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SUBJECT: DISCUSSION OF MAGNETIC DRUM SYSTEMS AT ENGINEERING RESEARCH ASSOCIATES, JUNE 10 & 11, 1952

To: J. W. Forrester

From: E. S. Rich

Date: June 23, 1952

Abstract: E. S. Rich and K. E. McVicar visited Engineering Research Associates, St. Paul, on June 10 and 11 to discuss questions that had arisen in connection with their construction of two magnetic drum systems for this project. Several details regarding circuit design, pulse timing, and mechanical construction were considered and satisfactory solutions to the problems presented were found. We obtained several circuit schematics for familiarization with their design techniques, and we obtained a proposal for the power distribution, monitoring, and control which will be provided in the equipment. The Auxiliary Drum system is somewhat behind schedule at the present time. This is a result of factors within their service organization rather than because of a lack of parts. The Buffer Drum system appears to be slightly ahead of schedule.

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1.0 INTRODUCTION

On June 10 and 11, K. E. McVicar and E. S. Rich visited Engineering Research Associates, St. Paul, to discuss the status of construction of our magnetic drum systems and to settle questions raised in a letter from W. W. Butler dated 28 May 1952. Those present for the discussions from ERA included W. W. Butler, R. Eulberg, L. W. Reid and N. Yarosh. Yarosh is carrying out the design of power-supply regulators and power control circuits. We also met W. R. Johnson who is specifically concerned with engineering details of the auxiliary drum. At present R. Eulberg is concentrating on the buffer drum system.

2.0 PRESENT STATUS

2.1 Cabinets

The parts for the cabinets for both systems are on hand and those for the auxiliary system have been largely assembled. These are finished in gray hammertone similar to that used on Whirlwind I panels. The manufacturer's specification for this finish is as follows:

paint: gray Hammerloid, Glidden #33-E-609
primer: zinc chromate, Glidden #44-Y-76

A narrow skirt around the base of the cabinets will be painted black. These cabinets are mounted on casters and have leveling screws provided for leveling the units once they are in place.

2.2 Drums

The drum which will be used in the auxiliary system has been completely assembled including the steel inserts for the heads. It also has a gray hammertone finish. This drum is now being run in prior to being passed by their inspection shop. Following the run-in period it will be disassembled to make a final check on bearing alignment and other tolerances.

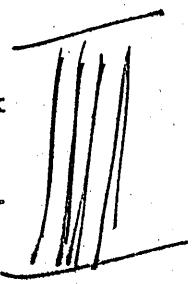
The drum to be used for the buffer system has not yet been assembled. During my visit in March it was reported that a second casting for this drum had to be fabricated. This new casting is completed and bearing holes have been counterbored. The holes for mounting the heads have yet to be bored and other less critical machining operations have yet to be done.

2.3 Chassis Construction

Sufficient chassis designs have been completed so that chassis assembly is now under way. This is being done in their shops on a production line basis. Testing of these chassis will also be done by shop personnel in cases where there are more than 6 chassis of a given type. Otherwise the testing will be handled by engineers working on the project.

2.4 Procurement

They stated that there is still no bottleneck in sight for lack of components for assembly. The specially packaged crystals which were ordered from General Electric Company are now being delivered and appear to be satisfactory. These crystals are junction type diodes with characteristics similar to those of GE's GT10 series.



Deliveries of 7AK7 tubes from Sylvania continue to be very slow. The reason given for this slow delivery is that Sylvania is having difficulty in their present production of these tubes so that the yield obtained is low.

2.5 Schedules

According to an estimate given us during my visit in March, the wiring of the auxiliary drum was to have started the last of May. As yet this work has not been started so that there is a possibility delivery of the auxiliary drum system will be delayed beyond the estimated October 1 date. Since work on the buffer drum appears to be progressing well there is also an indication that the delivery of the latter may be possible somewhat in advance of the January 15, 1953, date. Reasons for the delay of the auxiliary drum schedule seem to be factors within their internal service organization, so there is hope that the situation can be corrected to prevent further setbacks.

3.0 POWER SUPPLIES AND POWER CONTROL

3.1 Tentative Drawings

N. Yarosh has completed a tentative arrangement of the power distribution and control circuits for each of the systems. A copy of their proposed circuits is shown in attached drawing SD-51793. Some slight changes can be expected before they produce their final drawings but the information contained should enable us to plan integration of the drum power system with the Whirlwind system. The drawing shows the distribution for one drum. Identical circuits (except for the M-G set) will be provided for the other drum.

3.2 Regulators

The drum systems require 4 positive voltages and 2 negative voltages, each of which is regulated. The values of these voltages and approximate estimates of the amount of current required by each system for each of these voltages is given in the table below.

Voltage (volts)	Buffer (amps)		Auxiliary (amps)	
+200	3.25	650	1.5	300
+150	2.3	345	1.25	187
+90	2.5	225	.85	77
+5	-	3	-	3
-15	-	9	-	9
-60	2.14	128	1.2	72
		1360		648

Unregulated voltages of +250 and -125 are also available direct from the generators.

A regulator circuit has been designed which, with relatively simple changes, can be used for all of the different voltages. This regulator is of a series type utilizing 6AS7 tubes. The regulators are built on 3½ inch chassis and arranged so that additional capacity is obtained

merely by connecting additional 6AS7's in parallel. The regulator panel itself contains 3 such tubes so nominally it has a capacity of 0.6 amperes. The units to be connected in parallel, called slave units, have 4 of these tubes and therefore a nominal capacity of 0.8 amperes. The parallel connection is made simply by plugging into a Jones connector on the panel. Tests have been made of the performance of these regulators when a low frequency ripple is applied to the input. For a 10 volt ripple on the +200 volt regulator a maximum of 150 millivolts of ripple was measured on the output. It was learned that no tests similar to the ones being made by J. Gano on the Whirlwind I supplies have been made. Yarosh is interested in learning more about this type of test so that he can further analyze the regulator performance.

3.3 Metering

As shown on the drawing, metering of the drum power is accomplished by a single center-reading voltmeter and an ammeter which can be switched from one voltage to the next. This metering setup will be mounted near the regulator circuits so that any necessary adjustments to the regulators will be facilitated. Since we plan to include our marginal checking circuits in the drum power distribution it will be possible to route the output of these regulators through a similar metering station in Test Control if it seems necessary.

3.4 Features

The drawing indicates wires which will be made available for such remote control as we feel desirable. Included in this remote control can be starting and stopping of the power supply M-G set as well as starting of the drum motors.

They plan to supply a monitor circuit on the +200, +150, and -15 voltages. If any of these voltages varies by more than a fixed amount (approximately 5%), all voltages to the system will be automatically cut off. This monitor is primarily for the purpose of protecting the system. We were informed that this monitor circuit could be easily adapted to the remaining voltages so that an indication could be obtained at Test Control if any one of the voltages were missing. It appeared that these monitoring schemes would provide the indication which we would like as to whether all voltages are present. It did not seem convenient to use grasshopper type fuses or their equivalent to give blown-fuse indication in addition.

4.0 CIRCUITS AND COMPONENTS

4.1 Writing Circuits

In a letter from Butler of ERA to E. S. Rich dated May 28, 1952 it was pointed out that they have discovered a possible source of interference in the auxiliary-drum writing circuits. This interference is caused by a small amount of capacitive coupling between suppressor grids and plates

in 7AK7 tubes used as both writing amplifiers and writing gate tubes. The suppressor grids of these tubes are connected to the outputs of the flip-flops in the in-out register. Effectively, then, changing the contents of the in-out register causes a transient signal to be fed into the input of a reading amplifier. This transient is about equal in amplitude to a legitimate signal picked up by the head, so the interference can be avoided only if the changing of the contents of the in-out register is properly phased with respect to a drum reading operation. The problem was analyzed in some detail and it appeared that satisfactory phasing to avoid the above difficulty can be guaranteed. However, the timing with respect to computer operations will be studied further, and ERA will examine more completely the nature of the transient generated.

In all they have 3 types of writing circuits in use in the 2 drum systems. That used throughout the auxiliary drum has been designated as a gate writer, while that used for most of the heads in the buffer drum is called a flip-flop writer. A third circuit is needed for the status heads in the buffer drum and is similar to the gate writer except it contains an additional amplifier following the output of each gate tube. Drawings of the gate writer and the flip-flop writer were obtained. The numbers of these drawings are listed in section 5.0.

4.2 Cables and Connectors

Butler's letter of May 28 also raised the question as to what type of cable should be used between the drums and WWI and how these cables should be connected. They had suggested that we use shielded twisted pair with the shield grounded at one end only. Our preference for RG 62-U coax cable was stated and we discussed at some length the problem of cross-talk that can be introduced by having multiple ground circuits. It was decided that ERA would provide the necessary standard BNC connectors for coax cable but that these connectors will be mounted in a phenolic board so that they can be insulated from ground if desired. They also agreed that termination facilities for these coax lines would consist of two jacks in parallel rather than provision for using a T connector. Reid is now in the process of designing a mounting arrangement for these connectors. It appeared that there might be some difficulty in getting the terminations near the destination of the lines in some cases without an unattractive bunching of wires. However, it was felt that for the most part entirely satisfactory layouts can be devised.

The necessary coax connectors will be ordered immediately. Reid has been furnished the names of the sources which this laboratory uses and he will inform us as soon as possible if a delay in procurement of these items is expected.

4.3 Indicators

ERA plans to put neon indicator lights on every flip-flop in each of the systems. For flip-flops of the addressing and control circuits an indicator will be provided on each side of the flip-flops, but for the flip-flops found in the writing circuits of the buffer drum only one indicator light per flip-flop will be provided. In all cases the leads from the flip-flop to the indicator lights will be brought out in cables wired into a multi-pin plug. The indicator light circuit will be completed through a socket which receives this plug. Actually, two such sockets will be provided for each plug so that either local or remote indication may be obtained. Switching from the local lights to the remote ones, therefore, will be accomplished by changing the plug connections.

4.4 Other Circuits

Two other changes in their circuit design were pointed out. The first of these is in the signals that will be provided by the outputs of the 8-position matrix on the angular position counter in the buffer drum. The signals from these outputs will have excursions from -22 volts to +15 volts. This change is one which was required on another project and which was adopted as a standard. In our case the change should be of no concern since the positive value can easily be limited to slightly more than ground potential.

Their flip-flop design has recently been changed so that standard flip-flop output voltages are now -20 volts to +10 volts instead of their former swing of -15 volts to +5 volts. The point was brought up that their gate writers had been planned for use with such a flip-flop. Since the inputs which we can conveniently supply to these gate writers will be voltages which swing only slightly positive, they are going to change the gate writer design so that it will work satisfactorily with a signal input of +1 volt.

A decision has been made to mount the diodes for the group selection switches outside the plug-in chassis on strips located near the bottom of the panels containing the reading amplifiers. Cables from the heads on the drum terminate at these diodes so such an arrangement greatly reduces the number of signal leads which must be distributed over the rear of the panels. In the case of the auxiliary system this reduction is by a factor of 12.

5.0 DRAWINGS

Several drawings were obtained of typical circuits found in both of the drum systems. These drawings represent the circuits contained in a single type of plug-in chassis. It should be recognized that the drawings in themselves are incomplete since they do not indicate destinations of interconnecting leads. However, they do enable us to become conversant with some of ERA's circuit standards and techniques. The drawings obtained are the following:

Drawing No.	Title	No. of Copies
XD61234	Equipment Layout	2
XD61158	Shorthand Symbols	2
XG46024	Block Diagram Auxiliary System	1
XD661800	Schematic Diagram - Gate Writing Amplifier	2
XR61241A	Writing Group Selector Driver and Relays	2
XD61235A	Reading Group Selector Driver and Relays	2
XD61233A	Schematic - Group Address Register	2
XD61228A	Schematic - Angular Position Locator	2
XD61224A	Group Selector Switch	2
XD61185	Reading Gates	2
XA61170	Flip-Flop Writing Amplifier (Engineer's sketch)	2

The last listed drawing has two variations as used in the buffer drum. One variation is for circuits where word information is supplied as pulses while the other variation is for word information supplied as gating signals. These variations are indicated on the drawings.

The drawing showing the block diagram of the auxiliary drum system contains two changes from the drawing which we had developed from previous and rather sketchy information. One of these is a change in the alarm circuit associated with the angular position counter. As it now stands this alarm circuit is arranged to cut off the supply of timing pulses whenever an error is detected. The second change concerns the relay circuits for writing group selection. These relays are now operated by vacuum tube circuits rather than thyratrons. This change was made to eliminate the need for a releasing circuit to extinguish the thyratrons when a new group is selected.

SIGNED E S Rich
E. S. Rich

ESR/cp
Drawing Attached: SD-51793

cc: C. R. Wieser, H. Fahnestock, R. R. Everett, C. W. Watt, R. E. Hunt, J. A. O'Brien, S. H. Dodd, B. E. Morriss, J. H. Newitt, H. B. Morley, K. E. McVicar, W. W. Butler, ERA, (2 copies)