Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, November 7, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

1.11 Operation (D. Morrison)

The usable percentage of assigned operation time and the number of computer errors for the period 24 October - 7 November 1952 as reported by the computer operators is as follows:

Number of assigned hours	102
Usable percentage of assigned time	84
Usable percentage of assigned time since March, 1951	84
Number of transient errors	32
Number of steady-state errors	12
Number of intermittent errors	30

(N. L. Daggett)

By November 8, the series of changes being made to Test Control should be practically complete. When these are completed, there will be very few pieces of test equipment left in the system; those that remain will be so isolated that malfunctioning will not interfere with normal operation of the system.

(S. H. Dodd)

The Computer is being modified to enable it to operate with Magnetic Drums. The auxiliary drum is expected to be delivered during the next biweekly period and installation work in 156 and the power room should make us ready to test the auxiliary drum as soon as it is delivered.

Installation periods have been running for a full day rather than 1/2 day for the last couple of weeks to allow us to make the required modifications.

1.11 Operation (continued)

(A. J. Roberts)

A total of 6 storage tubes were replaced during this biweekly period. Three of these changes were made to permit installation of the new ion-collector tubes. Two failures of a similar nature have occurred in the new tubes. RT-344 failed to hold a plus array after the power had been brought back on following a shutdown for installation. Operation returned to normal after increasing the collector voltage. RT-345 failed to hold a plus array after a failure in the storage-tube mount and the removal of power from the tube for approximately 17 hours. This tube had to be removed from the system. Further experience will be necessary to determine if this fault will be common to this type tube. Three ion-collector tubes are now operating in the system.

Plans are being made to complete the outstanding modifications in the storage-tube mounts in an effort to increase storage reliability.

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

The following failures of electrical components have been reported since October 23, 1952:

Component	No. of Failures	Hours of Operation	Reasons for Failure
Cyrstals			
1N38A	1	1399	low R_b
1N34A	1	13800	low R_b
D-357	5	12000 - 13000	low R_b
Resistors			
5000-ohm 1-watt ±1% Nobleloy	2	5983	above tolerance
5000-ohm 1-watt ±1% Nobleloy	2	6395	below tolerance
100-ohm 1-watt ±5% Carbon	1	11382	burn out
125000 1/2-watt ±1% Nobleloy	4	12000 - 13000	over tolerance
450000 1/2-watt ±1% Nobleloy	2	12000 - 13000	over tolerance
125000 1/2-watt ±1% Nobleloy	2	12000 - 13000	over tolerance

1.12 Component Failures in WWI (continued)

Component	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
7AD7	1	1000 - 2000	low I_b
	3	3000 - 4000	unbalance
	2	4000 - 5000	gassy
	1	5000 - 6000	low I_b
	1	7000 - 8000	low I_b
	3	8000 - 9000	1 - unbalance 1 - low I_b 1 - grid emission
	1	10000 - 11000	low I_b
	2	11000 - 12000	low I_b
	4	13000 - 14000	3 - low I_b 1 - unbalance
	1	14000 - 15000	low I_b
7AK7	2	13238	change in characteristics
6AG7	2	10046	low I_b
6AL5	4	2 - 10046 2 - 10011	low I_b
6AK5	5	10046	2 - change in characteristics 3 - low I_b
	5	10011	3 - low I_b 2 - change in characteristics
6L6	1	6405	open heater
6AN5	1	4057	unbalance

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

The following Storage-Tube Failures were reported during this biweekly period:

ST-534-2 was rejected after 3168 hours of operation because of poor margins and holding-gun coverage.

ST-620-C was rejected after 112 hours of operation because of unstable HV gun and incorrect read-out from negative surface.

ST-608-1 was rejected after 1779 hours of operation because of poor margins.

ST-622-C was rejected after 102 hours of operation because of low emission from both guns.

ST-544-1 was rejected after 2098 hours of operation because of poor margins.

1.13 Storage-Tube Failures in WWI (continued)

RT-345-C was rejected after 130 hours of operation because of failure to hold a plus array after probable tube arc-over.

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

Following is the storage-tube complement as of 2400 November 6, 1952:

Digit	Tube	Hours of Installation	Hours of Operation
0 B	ST-619-C-1	10069	762
1 B	ST-606-1	9599	1232
2 B	ST-612	9575	1256
3 B	ST-601	8524	2312
4 B	ST-516	6641	4195
5 B	ST-548-1	8299	2536
6 B	RT-344-C-1	10637	194
7 B	ST-540	7937	2899
8 B	ST-549	8259	2577
9 B	ST-519	6624	4212
10 B	RT-347-C	10782	50
11 B	ST-542	8148	2689
12 B	ST-604	10827	4
13 B	RT-346-C	10756	75
14 B	ST-624-C-1	10507	324
15 B	ST-603	8322	2513
16 B	ST-533	7801	2945
16 A	ST-613	9046	1790

ES Clock hours as of 2400 November 6, 1952 10831

Average life hours of tubes in service 1809

Average life hours of last 5 rejected tubes. 844

1.2 Five-Digit Multiplier (C. N. Paskauskas)

The multiplier has been operating without error since noon of October 27.

During the period of this report no components were replaced as a result of marginal checking.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.13 Arithmetic Element and Arithmetic Control (S. Thompson, A. Heineck)

The past two weeks have been spent analyzing IBM computer circuits. A block schematic was completed for a four-bit accumulator which can add and subtract.

2.14 Input-Output (J. Dintenfass, T. Sandy)

This biweekly period was spent trying to locate the source of 60-cycle ripple on the display deflection line in WWI. Measurements of the ripple amplitude were made at various locations and found to be as high as 30 mv. These measurements will continue into the next biweekly period. A report will be written at the end of our investigation.

(R.H. Gould)

The block schematic design of Phase II of the In-Out system for controlling the magnetic drums has caught up with the block-diagram design. About one-half of the necessary modifications to existing panels have been made. Construction of new panels must wait upon the delivery of Plug-in Unit Mounting Panels. Video cables can be ordered now that the design has settled down.

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

During the early part of the past two weeks, marginal checks were made on each available flip-flop individually, both with and without a 10-k resistor from crystal junction to ground. The results showed no appreciable change in margins for either condition; further checking along this line with the flip-flops together in a counter circuit again showed no significant change in margins . However, two modified flip-flops with balanced crossover resistances were found to have more balanced margins comparing those for the "zero" with those for the "one" screens and, therefore, to have better overall margins than the flip-flops without balanced networks.

Several samples of the new Potted Ferrite pulse transformers were received and immediately substituted for the standard hypersil transformers in a few plug-in units for comparison testing.

2.14 Input- Output (continued)

At this writing, the 1:1 Potted Ferrite compares very favorably with a similar hypersil transformer. This vital testing will continue until it is proved (as is expected) or disproved that potted Ferrite transformers can be used exclusively for all plug-in units.

Changes in the logical circuits of the M.I.T.E. which include removal of zero-gate readouts and of delay lines in the control section will be incorporated into the tentative M.I.T.E. layout drawings; the actual operation with these changes is being checked.

A rough-draft has been written describing each of the present plug-in units; the finished descriptions should be available in the near future.

The past few days were spent working on modifications to the PEC-730C power supplies which were bought for testing plug-in units. The supplies have been changed to provide standard voltages at all seven terminals; these have been tested to insure proper regulation under various loads and are now being modified in finished form. One additional required voltage will be provided from a P-1 supply which will be modified for rack-mounting sometime during the next biweekly period.

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

A number of minor mechanical problems have beset the Raytheon plug-in unit production, but they have been overcome, and everything should go smoothly from now on. A few plug-in units, the first, were delivered Friday, November 7, and Raytheon expects to make up for its slow start during the next few weeks.

2.2 Vacuum Tubes and Crystals

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

Some troubles were encountered in a 514 scope being used with infrequent triggers in a study of a relay pulse circuit (see below). The symptom of the difficulty was self-triggering of the scope, with very little influence by the sweep stability and trigger amplitude controls. The difficulty was finally resolved to an intermittent breakdown in the CR tube (a developmental tube similar to the recently announced RCA 5ABP1). There were as much as 7 volts of short pulses less than 1-microsecond long between different parts of the scope frame. The tube was hi-potted at 3 kv for an hour, after which the trouble largely cleared up. A similar breakdown may be behind some of the troublesome random triggering experienced in other Tektronix scopes at times. If such trouble is suspected, the sweeps should be observed with another

2.21 Vacuum Tubes (continued)

scope while the high-voltage power supply is disabled by removal of the oscillator tube. If the random sweeps disappear, the CR tube is suspect. If the random sweeps disappear with the high voltage on and the CR tube out, the CR tube should be replaced.

A relay pulsing circuit formerly used with the transconductance bridge has been modified to allow pulses of variable but controlled length to be generated. A one-shot multivibrator is used whose stable position locks the relay in. When the relay is locked in, a condenser is charged through various resistors, selected according to the pulse length desired. A Schmitt circuit connected to the condenser triggers when a fixed voltage is reached and returns the one-shot to its unstable position. After two seconds the one-shot pulls in the relay again, and the cycle is repeated. Pulse lengths from about 5 milliseconds to 1.5 seconds can be obtained. The oscilloscope in the system is triggered during the 5 milliseconds or so before the relay drops out after it is deenergized.

The plants of the Hytron company and Raytheon were visited during this period. Vacuum-tube-production facilities were examined by the authors, Ted Clough, and Pat Youtz. Matters pertaining to vacuum-tube quality were discussed with various engineers at these plants. These visits were made as part of the study which will determine the tube types to be used in new developmental work.

Mr. Ceterson, an engineer at Electronics Park, Syracuse, was consulted concerning the difficulties encountered with the G.E. 4SN1A3 flip-flops used in the 2^6 counters. He was sent the circuit schematic of the unit, along with stray capacities as measured by Herb Platt, so that possible circuit changes can be suggested by G.E. to allow us to use these units.

A phone call to Roger Slinkman at Emporium on October 29 resulted in the receipt on October 31 of 100 sample 6145 tubes. We have about 6000 of these tubes on order for new equipment designed to use the 7AD7 and for 7AD7 replacements in Whirlwind and test equipment. These tubes were tested by November 3, with the result that 46 failures were found, mostly shorts and tap shorts between grids 1 and 2. Examinations by Frost and by Ted Clough showed that lint was primarily responsible. Another call to Slinkman brought the information that these tubes had been made in engineering tests and are not representative of production. Apparently this tube is not in quantity production yet, but will be in the near future. They will take more precautions to avoid lint difficulties in the future. Arrangements have been made for samples of all future lots so that checks can be made on characteristics and quality. The quality of the samples received is not expected to be representative of the quality of the production tubes.

2.21 Vacuum Tubes (continued)

We have been requested by Professor Walter Jones of Cornell to cooperate with them in some tests of interface impedance. Cornell has a contract to analyze service rejects. They are receiving defective tubes from the various services, ARINC, and some of the service computers. This is a study of why vacuum tubes fail in service, information that is very badly needed.

Mr. Dante Ottolini of the Research Division, Burroughs Adding Machine Co., Philadelphia, visited the laboratory on November 5. He was concerned with special tests (on vacuum tubes) to be made in conjunction with an operating-life test which Burroughs is doing on a Signal Corps contract. They will attempt to correlate JAN life conditions with digital-computer life conditions. They will make interface-impedance measurements during life, a study which has largely been neglected except for a few laboratories. Pulse-emission measurements will be made in conjunction with the life test, and a large part of the visit was spent in discussing the proper type of tests to make and means of making these tests.

A model-3 tube tester is now under design. Present tentative designs are based on a G.R. vacuum-tube bridge, which will give us much more versatility than at present. Important provisions will be made for more accurate metering and easier meter standardization. Short-testing features will be built in, along with preheating circuits. Some power-supply redesign will be made to give better characteristics for the service intended.

Thesis Studies (H.B. Frost)

A breadboard panel for the study has been completed and partially checked out. Receipt of a 934 phototube used in the sweep circuit is awaited for complete checkout, as the 934 reserved for this circuit was found defective.

My thesis proposal has been discussed again with Dr. Nottingham. With very minor modifications, it is now acceptable in the present form.

2.22 Transistors

Life Tests (N.T. Jones)

Four Bell and four GE transistors have been removed from the life tests because of drastic changes in characteristics during the 1800 hours of operation. Numerous other units of the original 119 transistors on life tests have changed parameters but not sufficiently to necessitate removal.

The processing of the large quantity of data for the life-test progress report continues. Correction for changes in ambient temperature between the original and the most recent measurements must be made for each of three parameters for every transistor. The magnitude of this job is such than an excessively long delay occurs between the data-taking and the report writing. The data now being processed was taken in September.

Twenty RCA TA-165 transistors were added to the life tests during this period. Eight of these were plugged into the sockets vacated by the removal of the units described above, and the remainder were placed in the elevated shelf, room-temperature shelf, and underwater tests.

Switching (N.T. Jones)

Rough preliminary measurements were made to a group of Bell 1768's, 1698's and 1734's, and RCA TA-164 and 165 transistors to correlate "hole storage time" with other parameters. The results have not been determined as yet.

Specifications (N.T. Jones)

Work is beginning on the significance of the emitter parameters and characteristics in switching circuitry. The inconvenience of emitter measurements and the lesser importance as compared to the collector characteristics are the reasons for our neglect of them.

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

The transistor grounded collector coupling circuit is now working in the partial-sum flip-flop and gate unit. The maximum repetition rate of input pulses to the gate has been raised to 800 kc. The main problem left is to reduce the minimum input trigger amplitude needed to give the full output voltage. This will also reduce the supposedly rejected input signal which now gives an appreciable output.

Circulating Pulse Circuits (R.H. Gerhardt)

Most of the transformers for the four-bit register using the delay-line circuit have been received and the breadboard is nearly done.

The collector outputs from the cascaded one-shot multivibrator circulating pulse circuit have been mixed to give an output d-c level. Because the pulses do not overlap completely and have a finite rise time, the output had considerable 1 and 2 megacycle components. A filter was designed and it was found that the output had sufficient amplitude that a gate could be connected to this output. The

2.22 Transistors (continued)

gate is again a one-shot multivibrator and has a very good rejection ratio. However, the gate is somewhat critical of the bias-level voltage; that is, the swing of the d-c output level from the circulating pulse flip-flop is not as much as is desirable.

Transistor Accumulator (D. Eckl, R. Callahan)

The total time on the accumulator is now 1136 hours.

To increase the operating speed of the accumulator, the isolation resistors between the flip-flops and gates were reduced from 47k to 10k. This increased the operating speed to 160 kc (command-pulse repetition rate) but the added loading made operation less reliable. A gate when firing with a 10k resistor isolation will cause a drop of about half in the flip-flop output. The isolation resistors were then replaced with 22k in the partial-sum unit. A satisfactory test of reliability under these conditions has been held up by difficulties with the mechanical-error counter.

Now that the new transistor collector characteristic tracer is available, new data is being recorded on each transistor in the accumulator. Photographs have been taken of the collector curves for each transistor. The transistor will be rechecked in this manner if it is removed for any reason. This should help make possible determination of cause of failure.

A study, dealing with switching times as predicted by the equivalent circuit of the transistor, is being carried out.

(I. Aronson)

The transistor-characteristic plotter has been completed and put into operation. It was necessary to borrow a scope from M.T.C. since the Dumont 304HR we ordered for this tester has not yet come in.

Sixteen more RCA TA-165's have been received and completely processed. This brings the total up to 112 received on our order for 300.

2.23 Crystal Diodes (I. Aronson)

M-1686, describing the Western Electric gold-bonded diodes, was completed early in this biweekly period. Similar tests on Transistor Products Co. gold-bonded diodes have been started.

2.3 Ferromagnetic and Ferroelectric Cores

2.31 Magnetic-Core Materials

Ferrite Cores (W. J. Canty)

The past biweekly period has been spent selecting approximately 300 more MF-1326, F-291, ferrite cores to be used in a second 16 x 16 memory array. Results of the tests on these and previous cores of this type indicate that if the selection test on this type core is to consist of noting the instantaneous value of the disturbed-one output pulse at a given time, then 45% of the cores tested will fall within ± 5% of a mean value, 65% will fall within ± 10% of a mean value and 89% will fall within ± 20% of a mean value.

Model III Core Tester, No. 3 (J. R. Freeman)

The Model III Core Tester, No. 3, is now being used for testing. One Ferramic H (F-259), one MF-666 (F-259), and four MF-1312 (F-259) ferrite cores have been tested to determine their switching characteristics prior to being sent to Oak Ridge, Tenn., to be neutron irradiated.

Production Core Tester (R. F. Jenney)

The electronic and mechanical operation of the production tester is now satisfactory but an unusual amount of trouble is being experienced with sense winding pickup.

A new production tester is undergoing preliminary design. It should relieve the sense problem and operate faster. It will be several weeks before the new design is ready, however, and so the present model will have to be used.

Automatic Core Tester (R. E. Hunt)

I am doing some work on a new design for an automatic core tester for the .090 OD ferrite cores. The semi-automatic core tester is weak on this application as it was designed for much larger cores.

We have modified the semi-automatic machine to handle these cores, however, and Dick Jenney is using it. As soon as his ideas have crystalized, we will proceed with the new design.

Automatic Curve Plotter (J. D. Childress)

The last period was spent in refinement of design of the logic and component elements of the Automatic Curve Plotter--Core Output Voltage vs. Driving Current.

2.31 Magnetic-Core Materials (continued)

Scope Calibration (B. Smulowicz, R. A. Pacl)

The Oscilloscope Comparator has been constructed and tested with satisfactory results. Work has also started on eliminating noise pickup in the Production Core Tester.

Core Stresses (P. K. Baltzer)

Further correlation has been made between pulse data and applied stress for Ferroxcube 4B. An analysis of the applied stress will be made using polarized light and plastic toroids.

Life Test (P. K. Baltzer)

Original data is being collected on MF-1326B, F-291, cores that will be life tested. Special attention will be given to testing the cores during the first 200 hrs. in order to observe any aging effects.

Hysteresigraph (C. D. Morrison)

A new operator is being trained to take over the operation of the hysteresigraph.

The 24 MF-1326, F-291, cores which are going on life test were B-H loop tested. These were part of the original batch of 2,000 we received from General Ceramics. The 13 Mo Perm (1/8 x 1/8 x 1/8 x 10 wraps) cores which are going to be used on shelf test were B-H tested also.

Chemistry and Ceramics Laboratory (F. E. Vinal)

Competitive bids for building changes and laboratory installation have been collected, a selection made and all local approval received. A number of large equipment items have already arrived while many more have been placed on order. Grinding jars and mill facilities are under construction in our own and Lincoln shops.

Structure of Ferrites (F. E. Vinal)

Fourteen specimens have been submitted to Group 35 for microstructure examination. These cores are representative of good and bad loops and output voltages, large and small die sizes, various compositions, etc.

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

The x-ray diffraction apparatus is being modified to accommodate large toroids in order to attempt to detect their state of strain. At the same time, 2.31 Magnetic-Core Materials (continued)

it is being arranged that measurements can be made in the presence of a magnetic field, on the chance of detecting the small magnetostriction effect.

Preparation of Ferromagnetic Materials (J. Sacco)

Work has been started on several new ternary series. Three of these consist of magnesium-manganese ferrites of varying mol percentages. Two are nickel-zinc ferrites and one is a nickel-manganese ferrite. The raw materials have been weighed out in all cases and the compounding will begin upon the arrival of the new mill jars.

A quick check is being run on one of the nickel-zinc ferrites to determine the proper firing temperature. A number of 304 toroids are now in the kiln and will be available for tests on Monday, November 10.

Ferrite Compositions (G. Economos)

The preparation of new magnetic-ceramic compositions is proceeding satisfactorily. These should be ready for use in about two weeks. The modified F-109 toroid die has arrived and is being adapted for our presses by M. L. Prentice. Impermeable muffles are also being set up for use in controlled atmosphere firing. Specimen fabrication will be started when this preparatory work is completed.

Analysis and Preparation of Magnetic Materials (J. H. Baldrige)

New analyses include the determination of manganese in manganous carbonate and an iron determination. A sample of synthetic magnetite has been received for analysis.

A quantity of lanthanum oxide has been ordered from Research Chemicals, Inc. for synthesis of ferromagnetic manganese compounds.

Switching Time in Magnetic Cores (J. B. Goodenough)

A qualitative analysis has been made of the factors which contribute to the switching time in metal tapes and ferrite cores. On the basis of this analysis, it has been suggested that 100 tapes perforated with pin-point holes be ordered. Lattice inclusions, cavities and second-phase precipitate are correlated with the short switching time in ferrite cores.

An analysis has also been made of the internal stresses to be expected in a ferrite ring. This serves as a basis for correlating the squareness of the hysteresis loop with the dimensions of the ring. A quantitative calculation is in progress for the switching-time analysis. It is hoped that these calculations will substantiate the present qualitative concepts of the various factors and their correlations which affect coercive force, switching time, and loop squareness.

2.32 Magnetic-Core Memory

Switch-Core Study (A. Katz)

An E-note has been completed in which is interpreted, in terms of a simple linear model, the data derived from an experimental study of ferritic switch cores.

The staircase generator is being assembled and should soon be in operation. Further experiments will then begin.

Memory-Test Setup I (Metallic) (B. Widrowitz, S. Fine)

Buffer amplifiers were installed between the x and y flip-flops and the crystal matrix. The impedance of the crystal matrix changes greatly with temperature and previously caused erratic flip-flop operation. The buffer amplifiers isolate the flip-flop and present a constant load to it.

B. Widrowitz and R. DiNolfo have been working on a side project in an attempt to read out of metallic cores by using bursts of R.F. currents.

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

A breadboard amplifier was designed and built to amplify the lower output signals from memory plane #4 (MF-1326B, F-291) which has now been installed in Memory-Test Setup II (Ceramic).

Initial tests indicate that this new memory plane is at least as good as memory-plane #2 (MF-1118, F-262) which has been removed from the test setup.

Construction has started on memory-plane #5 (same as #4) and in the near future this will be operated together with plane #4 as a two-digit memory.

Memory-Test Setup III (Ceramic) (J. Mitchell, R. DiNolfo)

After eliminating most of the prf sensitivity in the z plane driver, we were able to operate the array with a read-write time of 5 microseconds at a prf rate of 170 kc. Marginal operation was obtained at the maximum prf rate of 200 kc.

In addition, some tests were run to determine the effect of the size of the memory driving terminating resistors on the driving current wave forms. We found the optimum value to be about 2.2 ohms, the size now being used.

Sensing-Panel Development (C. A. Laspina)

A sensing panel for use with the ceramic array has been built and is now being debugged. The unit is a direct-coupled, balanced amplifier with a rise time of about 0.3 μsec. for a step input and a maximum gain of about 1000.

2.32 Magnetic-Core Memory (continued)

Because of the balanced system used, the amplifier is unaffected by variations in the supply voltages. The unit provides a positive pulse of about 20 volts, regardless of the polarity of the input pulse. The unit now awaits testing on the ceramic array.

Z-plane Driver (C. A. Laspina)

A driver for providing the z-plane inhibiting pulse has been designed and is now being built.

2.33 Magnetic-Core Circuits

829 Core Pulser (H. K. Rising)

The 829 core pulser is being revamped to allow operation at a 50% duty factor at speeds up to 2 mc. To reach this repetition rate, delay-line-controlled Burroughs Flip-Flops are being substituted for the gas-tube pulse-forming circuits. These changes are necessary to facilitate work on core driver matrix circuits and high-speed stepping registers.

Stepping Register (G. R. Briggs)

I have previously shown that operation of a gate-core coupled stepping register at WWI speed is not now possible if pure resistance is used in the coupling circuit. However, operation at about 50 kc should be possible. The stepping register operating at speeds of this order would still be highly useful for in-out applications, such as conversion of slowed-down video to binary, etc. An all-core register would be most desirable because of greater reliability through elimination of diodes.

In order to investigate lower-frequency applications, Burroughs equipment has been set up to drive the pulsers, replacing the special sawtooth pulse distributor used previously. This distributor had a lower frequency limit of 150 kc. Also, additional gate-core driving pulsers have been set up and debugged. Considerable circuit alteration has been carried out on the remaining pulsers to obtain more uniform pulse lengths. These pulsers will eventually be replaced with Model 5 units as these become available early next year.

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

An analysis of the small signal-to-noise ratio for certain combinations of addition and subtraction indicates that different bias currents will produce better ratios. The necessary circuit changes are being made to so operate the matrix.

An E-note describing the operation of the core matrix adder is being prepared.

2.33 Magnetic-Core Circuits (continued)

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

Tests on the high-current pulse generator show that the unit has a rise time of 0.1 microsecond, and will supply twenty-ampere pulses from a 250-volt supply. Further tests are underway to determine the cause for this slow rise time. Two suspected causes are series inductance in the discharge circuit, and slow ionization of the thyratron. The goal is a rise time of 0.01 microseconds and 50-ampere pulses from a 500-volt supply.

Pulse Transformers (E. K. Gates)

An M-note has been completed on the comparison of WWI 3:1 pulse transformers and Radio Music 3:1 pulse transformers as they are used in Burroughs Test Equipment. The Control Instrument Company, manufacturers of the test equipment, desired to substitute the Radio Music transformer for the present model and the tests show that the substitution can be made.

At the present time, I am writing an E-note on the test specifications for ferrite 3:1 and 1:1 pulse transformers.

2.34 Ferroelectric Materials

Ferroelectric Pulse Tester (J. Woolf)

The negative half of the pulse tester has been modified and checked out. The high voltage to the final stage has not been applied, due to difficulty in obtaining the necessary floating supplies. This problem has just been solved and the final stage will be checked out.

2.4 Test Equipment

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

The first five low-speed counters inspected by Nickerson's group did not work as expected. Further construction was halted pending correction of the faults.

It was suspected that the trouble lay with the sensitivity of the new model binary-scaling units to loading. Careful measurements were made on the low-speed counter with the following results:

1. If only one stage were connected in for counting, the output of the stage would see more than 100 μμf.

2. The output of one counter sees 25-30 μμf when looking into the next stage without any binary-scaling units being plugged in.

3. The output and input capacitances of a binary-scaling unit are 17 and 8 μμf respectively.

The manufacturer's specifications for the binary-scaling units states that the maximum loading is 50 μμf in parallel with 100,000 ohms. However, in a breadboard scale-of-64 counter, wherein the lead lengths were kept to a minimum, the scaling units failed to count when loaded by the following counters, the indicator circuits, and 27 μμf from both sides to ground.

Investigation is being carried out to either decrease the loading or else to redesign the circuit.

The counters have been made to count by 1) reducing the plate-supply voltage to the scaling units to about 100 volts, 2) removing the in-out and preset switches.

The first method is impractical because the plate-supply-voltage margin is less than 10 volts. The latter solution makes the circuit a scale-of-64 counter with none of the present flexibility. It is believed, however, that the in-out switches might be returned to the circuit without affecting the operation.

Variable-Width Pulse Generator (D. Shansky)

The variable-width pulse generator mentioned in previous biweekly reports has been redesigned to produce half-sine wave pulses 30 volts in amplitude variable in width from 0.15 μsec to 0.5 μsec in 6 steps. The proposed steps are:

0.15 μsec
0.20 μsec
0.25 μsec
0.30 μsec
0.40 μsec
0.50 μsec

2.4 Test Equipment (continued)

Either polarity pulse (+ or -) will be available with continuously variable amplitude.

2.5 Basic Circuits (F. Irish)

Design work on the gate-generator and the dual gate-generator buffer-amplifier has been completed. Drawings for these two plug-in units are being finished by the drafting room.

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

Due to clamping, the 12AV7 flip-flop design #1 -- mentioned in the last report -- was not susceptible to optimizing. Design #1, therefore, resulted in a 1-mc flip-flop with poor counting characteristics, but capable of driving 100μμf/side. After studies on this flip-flop were exhausted my original flip-flop design was reverted to.

Two basic variations (design #2 and #3a)of the original type of flip-flop were built and tested. Both flip-flops will work at prf's in excess of 5 mc--with restrictions on trigger amplitudes,--and can drive loads in excess of 100 μμf/side (about 7-7AK7GT's per side). All considered, design #2 is a 3-mc flip-flop with a maximum load in the order of 100 μμf/ side; whereas, design #3a is a 4-mc flip-flop with up to 50 μμf/side, and a 3-mc flip-flop with up to 100 μμf/side. It is very likely that both will have excellent counting characteristics, although design #2 has the better output waveforms. Theoretically design #2 will work with poorer tubes than #3a although both work with good and retired 12AU7 (5963) tubes -- a tube for which neither was designed. More extensive studies and comparisons are now under way.

2.6 Component Analysis and Test (B.B. Paine)

Robert W. Hudson has joined this group, and will do all the transformer, relay, and other involved testing previously done by various part-time students. Students will now be used on special testing projects.

Tests are being performed on several types of resistors to determine their performance under short-time surge conditions.

Samples of CBS-Hytron crystal diodes, and of GE junction diodes, have been received for evaluation.

2.7 Memory Test Computer

Block Diagrams and Logic (H.E. Anderson)

It has been decided to trouble shoot MTC step by step. As a beginning the MTC Control has been assembled from Burroughs units and is now awaiting

2.7 Memory Test Computer (continued)

d-c power. A new feature of control is that the logic has been made independent of how fast the memory is.

Block Diagrams and Logic (W.A. Hosier)

At a meeting on October 28, it was agreed to incorporate three new orders (special add, shift left, and display address) in addition to those (start reader, copy in, start punch or printer, copy out) presumably needed for IBM card equipment. The shift left would operate as a carry, hence need no special gates. For ease of understanding its operation, the accumulator was made an adder instead of a subtractor. Anderson and I, with emphatic encouragement from others present, volunteered to set up and test the MTC control, composed of Burroughs test equipment. Exclusive of the units exclusively concerned with memory timing, this will run to a minimum of 6 flip-flops, 19 coincidence-detector panels, and 18 delays. Louis Sutro told us that this test equipment was either on hand or shortly available.

A conference with Mr. Butler and Mr. Housman of IBM on November 7 threw more light on the IBM terminal equipment, and gave promise of more detailed drawings, etc., next week.

A system block diagram, E-37366, is under way in the drafting room.

Power Supplies (R.G. Farmer)

The schematic diagrams for the rectifier circuits of the power supplies have been completed. In preparing the physical layout of these units we are trying to minimize the amount of weight in the back of the sub-chassis which will simplify the problem of support.

I have spent some time testing a 400-volt, 5-amp rectifier which will be installed in Whirlwind I. This rectifier is similar to the rectifiers which will be used in MTC and this work has helped me to become familiar with the unit.

(R. Pfaff)

A panel layout for the part of the computer containing the accumulator, A-register, panel storage, program counter, etc., has been completed.

Measurements have been made to determine the capacitance of the A-register video bus output. This capacitance was in line with what was expected.

(J.D. Crane, Jr.)

Toggle-switch storage is being designed.

A 32-position crystal matrix has been designed and is now in drafting.

2.7 Memory Test Computer (continued)

(R. von Buelow)

There will be approximately 150 separate marginal-check lines brought out to toggle switches. These lines may be marginally checked together or individually. The marginal-checking console has been laid out.

The input and output card machines were discussed with IBM personnel. The method of adapting these to MTC is being worked out.

It also seems probable that IBM plug boards will be used as an additional toggle-switch storage.

(R. Hughes)

A gas-tube pulse generator has been developed for MTC.

(H. Henegar)

The first week of this period was spent checking and making the necessary drawings of the parity check panel. The past week was spent designing a floating power-supply for the marginal check, which gives a continuously variable voltage between + and -100 volts.

(H. Smead)

A rack for the power supplies for MTC has been sketched and is now in drafting. It is expected that an outside contractor will build these.

Some assembly work has been started in the shop on the cathode follower panels, and other panels will soon be started.

The power-distribution panels will be assembled outside; sufficient filament transformers are not yet available.

Wireway duct has been received for power-distribution purposes.

3.0 STORAGE TUBES

3.1 Construction (P. Youtz)

A group of 700-series prototype storage tubes were constructed as replacements for Bank B. These tubes were 600-series storage tubes with a small Faraday cage on the target assembly and an ion collector plate at the gun end of the tube. Several of these tubes were tested and installed in the computer.

The activity on Philips "L" cathodes was continued this period by reprocessing a 600-series storage tube with a high-velocity gun which contained a Philips "L" cathode. An experimental tube was constructed this period to calibrate a thermocouple for use in the "L" cathode tubes.

Work was continued toward developing techniques to produce a stable stannic-oxide coating which will be used instead of dag. A 700-series prototype storage tube with a stannic-oxide coating was constructed and tested during this period.

3.2 Test (C. L. Corderman)

Recently we have had indications of an undesirable reduction in the secondary emission of storage tube surfaces. This instability appears to be more severe and to occur more rapidly in the new 700-series-type tubes which have an ion-collector plate. However, recently constructed 600-series tubes have shown some changes in secondary emission.

The new degassing schedule, which has been used on all tubes after ST620-C and which has insured that the storage surface will remain positive during holding-beam bombardment, is a suspected cause for the lowered secondary-emission ratio. The exact role of the ion-collector plate is not known. It is quite possible that during the initial hours of operation, the plate acts as a getter and removes oxygen from the tube which might otherwise be available to the storage surface. (It is known that pure beryllium has a much lower SER than oxidized beryllium.)

Appropriate changes have been made in the surface degassing schedule. Four research tubes are also planned, two of which have ion-collector plates made of tantalum rather than stainless steel, and two in which the plate is coated with aquadag. Within the next month, we should know if this problem is peculiar to ion-collector tubes and if it is serious enough to require further consideration of other methods for reducing the ion deflection shift.

3.2 Test (Continued)

(C. T. Kirk)

During this biweekly period, the unit to measure the current density distribution of the high-velocity beam was tested and found to be satisfactory. The problem of obtaining normal target currents has been solved. It was discovered that some of the target current was going to the accelerating anode of the holding gun (A_2'). Normal target currents in the order of 60 - 120 microamps were obtained by tying all the holding-gun electrodes back to the target elements.

Momentary loss of cage current which occurred at more or less regular intervals was noticed during preliminary testing. This was traced to the voltage regulator tubes in the positioning voltage power supply. During the interval in which cage current decreased, the glow in the voltage regulator tubes appeared to switch from one region of the cathode to another. However, this effect disappeared before any corrective measures were taken.

Pretest (D. M. Fisher)

Seven research tubes were pretested during this biweekly period. RT345-C, RT346-C, RT347-C and RT349-C were satisfactory and are now available for test at the STRT. RT343-C-R1 was rejected because of dark spots on the surface and will be dissected. RT348-C was rejected because the W^- signal plate gate was above the limit. This was apparently caused by a buckled mica target. RT332-C-2 which is a stannic-oxide tube has shown no signs of surface contamination and the secondary-emission characteristics of the surface are equivalent to those in dagged tubes.

Tests are now underway to determine the effect of the ion collector on the holding-beam current density distribution.

Storage Tube Reliability Tester (R. E. Hegler)

During this period, five tubes were tested at the STRT. Four were research tubes containing ion collector plates and one was a 600-series storage tube. ST629-C-2 had a normal spot interaction area. RT344-C-1 and RT347-C were satisfactory with average spot interaction areas; RT346-C and RT345-C had smaller than average spot interaction areas, but were also considered satisfactory. From observations at the TVD and the STRT, it appears that these two smaller than normal areas are due to non-uniform collector-to-mosaic spacing.

Since the purpose of the collector plate is to reduce deflection shift caused by positive ions, it is now possible to operate with A_3 at 150 volts and the holding gun at 0 bias. The spot interaction area of tubes operated under these conditions appears to be about the

3.2 Test (Continued)

same as that of tubes operated under normal conditions. Operating a tube with the holding gun at 0 bias and A_3 at 150 volts insures sufficient restoring current at the corners of the storage surface.

It was found that the ion collector plate was picking up r-f which resulted in poor readout. Because the plate is connected to the holding-gun cathode, increasing the r-f bypass at the cathode reduced the effect of the r-f picked up by the plate.

RT351-C which contains an "L" cathode had a smaller than normal spot interaction area and, in addition, the extent of the spot interaction area was limited by the low target current. At zero bias the target current was only 20 microamps.

3.3 Research and Development

Velocity Distribution Measurements (C. T. Kirk)

Methods of separating the small cage-current pulse from a large linear sweep applied to the cage have been considered. So far only one method seems to be promising. This method will be tried out some time during the next biweekly period.

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

The emission of RT341, a type "L" cathode in an RCA 5U gun, continued to decay during the early part of this period. An attempt to reactivate the cathode by initially increasing the filament voltage appeared to be unsuccessful. However, after the voltage had been returned to normal (8.0 volts) the emission increased to a level only slightly less than that obtained when the tube was first operated. Two hundred hours of subsequent operation resulted in no further decay of the beam current and only a small decay in the cathode current.

An experimental tube, XT57, was constructed to calibrate a thermocouple which consisted of the molybdenum cathode shell of an "L" cathode and a platinum lead. The range and precision of the thermocouple seemed adequate, but a considerable evaporation of platinum was noted at activation temperatures (1250°C). This may prove to be a deciding factor in the utility of the thermocouple for use in the "L" cathode tubes.

A storage tube, ST621-C (now RT351-C), was reprocessed using a high-velocity gun which contained an "L" cathode. In contrast with the earlier "L" cathodes, activation took approximately twice as long on this tube. Other than this, there were no unusual characteristics noted during processing. When the tube was first installed in the TVD there was no more than 1 microamp of d-c beam current available. This

3.3 Research and Development (Continued)

low beam current was the final value of a rapid and repeatable decay from about 14 microamps. However, when the tube was operated with pulsed emission, it appeared to activate and subsequent measurements gave identical pulse and d-c beam currents of 20 microamps at 0 bias. Both the TVD and STRT tests were satisfactory.

The tube was operated overnight in the STRT and the emission fell to 1 microamp maximum beam current. During all of the previous tests the filament voltage had been 8.0 volts and it was now raised to 10 volts with the tube biased off. After three hours, normal emission was restored.

The following night the tube was again placed in the STRT and operated at $E_h = 8.0$ volts. This resulted in no measurable emission on the following morning. Following this, sudden removal of filament voltage apparently caused the filament to open.

ST622-C, which has been rejected from WWI because the high-velocity gun failed, will be reprocessed soon with a Philips "L" cathode in the high-velocity gun.

Video Readout (A. J. Cann)

Simplified analysis has shown a certain amount of ringing to be unavoidable with the use of filters. On the other hand the readout voltage obtainable is limited by the capacitance of the signal plate and the beam current. The readout was slightly improved by the following two measures: 1.) The rise time of the pulse on the high-velocity-gun grid was reduced so that it now rises 60 volts in 0.02 microseconds; and, 2.) The signal plate capacitance to ground was decreased by putting a choke in series with the collector which otherwise is directly at signal ground. The latter can not be carried too far because it delays the effect of the signal plate gate by the duration of the transient induced on the collector.

It now seems that further improvements must come from using simpler filters which will produce short, high spikes and from using a good non-blocking amplifier.

H. B. Frost has developed an idea for a non-blocking amplifier which is now being built.

Secondary Emission (J. Jacobowitz)

A setup for measuring the secondary emission of storage tube surfaces is being developed. The operation cycle chosen for preliminary testing consists of a period in which the holding gun stabilizes the

3.3 Research and Development (Continued)

surface, followed by alternate periods in which the surface is raised above and below the collector voltage. During each of the latter two conditions, the high-velocity gun will be gated ON for a short period.

Ion Gauge Study (H. B. Frost)

Additional studies have been made of three different ion gauges, the standard RLE type used on the vacuum systems up to this time, the Westinghouse Bayard-Alpert tube, and a design by Wayne B. Nottingham, Professor in the Physics Department. The latter tube is based on the Westinghouse Bayard-Alpert tube which uses a fine wire collector, but has several additional features which greatly improve its operation. Long-continued pumping tests indicate that vacuum system #7 will pump to about 1×10^{-9} mm Hg with liquid nitrogen on the system. There appears to be a difference of a factor of two between the standard gauge and Nottingham's gauge if previously-determined calibration constants are used. Instability in the calibration of the Westinghouse tube was observed in confirmation of work done in the Physics Department. The instability is caused by charging of the tube walls from secondary emission similar to the wall charging which gave trouble in early storage tubes.

The Nottingham tube will operate on the present gauge controls quite satisfactorily and has a background pressure well below possible system pressures. The present RLE gauge has a background pressure of about 2×10^{-8} which is its chief limitation. Disadvantages of the Nottingham tube include its higher cost and the need for a special outgassing power supply. If we are successful in the use of stannic oxide as a conductive coating, the lower pressures during tube processing may well require the use of this new design gauge for proper measurement.

4.0 TERMINAL EQUIPMENT

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

Trouble with the output printer printing characters while the carriage was tabbing to a new column has apparently been corrected by a modification of the FL Printer Adapter Plug on the console.

A plug-in adapter has been added to the typewriter on which the output punch is mounted to provide the following:

1. To permit use of the TAPE-FEED switch on the typewriter for feeding out blank tape from the output punch (the tape-feed switch on the console continues to perform this same function).

2. To prevent the keyboard of the output printer from locking up should the typewriter PUNCH-ON switch be inadvertently depressed.

Investigation is now underway to see if the FL typewriter can be easily modified to provide for automatic carriage return when the typewriter is being used as an output printer.

4.2 Magnetic Tape (J. A. O'Brien)

We have made arrangements with Mr. Gillison of Building 32 to examine and adjust the pulley system on another one of our tape-drive units. He is going to make some spare drive capstans of aluminum and plastic in order to experiment on the amount of flange and crown required.

(E. P. Farnsworth, J. W. Forgie, S. B. Ginsburg)

The reliability of the system is still being improved by the elimination of defective components and the replacement of unbalanced Reading Cathode-Follower tubes. Most of our computer time is now devoted to making significant reliability tests.

The transfer switch for magnetic-tape print-out has been received and will be installed in Test Control to permit print out from magnetic tape.

4.3 Display (R. H. Gould)

A new method of adjusting the display decoders has been devised. It should be much more precise than the methods previously used and is straightforward enough for routine maintenance. The problem of the random variations of the intensified spots on the display scopes is still not solved. It is quite certainly 60-cycle oscillations of the electron beam apparently caused by 60-cycle voltage that gets onto the deflection lines between the decoder output amplifiers and the display scopes. Getting rid of this voltage may prove to be very possible and the most effective solution

4.3 Display (Continued)

may be to inject 60-cycle voltage into each amplifier to buck out the noise voltage.

A third 16-inch display scope will soon be available for permanent use with the automatic scope camera. This scope will have a CRT with a P-11 phosphor and will be modified slightly to make position and gain calibrations more convenient.

4.4 Magnetic Drums (E. S. Rich)

A series of meetings has been started in which details of the Auxiliary-Drum system are being described to engineers and technicians of Group 64 who will be involved in testing and maintenance of the drum systems and their associated equipment. These meetings are planned for one hour every other day until pertinent details of logical operation, circuits, power control, marginal-checking facilities, etc., are covered. To date one meeting has been held. It is intended that these discussions will give systems personnel a firm background on the expected operation of this drum so integration with the WWI system can proceed as fast as practicable.

(P. W. Stephan, S. B. Ginsburg)

All of the equipment necessary to assemble the various Auxiliary-Drum test set-ups has been collected. Modifications were make on those panels originally used in the interim magnetic-tape system. An erase box was built as requested by Ken McVicar.

5.0 INSTALLATION AND POWER

Progress of M.I.T.E. Installation (C. W. Watt)

Wiring of room 156 is progressing at a steady rate. The change-over of alternators for WWI proper from the old 400A unit to the new 600A unit was done Friday, November 7. The 400A unit will be integrated with the 156 system Thursday, November 13, if all goes well, at which point the power facilities for the Auxiliary Drum will be ready. The drum is expected toward the end of November.

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

Power distribution in room 156 has been proceeding rapidly. D-C power wiring is all that has been installed to date. The A-C power wiring cannot be installed until the #10 twisted-pair cable has been received. We should have this wire next week.

5.1 Power Cabling and Distribution (Continued)

The filament voltage-control panel has been completed and installed. Panels that are to be delivered next week are: 8 power-distribution panels, power supply for filament-alternator regulator, Mod. II, and filament bus panel. When these panels are received and installed, we will have the necessary power to room 156 for the M.I.T.E. racks.

5.2 Power Supplies and Controls

Whittemore Building D-C Supplies (R. Jahn)

Permanent installations have been made of the -15 and -30 volt supplies. A new -300 volt, 15-ampere D-C supply has been delivered and tested. It will be installed early next week.

New 600-Amp Filament Supply (J. J. Gano, G. A. Kerby)

Regulation. The supply is now being tied into WWI. The regulator has been thoroughly tested for stability at loads up to 500 amps. Steady-state regulation shows a drop of .3 volt RMS from no load to 200 amps and then a rise of .8 volt above the voltage setting when loaded to 500 amps. This rise is due to a change in wave shape of the A-C output voltage and the fact that the detector measures an average value. The computer is interested in the RMS values for filaments. This combination of fortunate circumstances results in the computer buses having an almost constant RMS voltage at loads above 200 amps because the drop in voltage in the cables is compensated by the increase at the output of the alternator.

Mechanical Balancing. After both the motor and generator were sent out for dynamic balancing the motor was returned relatively free from vibrations. When the motor was coupled to the alternator, the alternator showed an unbalance, though insufficient to pass through the vibration isolators and disturb the computer floor. We will try to borrow instruments from the Institute and make periodic checks for amplitude of vibration on this and other critical rotating machinery.

Vibration Isolation. The vibration isolators quickly supplied by Barry Corporation appear to be overloaded and most likely will have to be replaced by a larger size.

Emergency Operation. Since the alternator had to be disassembled for balancing, stator leads were brought out so that reconnection for 120-208 volts could be rapidly made and thus afford an emergency source for the plate alternator. At such a time the old alternator would supply WWI filaments and the emergency transformers would supply M.I.T.E.

6.0 BLOCK DIAGRAMS (B. E. Morriss)

All block-diagram work for the integration of the two magnetic drums into the In-Out System has been brought up to date and passed on to the appropriate people so that necessary changes may be made. This is reflected in the only up-to-date drawing of IOC, SD-37367-1.

The changes in Buffer Drum proposed by ERA eliminate the need for 14 gates in each of the M.I.T.E. units and 8 gates in the unit selector attached to the drum. These changes and several other changes which should eliminate the need for a couple of delays in each M.I.T.E. unit have been discussed with A. Werlin who has been preparing wiring and layout drawings for this equipment.

A draft of a note which will revise the sections of E-466, Operation of In-Out Control, which pertain to the block transfer orders has been written.

Considerable time has been spent on the preparation of a note describing the operation of the Buffer Drum and associated equipment.

(G. A. Young)

During the last biweekly period representatives from Raytheon visited the laboratory and proposed a decimal-display system using cores for buffer storage. The problem of indicators, which is of interest to us, was not discussed.

A study of the operation of the Punch, Printers, the PETR, and the Mechanical Reader is being conducted in anticipation of bringing block and line diagrams up to date and writing an E-note describing the units.

(J. H. Hughes)

I spent some time working out an economical way of assigning CPO units to do the commands needed by bi and bo.

7.0 CHECKING METHODS

7.1 Test Programs (G. A. Young)

A test program for the Auxiliary Drum has been written and is ready to be checked and organized into a final form.

7.4 Marginal Checking (J. H. Hughes)

I have finished a sketch of the cabling needed between the various panels of the new marginal-checking control system. Construction requisition numbers have been assigned to the Control Panel and Relays Panel but no date for delivery has been decided on.

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, 67 hours; Demurjian, 26.5 hours; Frankovich, 56 hours; Helwig, 60 hours; Kopley, 69 hours; Porter, 71 hours; WWI, 1701 minutes

The read in program for the programmed arithmetic and output sections of the comprehensive conversion program has been rewritten so that the results of read in will be punched out on paper tape in the 5-56 form. The programmed arithmetic section is now ready to be included in its final form in the comprehensive conversion program.

All three parts of the comprehensive conversion program have been tested on the computer. The only remaining major difficulty lies in sufficiently shortening the third part of the program so that the conversion of "generalized decimal" numbers can be accomplished.

The adaptation portion of the comprehensive output program is divided into four logical phases. The first phase has been completed, the second is being tested and the third and fourth have been written.

The mixed number output program is still being tested for errors in the output of non-interpreted numbers. When this program is completed it will provide a general output for any type of number. Programs for handling special cases will then be written. These special programs will provide economy in storage space and will be selected automatically by the adaptation program.

94. Factorization of Integers: Denman, 69 hours; Uchiyamada, 74.5 hours; WWI, 243 minutes

A program in which arbitrary numbers to three register length are successively altered in steps of ± 1 (up to a preset limit) until the prime factors of the resultant number are all less than 600 has been successfully run on the computer. This routine prints the original number, the sign and magnitude of the alteration, and then the factors of the resultant number.

This program has now been modified so that it prints out the first set of prime factors (all less than 98), but then continues to vary the original number and print other sets of such factors as they are found until the preset limit is reached.

Computer time, hours	
Programs	40 hours, 48 minutes
Conversion	4 hours, 14 minutes
Demonstration	1 hour, 11 minutes
Total	46 hours, 13 minutes
Total time assigned	54 hours, 12 minutes
Usable time, percentage	86%
Number of programs operated	143

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-215	Standard Test Equipment	69	9-1-52	R. Best, R. Rathbone, W. Drogue, L. Sutro
E-492	Introduction to the Theory of Semi-conductors IV, Quantum States in Crystals. The Bound Electron Case	17	10-22-52	D. J. Eckl
E-494	Modification of the Dumont 304-H Oscilloscope to Reduce Drift Encountered in WWI Display	7	10-29-52	D. J. Neville
E-497	External Control Box for WWI Display Oscilloscopes	3	11-5-52	D. J. Neville
M-1684	Association of Computing Machinery Convention, Sept., 1952	3	10-27-52	C. L. Corderman
M-1686	Western Electric Gold-Bonded Diodes, Models A-1764, A-1815, A-1816	7	10-22-52	I. Aronson
M-1687	Group 63 Seminar on Magnetism, IV	5	10-27-52	A. Loeb, N. Menyuk
M-1688	Group 63 Seminar on Magnetism, V	3	10-28-52	See Above
M-1689	Group 63 Seminar on Magnetism, VI	5	10-27-52	See Above
M-1690	Stock Room Procedure	1	10-27-52	G. Lexander
M-1691	Rectangular Hysteresis Loop Materials in a Non-Destructive Read System (B.S. Thesis Proposal)	5	10-20-52	W. Frank
M-1692	Biweekly Report, October 24, 1952	39	10-24-52	
M-1693	Laboratory Personnel	14	11-1-52	
M-1696	Liaison with IBM Corp.	1	10-28-52	H. Fahnestock
M-1699	Test Checking of a Magnetic Drum Buffer Storage System, Progress Report	2	9-22-52 to 10-24-52	C. Zracket
M-1700	Group 63 Seminar on Magnetism, VII	5	10-27-52	A. Loeb, N. Menyuk
M-1701	Thesis Progress Report No. 1	2	9-1-52 to 10-1-52	W. Frank
M-1703	Test Equipment Committee Meeting, 10-23-52	2	10-30-52	L. Sutro
M-1705	Visit of October 28 to Bell Telephone Labs, Murray Hill, N. J.	2	10-31-52	D. A. Buck
M-1706	Thesis Progress Report No. 1	5	9-10-52 to 10-24-52	T. S. Greenwood
M-1709	Utilization of Group 61's Computer Time	4	11-4-52	R. Wieser
M-1710	October 1952 Storage and Research Tube Summary	4	11-4-52	D. M. Fisher
M-1712	Discussion of Magnetic Drum Systems at Engineering Research Assoc., Oct. 20-22	5	11-5-52	E. S. Rich

9.1 Publications (Continued)

LIBRARY FILES

No.	Identifying Information	Source
2112	ELECTRONICS Cumulative Index, 1930 to 1949	McGraw-Hill Co.
2113	Matrix Inversion by an N Step Gradient Process	Ballistic Rsch. Labs.
2115	On the Rounding off of the P. P. Tables for Linear Interpolation	N. B. S. No. 1845
2116	On the Linear Iteration Procedures for Symmetric Matrices	N. B. S. No. 1844
2117	System Specifications for the DYSEAC	N. B. S. No. 1951
2118	Graphical Method for Rapid Design of Bridged-And Parallel-Tee Notch Networks	Jet Prop. Lab.
2123	The Selective Electrostatic Storage Tube, Reprint	R.C.A. REVIEW, 3/51
2124	Ferromagnetic Spinels for Radio Frequencies, Reprint	R.C.A. REVIEW, 9/50
2125	Static Magnetic Matrix Memory and Switching Circuits	R.C.A. REVIEW, 6/52
2126	A Complete Telemetry System for the Flight Testing of Aircraft	Douglas Aircraft
2127	Index of Specifications and Standards, Vol. III	Dept. of the Navy
2128	Recording and Storing of Information Contained in Electrical Voltage Signals	Servomech. Lab.
2129	French Electronic Equipment Industry Productivity Team, Program and Itinerary	Mutual Security Agency
2130	Digital Comp. Technical Progress Report	Univ. Illinois
2131	Symposium on Ferrites, 13th Conference	CERAMIC AGE, 5/52-8/52
2132	The Computing Machinery Field, Vol. 1, 10/52	Berkeley & Assoc.
2136	Performance Test of the Philips Model 1/4D Air Engine	Lincoln Lab.
2137	Progress Report on the EDSAC II	ONR/London
2138	Univ. Illinois Order Codes: Loss of F & K Orders	Univ. Illinois
2139	Proceedings for the Association for Computing Machinery, Pittsburgh	A. C. M.
963	Signal Corps Electronic Comp. Research and Dev. Quart. Prog. Report No. 11	Univ. of Pa.
2033	SEAC Operating and Programming Notes, V	N. B. S.

JOURNALS

PHYSICS ABSTRACTS, September, 1952
ELECTRICAL MANUFACTURING, November, 1952
INDUSTRIAL DISTRIBUTION, November, 1952

9.2 Standards, Purchasing, and Stock

Procurement and Stock (H.B. Morley)

500 Amperex 1N38A crystals intended for this lab were shipped to Division I of Lincoln. This type of manufacturer's error seems to be accumulating, especially on this critical item, for the same thing happened three weeks ago on Sylvania's shipment of 1750 crystals intended for us, but shipped elsewhere to Lincoln. The 1N38A situation is now as follows:

A. Sylvania. 400 received October 28, as promised. They hope to ship 400-500 on November 20, and 400-500 again on November 28.

B. Amperex. Shipment of 5000 was delayed in customs; portions are now being cleared. 2000 pieces are promised for shipment November 13, 3000 pieces for December 1.

These delivery promises, if kept, should insure us sufficient crystals to provide for immediate critical construction needs, if no other untoward developments occur.

The type of manufacturer's error involved in the crystal situation seems to coincide with the adoption of the new Lincoln Purchase Order forms. Another increasing difficulty is the delay in receiving acknowledgments or other inquiries on orders placed, which are being sent by the manufacturer to the Lincoln Division I address shown on the order. The routing back to us from Lincoln sometimes takes a week or more.

Approval of Ferranti Tape Readers has been received, and orders sent. Deliveries are hoped for in February and March.

A form is in preparation to facilitate "expediting" requests, and to inform requisitioners of the delivery expected, with particular attention to production control.

We are informed that the Automatic Recording Camera ordered from the Navy, and promised for delivery, cannot be shipped. This problem is being investigated, for there may be a misunderstanding.

Departmental organization is progressing favorably. The stock-control system is being readied physically; mail and delivery service are improving; files are being brought into good shape.

Poor deliveries are reported for PMP terminals; Alpha Wire; Federal Supply on furniture and equipment; IPC connectors. A slight improvement is noted on Jones connectors from local suppliers, although the general production at the factory is three months or more behind. Elastic Stop Nuts may show improvement soon.

Administrative Memorandum A-141 sets up a mail delivery schedule. In order to keep good delivery, mail messengers should not be asked to perform any other deliveries directly. If general messenger delivery service is needed, please call G.A. Lexander in Stock Control, Extension 3460.

9.2 Standards, Purchasing, and Stock (continued)

Standards (H. W. Hodgdon)

New or revised standards issued this period:

6.013-1	Panels, Aluminum, 19 inch, 1/16" thick
6.013-2	Panels, Aluminum, 19 inch, 1/8" thick
6.021-1	Capacitors, Fixed, Ceramic Tubular
6.042	Connectors, Coaxial
6.076-2	Tube Clamp, Miniature
6.101	Meters, Panel, D.C.
6.102 & .103	Meters, Panel, A.C.
6.133	Introduction & Application Design Notes, Selenium Rectifiers
6.133-1 thru -3	Selenium Rectifiers
6.141-1 thru -7	Relay Coils (Clare)
6.142-1 thru -6	Relay Frames (Clare)
6.143-1 thru -42	Relay Assemblies (Clare)
6.152-1 thru -3	Resistors, Fixed, Deposited Carbon
6.171-3	Switch, Sensitive, DPDT
6.192-13	Transformer, Power
6.200	Electron Tube Test Specifications
6.201	Vacuum Tubes, Preferred Types

Assignment of part numbers for Kardex Stock Control has been completed. As soon as practicable, these numbers will be indicated on all standards sheets, to be used for parts lists and stock withdrawal.

9.3 Construction

Production Control (F.F. Manning)

There was a mechanical error in the biweekly report of October 24, 1952. The units following and including CR# 1283 were still under construction.

The following units have been completed since October 24.

CR#	Qty	Unit Title	Originator
1283-1	1	10 A. 600 V Rectifier Mod II	Hunt
1560	1	Fuse Indication Panel	Mercer
1561	1	Standardizer Amplifier	Mercer
1633-1	3	Lab Benches	Mercer
1667	1	Check Register	Watt
1714	1	Fil. Voltage Control Mod II	Sandy
1716	1	Fil. Alternator Control Panel Mod II	Kerby
1771	5	Capacitor Boxes	Platt
1771	5	Indicator Boxes	Platt
1788	20	D-C Power Strips 8 Plug	Test Equip Com
1795	5	Fil. Power Panel Mod II	Test Equip Com
1900-1B	14	Terminal Strip & Fusing Board	Sandy
1949	1	Magnetic Tape Transfer	Farnsworth

9.3 Construction (continued)

CR#	Qty	Unit Title	Originator
1950	1	Mag. Tape Print-Out Receptacle Panel	Farnsworth
1981	1	Cathode Drift Studies	Frost
2010	50	Storage Jig for Cores	Brown
2000-3	75	Video Cables	Norman
2000-4	31	Video Cables	Norman

The following units are under construction:

CR#	Qty	Unit Title	Originator
1793	15	Mul. Frequency Divider Mod II	Test Equip Com
1788	30	D-C Power Strips (8 Plug)	Test Equip Com
1617	1	5 Amp -300 Volt Regulator	Kerby
1817	1	Mag. Tape Print-Out Control Register	Farnsworth
1889-5	1	Rack D-C Switch Panel	Sandy
1900-1B	26	Vertical Fusing Strips	Sandy
1900-3F	8	Power Distribution Panel	Sandy
1900-3G	1	115 V A-C Filament Bus Panel	Sandy
1900-3C	40	Filament Transformer Panel	Sandy
1912	1	Mag. Tape Print-Out Switch Panel	Farnsworth
1952-6A	48	Sub. Assy. Cathode Follower	Smead
1952-9A	16	Sub Assy. Parity Check	Smead
1983	as req	Plug-in Units Modification (issued units brought up to date)	Smead
1990	1	Power Supply for Filament-Alternator Regulator	Kerby
1993	1	Tube-Tapper Indicator	Twicken
2016	2	Preburn Panel	Frost
2018	1	Metallic Array Panel	Widrowitz

The following units have been completed since Oct. 24, 1952 by outside vendors:

CR#	Qty	Unit Title	Originator
1697	15	Fixed-Voltage Switching Panel Mod II	Hunt
1952-23	137	1:1 Pulse Transformer	Smead
1952-23	150	3:1 Pulse Transformer	Smead
1969	22	3:1 Pulse Transformer	Hunt

The following units are under construction by outside vendors:

CR#	Qty	Unit Title	Originator
1696	12	Assy. Voltage-Variation Switching Panel Mod II	Hunt
1703	8	Assy. Fuse-Indication and Rack-Interlock Panels	Hunt
1952-1	100	Plug-in Units D-C Flip-Flop Serial #1-100 - Mod III	Smead
1837	50	1:1 Pulse Transformer	Brown
1837	50	3:1 Pulse Transformer	Brown
1952-23	63	1:1 Pulse Transformer	Smead
1969	100	1:1 Pulse Transformer	Hunt
1900-3E	380	External Power Cables	Sandy
1492-37	550	D-C Flip-Flop Plug-in Unit	O'Brien

CR#	Qty	Unit Title	Originator
1492-38	1305	Gate-Tube Buffer Amp Plug-in Unit	O'Brien
1492-39	210	Dual Buffer Plug-in Unit	O'Brien
1492-40	272	Switch-Tube Plug-in Unit	O'Brien
1492-41	310	26" Mounting Panel Plug-in Unit	O'Brien
1492-42	84	Mech. Sub Assy. Chassis & Handles	O'Brien
1492-43	150	Special Delay Lines D-C Flip-Flop	O'Brien
1984-13	100	D-C Flip-Flop Plug-in Unit	Test Equip Com.
1984-14	200	Gate-Tube Buffer Amp Plug-in Unit	Test Equip Com.
1984-15	50	Dual Buffer Plug-in Unit	Test Equip Com.
1984-16	65	19" Mounting Panel	Test Equip Com.
1984-17	66	Mech Sub Assy. Chassis & Handles	Test Equip Com.
1938-A	2	Mold for 0.1-μsec toroidally wound pulse transformer	Hunt
2006	6	One-gallon Rubber-Lined Assay Jar	Vinal
2006	6	One-quart Ball Mill Jar	Vinal
1872	100	Heaters for Storage Tube	Palermo

Plastic Packaging (R.E. Hunt)

We are currently working on the following plastic packaging work:

1. A two-stage crystal mixer was packaged in a clear plastic cube 1 x 1 x 1-3/4. Electrical characteristics after packaging were excellent.

2. Work is being done to prestress ferrite cores to make their BH curves more rectangular.

3. We have completed packaging 12 special transformers for the transistor group.

4. We are doing further work on experimental 0.1-μsec pulse transformers.

9.4 Drafting (A.M. Falcione)

1. New Drawings

Title	Cir. Sch.	Assy & PL	Al. Panel
Fil. Alt. Reg. Mod II (WWI)	D-51746	E-51872	D-51873
Relay-Panel Marg.-Checking Control Mod II (WWI)	E-52673		
Power-Control Indicator Panel (TE)	A-52326	D-52387	D-52404
Remote Video-Switch Panel (WWI)	B-52892	D-52893	D-52894
Plug-in Unit Mtg Panel MTC		R-52937	R-52939
9-Rack Assembly MTC		E-53012	

9.4 Drafting (Continued)

2. Print Distribution to Outside Vendors

Memorandum M-1685 has been written and is awaiting approval prior to distribution to staff. This memorandum describes the procedure for print distribution to outside vendors, for the DCL Laboratory.

3. Use for Obsolete or Discarded Memorandums

A memo will be written shortly to all personnel requesting that all memorandums, reports, etc., which are to be discarded or thrown away, to be sent to the Print Room for future use. In our multilith operation procedure we have a need for scrap paper, which is used for absorbing the ink from each master after the initial run has been made. This process is necessary to preserve the master for future re-runs; therefore, this would be a good place for all discarded memorandums to be sent for eventual scrap.

10.0 GENERAL

New Staff (J.C. Proctor)

John B. Bennett, who graduated from Wesleyan College, has been assigned to Ulman's group. He worked as an Asst. Chief in the M.P. Division for the War Department and also as an editor of Ginn and Co. Before this time he served in the U.S. Army.

Henry E. Frachtman, a new staff member working in Wieser's group, has a PhD in Chemistry from New York University. He has worked with American Power Jet Company in Ridgefield, N.J., as an Operations Research Analyst, and also at the Kellex Corporation as a staff member.

Margaret F. Mann has returned to work with Dodd's group on a part-time basis.

Edmund Cohler has just completed his work for a PhD in EE at Northwestern University, where he previously received his BS and MS degrees. He has been doing part-time research in the Communication Circuitry Laboratory at Northwestern.

James Schallerer, a graduate of the American Television Institute, has been assigned to Brown's group. While attending ATI, he worked as a laboratory technician at Standard Coil Prod., and also served 3 years in the U.S. Army as a topographic draftsman.

Terminated Staff (J.C. Proctor)

John W. Craig, Jr., has transferred from Group 61 to Group 35.

10.0 GENERAL (continued)

New Non-Staff (R.A. Osborne)

Ernest Bertrand is a laboratory assistant working with Hunt.

Joan Buckley is a new messenger at the Whittemore Building.

John Coyne is a new stock clerk.

Peter Donaldson has joined the Storage Tube Group as a technician.

Marcel Filteau is a laboratory assistant in the Construction Shop.

Barbara Halpern has returned to work as a secretary in R. Nelson's group.

Robert Hudson is a laboratory assistant working with B. Paine.

Richard Johnson is a senior detailer in the drafting room.

David McHale has joined the Applications Group as a laboratory assistant.

Michael Paecopalas is a laboratory assistant in the Construction Shop.

Anthony Puleo is a laboratory helper in the Sheet Metal Shop.

Janet Taylor is new secretary for Hunt, Paine, and the MTC Section of Group 62.

Non-Staff Terminations

Richard Driscoll
Joseph O'Leary
Joseph Rodriguez
Dennis Twohig

I.B.M. Subcontract (A.P. Kromer)

A letter of intent has been issued to IBM Corp to authorize start of engineering activity during the period while the formal subcontract is negotiated. A total of 14 different IBM engineers have visited here to obtain background information which will be required to have their work properly complement the work of our laboratory. Visits to related Lincoln Laboratory activities have also been made.

The broad scope of work to be done has been outlined in general terms and within the next few days specific tasks for work by IBM personnel will start to be determined.