Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, December 23, 1949

To: 6345 Engineers

From: Jay W. Forrester

1.0 SYSTEMS TESTS

1.1 Whirlwind I System Test

(N. H. Taylor and S. H. Dodd)

The Eastman Reader Recorder has been undergoing circuit changes to improve sensitivity to prf. This work was interrupted by a power shutdown December 15 but substantial progress had been made at that time and considerable improvement in performance was evident.

In the Storage Row the high frequency response of the r-f output system was found inadequate for the television display. Modifications in sweep speed were made to avoid this difficulty. Planning for future testing and test equipment in the storage row is now in progress.

In the system itself automatic marginal checking has successfully located a few low margins which may well have been overlooked without it. By running this automatic sequencing arbitrarily on all the test and display problems, a trouble was located due to the ringing of filter chokes when the computer was subject to certain program routines.

Detailed planning concerning the test equipment which will fill the 9 new racks in the Control Room is under way. These plans call for some enlargement of the Control Room itself to make room for typewriters, Reader Recorders, and the increased personnel needed to integrate the rest of the system.

1.1 Whirlwind I System Test (Continued)

(G. C. Sumner)

The system test group has continued to spend a large amount of time on using automatic marginal checking equipment. Much information is being gained to determine what circuit on a variation line fails first and why. In several cases changes are indicated. For example, it was found that the first failure (in each digit) in lowering +90 V in the repetitive units was improper readout of FF storage. In this case, the screen voltages of three stages in cascade (two gate tubes and an inverter) were being varied simultaneously. Thus the operating margins of other gate tubes in the repetitive elements were being masked. This situation is being improved by installing, during the present shutdown, fixed voltage for the inverter screen grids.

Switch time of the control matrix has been improved by changing peaking inductors from 10 microhenries to 50 microhenries and adding clipping crystals. Some lines, notably sp, were nearly marginal in rise time.

(C. Rowland and R. Read)

Plans are being made to move the ES test control and viewing scopes to the control room. The equipment will be operated in its present location until about January 15 when the cables and other special test equipment units will be available.

(H. F. Mercer)

Component Failures in WWI

TUBES	QUANTITY	COMMENTS
7AD7	11	1 Flip-Flop tube in Accumulator Serial #11 replaced after 1373 hours of operation because of control grid to cathode tap short.
		1 Buffer Amplifier tube in Bus Driver Arithmetic Element Serial #16 replaced after 2293 hours because of change in characteristics, low plate current.

1.1 Whirlwind I System Test (Continued)

TUBES	QUANTITY	COMMENTS
		1 Flip-Flop tube in Clock Pulse Control replaced after 1723 hours because of tap short.
		2 Flip-Flop tubes in Divide Control replaced after 2345 hours: one because of low plate current and the other because of control grid to cathode tap short.
		1 Flip-Flop tube in Flip-Flop Storage Register Serial #6 replaced after 1592 hours because of control grid to cathode tap short.
		2 Flip-Flop tubes in Program Register Serial #26 replaced after 1260 hours because of plate to shield leakage.
		2 Flip-Flop tubes in B-Register Serial #13 replaced after 2385 hours, one because of control grid to cathode leakage and the other because of change in characteristics.
		1 Buffer Amplifier in Control Pulse Output Unit Serial #51 replaced after 512 hours because of change in characteristics.
7AK7	1	Gate tube in Point-Off Control replaced after 1956 hours because of change in characteristics.
CRYSTAL RECTIFIERS		
D-357	3	1 Grid crystal in B-Register Serial #13 replaced after 2200 hours because of excessive drift.
		2 Grid crystals in Control Switch Switch Panel replaced after 1617 hours because of excessive drift.

1.1 Whirlwind I System Test (Continued)

CRYSTAL RECTIFIERS	QUANTITY	COMMENTS
D-358	3	2 Clamping crystals in ES Deflection Decoder replaced after 366 hours because of excessive drift.
		1 Crystal between line #27, shift left, and vertical program timing line of Operation Matrix replaced after 2227 hours because of excessive drift and low back resistance.
CAPACITORS		
0.001 MFD Mica	1	Coupling capacitor in Toggle Switch Storage Output panel replaced after 1547 hours because of faulty pigtail connection which caused erratic operation.

1.2 Storage Tube Reliability Tester

(H. B. Frost)

During the last period the tester has cycled ST 110 for periods up to 5 hours. No attempt for an extended run was made.

Two modifications of the block diagram were made during the last period. It was found that register panels and DVG flip-flops tended to stall at any interruption of restorers. This was attributed to the long restorer interval used. Therefore, the restorer interval was shortened to 20 microseconds from the 50 previously used. This requires the use of two restorer intervals for one read-write interval. At present, this time is further extended to four intervals or 80 microseconds. Only half of the intervals are used.

The other change in the block diagram involved the elimination of re-writing of spots. Only when the information on a spot is to be changed is the spot written at present. This is possible in the reliability tester because of the long interval between reads. A study should be made of the minimum interval allowable between reads before re-writing is necessary.

1.2 Storage Tube Reliability Tester (Continued)

RT-105, an experimental storage tube with an 8 inch throw in comparison to the usual 12 inches, was installed in the reliability tester and has been tested very briefly. 16 x 16 arrays were cycled with very little trouble. The DVG was then cabled to supply a 32 x 32 array; it was found that this would cycle with some errors. The low deflection sensitivity of RT-105 made modifications of the TV sweep generator used in the reliability tester necessary in order to cover the signal plate completely. Minor troubles in the r-f system of the reliability tester have made more testing difficult to date.

1.3 Five-Digit Multiplier

(E. S. Rich)

There have been two periods of incorrect operation in the multiplier during the past two weeks. Continuous errors were recorded over the week end of December 4 and 5, and also on December 12 and 13. In both cases the errors were caused by failure of the -15 volt bias-supply generator. After the first failure the generator was disassembled for inspection and cleaning and new brushes installed. After the second failure the commutator was turned down and the mica was undercut.

A third relay error-counter has been installed in an effort to resolve some random counts that have been occurring on one of the other two counters. This additional counter has shown that these random counts have not been due to errors in the multiplier system.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

203 Flip-Flop Storage

(W. Papian)

It has been noticed that an audio-frequency damped oscillation occurs on the 90-volt supply to the gate-tube screens in each digit of Flip-Flop Storage, particularly at some duty factors. Again, the offending circuit consists of the digit-rack filter-panel choke (1 MH) and condenser (1 mfd), plus miscellaneous other capacity and load (see last Bi-weekly under 2.1 - 203). Removal of the condenser only changes the frequency; shorting the choke kills the oscillation; shunting the choke with 22 ohms resistance greatly reduces the oscillation, but presumably also reduces the efficacy of the filter. Reducing the amplitude of the current step taken by the panels is possible, but looks difficult at this writing.

The whole question of the use of high-Q circuits in such places needs reviewing. As long as current steps of any sort are possible, the danger of large ringing oscillations will be present. In view of this, perhaps it might be advisable to add damping to the filters, while taking the calculated risk of a reduction in filter efficiency where it can probably be afforded.

410 In-Out Control

(K. E. McVicar)

Tests on the Input-Output Element indicated that it was reliable enough for preliminary connections to the film unit and a step-by-step tie-in was made.

As far as the Input-Output element was concerned the tie-in was a complete success, and some films were made in which alternate ones and zeros were recorded. The versatility of the test set-up was such as to permit a complete interchangeability of the simulated pulses with those produced by the reader-recorder except for the initiation pulse. The cause for trouble in this case has not as yet been ascertained.

A complete description of the test equipment used as well as a block diagram is being prepared for issue as an Engineering Note.

602 Alarm Indicator

(R. H. Gould)

In order to simplify trouble shooting of the computer, an alarm indication light will be installed that will remain lighted only while an alarm is being received. The modification will probably consist of replacement of one of the 2D21 alarm indicator tubes in the alarm-indicator control with a triode and integrating circuit similar to the standard flip-flop indicator circuit. One of the spare incandescent indicator lights in test control will be replaced by a neon light controlled by the triode.

700 Console

(C. W. Watt)

The need for consolidating test controls for electrostatic storage and Input-Output with the rest of WWI has led to the enlargement of the control room. The partition that has enclosed the Eastman equipment has been removed, the air ducts overhead are being straightened out, and a section of duct is being lowered to permit easier access for new video cables. Power strips for the additional Test Control Racks are being installed, power switches and indicator lights are being rearranged for greater clarity, and all digit master switches are going to be moved to test control. The latter will not be done for a few weeks, pending fabrication of a new switch panel.

831 ST Mount

(R. E. Hunt)

ST Mount construction is running about one and one-half weeks behind schedule.

10 mounts are now in process in the construction shop. Probably about one more week will see them finished and ready for inspection.

834 Gun Drivers

(C. W. Watt)

Production is continuing, and the production quantity of 18 should be finished by January 9, one week behind schedule.

		Block Diagram	Block Schematic	Circuit Schematic
2.2	WWI Drawing List			
	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	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-33843-2	R-32722-5
	Switch Panel	B-37066-5	B-34100	Z60CS00-2-J
	Output Panel	B-37066-5	B-34101	Z60CS00-E
105	Operation-Matrix Driver Panel		S600M00-B	Z600M00-1-G
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 Delay	C-37159-5	A-34446	D-34416
110	Frequency Divider	B-37154-4	B-32264-1	R-31729-4
111	Synchronizer	B-37172-2	C-33485	R-33486-2
112	Restorer-Pulse Generator	B-37160-3	B-32209-4	D-31909-10
200	Test Storage	B-37156-3		

2.2	WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
201	Test-Storage Amplifiers		C-32855-4 C-33768	D-33706-3
201	Storage Switch			
	Input Panel	C-37121-3	B-34322-1	
	Matrix Panel	C-37121-3	C-32855-4	R-32722-5 D-33706-3
	Switch Panel	C-37121-3	B-34102	Z60CS00-2-J
	Output Panel	C-37121-3	B-34103	Z60CS00-E
202	Toggle Switch Storage			
	Switch Panel	B-37122-4	C-33768	D-33706-3 C-33707-1
	Output Panel	B-37122-4	C-32080	E-32721-5
203	Flip-Flop Storage			
	Output Panel	C-37060-6	B-32269-1	E-31635-8
	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-31277-11
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
305	Step-Counter Output		A-32723-1	D-32735-2

2.2 WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
306 Multiply &		C-31532-3	E-31588-6
307 Shift Control	D-37072-10		
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		
403 In-Out Register	D-37178-2	B-32434-3	D-31277-11
403 IOR Auxiliary	D-37178-2	B-34860	E-34833
404 Comparison Register	D-37178-2	B-32578-4	E-32576-10
404 Comparison Register Check	D-37178-2	B-33488-1	E-33515-3
410 10C Synchronizer	D-37178-2	A-34320	D-34338-1
10C Program Alarm	D-37178-2	B-34834	D-34831
10C Read-Record Memory	D-37178-2	B-34859	D-34830
10C 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
831 ST Mount	D-37220-1		E-34040-3

2.2 WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
832 EST Output			
RF Amplifier	D-37220-1		D-34315-2
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
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	E-32261-12
Register Driver, Type II		B-32691-2	D-32690-5
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			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-34473-1
Power-Supply Control		D-32017-5	D-33184-4
ESD Monitor			B-34756
LV Floating Power Supply			C-34652-4
500V Regulator			D-35031

2.2 WWI Drawing List (Continued)	Block Diagram	Block Schematic	Circuit Schematic
HG Anode Supply			D-34824-1
HV Cathode Supply			D-34977-1
600V Rectifier			C-34909 (cabling Diagram)

2.5 Vacuum Tube Studies

(H. B. Frost)

During the past period, shop time has been devoted to testing and marking all tubes in the Eastman Reader-Recorder units. This has been completed and the tubes returned to the proper sockets. Several defective tubes were replaced. In addition, tubes for the low voltage floating power supplies were tested.

Secretarial time has been devoted to completing WWI tube records as to hours in service. This information is changed as the spare panels are placed in service or their functions changed.

The SR 1407 (modified 7AD7's) reported received during the previous period have been preburned. After 100 hours, the standard period, all tubes were down about 4 ma from the previous readings. The tubes were preburned for another period of 160 hours, after which all readings were within 2 ma of the initial readings. These tubes will now be tested for circuit applications. As indicated by the initial test, the plate current is not yet as great as is desired for our uses.

The report on life test results previously mentioned is now to be revised. A draft as an E-note has been completed; however, this will now be expanded and revised to be issued as an R-report.

3.0 STORAGE TUBES

3.1 Construction

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

Four storage tubes (ST141, ST142, ST143, ST144) for use in WWI were constructed and processed. In order to use our facilities for the construction of research tubes we made only three evaporation tubes. Therefore we had to use two beryllium mosaics from the stock pile of mosaics which were assigned for research tubes.

Eight research tubes were constructed and processed in this period. Six of these research tubes will be used to investigate cathode construction methods. The seventh research tube (RT104) will be used to line up the deflection circuits in WWI storage tube mounts. The eighth research tube (RT105) was a large research tube similar to a regular storage tube except that the spacing between the target assembly and the high velocity gun was 8 inches instead of 12 inches. This reduced beam length was achieved by moving the high velocity gun 2 inches toward the target and cutting 2 inches out of the body of the envelope.

Since the test results on this tube were encouraging the test group requested two more tubes of this reduced beam length to study these tubes in all of their facilities. During the past six weeks we had a consistently good run of WWI storage tubes. Therefore we felt justified in scheduling two research tubes of this reduced beam length the first week of the next bi-weekly period.

Mr. J. Kelar of Engineering Research Associates, formerly of RCA Cathode-Ray Tube Division, suggested that we use a 7JP type gun instead of the 5UP type. His suggestion was based on the facts that an oscillographic cathode-ray tube gun like the 5UP was designed to work with considerable negative bias, whereas the 7JP type gun was designed to produce television rasters. We have a 7GP gun which we will study in a moving Faraday cage research tube pending the procurement of some 7JP guns.

(W. E. Pickett)

Glass Components - During this last period construction of storage tube envelopes continued and we now have on hand a supply sufficient to take us through the next bi-weekly period.

The supply of evaporation tube envelopes still remains very low, due to the lack of bulbs used for making this envelope. We

3.1 Construction (Continued)

should have enough evaporation tubes prepared to take us through this next period.

During the next bi-weekly period, time will be spent on constructing an 18-pin stem. We have already received the dies for making this 18-pin stem and the necessary fixture for holding these dies is being prepared and should be ready for use soon.

During this last bi-weekly period, a 20° angle 2-arm envelope was constructed for use in a research tube.

No unusual difficulties were encountered.

(J. S. Palermo)

Mechanical Components - Numerous experiments have been conducted in the past two weeks to produce cleaner evaporation and storage tube screens. The method used to date has been adequate but considerable microscopic probing has supplemented the original cleaning process. The writer has suggested an acid technique which has produced good results. However, with the introduction of certain variables, a revised technique was substituted which has produced better results. ST144 has a screen cleaned by the acid process, although it had been cleaned as per W-104.2a previously. Therefore the next tube, namely RT109, will have the first screen cleaned only by the use of warm chromic acid (H_2CrO_4). It is also suggested at this time to use a similar technique in the cleaning of evaporation tube screens in addition to hydrogen firing.

The present inventory for evaporation tube and storage tube target assemblies is very good. Procurement of an additional order for parts will be submitted shortly due to the replacement of about 10 target frames which have been used repeatedly for the past 4 months for evaporation tube target assemblies. We also have at present 5 silvered mica targets ready for evaporation tube target assemblies, in addition to 3 others which have been sent to High Vacuum for silver processing.

(R. Shaw)

Additional target assembly fixtures have been drawn and are being made in Bldg. 32.

Layouts were made of various possible short-throw storage tubes, and a tube was made in accordance with one of these.

3.1 Construction (Continued)

The final assembly drawing for the WWI storage tube is being held in abeyance pending a possible change to a shorter tube.

The storage tube drafting group has been working on tools, research tube drawings, a target assembly for silver evaporation and thesis illustrations.

(J. O. Ely)

Six research tubes for cathode study were processed. These tubes are of the same design as RT88 and will be used by Collier in his thesis work. One research tube (RT104) for use in lining up deflection circuits in the WWI ST mounts was constructed and processed.

Our conference with Mr. Kelar of Engineering Research Associates produced a number of interesting facts and suggestions concerning electron-gun construction. A memorandum concerning this conference will be written soon for distribution to members of the storage-tube construction group involved in gun construction.

3.2 Test

(H. Klemperer)

During this period tube development work was directed toward the aim of obtaining more spots on the storage surface by reducing the length of the writing and reading electron beam. Evaluation of data obtained with RT67, the tube that was designed to measure the electron density in the beam at various distances from the gun, showed that the current density in the beam varied roughly with the inverse square of the beam throw. Thereupon a storage tube (RT93) was built with a storage surface that could be moved between distances of 5 and 12 inches from the electron gun. Experience with this tube showed that a storage of 32 x 32 spots on the present 4" target appeared feasible with only minor changes in the construction of our present storage tubes, if the beam length was reduced from 12" to 8". A storage tube with an 8" throw was built (RT105-1) and, in the static test with the television readout, it came up to expectation. Testing of this tube is being continued to explore the effects of larger deflection angles, increased angle of incidence upon the target, and the effects of smaller spot size on the present mosaic.

(D. M. Collier)

The past two weeks have been utilized to study the variation of cathode temperature as observed by an optical pyrometer

3.2 Test (Continued)

with the slope of curves of $\log_{10} i_b$ vs e_b. For metallic emitters, this slope is inversely proportional to the temperature of the emitting surface. For oxide-coated emitters, such curves appear to have a constant slope regardless of the temperature. RT78 is being used for this study. A continued effort is being made to correlate the power input to the heaters with the temperature of the emitting surface. Since most of the power is radiated and only a little is conducted, power input seems to vary as the temperature to the $\frac{7}{2}$ power (approximately). Only an approximate empirical relationship can result from this study, since slight variations in construction among tubes can change the power vs. temperature relationship and since changes during the life of a single tube can slightly modify it. It would appear that maintaining a constant heater voltage is the only reasonable approach to the study of cathode emission phenomena. Temperature variations are not readily controlled. This fact must, of course, be considered in the evaluation of results.

(M. I. Florencourt)

Three storage tubes were tested during the past two weeks. ST140 became gassy and the cathode of the holding gun was ruined. An attempt to reactivate it failed. ST141 and ST142 both passed the static standard tests satisfactorily.

RT93, a research tube in which the storage assembly could be moved toward the guns, was tested further. During the previous bi-weekly period it had been given standard tests at standard gun to target separation. Further tests were run on spot size, holding beam coverage, spot density and deflection sensitivity at various gun to target spacings. Results with this tube indicated that a tube with 8" gun to target spacing might permit storage of a 32 x 32 array with no change in either gun design.

RT105 was therefore built -- a storage tube standard in every respect but gun to target spacing. Standard tests run on this tube showed that it passed static tests, and furthermore showed that a 32 x 16 array could be written in the upper half of the surface as had been indicated by results on RT93.

(H. Rowe)

Tests have been run on RT102 and RT104 to determine beam and deflecting plate currents as a function of the beam deflection. Similar tests will be run on a 3JP1, a standard cathode-ray tube.

4.0 INPUT-OUTPUT EQUIPMENT

4.1 Eastman Kodak

(E. S. Rich)

The first film recordings were made with the reader-recorder functioning with the Input-Output equipment. These recordings were made to determine the proper time relationships between the monitoring and shift pulses out of the film unit and the word and complement pulses into the unit. The recently redesigned phototube-and-preamplifier circuits were used in these tests. Satisfactory results were obtained.

Work on this unit has been suspended during the power shutdown. However, an improved layout of the phototube-and-preamplifier circuits for the monitoring phototubes has been built and installed and will be tested after the shutdown.

A failure of a fan motor on the torque motor driving the film-supply magazine occurred prior to the shutdown. A replacement has been obtained and will be installed in time for tests to resume the first of January.

4.4 Unclassified

(J. A. O'Brien)

During the week of December 12, O'Brien, Taylor, and Rich went to various laboratories investigating different devices and developments that might be applied to computer Input-Output problems. The places visited were Engineering Research Associates in St. Paul, Minnesota, Wright Field in Dayton, Ohio, General Precision Laboratories in Pleasantville, New York, and the Federal Telecommunications Laboratory at Nutley, New Jersey.

5.0 INSTALLATION AND POWER

5.1 Power Cabling and Distribution

(H. S. Lee)

On December 15 the computer was inactivated. Within the subsequent week the installation group has accomplished the following:

1. Removed temporary wiring in ES Control, ES Deflection and E0 through E3 inclusive.

2. Installed preformed cables in E0 through E3 inclusive and between E0 through E3.

3. Installed permanent interrack wiring between EX3 through EX8 inclusive.

4. Installed power feeders from power racks to:

a. ES Control	EX3 through EX6
b. ES Deflection	EX7 and EX8
c. ES Digits	E0 through E15
d. ES Drivers	ED

5. Installed new "Power Bay Fuse Indication Panel" and associated cables and wiring.

6. Installed power relay interlock and control circuits for the LV circuits of the racks referred to in paragraph 4 above.

7. Installed HV conduit, junction boxes and wiring in E row.

It is believed that approximately seventy per cent of the installation projected for the two week shutdown has been completed. It is expected that testing of the installation will be started on Wednesday, December 28. It should be noted that to date all the preformed cables for the E row have not been received from Gavitt, but this will not hinder testing of the system as the missing cables are external power cables for panels.

Mr. R. W. Biggs of the New England Telephone and Telegraph Company, who has been attached to the project in an advisory capacity, has been recalled by his organization. He has been instructing Murch and O'Rourke in the proper adjustment and maintenance of relays.

5.1 Power Cabling and Distribution (Continued)

The relay maintenance activity is progressing but not as speedily as planned. This is primarily due to incorrect and inadequate information from the relay manufacturers plus the necessity for devising and fabricating special tools and test equipment for our particular applications. It is believed that the pace of the program can be accelerated within the next week now that the initial difficulties have been surmounted.

5.2 Power Supplies and Control

(R. E. Hunt)

Some modifications are being made to WWI power supply control during the present power shutdown. An overheat interlock is being added, which consists of a room type thermostat mounted above rack A.D. This thermostat may be set from 75°F. to 105°F.

An overheat trouble-light and a reset switch will be mounted on the power supply control panel.

The thermostat will probably be set initially at 90°F. An excessive temperature will be equivalent to unlocking the off switch--the plate voltages will drop out immediately and the filaments will sequence off.

An individual voltage light is being added for each WWI voltage including filaments. These lights indicate directly whether there is a voltage on the bus.

(J. J. Gano)

Arrangements have been made with the Tube Testing Laboratory to use marked tubes in our power supplies and to test them periodically. We are writing to the manufacturers of the thyratron tubes for recommendations on a test procedure for the purpose of anticipating failures.

The design of a permanent power supply for the marginal checking regulator will get underway at once.

(R. E. Hunt)

E.S. Power Supply Control - Design of this system seems to be stabilized and satisfactory to all concerned now.

5.2 Power Supplies and Control (Continued)

Work is progressing to outline cabling and work out schematics for connecting panels and power supplies. At present it looks as if the E.S. Power Supply Control Panel will be located in EX2. The master switch and indicator lights will be located in the operators console. Main fusing will be located in P5. No decision has yet been made on the location of Voltmeters.

All components needed except a voltmeter for the HV Cathode Supply have been ordered or are on hand.

Layout of the E.S. Power Supply Control Panel will start almost immediately.

(C. W. Watt)

Low Voltage Floating Power Supplies - These are complete in the shop and await testing.

(W. J. Nolan)

One of the production models of the low voltage floating supplies has been tested and found to perform satisfactorily. Specifications have been written for the testing of the remaining units.

Preliminary tests on this supply indicate that it will be stable to within 0.2 volt at 150 volts output. This is not as good as would be desirable for use as the increment voltage source for the decoders but will probably be useable. When the other units become available a more extensive test will be made.

(C. W. Watt)

High Velocity Cathode Supply - Fabrication of the sheet metal panel for this supply is expected to be done by January 1. Assembly will be done by the storage tube group. Covers will be fabricated later.

500 Volt Regulator - The sheet metal panel for this supply is complete and painted. The phenolic is being made. Assembly will be done by the storage tube group. Covers will be fabricated later.

5.3 Video Cabling

(T. Leary)

The present status of video cabling for Electrostatic Storage is as follows:

1. Schedules for the gun-driver cables (778-790) have been issued and fabrication of these cables by the shop is fifty per cent complete.

2. Schedules and construction requisition for the ES Deflection cables (805-814) have been issued and these cables will be fabricated by the shop after completion of the gun-driver cables.

3. EST Output cable schedules (cables 791-804) are complete in rough form. When available shop time becomes imminent, these cables will be measured and schedules and construction requisitions issued.

4. The installation of ES Control cables is complete except for five cables which must be remade and two new cables not originally called for.

5. Thirteen temporary cables from ES Control to ES Test Control are being designed. These cables will be given cable numbers starting at 1,000.

5.4 Air Conditioning

(J. C. Proctor)

A representative of the American Air Filter Company, manufacturers of our electrostatic filter, inspected the system this week. He felt that we were getting good results, although he made several suggestions which should increase the filter efficiency somewhat. A detailed maintenance procedure has been prepared, and will be put into effect in January after the clean up. It must be remembered, however, that the system cannot possibly be 100% efficient, and we will have to accept the fact that a certain amount of dirt is going to come through the filter.

6.0 BLOCK DIAGRAMS

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

It is planned to check transfer to the control switch through the control matrix. At the present time, the transfer is checked by simply reading out of the control switch flip-flops. This, of course, does not insure that the proper operation line of the control matrix has actually been selected.

The role of the control switch is to decode a 5-digit binary number into the selection of one of 32 operation lines. To check the selection it is necessary to code it back to a 5-digit binary number. By using the same scheme as that of the control switch, 80 crystals are needed to control 5 gate tubes. A more devious scheme cuts this number down to 69 crystals, which appears to be the minimum even after consideration of David Brown's thesis (R-157). It appears that the saving of 11 crystals is an insignificant gain in exchange of straightforwardness.

(R. P. Mayer)

The sketch, Control Matrix Output Connections, SB-37190, has been redrawn on a D-size sheet. Two drawings have been made -- one showing "permanent" orders and connections only, the other one including temporary ("q") orders and connections. The latter includes latest information on the method of reading the Control Switch out to the bus via the matrix, etc. The drawings should be available in the print room in a few days.

A new order has been suggested: ex, Exchange, which will be wired into the computer as temporary order qe -- see section 7.3, Checking Circuits. The order exchanges the information in storage and in AC, and requires only one control pulse output unit, in addition to a few crystals on the control matrix.

An investigation is being made concerning various methods of coding the manipulation of individual digits of a word. This is required in order to show the relative advantages of certain new orders, such as lm, logical multiply. Any suggestions concerning coded programs to manipulate individual digits will be welcomed.

7.0 CHECKING METHODS

7.1 Test Programs

(C. W. Adams)

A revised form of Test Program No. I has been prepared. This new program, Test Program No. I-1, is intended to be run with a millisecond delay between TP 2 and TP 3. That is, TP 2 should (1) switch to pushbutton immediately and (2) restart the computer one millisecond later, without clearing or resetting. The delay is necessary for a satisfactory check, since a faulty FF may accept and hold a one or zero for a few microseconds but will probably not hold for a millisecond. TP 2 is used rather than any other because the FFs in AC Carry can hold ones only between the add (TP 2) and carry (TP 3).

The revised form may not completely replace Test Program No. I because the counted delay in No. I gives an excellent check on FF Storage, and this delay is omitted in No. I-1.

The new program and the procedure of delaying for about a millisecond after every TP 2 may partially solve the problem of automatizing the computer complement check which was discussed in section 7.3 of the last bi-weekly report.

(G. Cooper)

Comparative margins were determined for Test Programs 1 and 2, Display Program 1 (both parts), and Test Sequences 1, 2, and 3. The most notable result was the speedy location of the cause of a low margin on line 113 through use of Test Sequence 3. The cause of a relatively low margin on line 79 was also determined using Test Sequence 2. These results are very encouraging.

The Test Sequences will be described in the thesis report now being written, "A Method of Test Checking an Electronic Digital Computer".

7.2 Display Programs

(G. Cooper)

A method for improving the quality of the displays obtained with the present display system has been discussed briefly with C. W. Adams and E. S. Rich. It is felt that a considerable part of the distortion caused by the a-c coupling network is due to the fact that the decoder retains any information read in until just before the next number is read in. This results in a non-zero voltage being applied to the a-c coupling network most of the time. If the decoder were cleared immediately after each spot is displayed, this effect would be considerably reduced. A relatively simple scheme which requires only a gate tube (an amplifier may also be needed) has been worked out.

(C. W. Adams)

"Display Program Number IV: Non-Homogeneous Second Order Differential Equation" has been written up as an E note, but this note will not be issued immediately, pending further developments in connection with a new function-generating technique and a new temporary order (see section 7.3).

The new technique involves the use of elementary difference equations to generate functions like e^x and sin x. By combining such functions it is possible to generate amplitude or frequency modulated waves using programs requiring even fewer than 32 registers of storage. The new temporary order, qe, makes these simpler and shorter but is not essential to their operation.

7.3 Checking Circuits

(C. W. Adams)

Henceforth all new temporary operations will be described in this section of the Bi-Weekly Report. The meaning of the temporary status and of the letter q which characterizes them is discussed in E-250. The present status of the temporary operations is as follows:

qc - check already installed - see E-250 and Timing Diagram SB-37260

7.3 Checking Circuits (Continued)

qd - display - already installed - see E-250 and Timing Diagram SB-37259

qs - switch check - to be installed - see E-313 and Timing Diagram SB-37261

qi - in-out/storage check - under consideration - see Bi-Weekly Report M-951

qx - external program - just proposed - This operation would be used to permit the computer to take orders direct from film. A qx order would not actually appear in a program, but by means of a single video reconnection the computer would be set up to switch automatically to the qx operation between each order of the program. The qx would then substitute a word taken from a prearranged film reader for the word which would normally have been taken from storage by the program timing sequence for use as the next order. This procedure might be useful in various test programs and in operating the computer before or between successful operations with electrostatic storage. Use of the procedure would preclude the use of input-output and the sp and cp operations.

qe - exchange - just proposed - This operation would exchange the contents of AC with the contents of the storage register indicated in the address section of the qe order. The necessary temporary storage would be provided by the AR. Only one new CPO unit would be taken by this operation. It appears likely that the qe operation will be installed at an early date. Details and applications will be given in a forthcoming memo.

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-312-1	Calibration of Vacuum Measurements in Storage Tubes	3	12-9-49	H. E. Rowe
E-314	Display Program Number III: Target Seeking Simulation	10	12-8-49	C. W. Adams
E-315	Test Results on RT 66 and RT 91	2	12-12-49	H. E. Rowe
M-949	Master's Thesis Research Proposal: The Effect of Mosaic Size Upon the Storage Stability and Capacity of Electrostatic Storage Tubes	11	8-30-49	C. L. Corderman
M-950	WWI Partial Bill of Materials	10	12-9-49	H. F. Mercer
M-951	Bi-Weekly Report, December 9, 1949	33	12-9-49	
M-952	Preliminary Communication on Test Results with RT 68	1	12-14-49	H. E. Rowe
M-953	Preliminary Communication on Mosaic Size	2	12-14-49	C. L. Corderman
M-954	Transfer of Storage Tubes from ST Group to WWI	2	12-15-49	S. H. Dodd
M-955	Progress Report: A Method of Test Checking an Electronic Digital Computer	2	11-26-49 to 12-14-49	G. Cooper
M-956	Progress Report: Mosaic Characteristics of the MIT Storage Tube	2	11-15-49 to 12-15-49	C. L. Corderman
M-958	Procurement of Material and Fabrication of Components for Research and Storage Tubes	1	12-19-49	H. Klemperer P. Youtz
A-90-1	Thesis and Seminar Information	2	12-8-49	H. R. Boyd
A-104	Abstracts of Reports	2	12-23-49	J. W. Forrester

Library Files

McGraw-Hill Books -- 1949 Catalogue	McGraw-Hill Publishing Co.

Library Files (Continued)

No.	Title	Author
.004	European Scientific Notes: 15 August, 1949; 1 September, 1949; 15 September, 1949; 1 October, 1949; 15 October, 1949	London ONR
180	Document Office Bulletin: December 9, 1949	RLE, MIT
232	Physics Today: October, 1949	Amer. Inst. Physics
407	Improvements in Glide Path Transmitters: Radio Development Division, Civil Aeronautics Administration; Technical Report No. 91, April, 1949	C. H. Jackson
408	Flight Tests of an Off-Schedule Distance Computer: Radio Development Division, Civil Aeronautics Administration; Technical Report No. 93, May, 1949	F. J. Gross H. Kay
409	System Characteristics: Project Meteor PAM-FM Telemetering System: September 22, 1949	RLE, MIT
410	Theoretical Aspects of Asynchronous Multiplexing: Air Instruments Laboratory, Inc.; June, 1949	W. D. White
411	Naphthazarin as a Colorimetric Reagent for Beryllium: Atomic Energy Project, University of Rochester	W. F. Neumann A. L. Underwood
559	Technical News Bulletin: December, 1949	National Bureau of Standards

9.2 Standards, Purchasing and Stock

(H. B. Morley)

Standards - No new standards issued this period.

National Military Establishment Specifications were recently issued and are on file in the Procurement Office.

JAN-C-172A	Cases and Mounting Bases, Electronic, Aircraft
MIL-I-3042	Insulation, Electrical, Cotton-Fiber, Untreated
MIL-I-3053	Insulation, Electrical, Asbestos-Fiber, Treated and Untreated
MIL-D-3054	Dielectric Material, Polyethylene

Procurement - Ten of the Storage Tube Mount boxes have been received from the Millen Company and the next six are scheduled for delivery by the end of the month.

Several more of the WWI transformers have been received, and delivery of the balance is expected soon.

Procurement activity for the past two months has been somewhat above the last six-month average, due mainly to the accelerated S.T. construction program.

9.3 Construction

(L. Prentice)

Machine Shop - Work is nearly complete on special bolts for the storage tube mount. We have completed, as far as material on hand permits, parts for 36 storage tubes, with the exception of the backing plate. Some experimental work has been done to cut the machining time on this plate.

All parts for the rubber model have been completed. Work is continuing on reconditioning the machine tools received from surplus. All repair parts for these machines have been ordered this past week. It is expected that some miller parts will require 4 weeks for delivery.

Sheet Metal Shop - Aluminum panel for 500 volt regulator and parts for 600 volt rectifier have been completed. The work load is heavy and will remain so for some time to come.

9.3 Construction (continued)

(R. A. Osborne)

Production Report - The following items have been completed since December 9, 1949:

4	Gun Drivers
1	Power Bay - Fuse Indication Panel
2	External Power Cables - Power Bay Fuse Indication Panel
125	Video Cables - Signal Plate Drivers
1	Rotary Switch Reset Control Panel
1	Breadboard - Voltage Regulator
1	Remote Control Panel Modification

(D. V. Mach)

The Whirlwind I Holding Gun Anode Supply is 90% complete.

832 r-f amplifiers are on schedule; i.e., one amplifier every two days. Serial number 11 will be completed today.

9.4 Drafting

(A. M. Falcione)

T. Leary has been assigned to the Video Cabling system work and has been working on it full time. All electrical and mechanical checking work is now being done by V. Savio with assistance from F. Manning when necessary. This may hold up checking work but we do not expect to hold up or delay any construction drawings.

The drafting load has been very heavy in the past three weeks with thesis drawings. We expect to clean up all thesis drawings by next week. Change notices and other WWI drawings have been slightly delayed for this reason.

A WWI drawing list has been issued to system and group engineers. Comments and criticisms will be appreciated with reference to any improvements or omissions.