Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, January 30, 1953

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

1.11 Operation (F. J. Eramo)

The following is an estimate by the computer operators of the usable percentage of assigned operation time and the number of computer errors for the period 16 - 29 January 1953:

Number of assigned hours	103
Usable percentage of assigned time	93
Usable percentage of assigned time since March 1951	85
Number of transient errors	27
Number of steady-state errors	5
Number of intermittent errors	12

(N. L. Daggett)

The number of failures that have occurred due to phenolic breakdown make it necessary to consider what action can be taken to eventually eliminate this source of trouble. Since Paine's investigations indicate the trouble is due to silver migration from the turret lugs, the most reasonable possibility would seem to be some method of slotting the phenolic board to break up leakage paths. Apparently the silver migration is aggravated by high humidity; therefore the humidifier in the air-conditioning system has been turned off.

(A. J. Roberts)

Storage reliability continues to improve. Most of the errors now recorded are of a transient nature. The usable time between errors has increased greatly.

1.12 Component Failures in WWI (L. O. Leighton)

The following failures of electrical components have been reported since 16 January 1953:

Component	No. of Failures	Hours of Operation	Reasons for Failure
Capacitors			
.01-mfd 600-V DC oil-filled bathtub	1	5569	Oil leakage
Crystals			
1N38A	3	15504	Drift to low R_b
Resistors			
220-ohm ±5% 1-watt	2	6091	Burn out
	1	253	Burn out
Transformers			
5:1 Pulse	1	16003	Open primary
Tubes			
2D21	1	14000 - 15000	High firing
3E29	2	11000 - 12000	Low I_b
5U4G	2	11000 - 12000	1-Gas; 1-low I_b
6Y6G	1	15000 - 16000	Short
6AK5	1	1000 - 2000	Short
	2	5000 - 6000	Short
	26	10000 - 11000	11-Short; 1-leakage; 14-low I_b
6AL5	6	10000 - 11000	Low I_b
6AG7	6	10000 - 11000	5-Low I_b; 1-short
6SN7	1	15000 - 16000	Low I_b
	1	16000 - 17000	Open cathode
6AS7	1	6000 - 7000	Low I_b
	1	11000 - 12000	Low I_b
7AK7	1	2000 - 3000	High grid cut off
	2	3000 - 4000	1-Leakage; 1-gas
	1	15000 - 16000	Short

1.12 Component Failures in WWI (continued)

Component	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
7AD7	1	0 - 1000	Short
	2	4000 - 5000	Short
	2	6000 - 7000	Low I_b
	2	7000 - 8000	Short
	1	8000 - 9000	Low I_b
	6	9000 - 10000	2-Short; 4-low I_b
	2	10000 - 11000	1-Short; 1-low I_b
	1	11000 - 12000	Short
	2	12000 - 13000	Short
	2	14000 - 15000	1-Short; 1-low I_b
	9	15000 - 16000	6-Short; 2-low I_b; 1-leakage
6V6	1	4000 - 5000	Short
SR-1407	1	2000 - 3000	Short

1.13 Storage-Tube Failures in WWI (L. O. Leighton)

The following storage-tube replacements were reported during this biweekly period:

ST-724-C-1 was rejected after 68 hours of operation because of intermittent read-out.

ST-726-C was rejected after 38 hours of operation because it failed to hold plus array.

1.14 Storage Tube Complement in WWI (L. O. Leighton)

Following is the storage tube complement as of 2400,29 January 1953:

Digit	Tube	Hours of Installation	Hours of Operation
0 B	ST-619-C-1	10069	2160
1 B	ST-711-C	11989	240
2 B	ST-603	8322	3907
3 B	ST-601	8524	3705
4 B	ST-516	6641	5588
5 B	ST-702-C	11113	1116
6 B	RT-344-C-1	10637	1592
7 B	ST-540	7937	5292
8 B	ST-549	8259	3970
9 B	RT-347-C	10782	1447
10 B	ST-700-C	10917	1312
11 B	ST-717-C-1	11793	436
12 B	ST-604	10827	1402
13 B	RT-346-C	10756	1473
14 B	ST-624-C-1	10507	1722
15 B	ST-730-1	12223	6
16 B	ST-716-C-1	11702	527
16 A	ST-613	9046	3183

ES Clock hours as of 2400, 29 January 1953 . . .12229

Average life hours of tubes in service 2171

Average life hours of last five rejected tubes . 95

During recent weeks many Storage Tubes have been replaced merely to install as many new-type tubes as possible. Accordingly the figures on tube life are of very much less significance than before this program was started.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits By System Number

2.13 Arithmetic Element (A. Heineck, B. Remis)

Several methods of triggering the cathode-follower-coupled flip-flop from diode gates are being investigated. Plans for a two-stage diode adder using this type of flip-flop have been drawn up.

Diode Adders (S. Thompson, I. Aronson)

The past biweekly period was spent studying diode adders. The circuit design was carried out for the most promising type considered, and panel layouts were drawn for a two-digit adder with high-speed carry. Control and error-detecting circuits that use standard test equipment have been designed. Construction started on January 27 and will probably be completed about February 5.

2.14 Input-Output

MITE (R. Paddock, A. Werlin)

One panel was added to the completed rack of MITE, and the whole rack was rewired to conform to the recently modified input system; meanwhile wiring drawings are being changed to agree with the new system both for the extended and for the standard inputs. Testing, revised to encompass the above changes, is continuing on the completed rack.

The test-unit power-supply panels were completed for installation with the PEC-730C power supplies. These panels provide terminals for all required voltages both from the PEC-730C and from the modified 120-volt supply so that all voltages are available at any one of the four Jones Sockets mounted at the rear of the chassis. A switch and meter terminals are also provided at the front of the panel to facilitate checking or adjusting all voltages.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes (H. Frost, S. Twicken)

Life tests of new-type 5687 and 5963 tubes have completed 2000 hours. Although the test data are not complete, results indicate that additional life tests at different heater voltages are highly desirable. These tests will be started in the near future.

Extensive design refinements and modifications have been made in the drawings for the Mod. III tube tester. The electrical design

2.21 Vacuum Tubes (continued)

is essentially complete, but the mechanical design is progressing slowly.

Additional tables have been prepared for the quarterly progress report. These tables list all tube failures in WWI from the start of operations in December 1948 to the first of January 1953. The breakdown is according to the kind of failure (change in characteristics, gassy, mechanical, and burnout) for each 1000 hours of tube life.

In the use of the modified 514D scope(reduced transient drift), it has been found that 6AN5 tubes are apt to be quite microphonic, with natural frequencies under 300 cps with low damping in some cases. The 6AN5 mount is cantilever-supported from the button base with no snubbers, a construction resistant to shock but poor for microphonics. Selection of 6AN5 tubes is required for those applications where microphonics are critical, and they should ordinarily not be used in such applications.

Modifications have been made to the G_m bridge setup for interface measurement. The primary object was to increase the precision, but stray capacities were reduced at the same time.

A meeting of the ASTM committee B4 section VIIIA (cathode materials) was attended by H.B. Frost on January 29.

2.22 Transistors

Life Tests (N.T. Jones)

A 5-inch panel with space for 30 transistors in a typical life-test circuit has been breadboarded by B. Burke. When the design is considered satisfactory, a number of these panels will be built up for use in the expanded life tests.

Two forms have been prepared to show parameter distribution and drift in the life-tested transistors. Data to December 8 has now been sent to the Drafting Room for completion.

Measurements (N. T. Jones)

Transistors measured this period were:

5 Raytheon CK 721 p-n-p junctions

5 Raytheon CK 722 p-n-p junctions

70 RCA TA 165K point contacts

20 GE special G11A point contacts

In addition, the measurements were completed on 50 GE G11A point-contact transistors. (Note: Unless otherwise specified, the term "transistor" refers to point-contact units. The above ten junctions represent the

2.22 Transistors (continued)

first procurement of such units in this Laboratory.)

The prototype of the revised rise and fall time measurement has been completed and was used to measure the above transistors.

Hole Storage (N.T. Jones)

The circuit to use as a standard hole-storage measurement on all our transistors is being designed. It will be a modification of the Bell base-driven hole-storage measurement but the revisions have not been completed.

Transistor Accumulator (D.J. Eckl)

The total operating time for the accumulator is 2580 hours.

During the past biweekly period, two tubes have been replaced in the controlling test equipment:

6AG7 Buffer amplifier (V6) in WWI Coder.

6AG7 RLC peaker (V2) in Burroughs Gate Tube Panel.

These both resulted in an output pulse of about one-third normal amplitude. They were replaced at a clock reading of 2500 hours but it is impossible to determine total life since the number of hours logged on these tubes before they were placed in the accumulator control system is unknown.

Failure of FF-2 in the 2^6 counter to pretest automatically has occurred occasionally but only during the evening hours. The period of such failure has ranged from once per 2-3 minutes to once per 20 minutes. The 2C51 in the preset circuit has been sent for checking.

A new control system has been installed which eliminates the critical nature of the delay produced by the Gate and Delayed Pulse Generators. A 2^6 counter is now used making it possible to perform from 1 to 64 successive additions. All pulse intervals are obtained by recycling through the same Gate and Delayed Pulse Generator.

Meetings

General discussions on transistors and their applications to computers were undertaken with Dr. Paul P. Beroza, Assistant Professor of E.E. at University of Southern California, who is doing part time work at Hughes, and with Dr. William Liben of the Applied Physics Lab at Johns Hopkins University.

2.22 Transistors (continued)

A Transistor Flip-Flop (E. Cohler)

The d-c design of a flip-flop has progressed to the stage of a circuit for the d-c action of the flip-flop. A two-transistor flip-flop was decided upon in order to provide a simple arrangement for obtaining the conventional "0" and "1" outputs. A common emitter type of flip-flop was decided upon because of the simplicity of the circuit as to the number of elements and the ease of complement triggering. With this decided upon, the theory of the d-c action of the flip-flop was investigated, and the final circuit designed for the optimization of several quantities. The factors desired were:

1. The voltage change across the collector resistor should be a maximum from the on condition to the off condition.

2. The emitter input resistance (which the trigger source sees) should be as high as possible.

3. The dissipation to which the transistor might be subjected should be well within the rated values.

4. The circuit should be only bistable (not tristable).

5. The circuit should work with a large number of received transistors.

6. The maximum supply voltage used should be easily obtainable around the Laboratory.

A circuit was designed which satisfied these requirements as well as possible. Some consideration was given to the specification of the transistors for this circuit, and work on the importance of various parameters is still in progress. Since a rather wide variation in transistors is expected even within the specs, a simple d-c balancing scheme is being investigated.

With the d-c circuit temporarily fixed, a thorough study of the a-c operation of the flip-flop will be undertaken, with good wave shaping at high repetition rates the primary objective. In addition, optimum trigger sources and load sinks will be included in the study of the a-c characteristics.

Transistor Core Driver (S. Oken)

Driving cores with transistors appears to be plausible. A regenerative transistor amplifier using a 10:1 step-down transformer as a load has been used with good results.

2.22 Transistors (continued)

A pulse of current, across the equivalent of a 16-core line, of about 0.2 µsec in width and 450 ma in amplitude was obtained. The maximum amplitude will probably be determined by the maximum power dissipation allowable in the collector of the transistor. Thus far, the transistor has shown no signs of breaking down, and it is possible that the output can be increased without harmful effects to the transistor.

After the problem of increasing the pulse width to about 1 µsec has been solved, I plan to obtain several cores and set up a circuit which is capable of reading and writing numbers in the cores.

2.3 Ferromagnetic and Ferroelectric Materials

2.31 Magnetic-Core Materials (David R. Brown)

Over 13,500 tested cores for MTC are on hand. An additional 11,000 cores were shipped from General Ceramics on January 28. The yield from these cores is expected to be greater than 50 percent and will bring us very close to the required total of 20,000. All of these 11,000 cores were made by the automatic Stokes press.

Samples of the RCA Victor body XF-96 evaluated here exhibit excellent characteristics for coincident-current memory application. They are very similar to the General Ceramics' cores.

The semi-automatic core tester, a device for handling MTC cores during pulse test, is now being used on a trial basis for brief periods of time.

Shelf-life and pulsed-life tests of MTC cores to determine aging during the first 400 hours have indicated that no change takes place at room temperature.

Ceramic Preparations (G. Economos)

The toroid die does not release pressed specimens intact, even though a new center post was made and the assembly polished. A one-degree taper will be put on the outer surface in an attempt to remedy the difficulty.

Magnetite was prepared by firing iron oxide at 1000° C in a controlled partial pressure of oxygen to insure stoichiometric proportions of ferrous and ferric ions. The initial batch made in a stainless-steel container was not of the desired quality because of the apparent reaction with the container and grain growth due to compacting. The stoichiometric proportions were found to be quite satisfactory. More magnetite is being prepared at 800° C in platinum containers with no compacting.

Preparation of Ferromagnetic Materials (J. Sacco)

Toroids from batches DCL-2-68, DCL-2-68A, DCL-2-68B, and DCL-2-68C have been pressed, fired, and submitted to Group 63 for hysteresigraph and pulse tests. The composition of the four batches is the same in all cases (approximately that of the General Ceramics mix), but a different binder was added to each. The four binders used were Carbowax 4000, Elvanol 51-05, a zinc-stearate suspension, and a mixture of Elvanol and stearic acid.

Analysis of Ferromagnetic Materials (J. H. Baldrige)

Recent work includes analyses, qualitative and quantitative, of a sample of magnetite prepared in this Laboratory by George Economos. The ratio of ferric to ferrous iron in this material was found to be 2.02 : 1.

2.31 Magnetic-Core Materials (continued)

New Materials (B. Smulowicz)

Pulse tests have been performed on XF-96, an RCA Victor ferrite, with satisfactory results. Preliminary tests have been started on the experimental cores produced by L.I.R.

Semiautomatic Production Tester (R. F. Jenney)

The semiautomatic production tester was working for a short time on cores from the Stokes press. For short periods the testing rate was between 30 and 40 cores per minute, but stoppage cut this to a rate of 15 per minute (600 in 40 minutes).

A tester from General Ceramics was tried out. It looked good for tests of large batches of cores, but it is still in the development stage.

Core Response (N. Menyuk)

In the previous report, the writer stated that theoretical considerations predicted the result $(H - H_o)\, t_s = K_s$ (a constant) for a particular material, where $(H - H_o)$ = effective magnetic field and t_s = core switching time.

Further considerations show that, for materials in which eddy-current effects are ignorable,

$$K_s \sim \frac{\rho \Lambda K^{1/2} a^{1/2}}{\gamma^2 I_s k^{1/2} T_c^{1/2}}$$

where I_s is the saturation magnetization, Λ the relaxation frequency, K the anisotropy constant, a the lattice constant, γ the gyromagnetic ratio, k the Boltzmann constant, T_c the Curie temperature, and ρ the maximum distance the Bloch walls move in the course of switching.

In order to obtain a result consistent with the model, a calculation is being undertaken to determine the energy associated with a cylindrical Bloch wall.

Magnetism Seminar Reports (N. Menyuk)

During the past two weeks, seven additional memoranda based on A. Loeb's Seminar on Magnetism have been printed. These reports cover meetings 18 to 23, inclusive, and an appendix.

Domains of Reverse Magnetization (J. B. Goodenough)

Grain boundaries and inclusions are currently being considered as the lattice defects responsible for nucleating the domains of reverse magnetization which grow to switch a core in a magnetic field. The conditions for grain boundaries to act as nucleating centers were reported in the last biweekly report. A semiquantitative calculation of the external field strength required to nucleate domains of reverse magnetization at an inclusion in a lattice with only one axis of easy magnetization gives

$$H_N = I_s \left\{ 4.3 \times 10^{-2} + f(r_1/R) \right\}$$

where I_s is the saturation magnetization of the material and r_1/R is the ratio of the radii of the nucleated domains to the radius of the inclusion at the moment of nucleation, $f(r_1/R) \sim 10^{-2}$. For materials, such as 68 permalloy, which have $I_s \sim 10^3$, the nucleating field strength is of the order of 50 Oe., a value which is much higher than the coercive force. It is concluded, therefore, that inclusions can act as nucleating centers for domains of reverse magnetization only in materials of low I_s, such as the Ferrites. A calculation of the nucleating field strength for inclusions in materials with three axes of easy magnetization is being completed. A report is also being prepared with a full discussion of the importance of the concept of nucleating centers for an understanding of the switching mechanism in cores. It is hoped that this understanding will permit a more systematic approach to a satisfactory material for the magnetic memory.

(A. Loeb)

Dr. A. Sprague Coolidge of the Department of Chemistry, Harvard University, visited the Laboratory and Computer and made some helpful comments on the statistical model of magnetism.

As a first test of the statistical model (see Memorandum M-1744), Channing Morrison's data on the hysteresis loop as a function of temperature were examined on the basis of the model. Excellent agreement was found between theoretically predicted and experimentally observed values.

The seminar is now in the final phase of quantum mechanics. Next will be considered the collective electron model of magnetism, Zener's papers on magnetism, and the Washington meeting on magnetism of September, 1952. The lecture notes are being issued regularly.

D. A. Buck and A. L. Loeb had a very fruitful discussion with Prof. Louis Harris regarding formation of thin iron films by evaporation.

The meeting of the Physical Society at Harvard proved most rewarding for magneticists, particularly talks by Purcell, Bitter, van Vleck, and Abragam.

<u>Special Pulse Testing</u> (P. K. Baltzer)

A study is being made concerning the effect of current-pulse duration (T) on the pulse response of MTC memory cores. "T" will be defined as the time from 10% of maximum to 10% of maximum of current pulse, which has about 0.2-μsec. rise time and 0.4-μsec. fall time.

A preliminary experiment was made concerning the average "Disturbed One" output of 60 cores. There was no change as "T" was reduced from 20 μsec. to 2 μsec. However, as "T" was reduced further to 1.2 μsec. the output voltage increased, due to the core becoming "Disturbed Sensitive". When "T" was reduced

2.31 Magnetic-Core Materials (continued)

below 1.2 μsec., the core output dropped rapidly.

The "Delta" is expected to rise rapidly as "T" is decreased from 2 to 1.2 μsec. An experiment has been designed to investigate this as an average value for 100 cores. Other pertinent pulse data will also be taken as a function of current-pulse duration.

Short-Time Life Test (J. D. Childress)

The short-time life test was initiated during the last period. Almost nothing was learned of the aging of the cores, but this test disclosed that the reproducibility of the production measurements is poor.

Work is being done to improve the accuracy of the production test. As soon as possible, a new short-time life test will be started.

MF-1326B, F-291, Life Test No. 1 (J. R. Freeman)

At the end of 400 hours of life test, twenty-four MF-1326B, F-291, cores from Lot 0 were retested for the maximum disturbed-one output at 1.0 ampere-turns. The output-voltage measurements were reproduced with a variation of less than 3 percent for all cores except four; and to within 1.5 percent for all except nine. On the basis of these results it is concluded that no change in the core outputs have taken place for either the pulsed or shelved cores.

Pulse Tests on MF-1326B, F-291, Lots 13-23A (J. R. Freeman)

Tests have been performed on two selected cores from each of the seven lots 13, 14, 15A, 17, 18, 19, and 23A. Sense windings with ten turns on each core were used. The values of disturbed one, disturbed zero, first-half selected, second-half selected, and the half-selected zero were measured. The tests were performed at 0.95 and 0.87 ampere-turns and values measured at the optimum sensing times.

2.32 Magnetic-Core Memory

Memory-Test Setup IV (Ceramic) (J.L. Mitchell, R.S. DiNolfo)

Experiments to obtain data that will enable us to compare the quasi-static switch-core biasing system that was used in Memory-Test Setup II with the pulsed switch-core biasing system that was used in Memory-Test Setup III will be under way soon. Minor modifications are being made in the pulsed-bias driving equipment so that the waveforms, etc. of the quasi-static bias system can be duplicated.

Memory-Test Setup V (E.A. Guditz)

Construction of Memory-Test Setup V is continuing. All of the necessary test equipment has been mounted except a few units which are on order. The memory rack is completed and ready for painting. Several special-driver and breadboard panels are under construction, and work is proceeding according to schedule. Two additional exhaust fans have been received and will be installed shortly.

Switch-Core Study (A. Katz)

A 16-position matrix switch using MF 1131 (F262) cores has been constructed in the form of a planar array and is now undergoing test. A second switch (32-position) using MF 1312 (F262) cores will be designed shortly. In contrast to the first switch, the second will have each of its core elements made up of F262 core bodies stacked three high and will consequently be arranged in a modified planar array.

From tests on these switches, we hope to determine what problems arise in the operation of large matrix switches in memory applications.

Switch-Core Testing (J. Raffel)

Single-core testing of switch cores has been undertaken in order to determine the effects of loading, input-current rise time, secondary turns, and core height on output-current waveforms. The results of these tests will be used to design a switch which will provide the square pulses necessary for a coincident-current memory.

2.33 Magnetic-Core Circuits (E.K. Gates)

I have started to design a ferrite model of the 193-11, 3-winding pulse transformer used in the alarm circuits of WWI. A Ferroxcube 3 C pot core has produced the best results. Further attempts will be made to use a small toroid.

2.34 Ferroelectric Materials

Ferroelectric Pulse Generator (J. Woolf)

The positive and negative halves of the voltage generator were in operation this past period. The positive half has a jitter in the leading and trailing edges. This trouble will be rectified in the coming period.

The inhibit circuit is operating and performing its function; however, it will be improved upon in order to get larger pulse widths.

The pulse amplitude for the negative half had to be improved, as the flat top trailed off. This was rectified by grid clamping and is now operating properly.

2.4 Test Equipment

Test Equipment Headquarters (L. Sutro)

A file with one card for each piece of test equipment is now nearly complete. To check its accuracy, Ted Chleboski is now visiting each bench and rack. Such a check will be made every 3 or 4 months.

A class for technicians who use standard test equipment is meeting one hour a week to go through each test-equipment circuit and learn how the waveforms are created. I am now going through typical multivibrator circuits for the class.

Work performed in the past two weeks:

Standard Test Equipment		Tektronix Equipment	
Inspected	20	Repaired and adjusted	1 (513D)
Tested	79	Adjusted	1 (517)
Repaired	3	Completely serviced	3 (514D)

The 513D differentiated a square wave in the preamplifier. This was found to occur in the third stage which is a 12AT7. Substitution of new tubes brought no imporvement until Bonnell Frost put one with exceptionally low grid emission.

Test Equipment Committee (L. Sutro)

Portable power supplies are to be purchased again for the first time in several years. The Committee approved purchase of three supplies each with a choice of range from 150 to 250 volts or 250 to 350 volts at 300 ma for the use of Group 63. These are made by Power Designs in Richmond Hill. The Committee also approved purchase of two supplies continuously variable, one from 0 to 325 volts at 200 ma, the other from 0 to 500 volts at 300 ma for the use of Best's Vacuum Tube Circuits Section. These are made by Universal Electronics of Los Angeles.

Low-Speed 2^6 Counters, Mod. II (H. Platt)

The first two counters were tested and found to be operating satisfactorily. It was discovered, however, that the marginal check on the binary scalers was too severe. An appropriate modification was made to reduce the marginal-testing voltages applied to the grid of the flip-flop tube in the binary scaler.

2.4 Test Equipment (continued)

A report, E-521, describing the operation and circuitry of the low-speed 2^6 counter is now being processed and will be issued shortly.

Core Driver, Mod. VII (H. Platt)

The initial version of this circuit did not meet the requirements of regulation. The cathode degeneration used in the output amplifier stage did help, but the regulation desired was 5% and the best obtained was about 20%. Consequently, a feedback circuit was designed which should give the desired output characteristics. At this writing, the circuit is unstable and is being analyzed to determine what correction networks are needed to insure stability.

Modification of Core Drivers (H. Boyd)

Recent experiments with cores have suggested that the quiescent output currents of both Model V and VI Core Drivers should be less than 0.1% of the output-current pulse amplitude. Changes have been made on both units in order to realize this new requirement. Arrangements have been made for changing the units now in use to agree with the new modifications.

2.5 Basic Circuits

4-mc Flip-Flop (H. Boyd)

The 4-mc 5965 high-reliability flip-flop for driving gate tubes will probably become a standard circuit. Further tests are being conducted on the circuit here and at IBM.

Designing is underway for a similar circuit to drive diode gates.

Gas-Tube Pulse Generator (C. Laspina)

Gas-tube pulse generators now in use as test equipment and in WWI are being investigated, and new methods of obtaining single(synchronized or random) 0.1-μsec pulses are being evaluated.

Gas-Tube Circuitry (H. Platt)

A series of tests is being started on a 7AK7 gate-tube circuit to find the sensitivity of the circuit to all of its parameters. The results of these tests will give much information on the best operating conditions and allowable margins for this circuit.

2.7 Memory Test Computer

Toggle-Switch Storage (J. Crane)

The melamine mounting strip for the 32-position switch, MTC, is completed. Drawings for this switch will be finished soon.

Toggle switches for 32 registers of storage have been mounted in a panel to be placed on the MTC console. The seventeenth digit will contain a switch which allows the operator to choose either the associated toggle-switch register or a live register.

Digit-Plane Driver (P. Bagley)

The digit-plane driver developed by Laspina is being repackaged in a plug-in unit. The plug-in unit has been increased in size to make parts more readily accessible, and parts have been placed to keep crystals and electrolytic condensers away from resistors dissipating more than a watt. Sketches have been made, and a laboratory model will be constructed and tested.

Plug-in Flip-Flop Testing (H. Henegar)

Static resistance and voltage measurements have been completed on all of the MTC plug-in flip-flops. Nine out of one hundred were found defective.

Sixteen flip-flops were completely tested; the tests included static resistance and voltage measurements, balance measurements, and video checking. The upper-frequency limit at which the FF may be complemented runs about 2.2 to 2.5 megacycles. Marginal checking was performed while complementing at 4 kilocycles. Results show that operation is marginal at screen-voltage variations of +55 to +70 volts and -40 to -50 volts.

MTC Power Supplies (R.G. Farmer)

The design of the regulator section of the power supplies is under way. The regulator will be divided into three sections; the amplifier section, the auxiliary-supply section, and the series-tube section.

The only difference between a 1-amp regulator and a 10-amp regulator is the number of series tubes which it contains. For this reason, it has been decided to make the series-tube section from a number of panels. Each panel will contain 6 series tubes and will provide 1.2 amps. The number of series-tube panels to be used in the regulation will now depend upon the desired output of the supplies.

Terminal Equipment for Flexowriter (R. Pfaff)

Design of the terminal equipment for the Flexowriters has been completed. Two Flexowriters (which should arrive shortly) will be modified to

2.7 Memory Test Computer (continued)

WWI specifications. Our in-out system will be similar to WWI's but considerably simplified. One Flexowriter will be used for tape preparation, the other for in-out to the computer.

Mod. I Flip-Flop (W.A. Klein)

Investigation of the MTC Mod. I flip-flop is proceeding with the aim of improving the margins. Measurements thus far indicate that a deterioration of the margins occurs when the flip-flop is loaded by the MTC Mod. II cathode follower. Subsequent capacitive loading of the cathode follower (up to a value of 10,000 $\mu\mu f$) has little effect on the margins.

Panel Testing (R.H. Gerhardt)

Nine dual gate-tube panels, three gate-tube buffer-amplifier panels and one cathode-follower (Mod. I) panel have been completely tested. Resistance and voltage checks have been made on two other cathode-follower panels and on one parity-check panel. The gate-buffer panels each had 3:1 transformers erroneously marked 1:1 in at least one digit. The other panels have been relatively free from errors.

Accumulator (H.E. Anderson)

Approximately half of the work involved in assembling the accumulator panels has been completed. In the near future, plans for assembling the A-register will be made on the basis of our experience with the accumulator.

Panel Design (P. Bagley)

A memory-address panel containing the memory-switch cathode followers and the memory-switch decoder has been designed; the sketches have been sent to the Drafting Room.

32 x 32 Memory Plane (W. Ogden)

A 32 x 32 memory plane was completed, and wiring of a second is in progress. The first unit will be used for preliminary tests, and the second will serve as a model for production. Work on the first of the 17 memory planes to be used in MTC will begin about February 9.

3.0 STORAGE TUBES

3.1 Construction (P. Youtz)

The construction and processing techniques of all 700-series storage tubes were modified during this past period to stop the recent run of failures caused by a possible breakdown and gas discharge within these tubes. To improve the ultimate vacuum of the tubes, a lighter gas, helium, instead of the heavier gas, argon, was used during the glass-working stages. Also the tubes were baked at 475°C instead of 450°C. Since the Faraday cage on the target assembly was close to A_3, it was not put into this series of tubes in order to remove all hazards.

No research tubes were constructed this period for the Philips "L" cathode studies.

Work was continued on the problem of getting more uniform and closer spacing between the collector screen and the storage surface in order to obtain larger operating margins in ES row. At present until we receive certain parts from the vendors, this closer spacing is obtained by putting a small center post between the collector and storage surface. There are certain calculated risks in this type of assembly. As a result several tubes were rejected because of buckling mica targets.

3.2 Test

Pretest (D. M. Fisher)

Seven tubes were pretested during this period. ST727-1, ST729-1, ST730-1 and RT370 were accepted and were transferred to the STRT for further testing. ST728-1, RT371-R1 and ST731-1 were rejected because of buckling mica targets.

Work is continuing on the development of an electronically controlled lower switching detection device. Progress is being made, but no final conclusions have been established at this time.

Storage Tube Reliability Tester (R. E. Hegler)

During the last biweekly period, one research tube and four storage tubes were tested at the STRT. ST726-C, ST727-C, ST729-1 and ST730-1 all had satisfactory operating margins. After twenty-three hours in the STRT, ST727-C exhibited the lower stability failure as outlined by C. L. Corderman in the last biweekly report.

RT369-C-1 had a modified target assembly and also contained an IBM-85 high-velocity gun. Because of the poor readout caused by low beam current, it was impossible to evaluate the modified target assembly of this tube.

3.3 Research and Development

Lower Stability Failure (C. L. Corderman)

During this period the following observations were made concerning the sudden failure of recent storage tubes. This failure is manifested by an upward shift of the lower stability voltage following a possible breakdown and gas discharge within the tube.

All 700-series storage tubes up to and including ST728-1 have been processed at 450°C, and argon was used during glass-sealing operations. Beginning with ST729-1, helium was used during glass sealing and the tubes baked out at 475°C instead of 450°C. In addition, the Faraday cage has been omitted in all tubes beginning with ST728-1, i.e., ST727-C was the last tube with a Faraday cage. This is mentioned because the most probable point of arcing, which might initiate a gas discharge, was from the cage shell to the auxiliary collector.

ST726-C operated satisfactorily for 49 hours at the STRT and was then sent to WWI. After about 20 hours of computer use, the tube failed with an internal breakdown.

ST728-1 failed after about 30 hours of operation at the STRT.

Neither ST729-1 nor ST730-1 had failed after 50 hours of operation at the STRT. These two tubes are the only ones using helium which have been tested. ST730-1 has also operated an additional 10 hours in WWI without failure.

Tubes which have been sealed-in using helium, but rejected for any reason at the time of initial test, are being tested at the STRT for at least 100 hours. In addition, those tubes previously sent to WWI without 50 hours of use are being returned to the STRT for an additional aging period. Judging from the experience of ST726-C, it appears that a 100-hour test period will be needed. This will be divided into two 50-hour runs, with power being removed between the two.

"L" Cathode Research (T. S. Greenwood)

The storage-tube life-test unit is being moved to a new location,and in the process it is being modified to provide more effective interlocking of supply voltages and more reliable operation. Previously, interruptions of d-c lab power forced a shutdown of the unit. In the new unit lab power will be used solely for providing a pulse source.

During the period one of the impregnated "L" cathodes has been on life test under d-c emission conditions at zero bias. The cathode temperature has been held at $950^{\circ}C_b$. No evidence of cathode poisoning has appeared and the emission has been very stable. Unfortunately, a degree of potential instability is present because the emission is strongly dependent on cathode temperature. Space-charge saturation does not exist at any

3.3 Research and Development (Continued)

acceptable operating temperature.

There is some indication that grid emission may be greater with this cathode than with the regular type. Accordingly, more attention is being given to means of reducing such emission. Platinum plating of Grid #1 is being considered but a few attempts have failed to produce a satisfactory plating. Further consideration will be given to this problem.

A satisfactory mounting for the cathode continues to be a difficult problem. Parts for what was hoped to be a stable mount were received during the period. After assembling a few of these it became apparent that the deviations in cathodes (principally deviations in contour rather than in nominal dimensions) would require changes in the mount. Several possible modifications are now being considered.

Velocity Distribution Measurements (C. T. Kirk)

Using a modified storage-tube mount, the stray r-f level at the cages was brought down to a point where it no longer saturated the r-f amplifier. This enabled cage readouts to be obtained from a cage located in the center of the target area. No attempt was made to observe signals from other cages in the array as most of this biweekly period was spent improving the signal-to-noise ratio (S/N).

The availability of 10-mc r-f equipment led to its use in this test setup. Unfortunately, the following two features of this equipment give rise to a poor S/N.

1. The modified tube mount and the r-f amplifier have rather wide bandwidths (in the order of 3 mc).

2. A good r-f ground at 10 mc is difficult to obtain.

Improved shielding and grounding of equipment along with reducing the bandwidth of the r-f amplifier has improved the S/N somewhat.

From a consideration of the velocity distribution curves of the holding beam obtained by J. McCusker (SA-38695-G-1), it appears that the bandwidth necessary to reproduce this curve at the present sweep rate would only have to be 5 kc. This would indicate that going to a lower frequency, using a bandwidth of 5 kc, would greatly improve the S/N.

Since the S/N can still be improved in the existing equipment, it is not known at this time whether the scheme of going to a lower frequency will be followed.

3.3 Research and Development (Continued)

Pulse Readout (A. J. Cann)

Some difficulty has been encountered in returning to normal operation in the Alignment-Demonstrator for comparing with pulse readout. Unrelated to this, three unnecessary 0.1-microsecond delay lines have been removed from the A-D, and a push button to write a single spot has been added.

4.0 TERMINAL EQUIPMENT (J. A. O'Brien)

Preliminary designs for most of the new terminal equipment have been worked up. Designs for the indicator-light registers and for the intervention registers are being investigated, and the results look quite good.

Most of the problems of what we are going to do and how we are going to do it have been settled. There are still, however, a few problems connected with logical meshing of the new equipment into the in-out system.

4.1 Typewriter and Tape Punch (L. H. Norcott)

During the past few weeks our FL Flexos have been taken to the shop for inspection, replacement of worn parts, and overhaul.

A recent apparent failure of the output printer was caused by a switch on the typewriter being left in a position labeled REPRODUCE, NO PRINT. To minimize the possibility of this happening again, it is planned to install an indicator which will bear the illuminated legend NO PRINT when the switch is so positioned.

A new tape corrector using an FL punch has been completed and made available for use in the tape room.

A tape spindle has been provided for holding paper tapes being read into PETR. Comments of users of the present breadboard version are requested so that a more improved version can be built.

4.2 Magnetic Tape

Magnetic-Tape System (E. P. Farnsworth, J. W. Forgie, S. B. Ginsburg)

Reliability of the magnetic-tape system was poor during a portion of this biweekly period mainly due to an error in the installation of the new si stop order which has since been connected.

Additional difficulties may have been caused by a large piece of foreign matter adhering to the tape on unit #0 underneath the magnetic coating. Such tape defects are rare and may not be detected unless information has been recorded on the area. This defect was discovered during Sunday testing, several days after the tape had been placed in service on unit 0.

We are still being troubled by occasional dropout of a digit. Jitter in the timing of the sync read-out pulse with respect to the read-out gate caused by a marginal pulse from one of the redundant channels is a possible source of trouble which is being investigated. Several schemes for reducing the sensitivity to this jitter have been suggested and will be tried.

4.2 Magnetic Tape (Continued)

Magnetic-Tape Mechanisms (E. P. Farnsworth)

Realignment and modification of two tape mechanisms by Raytheon was completed last week. One of these units was prepared for reinstallation and tested in the computer. Operation of this unit is satisfactory so that there are now four tape units available, units 0, 1, 3(a), and 3(b). Unit #2 will be put into service early in March when the fifth drive-control unit is received from the shop, but it is expected that this unit will be considered as a spare to replace any of the other four units in case of trouble, and will thus be available conditionally. Replacement components are being ordered to provide spare parts for the non-standard electrical items in the Raytheon units.

4.3 Display (R. H. Gould)

Experiments with the Syntronic Instruments deflection yoke for the 16-inch display scope have shown that the yoke is not as fast as they claimed. Some increase in speed over that of the yokes presently in use can be obtained by changing the impedance of the yoke but a deflection time of about 60 μseconds seems to be minimum.

Some experimentation will be done on the decoder output amplifier to reduce the noise on the deflection lines. A twin-ax connection between the amplifier and the 16-inch scope will also be tried.

(D. J. Neville)

Indicator lights which will be in-out equipment are being designed. The holding circuits will be thyratrons. One 16-digit register has been built in breadboard form. It appears that satisfactory results can be obtained.

4.4 Magnetic Drums (K. E. McVicar)

The drum has been connected to the computer temporarily through switch panels which enable us to operate either with the computer or test equipment.

Elementary programs were inserted in FF storage to check on the group- and storage-address selection. Once these programs were working, slightly more elaborate programs were written for toggle-switch storage. We now have three toggle-switch programs. The first program records, then reads and checks a count in a single register on the drum. The second program records a count around the drum, then reads and checks it. The third program is similar to the second except that the bi order is used in the reading process. More elaborate programs are in the process of being written.

4.4 Magnetic Drums (Continued)

Results obtained with the three programs above are just about the same. If a particular group will run satisfactorily with one program it will run satisfactorily with the others.

The number of groups which will run properly varies from day to day and seems to depend upon the drum temperature that day. We have had ten of the groups running at a time when the drum was hot and as few as six when it was 8°C colder.

Some marginal checking is now being done with the aid of the computer and our toggle-switch programs.

(C. W. Simmonds)

The testing of the voltage sensor circuit is continuing as planned. Also, a test set-up has been built for the purpose of simulating line transients in order to determine the response of the voltage sensor circuit to disturbances of short duration.

Erase System (H. L. Ziegler)

A temporary Auxiliary Drum Erase Control has been assembled from test equipment and a few special panels. Operation is completely automatic under control of a single pushbutton and erases an entire group of sixteen tracks in 25 seconds. Erasures produced with this equipment seem fairly complete and leave little or no bias traceable to the erase system.

Auxiliary Drum Monitoring (H. L. Ziegler)

Further work on the TV presentation of auxiliary-drum information has given encouraging results. A satisfactory mixer-amplifier for the horizontal axis has been built. With a few minor modifications this mixer-amplifier will also be satisfactory for the vertical axis. When both of these panels are available an actual TV display can be tried.

5.0 INSTALLATION AND POWER

5.1 Power Cabling and Distribution

Room 156 Power Distribution (G. F. Sandy)

The modifications and changes have been written to bring our records up to date on the power and power-supply control for the equipment in Room 156.

Rack L15 has been removed from the MITE control and is now controlled by the auxiliary-drum control. L15 is to be used exclusively with the auxiliary drum. Its filament power is fed from the auxiliary-drum filament bus. Its d-c power is obtained from the Whirlwind buses but is switched on and off by the auxiliary-drum control.

5.2 Power Supplies and Controls

Magnetic Drum D-C Power (R. Jahn)

Tests on the -125- and -250-volt d-c generators for the magnetic drum have shown an extraordinarily high ripple with spikes as great as 50 volts for light loads. This can be reduced to a reasonable value by shunting the lines with 500 mfd of capacity.

90-Volt D-C Whittemore Supply (R. Jahn)

The regulated 90-volt d-c supply has been moved to the Whittemore Building and will be installed as soon as final tests have been completed.

600-Amp Filament Alternator (G. A. Kerby)

Mr. Carlson of Westinghouse has inspected the M-G set and will prepare an estimate for the new base. We are specifying rigid construction, which will allow sufficient accuracy in alignment to prevent vibration. The quotation will be ready in a few days.

Drawings of the new circuitry are still in drafting and are being checked as they are completed.

The final chassis of the Filament Alternator Regulator, Model II, is due to be built soon, and it is hoped will be finished in time to release the prototype regulator from WWI in about three weeks.

Test Equipment (G. A. Kerby)

All parts for the mechanical oscillator should be here in a couple of weeks. Bob Hunt will make a breadboard test, then build a final unit.

5.2 Power Supplies and Controls (Continued)

MTC Filament Alternator Regulator (G. A. Kerby)

A detector circuit is being prepared which uses a temperature-limited diode.

WWI Power Supplies (J. J. Gano)

A 15-hp M-G set for which we will build a regulator has been ordered and is scheduled for delivery in late April. This supply will serve as a standby unit for all the WWI voltages except 500 volts.

7.0 CHECKING METHODS

7.4 Marginal Checking (J. H. Hughes)

I am ordering the mechanical parts needed for the automatic potentiometer drive of the new marginal-checking system, and sketching a proposed layout. I have the one-shot clutch already from Bob Hunt for safekeeping.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

Progress during this biweekly period on each general applications problem is given below in terms of programming hours, minutes of computer time, and progress reports as submitted by the programmers in question.

The main portion of the S&EC group staff time is still being devoted to the development of the comprehensive system of service routines (CS). In parallel with this, background work is being carried on for the offering of an introductory course on programming for WWI and for an advanced seminar on programming techniques. It is expected that the introductory course will be of two-weeks' duration beginning some time in February. The course will be repeated at a frequency depending upon the demand and amount of staff time available. Applications for this course are available from the training supervisor in Room 216 at the Barta Building. It is planned to develop a manual from this course work that will serve as a useful introduction for new programmers.

100. Comprehensive System of Service Routines: Briscoe, 66 hours; Demurjian, 35 hours; Frankovich, 70 hours; Hazel, 30 hours; Helwig, 50 hours; Kopley, 20 hours; Porter, 15 hours; Vanderburgh, 10 hours; WWI, 352 minutes

The magnetic-tape version of the CS which records 5-56 tape on the magnetic tape was tested during the past bi-weekly period but was not run successfully. Work will continue on this program.

It has also been decided to write a version of the CS in which the program itself is recorded on magnetic tape and which punches out 5-56 paper tape.

The output-adaptation section of the CS is being rewritten so that 20 output requests can be handled per program.

Tests for typewriter output have been successfully completed. These blocks will be added first to the CCP and finally to the CS.

The fourway post mortem has been rewritten to store its out put on the delayed printer. Post mortem programs are also being written to print out or photograph intervals in storage as generalized decimal numbers or as interpreted instructions.

Helwig

101. Optical Properties of Thin Metal Films: Denman, 1.5 hours; Loeb, 2 hours; WWI, 6 minutes

Tape 2265, which computes the percentage reflexion and transmission of radiation by metallic films, with parameters 0 and 1, gave excellent results; parameter 3 was not so satisfactory. Different parameters refer to different thicknesses of the same metal. Parameter 3 is thought to be wrong by comparison with previous results obtained.

Plans for the future are to trace the error in parameter 3, and incorporate Tape 2265 into an automatic program.

Loeb

8.1 Programs and Computer Operation (continued)

102. Scattering of Electrons from Gases: Uretsky, 20 hours; WWI, 99 minutes

The mistake diagnosis is continuing and is estimated to be 90% completed.

Most of the difficulties were found to be due to misunderstanding of the new sub-routines, particularly the cycle counters. About 30% of the original program has been completely rewritten.

Is is expected that one phase of the problem will be finished during the next two or three weeks.

Uretsky

103. Transmission Cross Section of Absorbing Spheres; Spherical Bessel and Hankel Functions: Demurjian, 4 hours; Terrell, 20 hours; WWI 0 minutes

The program for the entire problem has been coded for tape preparation (Tape 2360). The programmer has checked through the program order by order using a desk calculator to check that the program will compute the desired quantities.

Plans for the future are to obtain an analysis of results from the above program.

Terrell

104. Hydro Thermal Power System: Calculus of Variations: Demurjian, 4 hours; WWI, 102 minutes

The following difficulties were encountered during the past bi-weekly period: 1) defects in the (24,6) delayed print-out; 2) erroneous correction in the magnetic-tape units. It is hoped that with these difficulties out of the way we can proceed with the testing of our program.

Cypser

106. MIT Seismic Project: Briscoe, 2.5 hours; Robinson, 40 hours; Simpson, 20 hours; WWI, 128 minutes

The basic prediction program has been modified so that it will handle a wider range of values of the data, thus eliminating many of the difficulties due to overflows. Three error curves have been derived using the modified program.

Robinson

107. (a) Autocorrelation and (b) Fourier Transform, Evaluate Integrals: Ross, 40 hours; Frankovich, 2 hours; WWI, 74 minutes

Two programming errors were found in T-2235. Minor deletions in T-2301 were made to allow all results to be stored, but the program has not been tested yet. T-2249 was stated to be operative in the last biweekly, but answers were found to be wrong. One mistake in programming for CS has been located.

Ross

8.1 Programs and Computer Operation (continued)

108. An Interpretive Program: Hazel, 4.5 hours; Laning, 30 hours; Zierler, 6 hours; WWI, 36 minutes

The portion of the program that handles negative exponents contained an error which has been corrected.

The part of the program that does conditional programming was tested and an error was detected.

Error diagnosis is under way. The main part of a program to permit the solving of larger problems by holding unused subroutines on magnetic tape has been written.

Zierler

112. Lawley's Method of Factor Analysis; Characteristic Vectors (modified): Denman, 63 hours; WWI, 97 minutes

The main program has been checked and made to operate correctly for 1 complete iteration. However, there still are some errors in the program which cause an alarm after the first iteration. The errors in the program are being sought, and after they are eliminated, we shall be ready for production.

A loop was made out of the magnetic tape containing the R_{ij} matrix to save the time required for reversing the tape used in the present system. This loop is about 14' long but it was found possible to mount it on a magnetic-tape unit. However, it did not operate satisfactorily. The reasons for this will be investigated when the time becomes available.

Lord

113. Shear Wall Analogy, Simultaneous Linear Equations: Kopley, 6 hours; Sydney, 21 hours; WWI, 48 minutes

A few more programming errors have been located with the aid of a post mortem. These errors have been corrected and it is hoped that the program will now operate properly.

The use of multiple-length numbers is being considered.

Sydney

114. Design of Optical Instruments: WWI, 28 minutes; Combelic, 37.5 hours; Helwig, 3 hours

Results from the test of the ray-tracing routine check with numerical values calculated by hand.

Using this ray-tracing routine as a nucleus, a program has been assembled, but not yet run, which will trace several rays through a specified optical system and print the results using the magnetic-tape delayed printer. Certain parameters of the system are then varied and the process repeated for a total of 24 sets of parameters.

The final assembled program is approximately 1400 registers long so that part of it is laid out on magnetic tape to be called in as needed. For this purpose one of the generalized self-checking magnetic-tape subroutines is being used.

Helwig

8.1 Programs and Computer Operation (continued)

115. Transient Aerodynamic Heating of a Flat Plate; linear partial differential equation: Helwig, 10 hours; Isakson, 12 hours; WWI, 289 minutes

Seventeen parameters were successfully run on the I-beam and plate problems. A large number of parameters remain to be run. It is hoped to be able to run these successfully in the next bi-weekly period.

Isakson

117. Speech Output; Counting and Assembly: Demurjian, 1 hour; Mayer, 1 hour; WWI, 6 minutes

T 2251-1 with a minor correction was run successfully. It includes a number of vowel tests which suggest that a little more work remains to be done in perfecting "oo" and "ee". Counting was also performed with various consonant modifications.

The counting test must be performed more slowly for a detailed analysis of the consonant problem.

Mayer

119. Spherical Wave Propagation: Vanderburgh, 6 hours; Fox, 4 hours; Ralston, 15 hours; WWI, 22 minutes

Errors in tape 2325-0 caused the initial run to be unsuccessful.

A corrected tape is to be prepared and run. Concurrently, tests are being run on the (24,6) subroutines for calculating the logarithms and exponentials which are used in the main program.

Fox and Ralston

120. Thermodynamic and Dynamic Effects of Water Injection into Gas Streams of High Temperature and High Velocity, simultaneous algebraic equations: Demurjian, 9 hours; Gavril, 40 hours; WWI, 87 minutes

This problem is connected with the development of a potential gas turbine component called the "Aerothermopressor". Essentially, this device consists of a pipe (which may or may not be of constant cross-sectional area) into which flow the exhaust gases from the gas turbine. These hot gases are expanded to high velocities at the aerothermopressor inlet where special nozzles inject water into this hot, but now high-velocity, gas stream. The complicated thermodynamic and dynamic effects of the water injection that occur during the passage of the stream through the Aerothermopressor are brought about by the simultaneous action of a) the evaporation of the liquid water, b) the momentum interaction between the injected liquid and the gas stream, c) wall friction, and d) changes in cross-sectional area of the duct. In the optimum case, these effects will give rise to conditions in which the stagnation pressure at the outlet of the Aerothermopressor is higher than that at the inlet. The net effect is that the stream passing through the device has been cooled with an attendant rise in total pressure. If the pressure ratio across the Aerothermopressor is sufficiently large, the entrance pressure may be maintained at a pressure below atmospheric, thereby providing a larger expansion ratio for the turbine. The overall function of the Aerothermopressor as a gas-turbine component is, then, to increase the efficiency

8.1 Programs and Computer Operation (continued)

of the plant by allowing the turbine to deliver more work due to the phenomena described above.

Bruce D. Gavril, of the MIT Mechanical Engineering Department, is in charge of the calculation program under the guidance of Professor Ascher H. Shapiro.

The work carried out in this biweekly period may be divided into three groups:

Development and testing of a subprogram for determining non-integral roots of fractions: -This program finds roots of fractions by generation of an octal representation of the decimal-fraction exponent while simultaneously raising the eighth root, the sixty-fourth root, etc. of the decimal-fraction base to the appropriate power given by the corresponding numerator of the octal representation. The factors (four are satisfactory for our purposes) are then multiplied together to form the desired root. This subprogram was tested successfully giving results differing from as little as one in the fifth decimal place to one in the fourth place. For example, $(+.1719)^{+.1184}$ was delivered by Whirlwind I as +.81182. The correct value, to five decimal places, is +.81181. This subprogram was then incorporated into the main program.

Development and testing of the main program for predicting the thermodynamic and dynamic effects of water injection into hot, high-velocity gas streams:- Four successive performance tests were carried out until the main program incorporating six modifications produced results which were corroborated by nine sets of hand calculations. During this testing, the calculations were timed, and it was found that each set (one set of values for the initial parameters) required about 47 seconds for computation alone! Since this program was to have been used for at least 384 sets, it was decided to eliminate all but the most essential cases. Case I, as described in Form DL-518, now consists of 216 sets which can be conveniently subdivided into four groups of 54 (one for each injection rate), each requiring less than 45 minutes computation time and each easily capable of being stored on one reel of the delayed printout magnetic tape.

Production:- The first set, 54 combinations of initial parameters, was run successfully in about 42 minutes. Results were obtained in the form of a typewritten copy and punched tape from the delayed printout equipment. These long-desired numerical results were of immediate value. As indicated above, this represents one fourth of the data required for Case I.

With the exception of some initial trouble in getting satisfactory performance from the delayed printout equipment, all of the difficulties were in the program itself. Here the main difficulty was in obtaining sufficient precision for the entire range of the initial parameters used. Other difficulties were encountered in the technique for resetting the initial parameters when the program is not completed due to intentional divide alarms which arise from time to time. All difficulties were disposed of by the sixth modification of the original tape.

8.1 Program and Operations (continued)

There are, in all, three programs planned for this problem. The first is completed and now producing data. The second is quite similar to the current program with, however, the addition of two more parameters for the case of variable area. This program is expected to be producing data by 5 February. The third is the most significant of all since it is to treat the case of droplet-evaporation history. The first two programs are exploratory in the sense that they provide information for determining the realm in which the more detailed droplet analysis is to be carried out. It is hoped that the third program will be completed by the end of February.

Gavril

122. Coulomb Wave Functions: Uretsky, 3 hours; WWI, 8 minutes

Two runs were made on mod 0 and mod 1. Indications were that round-off error would be troublesome and the program was completely rewritten (mod 2).

In rewriting the program it was necessary to provide for storage and use of (30,15) numbers in a (24,6) program. A technique for doing this has been worked out and incorporated in mod 2.

Plans for the future are to run and troubleshoot mod 2.

Uretsky

Computer Time

Programs	23 hours, 35 minutes
Conversion	13 hours, 46 minutes
Scope Calibration	21 minutes
Magnetic-Tape Test	12 minutes
Demonstrations	40 minutes
Total Time Used	38 hours, 34 minutes
Total Time Assigned	46 hours, 28 minutes
Usable Time, Percentage	79.5%
Number of Programs Operated	125

9.0 Facilities and Central Services

9.1 Publications

(Diana Belanger)

The following material has been received in the Library, W2-301, and is available to laboratory personnel.

LABORATORY FILES

No.	Title	No. of Pages	Date	Author
R-219	Electronic Selection and Control of Read-Record Heads of Magnetic Tape Units	51	12-15-52	J. A. O'Brien
M-1797	Proposed Revision of Whirlwind Power Supply Control to Provide Power Failure Protection	1	1-19-53	G. F. Sandy
M-1799	Bi-Weekly Report, January 16, 1953	36	1-16-53	
M-1800	Tentative Transistor Specifications	3	1-20-53	N. T. Jones
M-1801	Group 63 Seminar on Magnetism, App. IV	3	1-14-53	A. Loeb N. Menyuk
M-1803	Visit to R.C.A. Victor in Camden, Jan. 16	3	1-22-53	F. E. Vinal
M-1806	Pulse Tests of the R.C.A. Victor Ferrite, XF-96	2	1-22-53	B. Smulowicz
M-1807	Conference on Standards at Armed Services Electro Standards Agency	2	1-23-53	H. W. Hodgdon
M-1808	Limiting Use of Non-Standards Components	1	1-23-53	H. W. Hodgdon
M-1813	Test Equipment Committee Meeting, Jan. 23	2	1-28-53	L. Sutro

LIBRARY FILES

No.	Identifying Information	Source
2222	The Phase-Bistable Transistor Circuit	Lincoln Lab.
2223	Interference Characteristics of Pulse-Time Modulation	R. L. E.
2224	The Selection of Network Functions to Approximate Prescribed Frequency Characteristics	R. L. E.
2225	Periodic Sampling of Stationary Time Series	R. L. E.
2226	A High-Speed Product Integrator	R. L. E.
2227	Servomechanism Synthesis Through Pole-Zero Configurations	R. L. E.
2228	Synthesis of RC Transfer Functions as Unbalanced Two-Terminal-Pair Networks	R. L. E.
2229	An Electronic Differential Analyzer	R. L. E.
2230	The Transmission of Information, I	R. L. E.
2231	The Transmission of Information, II	R. L. E.
2232	Theory of Nonlinear Transducers	R. L. E.
2233	Amplifiers with Prescribed Frequency Characteristics and Arbitrary Bandwidths	R. L. E.
2234	An FM-AM Multiplier of High Accuracy and Wide Range	R. L. E.

9.2 Standards, Purchasing, and Stock

Procurement and Stock (H.B. Morley)

A Purchase Commitment Record has been devised which goes into effect February 1. This combines and replaces information formerly kept on three separate sets of records. The new system will permit a quicker analysis of purchase orders placed, payments approved, and payments still due vendor. Every effort has been made to keep this system as simple as possible, consistent with the scope of the problem.

Preliminary estimates indicate that more than 500 purchase orders were placed in January, which is a new high. In order to cope with this rapid growth and work load, some thought is being given to having buyers work Saturday mornings, if our vendors are open; the order typists might be considered for an 8 A.M. to 5 P.M. daily work schedule. A survey is being made of the vendors' daily and Saturday openings and closings to determine the feasibility of Saturday work.

An associated problem continues to be the lack of filing space, despite the complete chageover to new file cabinets made only two months ago. Completed orders for 1945, 1946, and 1947 have been placed in storage, but the need for more room increases constantly. There now seems to be no room in this office for the file cabinets which we will need within a month or two. This points up the larger problem, which is the overcrowding in this office and stockroom with every inch of usable area now occupied. A solution is being hopefully sought.

Components for the stockroom will be ordered in larger quantities than in the past. This change of policy is in line with an attempt to fill construction requisition needs from stock whenever possible, so that production can continue with the fewest possible delays stemming from poor deliveries and emergency needs not foreseen in original planning.

Components for production control withdrawn from stock will now be charged to the using group on stock withdrawal slips, on a money value basis. This further refines our accounting system to show, for internal use, the transfer of stock from Account #100 - General - to the using Account # - specifically.

The delivery situation remains at a minimum of 4 to 6 weeks delivery for standard electronic components; 4 to 9 months for special equipment, such as meters, pulse transformers, MIT spec transformers, relays, IN38A crystals, BNC connectors. Very little improvement is noted on any material which was a difficult delivery item in the past year.

Standards (H.W. Hodgdon)

Group leaders have been requested to designate persons within their groups who will be responsible for component selection. These persons will coordinate with the Standards Committee, particularly with regard to nonstandard items.

9.2 Standards, Purchasing, and Stock (continued)

A lab assistant has been transferred to the Standards group to assist with the detail of preparing and publishing standards sheets. This should expedite completion of the remaining items for the Standards Book and help to keep revisions up to date.

9.3 Construction

Production Control (F.F. Manning)

The following units have been completed since January 15, 1953:

CR#	Qty	Title	Originator
1492-33	17	Switch-Voltage Reference Regulator	Werlin
1492-35	348	Indicator-Light Brackets	Paddock
1684	5	2^6 Low-Speed Counters, Mod. II	Test Equip. Com.
1767	150	Video Cables	Norman
1795	24	Filament-Power Panel, Mod. III	Test Equip. Com.
1900-3C	6	Filament-Transformer Panel, Mod. II	Sandy
1952-0	3	Filament Phenolic Panel-Printing	Smead
1952-3C, 1952-7B, 1952-6C, 1952-57	36	Lamicoid Labels	Smead
1952-6C	2	Cathode Follower, Mod. I	Smead
1952-7B	2	Decoder-Switch Panel	Smead
1952-9B	2	Parity-Check Panel	Smead
1952-16	64pcs.	Selection Plane Driver (Rework Phenolics)	Smead
1952-51	7	Pushbutton Pulse Generator, MTC (Spot-face panels)	Smead
1952-52	8	Delay-Line Amplifier (spot panel)	Smead
1952-57	1	Cathode Follower, Mod. II	Smead
1952-64	3	Cathode Follower, Mod. I, MTC	Smead
1952-67	2	32-Pos. Crystal-Matrix Switch, MTC	Smead
1984-8	7	Core Driver, Mod. V	Test Equip. Com.
1984-12	2	Video Probe (Mod.)	" " "
2062	5	Sample Component Board	Watt
2104	4	Indicator Panel, Mod. II (Terminal Boards)	Neville

The following units are under construction:

1633-5	11	D-C Circuit-Breaker Boxes	Mercer
1633-7	3	Lab. Benches	Mercer
1684	14	Modify Low-Speed 2^6 Counter	Test Equip. Com.
1952-3B	3	P.I. Mounting Panel, MTC	Smead
1952-26A	5	Indicator Panels	Smead
1952-68	1	Indicator Panel, MTC	Smead
1952-70	2	Crystal Mixer	Smead
1952-71	1	Video-Jack Panel	Smead
1984-8	5	Core Driver, Mod. V	Test Equip. Com.
1984-12	16	Video Probes (Mod.)	" " "
1984-23		Core Driver, Mod. VI	" " "

9.3 Construction (continued)

CR#	Qty	Title	Originator
1984-28	102	Lamicoid Labels	Test Equip. Com.
2000-10	88	Video Cables	Norman
2028	1	Mech. Tape-Reader Clutch Control	Farnsworth
2050	2	D-C P.I. Cathode Follower	Farnsworth
2034-8	1	Blanking Circuit	Israel
2034-9	1	16" Display Scope	Israel
2093	10	D-C Extension Unit	Carroll
2096	4	Power Cables	Dickie
2102	6	Transistor D-C Strips	Eckl

Outside Vendors (R.F. Bradley)

P.O.	From	Title	Ord	Del	Type Work
L-14099	Advance Mach. Tool	Storage-Tube Parts	1835	1781	Machine
L-31954	Browning Lab. Inc.	16" Display Oscil-loscopes	4	0	Wir. & Assy.
L-33515	G.P. Clark Co.	Rack Power Indic. Pan.	40	0	" "
L-31851	Dane Electr. Lab.	D-C Power Strip Assy.	14	0	" "
L-33677	" " "	" " " "	50	0	" "
L-33372	" " "	Mod. II Power Distr. Panel	30	20	" "
L-31846	Hardware Prod. Co.	Storage-Tube Part	10	0	Machine
L-31855	Hauman Instr. Co.	Select. Plane Drivers	16	0	Wire & Assy.
L-31853	" " "	Buffer-Ampl. Panels	7	0	" "
L-33785	" " "	Mounting Panels	7	0	" "
L-33949	A.J. Koch Co.	D-C P.I. Flip-Flop Assy.	50	0	" "
L-33950	" " "	Delay-Line Amplifier	8	0	" "
L-31656	Metallic Arts, Inc.	Grid Ring Clamps	5	0	Machine
F-10440	Raytheon Mfg. Co.	Gate Buffer	1503	463	Complete Fab.
"	" " "	Flip-Flop	646	104	" "
"	" " "	Dual Buffer	260	258	" "
"	" " "	Switch Tube	272	263	" "
"	" " "	19" MTE Panels	65	12	" "
"	" " "	26" " "	310	87	" "
"	" " "	Spec. Delay Lines	800	150	" "
"	" " "	Chassis only	150	0	" "
			6082	3138	

9.4 Drafting (A.M. Falcione)

1. New Drawings

Title	Cir. Sch.	Assy. & PL	Al Panel
Low-Speed 2^6 Counter, Mod. II (TE)	D-53269	E-53271	C-53286
Video Connector Panel #2 (WWI)		D-53606	
Video Connector Panel #1 (WWI)		D-53480	
Plug-in Unit Mtg. Panel, Mod. I (MTC)		R-53623	D-53545
Plug-in Unit Sensing Ampl.,Mod.I (MTC)	C-53071	D-53585	D-53424
Parity-Check Panel A (MTC)	D-53572	E-53582	R-52706
Parity-Check Panel B (MTC)	D-52942	E-52946	R-52706
Selection-Plane Current-Control Panel (MTC)	B-53301	D-53591	D-53592
32-Position Crystal Matrix (MTC)		R-53570	R-53047
ST Monitor Intensifier (WWI)	C-53681	E-53680	E-53680
ESD Relay Panel (WWI)	B-53639	D-53717	D-53640
115V AC Power Bus Panel (WWI)		D-53370	D-53372
Cathode Follower, Mod. III (MTC)	C-53665	E-53764	R-52850

2. Block Diagram & Block Schematic Template

In the past few weeks several engineers have made the suggestion with reference to obtaining a standard template for making Block Diagram and Block Schematic Symbols, in order to facilitate the making of drawings. During the coming week, I will contact several engineers from the various groups with a sketch of the symbols for comments, criticisms, additions, or revisions, after which an order will be placed to procure the templates.

10.0 GENERAL

New Staff (J.C. Proctor)

Sydney Bradspies is a Research Assistant assigned to Taylor's group. He received a BS degree in EE from City College of New York in January of this year.

George A. Murdoch, a new DIC staff member assigned to Watt's section, received his BS degree in EE from Northeastern University in 1951. His co-op assignments at Northeastern included work on instrument development. For the past year and a half, he has been employed as a Field Engineer with Western Electric, re-packaging radar equipment.

New Non-Staff (R.A. Osborne)

Anne Albanese is a messenger girl at Whittemore Building.

Reynald Boisvert is the new truck driver.

James Cox is a laboratory assistant in Group 61.

10.0 GENERAL (continued)

Charles Deckett has joined the Construction Shop as a laboratory assistant.

Barbara Fellows is a new clerk in the 6345 section.

Mary Fisher is a new messenger at Whittemore Bldg.

Roderick Johnson is a new stock clerk.

Cynthia Koatz has joined the Systems Group as a senior clerk.

Anne MacIntire is a new senior clerk in Group 61.

Grace Munroe is a laboratory assistant in the Inspection Dept.

Joaquin Perry has joined the Whittemore Bldg. Janitor Group.

Florence DeCastro is a new Print Room clerk.

Michele Rheaume is a new clerk in the Print Room.

Stephen Stoller is a part-time student in the 6345 group.

Cecilia Waldron is a new laboratory assistant in the Inspection Dept.

Joseph Welsch is a new laboratory assistant in Group 61.

Daniel Wells is a new laboratory assistant in the Construction Shop.

Terminated Non-Staff (R.A. Osborne)

Joane Diebert
Murray Hill
Marie Hoer
Arnold Levine
Noble Prebble
Charles Riley
Victor Silverstein
Francis Stone

10.0 GENERAL (continued)

IBM Activity (A.P. Kromer)

In order to develop closer collaboration and to have better understanding of the work being done both at IBM and MIT, the first of a series of periodic meetings was held at Hartford, Connecticut. At this meeting, the status of a number of items was presented by various persons so that others will have knowledge of the activity being carried on in all fields.

Discussions have continued regarding the logical design of the arithmetic element of the proposed computer. As a result of these, certain tentative decisions have been reached, and a complete, descriptive proposal is being prepared.

Initial discussions regarding mechanical design and general appearance of the equipment have started with the IBM design people.