Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BI-WEEKLY REPORT, May 23, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

(D. Morrison)

The following is an estimate by the Computer operators of the usable percentage of assigned operation time and the errors due to the Computer. This covers the period 9 May 1952 through 22 May 1952.

Number of assigned hours	115
Number of transient errors	12
Number of steady state errors	10
Number of intermittent errors	14
Percentage of assigned time usable	73%
Percentage of assigned time usable since March 1951	85%

(S. H. Dodd)

Intermittent operation of the typewriter output on certain characters has been causing trouble during the last bi-weekly period. Efforts to find this trouble using special programs have so far been unsuccessful. Work is continuing on this.

Two types of component failures have caused trouble. Poor contacts in the holding gun socket of one of the mounts has caused lost holding-gun current occasionally. A new socket design is being investigated. Nobeloy resistors are still opening up in storage tube mounts.

(N. Daggett)

Marginal readouts from flip-flop storage when operating at low duty cycles have been traced during the last week to clamping difficulties in the flip-flop storage selection gate circuits. The trouble has been present since the panels were first installed but had not been recognized because it is not present during normal

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1.1 Whirlwind I System (continued)

(N. Daggett) (continued)

high-speed operation of the computer. The difficulty has been eliminated by d-c coupling all stages of the selection gate circuits. (A -300 volt power supply was added to make this possible.) Rise and fall times of the selection gates were increased in order to provide sufficient gain for clipping in each stage. This has resulted in a gating system which is extremely tolerant of tube variations.

The cause of frequent blown fuses in the R-F Pulser when using TV display was found to be an improperly operating bias regulator for the 715-B output amplifiers. Addition of an adequate bleeder load for the regulator eliminated the trouble.

(H. L. Ziegler, A. J. Roberts)

Storage reliability during the past bi-weekly period was somewhat below that experienced in the last few months. Two tubes were replaced during this period. The new tubes showed signs of high velocity gun deterioration after a few days of operation. We will resume taking transfer characteristics as an aid to determining best operating points.

Work is continuing on obtaining data for rewrite-time studies.

(M. F. Mann)

To test the repetition rate sensitivity of computer operations, a short subroutine has been written which will add a delay to the program -- the delay increasing linearly each time the program is cycled through. It is to be tried first with T-106, the marginal-checking program. This automatic, linearly varying delay can be omitted from the program by a simple flip-flop reset.

(L. O. Leighton)

Component Failures in WWI

The following failures of electrical components have been reported since May 9, 1952.

Component	No. of Failures	Hours of Operation	Reason for Failure
Crystal			
D-357	1	10522	Shorted
	1	11119	intermittent open
D-358	1	10630	Low R_b

1.1 Whirlwind I System (continued)

(L. O. Leighton) (continued)

Component Failures in WWI (continued)

Component	No. of Failures	Hours of Operation	Reason for Failures
Condenser			
.01 mfd mica	1	10522	shorted
Resistor			
2200 ohm 1 watt ± 5%	2	9302	change of value
1200 ohm 2 watt	1	11364	change of value
Tubes			
2D21	1	10292	Change in characteristics
2C51	1	10419	Low I_b
	1	10486	Low I_b
C16J	1	7765	Change in characteristics
6L6	2	3068	Low I_b
5U4G	2	5037	2-Low I_b
	1	7662	1-Open heater
6AC7W	1	11298	Open cathode
6J5	1	11298	Low I_b
6X5	1	11298	Low I_b
6SN7	1	8044	Excessive grid cutoff
	1	3605	Excessive grid cutoff
	2	11298	1-Open Filament 1-Low I_b

1.1 **Whirlwind I System** (continued)

(L. O. Leighton) (continued)

Component Failures in WWI (continued)

Component	No. of Failures	Hours of Operation	Reason for Failures
Tubes			
7AD7	1	1000 - 2000	Mechanical
	2	3000 - 4000	1-Change in characteristics 1-Low I_b
	2	6000 - 7000	1-Mechanical 1-Low I_b
	1	7000 - 8000	Low I_b
	1	8000 - 9000	Low I_b
	3	9000 - 10000	3-Low I_b
	7	10000 - 11000	3-Mechanical 4-Low I_b
	1	11000 - 12000	Mechanical
6AG7	1	4964	Interface
	1	9515	Low I_b
7AK7	1	6654	Low I_b
	2	10000 - 11000	2-Mechanical
	2	11000 - 12000	2-Mechanical
6Y6G	3	11000 - 12000	1-open filament 1-Low I_b 1-Broken envelope

Storage Tube Failures in WWI

The following Storage Tube failures were reported during this bi-weekly period:

RT-234 was rejected after 2967 hours of operation because of weak high velocity gun.

ST-504 was rejected after 1072 hours of operation because of poor margins and consistent failure to erase.

1.1 Whirlwind I System (continued)

(L. O. Leighton) (continued)

Storage Tube Complement in WWI

Following is the storage tube complement of Bank B as of 2400 May 22:

Digit	Tube	Hours of Installation	Hours of Operation
0	RT-233	4722	3017
1	ST-521	7059	680
2	RT-247	5198	2541
3	ST-535-2	7672	67
4	ST-516	6641	1098
5	RT-237	4714	3025
6	ST-534-2	7469	270
7	ST-508	6321	1418
8	ST-505	6176	1563
9	ST-519	6624	1115
10	ST-536	7736	3
11	ST-520	6639	1100
12	RT-258	5207	2532
13	ST-517	6493	1246
14	ST-524	7313	426
15	RT-255	5150	2589
16	ST-506-1	6218	1521

ES Clock hours as of 2400 - May 22 -- 7739

1.2 Five-Digit Multiplier

(C. N. Paskauskas)

At about 0200 on May 14 the multiplier started making continuous errors. The trouble was traced to three separate faults in the Adjustable Scale Binary Counter. One gate tube had a burned out plate decoupling resistor; another had a shorted screen grid by-pass condenser; one flip-flop had a badly unbalanced cross-over network. Correcting these faults restored the multiplier to normal operation.

During the period of this report, one 7AD7 F.F. tube was replaced as a result of marginal checking.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.14 Input-Output

(A. Werlin)

The three panels for the plug-in unit testers have been completed by the machine shop, and the schematic drawings of these test panels have been completed by the drafting room. The components will be mounted when camloc receptacles arrive, and the panels will then be sent to the shop.

The layout of the buffer drum terminal equipment using plug-in units has been changed so as to be consistent with the changes in the block diagram.

Another filament bus will be run on the lower wire guide of the plug-in unit mounting panels. This will require another Jones strip on the panel and both wire guides can now be made identically. This was done in order to provide a separate source of filament voltage to those plug-in units whose cathodes are below ground potential. The center-top of the transformer supplying these units will be returned to a negative voltage.

(R. H. Gould)

The video testing of the In-Out panels in A x 4 has been neglected during the past two weeks in favor of intensive study of the In-Out System drawings. More time will be spent to learn thoroughly the workings of the system and to check that there is proper correlation between the various drawings of the system now extant.

(C. W. Watt)

The first small batch of Plug-In Units of the new design have been completed in the assembly shop. Assembly went smoothly, and the results look good. Actual time of assembly was less than estimated. Some minor mechanical changes will be made to improve appearance.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes

(H. B. Frost, S. Twicken)

During this past period most of the engineering time has been spent in the investigation of the long-time-constant droop

2.2 Vacuum Tubes and Crystals (con't)

(H. B. Frost, S. Twicken)

discussed in previous biweekly reports. Haywire but effective instrumentation has been devised to study the droop and recovery of plate current in afflicted tubes. So far, tentative studies of types 715B, 829B, 6AG7, 7AD7, 12AU7, and 6AS7G have shown them to be subject to this droop. There is no reason to believe that any particular type will not be subject to this droop, since all types studied have shown it in some form or other, particularly in old tubes. The plate current changes range up to about 10 percent of the total plate current. It is important in tubes used in gate generators with precision requirements(signal plate drivers) direct-coupled amplifiers (ESD amplifiers, 514D scopes, and 304H scopes), and in any other application where plate current must be a function only of tube voltages, not of duty factor or previous operating conditions.

Reports in the literature and also rough calculations indicate that emission cooling of the cathode is not the source of trouble. As the pulse emission of some tubes is 50 or more times the current at which the droop observations were made, it seems reasonable that changes in emission are not entirely responsible. A possible explanation may be the change in coating conductivity reported by Dr. Nergaard at the last Physical Electronics Conference. Some rough retarding potential measurements which indicate that the cathode surface potential goes positive during the droop substantiate this view. Efforts are being made to refine the measurements so that the effect may be definitely attributed to one or another cause.

An accelerometer has been ordered to measure the acceleration imparted to vacuum tubes during tap testing.

2.22 Transistors

(J. Jacobs)

A Thesis entitled, "A High-Speed Counter Employing Transistors" has been completed. This thesis describes the approach to the transistor circuit design problem which has been used in the transistor group. The counter which it describes uses Bell 1734 and Bell 1698's in Eccles-Jordan type flip-flops and Bell 1698's in transistor gates. It counts pulses at repetition rates up to 1.5 megacycles per second.

(N.T. Jones)

Gerhardt, Klein, and I visited Dr. R. Rediker and his group at Project Lincoln in Lexington. Circulating-pulse circuitry, static flip-flops, measurement of alpha cut-off, and philosophies of transistor circuit design were discussed at length. Eleven GE

2.2 Vacuum Tubes and Crystals (con't)

(N.T. Jones)

transistors were left with him to correlate his alpha cut-off and our collector-current rise-and-fall-time measurements. The first results indicate that correlation between the two is quite good.

15 RCA transistors and 147 GE transistors were received. All of the RCA TA 165 transistors have better high-frequency response than the best of the GE G11A transistors. The RCA's have rise and fall times less than 0.2 μs or f_c = 5 Mc, and the GE's have rise and fall times in the neighborhood of 1 μs or f_c = 1 Mc for the most part. About 10% of the GE's are as good as 0.4 μs and 2.5 Mc.

An experiment was run to observe the effect of collector saturation on rise and fall times. After the collector saturates or switches, rise time remains about the same but fall time increases sharply due to hole storage. For two units this increase was in the order of 1 μs/ma of emitter current after collector saturation.

(D. Eckl, R. Callahan)

The initial wiring on the test accumulator described in Memorandum M-1442 has been completed. The last gate panel and the carry flip-flops were completed this week.

(W. A. Klein)

A note is being prepared which will include a complete d-c analysis of the equivalent circuit for the transistor. This note will summarize and amplify the analyses which have been made previously.

The study of the Felker system of storage without flip-flops is continuing. W. A. Klein, N. T. Jones, and R. H. Gerhardt visited Project Lincoln where R. Reidiger and Lebow have been successful in using the Felker system for storage of four binary digits. A circuit with single digit storage has been built and problems concerning trigger sensitivity are being examined. Thermal drift of the transistor has caused difficulties and it is hoped that a circuit can be designed to minimize these effects.

(I. Aronson)

The problem of capacitance measurements of germanium diodes was discussed at the N.E.R.E.M. show on Saturday May 10 with Mr. Pitman of Marconi Instruments Ltd. He suggested the Wayne Kerr type B.601 radio frequency bridge for this purpose.

2.2 Vacuum Tubes and Crystals (con't)

(I. Aronson)

A telephone conversation with W. T. Hannigan, the New England representative of Marconi Instruments, led to a B.601 bridge at Project Lincoln. This bridge was lent to us by R. Gagnon at Building 22, and tests have been started to determine its suitability to our measuring problems.

To date, poor results have been obtained in trying to measure collector diode capacitance, but good correlation has been observed between junction diode tests made with the General Radio type 716-B bridge and the Wayne Kerr B.601. Emitter diode capacitance is under consideration at the present.

(A. Heineck)

Work has been started on obtaining some data pertaining to the reliability of transistors in different circuits.

During the past two weeks a transistor oscillator has been developed which produces a 0.2 μsec pulse at a one-megacycle repetition frequency. The maximum amplitude available is 15 volts. Both the repetition frequency and pulse duration are easily varied.

The characteristics of the RCA transistor used in this oscillator were measured prior to insertion in the circuit. Periodically, these characteristics will be remeasured and changes noted. Changes in the output waveform will also be noted in an attempt to obtain correlation.

The output from the oscillator is fed into a cathode follower to provide isolation and this combination is used as a trigger source for transistor flip-flop circuits which are now being investigated.

Several new RCA transistors have been received and measurements indicate that the characteristics are amazingly similar for each transistor. Furthermore, these characteristics are superior to all other transistors on hand, except the Bell 1734. The new RCA's have been tried in a two-transistor flip-flop and found to work at frequencies slightly in excess of one megacycle. It may be that RCA has made a significant advance in transistor production techniques, or maybe these are still lab models.

2.3 Ferromagnetic and Ferroelectric Cores

(E.A. Guditz, W. N. Papian)

Ceramic Array I

Casual operation of the 16-by-16 array continues to be quite stable.

2.3 Ferromagnetic and Ferroelectric Cores (con't)

(E.A. Guditz, W. N. Papian)

An unwanted signal output was traced to an "edge effect" at the top of the array; this edge is the only one where additive-polarity voltages were being induced by the di/dt in the coordinate wire (y_{15}). The cure was a rearrangement of the sensing winding connection at that edge so as to balance out the pickup.

A few memory cores seem to give signal ratios which are significantly poorer than the rest (this array was constructed of untested cores) and they will be replaced one at a time. The first, and worst, has already been replaced and sent to Dave Brown for a post-mortem examination.

Present driver-current variation margins are about ±10% when operating in the stationary-pattern mode.

16 x 16 Metallic Array

(B. Widrowitz)

During the past two weeks, two circuits were made to operate which used Bell type A1698 transistor to drive cores of the type used in the metallic array. This was part of an effort being made to evaluate the possibility of using transistors to drive a metallic memory. Since transistors are able to put out more than the power required to switch a metallic core, it was expected that transistors could be used as drivers.

The circuits tried did not give good current waveforms, and exhibited PRF sensitivities which may have been due to internal heating. One circuit used a 50 to 1 output transformer and allowed single-turn driving. The other circuit used a 50-turn exciting winding on the driven core. Better results were obtained with the latter circuit, which was run up to 60KC.

Some time has been spent in driving the Z axis winding, which links 256 cores, from a metallic switch core.

Memory Systems Study

(A. Katz, J. Mitchell)

A whiffletree diagram was drawn outlining various systems for driving and selection in a magnetic-core memory. Several systems, of the gated-driver as well as of the inhibited-driver types, were examined for various geometries of digit columns (plane of cores per digit, or

2.3 Ferromagnetic and Ferroelectric Cores (con't)

(A. Katz, J. Mitchell)

cube per digit). In the interest of simplicity, only non-redundant selection schemes were considered. Almost all of the systems examined offer one of two extremes -- either a relatively small number of drivers each actuating many cores, or a large number of drivers each actuating few cores.

(G.R. Briggs)

The last two weeks have been spent exclusively on the problem of developing a core gate circuit that would have the ability to act as an open-circuit if not supplied with an external pulse, but would act as a closed-circuit (switch) if pulsed externally. The first experiments showed promise enough to warrant building a 4-core stepping register using these devices instead of diodes between stepper cores. However this failed to work because the gate core material used, (ferramic - H) had too much residual induction. Better materials are now being sought, and also better experiments and analyses are being started in an attempt to make presently available materials workable. Gate and stepper core lengths and diameters are being varied, turns ratios changed, and pulse rise and fall times experimented with.

Magnetic Circuits

(R. C. Sims)

Work has continued on the development of a design procedure for stepping registers. The results, though necessarily based on simplifying assumptions, seem pretty reasonable and very informative.

Somewhat of a snag has been hit in that in order to estimate the limitations which presently available components will place on a stepping register, I need more information on the effects of pulse operation and germanium diodes than I have been able to find. If anyone has any information on this subject or knows of what might be a good source of such information I would like very much to hear about it.

Storage and Records for Magnetic Cores

(D. R. Brown)

The Magnetic Materials Group has set up a system for receiving magnetic cores which is described in Memorandum M-1490. All technical information on cores which we have received will be kept in a magnetic materials looseleaf notebook and include hysteresis-test data and pulse-test data and curves. All magnetic cores will be kept in small labeled

2.3 Ferromagnetic and Ferroelectric Cores (con't)

(D. R. Brown)

cardboard boxes and stored in a steel cabinet. All users of magnetic materials are invited to make use of these facilities but to check with a member of the magnetic materials group before removing cores from the storage cabinet.

Magnetic Core Testing

(R. Pacl)

The hysteresograph previously described used 5879's in a differential amplifier. Further investigation revealed the desirability of using triodes rather than pentodes in order to achieve optimum signal-to-noise ratio. 12AY7's and 6SC7's were tried and the results seemed to favor the 6SC7's. It is possible, however, that the small stock of either type prohibited selection of the tubes having the lowest inherent noise.

(J. H. McCusker)

Pulse tests were made on new materials from General Ceramics. At low currents and with single turns on the ferrite cores, the geometry of the current and sensing windings had a pronounced effect on the signal outputs from the core.

Magnetic Materials

(D. A. Buck)

Single crystals of nickel-ferrite were obtained from Dr. G. W. Clark of Linde Air Products. These crystals, grown by the Verneuil process, seem to have high residual stresses. Attempts to cut small toroids out of these crystals for pulse studies were unsuccessful. A study of annealing is being made at Linde (Tonawanda, N. Y.). Attempts by Linde to grow stoichiometric nickel-ferrite crystals failed; those left with us were rich in iron.

A study is being initiated to determine the role played by residual mechanical stresses in shaping the hysteresis loops of ferrite toroids. (W. N. Papian long ago demonstrated an improvement in rectangularity of the hysteresis loop of Ferroxcube IV due to mechanical stress.) The M.I.T. Laboratory of Experimental Stress Analysis was consulted on stressing procedures. Since no equipment has been built which can subject our small ferrite toroids to the desired stress, an equipment to do so was designed and is now being constructed in the shop.

Laboratory for Insulation Research

(D. R. Brown)

Fourteen ferrite rings were received during the last bi-weekly

2.3 Ferromagnetic and Ferroelectric Cores (con't)

(D. R. Brown)

period. None of these had rectangular loops. The best core received from LIR remains LIR-62-13IIA, 7500 psi, received on April 21. A program of systematic variation of parameters based on this core is underway. All cores made so far have been with the large die, F-108. A small die suitable for pulse testing will be procured.

(G. Economos)

Work planned by Prof. Vinal is being carried out in his absence by D. Bates under the direction of G. Economos. Ceramic body LIR 62-13II-A, which was found to give the best square loop is being further investigated. Variations are being made in the mixing procedures. Test results from fired torroids are being awaited. Pressing techniques are being studied by varying the amount of binder used.

G. Economos is studying some basic ferrites and the tertiary ferrite as produced by General Ceramics. Body preparation procedures have been standardized so that the parameters molding pressure, firing temperature, firing time, particle size, etc. can be correlated with the electrical properties. Their effects on Hc, Bs, Br, Mmax, Mo, etc. will be used to produce exactly the body required for a particular use.

(J. H. Baldrige)

Quantitative determinations of common constituents have been made on an MgO material used in preparation of Ferrites and on a Ferritic material, 62-13II-A, prepared in this laboratory. A sample of manganese carbonate has been analyzed for Mu_2O_3 and a loss on ignition determined on a sample of magnesium carbonate. Solutions for volumetric analysis have been prepared and standardized.

(H. Neumann)

Measurements of the initial permeability dielectric constant for ferromagnetic semiconductors were continued. Six ring cores have been received from General Ceramics, and have been wound on the toroidal winder in RLE. This toroidal winder was found to be very satisfactory.

2.6 Component Analysis

(B. B. Paine)

Work on miniature delay lines is progressing slowly. It seems easiest to do preliminary tests using a silver spiral fired on a flat

2.6 Component Analysis (con't)

(B. B. Paine)

titanate plate, with a solid or comb-shaped silver ground plane conductor, than to begin with titanate tubes or cylinders, since these are far more expensive than flat plates, and harder to fabricate.

In connection with the failure of Nobleloy resistors in storage tube mounts, it has been determined that the discharge of a .05mfd capacitor charged to 1750 volts is enough to cause a great change in a 5000 ohm resistor.

Additional test equipment is being built to allow the rapid testing of plug-in relays and to complete the equipment required for rapid testing of crystal rectifiers by plotting their voltage-current characteristics on a scope. This method of testing crystal rectifiers may be tried in the incoming-component-inspection department shortly.

3.0 STORAGE TUBES

3.1 Construction

(P. Youtz)

The electrical work on the second of the new vacuum systems has been finished and the oven has been seasoned. The glasswork in the system will be finished next week. As soon as the system is completed, it will be used to process storage tubes having stannic-oxide coatings.

The new activation units and the new ion gauge control units under construction in the electrical shop have been delayed because of the vendor's failure to deliver the meters.

The program to produce 500-series storage tubes as replacements for Bank B has continued to yield tubes with satisfactory margins during this last bi-weekly period. A new target assembly designed to give closer collector-to-mosaic spacing has not been satisfactory. However, closer collector-to-mosaic spacing has been obtained in recent tubes by using a slightly smaller mica target.

A new type of collector screen was used in one of the research tubes, RT318-1. This was a 48-mesh electrolytic copper screen with wire .008" deep and .003" wide. It had been discovered in other tube laboratories that this type of (egg-crate) screen reduced the secondary redistribution. During the bakeout of RT318-1, the copper screen contaminated the beryllium mosaic so that the tube processed with a non-uniform target. The next egg-crate collector screen will be vacuum baked before it is put in a target assembly.

3.2 Test

(R. E. Hegler)

During this bi-weekly period, six tubes were available for pretest: ST537, ST538, ST539, ST540, RT316, and RT318-1. Of the four storage tubes which were pretested, one was satisfactory, two were marginal, and one was rejected.

ST537 was marginal because of an area in the lower right-hand corner on which it was difficult to Write-. ST538 was rejected because the target and collector were touching. ST539 was first rejected because of a short between A_2 and one vertical deflection plate. This was cleared by rebasing the tube. The tube was again pre-tested and found marginal due to a low maximum V_{HG} which was caused by improper centering of the holding beam. ST540 was found satisfactory.

3.2 Test (continued)

(R. E. Hegler) (continued)

RT316 had a new target design for closer target-to-collector spacing. It was rejected because the mica buckled in one area. RT318-1 was constructed to test a different form of collector mesh. It took a V_{HG} of 200V to write a 16 x 16 array. When the V_{HG} was lowered by hand, the first spot went negative with V_{HG} = 180V, and the last spot went negative with V_{HG} = 52V.

(A. M. Stein)

RT150, which is a 100-series storage tube employing an auxiliary collector approximately 0.87 inch in front of the collector, was examined during this bi-weekly period. It was found that the slope, r_{e_2}, of the spot size vs write+ time characteristic had a value of 1150 mils. Tubes of the 400-series type, which have an auxiliary collector-to-collector spacing of about 90 mils, have an average r_{e_2} of 85 mils. Using data from RT314 which has a variable auxiliary collector-to-collector spacing, it was found that the slope, r_{e_2}, at a spacing of 0.87 inch, should have a value of 1060 mils. This finding substantiates experimental results which relate the increase in spot size to the above spacing.

A report entitled "Current Distribution in the High-Velocity Beam in the M. I. T. Electrostatic Storage Tube" was submitted to the Electrical Engineering Department as a Master's thesis.

(C. L. Corderman, T. S. Greenwood)

During the last bi-weekly period, the gate-measuring set was tested. Adequate rise times were not obtained with the original design and modifications in the circuit are now being made.

Four tubes were tested in the STRT: RT234, ST526, ST537, ST539. RT234 and ST526 were rejects from Whirlwind. RT234 had very little emission but test results indicated that the surface was still in good condition. An attempt will be made to use the surface again in another tube. ST526 was removed from Whirlwind because of "weak guns". This was not verified in the STRT. The emission from the high velocity gun was normal; and although the spot-interaction area was not large, it was not small enough to have caused the tube to be rejected. This experience was identical to that obtained earlier on ST525 which was returned to Whirlwind but which has not yet been reinstalled.

3.2 Test (continued)

(C. L. Corderman, T. S. Greenwood) (continued)

The two new tubes, ST537 and ST539, were both satisfactory. The first was exceptionally good having an extremely large spot-interaction area. The latter had a reasonably good area. These two tubes were part of a series starting with ST534 in which special care was exercised in order to keep the collector-to-mosaic spacing small and uniform. Although the average spot-interaction area on these tubes has been considerably improved, there still exists a wide variation between individual tubes which does not appear to be due to spacing.

In regard to the Philips type "L" cathodes, the two tubes on life test continue to have constant emission. Preparatory to installing type "L" cathodes in storage tubes, some work has been done to improve the mounting of the cathode. Because of the high temperatures to which the cathode is subjected during activation, the mountings used for oxide cathodes are not suitable for type "L" cathodes. In the experimental designs, the type "L" cathodes have been mounted to the glass stem. In addition to requiring all ten base pins, this method has the added disadvantage of allowing considerable play between grid and cathode. A new assembly in which the cathode is mounted to the grid has been designed and will soon be tested.

(A. J. Cann)

The design of the deflection amplifier is complete and a drawing of it will be made next week. Oddly enough it is not very different from the original deflection amplifier, except that its drift is now known (and is sufficiently low).

The various gates and delays associated with writing in the TVD have been shortened sufficiently to permit writing to take place during the horizontal retrace of the TV sweep instead of during the vertical retrace as before. The fast writing at sweep frequency is interesting, but a more useful display seems to be obtained when writing at about one-fifth sweep frequency. While writing alternate positive and negative arrays -- about two per second -- the gate amplitude limits may be easily and quickly found.

(H. Jacobowitz)

A portion of this period was spent in writing the final draft of a thesis proposal titled "The Effects of Ions in the M. I. T. Electrostatic Storage Tube." This has been issued as an M-note.

3.2 Test (continued)

(H. Jacobowitz) (continued)

The remainder of this bi-weekly period was used to initiate a simplified theoretical attack on the deflection shift of the high-voltage beam. In order to reduce the work required to estimate the amount of ionic space charge needed to materially affect the deflection of the high-voltage beam, the following simplified situation was analyzed. A beam of high-velocity electrons is traveling, initially, parallel to a line of stationary positive charge. The beam, of course, is deflected and since the maximum amount of deflection shift that can be tolerated is known, one can calculate the charge density required to produce this deflection in the length of tube we now have.

An equation has been obtained describing this situation, but since it is in an integral form which is difficult to solve, it has not been carried to a numerical answer. Instead, I will next consider a more realistic situation, and, if the degree of difficulty is not materially greater than required for the simplified case, I will attempt to get numerical results for this more realistic condition.

A short time was also spent in becoming familiar with the basic operation of the equipment used by A. M. Stein to investigate the high-velocity beam. I intend to use this equipment to measure the deflection shift.

(H. J. Platt)

The Alignment Demonstrator has been completed and now works satisfactorily in all modes of operation. A thesis, which was concerned with the Alignment-Demonstrator, was completed and submitted. It is entitled, "A System for Testing M. I. T. Electrostatic Storage Tubes."

Most of the difficulties have been ironed out. The TV display defects were cleaned up and the r-f pulser is now able to provide sufficient drive to operate the storage tube. All drawings for the A-D have been submitted to the Drafting Room.

With this bi-weekly period, two years of pleasant and satisfying association with the Storage Tube Group is terminated. I am transferring to Norm Taylor's group to work with Dick Best.

4.0 TERMINAL EQUIPMENT

(E.S. Rich)

Terminal Equipment Planning

L.W. Reid of Engineering Research Associates visited this lab on May 20 and discussed some of the mechanical features of the magnetic drum systems being built for us. In the meeting agreement was reached on how the drum cabinets will be placed in Rm. 156, where the air supply and wiring ducts will be located, and how cable connections to the drum circuits will be made. Power switching and indication was also discussed but since Reid is not cognizant of the plans on these points, we asked that ERA send us the details of their proposed power control within the drum systems. In the meantime Bob Hunt is planning that portion of the power control for which we are responsible.

(R.E. Hunt)

Layout work on Rm. 156 is progressing at a satisfactory rate. Layout and details of the racks are pretty well along. We should be ready to contact outside vendors on this work this coming week.

The designs of the new power distribution panels have been more or less frozen and we should be able to proceed now to an early conclusion of this work. All components for these panels have been ordered.

A block schematic for a proposed power supply control system has been drafted. We will work this up into a formal proposal in the next few weeks.

4.1 Typewriter and Tape Punch

(L.H. Norcott)

Work on the tape comparer has progressed to the point where we can now run test tapes through the comparer to attempt to evaluate its reliability. Present tests are being run using an external D.C. supply to determine the optimum D.C. voltage, but the finished comparer will be self contained.

On the basis of the very limited tests made to date, it appears that the comparer will successfully detect all errors in a tape. The problems we have encountered to data have involved alarms when no differences actually existed in the tapes.

4.0 TERMINAL EQUIPMENT (Continued)

4.2 Magnetic Tape Print Out

(E.P. Farnsworth)

The addition of a thyratron-plus-relay interlock circuit now prevents the possibility of printer code being read into the Flexowriter solonoids after the printer has entered its printing cycle. This new circuit thus protects against sparking at the Flexowriter whiffletree translator relay contacts and prevents the resulting misprint or mechanical interference which may occur after an untimely read-in operation caused, for example, by the spacing of the characters on the magnetic tape exceeding 20 milliseconds. Thus there is now no maximum limit on the allowable spacing between Flexo characters which a program may record on magnetic tape for subsequent print-out. However, the magnetic tape Flexowriter will print out at half speed if the spacing delay exceeds 20 milliseconds, one-third speed if it exceeds 120 milliseconds, etc. This interlock circuit does not prevent the reading of one Flexo character on top of another in the thyratron storage register which can occur if the recorded spacing is less than the minimum limit of seven milliseconds; protection against this eventuality will be provided by the error alarm equipment described previously.

(B. Ginsburg, K. McVicar)

The interim magnetic tape system is being run continuously from 8:00 to 17:00 every day that the computer is operating. It is available for immediate use by simply throwing on the "standby" switch which is mounted on the front of the tape unit. Eventually the magnetic tape system will operate continuously with the computer cycling on and off at the same time. This will be done as soon as new, heavier circuit breakers, now on order, are installed in the d.c. supply box in Rm. 226 which supplies the tape system.

A Magnetic Tape Control Panel has been mounted in the test control room and is now operating. Indicator lights on the panel show in which direction the tape is running, whether the system is reading or recording, and when the tape has hit the limit stop at either end. Control buttons on the panel permit the operator to erase the tape, start over, start the tape, and clear the limit switch alarm.

The second tape unit which has been giving us some trouble in its tape handling qualities has been improved. However, now that we have become more critical of the Raytheon unit, it is clear that all the units are far from ideal. The second unit has been altered to permit insulation of the head from the ground in the hope that this may eliminate the trouble we have been

4.0 TERMINAL EQUIPMENT (Continued)

4.2 Magnetic Tape Print Out (Continued)

(B. Ginsburg, K. McVicar) (Continued)

having with the head coils shorting to ground. Tests on this feature, which were interrupted by the mechanical troubles with the tape unit itself, can now be continued.

5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control

(J.J. Gano)

New -150 Volt, 25 Ampere Supply

The rectifier operates into a capacitance input filter, resulting in interrupted conduction of the thyratons. Such a circuit is non-linear. An attempt to find a method of treating this characteristic in a frequency response analysis is being made.

(G.A. Kerby)

Continued with construction of the new 400 v rectifier/ 300 v regulator.

Orders have been placed for all parts for the new filament supply.

Drawings are being made for the new WWI power supply rack.

Whittemore power-supply interlock will be installed during the D.C. shut-down period, May 24, 1952.

(R.E. Hunt)

Marginal Checking

A breadboard panel of cold-cathode tube stepping circuits has been constructed by the shop and is now being tested. It seems to operate very well. We so far have been unable to find any major weaknesses in the design.

5.3 Video Cabling

(T. Leary)

Thirty-five more cables for the new in-out panels have been measured and will be built in the next bi-weekly period. Twenty more 75-foot temporary cables will be made and quite a few cables involved in the recent changes in PR clear and Storage clear must be measured.

6.0 BLOCK DIAGRAMS

(J.H. Hughes)

The 21st of May the control matrix was changed as follows: CPO's 62 and 85 were deleted completely and TP 6 of CPO 75 was eliminated. These changes were made to prevent the STORAGE CLEAR on TP 6 which had been giving trouble. CPO 84, E.S. READ on TP 6 has been made to do PR CLEAR also thus taking over the PR CLEAR functions of CPO's 62, 75, and 85 on TP 6.

The PR CLEAR connection from CPO 61 has been removed and this function of CPO 61 had been replaced by the addition of the necessary crystals(ri, qh, qd, ts, ex, ao, qf) to PR CLEAR CPO 88.

I am working on a new edition of the WWI timing diagrams.

The "Guided Tours" seem to be enjoying unexpected popularity. Please let me know if you find any errors or have any suggestions for their improvement.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

Progress during this bi-weekly period on each general applications problem is given below in terms of programming hours spent by laboratory personnel (exclusive of time spent by outsiders working on some of the problems), minutes of computer time used, and progress reports as submitted by the programmers in question.

4. Floating Point and Extra Precision Interpretive Subroutines (Programmed Arithmetic, PA): Frankovich, 16 hours; WWI, 19 minutes

Minor modifications were found necessary in the revised (24,6,0) and in the (39,6,0) programmed arithmetic interpretive subroutines. Further tests will continue to be made on the computer.

8. Magnetic Flux Density Study: Helwig, 3 hours; WWI, 55 minutes

The (24,6,0) Runge Kutta solution for the non-lined magnetic tape problem has been reprogrammed to print only the values of the flux. A partial solution for a core was obtained using a previous tape. The flux curve does not exhibit the double bump which is obtained experimentally.

11. Point-by-Point Scope Plotting of Alpha-Numerical Characters (Output Camera, OC 1): Kopley, 13.5 hours; WWI, 61 minutes

13. Point-by-Point Scope Plotting of Calibrated Axes (Output Camera, OC 2): Mackey, 3 hours

21. Optical Constants of Thin Metal Films: Carr, 1 hour; Neeb, 8 hours; WWI, 89 minutes

The main program has been tested and the results compare quite well with those obtained from the (15,0,0) program. It is planned to introduce new data obtained from hand calculations into the program in order to check it more thoroughly.

23. Print-Out of Contents of Storage (Post Mortem Error Diagnosis, PM): Gilmore, 4 hours; WWI, 42 minutes

A post mortem has been written for (15,15,0) floating point numbers and will be tested during the next bi-weekly period. An error diagnostic print out of the (15,15,0) interpretive routine's arithmetic and control elements has been written and will also be tested next week.

24. Matrices, Determinants, and Systems of Linear Equations: Aronson, 22 hours; Carr, 25 hours; WWI, 195 minutes

The routine for Jordan Elimination (24,6,0) is now available in subroutine form (T1195-1). The Gauss Relaxation routine is still under test.

8.1 Programs and Computer Operation (continued)

24. (continued)

A number of successful solutions were obtained with the revised relaxation routine but the subroutine form has yet to run. The program for the conjugate-gradient method is now under test.

The solution of systems of linear equations, and determination of eigenvectors for matrices by means of iteration procedures became possible for the first time during the past bi-weekly period. In conjuction with Alvin Meckler of the MIT Physics Dept. and Dr. Perlis and Mr. Aronson of the Digital Computer Laboratory, the following iterative procedures have been coded and tested in general form: (This means that any size matrix up to about 15 by 15 may be attacked using the programs listed below. It should be stated that although the programs work, there has not as yet been enough experimentation with the methods to know enough experimentally about the convergence properties, accuracy, and speed of solution.)

Tape 1051: This program uses the standard "Gauss-Seidel" or "Seidel" classical iteration scheme to solve a system of linear simultaneous equations. Sufficient conditions for convergence include positive definiteness of the matrix of coefficients. So far, various 4 x 4 and 8 x 8 systems have been tested. The latest modification of the program notes the number of iterations in a flip-flop register, and also notes the binary exponent of the largest residue, so that the program may be stopped at any portion of the iterative cycle and the answers printed out. With the (24,6,0) floating point scheme, it has been difficult as yet to devise a satisfactory stopping criterion for ill-conditioned matrices. This scheme of iteration is very slow for ill-conditioned matrices. A matrix with a zero eigenvalue required 400 iterations for solution. The standard "Wilson" 4 x 4 ill-conditioned matrix with condition number 3,000 required 1200 iterations and 5 minutes of operation compared to an almost instantaneous solution using Aronson's Gauss Elimination program. However, it is apparent that a combination of one of these iterative schemes mentioned here may provide a satisfactory combination for accurate solutions of large-order systems of linear equations.

Tape 1130: This program is the "Gauss" or "Southwell" scheme for minimizing the largest residue. A sufficient conditon for convergence is again positive definiteness. This program has been tested satisfactorily on a 4 x 4 matrix, but no further experimentation has as yet been done. However, it is expected that far fewer iterations will be necessary with this program than with the Gauss-Seidel scheme.

Tape 1150: This program iterates to determine the highest eigenvector and eigenvalue of a matrix. It has worked satisfactorily for a 4 x 4 matrix with multiple roots to its characteristic equation, and it is being further tested on matrices of order 9 x 9 and 12 x 12. The program will be improved, it is hoped, so that other eigenvalues and eigenvectors may be turned out automatically.

28. Ambipolar Diffusion: Gilmore, 1.75 hours; WWI, 186 minutes

The latest modification of this problem's (24,6,0) program which was mentioned in the last bi-weekly program proved to be successful. Prof. Allis of the MIT Physics Dept. and Robert Minnick of Harvard University have examined the data and are quite satisfied with the results. Prof. Allis has requested some six parameters to be operated; the results of which he plans to include in a paper to be issued some time in June.

8.1 Programs and Computer Operation (continued)

30. Digitally-Controlled Milling Machine Program: Frankovich, 6.5 hours; WWI, 66 minutes

Parts of Mr. Runyon's new tape preparation program have been successfully tested on the computer, but errors still exist in the complete program. Mr. Runyon is renewing work on a "point-by-point" program which will prepare tape to instruct the milling machine to cut rectangular surfaces in three dimensions.

37. n-th Root Approximation for Subroutines: Demurjian, 5.5 hours

38. Typewriter Print Out for Subroutines: Demurjian, 9 hours; Helwig, 2 hours; Kopley, 1 hour

39. Subroutine Library Editing: Carr, 5 hours; McQuillan, 4.5 hours.

40. Input Conversion Using Magnetic Tape Storage: Frankovich, 13 hours; Gilmore, 6 hours; Helwig, 14 hours; WWI, 20 minutes

A proposed number conversion procedure for use in the new conversion program is being programmed so it can be tested on the computer.

Plans are being made to arrange floating addresses and preset parameters to be denoted by any alphabetical character and number with the exception of the letters o and l (because of the ambiguity between them and the numerals 0 and 1). This will enable programmers to associate addresses of certain constants with the same letters which represent the constants in the programmer's equation.

41. Binary Matrix Product Statistics: Carr, 3 hours

42. Spherical Waves - Numerical Integration of Hyperbolic Partial Differential Equations via Characteristics: WWI, 2 minutes

43. Generation of Random Numbers: Carr, 3 hours; WWI, 63 minutes

45. Crystal Structure: Aronson, 17 hours; WWI, 40 minutes

46. Torpedo Depth Response: Neeb, 1 hour; WWI, 28 minutes

Results from the (15,15,0) program have been obtained with an average error of less than .5% for a time step of .1 second. The computing interval is being changed to .2 seconds to determine how small an interval must be used to give good results.

47. Partial Differential Equations of Engine - Part I: Carr, 7 hours; WWI, 157 minutes

Mr. Tsai has now run off several cycles of the combustion engine performance calculations, with satisfactory results. The program is now being changed so that printing will begin only after four or five cycles have been calculated, since the steady-state conditions are the desired results. A second program will display the steady-state solution on the oscilloscope. It is hoped the latter output will be satisfactory enough so that a large amount of printing will be eliminated. Upon completion of testing of these two programs, this problem will become more of a production job.

8.1 Programs and Computer Operation (continued)

48. Gust Loads on Rigid Airplanes in Two Degrees of Freedom: Helwig, 24 hours; WWI, 169 minutes

Several modifications have been made in the program for the computation of the response of an aircraft to a graded gust, but the program is not yet working properly.

A similiar program which prints only the maximum value of the independent variables has been partially tested and appears to be working properly.

50. Lattice Analogy Applied to Shear Walls: WWI, 117 minutes

51. Magnetic Tape Programming: Kopley, 26 hours

52. Oil Reservoir Depletion Analysis by Iteration: Kopley, 6.5 hours; Porter, 22 hours

From trial runs made on WWI it appears that the analysis suggested by Dr. D. R. Shreve of the Carter Lab is not a convergent one. Moreover it appears that round-off errors accumulated in the extrapolation for the new pressure distribution in our model reservoir may be contributing to our difficulties. A set of partial results were given to Dr. Shreve to enable him to study these effects.

In the meantime I have revised our analysis to give us some measure of control on the convergence. This revision will keep track of successive iterations and if the oscillations observed in our first runs arise their amplitudes will be reduced by an averaging process.

This analysis is now being coded.

54. Optimizing the Use of Water Storage In a Combined Hydro-Thermal Electric System: Demurjian, 3.5 hours

A new method for handling system's constraints was written. The period under consideration is now fifty-two weeks. The complete new program was checked and will be tested in the forthcoming period.

55. Solution of 2nd Order Non-Linear Ordinary Differential Equation: WWI, 64 minutes

56. Determining Pupil Dates and Two Dramatic Aberrations in Optical Lens Systems: Helwig, .5 hours; WWI, 96 minutes

57. Runge-Kutta Differential Equations: Aronson, 10 hours; Carr, 18 hours; WWI, 18 minutes

Mr. Zierler of the Instrumentation Laboratory has written a generalized program that will accomplish time-step integrations automatically by the Runge-Kutta method, referring to the necessary functions whenever needed. With this program, for an integration of a system of ordinary differential equations, only the right-hand-sides (functions) would have to be supplied by the programmer. This program will go under test during the next bi-weekly period.

58. Determination of Energy Levels of Oxygen Molecule: Carr, 10 hours, WWI, 131 minutes

8.1 Programs and Computer Operation (continued)

58. (continued)

Although a complete program now exists for determining the eigenvalues and eigenvectors of a matrix by a combination of steps, it was found that the direct method employed, using (24,6,0) numbers, was not accurate enough, with round-off building up for matrices above the order of 7 x 7. For this reason, since solutions to 9 x 9 and 12 x 12 matrices are desired, other methods are being investigated. One iteration scheme is described under problem 24 above. Another, now coded by Mr. Meckler, is the "Givens" tri-diagonalization scheme, similiar to Lanczos's minimized iteration method. This gives a tri-diagonal matrix whose eigenvalues and eigenvectors can be easily found. The program has been written and tested, with a slight error in the method still undiscovered. At the same time, Dr. Perlis (see problem 67) is completing the program for direct determination of all eigenvalues by an iterative scheme.

59. AEC Positron-Electron Calculation: Carr, 8 hours

Latest reports from Oak Ridge indicate that this problem has now been programmed. Using (39,6,0) floating point precision (with division) as required for desired accuracy, this program may run to 1300 registers, which is over the allowed value at present. This means that very probably a shuffling scheme using magnetic tape must be devised so that numbers or program can be fed back and forth from magnetic tape in order that the machine can be used with present ES. It is hoped that during my vacation period, I will be able to talk to Dr. Perry at Oak Ridge in an effort to solve this problem of storage.

60. Calculation of Deuteron Energy Levels: WWI, 355 minutes

62. Reflection of Scalar Waves from a Cylinder with Inhomogeneous Accustical Properties: Rotenberg

The first part of this problem has been completed with satisfactory results. The second part is still in the stages of discussion, and will be programmed this summer.

69. Programming with a Magnetic Drum: Carr, 6 hours;

A tentative scheme of investigation for this problem has been set up. So far, sources have been searched for magnetic drum programming material. The only experience with combined magnetic drum and electrostatic storage has been with the Manchester (Ferranti) machine. Magnetic drums using optimum programming techniques have been used by ERA and the small computers such as CADAC and Circle, but little operating data is available. A study will first be made of the Ferranti procedure. It is recommended that later on after installation of a Ferranti machine at Toronto, some member of the programming staff be sent there for a period to study their operation technique. C. W. Adams is now visiting the English machines, and may have an opportunity to get first hand information on the Ferranti set-up in Manchester.

70. Correlation of Solvolysis Rates: Demurjian, 4 hours; WWI, 61 minutes

8.1 Programs and Computer Operation (continued

70. (continued)

The program was modified to insert a value in the MRA to serve as an exponent when ever a single length number was multiplied by a number in the (24,6,0) system.

75. Solution of Algebraic Equations: Carr

This problem was first started in connection with Problem 58 above. In that case, a method for solving for real roots of a polynomial was needed in the (24,6,0) scheme. The first procedure was direct "hunt" scheme in sequence to determine real roots, since it was known all roots of the matrices being investigated were real. This program is now available and works satisfactorily on all except close pairs of real roots. A second program has now been written and is under test making use of the experience gained by Brooker and Wheeler at EDSAC and Manchester. Their recommendation is for a second-order iterative Newton's procedure to determine either real or complex roots. A real-root finder has been programmed, and works satisfactorily on third degree equations. It will be tested on those of a higher degree. If successful, it is hoped it may be extended to solving equations with complex roots, which are also of importance in numerous engineering and physical fields.

TOTAL COMPUTER TIME USED FOR PROGRAMS: 47 hours, 51 minutes

TOTAL COMPUTER TIME USED FOR CONVERSION: 4 hours, 50 minutes

TOTAL COMPUTER TIME USED FOR DEMONSTRATIONS: 30 minutes

TOTAL COMPUTER TIME USED: 53 hours, 11 minutes

TOTAL COMPUTER TIME AVAILABLE: 76 hours, 12 minutes

USABLE TIME PERCENTAGE: 69.7%

TOTAL # OF PROGRAMS OPERATED: 181

8.2 Subroutine Library

Below are listed all subroutines which have been suggested, worked on, or completed during this bi-weekly period.

Being Tested

LSR #	Tape #	Title	Programmer
NR	T-552-1	Square Root of C(AC), Gaudette's Method, Result in AC.	Demurjian
AD	T-1246	Single Step Extrapolation of n simultaneous 1st order differential equations by Runge-Kutta.	Frankovich

8.2 Subroutine Library (continued)

LSR #	Tape #	Title	Programmer
PA	T-1182	(24,6,0) Interpretive subroutine with minimum time per interpreted instruction and with facility of working in the 30,15,0 number system	Frankovich
PA	T-1180	(39,6,0) Interpretive subroutine	Frankovich
		Being Written	
TF		39,6,0 Sini-Cosine Interpretive Subroutine	Aronson
		Under Consideration	
		Master Output Routine	Demurjian Helwig Kopley Frankovich

8.3 Procedures

(J. Gilmore)

It has become necessary to change the Whirlwind performance request form in order to increase the efficiency of operation. Starting next bi-weekly period none of the old requests will be accepted by the operators.

A memo is being issued which lists all of the utility programs available to the operators in the control room. It is hoped that those be used whenever possible rather than waste programming time by writing programs which perform the same functions.

9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications

(Anola Ryan)

The following material has been received in the Library, Room 217, and is available to laboratory personnel.

LABORATORY REPORTS

No.	Title	No. of Pages	Date	Author
M-1476	Laboratory Personnel	9	5-1-52	
M-1477	Design of Low-power Pulse Transformers Using Ferrite Cores, M.S. Thesis Proposal	9	5-5-52	R. D. Robinson
M-1478	Transistor Circuits as Realizations of Boolean Functions	3	5-6-52	J. F. Jacobs W. A. Klein
M-1483	Stereo Display for Whirlwind	2	5-9-52	J. H. Hughes
M-1484	Bi-Weekly Report, May 9, 1952	32	5-9-52	
M-1485	Symposium of Progress in Quality Electronic Components, Washington, D. C., May 5,6,7	11	5-13-52	C. W. Watt B. B. Paine
M-1487	Proposed Layout of Room 156 and Required Wireways	2	5-13-52	R. Hunt
M-1490	Procedure for Receiving Magnetic Cores	2	5-16-52	R. D. Brown
M-1491	Effects of Ions in the M.I.T. Electrostatic Storage Tube (M.S. Thesis Proposal)	7	5-22-52	H. Jacobowitz
M-1494	Subject Card Index for Laboratory Publications	2	5-19-52	A. F. Ryan
M-1497	Purchase Order Notification	1	5-22-52	H. Fahnestock

LIBRARY FILES

No.	Identifying Information	Source
1811	Analysis of Errors in Certain Sampled-Data Control Systems (M.S. Thesis)	R. W. Sittler
1812	A Magnetic Flip-Flop (M.S. Thesis)	R. J. Pfaff
1813	Applications of Self-Checking and Self-Correcting Codes to Digital Computers (M.S. Thesis)	F. E. Heart
1814	Errors in the Condenser Type Continuous Phase Shifter Radiation Lab. Report No. 633	M. I. T.
1815	The Display of Arabic Numerals on a Cathode-Ray Tube (M.S. Thesis)	F. E. Irish
1816	Regenerative Transistor Pulse Amplifiers (M.S. Thesis)	A. W. Heineck, Jr.
1817	Ferroelectrics for Digital Information, Storage and Switching (M.S. Thesis)	D. A. Buck

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information	Source
1818	A System for Testing M.I.T. Electrostatic Storage Tubes (M.S. Thesis)	H. J. Platt
1819	Current Distribution in the High-Velocity Beam in the M.I.T. Electrostatic Storage Tube (M.S. Thesis)	A. M. Stein
1820	Complex Boundary Value Problems (Dept. of Math., Stanford Univ., Calif.)	P. Garabedian D. C. Spencer
1821	The Solution of Linear Equations by Minimization (M. R. Hestenes and M. H. Stein)	Nat. Bur. Standards, Los Angeles, Calif.
1822	Use of Continued Fractions in High Speed Computing (N. B. S. Report No. 1514)	D. Teichroew
1823	Note on the Numerical Solution of Equations Involving Differential Operators with Constant Coefficients (N. B. S. Report No. 1584)	G. Blanch
1824	The Role of Analogue Computers in Industry (Figures from talk)	F. Verzuh
1825	Potter Instrument Company Pamphlet	Potter Co., N. Y.
1826	Catalog of Digital Computer Designs (Bell Telephone Labs.)	J. H. Felker
1827	Survey of M. I. T. Computing Machines	S. I. Rubinow
1828	The Physical Review, April 15, 1949	Amer. Physical Soc.
1829	Nonlinear Control Systems with Statistical Inputs	R. C. Booton, Jr.
1830	Servomechanism Transient Performance from Decibel-Log Frequency Plots (AIEE Technical Paper)	Harris-Kirby-VonArx
1831	Successive Approximation (Rand Corp. Report)	H. H. Germond
1832	Numerical Methods of Obtaining Solutions of Fixed End Point Problems in the Calculus of Variations (Rand Corp. Report)	M. R. Hestenes
1833	On Approximate Expressions for the Exponential Integral and the Error Function (Rand Corp. Report)	R. Bellman
1834	Mechanical Inversion of the LaPlace Transform (Rand Corp. Report)	D. Widder
1835	A General Problem in the Calculus of Variations with Applications to Paths of Least Time (Rand Corp. Report)	M. R. Hestenes
1836	Least Square Approximations by Sums of Separable Functions (Rand Corp. Report)	G. W. Brown
1837	Representation by Sums of Separable Functions in n Dimensions (Rand Corp. Report)	Oliver Gross
1838	Representation by Sums of Separable Functions (Rand Corp. Report)	Oliver Gross
1840	Computational Methods Useful in Analyzing Series of Binary Data (Amer. Journal of Psychology)	E. B. Newman

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information	Source
1841	Calculation of Deuteron Binding Energy as a Function of Potential Well Shape (B.S. Thesis)	D. Combelic
1852	A High-Speed Counter Employing Transistors (M.S. Thesis)	J. F. Jacobs
.004	European Scientific Notes, April 15, 1952	ONR/London
150	Fundamental Research on Raw Materials Used for Electron Emissivity on Indirectly Heated Cathodes	Raytheon Mfg. Co.
180	Bulletin of the Document Office, May 9, 1952	R.L.E./M.I.T.
333	The Oscillographer, January-March, 1952	A. B. Dumont Labs.
597	Reports on Research, May, 1952	M.I.T.
963	Quarterly Progress Report No. 9, Jan.-April, 1952 Signal Corps Electronic Computer Res. & Dev.	Moore Sch. Elect. Eng., Univ. Pa.
1671	Nuclear Science Abstracts; March 31, April 30, May 15	U.S. Atomic Energy Comm.
1690	Technical Data Digest, May, 1952	ASTIA

No.	Identifying Information
B-196	E. A. Guillemin: THE MATHEMATICS OF CIRCUIT ANALYSIS, John Wiley & Sons, 1949
B-197	A. N. Lowan, L. J. Briggs: TABLE OF ARC SIN X, Columbia University Press, for National Bureau of Standards, 1945
B-198	A. N. Lowman, L. J. Briggs: TABLES OF FRACTIONAL POWERS, Columbia University Press, 1946
B-199	CHAMBERS' SIX-FIGURE MATHEMATICAL TABLES, VOL. I, Logarithmic Values, D. Van Nostrand, 1949
B-200	CHAMBERS' SIX-FIGURE MATHEMATICAL TABLES, VOL. II, Natural Values, D. Van Nostrand, 1949
B-201	L. J. Briggs, A. N. Lowan: TABLES OF LAGRANGIAN INTERPOLATION COEFFICIENTS, Columbia University Press, 1944
B-202	L. J. Briggs, A. N. Lowan: TABLES OF CIRCULAR AND HYPERBOLIC TANGENTS AND COTANGENTS FOR RADIAN ARGUMENTS, Columbia University Press, 1943
B-204	1400 GEAR RATIOS: Ray M. Page, Industrial Press, 1942
B-203	H. T. Davis: TABLES OF THE HIGHER MATHEMATICAL FUNCTIONS, Principia Press, 1935
B-205	J. Peters: FACTOR TABLE, Vol. V, British Association Mathematical Tables, Cambridge University Press, 1935
B-206	Royal Society: CIRCULAR AND HYPERBOLIC FUNCTIONS, 3/E, Vol. I, British Association Mathematical Tables, Cambridge University Press, 1951
B-207	H. T. Davis: TABLES OF THE HIGHER MATHEMATICAL FUNCTIONS, Vol. I, Principia Press, 1933

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information
B-208	Staff of the Computation Lab.: TABLES OF THE FUNCTION $\frac{\text{SIN } \phi}{\phi}$ AND OF ITS FIRST ELEVEN DERIVATIVES, Harvard University Press, 1949
B-209	Staff of the Computation Lab.: TABLES OF INVERSE HYPERBOLIC FUNCTIONS, Harvard University Press, 1949
B-210	W. J. Kohl: MATERIALS TECHNOLOGY FOR ELECTRON TUBES, Reinhold Publishing Corp., 1951

Journals

Proceedings of the I.R.E., May, 1952

Machine Design, May, 1952

Physics Abstracts, April, 1952

U. S. Govt. Publications Catalogue, April, 1952

Oil & Gas Journal, May 19, 1952

Science News Letter, May, 1952

9.1 Publications

(J. W. Craig)

The final draft of the condensed form of Salzer's thesis is virtually finished. Most of the drawings that the report contains are the same as those in the thesis, so there is little work to be done in the drafting room.

9.2 Standards, Purchasing, and Stock

(H. B. Morley)

Procurement and Stock:

Organization of the department is shaping up well - although a great deal of work is yet to be done, including revision of Kardex to coincide with new Standards and complete revision of catalog filing and index systems. Stockroom work load is very heavy and it will probably be necessary to increase personnel in that division. The cooperation of all personnel will be appreciated during this transitory period as a certain amount of confusion always accompanies such an expansion program.

More manufacturers continue to accept our status as an industrial account, and are taking orders from us directly. This avoids higher jobbers' prices, cuts project procurement costs and helps to improve delivery.

A slight improvement in deliveries has been noticed during the past bi-weekly period. Deliveries of some critical items have improved to the point where certain manufacturers are making shipments well in advance of promised dates.

Expediting numerous small orders has continued to be a problem. Much of the delay encountered in these small orders can be traced to the failure of the manufacturer to maintain his shipping promises to our local suppliers.

Planning foresight on the part of project personnel requisitioning material will continue to help this office in our effort to consolidate orders, a factor which helps to improve deliveries and reduce prices through quantity discounts.

Standards Committee:

The work of the standards committee will soon be expedited by the addition of Ken Olsen of the Development group. It is expected that our work will be of more general help to the various engineering groups as we strengthen our liaison with them.

9.3 Construction

(F. F. Manning)

Production Control

The following units have been completed since May 9, 1952.

CR No.	QTY.	UNIT TITLE	ENGINEER
1492-2	12	Plug-in Unit Gate Tube Mod II	Watt
1492-16	42	Assy Special Delay Line for Flip-Flop Plug-in Unit Mod II	Watt
1555	5	A.C. Circuit Breaker Boxes	Gano
1655	1	Control Unit for Test Accumulator	Eckl
1666	1	Relay Panel for D.C. Power Supplies	Kerby
1671	1	Stepping Circuit Prototype	Hunt
1672	2	Gate-Buffer Amplifier Breadboard	Woolf
1672	2	D.C. Power Cords for Gate-Buffer Panels	Woolf
1694	2	R. F. Cables (RG22/U)	Platt
1505	10	D.C. Circuit Breaker Boxes	Gano
1702	1	Delay Line	Baltzer
1691	1	Cabinet for Public Address System Whittemore Bldg.	Carroll

The following units are under construction.

CR No.	QTY.	UNIT TITLE	ENGINEER
1561	1	Standardizer Amplifier	Mercer
1415	5	Storage Tube Mounts	Dodd
1563	6	Multivibrator Frequency Dividers	Taylor
1614	1	Vacuum Tube Processing Pwr Supply	Palermo
1637	2	Filament Supplies for Vac. Tube	Caswell
1615	2	Ion Guage Control Chassis	Palermo
1429	35	Lab Bench Cabling (A.C. Wiring Completed)	Hepp
1625	1	D.C. Outlet Box Modification	Platt
1652	2	Preburning Panels (Top & Bottom)	Frost
1659	6	Mixer Operation Matrix	Platt
1591	1	Magnetic Tape Control Block Mark Detector & Shaping Circuit	O'Brien
1691	1	Chassis for Public Address System Whittemore Bldg.	Carroll
1560	1	Fuse Indication Panel	Mercer
1492-3	44	Gate-Buffer Amplifier Plug-in Unit Mod II	Watt
1609	1	In-Out Switch Magnetic Tape Matrix	O'Brien
1704	2	Core Pulse Amplifiers Breadboard	Brown
1688	24	1:1 Pulse Transformers	Hunt

9.3 Construction (con't)

(F. Manning)

CR No.	QTY.	UNIT TITLE	ENGINEER
1492-6	32	D.C. Flip-Flop Plug-In Units Mod.II	Watt
1704	2	Core Pulse Distributor	Brown
1707	6	D.C. Power Cords	McVicar
1699	110	Video Cables	McVicar
1608	1	Magnetic Tape Control Mode Switching Flip-Flop	O'Brien

9.4 Drafting

(A.M. Falcione)

1. Thesis Drawings:

The drawings required (312) for the twelve thesis candidates were completed in time to meet the required deadline. In connection with the title page of the theses, Professor Gardner's office has informed us that from now on, all title pages must be signed personally by the author and thesis supervisor. The signature made on the multilith master is not acceptable.

2. Electrical Standards Book:

About two years ago, I started to work on an Electrical Standards Book for the Digital Computer Laboratory Drafting Room. These standards incorporate all of our existing practices and standards. Copies of this standards book will be issued to all drafting personnel within the next few weeks. Additions or revisions to existing standards should be brought to my attention if an engineer feels that our existing standards are not adaptable for his particular requirements. Copies of the Electrical Standards Book will be available for the use of engineers either from the Drafting Room Library, or the Barta Building Library.

10.0 General

(D. R. Brown)

Test Equipment

A new Test Equipment Committee has been formed with the following membership:

Group 60 - Louis Sutro
Group 61 - Ed Rich

10.0 General (con't)

(D. R. Brown)

Group 62 - Dick Best
Group 63 - Dave Brown, Chairman
Group 64 - Gus O'Brien
Group 65 - Chuck Corderman

The Test Equipment Committee will be responsible for the initiation of purchase requisitions, design, allocation, and maintenance of commercial and standard test equipment. We will also consider the design of additional types of standard test equipment and certain special test equipment, such as tube testers. Please discuss your test equipment needs with your group representative on the Test Equipment Committee.

10.0 GENERAL

(J. C. Proctor)

New Staff

G. Ferrell Sandy, who has been assigned to work with Watt, received his B. S. in EE from the University of Louisville in 1947 and did some graduate work at Case Institute of Technology. He has been an assembly engineer with the Packard Electric Division of General Motors for the past four years.

New Non-Staff

Alta Coulter is a secretary assigned to work with Proctor and Osborne.

Dorothea Diffenderfer is a secretary assigned to work with Adams.

Virginia Nicholson, who formerly worked in the MIT Laboratory Supplies Office, is a secretary working with Morley.

E. Jean Friberg is a secretary assigned to work with Proctor and Osborne.

Rita M. Langley is a secretary working with Falcione.

Priscilla Coleman is the new telephone-operator - receptionist in the Barta Building.

Barbara Durso is the new messenger in the Whittemore Building.

Alvan Lamke, a detailer, has been assigned to work with Falcione in the Drafting Room.

Helen Carr is working with Adams' group as a computer.

Raymond Quinn is working with Wiercinski as a laboratory helper.

Three full-time summer student technicians have been assigned to work with Adams' group. They are John Genowicz, Haig Parechanian, and Joseph F. Kapczynski.

Anna McLaskey, a laboratory assistant, has been assigned to work with Watt.

Henry Karsh is a laboratory assistant working with Grant.

10.0 GENERAL (continued)

(J. C. Proctor)

James Sullivan, a laboratory assistant, has also been assigned to work with Grant.

Neal H. Kempt is a laboratory assistant working with Mercer.

Dennis Twohig is a laboratoty assistant working with Adams.

Walter R. Vecchia is working with Wieser's group as a laboratory assistant.

Marie Osenton has been assigned to work with Brown as a laboratory assistant.

Mary Delaney is a laboratory assistant working with Youtz.

Terminated Non-Staff

Cynthis Warner
Ramona Ferenz
Ann Staffeld
Robert T. Schultz
Richard H. Daly
George Pierce
David Keast