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Memorandum M-186

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Project Whirlwind  
Servomechanisms Laboratory  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

**SUBJECT:** BI-WEEKLY REPORT, PART II, DECEMBER 15, 1947

**To:** 6345 Engineers

**From:** Jay W. Forrester

**Date:** December 15, 1947

**6.0 MATHEMATICS**

(Charles W. Adams) Effort has been directed toward understanding planning and coding procedures so that consideration may be given to the question of maintaining a suitable scale factor throughout the solution of a given problem.

The importance of preventing loss of significant figures through overflow or round-off can hardly be overestimated, and some procedures should probably be established for typical problems.

The machine can, through proper programming, be required to adjust scale factor either continuously or at preselected critical times. Critical readjustment is indicated, but just how mathematical methods and physical intuition can best be used in the preselection process is not immediately apparent and will be investigated further, as will methods of ordering the readjustments.

(Prof. Philip Franklin) The principal subjects at present considered by the mathematics group are coding, the solution of linear algebraic equations, and methods of numerical integration.

A comparison of the Blaess procedure with that of Runge-Kutta has shown the latter decidedly superior for the step-by-step integration of ordinary differential equations.

(M. Daniloff) Work carried on at present consists of: the writing and editing of

- 1) Report on numerical integration methods of ordinary differential equations suitable for WWI and WWII.
- 2) Four papers on the Abraham-Bloch multivibrator and the Eccles-Jordan flip-flop circuit.

The results arrived at, at date of writing are:

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- 1) Most accurate and easiest to code method is the Kutta Method.

The planned future work consists of:

- 1) Handling of decimal point
- 2) Coding of the Kutta Method
- 3) Study of the equations of motion of an aeroplane in order to obtain approximations for some of the functions entering into the 92 equations now under consideration and which would overtax the storage capacity of WWI and WWII in their present form. The simplified equations would also serve as check problems and help in determining the position of the decimal point.

Main difficulties met with:

Stenographers have great difficulties in typing equations because of improper typewriters in use.

Results of investigations are being reported in M-176, Methods of Numerical Integration of Ordinary Differential Equations Most Suitable for Use by WWI and WWII.

(Edgar Reich) The main investigation being carried on is a study of numerical methods for solving systems of linear algebraic equations, suitable for the Whirlwind computer.

So far, of the classical methods, the Crout method is the most promising, as it seems to involve the smallest storage plus time factor. The coding, however, is not very easy.

Iterative procedures, such as the Southwell method will also serve well for certain purposes such as indicating a near-zero system determinant, or minimizing round-off errors.

Another recent investigation is into the optimum distribution of intervals in a table so as to obtain minimum error in linear interpolation. It was found that the maximum possible error is inversely proportional to the square of the number of intervals in a given range. If desirable, the study of higher degree interpolation along the same lines will be made at a later time.

## 7.0 INPUT AND OUTPUT

### 7.1 Eastman Kodak Recorders

(Hugh R. Boyd) Trip to Eastman Kodak on December 4: they

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will have a working breadboard of the Film-reader Recorder unit operating in January, a packaged prototype by June, and a production prototype by late fall.

(David R. Brown) Hugh Boyd and I visited Eastman Kodak at Rochester, New York, on December 4. The visit is reported in M-179.

### 7.2 Analog to Binary Conversion

(C. R. Wieser, Wm. Linvill) Study has been made of systems to convert a voltage to a binary number. Desired characteristics of the converter are: high accuracy, minimum equipment, short conversion time, the possibility to convert several separate quantities serially with one converter, the provision for simple transfer of the binary number to the computer. Two systems have been proposed, the decoder tube of Bell Laboratories and a system using time as an intermediate analog quantity. The decoder tube was described in ELECTRONICS, December '47, pp. 126-131. Foreseeable difficulties in its use are a lack of accuracy - it converts only a seven-digit number-- and difficulty in transferring the serially coded binary signal, into the computer.

The system using time as an intermediate quantity has inherent advantages resulting from the fact that time delays can be controlled and switched easily and with good accuracy. The conversion is done in two steps; the voltage is converted to a time delay and a binary counter counts uniformly - spaced, high-frequency pulses during this time delay.

The conversion from voltage to time delay may be accomplished with a phantastron circuit or with a sweep generator and pick-off diode, both of which have been developed in Radar work. Professor Zimmerman of R.L.E. expects greater accuracy in the voltage-time conversion by use of the sweep generator and pick-off diode than with the phantastron since its delay does not depend so much on tube characteristics as the phantastron delay does. Present plans include use of a 5 megacycle pulse generator, decade counters, along with a Type VF radar ranging unit to investigate possible accuracies and speeds of overall conversion.

(E. W. Sard) Time was spent learning about the problems and possible schemes of binary number to shaft rotation and shaft rotation to binary number conversions. A master's thesis is to evolve from this.

### 7.3 Binary to Analog Conversion

(C. R. Wieser, Wm. Linvill) No direct binary to analog conversion device has been found with suitable accuracy. The binary to analog conversion will be carried out by use of a feedback system

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with the analog to binary converter in the feedback link thus transferring the burden of accuracy to the analog to binary converter. The development of the binary to analog converter naturally must await completion of the analog to binary converter.

(E. W. Sard) - Same as under 7.2

#### 7.4 Magnetic Recording

(Edwin S. Rich) Apparatus for recording pulse signals on a magnetic tape is being constructed. Assembly of the magnetic heads has been completed and the tape-driving system should be ready in a few days. Some work is also being done on a playback head for obtaining static readings from a tape.

The design of a head that will give static readings shows some promise. The principle used is to produce a change of inductance in the head by bringing a magnetized spot on the tape over the head and then to detect the change of inductance with a bridge circuit. In the first model of such a head, a 4 percent change of inductance was obtained when a magnetized spot on a piece of vicalloy tape was moved over the head. Changes in core design and core material should result in larger changes of inductance.

Testing of the magnetic heads to determine their pulse characteristics will be begun immediately. Following that, tests of the complete tape-recording system will be commenced. A second model of a static reading head will also be constructed.

No serious difficulties or delays have been encountered as yet.

A discussion of the nature of magnetic recording is given in R-124 and R-62, and the proposed program for investigation of pulse recording is given in M-106.

### 8.0 STORAGE TUBES

#### 8.1 Tube Construction and Testing

##### 8.11 Tube Construction and Processing

(S. H. Dodd) A system is being established for obtaining a complete set of assembly and detail drawings for each new storage tube before completion of construction of tube or earlier. As a preliminary measure, drawings are being made of the older tubes. The time consumed in making these drawings is very large at the present time but it is expected that many of the drawings will apply to a large number of tubes and the

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drafting room will be able to process drawings faster.

(J. H. McCusker) The following tubes were processed with R.L.E. facilities during the past two weeks:

Storage Tubes

S.T. 14B  
S.T. 20B  
S.T. 15B

Evaporation Tubes

E.T. 13  
E.T. 14  
E.T. 15  
E.T. 16(evaporation and oxidation of Be surface)

Research Tube

R.T. Model 1

E.T. Model 19 was processed with our facilities.

Future plans are to process all tubes designed and constructed by storage tube group, and to study characteristics of 15E tube as an ionization gauge.

Vacuum fired anodized aluminum targets S13, S14, S15, and S16, with R.L.E. facilities.

(Patrick Youtz) The following tubes were designed, constructed and processed during the past fortnight. The objectives in constructing these tubes are described in M-121 and M-164:

Storage Tubes

S.T. 14B(storage surface is willemite)  
S.T. 20B(storage surface is calcium tungstate)  
S.T. 15B(storage surface is 40 mesh mosaic of beryllium)

Evaporation Tubes

E.T. 13)  
E.T. 14) beryllium surfaces were evaporated  
E.T. 15) and oxidized in air  
E.T. 16)  
  
E.T. 19) caesium chloride and silver surface  
E.T. 21) evaporated and oxidized in oxygen

Research Tube

R.T. Model 1(designed to study secondary emission of nickel and test techniques of measuring secondary emission)

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Gas Data Storage Tube  
Model IVA  
Model V

The following tubes are under consideration, partially designed and constructed. They are scheduled to be processed the next fortnight. New tubes will be added to this list as analysis of our work indicates the need:

Gas Data Storage Tube  
Model VI - This will complete the tube complement necessary for RFM's present work.

Evaporation Tubes

E.T. 18 (evaporation of beryllium on nickel and oxidization)

This tube will be used to study dielectric properties of the beryllium oxide layer and study the S.E. properties.

E.T. 17 (evaporation of beryllium thru 40 mesh .0022 wire mask)

This will give a mosaic with more than 80 percent of conducting area.

E.T. 22, 23 (Tubes to produce caesium activated silver surfaces.)

E.T. 20, 24 (Put beryllium in pockets of embossed surface.)

Research Tubes

R.T. 2 (Purpose of this tube is to study suitability of Eimac 15E as an ionization gauge on a sealed off tube.)

R.T. 3 ) Study S.E. properties of caesium activated

R.T. 4 ) silver surfaces.

Storage Tubes (Storage surface comes from E.T. 20 or E.T. 24.)  
S.T. 17

Components for more tubes will be constructed but these are the only tubes scheduled to be processed. We will continue to use R.L.E. facilities to process the research and storage tubes. During this next period we will complete arrangements to process all tubes in Barta Building.

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### 8.12 Tube Testing

(S. H. Dodd) Complete operation tests on several of the storage tubes are being conducted by W. J. Nolan. The other set of test benches equipped for holding gun operation is being used as an interim demonstrator. This equipment will also be used to obtain preliminary data on new storage tubes as they are completed.

### 8.13 Storage Tube Demonstration

(S. H. Dodd) Until the storage tube demonstration equipment is complete, a set of test benches will be used as a demonstration. This test bench equipment has been modified to release as much test equipment for other benches as possible.

A clamp circuit for isolating switching transients from the video output system has been built. No effort has been made to obtain a fast acting circuit and the number of tubes and power consumption is high. This circuit is for use with the demonstrator which is now being assembled.

(Joel Simmons) All video circuits of the EST Demonstration Unit have been built and checked. Connections between the various units and further checks are now being made. Provisions are being made to use the bench power supply as a temporary source of power until the HV power supply can be constructed.

(C. H. R. Campling) Work is progressing on the development of a voltage regulator to regulate, at loads up to 2 amperes, the output of a d-c generator rated at 360 volts and 4.75 amperes. This power source is to be used with the Storage Tube Demonstrator now under construction. The design is based on that described by B. B. Drisko in Report R-71. However, Drisko's design has been modified considerably and will require further modification to meet the needs of this application. The regulator should be easy to adjust and should be capable of supplying a remote load without undesirable effects such as oscillation or impaired regulation.

The d-c amplifier for the regulator has been redesigned completely. The auxiliary power-supply associated with this amplifier has been redesigned also. It is being constructed at present.

Some success has been attained in suppressing parasitic oscillations in the system. This matter probably will require further attention. In addition, it is proposed to substitute 6As7's for the 6B4G's which are being used at present as the current-carrying tubes.

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## 8.2 Storage Tube Research

### 8.21 Surface Material Characteristics

(Patrick Youtz) Unreliable behavior of the phosphor storage surfaces in Models 14A, 18, 18A, has diverted our attention temporarily from phosphors. However, we have samples of fifteen different materials which could be investigated when time permits.

Conferences with Dr. Lee DeForest and Dr. E. D. Carter of A.T.L., Inc., Chicago, indicated feasibility of using caesium activated silver surfaces. Conferences were held with M.I.T. staff members who had worked with these surfaces. More conferences are scheduled for next week.

Our first two attempts to produce caesium activated silver were to evaporate three parts of powdered silver to one part of caesium chloride. One more attempt will be made with this material under a different evaporation procedure. The fourth attempt will be made with caesium chloride and silver oxide.

It would be easy enough to produce caesium activated silver surfaces with a high-secondary emission yield if it was not necessary to expose it to the air. We are investigating all techniques that are used to produce photocells and image-tube screens. These techniques might be adaptable to our problem.

(H. L. Heydt) In the search for a reliable secondary emission measurement technique, a research tube is being studied which contains an electron gun assembly and a target structure composed of a nickel collector and a nickel signal plate. Secondary emission curves for the nickel target have been obtained by the dynamic (pulse) and the conventional (D.C.) methods. Results obtained using the two methods compare favorably. By eliminating certain factors which exist when a target composed of dielectric material is used, the research tube has been of considerable value in arriving at an adequate dynamic measurement technique. This dynamic method will now be applied in the study of dielectric surfaces which are to undergo life tests.

(Margaret Florencourt) Secondary emission ratios under both pulsed and DC conditions have been measured for Be surfaces evaporated on  $Al_2O_3$ . Results of this work are summarized in Howard Heydt's Bi-weekly report and thesis reports. Future plans include initiation of life tests on tubes with new surface materials. Difficulties causing delays have been encountered due to charging of inside dielectric surfaces of the tubes. These difficulties have now been compensated, although not corrected, so that life tests may be initiated.

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### 8.22 Anodizing

(Margaret Florencourt) Smooth and griddle targets are being anodized as needed by other members of the storage group. One piece of work was anodized for the electronics group. Delays had been encountered by not having unanodized targets prepared (cut, drilled, machined, tapped, etc.) by the time they were needed for anodizing. It has been requested that a stock of samples be kept prepared for anodizing at any time. No results have been obtained from this request as yet.

### 8.26 Library Research

(Patrick Youts) Library research has been and will be confined during the next fortnight to studying techniques for producing caesium activated silver. A patent search will be conducted in the patent room of the Boston Public Library to study patented methods of producing these surfaces.

(Margaret Florencourt) No research is being done in the library now. Articles on secondary emission and anodizing which were translated during the summer are now being issued as M series memorandums. M-168, M-167, M-169, M-171, M-172, and M-174, have already been assigned. Others will be assigned later.

### 8.27 Gas Data Storage

(Patrick Youts) Conference with R.F. Markel on general progress of work was held. Set up Alphatron system with supplies of hydrogen, argon, and helium available to fill the tubes.

Constructed the last three tubes to complete the complement for R. F. Markel's project which will be finished January 17, 1948.

(R. F. Markel) A) The present work consists in the determination of the static characteristics of data storage gaps Model IV-A and Model V, using argon gas. The theoretical portion of the thesis draft is also being prepared.

B) The main purpose of the present work is to determine the effect of varying the lateral dimension (width) of the gap. Results indicate that an optimum value exists, because although glow current increases with increase in width, breakdown voltage decreases, and operation becomes much more stable.

C) The experimental work will be continued on a third gap, Model VI, and then entire procedure will be repeated using helium gas.

D) The chief difficulty has been in achieving a stable cathode surface. Despite careful outgassing and "conditioning" by passing glow current, performance characteristics have been

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observed to change considerably with time. Breakdown between leads inside the tube has also been a source of trouble. These difficulties give a brief indication of the problems which will be encountered if a gas data storage method is eventually constructed.

### 8.3 Unclassified

(W. J. Nolan) Considerable time has been spent in getting new test facilities and instruments in operation. A new test bench (See M-164, Section B-4) was assembled about December 1st. This equipment was operated for a short time and some data taken on Model 10 storage tube. The results obtained gave no support to the theory that the faulty operation of this tube was caused by breakdown or leakage through the dielectric surface.

The time required to obtain these waveforms with the TS-239 scope indicated that for the number of curves to be taken, it would probably be more efficient to modify a P-5 synchroscope for use with a long-persistence tube such as a 5RP2. This was done and found satisfactory so a video amplifier, available in the laboratory, was modified to work with this scope and a gain calibrating unit was built. Some sample data has been taken with this equipment and it appears to be reliable but is not entirely satisfactory from the standpoint of deflection amplitude and rise-time. While tests will continue with this equipment, a more suitable amplifier is being built to fit into the scope.

(Patrick Youts) Nonex presses - We have lost our suppliers of nonex presses. We worked out an interim design which Larry Ryan will produce for us. Meanwhile, we will have dies prepared and develop a technique of producing these presses. This may develop into a bottleneck.

Corning Visit to M.I.T. - Corning's representative visited us and we discussed our present and future needs of nonex. We are fairly well supplied with nonex blown bulbs and tubing.

## 9.0 SERVOS AND SIMULATION

### 9.1 Cockpit

#### 9.11 Structure

(E.S. Prohsaka) We are laying a tentative design of an adjustable control column and aileron wheel assembly.

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The total deflection of the column assembly has been calculated to be less than one inch (less than 10% of the column half-travel) under the maximum designed input force (750 lbs.).

Future plans include the design of an adjustable rudder and brake pedal assembly, a pilot's seat and control pedestal, the supporting structure, and the engine and rough air simulation.

### 9.12 Instruments

(Richard Shaw) Preliminary layouts have been made of the altimeter, air-speed indicator, rate-of-climb indicator, gyro-horizon and bank and turn indicator. Details are being made of an experimental version of the bank indicator.

It is planned to make experimental models of the bank indicator and altimeter since these require respectively the fastest response and the greatest accuracy of any of the instruments contemplated.

All preliminary designs are based on the assumption that the instrument servos will employ potentiometers to indicate position. In the case of the magnetic compass and direction gyro, which may rotate continuously in one direction, a different arrangement will be required. Work on these instruments is therefore being held temporarily in abeyance.

### 9.13 Control Force Loading

(Carleton G. Eaton) The function of the Control Force Loading Equipment is to provide the proper "feel" to the cockpit control. A breadboard Control Force Loading System (elevator forces only) was built earlier in the program (Report R-36) and found to leave much to be desired. A new servo system is being constructed.

The difficulties experienced with the old model were traced to the pressure regulating valves. The new system includes (1) a method of easing the requirements on the valves and (2) redesigning the valves for improved linearity of differential-pressure regulation.

The new differential-pressure regulator is being machined. Repair and modification of the existing control-force loading equipment is underway. Test apparatus for the new valve is being designed.

### 9.14 Elastance, Backlash, Coulomb Friction

(Mark Flomenhoft) For the past several weeks my attention has been given to coding a linkage problem, with special emphasis on the discontinuities created by the presence of Coulomb friction.

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More specifically, this "linkage problem" deals with the transfer of force from some control actuated by the pilot to the member of the aeroplane structure under analysis, such as a wing flap. Final conclusions to soon appear in M-184, are:

- 1) A cycle of computation ranges between 600 and 1200 microseconds
- 2) About 140 memory positions must be reserved for the problem

(E. S. Prohaska) We have made a preliminary layout of a method of introducing any desired value of elastance, backlash, and Coulomb friction into the controls system on a 1:1 scale.

Some consideration has been given to a model system that would feed strain gauge data to the control force loading servo.

All work of this phase (9.14) of the cockpit has been held up pending a report from the mathematics group on the feasibility of doing this job in the computer.

#### 9.2 Sampling Servo Stability Study

(C. R. Wieser and Wm. Linvill) Since any servo operating in conjunction with the computer must operate on intermittent data, the question of stability and general performance of sampling servos must be considered. No reportable results have been obtained as yet in this study.

### 10.0 TRAINING

#### 10.1 Seminar Series

(Robert R. Everett) Work is proceeding on an outline for the seminar series.

There are some problems arising in the use of the basement lecture room for these seminars. Space for the expected attendance which may reach 60, use of the visual aid projector, lecture recording, and possible use of a PA system are being considered.

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11.0 FACILITIES AND CENTRAL SERVICE

11.1 Publications

(J. N. Ulman, Jr.) The following material has been received in the Library, Room 217, and is available to 6345 personnel:

6345 Reports

Summary Report No. 2

E-77	Blackout in 6AS6 and SR-1030 Gate Tubes	R. L. Best
E-78	Standard Test Equipment Program	J. O. Ely
M-137	Computer Codes for Whirlwind I	R. R. Everett
M-175	Hydraulic Servomechanism for Cockpit Tilting	C. R. Wieser

Library and P.E. Files

Library File

519-H	Simplified Television for Industry from Tube Dept., RCA, Lancaster, Pa.	(R. E. Barrett (M. M. Goodman
519-I	Electron Tubes Application Note. Compensation of Frequency Drift from Tube Dept., RCA, Harrison, N. J.	
519-J	Electron Tubes Application Note. Receiver Microphonics caused by Heater-cathode Capacitance Variations from Tube Dept., RCA, Harrison, N. J.	
519-K	Miniature Tubes in War and Peace from Tube Dept., RCA, Harrison, N. J.	N. H. Green
40	Inter-departmental M.I.T. Experiments on Digital Computer Laboratory Work Note on Electronic Counters and Counting Circuits	F. M. Versuh Course 6.602

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P.E. Report File

Classification: 10

79523	Special Report on Minimum Detectable Radar Signal and its Dependence upon Parameters of Radar Systems from Naval Research Lab. Anacostia Station, Washington.	A.H. Taylor Supt. Radio Div.
79523-S	Minimum Detectable Radar Signal and its Dependence upon Parameters of Radar Systems from Proceeding of the I.R.E. and W. - E. Vol. 34, No. 11. Nov. 1946.	A.V. Haeff Sen. Member I.R.E.
66148	Audibility of Echoes Masked by Sea Reverberation and Noise U.S. Navy Electronics Laboratory, San Diego 52, California.	A.W. Small

(John C. Proctor) Nineteen sets of Summary Report No. 2 have been completed and distributed. Five more sets will be sent to the press for shearing on Monday, December 15th. Assembly and checking of the remaining sets should be completed next week.

11.2 Standards Committee

(S. Abbott) A) The present work involves coordination of engineering staff opinion and procurement factors toward revision of the present Standards Book.

An inspection function between receiving and stock has been established for quality control.

An inventory control of standard stock is being coordinated between stock and procurement.

Specification sheets covering special design items are being included in the Standards Book as an aid in procurement and reference.

B) In cooperation with procurement, manufacturers are being contacted in order to achieve the ultimate in desired specifications.

C) It will be necessary in the future to continually elaborate and refine specifications in cooperation with the engineers and procurement.

D) Delays are unavoidable in reaching decisions since there

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is a normal time elapse from manufacturers in response to requests for samples, information, and specifications.

(Hugh R. Boyd) The Standards Committee in charge of Sam Abbott is working on the revision of the Standards Book, additional index for mechanical parts, considering Whirlwind specifications.

### 11.3 Purchasing - Stock

(H. B. Morley) A) Present work is concerned chiefly with maintaining a stock of standard items, and procuring special items as required. Catalog files are maintained and assistance rendered to personnel in selection of items. Assembly and/or construction by outside vendors of separate units of laboratory and test equipment other than WWI construction are handled through this office. The work of this unit must of course be closely coordinated with the Standards Group.

B) Numerous manufacturers have been found to be very cooperative in making up special designs and/or special applications of standard items.

C) Future plans include general improvement of stock room practices, revision of records system, adoption of better security measures, and the formulation and adoption of standard operating procedures.

D) Most difficulties encountered at present are manufacturers' material shortages and procurement delays beyond the control of the laboratory. Internally, the present status of development necessitates a flexible stock, making it difficult to determine future requirements and establish complete standards. Typical of the first type of delay is the discontinuance of manufacture of a type of dial knob which has been adopted as a standard.

(Hugh R. Boyd) Stock room is taking inventory. Some tools and equipment appear to be missing. Am investigating. Stock room arrangement is taking shape. Some inspection of incoming parts is being done.

### 11.4 Electronic Construction

(Albert Taylor) A) I have been running conduit from the generator room to the multiplier room and other general mechanical repairs. Also, on the fire is the construction of an annealing oven for the storage tube group.

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C) Difficulties in determining relative priority of my jobs and delays caused by frequent interruptions to do odd jobs.

(T. F. Clough) - Tube construction and processing -  
The envelopes for the following tubes had aquadag bakeouts:

RT 1  
ST 14B  
ST 20B

The following tubes were assembled into envelopes (sealed in)

G.D.S.T. IV <sub>A</sub>	E.T. 14A
	E.T. 15
G.D.S.T. V	E.T. 13

The following tubes were bused:

S.T. Model 18A	RT-1
S.T. " 20A	
S.T. " 14B	

The following surfaces were coated with phosphors:

S.T. 14B  
S.T. 15B

Miscellaneous tube construction - Various incidental parts were prepared for tube construction. These included nonex envelopes for research tubes and evaporation tubes as well as Pyrex loading cores for storage tubes.

Facilities - A bench was set up for R. M. Markel's gas data storage investigation. This included a mechanical forepump, Alphatron gauge, gas dryer and injection arrangement together with the necessary glass manifolds and stopcocks.

During this period (to Dec. 12th) the vacuum system in the tube laboratory was thoroughly degassed and is now in operating order.

Numerous technical phases of procurement and expediting were pursued including a conference with S. H. McKibben of Corning to acquaint them with our problems.

(F. H. Caswell) The following is a list of tubes fabricated and assembled by me from November 28 to December 12.

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**Storage Tubes**

- S.T. Model 14B
- S.T. " 20B
- S.T. " 15B

**Research Tube**

- R.T. Model 1

**Evaporation Tubes**

- E.T. Model 15
- E.T. " 16
- E.T. " 19
- E.T. " 17

**Gas Data Storage Tubes**

- G.D.S.T. Model 5
- G.D.S.T. " 6
- G.D.S.T. " 4A

The storage tube assembling includes electron gun modification and coating envelopes with aquadag.

Photographs of each operation of assembly and complete assembled elements were taken wherever possible.

Belongs  
under  
STORAGE  
TUBES  
Section  
8.0

- ( 8.11(Herbert A. Ladd)
- ( Anodizing discs machined and finished for bath.
- (
- ( 8.3(Herbert A. Ladd)
- ( Storage tube mount for secondary emission tests.
- (
- ( 8.3(Herbert A. Ladd)
- ( Modification of several power transformers.
- (
- ( 8.3(Herbert A. Ladd)
- ( Scope Calibrator.
- (
- ( 8.11(Herbert A. Ladd)
- ( Fabrication of tube elements.

**11.4 Electronic Construction, Continued**

(A.R. Curtiss)

- 1) Modified Model 5 Synchroscope for use with 5BP2 Tube.
- 2) Modified video amp. of E.S.T. demonstrator.
- 3) Constructing 100  $\mu$ s pulse generator chassis and power supply section completed.
- 4) Brazed Nichrome bus - lead in - vacuum system.
- 5) Constructed voltage switching unit and various test cables.

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(Peter Darvirris)

- 1) Assembly and wiring of H.S.T. demonstrator and control and power panel.
- 2) Assembly of circulating system (water) and R.F. feeder leads, induction heater.
- 3) Start of power installation for M.G. set associated with voltage regulator.
- 4) Installed bench circuit breakers.
- 5) Installed foot switch for remote control of induction heater.

(Joseph Crowley)

- 1) Constructed 15 tube clamping circuits.
- 2) Constructed 2 portable bench power distribution outlet bases, plus cables.
- 3) Setting up electrolytic tank.

(Robert Murch) The following units are in the Electronics Laboratory for construction:

- 1) Single Pulse Synchronizer - 4 under construction with approximately 16 man hours to complete.
- 2) Binary Freq. Divider 2-1 4-1  
Prototype and layouts completed.  
4 more will be constructed as soon as technicians become available.
- 3) Frequency Divider 16-1 32-1  
Layout and construction started December 12.
- 4) Low Frequency 5-Stage Binary Counter with Trigger Phase Control  
Will be completed and ready for final test December 13.
- 5) Periodic Program Control for Multiplier  
Will be completed and ready for test December 16.
- 6) Pulse Amplitude Monitor  
Construction will start December 13.
- 7) Gate Tube Test Rack  
Machine work on panels will be completed today, December 12. Estimated time to complete is 1-2 weeks.

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- 8) D.C. Bench Outlet Boxes  
20 to be constructed.  
Boxes are in Machine Shop for machine work.
- 9) Rack Power Control Unit  
5 to be constructed.  
Prototype approximately 1/4 completed.

#### 11.5 Drafting

(Hugh R. Boyd) Drafting memorandum being worked on with Watt, Sylvania, and others. This should be out next week and looks very promising. The new memorandum, A-34, will include Parts List and Bill of Materials procedures.

(C. W. Watt) A) Much work and time has gone into the writing of a new Administrative Memorandum, A-34, covering Drafting Room procedures and Parts listing.

B) The memorandum has been nearly finished and general agreement has been reached on all phases. A number of compromises has been made and it is hoped the new system will be found simple enough to be workable.

C) Future work will include the education of both draftsmen and engineers in the use of the new system, and some trouble shooting on the snarls that will undoubtedly get into the new red tape. The system will work if everyone cooperates and it is necessary to make it work to keep information flowing smoothly, and to keep good relations with Sylvania.

(A. M. Falcione)

- 1) Work Load - The present work load on the Drafting Department is increasing daily. The present backlog of work is estimated at 4 weeks.
  - a. In order to obtain efficient handling of requests from engineers on the Drafting Department, it is suggested that the engineers advise the department head as far in advance as possible of any work forthcoming so that proper planning can be effected for all concerned.
  - b. It is expected that the trend of increase work load will require at least 2 other draftsmen.
  - c. A record of work load as received is now being kept. In order to maintain this record up-to-date, the Drafting Department head should be advised of all or any work load.

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2) Lunch Hours - It is noted that the lunch hour for the Drafting Department is different from that of the other departments. This does not lend itself to good efficient operation. The lunch hour for the Drafting Department should be changed to agree with that of other departments. The present lunch hour is a carry over from Building 33 due to an overload on the time clock. This condition does not exist at the Barta Building.

11.6 Unclassified

(Harold Mercer) Parts Lists for all units given me are ready in draft form and waiting for final decision as to form and procedures to be adopted by us for accomplishment of Electronic Parts Lists.

(John A. Proctor) The furniture inventory is progressing and it is hoped that it will be completed before Christmas, although the location of certain missing items may hold up the final list longer than expected.

The usual service and maintenance activities seem to be progressing satisfactorily.

(Wm. C. Bohm) The automatic fire alarm and sprinkler system in the Barta Building is now in satisfactory operating condition. Certain suggestions in regard to possible fire hazards, which were made at the time of inspection by the Eastern Inspection Bureau, Boston, have been reported in Memorandum M-178. Most, although not all, of the suggestions made have already been carried out.

Duplicate keys have now been made for most of the locks in use in the Barta Building. These are now in Mr. John Proctor's custody.

12.0 GENERAL

(Jay W. Forrester)

Block Diagram Reports should be turned in to Proctor for stamping the security classification. They, along with other classified material should be in locked files when not in use. Taking classified material outside the building should be avoided when possible.

Leave carbon in place between original and first copy when turning in Project notes.

Delete "Section 2.31 Timing Studies" and add "Section 4.1 Timing Studies" in the Decimal Classification.

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The next report may be turned in on December 24 or 26. Those who have arranged vacations should write reports before leaving.

I feel we are neglecting to write up R-series reports on research results as phases of the work are concluded. In general an R-series report might be expected to cover four to six weeks effort. Informal E-series reports are too often replacing the preparation of well written R-series documents. R-series reports are the only ones receiving automatic distribution outside the laboratory and must be prepared for the navy sponsors and other research laboratories.

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