Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, December 5, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

1.11 Operation (D. Morrison)

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 21 November - 3 December 1952:

Number of assigned hours	155
Usable percentage of assigned time	86
Usable percentage of assigned time since March, 1951	84
Number of transient errors	30
Number of steady-state errors	9
Number of intermittent errors	8

(S. H. Dodd)

The deflection circuits for electrostatic storage have been reconnected so that consecutively numbered registers fall at widely separated points on the surface of the storage tubes. This was done in an effort to reduce interaction between spots by allowing as much holding-gun time as possible between operations on adjacent spots. A sharp reduction in the number of parity alarms encountered during applications and some increase in the margins on test program L-2 indicate a substantial improvement in storage reliability. Coupled with the good operation of the 700-series storage tubes, prospects for good storage reliability look promising.

We are still waiting for delivery of the auxiliary drum by Engineering Research Associates. According to the latest information, we should expect delivery on December 10.

A substantial amount of time was used in trying to find the reason for the noise in the 16-inch display scopes in Room 222. The evidence seems to point to this noise originating in a variety of places in the deflection system, and a major change in the deflection system will probably be required to eliminate this difficulty. The display system as it now stands is, 1.11 Operation (continued)

(S. H. Dodd continued)

however, quite usable, although the displays are not as pretty as desirable.

In an effort to clear the decks for intensive work on some of the new terminal equipment which is now being installed, the systems group is scheduling more frequent installations during the next few weeks to eliminate a large number of small potential troubles in the computer.

(A. J. Roberts)

The ES deflection decoders have been recabled so that the count pulses start with the largest increments being switched. This places consecutive registers 16 spot positions apart and reduces the cross coupling between adjacent spots. Storage-tube parameters have been adjusted to provide balanced margins under these conditions, and storage-tube reliability has become excellent.

One additional failure to hold a plus array has occurred in the new ion-collector tubes but the others have been relatively error-free. We are still plagued with storage surfaces switching positive during computer operation. An alarm circuit has been constructed in an attempt to isolate the cause of this trouble.

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

The following failures of electrical components have been reported since November 21, 1952:

Component	No. of Failures	Hours of Operation	Reasons for Failure
Crystals			
1N34A	2	11000 - 12000	low R_b
D-357	4	1 - 11000 - 12000 3 - 13000 - 14000	low R_b low R_b
D-358	1	13000 - 14000	low R_b
Resistors			
220 ohm 1 watt ±5%	1	4930	overheated
Tubes			
715B	1	0	open grid
6L6G	1	3916	low I_b
5651	1	14558	poor regulation and high voltage

1.12 Component Failures in WWI (continued)

Component	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
5U4G	3	5238	1 - low I_b 2 - short
3B24W	1	0	open heater
7AK7	1	13428	flicker short
7AD7	2 2	9543 8412	low I_b 1 - low I_b 1 - flicker short
6AK5	1	8007	flicker short
6AS7G	1	128	flicker short
2C51	3	0	1 - leakage 1 - broken envelope 1 - broken pin

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

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

ST-701-C was rejected after 90.7 hours of operation because of failure to hold a plus array with V_{HG} = 125 V.

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

Following is the storage-tube complement as of 2400 December 4, 1952:

Digit	Tube	Hours of Installation	Hours of Operation
0 B	ST-619-C-1	10069	1232
1 B	ST-606-1	9599	1702
2 B	ST-603	8322	2983
3 B	ST-601	8524	2782
4 B	ST-516	6641	4665
5 B	ST-548-1	8299	3006
6 B	RT-344-C-1	10637	664
7 B	ST-540	7937	3369
8 B	ST-549	8259	3047
9 B	ST-700-C	10917	384
10 B	RT-347-C	10782	520
11 B	RT-349-C	10902	399
12 B	ST-604	10827	474
13 B	RT-346-C	10756	545
14 B	ST-624-C-1	10507	794
15 B	ST-702-C	11113	188
16 B	ST-533	7801	3515
16 A	ST-613	9046	2260

1.14 Storage Tube Complement in WWI (continued)

ES Clock hours as of 2400 December 4, 1952 11301

Average life hours of tubes in service 1807

Average life hours of last 5 rejected tubes 1706

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

2.14 Input-Output (J.A. O'Brien)

A very considerable effort was made to eliminate the noise in the display system during the past biweekly period, but without success. It was found that the noise was being contributed to by all of the various components of the system (amplifiers and cables). In order to obtain the spot resolution desired and maintain the present number of scopes, it will be necessary to redesign the system.

An improvement appears to have been made in the magnetic-tape system by connecting the heads of the redundant channel pairs in series and using one amplifier per pair rather than having separate amplifiers for each channel and paralleling the outputs. Further changes in the system are being planned in order to allow a lower gain in the amplifiers with consequent reduction in noise pickup.

The manufacturer's testing of the auxiliary-drum system has been completed, and we hope to get it sometime next week.

(T. Sandy, J. Dintenfass)

Cables connecting the In-Out Control of WWI to Auxiliary-Drum Input Control have been ordered.

Video wiring layouts for auxiliary-drum control were completed.

Plug-In Unit Production (C.W. Watt)

Delivery of Raytheon plug-in units has now passed the 300 mark. As yet, we have no mounting panels, but testing of the units is progressing well. Quality has improved greatly over the first few received. Raytheon now has a separate shop of about 11 or 12 wiremen working on this job; delivery will undoubtedly pick up sharply from now on.

M.I.T.E. (R. Paddock, A. Werlin)

Work is continuing on testing of the three-panel prototype of M.I.T. E. control section and of the potted ferrite transformers in the plug-in units.

2.2 Vacuum Tubes and Crystals

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

During the first part of November, as reported in the biweekly report of November 7, a lot of 100 type 6145 tubes were received from Sylvania and tested. These were engineering samples produced prior to

2.21 Vacuum Tubes (continued)

the main production. As many of these tubes were defective, a second sample was requested. This second sample of 70 tubes, from 14 different runs covering the same lots as the previous samples, was tested during the last week of November. There were 34 percent failures in the second sample, but the failure patterns were entirely different. The test information has been relayed to Sylvania for their information and corrective action. None of these later tubes have as yet been opened due to the press of other duties.

The information on 6145 tubes is particularly pertinent at this time. At present the old stock of SR1407 tubes has been almost completely depleted. Tubes are being issued for only MITE equipment and replacements. The stock is so low that only necessary replacements will be available by the middle of December until part of the order of 6145 tubes arrives. It will probably be necessary to issue such samples as are now available instead of using them for life tests. Close contact is being maintained with Sylvania in order to expedite the delivery, which has been promised for this month.

During this past week discussions with Dick Best, Jack Jacobs, Dave Crawford, and Harold Ross have been held concerning selection of vacuum tubes for new designs. The tubes to be used depend to a certain extent upon the logical design and upon the performance of other components, primarily ceramic cores.

Work on the new intermittent tester for tubes is progressing. It is expected that it will be available for debugging and checking by next week. The new testing console is now being delayed by drafting.

Curves of interface impedance vrs the length of cathode-current pulses have been taken for several tubes. These curves fill the gap between the values of interface impedance for pulses, which were known to be low, and the values of interface impedance under steady-state conditions, which could be several times the pulsed values. When the values of resistance are plotted on semi-log paper, a relaxation time of 0.1 to 0.5 second seems to be present. Insufficient data has been taken to give any typical values; there seems to be considerable variation in this effect, with very little or no change in impedance with time in this range of time (5 milliseconds to 1.5-second pulse lengths) in some cases.

2.22 Transistors

Switching (N.T. Jones)

During the past biweekly period, an SM Thesis proposal "Hole Storage in Point Contact Transistors and Germanium Diodes", M-1738, was completed. Some experimental analysis of hole storage has begun.

2.22 Transistors (continued)

Life Tests (N. T. Jones)

As yet, the first results of the life tests are not ready for publication; but in general the collector resistance, r_{co}, and current gain, α, have deteriorated during the 2500 hours of operation. The rate of deterioration is such that unit lifetime will be much less than the 70,000 hours predicted by Bell Laboratories.

A scheme has been tentatively worked out whereby the temperature corrections to the parameter values will be greatly simplified. Data processing time will be cut about 90%, thus expediting future publication of results.

Transistor Processing (I. Aronson)

Twenty-five Transistor Products Co. type 2C transistors were received and processed. Although they all passed our d-c specifications several failed to meet the 0.2-μsec. rise time requirement. The manufacturer has promised to replace these units within the next two weeks.

Ten IBM transistors were also received, but we do not have enough data yet to evaluate their characteristics.

Transistor Accumulator (D. Eckl, R. Callahan)

The total time on the accumulator is now 1800 hours.

Of the 68 transistors in the accumulator all except 7 have been in use 1000 hours or more. There are 25 transistors which have been in service the entire 1800 hours. In most cases, transistors have been removed from service as a result of the increasing availability of more satisfactory units.

Recently, several minor changes have been made in the control circuits which make automatic restarting after an error more satisfactory. No further trouble has been caused by the water-cooler motor since the filter was installed. During the past biweekly period, two error-free runs of 44 hours each have been made, one over a weekend, and the other during working hours. These are the longest to date. For the most part, errors which now occur consist of a series of 10-15 incorrect answers after which normal operation is resumed without manual interference. Steps are being taken to check times and durations of these errors against possible voltage transients.

2.22 Transistors (continued)

Circulating Pulse Circuits (R.H. Gerhardt)

The delay-line dynamic storage register has 158 hours of operation. The only checking is done by looking at the waveforms at frequent intervals. The register has been run nights and has been found running satisfactorily in the morning. Occasionally, it has been necessary to change a bias level for correct operation. The operation is better after the register has been run a long time. This may be due to evaporating moisture from the transistors, but this is not definitely known.

A mathematical analysis of the one-shot multivibrator circulating-pulse system is being undertaken.

Transistor Pulse Standardizer (E.U. Cohler)

Work is proceeding on the testing and further development of a transistor pulse standardizer which was described by Lo in the November '52 Proc. I.R.E. This standardizer is to take pulses of various sizes and shapes (within limits) and convert them to a standard size and width. This width will be independent of the transistor and circuitry. The amplitude will depend as little as possible upon the transistor and mainly on the circuitry.

Since the correct values and exact circuit for the standardizer are not yet determined, the work is a matter of cut-and-try at this point. However, the results achieved so far indicate that this circuit will give very satisfactory results. Pulse widths of less than 0.1 μsec. will trigger the circuit, and output widths of less than 0.2 μsec. are available (this work is with an RCA TA-165).

Transistor Coupling Circuit (S. Oken, W. Klein)

Graphs and data for the report on the transistor coupling circuit are still being taken. We may have one of our vendors build a transistor to our specifications. Such a transistor would have a low "α", high "r_{co}", and a high current rating. These values of the parameters would make a maximum input impedance as well as a minimum delay time through the circuit.

2.23 Crystal Diodes (I. Aronson)

A study of several common types of diodes has begun. So far, 300 Sylvania 1N34A's have been processed, and 100 Hughes 1N69A's and 25 Hytron 1N69a's are now in process. Distribution curves of back resistance, forward resistance, and reverse recovery time are the objectives of this study.

2.3 Ferromagnetic and Ferroelectric Cores

2.31 Magnetic-Core Materials (D. R. Brown)

Ferrite cores for MTC are now being produced at the rate of 2000 per day at General Ceramics. Each day's production is identified by a lot number. Lots 1 and 2, the only lots we have been able to measure here, have "one disturbed" voltages considerably lower than those reported by General Ceramics for subsequent lots. Lots 1 and 2 will be rejected. Reports from General Ceramics indicate that we will be able to use lots 3, 4, 5, 6, and 11 with a yield of greater than 50 per cent. These lots evidently have slightly lower coercive force than earlier lots, requiring a reduction of the peak current from 1.00 amperes to 0.95 amperes.

Our manually operated core tester, now operating with a crew of three, has been able to average 1000 cores per day for the last two days. Operation can be improved somewhat by adding another member to the crew. A second manual core tester will be put into operation during the next week.

The semi-automatic core tester, being developed by Bob Hunt, is urgently needed for retesting MTC cores selected by our manual core testers.

Ferrite Cores for MTC (J. H. McCusker)

Two setups utilizing Model V core drivers are now being used for uniformity testing of the ferrite cores for MTC. Lot 0 and Lot 1, approximately 5000 cores, have been tested. However, on the basis of tests conducted by General Ceramics on 12 lots, the specifications for the cores for MTC will be changed after preliminary tests now being conducted. It is hoped that a minimum of 2000 cores per day will be tested for uniformity.

(W. J. Canty)

One thousand and fifty cores of type MF-1325B, F-291, have been selected for use in a 32 x 32 memory array. A bad core from Memory-Plane 5 in the memory-test array was returned to this group for retesting. It was found that this core fell slightly below our standards and should not have been delivered to Group 62. At 1-amp. switching current, the 1_{d_T} voltage of this core was 0.08 v. while at 0.8-amp. switching current the 1_{d_T} output was only 0.02 v. A normal core of this type when operated at 0.8-amp. switching current would have a 1_{d_T} output of about 0.06 v.

(J. W. Schallerer)

Tests were run on two groups of cores of type MF-1326B, F-291. One group was tumbled in order to reduce suprs around the edge of the core. It was found that after tumbling the average output had dropped slightly. This was probably due to some of the material being worn off during the tumbling process.

A second production tester is about ready and should be in use in a few days.

2.31 Magnetic-Core Materials (continued)

(J. R. Freeman)

Pulse testing is underway on the twenty-four MF-1326-B, F-291, ferrite cores which have been selected for life tests. Pulse output measurements are being made for various modes of operation at currents of 0.6, 0.8, 1.0, 1.2, 1.4, and 1.5 amperes using a selection ratio between reads and disturbs of 2 : 1.

(P. K. Baltzer)

Engineering Note E-512, "A Method for Acceptance Testing of Ferrite Core Production Lots," was written concerning the screening of production lots for complete testing here.

Core Stresses (P. K. Baltzer)

A nickel-zinc ferrite made by Bell Laboratories and potted in a plastic, Selectron, was tested here. When stressed by the plastic, this material has a very square hysteresis loop, R_{smax} = .70 and the coercive force small, H_c = 0.10 oersteds. The pulse characteristics resemble those obtained for Mo Perm. The Disturbed One output is double humped and has a switching time of about 6 μs for the best operating point. The extremely low coercive force makes the use of this material attractive; a maximum driving force necessary for use in a coincident-current scheme would be about 0.100-amp turns for an F-291 size core.

Metallic-Core Tests (A. D. Hughes)

Completed test of 668 metallic cores for 16 x 16 memory array. Found 259 good (i.e., within the limits) , one disturbed output voltage 30 to 38 millivolts and switching time 7.6 to 9.3 microseconds ($\pm$ 15% of average). Work is being done on developing more accurate and faster test procedures for metallic cores. Test is being made on cores undergoing life tests.

(N. Menyuk)

A systematic study is to be made of the effects of varying inputs upon core response. The equipment has been assembled, and the oscilloscope to be used in conjunction with this experiment has been calibrated in the ranges used to date. A 1/8-mil Molybdenum Permalloy core is to be the initial subject of study. Thus far, the core response as a function of rise time has been examined.

Three additional memoranda on A. Loeb's seminar on magnetism have been printed.

2.31 Magnetic-Core Materials (continued)

Production Core Tester (R. F. Jenney)

The new mechanical part for the semi-automatic production tester is expected soon and testing with it will probably start within the next biweekly period.

A fully automatic tester is in the very early design stage and will not be ready for MTC cores.

(R. E. Hunt)

The Automatic Core Tester is about 75% complete. We are still troubled with irregular and flashed cores that are extremely hard to handle. However, we expect that we can tumble these cores to remove the flashing. We have tumbledsome cores and found that the process was non-destructive physically and electrically, but we have not yet found the right ball mix to do the job. We hope that General Ceramics will do a better job of quality control on the size of the cores. This should alleviate all of our major problems.

Model III Pulse Tester (B. Smulowicz)

A new Model III pulse tester is being constructed for general evaluation of cores.

Automatic Curve Plotter (J. D. Childress)

The electronic current stepper has been tested and is satisfactory except for the current-pulse rise time. This slow rise time will be corrected by a better physical layout. At present, work has been temporarily discontinued on this stepper.

Design has been completed and construction begun on another type of current stepper, this model using relays. The step repetition rate on this model will be slow, but will be useful for marginal checking of cores.

Pulse Generator for Testing Magnetic Cores (H. E. Zieman)

A new pulse generator has been built and tested which will produce 30-ampere pulses with a rise time of 0.03 μ sec. from a -450 v. D-C supply. The generator uses a Western Electric mercury relay which limits the prf to 100 pps. A new pulse-forming network is being built to decrease the rise time more and also to improve the pulse shape.

Voltage Calibrator (R. Pacl)

One of the four scheduled comparators has been completed and is being used currently on production test. A number of other models will also be constructed in the near future, as soon as the requirements have been definitely established.

2.31 Magnetic-Core Materials (continued)

B-H Tester (C. D. Morrison)

Two of the series of LIR cores (F-304, 3A4, 3A9) have been tested, and the results are being compiled so that a report can be sent to George Economos next week.

Switching Time (J. B. Goodenough)

Quantitative calculations for a proposed mechanism of switching time are being made. The qualitative ideas appear to be in harmony with the experiments which have been reported to date.

Microstructure of Ferrites (F. E. Vinal)

For some time, it has been realized that a correlation of microstructure of ferrite cores with their electrical characteristics was required as no visible characteristic or processing technique could explain the variation of electrical characteristics found among cores of the same composition. Originally it was planned that Group 35 would undertake this phase but it now appears that the numbers of samples to be prepared and examined would consume an undue amount of time in their group activities. We are, therefore, setting up facilities for handling this matter in the chemistry and ceramics group except that particular samples on which a research examination seems advisable will be forwarded to Group 35 for examination at higher powers of magnification than available here and for possible X-ray analysis.

These facilities in our Group will also provide the means to observe domains and domain action in magnetic materials.

Chemistry and Ceramics (F. E. Vinal)

The building contractors have completed their work in the third floor chemistry laboratory, Whittemore Building, and the laboratory contractor promises to have completed his work by January 15. The progress in the ceramics laboratory is a little slower because of the magnificient battle the old Corliss engine has given the wreckers.

X-Ray Studies of Ferrites (J. H. Epstein)

There was no measurable difference in non-homogeneous strain, as indicated by the width of X-ray diffraction lines, between a sample cooled to room temperature from 1000° C in 10 minutes and an otherwise identical one cooled from 1200° C in 20 hours. There was, however, an apparent shift in lattice constant, the slowly cooled sample having the smaller cell size. This might indicate a uniform strain, assuming that only one size of cell is the equibrium value at room temperature. More precise measurements are planned to make certain that this is a real effect. In this connection, if we can obtain toroids of $R_1 - R_2$ greater than a half inch, we could also determine whether the lattice constant varies between the region under compression near the inner and the region under tension near the outer edge.

2.32 Magnetic-Core Memory

Solid-Block Memory Array (D.A. Buck)

The geometric dual, as well as electric dual, of a ferroelectric memory array with many memory cells on a single ferroelectric sheet is a ferromagnetic sheet in which are drilled many tiny holes. Each hole is one memory cell -- the equivalent of a core. Pulse tests with a single .060" hole in a .250" ferrite section give promising results.

Single-Wire Driving Scheme (D.A. Buck)

A driving scheme has been devised which permits a two-coordinate-selection magnetic-memory plane to be operated with but a single wire through each core (or hole). Just as with the ferroelectric memory, the rows and columns are driven by voltage sources (rather than the usual current sources), and a resistor bridges each intersection of a row and column. Each resistor, or one of its pigtail leads, passes through a memory core (or hole). With plus V/2 volts on the selected row and minus V/2 volts on the selected column, only the resistor at the intersection of that row and column has the full V volts across it; other resistors see at most V/2 volts. The current through the resistor at the intersection is, therefore, I (I equals V/R), and the other currents are at most I/2. The selected core can therefore be made to switch. Reversing the polarity of the two voltages makes the selected core switch in the reverse direction. Current in the selected core does not go immediately to I. As a result of back voltage produced by the core, the current rises either slowly to I or rapidly to I depending upon whether or not the core switches. By "slowly" is here meant the natural switching time of the core in a memory array. The dip in current caused by the switching core can be detected by running the leads to the rows through a current transformer as proposed for the ferroelectric memory. Partial cancellation of unwanted signals, somewhat the equivalent of alternating the sensing winding in a conventional magnetic-core array, can be achieved by passing half of the row wires through the current transformer in one direction and the other half through in the opposite direction.

Memory Test Setup #1 (B. Widrowitz, S. Fine, R.S. Di Nolfo)

Memory-plane #6 has been delivered and is being wired into the memory-test system. The operation of the array has been checked in preparation for the new panel; logic to write a"worst" pattern into the array has been installed.

The non-destructive R-F readout is being considered by B. Widrowitz as a possible SM thesis topic.

2.32 Magnetic-Core Memory (continued)

Memory Test Setup II (Ceramic) (E.A. Guditz)

A sensing panel has been constructed and installed for Memory Plane # 5. Memory Planes #4 and #5 (both MF1326B and F291) have been operated simultaneously and independently with good results.

A bad core accidentally was included in the cores supplied for Memory Plane #5. This core was discovered after the array was installed and operating. It produced approximately half the required output voltage. The core was removed and sent back to McCusker for retest, which confirmed the fact that the core was bad. A new, tested core was substituted for the bad one with good results. Replacement time was 1-1/2 hours.

Memory Test Setup III (Ceramic) (J.L. Mitchell)

Experiments have been made to determine the effect of the switch-core noise on the operation of the memory under worst pattern conditions. In addition, work was done to measure delta and its effects on operation. At this time no conclusive results are available.

E.A. Guditz and I have been considering the problems involved in combining Memory Test Setup II and Memory Test Setup III into one setup. However, no decisions concerning this move have been made.

Switch-Core Study (A. Katz)

A note (E-500) summarizing work to date has been issued.

The "staircase" generator has been assembled and is in operation. Further experiments with ferritic cores for switch application are in progress. David Epstein of the Laboratory for Insulation Research has shown some interest in this generator since it may be useful for his research in switching phenomena.

Sensing Panel Development (C.A. Laspina)

The a-c coupled sensing panel mentioned in the last biweekly has been debugged and is now being tested for prf sensitivity and drift on Memory Test Setup II (Ceramic). Tests with very weak tubes showed that gain was fairly independent of tube parameters. Further tests are to be made on linearity and dependence of gain on plate and filament supply voltages. A gate and buffer stage have been built for use with the sensing panel. After debugging and testing the two stages will be added to the sensing panel chassis.

Z-Plane Driver (C.A. Laspina)

Work is continuing on the Z-plane driver.

2.32 Magnetic-Core Memory (continued)

Olsen Switch (J. Raffel)

A test setup has been assembled for experiments on a 16-position square Olsen switch.

The switch has been operated successfully using a storage battery on the bias windings and two current drivers from A. Katz's "staircase generator" for the drive and reset pulses.

Data will be taken to determine optimum operating conditions and to investigate noise problems arising in this type of switch.

2.33 Magnetic-Core Circuits

Gating-Core Stepping Register (G.R. Briggs)

The gating-core stepping register has been fairly completely investigated. The fastest speed of operation has been at a basic advance pulse period of 8 μsec. or 24 μsec overall. To pass a single "1" because of the 3-pulse logic used. The operation is very stable and non-critical, but the back emf's produced by the cores are inordinately large considering the speed of the device. For low-speed operation it has been decided to place the device on the shelf until other possible shift registers with lower back emf's can be evaluated. Especially promising is the use of junction diodes as coupling elements. The extremely low forward resistances of these diodes make possible slow switching of coupled cores with much greater efficiency than the slow-switching stepping register of Harvard. The recovery time of the junction diode is a problem, however.

Magnetic-Core Matrix Switch Adder (C.J. Schultz)

The present maximum operating frequency of one digit of the adder with its associated equipment is about 1 mc. The carry propagate time is 0.07 μsec. and a 0.5 μsec. pulse will switch the Mo-Permalloy cores.

2.34 Ferroelectric Materials

Preparation of Ferroelectric Materials (J. Sacco)

A series of pure barium-titanate samples fired at temperatures of 1300 to 1450°C has been completed and submitted for electrical testing in Group 63.

A new series of modified composition will have the curve point lowered to the range of 25° to 40°. These samples have been compounded and will be carried through forming and firing operations.

2.34 Ferroelectric Materials (continued)

Ferroelectric Pulse Tester (J. Woolf)

The positive and negative sections of the generator are operating but as individual units. An inhibiting circuit is necessary to prevent the positive half from firing when the negative section is triggered. This circuit will be checked out in the following period.

(C.D. Morrison)

I am still working on the interlock for the ferroelectric tester, and the work is about three-quarters complete.

2.4 Test Equipment

Test Equipment Committee (L. Sutro)

In the two meetings within the last biweekly period the committee considered the purchase of more Tektronix Scopes, the construction of more Video Probes, the administration of Test Equipment Headquarters, and the voltages provided in the laboratory. Members of the committee are now surveying the groups they represent to determine the need for scopes and probes. Both the standard Whirlwind probes and the two-input probe are to be ordered. The latter is capable of being hung between any two voltages. A prototype of a two-input probe is being used now by Abe Katz.

The question of laboratory voltages will be considered again at later meetings. A preliminary report indicates that much has been gained by providing three negative voltages at increments of 150 volts and that +120 volts can be avoided in future designs.

Test Equipment Headquarters (L. Sutro)

During the past biweekly period, acceptance tests were performed on 101 Burroughs Units and 3 Tektronix Oscilloscopes. Repairs were made to 3 Burroughs Units and 1 Tektronix Oscilloscope. Card-file records were completed for approximately 500 units of test equipment.

Low-Speed 2^6 Counters (H.J. Platt)

Work on the low-speed 2^6 counters has shown that the present method of wiring the binary scalers through preset and in-out switches causes failure or marginal operation. Hence, the in-out switches were removed and the output of each stage was directly wired to the input of the following stage. The preset circuits were isolated from the binary scaling units by means of crystal diodes.

The output-pulse-generator circuit was changed slightly to improve operation.

The construction of the low-speed 2^6 counters has been resumed. A report describing the operation of the unit will be written shortly.

2.5 Basic Circuits

12AV7 (5965) Flip-Flops (H.W. Boyd)

As was theorized in the November 7^{th} report, flip-flop #2 will operate with poorer tubes than flip-flop #3a. A tube capable of only 5.7 ma I_b at 100^v (E_c=0) will allow successful operation of #2; whereas a tube capable of only 6.2 ma I_b at $100^v E_b$ (E_c=0) will work in #3a. (Present specs call for a minimum allowable I_b of 15 ma at $120^v E_b$(E_c=0)). Both flip-flops worked with leaky tubes donated by I.B.M.

2.5 Basic Circuits (continued)

Both flip-flops will deliver their proper outputs with supply voltage variations of ± 30% and better, although both will operate with much greater variations. Both designs likewise, seem not to care whether or not good diodes and precision resistors are used.

Either flip-flop will operate directly from the output of the other -- the desired upper prf determining the extent of modifications, if any.

Marginal checking can be accomplished by inserting a bi-directional d-c voltage in one of the cathode follower's in both cathode follower's negative return.

Both flip-flops are capable of prf's in excess of 5 megacycles, although the maximum usable prf will ultimately depend upon the external requirements; i.e., triggering and output characteristics.

Plug-in Cathode Followers (E.P. Farnsworth)

A low current drain bi-polar quadruple cathode follower plug-in unit C-53230 using 6SN7GTW tubes has been designed for general utility. Initial use of this unit is mentioned in paragraph 4.2 of this report.

2.6 Component Analysis (B.B. Paine)

With C.W. Watt, I visited I.B.M. in Poughkeepsie last week to observe component-testing practices and assembly procedures. The trip is described in Memorandum M-1740. I also made trips to Ward-Leonard in Mt. Vernon, New York, to discuss resistors and Radio Receptor Company, Sylvania, and Transistor Products Inc. to observe the manufacture of crystal diodes.

A standard test for abrasion resistance of various types of magnet wire is being devised which should give us a better idea of the type of magnet wire that should be used in constructing magnetic-memory arrays.

2.7 Memory Test Computer (D. Shansky)

The breadboard of the Memory X & Y plane drivers and associated selection and switching circuitry has been debugged and is now operating in a satisfactory manner. The plane driver tubes furnish a variable-current pulse with a rise time of approximately 0.1 μsec. The time required to set up the 32-position crystal-matrix switch is approximately 0.75 μsec.

2.7 Memory Test Computer (continued)
(J.D. Crane)

The effects of the capacitance that exists between the wires connecting the 32-position matrix switch to the toggle-switch storage are being studied.

Present estimates indicate that the capacitance between wires designed for high voltage is low enough for this application.

Magnetic-Core Memory (W. Ogden)

General layout of the memory and associated equipment was continued, and a tentative production schedule was prepared.

Block Diagrams and Logic (W.A. Hosier)

The graded system diagram, E-37366, is now on file and will soon be available in a reduced size.

A revised diagram of central control, SC-37376, and a sample timing diagram have been prepared.

A slight alteration of control will have to be made to accommodate the recently added "disturb" or "helping-hand" gate for the memory.

Some time has been spent in familiarizing I.B.M. personnel with MTC.

Indicator Panel (H. Smead)

An indicator panel for MTC has been designed this period. It contains the equivalent of eight WWI Indicator Panels in a 19" x 17-1/2" panel.

It has been agreed that MTC will perform engineering liaison work with outside vendors fabricating MTC equipment.

Power Supply (R.G. Farmer)

A 500-volt, 10-amp rectifier which will be installed in Whirlwind I has been tested. The regulator which will be used with this supply is now being tested. When the tests are completed, the units will replace the 500-volt, 5-amp supply now in WWI.

The 500-volt, 5-amp rectifier and regulator will be used as a breadboard to be used in designing the regulators for the MTC power supplies.

2.7 Memory Test Computer (continued)

Console (R. VonBuelow)

The layout and cabling of the console have been fairly well fixed. The console will contain two display scopes, flip-flop indicator, toggle-switch storage, plug-board storage, start-and-stop controls, alarm indicators, push-button CPO control, marginal-checking selection switches and controls, an audio amplifier and speaker, and a meter panel.

A tentative layout of the plug-board connections has been made.

Memory Control (H.E. Anderson)

Plans for memory control are progressing. A block diagram (SB-37368-1) has been prepared showing how it will work. The purpose of memory control is to select the proper kind of storage and provide a central point for making any variation of memory read time, write time, sense time, etc.

Control (H.E. Anderson, R.A. Hughes)

The control has been placed on overnight life test since December 2. No conclusive results have been obtained thus far.

A systematic marginal-checking plan for gate panels and delay panels has been worked out. The plan has been divided into two parts:

1. Short check - this checks several panels simultaneously and indicates the worst margin of the group.

2. Complete check - this checks each panel individually.

Toreduce or eliminate transients, a D-C filter panel was designed and constructed. It worked out well as the number of errors decreased to about one or two per day. Troubles with equipment have been as follows:

A contactor in a Burrough's rack power control failed to hold in.

A flip-flop had a bad input transformer.

A gate-tube panel had a tap short in a 6AG7 Buffer. This opened a 180-ohm decoupling resistor and blew a 2-amp fuse.

A gate and delayed-pulse generator had an OD3 V.R. tube in it with a tap short. This was a source of intermittent errors.

2.7 Memory Test Computer (continued)

Buffer and Delay-Line Amplifiers (H. Henegar)

Layouts were completed for the buffer amplifier and 0.5-μsec delay line amplifiers. Three delay-line amplifiers were mounted on a standard 19" x 3-1/2" panel. Six buffer amplifiers were mounted on a standard panel. These panels are to be used in control.

Planning of a test unit for completely testing our plug-in FF's was also started.

3.0 STORAGE TUBES

3.1 Construction (P. Youtz)

During the last few weeks, the production of storage and research tubes was increased to five tubes per week. Between five and six tubes per week will be scheduled for the next five or six months. Of the five or six tubes to be constructed per week, four will be of the new 700-series type containing an ion-collector plate; one will be a research tube designed to study the conversion and activation processing of the Philips "L" cathode; and one will be a research tube constructed to study the design features for an improved storage tube.

One of the critical problems of the storage tube assembly is that of maintaining a uniform spacing between the collector screen and the storage surface. For satisfactory operation, it has been found that this spacing must be no greater than .005". It was observed during this past period that if this spacing is less than .004", the electrostatic force of attraction between the collector screen and the storage surface is sufficient to cause the collector screen to touch the storage surface. A number of research tubes will be made to investigate methods of improving the uniformity of the spacing.

3.2 Test

Television Demonstrator (D. M. Fisher, C. T. Kirk)

Seven tubes were tested during this period. ST702-C, ST703-C, ST705-C and RT350-C-R1 were satisfactory for STRT tests. ST704-C and ST706-C-1 were rejected because of buckled mica.

RT357, which had glass-rod spacers between the main collector and surface, was classified marginal because of the readout received from the glass spacers. This tube was sent to the STRT for further testing. It was felt that with further testing in the STRT a definite decision could be made as to whether the readout would affect WWI operation.

Storage Tube Reliability Tester (R. E. Hegler)

Two storage tubes and two research tubes were tested this period. All were considered unsuitable for WWI use.

RT350-C-R1, which contained a Philips "L" cathode, was satisfactory as a research tube but would not hold a positive array. RT357-C had four lengths of glass cane along the collector axis between the target and collector. This tube was constructed to investigate a method for obtaining closer target-to-collector spacing. The tube was rejected because of a small spot interaction area. A small area on the surface, which was not coincident with the glass cane, limited the size of the spot interaction area.

3.2 Test (Continued)

ST703-C was rejected because of buckling mica; ST705-C was rejected because of low deflection sensitivity which reduced the array size and increased the spot interaction to a point where the spot interaction area was practically non-existent.

(C. L. Corderman)

The modified counting sequence for the decoder flip-flops, as described in the last biweekly report, has been tried at the STRT. Using this counting method, the margins of operation obtained while running the standard spot interaction program were somewhat greater than observed when counting consecutively, spot-by-spot and line-by-line. The changes in margins with the "spaced" count indicated that interaction from both positive and negative writing was reduced. The reduction in the case of positive writing was apparently obtained by eliminating the effects of inter-square coupling capacitance. Negative writing is probably less destructive with the spaced count than with the consecutive count because, in the former, the interaction is measured upon completely stabilized positive spots rather than spots which are only partially stabilized. This spaced count sequence for consecutively numbered registers has now been connected in Whirlwind. Since results to date have indicated some improvement in storage reliability, the change will be left in permanently. A new chart of storage address locations is being prepared, and suitable modifications to the ESDD indicator lights are planned.

3.3 Research and Development

Pulse Readout (A. J. Cann)

Some thinking about the spectra of the switching gate and readout signal, and a re-reading of Nolan's Engineering Note, E-418, led to the conclusion that Nolan had made a good choice of frequency range. Accordingly, I have tried using the standard 832 type r-f amplifier excited with a short pulse (which has a "white" spectrum in the range of interest). In this case the amplifier selects its own spectrum. The signal obtained ahead of the detectors resembled the normal r-f signal in frequency, and rise- and fall-times; it merely lacked the flat portion observed using a 2 μsecond burst of r-f.

In order to detect the signal, a coherent phase-reference signal was needed. This was provided by a 10-megacycle blocking oscillator which was triggered with the read pulse and blocked after a few microseconds. The video output obtained from the detectors had about 15-v amplitude for positive and negative readouts and was about 1-μsecond long. The r-f system gives a video output of 20-v amplitude which has the same length as the r-f pulse supplied to the high-velocity gun.

3.3 Research and Development (Continued)

It seems attractive to use the present r-f amplifier; however, calculations will be made to determine the optimum bandwidth, center frequency, and pulse shape for maximum output with minimum spot charging.

Proposed Changes in Target Assembly (C. L. Corderman)

We have consistently rejected 10 - 20% of new storage tubes because the collector touched the surface at some point. Tubes with the lowest surface-to-collector spacings have generally given the best margins, so that a spacing of 0.005" or less is needed. However, due to a slight buckling of the mica surface and the presence of an electrostatic attraction between the surface and the collector, these two elements frequently touch when the spacing is 0.004" or less during assembly. We are going to make use of a small metal post, 0.004" thick, welded to the center of the collector screen. There is some possibility, however, that in depressing the mica only in the center, the buckle will simply move to some point between the center and the circumference. Negotiations are also in progress to have a suitable punch and die constructed so that we may punch out four small squares from a circular mica spacer whose diameter is equal to that of our mica target. These squares will be punched so as to leave a cross-shaped section of mica which will hold the collector and surface apart along both horizontal and vertical centerlines. This cross can be avoided for storage use by expanding the 16's deflection increment, but the problem of lining up the deflection plates with the sides of the mica spacer will be somewhat more severe.

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

Four tubes were processed during this period. Using RT353 and RT359 attempts were made to accelerate the activation of the cathodes through the use of voltage gradients at the cathode surface as is done with oxide cathodes. The results on these tubes seem to indicate that poisoning of the cathode occurs when a positive voltage is present on the grid. Unlike oxide cathodes, this effect is not sharply defined. Apparently the rate of poisoning is of the same order of magnitude as the rate of activation, which results in slow activations under these conditions.

One tube, RT358-C, was reprocessed from ST634-C using an "L" cathode in the high-velocity gun. This gun had very small cathode-to-grid spacing and developed an intermittent G - K short. This short did not appear until after the tube had been activated successfully. However, after the tube was sealed off, the G - K resistance was better than 35 K ohms and the tube seemed useable. A few preliminary observations were made in the TVD before an intermittent in the system caused a shutdown. These observations indicated satisfactory emission.

3.3 Research and Development (Continued)

RT350-C-R1 which was processed last period was tested. This was an ion-collector tube and developed the same defect that has beset other tubes of this type in the computer. Between the time it was tested in the TVD and the time it was installed in the STRT, a large portion of the surface developed a high lower-switching voltage. Tests performed by J. Jacobowitz confirmed previous findings that this effect was accompanied by a decrease in the normal secondary-emission ratio at 2500 v. The tube was later subjected to a temperature of 100°C for an hour and still later was left overnight at about 15°C. Neither temperature cycle affected the condition of the surface.

Following these tests, the tube was installed in the STRT for three days to test the high-velocity gun emission, and it was found to be stable. However, it was noted that the tube had developed grid emission which produced a spot at the screen. The peak current-density from grid emission was of the order of 1/16 that of the holding gun. This emission could be reduced somewhat by biasing the tube to about three times its cutoff value. While it may seem that this amount of emission is quite small, the current density is more or less uniform over a spot of 0.150" diameter. When superimposed on the normal beam distribution, the net result is a noticeable increase in effective spot size. Further tests will be made to determine how this emission can be reduced.

Secondary-Emission Measurements (H. Jacobowitz)

The Secondary Emission Measurement Unit mentioned in previous biweeklies is being used to compile a catalogue of the secondary-emission ratios of all available tubes. Although these measurements are not expected to be too significant on an absolute scale, they should indicate variations from tube to tube. The range of secondary-emission-ratio values which have been encountered thus far is 1.4 to 2.4.

Velocity Distribution (C. T. Kirk)

During this biweekly period, refinements of the difference amplifier circuit have reduced transients of the cage readout gate by a factor of 1000.

The noise introduced by the Laboratory power supply was eliminated with the use of a balanced output instead of the single-ended output originally incorporated in the design.

4.0 TERMINAL EQUIPMENT

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

New hand punches for the manual paper-tape corrector have been made by mounting Morse No. 50 drill blanks in modified pin vises. These have the advantage that broken or dull punch pins can be quickly and easily replaced without involving the manufacture of new punches in the machine shop.

Work on a more elaborate pushbutton-controlled tape corrector which uses an FL punch for perforating the tape is now underway. It is hoped that this will be completed within the next few weeks.

4.2 Magnetic Tape

Magnetic-Tape Mechanisms (E. P. Farnsworth)

The Servo Lab has procured the broached aluminum blanks from which the new experimental tape-drive capstans will be turned. The work will proceed when the necessary lathe mandrel is received from an outside vendor.

Magnetic-Tape Print-Out (E. P. Farnsworth)

The final Magnetic-Tape Print-Out Reading Amplifier panel has been installed in the computer. All the remaining Print-Out panels except the Index-Pulse Counter are complete and have been awaiting inspection. A quadruple cathode-follower plug-in unit C-53230 has been designed to reduce the loading effect of the decoder switching matrix on the index-pulse-counter flip-flops.

An erase-switch panel is in the process of being added to the Magnetic-Tape Print-Out Equipment to permit erasing a portion of a tape before beginning a recording. This facility together with a mark on the tape should eliminate initial misprints and confusion in locating the print-out starting point.

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

Marked improvement in the magnetic-tape-system reliability has resulted from the series read/record head connection. Over five million consecutive random words were read and checked without error during a solid six-hour test period. However, the cause of the frequent 12AY7 tube failures remains to be determined.

4.3 Display (R. H. Gould)

The extremely long response time of the Syntronic Instruments Inc. deflection yoke for the 16-inch display scope was greatly improved by removing the yoke from its aluminum case and mounting it in a phenolic frame. The response time of this yoke is still longer than the AFCRC yoke so the computer deflection delay has been increased from about 35 microseconds to about 100 microseconds. This does not seem to cause trouble with any of the display programs now in use.

Intensive testing of the display deflection system has not yet shown a cure for the noise which causes random variations in spot position on the scopes. Testing will continue and thought is being given to some amplifier redesign to decrease the sensitivity to power supply noise.

The 16-inch cabinet-mounted display scope that was loaned to another division of the lab has been returned. A Syntronic Instruments deflection yoke was installed and the scope functions very satisfactorily. A K1084PAH CRT with a very long persistence orange-red phosphor was temporarily installed in this scope to test the CRT. The long persistence phosphor was considered desirable for some applications but not for the scheduled demonstration so a CRT with a P7 phosphor was installed. Before the K1084PAH CRT was removed it developed a halo around the intensified spot. This halo could not be blanked by applying voltage to the CRT control grid and is probably caused by electron emission from the control grid. It is planned to return this CRT to DuMont as defective and to arrange a test set-up to check all CRT's before they are installed in the display scopes.

Investigation will continue into the availability and design of faster, more accurate deflection yokes for the display scopes. Suggestions as to sources of information on this problem will be welcomed.

Neon Display Lights (D. J. Neville)

The pulse generator for bench testing neon display lights, as described in last biweekly, is completed. Work is now being done on indicator-light circuitry.

4.4 Magnetic Drums

Buffer Drum Print-Out and Read-In (E. P. Farnsworth)

The circuits and descriptions of the buffer-drum equipment for the proposed Flexowriter print-out and paper tape read-in have been revised and rewritten to conform with recent suggestions and information. Print-out operation will be fully automatic, with a manual-intervention provision and inactivity alarm. Maximum read-in flexibility program-wise is compatible

4.4 Magnetic Drums (Continued)

with minimum circuit complexity. Simplicity of operation is achieved by the use of the single "Start Read" button to initiate the required sequence of machine functions to read one message into the drum and stop. Special provisions are included to prevent, detect, and nullify human and machine errors.

Test Circuits for Auxiliary Drum (S. B. Ginsburg, P. W. Stephan)

Several circuits for testing the auxiliary drum were assembled. A toggle-switch gating panel and pulse coder were built.

Testing is continuing on changing a 0.1-μsec pulse to a 0.5-μsec pulse and vice versa.

5.0 INSTALLATION AND POWER

5.1 Power Cabling and Distribution (G. F. Sandy)

Several filament transformer panels have been received and installed. One fuse-indication and rack-interlock panel has been received and installed. The other seven have been promised by December 15. Gavitt Mfg. delivered quite a few of the preformed cables for the power distribution in the MITE racks. These have been inspected and are being installed. The wireway out of the transformer room has been completed and power provided from the transformer room to Room 156. Room 156 now has regulated and unregulated 115-V. A-C and lighting from this source.

Seven D-C voltages are also available either from Whirlwind or lab supply.

The distribution of D-C voltages to racks L1 and L15 have been checked and found to be correct.

Twenty plug-in mounting panels are due to arrive December 12.

5.2 Power Supplies and Control

Marginal Checking Generator (R. Jahn)

Performance tests and parameter measurements of the spare amplidyne will require special test equipment. I have been building a duplicate of the output stage of the marginal-checking generator regulator for these tests.

Whittemore Building D-C Supplies (R. Jahn)

The new -15-volt D-C power supply has been installed and is operating satisfactorily.

5.2 Power Supplies and Control (Continued)

New 600A Filament M-G Set (J. J. Gano, G. A. Kerby)

Generator Vibration Check. The generator was decoupled from the motor and driven by its exciter. At rated speed of 1800 RPM, the vibration was negligible, indicating that the vibration occurring when driven by the synchronous motor is due to misalignment. Since the base flexes so easily an accurate alignment job (.005 inches) is extremely difficult and even then cannot be maintained with time. We will make inquiries to determine the availability of a new base of substantial strength. At the same time a check of flexible couplings will be made to determine whether or not to replace the present one.

-150 D-C Supply, WWI (J. J. Gano, R. Jahn)

Relay Trouble. The race condition among the relays, which has occasionally prevented the supply from cycling on, has been temporarily corrected by shorting some contacts. The circuit has been redesigned, reducing the number of relays from nine to six. A study, to mechanically modify a Kramer timer, is being made in order to eliminate another relay. The simplified circuit should give more reliable operation.

6.0 BLOCK DIAGRAMS (J. H. Hughes)

I am working on simplified block diagrams for the new Block Diagrams Report which Rathbone and Margaret Mann are preparing, and am also trying to bring the systems block diagrams up to date.

M-1734, a short report on the controls ordinarily used by operators in running programs on WWI, should appear soon.

(B. E. Morriss, G. A. Young)

Considerable time has been spent in discussing the present in-out system with the group from IBM. Most of the discussion was on the manner in which the buffer drum and its associated units will operate. Several meetings were attended in which methods of obtaining continuous scope displays using a magnetic drum were discussed. Some of these methods are being considered.

M-1733, A Word-by-Word Mode of Operation for the Paper Tape Punch, has been distributed. This note describes the use of the punch and the printers in the modes to be available after Monday December 8.

Several people have asked about obtaining the original contents of the various registers of the computer after an alarm from the indicator lights. It would probably be helpful if someone wrote a note describing how to do this for the various alarm conditions.

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.

40. Input Conversion Using Magnetic-Tape Storage: Briscoe, 58 hours; Denman, 2 hours; Demurjian, 30.5 hours; Frankovich, 68 hours; Helwig, 60 hours; Kopley, 14 hours; Porter, 37 hours; WWI, 836 minutes

The punched paper-tape version of the comprehensive conversion program has been operating successfully during the past bi-weekly period in conjunction with the programmer arithmetic sections. Various phases of this program are now being rewritten and tested which use the magnetic-tape units for intermediate external storage instead of paper tape. Future plans involve the use of two tape units with the CCP and the inclusion of a post mortem subroutine as an integral part of the proceedure.

Several of the more useful library subroutines have been adapted for use with the CCP. Included among these is a (24,6) printing program.

A programmers manual describing the CCP is presently being written.

52. Oil Reservoir Depletion Analysis by Iteration: Kopley, 20 hours; Porter, 11 hours; WWI, 142 minutes

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

84. Departure Curves for Various Types of Resistivity Logs in Oil Wells: Porter, 2 hours; de Witte; WWI, 1624 minutes

The program that was tested this summer (T1462) was rewritten in order to incorporate some modifications in the integration routine and the latest changes in Whirlwind programming.

The rewritten program was typed up, prepared as tape 2180 and tested. Several typographical errors in the program were located and corrected. Tape 2180-2 was tested for accuracy of the final data and performed correctly. It was thereupon used for production computation. During the first week of computations considerable trouble was experienced due to parities. This was caused partly by the shift in storage locations since this summer, which placed many of our temporary storage registers in the extreme corners of the storage tubes. To alleviate parity trouble an alternative program was written which changed most temporary storage locations to the center of the tubes. This program was tested and some small errors were found and corrected. The alternative program is now also operating correctly as T 2185-2. It can be interchanged with T 2180-2 and gives identical results. Using the two alternative

8.1 Programs and Computer Operation (continued)

programs parity trouble has been reduced to the point where it does no longer seriously effect the computer time.

To date 35% of the computations which remained after this summers period has been completed.

I will be absent for two weeks as I am scheduled to present a paper at the West Central Texas Oil & Gas Association meeting in Abilene, Texas on December 2 and to deliver a discussion on our Departure Curve computations on Whirlwind I at the Texas Petroleum Research Committee meeting in Austing, Texas on December 12.

Explicit instructions have been prepared for the operators to enable them to continue the computations in my absence. Most of the operators have already used these instructions and as far as we can tell all sources of possible confusion have been eliminated.

93. The Transmission Cross Section of Absorbing Spheres Using the Mie Solutions: Demurjian, 7.5 hours; WWI, 147 minutes

Tapes 2188 and 2199 have been run on the computer. These are two sections of the total problem representing approximately 85% of the total work. Tape 2189 has been prepared and is the remaining section; but because of time limitations no test run will be made inasmuch as the instructions are straightforward. Tape 2188 will compute spherical bessel functions and quantities dependent upon them. Tape 2199 will compute trigonometric functions and its dependent quantities.

Both tapes contained illegal "icm" instructions thereby causing the programs to give incorrect results. These have been corrected. Now the programs should perform satisfactorily.

Computer time, hours	
Programs	49 hours, 48 minutes
Conversion	12 hours, 51 minutes
Demonstration	
Total	62 hours, 39 minutes
Total time assigned	72 hours, 46 minutes
Usable time, percentage	86.5%
Number of programs operated	105

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 REPORTS

No.	Title	No. of Pages	Date	Author
R-216	The 16 by 16 Metallic Memory Array, Model I	63	9-25-52	B. Widrowitz
R-217	Design of Low-Power Pulse Transformers Using Ferrite Cores	81	11-3-52	R. Robinson
E-496	Instructions and Specifications for the Manufacture of 3:1 and 1:1 Microsecond Pulse Transformers on Ferrite Ring Cores	6	11-3-52	R. E. Hunt
E-500	Switch-Core Analysis I	14	11-4-52	A. Katz, E. Guditz
E-501	Pretest Procedures for 700-series Storage Tubes	3	11-20-52	D. M. Fisher, C. Corderman
E-503	A Magnetic Matrix Switch and Its Incorporation into a Coincident-Current Memory (Abstract of R-211)	1	11-20-52	K. H. Olsen
E-504	Ferroelectrics for Digital Information Storage and Switching (Abstract of R-212)	1	11-20-52	D. A. Buck
E-506	Effects of Ions in the M.I.T. Electrostorage Tube (Abstract of M.S. Thesis)	1	11-24-52	H. Jacobowitz
E-510	Design of Low-Power Pulse Transformers Using Ferrite Cores (Abstract of R-217)	1	11-24-52	R. Robinson
M-1727	Laboratory Personnel	14	12-1-52	
M-1730	Bi-Weekly Report, November 21, 1952	35	11-21-52	
M-1732	Test Equipment Committee Meeting of November 25, 1952	2	11-26-52	L. Sutro
M-1733	A Word-By-Word Mode of Operation for the Paper Tape Punch	3	11-26-52	G. Young
M-1736	Trip to General Ceramics, Nov. 19-20, 1952	7	12-2-52	W. J. Canty

LIBRARY FILES

No.	Identifying Information	Source
2153	The Aerodynamic Characteristics of Fin-Stabilized Rocket Models with Oversized Heads	U. S. Naval Ordnance Test Station
2155	The Validity of the Results of Analogue Computers	ONR/Spec. Dev. Center
2159	Programming and Coding Handbook for SEAC	NBS No. 1984
2160	Illinois Order Codes	Univ. of Illinois

JOURNALS

OIL & GAS JOURNAL, November 24 and December 1, 1952
BELL SYSTEM TECHNICAL JOURNAL, November, 1952
INDUSTRIAL DISTRIBUTION, December, 1952
ELECTRICAL MANUFACTURING, December, 1952
ELECTRONICS, December, 1952
ELECTRICAL ENGINEERING, December, 1952

9.2 Standards, Purchasing, and Stock

Procurement and Stock (H.B. Morley)

Approval for construction of the ceramic-processing laboratory has been received, and purchase order issued.

A manufacturing error was discovered in the numbering of some Jones plugs recently received. Action is being taken to correct this.

Lab personnel should avoid making petty-cash purchases without first getting authorization from this department or from their group leader or supervisor.

The administrative work load of this department has increased greatly during the past month, in ratio to the increased business volume.

Deliveries:

Improved delivery is noted from Allied Control Company.

750 1N38A crystals have been received from Sylvania, as promised. 2400 1N38A crystals have been received from Amperex. However, early spot checks indicate the Amperex crystals may not be as good as the original samples tested.

Standards (H. W. Hodgdon)

Tube-base and socket-connection diagrams are being prepared for all tubes commonly used in the lab and will be included in the tube section of the Standards Book.

On December 2, Paine and I visited Sylvania in Woburn to discuss germanium diodes. The rejection rate on some lots of 1N34A's has been excessive, and we wished to compare inspection and test specifications. Sylvania engineers identified the crystals in question as being from a production run which had given trouble, and assured us that corrective measures had been taken. Test procedures agree quite closely, the only difference being that Sylvania measures back resistance at -10 and -50 volts, while we measure at -20 and -50. To eliminate the necessity for interpolation in comparing specifications, it may be desirable to change our test voltages to agree with theirs.

9.3 Construction

Production Control (F.F. Manning)

The following units have been completed since November 21:

9.3 Construction (continued)

CR#	Qty	Title	Originator
1492-18	3	P-I Mounting Panel, 19" Mod.	Watt
1617	1	-300, 5-Amp. Regulator	Kerby
1767	100-6 ft 100-8 ft	Video Cables	Sutro
1788	12	D-C Power Strips, 8 Plug	Test Equip Com
1793	8	Multivibrator Frequency Divider	" " "
1795	10	Fil. Power Panel, Mod. III	" " "
1798	1	Magnetic-Tape Print-Out Thyratron Power Supply, WWI	Farnsworth
1817	1	Magnetic-Tape Print-Out Control Register	Farnsworth
1900-3C	12	Filament-Transformer Panel, Mod. II	Sandy
1906-2	7	Microphone Cables	McVicar
1952	5	Lamicoid Labels	Smead
1952-6A	48	Cathode Follower	Smead
1952-9A	16	Sub-Section Parity Check	Smead
1952-35	80	Video Cables	Smead
1952-35A	30	Video Cables	Smead
1984-22	40	Line Cords	Test Equip Com
1984-24	300	91-ohm Terminators	" " "
2016	2	Preburn Panles	Frost
2046	1	Decoder-Output Amp.	Holmes

The following units are under construction:

CR#	Qty	Title	Originator
1492-17	5	P-I Mounting Panel, 26" Mod.	O'Brien
1767	800	Video Cables	Test Equip Com
1788	18	D-C Power Strips	" " "
1793	8	Multivibrator Frequency Divider	" " "
1795	20	Fil. Transformer Panels	" " "
1900-1B	15	Vertical Fuse Strip	F. Sandy
1952-2A	48	GT-BA Panel Sub-Assy.	Smead
1952-2B	6	Assy GT-BA Panel	Smead
1952-7A	10	Sub-Assy. Decoder	Smead
1952-9B	2	Assy. Parity Panel	Smead
1900-3C	8	Fil. Power Panel	F. Sandy
1952-7B	2	Assy. Decoder Panel	Smead
1952-6C	6	Assy. Cathode Panel	Smead
1952-21	1	Elecy. Test Load	Smead
1952-22	1	Aux. Power Supply Test Load	Smead
1952-54	30	Delay Lines	Smead
1984-8	8	Core Driver, Mod. 5	Test Equip Com
1984-11	35	Two-Way-Switch Bracket	" " "
1984-12	24	Video Probes Mod.	" " "
1984-27	6	Tech. Coup. Units	" " "
1984-28	210	Lamicoid Labels	" " "
1993	1	Tube Tapper	Twicken

9.3 Construction (continued)

Outside Vendors (C.W. Watt)

We are cooperating with Division 1 of Lincoln in the location of satisfactory outside vendors for electronic assembly. We have exchanged lists of vendors used or investigated by each and expect to continue to share the information we obtain as time goes by.

(R. F. Bradley)

The following outline summarizes activity with outside vendors.

P.O.	Firm	Ord.	Del.	Type
L-14079	Advance Machine Tool	21	--	Machine Work
F-17320	American Assoc.	300	217	Plastic Fab.
L-33515	G.P. Clark	40	--	Assy. & Wire
L-33372	Dane Electronic	10	--	Assy. & Wire
L-33372	Dane Electronic	20	--	Assy. & Wire
F-13239	Dane Electronic	12	9	Assy. & Wire
F-13239	Dane Electronic	8	1	Assy. & Wire
F-14564	Gavitt Mfg. Co.	580	180	Assy. & Wire
F-14497	Hardware Products	100	6	Machine Work
L-33514	Hauman Instrument	40	--	Assy. & Wire
F-14234	A.J. Koch	50	--	Assy. & Wire
L-33429	A.J. Koch	50	--	Assy. & Wire
F-10440	Raytheon	4012	334	Complete Fab.
Work Order	Lincoln	5	1	Plastic Fab.
Work Order	Lincoln	5	1	Platic Fab.
		5253	749	

Inspection (C.W. Watt)

The Wiring Shop of Lincoln Laboratory, Division 7 is sending a man to study our inspection procedures next week. Lincoln expects to increase facilities in inspection and hopes to learn from us.

9.4 Drafting (A.M. Falcione)

New Drawings:

Title	Cir. Sch.	Assy. & PL	Al Panel
Flip-Flop Plug-in Unit Mtg. Panel (MTC)	D-53233	R-52937	R-52939
Dual Gate Panel (MTC)	D-52588	E-53043	R-52706
Push Button Pulse Generator (MTC)	C-53153	D-53094	D-53091
Cathode Follower Panel (MTC) Mod I	C-52585	E-52915	
Parity Check Panel (MTC)	D-52942	E-52946	R-52706
Power Control Ind. Panel (WWI)	A-52326	D-52387	D-52404

9.4 Drafting (continued)

Title	Cir. Sch.	Assy. & PL	Al Panel
Delay Line Amplifier Panel (MTC)	C-51939		
Buffer Panel (MTC)	C-53170		
Cathode Follower Panel (MTC) Mod II	C-53198		

The 16" display-oscilloscope drawings are now being brought up to date to comply with the latest DCL Standards for components. Several additional units are to be constructed in the near future.

2. Thesis Drawings:

According to the latest information received, Allan Roberts, Charles Zraket, Spencer Greenwood, and Werner Frank are writing theses to be submitted to the Graduate Department on or about January 16, 1953. All drawings for theses should be completed by Drafting on or about the 31st of December, in order to allow us a sufficient time to process all drawings for multilith reproduction. In order that no delays be encountered in the completion of drawings, the above mentioned engineers should submit their drawings to Drafting as soon as each drawing is completed. This will eliminate any possible delays, in the event Drafting time is taken by higher priority work which may be required at that particular time.

10.0 GENERAL

New Staff (J.C. Proctor)

Alexander Vanderburgh, Jr., a new staff member working with Adams' group, received a BS in EE Communications from MIT. He was formerly associated with the Sperry Gyroscope Company as an assistant project engineer and also with H.H. Scott Co., Inc. as an engineer.

New Non-Staff (R.A. Osborne)

The following laboratory assistants have joined the Construction Shop:

Leland Callender
Vincent Early
Louis Hirshberg
Billy Ridener
Paul Verbanas

Frank Kuritsky is a new laboratory assistant in Group 62.

Alan MacDonald has joined the Systems Group in Room 156 as a laboratory assistant.

10.0 GENERAL (continued)

Paul Messenheimer is a new technician in Group 62.

Helena Rebman is a new laboratory assistant in Group 63.

Mary Toner is Mr. Kromer's new secretary.

John Ackley is an MIT Student who will work for the Test Equipment Committee.

Terminated Non-Staff (R.A. Osborne)

Ruth Burke
Julian Kolinski
Alice Kowilicik
Lewis Lucy
Donna Maxon
David McHale
Mimi Rosenthal
Alvan Teton

I.B.M. Sub-Contract (A.P. Kromer)

The formal sub-contract covering I.B.M.'s activities for the first six months of our joint effort has been signed.

During this biweekly interval further visits to the Computer Laboratory have been made by the I.B.M. engineers assigned to this project. Discussion during these visits continued to present the overall problem of Air Defense and the part that a Digital Computer will play in processing data in connection with this problem.

Further discussion has also resulted in establishing specific assignments and fields of work for the I.B.M. personnel. This was discussed during a meeting with all design personnel, and a separate memorandum covering the minutes of this meeting is being prepared. This memorandum will indicate the fields of activity for I.B.M. people and the M.I.T. counterpart in each field. The memo will also indicate the overall time schedule required for design, construction, and testing of the computer if we are to meet our desired delivery date.