layout work has been done on RT127, a tube with an inclinable target for studying the effect of angle of beam incidence.

A few 18-pin stems have been made, using the tools mentioned in an earlier report. Some possible improvements to the equipment have been suggested.

Work on the annealing oven has been interrupted, but will be resumed when other more pressing matters are finished. The proposed oven is somewhat larger than the present one. However, by the use of better insulation and by keeping the heat-capacity of internal parts as small as possible, it is hoped that the power requirement will remain about the same.

A subject index of all drawings relating to storage tubes is in preparation.

3.2 Test

(M. I. Florencourt)

Two new storage tubes passed standard tests satisfactorily - one in each of the 100 and 200 series - ST204 and ST145. Two storage tubes passed WWI static acceptance tests - ST202, ST203.

Two research tubes in the series to study mosaic size and spacing were given standard tests. RT122 which has a 60 mesh beryllium mosaic evaporated on its storage surface gave stability limits (operating limits) similar to those for the 40 mesh tubes. RT123 with a 100 mesh mosaic gave a narrower operating range of V_{HG} than the 40 mesh tubes, but a wider range than had been found on the other two 100 mesh tubes, RT113 and RT120. V_{HG} operating for RT123 are between 125 and 170V for static displays. Cyclic tests on RT113 and RT120 seem to indicate that minimum operating V_{HG} for these tubes is much less than 125V; this is due in part at least to the size of the charged areas used in cyclic displays.

(C. L. Corderman)

Pending the design and construction of an electronic deflection unit for the TV Demonstrator, a second stepping-relay deflection-box is being made. This box is being assembled in a manner which should simplify maintenance of the stepping relays and the increment resistors, and will be completed during the week of February 20th.

The electronic deflection unit under consideration may make use of the GE Binary Scaler, type SN1A, which is a 12AT7 flip-flop with all components mounted in an octal base. Since 10 such stages are required to count through a 32 x 32 array, the use of this scaling unit would minimize the space requirements.

A research tube with a variable collector to surface spacing, RT125-2, has been examined. While tests are not complete, preliminary observations indicate that a 2:1 variation in negative spot size is present when the collector spacing varies from 2 to 14 mils. The largest negative spots were obtained within the area of the surface having the greatest collector spacing.

Some time has been spent on the STRT this period in order to become better acquainted with the dynamic operation of the storage tube during the tests which may be carried out on that equipment.

3.2 Test (continued)

(K. E. McVicar)

An investigation of the effect of deflection of the beam on the storage action of the Whirlwind tube is being made. This study will attempt to use the television display system to provide the necessary data for the evaluation of the beam incidence effects.

The effect of beam angle on the storage properties results from a change in the secondary-emission ratio of the target with angle of incidence, interception of the beam by the deflection plates, and deflection defocusing. It will be the purpose of this study to separate, as far as possible, these three phenomena and isolate the effect of the change in secondary-emission ratio.

Qualitative measurements are currently being undertaken and satisfactory techniques evolved.

(H. E. Rowe)

Testing has begun on RT114, the beam analyzer tube with a 3RP electron gun. Faraday cage current is plotted vs. beam deflection on a scope. Initial tests show that one of the two slots in the Faraday cage collects about 1 1/2 times as much current than the other, in spite of the fact that before processing they were of the same dimensions. Therefore, determination of the current density in the beam will make use of a correction factor to be obtained from additional measurement of slot width after dissection of the tube.

(D. M. Collier)

In the master's thesis study of deactivation of storage tube cathodes under standby conditions, data has been collected using six special research tubes (RT's 94 through 99). In addition, RT's 117, 118, and 119 have been placed under study. Temperature studies with RT78 are being resumed. Results should be ready to report by March 3 or shortly thereafter.

4.0 INPUT-OUTPUT EQUIPMENT

4.1 Eastman Kodak Units

(E. S. Rich, D. Hageman)

Further work has been done in improving the timing between shift pulses, input pulses and CRT blanking in the Reader-Recorder.

Means were devised for recording a series of 16 different words in a repeated cycle, each word being the complement of the previous word shifted to the left one digit. Tests of this mode of operation have just been commenced. When the system can be made to operate in this fashion for a few hours without error, a study of the reading function will be undertaken as the next step in the testing program.

The recordings made in the past few weeks have indicated the need for increasing the relative humidity of the air in the film chanber to reduce film curling. This curling does not interfere with testing of the recording function, but it produces distortion in a recorded pattern which might be a source of error while reading. Mr. Proctor is studying ways of correcting this situation.

4.2 Display

(J. A. O'Brien)

The breadboard of the special display vertical decoder has been received from the construction shop and tested.

After a change in the supply voltage levels to overcome the effects of power supply fluctuations, the unit was found to perform very well and is apparently quite stable.

A breadboard of a floating bias supply is being constructed, and this will be used along with a spare storage tube Low Voltage Floating Power Supply to power the decoder while it is being tested in the computer.

4.3 Typewriter and Tape-Punching Equipment

(F. A. Foss)

Tape-Preparation Equipment - A breadboard relay circuit has been designed and is being constructed in order to test

4.3 Typewriter and Tape-Punching Equipment (cont.)

some of the control functions needed for preparation of a corrected tape. As its first function, it will control the tape-punch selector magnets during the number punching operation. This operation initiates the complement-punching operation which in turn orders the resetting of the equipment for another cycle. Secondly, the relay control circuits will order the tape reader to feed through those portions of the tape bearing only blank and nullify code combinations. The first meaningful code combination encountered on the tape will then initiate the tape punching operation if the coincidence requirements between the tape-reader and checking-typewriter relay registers have been met.

It has been noted that frequently the tape punch has failed to produce the code combination for a lower case letter following a capital letter and/or the code combination for the shift to lower case. This is evidently caused by the typist striking the letter key too soon after releasing the shift key.

(J. S. Hanson)

Output Printer and Tape Punch - The past period has been devoted to becoming familiarized with input-output equipment, and particularly to the development of high-speed relaying circuits to transfer digital information from the IOR and COR to Flexowriter tape punching and typing equipment. Initial designs of thyratron-operated relay registers with self-contained checking and alarm circuits have been worked out so as to preserve desired isolation from the computer itself. Self-checking electrical circuits between the relay registers, translator, coder, punch, and printer are being developed and tentative relay requirements listed so as to avoid tieups and delay in delivery schedules.

5.0 INSTALLATION AND POWER

5.1 Power Cabling and Distribution

(C. W. Watt)

It is planned to shut down the computer April 5 for perhaps a week to permit the installation of all storage tube power supplies and their associated control equipment. In addition, power will be turned off every Saturday morning until April 1 to allow installation and modification work to proceed. A special 2 day shutdown March 7 and 8 has been scheduled for the purpose of changing the power feed to the Program Register. Since this register doubles as the output register for Electrostatic Storage, it was thought necessary to isolate it from the voltage variation of the Arithmetic Element, at least for the present. When ES is integrated with the rest of WWI, the present power feed system may be restored.

A detailed schedule for all the installation work to be done through April 12 is being prepared. Due to the reduced manpower in the installation group it probably will be necessary to borrow men from the assembly shop to do this work, thus slowing down shop schedules a little.

5.2 Power Supplies and Control

(R. E. Hunt)

E.S.Power Supply and Control - Work on this section is progressing satisfactorily. The "E.S.Power Supply Control Panel" is out to be painted. All components are on hand and assembly should commence next week.

Design of the "Power Control Panel" is complete. Drawings are being checked at the present time, construction should start next week. All components are on hand.

Layout and design of the high voltage distribution system is in progress at the present time. The layout is nearly frozen; the design should be available in about one week.

Layout of the E.S. Meter Panel and Rack is being done at present. All meters have been ordered and incorporating them into the system will present no special problem.

5.2 Power Supplies and Control (cont.)

E. S. Power Supply Control block schematics, cabling diagrams and schematics are being given a final check at the present time. In general they are in good shape although many problems of cross-reference and component numbering arise in incorporating this system into the presently installed system.

(J. J. Gano)

Storage Tube Reliability Tester Power Supply - This equipment has been operated from the supply of the alternator intended for WWI d-c plate supplies. The 115 volt 3 phase regulated supply has been brought in directly from the transformer room and connected to a throwover switch so that either supply is available. If the 115V - 3 ϕ supply does not have disturbances sufficient to interfere with the reliability, the equipment will be kept on it. Otherwise, other provisions will have to be made.

Plate Alternator Regulator - Transient behavior tests are being conducted on the Silverstat regulator which came with the machine to determine its suitability for our application.

(W. J. Nolan)

Testing of the 500 volt regulator and 600 V rectifier has been completed and the circuits now appear to operate satisfactorily into a resistive or low-Q inductive or capacitive load. It is believed that these loads simulated the WWI load with sufficient accuracy but a final check should be made after installation is complete. The rectifier and regulator will be used in WWI on a temporary basis until final installation can be made.

5.3 Video Cabling

(T. Leary)

The R-F cables (791-804, 813-818) have been completed by the shop and are at present being tested. The shop is now working on 25 Video-Probe cables (1028-1052). Still to be done are the remaining ES Register-Driver cables (828-833) and a group of miscellaneous cables.

5.3 Video Cabling (cont)

The revised WWI abbreviations list (section S7.504 of the Standards book) should be issued by the time this bi-weekly appears.

6.0 BLOCK DIAGRAMS

(R. P. Mayer)

A modified block diagram for point-off control was suggested as an aid in clearing up an electronic difficulty existing in the point-off pulse distributor, which is asked to trigger at 2 mc. With the new connections, the distributor is asked to set once at the beginning of the process and to clear at the end. Except for the first pulse (Read AC to Bus), all pulses command "shift left", and any "one" pulse shifting into AC 1 is made to stop the process. With this arrangement, the point-off process will be completed in about half the time formerly required -- or one mc pulses may be used with practically no change in required time but with less danger of timing difficulties. This modified block diagram will not be used unless further tests show that it is desirable.

7.0 CHECKING METHODS

7.2 Display Programs

(C. W. Adams)

A display showing a cubic curve plotted with calibrated x and y axes has been photographed.

A program has been written to extrapolate to determine the value of sin nh and display it in converted (binary decimal) form on the FF register indicator lights for any desired values of n and h. Data taken from this program shows good accuracy even for a large number of extrapolated points.

7.4 Marginal Checking

(G. Cooper)

Several proposed changes in the voltage variation facilities are being considered from the point of view of their effect on the use of test sequences. One of the more promising proposals (made by G. C. Sumner) would use fixed suppressor and control grid voltages for most of the gate tubes in the repetitive units, while retaining the facility for varying these voltages for a limited number of suitably chosen gate tubes. If a failure appeared during the variation of the suppressor voltages of the gate tubes of the repetitive units, the failure would be isolated to this limited set. If no failure occurred while the suppressor voltages were varied, but a failure appeared while the screen voltages were varied, then the failure would be in one of the gate tubes which is not in the above set. An investigation is being conducted to select the optimum set of gate tubes whose suppressor voltages are to be varied, as well as the set whose control grid voltages are to be varied.

The test sequences which were developed as part of my thesis have been run in conjunction with marginal checking. The results confirm the belief that they can be used in trouble location, but the extent of their usefulness is not yet known. The data obtained is being studied to discover an answer to this question as well as to learn more about the factors influencing the margins available on various circuits. It is expected that such knowledge will be instrumental in increasing the reliability of operation.

8.0 MATHEMATICS AND APPLICATIONS

(C. W. Adams)

"Techniques for Using Standard Automatic Subroutines" is the title of E-329 which will be issued in a few days. This is the first of a series of notes discussing the detailed programming procedures proposed for use in Whirlwind I. A second note will eventually be issued which will catalog and record some of the basic subroutines (sin x, $\sqrt{x}$, e^x, log x, $\int_a^b f(x)dx$, etc.) in a form in which they can be actually used as a beginning for the library of subroutines which will be stored permanently on film. A third note is planned to discuss the preliminary routines which will be needed in setting up a new program on the computer. These preliminary routines will include (1) a routine for converting and storing in the computer a program which has been written in decimal form and typed on a Flexowriter typewriter, (2) a routine to select the proper subroutines from the library film, and (3) a routine to adapt the selected subroutines to the particular storage locations assigned to them in the program at hand. The routines are tentatively called (1) conversion, (2) selection, and (3) adaptation routines. Establishing these routines will essentially establish the form in which programs will actually be prepared for use in the computer.

9.0 FACILITIES AND CENTRAL SERVICES

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	No. of Pages	Date	Author
E-328	Pulse Transformers and Interstage Coupling in Whirlwind I	11	1-31-50	C. A. Rowland
M-977	Vacuum Tube Failures During January, 1950	2	2-3-50	H. B. Frost
M-980	Bi-Weekly Report, February 3, 1950	33	2-3-50	
M-981	Progress From Storing 16 x 16 to 32 x 32 Arrays	3	2-8-50	H. Klemperer
M-982	Aging of Beryllium Mosaic as Observed on ST112 Life Test	2	2-14-50	H. Klemperer
A-90-2	Thesis and Seminar Information	2	2-10-50	H. R. Boyd
A-106	Library Operation	3	2-9-50	H. R. Boyd

Library Files

.004	European Scientific Notes: 15 November, 1949; 1 December, 1949	ONR, London
180	Document Office Bulletin: February 3, 1950. Index Volume Three, January to December, 1949	RLE, MIT
232	Physics Today: January, 1950	Amer. Inst. Physics
280	Digital Computer Newsletter: 21 April, 1949	ONR
408	Initial Flight Tests and Theory of an Experimental Parallel Course Computer: TD Report No. 83, Sept., [illegible]	(F. J. Gross (H. A. Kay
444	Papers Presented to the Naval Ordnance Laboratory Magnetic Materials Symposium, 15 June, 1948	(Naval Ord. Lab., (Maryland
445	Air Route and Airport Traffic Control Study Guide: November, 1948; November, 1949	C. A. A.
446	Monthly Summary of Air Traffic Control Operations: November, 1949	C. A. A.
447	Bibliographies: Selected Government Aeronautical and Related Publications	C. A. A.
448	Operational and Technical Criterion of the Air Traffic Control and Guidance Problem: May 13, 1949	G. Litchford
449	A Study of the Effect of Winds Aloft on an Air Traffic Control Computer	(J. N. Marshall (A. B. Faunce

9.1 Publications (continued)

Library Files (continued)

No.	Title	Author
450	Federal Airways Manual of Operations: Procedures for the Control of Air Traffic	Dept. of Commerce; C. A. A.
464	Federal Airways Manual of Operations: Communications	Dept. of Commerce; C. A. A.
465	A Special Study of Operation "Vittles": April, 1949	Aviation Operations Magazine
466	Airport Planning	Dept. of Commerce; C. A. A.
467	Study of Air Traffic Control: Reports 2, 3, 5, and 6 of the Series	Dept. of Commerce; C. A. A.
468	Ferromagnetism at Very High Frequencies: Naval Research Laboratory Report No. R-3359	M. H. Johnson; G. T. Rado
469	Air Traffic Control: December 26, 1947	The Aeroplane; D. Barnett
470	Airways Operations Service: Volume I. History. June 30, 1948	Dept. of Commerce; C. A. A.
471	High-Stability Radio Distance-Measuring Equipment for Aerial Navigation	H. Busignies
472	Technical Progress Report Number Eight to the Steering Committee from Visual Design Laboratory: ERL Report No. E 3047	Electronics Research Labs., Air Materiel Command
473	Omnidirectional Radio Range System Using Simultaneous Amplitude and Phase Modulation: Technical Report No. 44; 28 April, 1949	Watson Labs.
474	Air Transport Facts and Figures	Aviation Week
475	Programming of Interdependant Activities: I. General Discussion	M. K. Wood; G. B. Dantzig
476	Production and Measurement of Ultrahigh-Speed Impulses. Impulse Breakdown in the 10^{-9} Sec. Range of Air at Atmospheric Pressure: Technical Reports XX and XXI, Insulation Lab., MIT	R. C. Fletcher
512	Abbreviations and Symbols: Cross Reference Dictionary: Ordnance Department, Fort Bliss, Texas	Hist. & Edit. Section, Res. & Dev. Div.
597	MIT Reports on Research: February, 1950	MIT

9.2 Standards, Purchasing and Stock

(H. B. Morley)

Standards - New and revised standards:

S 7.412-5 831 Storage Tube Mount - Test Specifications (Revision)

S 6.181-D Terminal Blocks - Barrier Type - High Voltage

Procurement and Stock - Considerable quantities of material have been rearranged and moved from the stockroom, resulting in much improvement in appearance and better facilities for storage of active stock.

The program of equipment inventory and records revision has been started, and will probably continue over a period of several weeks. All equipment records will be checked and verified, and equipment inventories will be taken in the building and at Fort Heath. The work can be considerably expedited if any items of test equipment not being used will be turned in to the stockroom.

Items of used equipment and material being turned in to the stockroom should be marked to designate whether for salvage or storage. If to be stored for possible future use, enough information should be included to enable persons unfamiliar with the equipment to properly identify it.

9.3 Construction

(D. V. Mach) -

The 500 volt regulator for WWI is being inspected.

Another automatic TV control box is under construction.

The method of testing storage tubes for deflection sensitivities is being modified to obtain greater accuracy. Testing and alignment of the mounts will take longer for each unit than was originally expected, due to the necessity of measuring deflection sensitivity and focus voltage on the older tubes, then measuring Allen Bradley resistors for the deflection circuits due to lack of sufficient range of resistance in stock of Noballoy 1/2% resistors.

9.3 Construction (continued)

(L. Prentice)

Machine Shop - A new cross feed screw and a new compound feed screw were installed in the 13 x 30 P & W lathe. We are now making a small face plate to facilitate the manufacture of back plates for storage tubes. Other additions are: center sleeve, collet sleeve and alterations to draw-in bar.

Machine work for the last period has been for the most part small pieces for storage tubes and parts for power supplies.

Sheet Metal Shop - We have completed some covers and parts for power supplies. Lack of drawings has allowed us to complete several guards suggested by the safety committee. If the present work load continues we will complete the guards for the M.G. sets in time for the shutdown scheduled for April 5.

(R. A. Osborne)

Production Report - The following items have been completed and inspected since February 3, 1950.

11	Gun Drivers
18	EST Outputs
25	Video Probe Brackets
8	RF Cabling Terminator Boxes
1	15 Volt Bias Supply for Multiplier - (breadboard)
1	Display Vertical Decoder - (breadboard)
114	Video Cables

9.4 Drafting

(A. M. Falcione)

WWI Master Drawing List - A tentative WWI master drawing list and general rack layout of computer including power supplies and test equipment has been distributed. Corrections and alterations will be necessary; it will, however, serve as a guide to those requiring the ready source of information therein contained. Constructive criticisms will be appreciated as to any other drawings which should be incorporated for completeness of this master set. Lacking parts lists and other necessary drawings will be made as time permits.

9.4 Drafting (continued)

Security - In accordance with our established procedure of security we are sending out approximately 1000 tracings for microfilming. These microfilms are placed in permanent storage for future reference.

Work Load - Drafting load is moderate. At the present time we have on hand sufficient work load for the next three weeks.

10.0 GENERAL

(H. R. Boyd)

Non-Staff Terminations

Robert P. Ham
Vance S. Lemon
Frank C. Turner