Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, January 20, 1950

To: 6345 Engineers

From: Jay W. Forrester

## 1.0 SYSTEMS TESTS

### 1.1 Whirlwind I System Test

(J. C. Sumner)

System testing was recommenced on 16 January. Successful operation of Test Problem 1 was obtained the first day (after a shutdown of one month). Several faults were located the first day, among which were:

(1) Lack of -15 volt bias on multiply-shift panel because of faulty relay operation. This caused continuous transmission of high frequency clock pulses to the arithmetic element.

(2) Broken decoupling resistor in FFD8. This caused failure to clear FFS3.

(3) Unsoldered connection in digit 1 of FFS3.

(4) Lack of +120 volts to gate generator of Control Switch Driver. This was due to improper power wiring.

(5) Failure to read in CR caused by gate generator having a tube leaning out of its socket.

Because of increased familiarity and experience with the equipment, these faults were located and repaired in short order. However, the rapidity with which operation was attained

1.1 Whirlwind I System Test (Continued)

without extensive adjustment can without doubt be attributed to the program of extending operating margins which has been active for the past few months. Probably the most effective step in that program was in applying limiting in register drivers (a modification which was installed during the past shut-down).

(R. Read and C. Rowland)

Test control for the ES system has been checked in a rather cursory manner, and is operating successfully with ES Control. ES Control has been checked, and seems to be in about the same condition as before the shutdown. With ES Control and test control operating as a closed loop system, the amplitudes will be adjusted for most favorable operation. Marginal checking on ES Control will commence next week, and a better view of its reliability obtained at that time. One faulty 7AK7 was found in ES Control and replaced.

(H. F. Mercer)

The following failures of electrical components have been reported since January 6, 1950:

| CRYSTAL RECTIFIERS | QUANTITY | COMMENTS |
|---|---|---|
| D-357 | 1 | Grid crystal in B-Register serial number 15, digit 15, replaced after 2237 hours of operation because of excessive drift. |
| RESISTOR | | |
| 220 ohms 1 watt | 1 | Plate decoupling resistor in Register Driver Type I serial number 12 replaced after 1600 hours because it was open circuited. |
| TUBE | | |
| 7AK7 | 1 | Gate tube in ES Control Counter serial number 4 replaced after 619 hours due to change in characteristics. |

1.2 Storage Tube Reliability Tester

(H. B. Frost)

A new block diagram has been devised which uses gate and delay units for gate generation only. This should result in more reliable operation of the storage tube reliability tester, as all pulses are fixed in time by a crystal clock (256B scope) and by delay lines.

Cycling tests have been run on RT 105 (an eight-inch throw tube) which show that it can be operated with a 16 x 16 array using the same deflection voltages as a standard 12-inch throw tube.

Dynamic tests to determine the limits of stable operation for cycling were run on ST-138.

During this period a thesis proposal "Dynamic Determination of Usable Storage Densities in Storage Tubes" was prepared and submitted.

1.3 Five-Digit Multiplier

(E. S. Rich)

Single error counts were recorded on the multiplier on January 12 and on January 18, but the causes of these errors could not be determined. Small fluctuations in the 15-volt bias supply voltage have been noted during the past week. These variations are similar to those which preceded the bias generator failures in July and December 1949 so plans have been made to replace this machine with an electronic regulated supply working off the other multiplier supply voltages. It is estimated the new supply cannot be constructed and installed for about 3 weeks.

## 2.0 CIRCUITS AND COMPONENTS

### 2.1 Circuits by System Number

#### 104-105 Operation Matrix Driver Panels

(W. Papian)

The following changes are expected to raise operating margins: (1) plate-load resistor of each 7AD7 B.A. being raised to give greater than cut-off drive to each following 6L6 stage; (2) time-constant of each C.F. 3E29 cathode-supply decoupling filter being decreased from 2 to 0.2 micro-seconds to hasten end of transient when a line is selected or de-selected.

The problem of IR drop though the filter-panel (1MH) choke in the -15 v. bias circuit occurs here, too. Over a volt is lost across the 6 ohms. Lower resistance chokes and fuses should be installed in circuits like this one.

#### 400 Input-Output Element

(J. A. O'Brien)

Input-Output control and its associated test equipment were brought back into operation this past week, with all of the test equipment now being located in the control room racks. Some difficulties found in achieving correct performance were due to relay trouble in the power racks and readjustment of all of the test equipment.

#### 410 In-Out Control

(K. E. McVicar)

The test equipment for the Input-Output Element has been moved to a new location in the Test-Control Room. Minor adjustments have been made to reestablish operation in the new location.

The Input-Output Element is now operating with reasonable reliability in view of the power supply interference from adjacent test equipment. Pulse amplitudes must be set and a reliability test must be run before the reader-recorder can be connected to the Input-Output Element.

831 ST Mount

(R. E. Hunt)

ST mount modifications are being considered prior to ordering the remaining 16 mount boxes. The following modifications are being considered:

1. Different fastening devices--the present Dzus fasteners are too small and tend to jam.

2. Handles or pulls for the covers to facilitate removal.

3. Removal of sharp corners on small cover, and closer tolerances on this cover for a better fit.

832 ES Output

(C. W. Watt)

Production of the gate tube panel is about 80% complete.

834 Gun Driver

(C. W. Watt)

Shop production is complete.

| 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 | E-32333-6 |
| 102 | Program Counter | B-37062-6 | B-32213-1 | D-31516-9 |
| 103 | Program Register | B-37067-4 | B-39269-3 | D-33836-4 |
| 104 | Control Switch | | | |
| | Input Panel | B-37066-5 | B-34321-1 | |
| | Matrix Panel | B-37066-5 | C-33843-3 | R-32722-6 |
| | Switch Panel | B-37066-5 | B-34100 | Z60C500-2-J |
| | Output Panel | B-37066-5 | B-34101 | Z60C300-F |
| 105 | Operation-Matrix Driver Panel | | S600M00-B | Z600M00-1-H |
| 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-34416-1 |
| 110 | Frequency Divider | B-37154-4 | B-32264-1 | R-31729-4 |
| 111 | Synchronizer | B-37172-2 | C-33485-1 | R-33486-1 |
| 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-32855-5<br>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-32722-5<br>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<br>C-33707-1 |
| Output Panel | B-37122-4 | C-32080-1 | E-32721-5 |
| 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 |
| 305 Step-Counter Output | | A-32723-1 | D-32735-2 |

| 2.2 WWI Drawing List (Continued) | Block Diagram | Block Schematic | Circuit Schematic |
|---|---|---|---|
| 306 Multiply & 307 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 | | |
| 403 In-Out Register | D-37178-2 | B-32434-3 | D-31277-12 |
| 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 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<br>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<br>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-34315-3 |
| 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-32261-13 |
| Register Driver, Type II | | B-32691-3 | D-32690-6 |
| Bus Connections | C-37124-4 | C-37123-3 | |
| Fuse-Indication Panel | | | T6QPP00-7-F |
| Voltage-Variation Panel | | | T6QPP00-6-E |
| WWI Power-Connector Pin Connection | | | C-31955-6 |
| Digit-Interlock Panel | | | T6QPP00-8-C |
| Fixed-Voltage Switching Panel | | | S6QPP00-11-C |
| Power-Interlock & Indication Panel | | | Z6QPP00-12-B |
| Power-Bay Fuse-Indication Panel | | | C-34473-2 |
| Power-Supply Control | | D-32017-5 | D-33184-4 |
| ESD Monitor | | | B-34756 |
| LV Floating Power Supply | | | C-34652-5 |
| 500V Regulator | | | D-35031 |

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

## 2.5 Tubes and Components

(H. B. Frost)

A method of graphical presentation of vacuum tube life and failure rate data was devised. This method may be applied to a dynamic changing group of tubes with both failures and active tubes being considered. There are certain questions of statistical validity to be satisfied before general application can be made.

Work has continued on an R-report "Vacuum Tube Life." It is expected that this report will be completed in the first draft form during the next biweekly period.

Both 7AD7 and 6AN5 flip-flops have been operated for approximately 1,000 hours at present under conditions which presumably will cause "blackout." Flip-flops left in one position for as long as a week still respond to one trigger pulse. Tentatively, it appears that "blackout," if it is observed on this project, will be of minor importance.

An accelerated life test of 7AD7 and 7AK7 tubes was completed and analyzed during the last period. The results are summarized in M-969 by E. Rich. The results definitely differentiate between 7AD7's of B8B production and other lots. It thus appears that an accelerated life test for interface prediction is entirely practical.

## 2.6 Test Equipment

(C. W. Watt)

Video Probe Redesign - The mechanical design of the widely used video probe and attenuator combination has been changed to provide more strength, more positive shielding, and easier construction. Drawings are being made and eight more probes and twelve attenuators will be built. The modified design has been tested and found satisfactory.

## 3.0 STORAGE TUBES

### 3.1 Construction

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

Three storage tubes with the reduced high-velocity beam length of 8" from the first pair of deflection plates to the target assembly were processed this period. A storage tube with this reduced high-velocity beam length and a target mosaic with 60 mesh in one half and 100 mesh in the second half was processed. This tube was used to study the effect of mosaic size on stability when the density of storage elements was increased. The encouraging results with a 32 x 32 storage array on this tube led us to reconsider whether we should continue with the 40 mesh mosaics. There was no conclusive quantitative information to indicate the course of action, but we already had 5 available 40 mesh mosaics. Therefore we agreed to prepare one or two 100 mesh mosaics and a similar number of 60 mesh mosaics during the next bi-weekly period.

Previously we reprocessed two storage tubes (ST114 and ST136) by replacing the defunct electron guns with new guns. These reprocessed tubes passed all standard tests and could be used in WWI. We had four tubes to reprocess this last period. Accidents befell three of the tubes and the fourth one passed all standard tests. Beads broke on two tubes while debasing the tubes. This pulled the basing compound into the evacuated tube and ruined the storage surface. The third tube had to be removed from the exhaust system several times and in the course of this process, picked up several measles.

(W. E. Pickett)

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

Several envelopes were constructed for evaporation tubes from the shipment of bulbs which we received during the last period.

The supply of 10-pin stems and flat press stems is in good condition.

With our present production schedule of research and storage tubes the supply of glass components used in the fabrication of these tubes has just barely kept pace with the schedule. One of the difficulties which will turn into

3.1 Construction (Continued)

a definite bottle-neck if this schedule should be increased would be the supply of these components necessary for both production and research of the storage tube. Use of the present facilities of the glass shop will not be sufficient from a standpoint of manpower or time to fabricate these glass components if the schedule should be increased.

Aside from the lack of time needed for the construction of sufficient glass components, no unusual difficulties were encountered.

(J. S. Palermo)

Mechanical Components - Construction in the Filtered Air Room has been suspended for a few days so that the walls, benches and floor can be painted. The move was necessitated by the general appearance of the room together with the condition created by the reorientation of the furniture in the Filtered Air Room in an effort to expedite construction.

The camera mount designed for use in the Filtered Air Room is expected to be in operation within the next few days. This has definitely been considered a practical move since all targets in the future will be photographed before each and every process. This is expected to remove some of the ambiguity which may arise at some date after the construction of a storage tube target assembly.

A demountable cup assembly for the evaporation tube boiler has been discussed with Loren Prentice and construction thereof has been started. The purpose of this assembly is to allow reuse of the cup parts rather than the use of new parts for the construction of beryllium boilers. Chemical cleaning of the parts will be easier since no two parts of the cup assembly will be welded. The first assembly will be ready soon after completion of the necessary dies for the cup and first orifice.

With the construction of ST200 and ST201-1, several changes were incorporated in the storage tube target construction technique. Additional changes in jigs and techniques are planned to facilitate a smoother program.

The acid cleaning process of all nickel screens has been continued. This technique will shortly be incorporated into a revised wash series edition.

3.1 Construction (Continued)

(R. Shaw)

The storage tube assembly has been modified to show the target mounted on a 6-pin stem instead of a 10-pin stem as previously. The drawing now conforms to the tubes that have been furnished to WWI up to the present time. The future tubes will have 10-pin target stems and will be considerably shorter than the earlier ones; consequently a new assembly drawing will be required. The two drawings will be entitled "Storage Tube, WWI, 100-Series" and "Storage Tube, WWI, 200-Series" respectively.

Sketches have been made of equipment for producing beryllium mosaics in commercial vacuum-coating apparatus.

(J. O. Ely)

A research tube (RT106) for study of cathode life when a small continuous current is drawn from the periphery of the cathode disk has been processed and testing has been started. Initial test results show that approximately 15 microamperes can be drawn to the auxiliary electrode when the beam is cut off by the control grid. When first operated this tube showed an apparent deactivation of the entire cathode when the high-velocity beam was cut off. This effect was completely reversible, and, except for its severity and the fact that it made its appearance on initial testing, resembled the sort of standby deactivation which has been noted in storage tube high-velocity guns after several hundred hours of life. Further studies will be made in an attempt to discover the cause of this anomolous behavior.

In order to facilitate the contemplated tube construction program, the second glass lathe, which was procured some time ago, is being put into working condition. A drive motor has been mounted on the lathe and a breadboard speed control devised by W. J. Nolan has been tested and found to be satisfactory. This lathe should be in operating condition by the end of January.

Some accessories for the demountable coating system have been designed and drawings have been made. Power connections for this system also have been installed and we will be ready to use the equipment as soon as it arrives and is set up.

3.2 Test

(M. I. Florencourt)

No new standard storage tubes were tested during this

3.2 Test (Continued)

period. Two reprocessed standard tubes (ST115-R2 and ST140-R1) were tested and found unsatisfactory because of surface defects suffered during reprocessing.

Three new storage tubes and a reprocessed one with the short throw were tested and found satisfactory for static tests: RT111, RT112, ST200 and RT110-R1.

A research tube, RT113, containing 60 mesh and 100 mesh beryllium mosaic semicircles was given some tests. Very small, uniform spots could be stored on both mosaic sizes, but required a $V_{HG}$ of 160V for holding. Lower switching was near 75V $V_{HG}$, so the whole surface may have had an unusual secondary emission ratio. A neat, uniform 32 x 32 array with points separated by at least their own size could be stored on both mosaic sizes. It was observed that it was easier to write negative on a positive background on the 60 mesh than on the 100 mesh, and at low $V_{HG}$ than at high $V_{HG}$.

(C. L. Corderman)

The report concerning the operation of RT62-2 has been completed and will be issued soon. This RT had a surface with four quadrants, the mosaic squares within these quadrants differing in both size and spacing. With m as the mesh number in squares per inch and d as the distance between squares in mils, RT62-2 had the following mosaics:

| m | d |
|---|---|
| 40 | 2.2 |
| 60 | 3.0 |
| 100 | 2.0 |
| 120 | 2.5 |

Tests are now in progress to determine the variation in spot size with writing charge using RT89 and RT113. Both of these tubes have non-standard mosaics and in addition, RT113 is a "stubby" tube with a 10" high-velocity beam throw. The surface characteristics are as follows:

| RT89 | | RT113 | |
|---|---|---|---|
| m | d | m | d |
| 80 | 3.7 | 60 | 3.0 |
| 94 | 3.4 | 100 | 2.0 |
| 100 | 2.0 | | |
| 100 | 4.5 | | |

3.2 Test (Continued)

While the 100 mesh - 2.0 mil mosaics of both RT89 and RT113 have a higher operating $V_{HG}$ than the similar section of RT62-2, they also have a higher minimum operating $V_{HG}$. There is also evidence in RT89 that holding-beam secondary electrons from the 3rd anode can create a third stable level on the storage surface whenever the collector is positive to $A_3$.

The r.f. read-out television system has been given several much-needed repairs.

(H. Rowe)

RT67-1, the sliding cage tube with a 7GP4 gun, has been tested to determine spot size, current density, and greatest permissible deflection angle. The maximum permissible deflection is somewhat greater than for a 5UP gun. A memo describing these tests is being written.

(D. M. Collier)

During the past two weeks, in the study of deactivation of oxide-coated cathodes, the following steps have been taken:

1. A balanced d-c amplifier for use with the Brush recording oscillograph has been designed, built, and tested. This design appears to be quite suitable to the needs of the investigation.

2. A second life rack has been adapted for use in the investigation. Test positions for twelve tubes are now available.

3. A test rack was built with controls and metering terminals suitable for testing RT's prior to their being placed on life test.

4. Five commercial cathode-ray tubes (5CP1's), under sporadic study since 15 September 1949, have been removed from life test. Six research tubes (RT94 thru RT99) are being tested preliminary to being placed on life test. RT88 is still under observation.

5. Temperature studies on RT80 are being resumed.

## 4.0 INPUT-OUTPUT EQUIPMENT

### 4.1 Eastman Kodak

(E. S. Rich, D. Hageman)

Concurrent with the availability of power, work on two of the Reader-Recorder (RR) circuits - namely, the Vertical Deflection Amplifier and the phototube-preamplifier circuit associated with recording - was resumed. Considerable progress was made in improving both of these circuits. It was discovered, in connection with this work, that the position of the cathode-ray-tube (CRT) beam is quite sensitive to stray magnetic fields. E.g., closing the doors on the RR evidently alters the configuration of the earth's magnetic field near the CRT sufficiently to misalign the beam. Rotation of the entire machine has the same effect. Probably a more effective CRT shield is in order.

It appears that it will be possible to couple the RR in the In-Out Element again next week.

### 4.2 Display

(R. H. Gould)

The new Dumont type 304H oscilloscope has been tried in special display and is being modified to improve its performance. A pulse generator, triggered by the sweep thyratron, is being built into the scope to provide an output pulse suitable for controlling computer operation. A crystal diode will be added to the Z axis input circuit to reduce PRF sensitivity.

### 4.4 Unclassified

(J. A. O'Brien)

Material is being prepared for inclusion in a memorandum on the proposed input-output system.

## 5.0 INSTALLATION AND POWER

### 5.1 Power Cabling and Distribution

(C. W. Watt)

Power was applied to the computer again on January 16 after a 4 1/2 week shutdown. During this period the following was accomplished:

1. Permanent installation of power wiring to all of row E except racks EX1 and EX2.
2. Installation of high voltage distribution system in racks E0 through E15.
3. Installation of 9 new racks and necessary power wiring in the control room.
4. Enlargement of the control room by removal of all partitions.
5. Complete cleaning of control, computer, and maintenance rooms, using equipment borrowed from the New England Telephone and Telegraph Company, and following Telephone Company detailed cleaning procedures.
6. Installation of several hundred video cables.

### 5.2 Power Supplies and Control

(R. E. Hunt)

E. S. Power Supply Control - Work is progressing on E. S. Power Supply Control. It looks as if all sections should be available for installation by March 1.

1. The E. S. Power Supply Control Panel to be installed in Rack EX2 is entirely laid out and ready for detailing in the drafting room.
2. E. S. Metering and H. V. distribution has been tentatively laid out and approved.
3. Power Supply remote control panel is being redesigned to accommodate the E. S. controls.
4. Schematic drawings and cabling diagrams for the above are about 80% complete in the drafting room.

5.2 Power Supplies and Control (Continued)

(C. W. Watt)

Installation of Rack EX1 - The design of the terminal strip protective trough and shields is complete. Cables will be drawn up shortly.

High Velocity Cathode Supply - Shop work is completed, and the panels have been turned over to the ES group for assembly.

Video Probe Power Supply - This is merely a regulator to deliver +75 volts to a room-wide distribution system into which video probes may be plugged. Drawings are done and shop work has begun. Completion of the power supply is scheduled for February 6.

(J. J. Gano)

Marginal Checking Power Supply - The power supply for the regulator should be completely assembled and tested next week. Construction of the regulator will start immediately thereafter. Panel drawings for these units are completed and will be sent to the shop early next week.

Final design of the generator panel is awaiting information from suppliers on availability of large a-c capacitors for the generator output filter.

(W. J. Nolan)

Temporary transformers have been installed in the 600 V rectifier to permit testing of it and the associated 500 V regulator. The circuit breaker installed in the rectifier was of the instantaneous magnetic type and would not stay closed on the magnetizing transient of the low impedance power transformers used. After replacing it with breakers having about 0.1 sec. delay, operation was satisfactory. There does not appear to be any other change necessary in the rectifier.

5.3 Video Cabling

(T. Leary)

The temporary cables (1000-1027) have been finished by the shop, which is now working on the ES Restorer cables (819-827).

5.3 Video Cabling (Continued)

Next in shop priority come (1) a group of changes in and additions to the cabling for ES Control, (2) the EST Output and R-F cables (791-804, 813-818), and (3) a group of cables (828-833) to complete the cabling of the ES Register Drivers.

The reinstatement of the video-cabling panel schedule system is being considered. These panel schedules, when complete, would list all jacks on WWI panels, panel by panel, and the cables attached to each jack.

The WWI abbreviation list (section S7.504-4) in the Standards Book has been completely revised and retyped and will be reissued shortly.

## 6.0 BLOCK DIAGRAMS

(R. P. Mayer)

The B-reduction of D-35146, Control Matrix Output Connections, is now available. This drawing (B and D sizes) is not now graded nor up-to-date, since it was used for a thesis which described only the connections shown. Spaces were left for the up-to-date additions, and the process of revision and grading should be completed in the next week or two.

The order ge, exchange, (see pages 23 and 26 of M-960) seems to be quite helpful for use with test storage. Its permanent addition to WWI, as ex (or ch), depends on its usefulness in programs using ES, or using TS for special subprogramming. Uses are being investigated, and any suggestions will be welcomed.

## 7.0 CHECKING METHODS

### 7.2 Display Programs

(C. W. Adams)

A program which displays an amplitude modulated sinewave, where the modulating wave is also a sinewave, has been tried successfully on the computer since the computer was returned to operation. Several improvements will be possible when the "exchange" order (qe) is installed. In particular, it is desirable to make the modulating and carrier frequencies variable, independent of the amplitudes. At present, a change in frequency causes a change in amplitude which must be compensated for manually. The frequency modulated version of this display program will be tried out soon.

### 7.3 Checking Circuits

(C. W. Adams)

The temporary operation qe - exchange will be installed soon. This order, described in the December 23rd Bi-Weekly Report (M-960), simply exchanges the contents of AC with the contents of the indicated storage register. Timing Diagram is SB-37275.

The imminent installation of a horizontal decoder for special display will necessitate a new temporary operation, qh - horizontal deflection, to permit desired settings to be read into the horizontal decoder.

## 8.0 MATHEMATICS AND PROGRAMMING

(C. W. Adams)

Some thought is being given to the actual mechanics by which a program will be put into the computer and the results obtained. A number of questions arise, none of which is hard to solve. In fact, the primary difficulty is not "can it be done?" nor even "how can it be done?" but "what is the best way to do it?" There generally turns out to be a number of ways to handle each question and the selection of one method requires certain compromises between the requirements to be placed on the human beings, the intermediate (terminal) equipment, and the computer. The preference of those most deeply concerned with the problem seems to be to minimize the difficulty for the human and the complexity of the terminal equipment, both at the expense of the computer.

The questions being considered are:

(1) The form in which the program should be typed onto Flexowriter tape.

(2) The nature of the preparatory routine which would presumably be kept stored in binary form on film for use in reading in, converting, etc., the various programs taken in coded form from the Flexowriter tape.

(3) Some idea of the nature of the library of standard subroutines which should be available.

(4) Means for selecting the desired subroutines from the library for use with the program in question; and means for making any necessary modifications in these subroutines to permit their use at any given set of storage addresses in any given program.

(5) Means by which the desired subroutines can be reached from the main program. As mentioned in the last Bi-Weekly Report by Salzer, this problem was solved quite satisfactorily several months ago.

(6) The manner in which the end of the computation would be indicated in a given program and the means by which the results would then be transcribed (converted and in some tabular form) onto paper or film.

8.0 MATHEMATICS AND PROGRAMMING (Continued)

Because the need for working programs will soon be pressing, these questions will be answered soon in some satisfactory, if preliminary, form and the conclusions will appear in one or several reports.

Anyone who knows of a good practical problem which requires much computation of a repetitive nature, but not too many different steps or too much new analysis for its solution is invited to submit the problem to me. I am looking for a good example, involving all the questions mentioned above (input, library routines, output), to work out in full detail. The purpose of this would be primarily to test out various answers to the questions, but the problem may as well be one that would be interesting, since it will undoubtedly be tried out as soon as electrostatic storage is working satisfactorily. Unless some better suggestion is forthcoming, the solution of some comparatively simple integral equations will perhaps be used. Incidentally, it is necessary that the solution be known, or can be checked in some way by the computer, for obvious reasons.

## 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 |
|---|---|---|---|---|
| R-173 | Project Reports of Current Interest (Includes M-936 to M-945) | 20 | 12-1-49 | J. N. Ulman |
| E-318-1 | Tests on a 3JP1 Cathode Ray Tube | 2 | 12-30-49 | H. E. Rowe |
| E-319 | The Significance of a Shorter Beam Length for the Whirlwind Storage Tube -- Part II: Fundamental Limitations on Spot Size and Current Density | 7 | 1-3-50 | H. Klemperer |
| E-321 | Storage of Pulse-Coded Information (Abstract of SM Thesis) | 2 | 1-10-50 | A. J. Lephakis |
| M-936 | Project Reports of Current Interest: I. General -- Introductory | 1 | 12-1-49 | |
| M-937 | Project Reports of Current Interest: II. Systems Work -- Block Diagrams | 1 | 12-1-49 | |
| M-938 | Project Reports of Current Interest: III. Circuits and Components | 3 | 12-1-49 | |
| M-939 | Project Reports of Current Interest: IV. Storage | 2 | 12-1-49 | |
| M-940 | Project Reports of Current Interest: V. Test Equipment | 1 | 12-1-49 | |
| M-941 | Project Reports of Current Interest: VI. Mathematics | 3 | 12-1-49 | |
| M-942 | Project Reports of Current Interest: VII. Programming and Application Studies | 4 | 12-1-49 | |
| M-943 | Project Reports of Current Interest: VIII. Checking and Trouble Location | 1 | 12-1-49 | |
| M-944 | Project Reports of Current Interest: IX. Input and Output | 1 | 12-1-49 | |
| M-946 | Not Issued | | | |
| M-957 | Master's Thesis Proposal: Investigation of the Deactivation Decay and Reactivation Recovery of Emission from Oxide-Coated Cathodes | 20 | | D. M. Collier |
| M-964 | Bi-Weekly Report, January 6, 1950 | 28 | 1-6-50 | |
| M-965 | Preliminary Notes on RT 93 Test Results | 2 | 1-9-50 | (H. Klemperer<br>(M. I. Florencourt |

6345 Reports, Continued

| No. | Title | No. of Pages | Date | Author |
|---|---|---|---|---|
| M-966 | Master's Thesis Proposal: Dynamic Determination of Usable Storage Densities in Storage Tubes | 7 | | H. B. Frost |
| M-967 | Electrostatic Storage Tube to Program Register Transfer Check | 5 | 1-13-50 | R. P. Mayer |
| M-969 | Accelerated Life Test for Cathode Interface | 5 | 1-19-50 | E. S. Rich |
| A-105 | Barta Building Safety Committee | 1 | 1-17-50 | H. R. Boyd |

Library Files

| | | |
|---|---|---|
| | Proceedings of the IRE; January, 1950 | IRE |
| .004 | European Scientific Notes; 1 November, 1949 | London ONR |
| 47 | Technical Information Pilot: August 29, 1949; August 31, 1949; September 21, 1949; October 5, 1949; October 25, 1949; December 2, 1949; December 14, 1949; January 3, 1950; January 5, 1950 | ONR -- Library of Congress |
| 134 | Photographic Digital Reader-Recorder; Monthly Progress Report #17 | Eastman Kodak Co. |
| 150 | Fundamental Research on Raw Materials Used for Electron Emissivity on Indirectly Heated Cathodes: Sixth Quarterly Periodic Status Report, 1 September, 1948 to 1 December, 1948 | Raytheon Manufacturing Co. |
| 180 | Document Office Bulletin: January 9, 1950; January 20, 1950 | RLE, MIT |
| 232 | Physics Today; December, 1949. Index Physics Today, Volume I, May - December, 1948 | American Institute of Physics |
| 425 | Tabulation of a Function: Harvard University HUX-2, July, 1949 | W. L. Semon |
| 426 | Calculation of Internal Conversion Coefficients for the K-Shell: Harvard University Computation Lab. HUX-3, July, 1949 | J. A. Harr<br>P. Strong |
| 427 | Electronic Digital Computers | Barber-Coleman |
| 428 | Double Refraction of Flow and the Dimensions of Large Asymmetrical Molecules: Harvard University Computation Lab. HUX-4, September, 1949 | H. A. Scheraga<br>J. T. Edsall<br>J. O. Gadd, Jr. |
| 429 | Effect of Tensor Range in Nuclear Two Body Problems: Harvard University Computation Lab., HUX-5, November, 1949 | H. Fishback<br>J. Schwinger<br>J. A. Harr |
| 430 | Periodic Heat Transfer by Radiation Through Layers in a Vacuum: Harvard University Computation Lab. HUX-6, December 1949 | F. L. Whipple<br>J. O. Gadd, Jr. |
| 432 | Navascreen: An Address Given 10 June, 1949 | R. C. Henn |

Library Files, Continued

| No. | Title | Author |
|---|---|---|
| 433 | Digital Computer Research at Birkbeck College: London ONR, Technical Report Number OANAR-50-49 | J. C. Lowell |
| 434 | An Investigation of the Possibilities for Improving Pentode-Gate-Tube Circuits. SM Thesis, January 14, 1950 | C. A. Rowland |
| 435 | Magnetic Drum Storage for Digital Information Processing Systems. 7 July, 1949 | Engineering Research Associates |
| 436 | Secondary Emission from Beryllium Surfaces at Low Incident Electron Energies. SM Thesis, January 14, 1950 | H. E. Rowe |
| 437 | Devices for Conversion Between Analog Quantities and Binary Pulse-Coded Numbers. SM Thesis, January 14, 1950 | R. L. Sisson<br>A. K. Susskind |
| 438 | Description and Use of the ENIAC Converter Code: Technical Note 141, November, 1949 | Ballistic Research Labs. |
| 439 | Mosaic Characteristics of the MIT Storage Tube. SM Thesis, January 14, 1950 | C. L. Corderman |
| 442 | Bulletin of American Physical Society: October 15, 1948 | American Physical Society |
| 559 | Technical News Bulletin, January, 1950 | National Bureau of Standards |
| 587 | The Metrotype System of Digital Recording and Telemetering: AIEE Technical Paper 50-84, December, 1949 | G. E. Foster |
| 588 | Clampers in Video Transmission: AIEE Technical Paper 50-72, December, 1949 | S. Doba, Jr.<br>J. W. Rieke |
| 589 | An Electronic Simulator for Nonlinear Servomechanisms: AIEE Technical Paper 50-47, December, 1949 | C. M. Edwards<br>E. C. Johnson, Jr. |
| 590 | A Generalized Analogue Computer for Flight Simulation: AIEE Technical Paper 50-48, December, 1949 | A. C. Hall |
| 591 | Fundamentals of the Automatic Telephone Message Accounting System: AIEE Technical Paper 50-42, December, 1949 | J. Meszar |
| 592 | New Techniques on the ANACOM -- Electric Analog Computer: AIEE Technical Paper 50-85, November, 1949 | E. L. Harder<br>J. T. Carleton |
| 593 | The Application of Germanium Diodes in High and Ultrahigh Frequency Television Receivers: AIEE Technical Paper 50-71, December, 1949 | J. H. Sweeney |
| 594 | Statistical Nature and Physical Concepts of Thyratron Deionization Time: AIEE Paper 50-56, December, 1949 | H. A. Romanowitz<br>W. G. Dow |
| 595 | Analogue Computer for Multi-Component Fractionation Calculations: AIEE Technical Paper 50-15, November, 1949 | G. W. Goelz<br>J. F. Calvert |
| 596 | Phase Lead for A-C Servo Systems with Unregulated Carrier: Engineering Report Number 18, Servomechanisms Laboratory, MIT, September, 1949 | A. B. Notthoff |
| 597 | MIT Reports on Research: January, 1950 | MIT |

Library Files, Continued

| No. | Title | Author |
|---|---|---|
| 598 | Ferdinand Braun, Inventor of the Cathode-Ray Tube. Reprint from Electrical Communication | (International (Telephone and (Telegraph Corp. |
| 599 | Electrical Characteristics of the Interface. Section from Quarterly Progress Report of September 15, 1949; Physics Department, University of Missouri | A. S. Eisenstein |
| 600 | Quarterly Progress Report: Research Laboratory of Electronics, MIT. October 15, 1949; January 15, 1950 | RLE, MIT |
| 622 | Aerovox Research Worker: November, 1949; December, 1949 | Aerovox Corp. |
| 271 | Investigation for Design of Digital Calculating Machinery: Harvard University Computation Laboratory. Progress Reports 3, 4, 5, and 6. | (Harvard Univ- (ersity |

9.2 Standards, Purchasing and Stock

(H. B. Morley)

Standards - Standards approved and issued:

6.195-7 26 volt Filament Transformer
7.411-5 Control Switch Matrix Panel
7.412-5 Storage Tube Mount
7.413-4 Standardizer Amplifier
7.415-1 IOC Synchronizer
7.415-3 IOC Interlock
7.415-4 Read-Record Memory
7.420-3 Test Specifications - 26 volt Filament Transformer

7.504-4, WWI Abbreviations, is being completely revised for reissue.

Attention of all Laboratory personnel is directed to the fact that much general and special information is contained in the Standards Book. Often it will be found time-saving to refer to this source for information which would take considerable time to obtain from manufacturers' catalogs, data sheets, or other material. In many cases, information will be found in the Standards Book which is not available anywhere else.

Procurement and Stock - Storage racks have been received and set up in the basement storage room to provide space for excess and little-used stock. Benches are being provided for assignment to various groups for temporary storage.

An order will be placed shortly for sixteen additional storage tube mount boxes. Most of the other material required for the additional ST Mounts and R.F. Amplifiers is either on hand or on order. Samples of various types of fasteners have been ordered for possible modification of the method of fastening storage tube mount box covers.

New Products - Samples of the new Sprague high voltage capacitors in .01 and .05 mfd., 6000 volt, have been ordered and will be available for inspection and test.

9.3 Construction

(D. V. Mach)

Eighteen r-f amplifiers have been completed, tested, aligned and delivered to WWI. As yet we have not received the chassis for the next six units. In the meantime a laboratory model of the WWI Holding Gun Anode Supply is being

9.3 Construction (continued)

constructed to replace the original, dangerous breadboard model. This is a lower current model than the WWI version with a few slight circuit changes.

The WWI 500 volt regulator was completed and is undergoing tests.

The WWI high voltage cathode supply is approximately 60% complete.

A low frequency blocking oscillator was constructed for ES Control WWI.

(R. A. Osborne)

Production Report - The following items have been completed since January 6, 1950:

28 Video Cables (Temporary)
3 Storage Tube Mounts
1 600V Rectifier

(L. Prentice)

Machine Shop - We have been trying to complete and perfect dies for all parts of the present evaporation boiler. This has had to be set aside because of lack of material and parts now on order.

Renovation and painting of machine shop is about 70% complete.

Safety covers have been installed on one foot-operated switch and on two foot-operated air valves. Safety goggles, cases, and signs calling attention to their use, have been mounted adjacent to the grinders. Rawhide strips have replaced all chains holding chuck keys throughout the area.

Sheet Metal Shop - This shop has completed 1 special video trough, power supply chassis for S.T. row and phenolic panels for 16 S.T. Mounts.

## 9.4 Drafting

(A. M. Falcione)

WWI Test Equipment Drawing List - A drawing list is now being compiled for all test equipment used in the computer. This drawing list will be similar to the WWI unit issue recently distributed. These drawing lists will serve as a guide to determine the number of drawings lacking for each unit in the computer.

The drafting load is moderate and steady, and increasing. From a preliminary review of WWI drawing lists indications are that many drawings and Parts Lists have yet to be done. The installation drawings are in need of many revisions and corrections. Test equipment drawings are far from complete.

10.0 GENERAL

(H. R. Boyd)

Staff Terminations

Harry S. Lee  Roger L. Sisson

Non-Staff Termination

Wallace R. Johnson