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Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BI-WEEKLY REPORT, May 9, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

(D. Morrison)

The following is an estimate by the computer operators of the usable percentage of assigned operation time and errors due to the computer. This covers the period from 25 April through 8 May.

Number of assigned hours	128
Number of transient errors	0
Number of steady state errors	0
Number of intermittent errors	39
Percentage of assigned time usable	91
Percentage of assigned time usable since March 1951	85

(S.H. Dodd)

Transfer characteristics of the storage tube high-velocity guns have been taken at frequent intervals during the past few weeks. These measurements have been quite helpful in analyzing the meaning of the margins of storage tube operation. On the basis of the transfer characteristics the heater voltage in several of the storage tubes was changed.

New record sheets have been devised for designing a composite picture of computer reliability. One record sheet shows component failures and the second sheet shows storage tube failures. The storage tube failure record will permit an immediate analysis of operation of any one of the storage tubes over a period of several months with information showing whether failures occurred during applications periods or during test periods and the type of errors involved.

A new program has been written to investigate more thoroughly the problem of obtaining optimum re-write times for storage tubes. It is too early as yet to give any definite conclusions.

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1.1 Whirlwind I System (continued)

(N. Daggett)

Plans have been made for keeping a complete record of the failures of each electrostatic storage tube in the computer. The usefulness of these records will depend to a large extent on getting information from the applications groups on what digit failed in any particular case. In order to keep the procedure from being too cumbersome, no attempt will be made to determine the reason for the failure (such questions as whether the program writes frequently on adjacent registers). Should any program appear to cause consistent failures, then it will be run again during a maintenance period and an attempt made to analyze the failure.

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

During the past bi-weekly period electrostatic storage operated with fair reliability. Some of the trouble was due to several digits switching positive during the running of a program. Two tubes were replaced during this period in an attempt to increase storage reliability.

A study of the effect that reading has on spot potential is being made. The maximum and minimum rewrite time has been determined for each digit for a large number of reads. The effect of read gate and r-f pulse amplitude on rewrite time will be investigated.

(S. Desjardins, D. Morrison, T. Leary, M.F. Mann)

Low margins on a number of marginal-checking lines were investigated, and the sources of a few located and corrected.

Tape T-208, Checkerboard Check, was modified to check all ESD decoder positions, and T-106 was modified to include the new order cycle left for marginal checking purposes.

(L.O. Leighton)

Component Failures in WWI

The following failures of electrical components have been reported since April 25, 1952:

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1.1 Whirlwind I System (continued)

(L.O. Leighton) (continued)

Component	No. of Failures	Hours of Operation	Reason for Failure
Crystal			
D-357	2	10803	Low R_b
D-358	1	2823	Low R_b
	1	8830	Drift
	1	9095	Drift
1N38a	1	5725	Low R_b
Resistor			
Variable, 1000 ohm 2 watt	1	2789	Intermittent operation
Carbon, 2200 ohm 1 watt	1	10318	Change in characteristics
	1	10254	Change in characteristics
Tubes			
3E29	2	2000-3000	1 low I_b 1 interface
	7	3000-4000	6 low I_b 1 mechanical
6AS7	1	1924	Change in characteristics
6AL5	2	2967	1 low I_b 1 Mechanical

(L.O. Leighton)

Storage Tube Failures in WWI

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

ST-526-1 was rejected after 85 hours of operation because it was gassy.

ST-503 was rejected after 1052 hours of operation because of poor margins and poor stability.

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1.1 Whirlwind I System (continued)

(L.O. Leighton)

Storage Tube Complement in WWI

Following is the storage tube complement of Bank B as of 2400 May 8:

Digit	Tube	Hours of Installation	Hours of Operation
0	RT233	4722	2773
1	ST521	7059	436
2	RT247	5198	2297
3	RT234	4705	2790
4	ST516	6641	854
5	RT237	4714	2781
6	ST534-2	7469	26
7	ST508	6321	1174
8	ST505	6176	1319
9	ST519	6624	871
10	ST504	6665	830
11	ST520	6639	856
12	RT258	5207	2288
13	ST517	6493	1002
14	ST524	7313	182
15	RT255	5150	2345
16	ST506-1	6218	1277

ES Clock hours as of 2400 May 8 - 7495.

1.2 Five-Digit Multiplier

(C.N. Paskauskas)

The multiplier ran without error during the period of this report. As a point of information, it has been in operation for over 34,000 hours.

During the period of this report two 6AS6 gate tubes were removed for retest as a result of marginal checking.

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2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

(S.E. Desjardins)

700-Console

The temporary console has been installed in the Test Control Room and is now in operation. The final push-button and switch panels are now being assembled and when installed will greatly improve the general appearance of the console. In line with appearance and to provide for still easier operation, a few minor changes will be made in the near future.

2.14 Input-Output

(R.H. Gould, J. Dintenfass)

The In-Out Control Reset Control panel has been installed in AX5 and has operated properly in simulation of reading from magnetic tape. Recording on magnetic tape will be simulated next to further test In-Out Control. The Reset Control panel will be modified by the addition of cathode resistors in its output amplifiers to decrease pulse amplitudes. Another instance of close timing has been discovered and various improvements are being considered.

The transient Control Block Mark Memory and Record Pulse Generator of Magnetic Tape Control are being video tested.

2.18 Electrostatic Storage Circuits

(B.R. Remis)

A method of obtaining a phase vs frequency response of a network, using only f-m generators, discriminators, mixers, and frequency multipliers is being investigated.

The amplitude and phase responses of the r-f amplifier of ES output are being carefully recorded to locate which tuning adjustments are most sensitive in producing phase shifts in the over-all amplifier.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes

(H.B. Frost, S. Twicken)

A problem noted previously has reappeared in a different place. About the first of the year considerable trouble was found in the deflectio

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2.21 Vacuum Tubes (continued)

(H.B. Frost, S. Twicken)

amplifiers in WWI because of drift in the current of 715B tubes when the operating point was changed. In the past period, some trouble with instability of signal plate drivers has appeared. This unstability is apparently caused by changes in the cathodes of the 829B and 6AS7G tubes of the signal plate drivers when the duty factor is changed.

Difficulties of a similar nature have apparently been found elsewhere. In particular, the vertical deflection amplifier of the Tektronix 514D scope is known to have similar changes. There are reports in the literature concerning cross-talk in time-division multiplex equipment which is apparently caused by the same effect.

A search of the literature will be made for all pertinent data, which is known to be scarce. A study of the possibilities of an engineering solution to this drift problem will be made.

Interface impedance tests for the ASTM repeatability study have been completed. Under the test conditions used, which were chosen to cause only small changes, repeatability was quite good. However, there were some changes considerably in excess of the probable equipment uncertainties. Sixteen 6SN7 tubes were read at 3 different heater voltages 4 different times.

(L. Sutro)

The classification of Whirlwind sockets according to use is nearing completion. A twentieth category has been added. Since the first 19 categories are numbered 0 to 18 this is number 19 and is called "High Level Gate Amplifiers Normally Off." An example is the 3E29 used as a holding gate amplifier in each Gun Driver Panel. High-level gate amplifiers normally on are being grouped with pulse amplifiers normally on.

2.22 Transistors

(R. Callahan, J. Jacobs)

A transistor counter has been built. It consists of a transistor amplifier, two transistor gates, and three transistor flip-flops. The counter has been operated successfully at frequencies above 1 megacycle. The counter has been left in operation at low frequencies for long periods of time (overnight and over one weekend), and it appeared to be operating reliably.

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2.22 Transistors (continued)

(D.J. Eckl)

Battery power distribution wiring for the first part of the test accumulator has been completed. Tests are continuing on the A-register and its associated amplifiers, but the major effort has been concentrated on the 3-stage counter during the past period. Wiring has been completed on the A-register, partial sum register, amplifier, and first gate panels. Work has started on development of a single transistor flip-flop for use in the carry register.

(N.T. Jones)

Correlation between the Bell, RCA, GE base-driven switching-time test and our collector-current rise-and-fall-time tests has not been attained. For that reason the latter was used to define transistor specifications. Minimum parameter values for present work are $r_{cc} = 15k$, $\alpha = 2.2$ and rise and fall times of 0.2 μsec. These measurements are described in detail in E-441 and E-455.

The life test circuit was set up but transistor difficulties caused another postponement.

(I. Aronson)

Square wave response of the emitter and collector diodes of 11 G.E. G11 transistors was investigated. The emitters were found to be similar to the N-type of cat-whisker diode, and the collector performance was duplicated by shunting a 1N38 with a capacitor and a resistor.

A 1N38 was subjected to forming treatment in a further attempt to simulate the transistor collector diode.

Two series of capacitor measurements were made on various diodes: the emitter and collector of Bell and G.E. transistors, G.E. G10B and G10 power diodes, and Kemtron 1N38 diodes. The second series of tests produced data within the correct order of magnitude but further measurements are necessary for confirmation.

(R.H. Gerhardt)

Difficulty has been experienced with transistors in a pulse amplifier circuit. Some transistors will operate properly and others will not. There seems to be no correlation between transistor parameters and whether or not the transistors will work. A re-examination of the circuit is being made.

Base stabilization is being studied in an effort to determine its operation in some of our circuits.

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2.22 Transistors (continued)

(R.H. Gerhardt) (continued)

A study of the Felker system of bit storage without flip-flops is being made and preliminary investigations have been started.

(W.A. Klein)

An M-note (M-1478) was prepared in which transistor operators were defined and some problems encountered in using these to realize logical operations were mentioned.

At present, an attempt is being made to realize the counter stage diagrammed on page 17 of E-458-1. Work is now concentrated on realizing the so-called sum-modulo (⊕) operation using diodes and/or transistors. The aim of this work is to develop gating circuits which will be useful in realizing a dynamic type logic such as Felker uses.

2.3 Ferromagnetic and Ferroelectric Cores

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

Ceramic Array I

The full 16-by-16 array is now in operation. Arbitrary information patterns can be held and cycled, and stability seems good. The highest successful operating repetition rate tried thus far has been 75 kc.

Optimum current and timing adjustments will be determined, and then current-variation margins will be measured. A "z-axis" inhibiting panel is under construction; when installed it will eliminate the extra time now spent in "delayed rewrite," and will give us information about driving larger numbers of series-connected ceramic cores.

(G. Briggs)

Work on the general core-driving core calculations to find required magneto-motive force driving currents demanded by combinations of cores containing "ones" and "zeros", and the energy required to flip the last core in a sequence of cores has been completed and will be written up in the near future. Only the time-independent case has been considered, i.e., step functions of driving current are applied to a sequence of cores, and no time lag between application of a M.M.F. to a core and the appearance of the corresponding flux change is allowed.

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2.3 Ferromagnetic and Ferroelectric Cores (continued)

(G. Briggs) (continued)

Attempts to generalize the problem to include the time-dependent case, as well as to include linear reactance between the core windings have so far failed, and have been dropped for the moment. All of the week ending with this report has been spent in experimenting with a two-core decoupling scheme to act as a gate while driving from one core into another. Fair success has been attained, and work is now under way to make a ferrite-core stepping register, without the use of diodes utilizing this device.

(R.C. Sims)

Magnetic Circuits

I have been investigating the practicability of using a magnetic-core stepping register in the control section of a computer. The main considerations, of course, are speed and reliability. Have also been trying to develop a clear-cut design procedure for the optimum design of a magnetic-core stepping register. Optimum design is defined as the fastest possible operation with a given number of ampere-turns for driving the register.

Both of the above investigations are parts of a bigger problem being considered, namely, can we reasonably expect to develop a stepping register which will be of real value in a computer. Results of this will be available shortly.

(H.K. Rising)

Magnetic Circuits

It has been shown experimentally that when a quadrature field is applied to a core in a manner similar to Buck's non-destructive readout scheme, the hysteresis loop of the core as observed from a driving winding can be made to decrease slope. That is, the inductance of a wound core can be changed from its high normal value to a very low value by application of a d-c quadrature field. This suggests the use of such an electrically controlled inductance as a switch in the link between two cores to gate the signal in the link. The advantage of such a gate is that the output circuit does not affect the input. This has been tried experimentally and has indeed allowed control of the transfer of information between two cores.

Two big difficulties were encountered in all the tests with metallic cores. There is insufficient insulation between tape turns in most cores and the required driving power required in the quadrature circuit is much too high to enable a core to drive the gate. Further investigation will be directed toward eliminating the insulation problem and reducing the driving power.

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2.3 Ferromagnetic and Ferroelectric Cores (continued)

(J. Mitchell, A. Katz)

Memory Systems Study

After a short orientation period we have begun a study of selection systems for a magnetic-core memory. In the near future we hope to develop a whiffletree diagram outlining various systems for driving and selection. This diagram will include such information as total number of drivers, number of switch cores, number of vacuum-tube drivers, number of memory cores per driver, etc., needed for the selection systems considered.

(R.E. Hunt)

Toroidal Winder

The toroidal winder has been delivered to the magnetics group and is now in use. It will wind cores down to 1/8" ID and up to 1" OD. When the pressure of other work permits, I shall develop other shuttles possibly down to 3/32 ID.

2.6 Component Analysis

(B.B. Paine)

The first part of this week, May 5-7, was spent in Washington, D.C. attending a Symposium on Progress in Quality Electronic Components. A brief summary of papers of interest to the Laboratory will be prepared by C.W. Watt and myself, and will be issued shortly.

An alarming number of failures of 5000-ohm 1-watt Nobeloy resistors has been occurring in the deflection circuits of the storage tube mounts in WWI. Failure is due to an increase in resistance, often of many hundred percent, but the resistor body shows no obvious signs of overheating. Analysis of the circuit shows no obvious cause for these changes. If anyone has any ideas concerning the reasons for failure of deflection resistors, I should like to hear from him.

It may be possible to construct a miniature delay line having properties similar to the distributed-constant cable now in use, but employing ferrites and titanates as base materials, with fired silver conductors. Different designs and techniques are being investigated.

Equipment is being assembled to give temperature and accelerated-life tests to components, at present particularly plastic-molded ferrite pulse transformers and paper capacitors.

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3.0 STORAGE TUBES

3.1 Construction

(P.Youtz)

Work on the second of the new vacuum systems has been delayed because electrician's time could not be assigned to finish the electrical work. This system was designed to hold a storage tube vertically during processing. When it is completed, it will be used to process storage tubes with stannic oxide coatings. There have been indications that the secondary emission properties of the mosaic surface have been affected by the position of the storage tube on the vacuum system during the bakeout cycle. An attempt will be made on the new vacuum system to mount a storage tube symmetrically with respect to the oven.

The new aging unit and the new ion gauge control units under construction in the electrical shop have been progressing satisfactorily.

The program to produce 500-series storage tubes as replacements for Bank B has yielded tubes with satisfactory margins during this last bi-weekly period. Some of the troubles in the previous run of tubes have been attributed to the collector-to-mosaic spacing in the target assembly. A new target assembly designed to give closer collector-to-mosaic spacing has been assembled. Tubes with this assembly will be processed and tested next week.

3.2 Test

(R.E. Hegler)

During this bi-weekly period, five tubes were available for pretest: ST529-R1, RT315, ST534-2, ST535-2 and ST536.

Of the five tubes that were pretested, three were satisfactory, one was marginal, and one was rejected.

ST534-2 and ST536 were satisfactory after A_3 was increased to 150V to give sufficient HG coverage. ST535-2 was found satisfactory with normal A_3 voltage.

ST529-R1 was marginal because of low minimum V_{HG}.

RT315 was rejected because of a short between auxiliary collector and main collector, and also because of an apparently non-uniform surface.

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3.2 Test (continued)

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

During this bi-weekly period ST515 and RT230-R1 were checked after rejection from Whirlwind. ST515, which had been operated only 200 hours in Whirlwind, had an extremely low spot-interaction area. No particular reason for the failure was determined. RT230-R1 which had been removed from Whirlwind for a bad HV gun eventually proved to have very high heater-to-cathode or cathode-to-grid leakage which caused sufficient a-c modulation of the beam to practically obscure readouts. However, the heater was being operated above rated voltage to obtain sufficient beam current.

Because of several apparent cathode failures on recent tubes, ST530 and ST525 were run continuously for several days to observe possible changes in emission. Neither tube showed significant change and after six days, ST525 was checked and found to have the same spot interaction area as it had prior to installation in WWI. The tube was deemed still satisfactory and returned to WWI. It had previously been rejected for low emission from both guns.

Two new tubes were checked, ST534 and ST535. These were constructed with close collector-to-target spacing and the results were quite satisfactory. ST534 had a very large spot interaction area, and ST535 had a fairly large area. It is becoming evident that to prevent excessive interaction while writing negative, close and uniform target-to-collector spacing must be maintained.

It was discovered during this period that previous calibrations of the read and signal plate gate drivers were considerably in error due to PRF sensitivity in a Techronix scope. For this reason, a floating power supply to facilitate gate amplitude measurements was designed and is being constructed. The deflection control unit built in the previous period was checked and found to have insufficient r-f rejection at the deflection plates. This was due to the high selectivity of the series resonant rejection circuit and the frequency variation in the r-f pulser. It has been decided that some neutralization of the r-f out-of-phase voltage will be added.

One incident of some interest was the implosion of ST513. The target end of the tube collapsed, but although three people were within six feet of the tube, no damage occurred. The electrical tape fortunately confined all of the glass. In this particular tube, for about a minute before the implosion, the glass started cracking at irregular intervals of perhaps ten seconds. Although sufficient warning was thus given, the source of the sounds was not recognized until just before the implosion took place.

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3.2 Test (continued)

(J. Jacobowitz)

The major portion of this bi-weekly period was spent in considering several problems concerning storage tubes in an attempt to select a problem suitable for a thesis investigation.

One of these problems has arisen from the work of A.M. Stein on the current distribution in the high-velocity beam. Specifically, the effect of a wire mesh on a focused high-velocity beam is of considerable interest and has never been adequately treated. This problem can be resolved into two portions:

1. The deflection of portions of the beam by the local field surrounding the mesh wires,

2. The contribution to the beam current by secondaries from both collectors. This contribution has a space variation which probably follows the cosine law and/or a law similar to that governing optical reflection. Superimposed on this is the energy spread characteristic of all secondary-electron emission.

Another problem which was considered was the change in density distribution from a uniform beam cross section to a Gaussian distribution as the beam passed through the field-free region of the A_3 cylinder. This has been observed experimentally by many people but no theoretical analysis of the shape which an unbounded cylinder of charge would assume after an infinite time.

An experimental approach to the above problem was also considered, but this was abandoned in order to work on a more pressing and fruitful problem, namely the effect of ions on the operation of the storage tube. Ions have often been considered as playing an important role in the tube -- the latest instance being the deflection shift of the HV beam which has been attributed to positive ions. However, there has been very little experimental data on ions or their effects on tube operation. Consequently, some time was spent reviewing the literature on ions, Faraday cage measurements and ionic diffusion. In addition, I am beginning to study some of the material on surface stability because of the important effects ion currents seem to have on the lower switching V_{HG}.

The problem of ions seems sufficiently important to warrant further study. I intend to make a thesis investigation of these phenomena and any others related to ionic behavior in the storage tube. At present, a thesis proposal draft is under way and should be finished during the next bi-weekly period.

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3.2 Test (continued)

(A.M. Stein)

Data was taken on RT314 which is a tube having variable collector-to-surface spacing. When testing this tube, it was found that the change in the spacing did not correspond exactly to the variations in separation originally specified. Measurements on spot size revealed that a closer collector-to-surface spacing results in a more gradual increase of spot size as a function of write time. If the first linear portion of the curves of spot radius vs ln W+ time is considered to have a slope "r_{e1}", a plot of "r_{e1}" vs five different collector-to-surface spacings results in a straight line with an intercept at a spacing of zero mils. This phenomenon is the same as the one observed with slope "r_{e2}" and different auxiliary-collector to collector spacings in RT280, a research tube having a variable auxiliary-collector to collector separation. These two observations lead to the belief that the electrons in the fringe of the high-velocity beam-current are due to secondaries emitted from the collector and auxiliary collector meshes at an angle to the main path of the primaries. The dispersion of these secondaries appears to be dependent on the spacing of these meshes to the surface.

ST535-2, using a collector-to-surface spacing of 4 mils instead of the usual 7 mils, was also examined. An evaluation of the "r_{e1}" of this tube showed that it corresponded closely to the "r_{e1}" as obtained from the "r_{e1} vs collector-to-surface spacing" curve derived from RT314.

(H.J. Platt)

The pulse logic of the Alignment-Demonstrator was tested and found to be satisfactory. However, certain other defects have shown up which caused some delay.

The Burroughs rack-power control units have contactors with silver-coated contacts. After several hours of use, the contacts became faulty and the -30 and -15 volt contacts failed to conduct. These contacts have been shorted out until a better solution can be found. A second unforeseen difficulty was that the r-f pulser was not able to drive the long length of twinax cable used. Its output is being raised by increasing the final amplifier plate voltage from +250 volts.

The display units did not work at the time of installation. The trouble has been traced to defects in the TV-switching panel which switches the deflection plates between the TV-sweep generator and the deflection decoders.

A block diagram of the Alignment-Demonstrator has been completed in the drafting room and awaits checking.

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3.2 Test (continued)

(A.J. Cann)

Some minor modifications have been made in the ST laboratory power control circuits to provide more automatic protection. In the near future, individual fuses for each setup using storage tube laboratory power may be added.

Some of the laboratory reports on deflection amplifiers have been digested and measurements have been made on the present TVD deflection amplifier. Some analysis has been carried out on paper and checked on breadboard. Because this amplifier has to produce a voltage output proportional to a current input, some of the common ideas regarding stability of gain and d-c level of voltage amplifiers do not apply. The new design will probably be finished next week.

(T.S. Greenwood)

The life test on the two remaining type "L" cathodes is continuing. The following hours have been accumulated with no significant variations in emission: RT264 - 4270 hours, RT265 - 4055 hours.

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4.0 TERMINAL EQUIPMENT

(R. E. Hunt)

Terminal Equipment Planning

A preliminary layout of Rm. 156 has been made and discussed at a meeting including Dodd, Watt, Daggett, Newitt, Rich, and myself. Several additions were suggested which have since been sketched out and included.

Formal layout work has been started in the drafting room, and a formal proposal will be issued in about one week.

4.2 Magnetic Tape

(B. Ginsburg, K. E. McVicar)

Work is continuing on the manual control and interlock circuits for the interim system, and it is hoped that the magnetic tape system will be left on continually, to be used at any time, within the next week or so. An auxiliary control panel will be mounted in the Test Control Room to permit erasing, stopping, and starting over of the magnetic tape and to provide indication of tape motion.

The d.c. power situation is still bad at times. The line drop in the +150 volt supply was measured to be 16 volts during the last week. This line drop, plus drop in the output of the supply when it is heavily loaded, has resulted in our voltage on the +150 volt line being only 110 volts in some instances.

Experimentation is continuing with our second tape unit but so far we have not been able to get it to operate satisfactorily. A representative of Raytheon was here to see what he could do about the unit's tape handling properties, but decided that he could do nothing constructive, at least here.

(E. P. Farnsworth)

Several circuit refinements including one 6SN7 have been added to the magnetic tape print-out equipment to provide the desired degree of operating simplicity. In addition, two error alarm circuits have been devised which will stop the printer, signal the detection of either incomplete or incorrectly spaced characters, will prevent a misprint, and will permit semi-automatic recovery of the mis-spaced character by the printer. The alarm equipment will require one flip-flop, four gates, one pulse delay unit and two thyratrons; it appears to provide sufficiently valuable monitoring, protective, and recovery service to justify the addition to the system. One spacing error has been discovered among the quarter million Flexowriter characters recorded by the computer to date.

Comparison of the Whirlwind magnetic tape print-out system with the Potter Instrument Company's "Flying Typewriter" (ELECTRONICS, May, 1952) is interesting. With regard to the speed with which information can be taken from a computer, the Potter machine with eighty six-digit flip-flop storage registers prints at a rate of five eighty-character lines per second, while Whirlwind can record Flexowriter characters on magnetic tape at a speed of two lines per second for direct print-out on equipment using but one six-digit thyratron storage register ahead of the typewriter. If Whirlwind used eighty storage registers in print-out, it could record at ten lines per second, five lines per second using eight registers, or three lines per second using

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4.0 TERMINAL EQUIPMENT (Continued)

4.2 Magnetic Tape (Continued)

(E. P. Farnsworth) (Continued)

two registers. The quality, readability, and reproducibility of printed output is in favor of the Flexowriter-magnetic tape equipment, as is simplicity and reliability, plus the value of the permanent storage feature of magnetic tape in case of failure of a mechanical or electrical component in the print-out equipment.

5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control

(J. J. Gano)

Old -150 volt, 10 ampere supply

Computed and measured dynamic impedance for the -150 volt, 10 ampere supply check very closely. The peak value is .5 ohms. With the addition of capacitance corresponding to the ratio of the load ratings of this supply and the new one which uses an active filter, this value may be reduced to about .15 ohms.

The frequency response of the ratio of output voltage to supply voltage has also been computed. Measuring means to provide a check are not available, but the results compare favorably with the measured response to a step of supply voltage.

(R. Jahn)

a) W. W.I. D. C. Supplies

1) A new regulator panel for the -30 volt supply has been installed.
2) Preliminary tests with the new commutation factor reduction chokes for the +250 volt supply show that they will make it possible to reduce the commutation factor well below the maximum rating recommended by Electrons, Inc., the tube manufacturer. This should result in a substantial increase in the tube life of the C16J's.

b) Arc Drop Voltmeter

A simple clipping circuit will be used in conjunction with an oscilloscope to measure arc drops on all WWI power supply thyratrons.

(G. A. Kerby)

Continued with construction of new rectifier/regulator; also with modification of present 500V, 5A unit.

Parts are being ordered for the control units for the new filament motor generator set.

Whittemore power-supply interlock has been constructed and will be installed.

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6.0 BLOCK DIAGRAMS

(J. A. Hughes)

The block sketch of the Arithmetic Element in detail with explanatory notes is available in the print room as SD-51501 "Guided Tour #1, Scale Factor", SD51502 "Guided Tour #2, Multiplication", and SD-51503, "Guided Tour #3, Division".

The Stereo Display sub-program was tried out and worked, but somewhat unsatisfactorily. It is to be written up in M-1483.

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8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

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

4. Floating Point and Extra Precision Interpretive Subroutines (Programmed Arithmetic, PA): Frankovich, 22 hours; Helwig, 8 hours.

Further study of the three register programmed arithmetic floating point interpretive subroutine indicated that a 39,6,0 system could be used without excessive difficulty in obtaining agreement in sign among the registers containing the "mantissa" part of a number. A subroutine which performs all the instructions performed by the comparable 24,6,0 routine, except dv, has been coded and is being tested on the computer. The revised, faster 24,6,0 routine has also been coded and is being tested. Subroutines are available to enable a programmer who uses it to have the arithmetic instructions performed in the 30,15,0 system. (24,6,0) subroutines have been written for the evaluation of the exponential, hyperbolic sine and hyperbolic cosine functions. These are being typed and tested.

8. Magnetic Flux Density Study: Helwig, 8.5 hours; WWI, 66 minutes.

A (24,6,0) Runge-Kutta solution for the non-linear magnetic tape problem was obtained for $\Delta t = 0.1\mu sec$. However, a coding error was made in the computation of the flux. The time required for the numerical solution to reach saturation agrees roughly with experimental results. A (24,6,0) solution for $\Delta t = 0.01\mu sec$ was attempted but did not work. The reason for failure has not yet been ascertained.

11. Point-by-Point Scope Plotting of Alpha-Numerical Characters (Output Camera, O.C.): Kopley, 27.5 hours; WWI, 17 minutes.

See Section 8.2 for the specific subroutines written. A slight modification made in the output camera subroutines makes them available for either the D or F-scope. One order was changed in the octal instruction subroutine to make it more flexible. Several innovations have been introduced into O.C. 2.6, the (24,6,0) MRA display, which will eventually be introduced into the other display routines to make them a more flexible and potent output medium. The numbers and orders appearing on the photos are now quite distinct and legible but a little small. It is expected that the characters will be made larger. People are urged to use camera output more frequently to save computer time. Further investigation will be made into magnetic tape as a means of temporary storage and as an output device.

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8.1 Programs and Computer Operation (continued)

21. Optical Constants of Thin Metal Films: Neeb, 11 hours; WWI, 58 minutes.

Tests of the arithmetic sections of the main program have been tested satisfactorily. The complete program has been written and is waiting to be run on the computer. When this program has been tested, it will be incorporated into the program for the infrared radiation on gold blocks.

23. Print-Out of Contents of Storage (Post Mortem Error Diagnosis, PM): Gilmore, 18.5 hours; WWI, 70 minutes.

A two-way 24,6,0 post mortem print out program has been written and tested successfully. The numbers may be printed in regular 24,6,0 decimal form or in the form of an octal mantissa and decimal exponent of 2, along with decimal or octal storage locations.

24. Matrices, Determinants, and Systems of Linear Equations: Aronson, 21 hours; Carr, 15 hours; WWI, 173 minutes.

Tape 950, Jordan Elimination for solving Ax=b (24,6,0) has been successfully run with two 4 x 4 matrices; one well conditioned and one very poorly conditioned (the so-called Wilson pathalogical matrix, condition number approximately 3,000). In both cases the results were very good; in the first case the largest residual was about 2×10^{-8} and in the second case an exact integer solution was achieved. The elimination procedure has been rewritten in subroutine form (T 1195) and is under test. The Jordan routine will handle up to 16 x 16 matrices. Tape 953, Gauss Relaxation (24,6,0) has been revised and is under test. The routine for the conjugate-gradient method is not yet complete.

28. Ambipolar Diffusion: Gilmore, 1 hour; WWI, 187 minutes.

(The diffusion of electrons and ions in a plasma in the presence of space charge leads to two second order, second degree differential equations. Compatible values of electron and ion cocentrations are desired.) A new modification has been introduced into the present program which should eliminate the trouble that has developed from the bisection method. The program was operated and produced enough data for the author, Mr. Robert Minner of Harvard University, to determine whether the program is functioning properly.

30. Digitally-Controlled Milling Machine Program: Frankovich, 4.5 hours; WWI, 62 minutes.

Several errors in Mr. Runyon's new tape preparation program have been discovered and corrected. Instruction tapes for the milling machine were prepared using the old program for demonstration purposes during Open House. More tapes are being prepared by means of the circle program to cut a cam according to specifications provided by an interested machine tool company.

36. Approximating Functions: WWI, 5 minutes.

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8.1 Programs and Computer Operation (continued)

40. Input Conversion Using Magnetic Tape Storage: Frankovich, 1 hour; Gilmore, 1 hour; Helwig, 4 hours; WWI, 20 minutes.

During the past bi-weekly period, the conversion program committee attended the ACM conference in Pittsburgh, Penn. We learned how some of the other computer people treat the problem of subroutines, their orientation, and their libraries. We were impressed by the input method used on the IBM Electronic Data Processing Machine by N. Rochester. He has developed two input routines which are essentially similar to our 5-5-6 binary input and Flexowriter conversion programs. Their input medium is IBM cards rather than perforated tape. Rochester also described a method of input which he believes will be a great aid to programmers. We were surprised to see that it was the same floating address method which is to be incorporated into our next conversion program.

41. Binary Matrix Product Statistics: Rotenberg, 2 hours.

43. Generation of Random Numbers: Rotenberg, 7 hours; WWI, 10 minutes.

Methods of generating random numbers are being investigated for use in Monte Carlo problems to be programmed in the near future. In the past, random numbers copied from Rand tables onto 5-5-6 tape have been used (See problem 41.), but read-in time necessary is excessive, and the large rolls of tape are cumbersome to handle. A subroutine which generates 15-digit random numbers has been completed and is now being tested.

45. Crystal Structure: Aronson, 11 hours.

One set of Crystal Structure data was submitted by the Insulation Research Group and is ready to be run on the machine. The indoctrination course in coding was launched during this period. There are 11 people enrolled. The course will meet from 2-4 on Thursdays (starting May 15th) in Rm. 2-355 M.I.T. for the next 6-8 weeks.

46. Torpedo Depth Response: Neeb, 4 hours; WWI, 44 minutes.

Mr. Kramer of the Servomechanisms Laboratory is continuing work on this problem. The results from this program still do not agree with those obtained by other methods. However, by means of a desk calculator he has shown that the method being used in this program should give satisfactory answers.

47. Partial Differential Equations of Engine - Part I: Carr, 16 hours; WWI, 324 minutes.

48. Gust Loads on Rigid Airplanes in Two Degrees of Freedom: Helwig, 17 hours; WWI, 261 minutes.

The programs for the computation of the response of an aircraft to a sharp edged gust and a graded gust were rewritten to use (24,6,0) computation and magnetic tape as auxiliary storage. Using these programs 39 correct lines of the solution were obtained. Several subsequent attempts to reproduce these results and to complete the solution have not been successful. A program has also been submitted by Brenner which repeats the previous calculations but prints out only the maximum value of the independent variables. This program will use punched paper tape as auxiliary storage.

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8.1 Programs and Computer Operation (continued)

50. Lattice Analogy Applied to Shear Walls: WWI, 58 minutes.

51. Magnetic Tape Programming: Kopley, 3.5 hours.

52. Oil Reservoir Depletion Analysis by Iteration: Kopley, 13.25 hours.

53. Solution of Schrodinger's Wave Equation which Contains a Singularity at the Origin: Gilmore, 1 hour.

54. Optimizing the Use of Water Storage In a Combined Hydro-Thermal Electric System: Demurjian, 2.5 hours; WWI, 300 minutes.

Complete results were obtained for the eight week test period. The magnetic tape remained in synchronization throughout this period. The results were very good for this method. The program is being revised with different sequencing of the ordinates to reduce errors in approximations to the derivatives. Improved methods are being introduced to take into account system's constraints.

55. Solution of 2nd Order Non-Linear Ordinary Differential Equation: Mackey, 21 hours; WWI, 118 minutes.

56. Determining Pupil Dates and Two Dramatic Aberrations in Optical Lens Systems: WWI, 31 minutes.

57. Runge-Kutta Differential Equations: Aronson, 10.5 hours

The tapes for Zierler's random number generator (T1203) and tests for randomness (T1202) have been prepared and are ready to be run on the machine. Mr. Zierler is also writing a routine to carry out the computation of the statistic on a binomial distribution hypothesis.

58. Determination of Energy Levels of Oxygen Molecule: Carr, 24 hours; WWI, 189 minutes.

60. Calculation of Deuteron Energy Levels: Combelic, 35 hours; WWI, 938 minutes.

The program has worked satisfactorily during the latter part of this bi-weekly period. Preliminary results indicate that no Eigen-values exist for certain values of the parameters. However, the computation time necessary to determine this with reasonable certainty is at present inordinately long. This time has been reduced considerably already and efforts are continuing in this direction. So far only a negligible loss in precision has resulted from these modifications.

62. Reflection of Scalar Waves from a Cylinder: WWI, 19 minutes.

63. M.I.T. Seismic Project: WWI, 73 minutes.

64. Solution of Fifth Order Ordinary Differential Equation: Frankovich, 3 hours; WWI, 524 minutes.

Solutions have been obtained by the methods of successive approximation using two different integration schemes, and by the Runge-Kutta method, using

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8.1 Programs and Computer Operation (continued)

64. Solution of Fifth Order Ordinary Differential Equation (continued)

two different independent variable increments. Preliminary analysis of these results indicate that the R-K method is more stable than the others. The R-K solution using the finer mesh agreed with the exact solution with six decimal digit accuracy after four thousand steps in the extrapolation process, whereas the solution obtained by using a mesh ten times coarser agreed, after 400 steps, with three digit accuracy.

67. A Method for Obtaining the Characteristic Values of Symmetric Matrices: WWI, 38 minutes.

70. Correlation of Solvolysis Rates: Demurjian, 11.5 hours.

The rates of solvolysis of twenty organic compounds in eighteen solvents are correlated by an equation of the form $Z = vX + wY$, where Z is the rate constant, v and w are parameters characteristic of the compound, and X and Y are parameters characteristic of the solvent. A set of v,w,X and Y have been obtained by trial and error by the originator, Robert Mosely, of the Chemistry Department. By use of an iterative procedure, it is desired to obtain a more satisfactory set of these parameters. The program, now completed and being converted, will be tested shortly.

TOTAL COMPUTER TIME USED FOR PROGRAMS: 65 hours, 44 minutes

TOTAL COMPUTER TIME USED FOR CONVERSION: 5 hours, 14 minutes

TOTAL COMPUTER TIME USED FOR DEMONSTRATIONS: 1 hour, 24 minutes

TOTAL COMPUTER TIME USED: 72 hours, 22 minutes

TOTAL COMPUTER TIME AVAILABLE: 80 hours, 24 minutes

USABLE TIME PERCENTAGE: 90%

TOTAL NUMBER OF PROGRAMS OPERATED: 121

8.2 Subroutine Library

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

Completed

LSR #	Tape #	Title	Programmer
MT 1.1	T-988-8	Record Block of N + 1 words on Magnetic Tape. In Forward Mode.	Bagley
MT 2.1	T-989-1	Transfer Block of N + 1 words from Magnetic Tape (in Reverse Mode) to Storage, storing $N \times 2^{-15}$ in First Reg. of Transferred Block	Bagley

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8.2 Subroutine Library (continued)

LSR #	Tape #	Title	Programmer
MT 2.2	T-1161-2	Transfer Block of N + 1 words from Magnetic Tape (in Reverse Mode) to Storage, storing final address of Block in First Reg. of Transferred Block	Bagley
OC 2.2	T-788-5	Display C(ES) as octal fraction, sign octal point, D or F scope, Layout	Kopley
OC 2.4	T-863-5	Display C(ES) as decimal fraction, no round-off decimal point sign, D or F scope, Layout	Kopley
	Being Tested		
EX 200.1	T-1216	Form e^x where x is (24,6,0) Numbers in the M.R.A.	Helwig
HF 207.1	T-1217	Form sinh x or cosh x where x is a (24,6,0) Numbers in the M.R.A.	Helwig
PA	T-1192	(24,6,0) Interpretive subroutine with minimum time per interpreted instruction	Frankovich
PA	T-1180	(39,6,0) Interpretive routine	Frankovich
	T-850-4	Display Contents of C(ES) as octal instructions. D or F scope, Layout and initial zero suppression	Kopley
	T-939-0	(24,6,0) Decimal Display of M.R.A. Layout Sign, Decimal Point, slant, D or F scope	Kopley
	Being Written		
		M.R.A. Log or Log Log Deflection Display for (15,15,0) and (24,6,0)	Frankovich
		Single Step Extrapolation of n simultaneous 1st order differential Equations by Runge-Kutta for (24,6,0) Numbers	Frankovich

8.3 Procedures

(J. W. Carr III)

At the meeting of the Association for Computing Machinery in Pittsburgh May 1-3, I took part in the programming sessions, of which Dr. A. S. Householder was chairman. The entire session was devoted to subroutines and their use. The paper which I presented, entitled "Progress of the Whirlwind Computer towards in Automatic Programming Procedure", discussed present and proposed uses of subroutines and other pre-tested automatic programs on the Whirlwind computer at the Digital Computer Laboratory. The paper stressed the advantages of subroutines, future programming organization

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(J. W. Carr III) (continued)

here, conversion and translation programs, automatic assembly, interpretive subroutines, error diagrams, "programmed" vs "electronic" instructions, and matrix calculations on Whirlwind. Its general theme was that "ideally, the machine should perform all the menial jobs now performed by the programmer". This paper is to be published in the Proceedings of the Conference.

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9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications

(Anola Ryan)

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

LABORATORY REPORTS

No.	Title	No. of Pages	Date	Author
E-461	A High-Speed Two Transistor Flip-Flop	4	4-24-52	J. F. Jacobs R. J. Callahan
M-1467	Bi-Weekly Report, April 25, 1952	32	4-25-52	
M-1471	Progress Report No. 3, M.S. Thesis, Dynamic Analysis of Regulated D.C. Power Supplies for Large Loads	2	4-1-52 to 4-30-52	J. J. Gano
M-1472	April Storage and Research Tube Summary	5	5-1-52	R. E. Hegler
M-1474	Additional Rack Space for Magnetic Tape Equipment	2	5-1-52	K. E. McVicar
M-1479	M.S. Thesis Proposal: Precise Determination of Phase at 10 Megacycles, and Presentation of a Curve of Phase Response vs. Frequency	10	5-7-52	B. R. Remus

LIBRARY FILES

No.	Identifying Information	Source
1795	A Study of Binaural Perception of the Direction of a Sound Source	General Electric Co.
1796	The Index Marking of Magnetic Tape, M.S. Thesis, 1951	T. L. Roess
1797	The Determination of Latent Roots and Invariant Manifolds of Matrices by means of Iterations (N. B. S. Report No. 1402)	K. A. Semendiaev
1798	The Double Description Method (N. B. S. Report No. 1403)	T. S. Motzkin
1799	A Remark on M. M. Day's Characterization of Inner-Product Spaces and a Conjecture of L. M. Blumenthal (N. B. S. Report No. 1515)	S. Schoenberg
1800	Smoothing of Noisy Data by Trigonometric Truncation	C. Lanczos
1801	Computing Laboratory	Ballistic Research Lab.
1802	The Remainder in Linear Methods of Approximation	W. E. Milne
1803	Random Determinants	R. Fortet
1804	Convergence of Cauchy-Riemann Sums to Cauchy-Riemann Integrals	O. Szasz & J. Todd
1805	Maximum Likelihood Estimates of Position Derived from Measurements Performed by Hyperbolic Instruments	E. Lukacs
1806	Proceedings of Federal Communications Commission re: Television Areas	F. C. C., Wash., D.C.
1807	A Statistical Method for Determining the Lowest Eigenvalue of Schrodinger's Equation	M. Kac
1808	Oscillating Circuit Incorporating a Choke with Rectangular Magnetization Curve	T. Buchhold E. Stuhlinger
963	Accelerated Life Program S. R. #21	Sylvania Elect. Prod., Inc.

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9.1 Publications (Continued)

No.	Identifying Information
B-191	Modern Magnetism: L. L. Bates, Cambridge University Press, 1951
B-192	Journal of Engineering Education: A.S.E.E., Feb., 1952
B-193	Theory of Games & Economic Behavior: John VonNeumann & Oskar Morgenstern, University Press, 1947
B-194	Die Lehre Von Den Kellenbruchen: Dr. Oskar Perron, Chelsea Pub. Co., 1950
B-195	Handbook of Human Engineering Data, 2/E: Tufts Institute of Applied Experimental Psychology, Special Devices Center, 1951
B-196	The Mathematics of Circuit Analysis: E. A. Guillemin, John Wiley & Sons, 1949

JOURNALS

Science News Letter: April 26, 1952
Journal of Mathematics and Physics: April, 1952
Electrical Engineering: May, 1952
Oil & Gas Journal: May 5, 1952
Oil & Gas Journal: April 28, 1952
Proceedings of the I. R. E.: April, 1952
Industrial Distribution: May, 1952

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9.1 Publications

(J.W. Craig)

About one-third of the final draft of the condensed form of John Salzer's thesis has been completed, and the remaining two-thirds is expected to come along rapidly.

9.2 Standards, Purchasing, and Stock

(H.B. Morley)

The Procurement Department has completed the move to the Whittemore Building and the Stockroom will follow by May 12. Tentative plans are being made to maintain a small stockroom and receiving facilities in the Barta Building.

Within the next week or two work will start on setting up a new purchasing catalogue library. This is a long-term project, which will be of increasing usefulness to project personnel in gathering data for material they may want.

New items which may have future use are being requested, and turned over to components testing section for evaluation. Suppliers have been most willing to cooperate in sending samples for test, at no cost to the project in almost every case.

Discrepancies have on occasions arisen between published MIL and JAN specifications and the item as produced by the manufacturer, due partly to continuous revision of specification data or the inability to meet these specifications under production methods. This office is cognizant of the difficulties in the situation and cooperates fully with Standards, to help in procurement of the correct material.

New personnel is being trained to help with the work of expediting. With this additional help, it will be possible to expedite orders as soon as they become overdue. A special file has been set up to assist in expediting all painting and engraving. Also, another painting concern is being investigated with a view toward improving both quality and delivery.

New Item of Interest: Cable Stripper, manufactured by TACA for cables 1/8" to 1-3/4" diameter.

(H.W. Hodgdon)

Twenty-seven copies of the partially completed new Standards Book have been distributed. Sections on capacitors, chokes, fuses, relays, resistors, and wire are complete to date, and partially complete sections on insulating materials and transformers are in-

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9.2 Standards, Purchasing, and Stock (continued)

(H.W. Hodgdon) (continued)

cluded in the new book, and the Standards Committee should be consulted for contemplated changes before making extensive use of unrevised sections.

Sections 6.142 and 6.143, Plug-In Relays, have been revised and reissued to cover the addition of a relay frame with heavy-duty contacts.

Rough drafts have been prepared and printed on turret-type terminals, receiving and special purpose tube sockets. Drafts on switches, transmitting tube sockets, and vacuum tubes are in process.

(C.W. Watt)

Paine and Watt attended the symposium on "Progress in Quality Electronic Components" on May 5-7 in Washington, D.C. A large number of papers on improved components and ways and means of obtaining increased reliability of electronic equipment were presented. A summary will be issued next week, and the Proceedings will be published officially in August and will be in the library.

9.3 Construction

(F.F. Manning)

Production Control

The following units have been completed since April 25, 1952:

6 Buffer Amplifiers (Breadboard) Woolfe
1 Magnetic Memory (Breadboard) Olsen
40 Wind and Mount Switch Cores (Breadboard) Olsen
2 ESD Output (Whirlwind) Dodd
2 Pulse Stretcher (Breadboard) Olsen
6 D-C Power Cables (Test Equipment) Woolfe
30 D-C Power Cables (Test Equipment) Jacobs
3 R-F Cables (RG22/u) (Lab Equipment) Platt
1 Marginal Checking Generator (Whirlwind) Gano
10 D-C Circuit Breaker Boxes (Lab Equipment) Gano
2 Buffer Amplifier Panels (Breadboard) Widrowitz
1 Two-Channel Gate Mixer Amplifier (Test Equipment) Platt
40 Video Cables (Test Equipment) Jacobs.
80 Video Cables (Whirlwind) Leary
2 D-C Outlet Box Modification Platt

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9.3 Construction (continued)

(F.F. Manning)

The following units are under construction.

10 D-C Circuit Breaker Boxes (Lab Equip.) Gano
1 Standardizer Amplifier (Whirlwind) Mercer
5 Storage Tube Mounts (Whirlwind) Dodd
6 Multivibrator Frequency Dividers (Test Equip) Taylor
1 Vacuum Tube Processing Power Supply (Storage Tube) Palermo
2 Filament Supplies for Vacuum Tube (Storage Tube) Caswell
2 Ion Gauge Control chassis (Storage Tube) Palermo
35 Lab Bench Cabling (Lab Equip) Hepp
1 D-C Outlet Box Modification (Lab Equip) Platt
42 Delay Line for Flip-Flop Plug-In (Watt)
2 Preliminary Panels (Lab Equip) Frost
2 Gate-Buffer Amplifier (Breadboard) Woolfe
6 Mixer Operation Matrix (Whirlwind) Platt
1 MTC Block Mark Detector and Shaping Circuit
1 Relay Panel for D-C Power Supplies (Breadboard) Kerby

9.4 Drafting

(A.M. Falcione)

1. New Drawings:

a. Rectifier 5 Amps -300 Volts

Complete drawings for this unit have been completed and graded; Circuit Schematic, C-51295; Aluminum Panel, D-51299; Assembly and Parts List, E-51298.

b. Driver for Magnetic-Core Tester

Complete drawings for this unit are complete except for checking. It is expected that they will be released within the next week.

c. Magnetic-Core Tester

Drawings for this unit are complete and are being held for further changes which are now being made in the prototype.

d. 420, In-Out Switch Paper Tape Unit Matrix

The drawings for this unit are complete and ready for grading; Circuit Schematic, D-51255; Aluminum Panel, D-51439; Assembly and Parts List, D-51254.

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9.4 Drafting (continued)

(A.M. Falcione)

e. Tape Output Relay Register

Drawings for this unit are complete and ready for grading; Circuit Schematic, D-50984; Aluminum Panel, E-51400; Assembly and Parts List, E-51401.

f. Magnetic Tape Drive Control

Complete drawings for this unit are ready for grading; Circuit Schematic, D-50425; Aluminum Panel, C-51385; Assembly and Parts List, D-51380.

2. Thesis Drawings

Approximately 279 drawings have been sent out this week for offset reproduction and printing in connection with eleven theses which are due on the 16th of May. Some of the drawings have already been returned, but most of them are expected on or about the 14th. It has been necessary to use all of our women draftsmen to keep up with the thesis work load, and it is expected that we shall meet the deadline of May 16th.

3. WWI Change Notices

Because of the great number of drawings to be made for thesis candidates, WWI change notices have been lagging far behind. It is expected that we will get caught up with the WWI change notices by the end of the month.

10.0 GENERAL

(J.C. Proctor)

New Staff

Harold W. Boyd, who will receive his BS in Electrical Engineering in June from Northeastern University, has recently joined Taylor's group. While attending Northeastern, he received his co-op training at Allis Chalmers and Electro-Switch Co. Before entering Northeastern, he served in the US Army Signal Corps for two years.

Robert Von Buelow received his BS in Electrical Engineering in 1941 from Purdue University and took a course in electronics at the Illinois Institute of Technology in 1946. Since that time, he has been employed as a project engineer with the Teletype Corporation and the DeVry Corporation. Prior to joining Taylor's group, he was employed as section supervisor with the Sandia Corporation in New Mexico.

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10.0 GENERAL (continued)

(J.C. Proctor) (continued)

New Non-Staff

Concettina Sitton is a secreatry assigned to Taylor's group.

Frances Christopher is a secretary assigned to work with A. Falcione in the Print Room.

Mrs. Nora McNeil recently assumed her duties as matron in the Whittemore Building.

Sheila Heffernan is a laboratory assistant working with Youtz.

James P. Leavitt, an electrical technician, has been assigned to work with Hepp and Gano.

Gilbert A.Jaynes is a mechanical detailer working with Falcione in the Drafting Room.

Six new laboratory assistants have been assigned to work with Paul Grant in the Construction Shop. They are Joseph Salvato, Charles Dunn, John Q. Johnson, Julian Kolinski, Lawrence Chiodi and James W. Delmege.