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Memorandum M-609

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: PROPOSED FIVE-DIGIT MULTIPLIER MARGINAL-CHECKING INSTALLATION

To: J. W. Forrester, H. R. Boyd, H. Fahnestock, R. R. Everett,
N. H. Taylor, J. J. O'Brien, C. W. Watt, H. Ziegler

From: E. S. Rich

Date: September 9, 1948

To check for marginal operation of tubes in the five-digit multiplier it is proposed that the following voltages be made variable.

1. Gate tube screen voltage.
2. Buffer amplifier screen voltage.
3. Cathode follower and trigger tube plate and screen voltages.
4. Flip-flop voltages.

A study of flip-flop marginal checking is being made by J. J. O'Brien, and as yet a satisfactory method has not been found. Making provision to vary two voltages on the flip-flop should be sufficient however. The above voltages will be varied independently for the following groups of tubes:

1. Digits # 1 & # 3.
2. Digits # 2 & # 4.
3. Digits # 5.
4. Control panel.

For such a system of checking it is necessary to be able to switch to any one of 20 lines. Although this number of lines might be reduced by further grouping of the tubes, it is felt that this should not be done until after some tests have been made with the actual system.

The 7AK7 gate tubes have their screen voltages (approx. +90v) supplied through dropping resistors from the +150 volt source. In such cases, it is proposed that the +150 volt source be varied. Otherwise it would be necessary to provide an additional d-c voltage supply. The actual screen voltage variation in these cases, of course, will not be that indicated by the voltmeter. The variation required to produce a failure in these gate tubes probably will be greater than can be tolerated by the 6AS6 tubes without failure. However, since 7AK7's are used only in the Whiffletree circuits in the shift-and-carry operation, a failure could be located in step-by-step operation. If this seems undesirable, an additional line from digits 1 & 3 and one from digits 2 & 4 could be

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used to vary the screen voltage on these tubes separately.

If screen voltages which are obtained through dropping resistors are handled as outlined above, it will be necessary to vary only the +150 and +250 volt sources. An amplidyne is available which is suitable for doing this. Its voltage can be varied manually by controlling the currents in its two field windings by means of a potentiometer as shown in drawing SB-40098.

The proposed marginal checking does not include varying any of the bias voltages. To vary the bias voltages, it would probably be necessary to provide an additional source of voltage such as storage batteries and to provide separate voltage controls since variations to within a fraction of a volt are desired and simple generator field control would not be that sensitive. It is felt that screen or plate voltage variation is sufficient to indicate deterioration within a tube. The additional information gained by varying the bias, then, would be information on the signal and the noise levels on the lines. It is possible to vary bias voltages throughout the entire machine by a control on the present voltage distribution panel.

Since a sufficient number of relay switching panels designed for WWI installation will not be available until about November 1, the manual switching arrangement sketched in drawing SB-40098 is proposed. Eight-position, 8-gang selector switches rated at 5 amps, 125 volts, d-c, are on hand in the stockroom and can be used. The generator thus may be placed in series with any line by setting two selector switches and opening the corresponding toggle switch in that line. A maximum of 32 lines may be switched in this manner. The possibility exists of short circuiting the generator when its voltage is other than zero but the generator can be protected with a fuse. This fuse should be of an indicator type. Providing automatic interlocks to prevent such a short circuit would considerably complicate the system.

The cabling required and a proposed control-panel layout are shown in drawing SB-40099. Leads to supply the variable voltage to the different tube circuits are brought out to terminal strips at the top of each digit panel in the multiplier. A cable of twenty-five lines goes from the multiplier to the marginal-checking control panel. A spare line is provided for each digit panel and two spare lines for the arithmetic control panel. Two spare lines are included for the latter since it is not known what check will be best for the step counter.

The wiring changes required are the following:

1. Gate tubes (6AS6).

Provide separate lead to screens from +150 v, and add decoupling condensers.

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2. Gate tubes (7AK7).

Provide separate lead to screen dropping resistors from +150 v.

3. Buffer amplifiers.

Provide separate lead to screen from +250 v, and add decoupling condensers.

4. Cathode followers and trigger tubes.

Provide separate lead to plates and screens from +150 v.

5. Flip-flops.

To be decided.

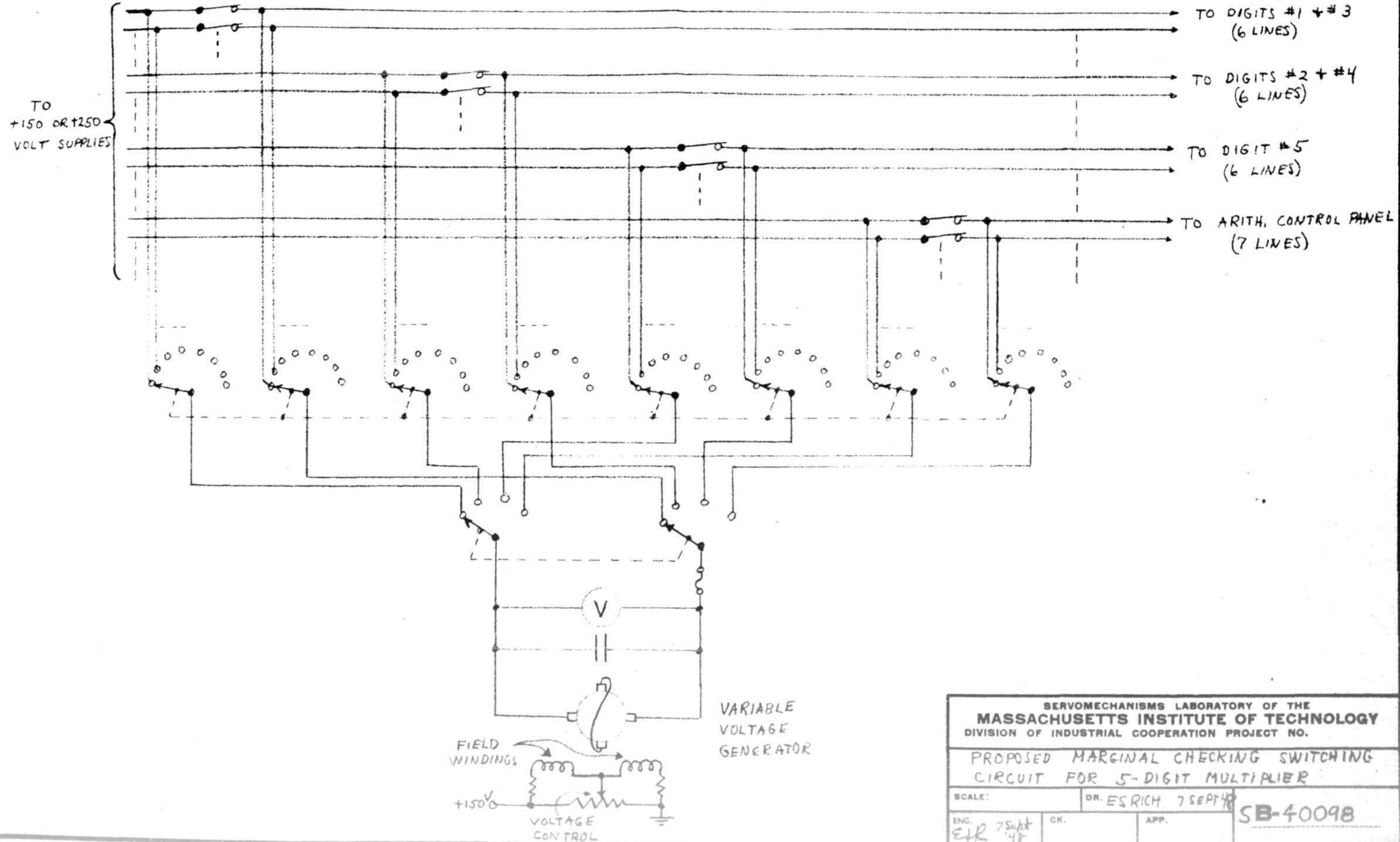
Since the present wiring does not follow a definite pattern, it is difficult to estimate the length of time required to make the wiring changes. However, Ziegler thinks that two men could do the work in about two weeks. The control panel could be constructed concurrently. Installation of cabling and wiring to the control panel, amplidyne, etc. would require two or three days.

Signed: _____

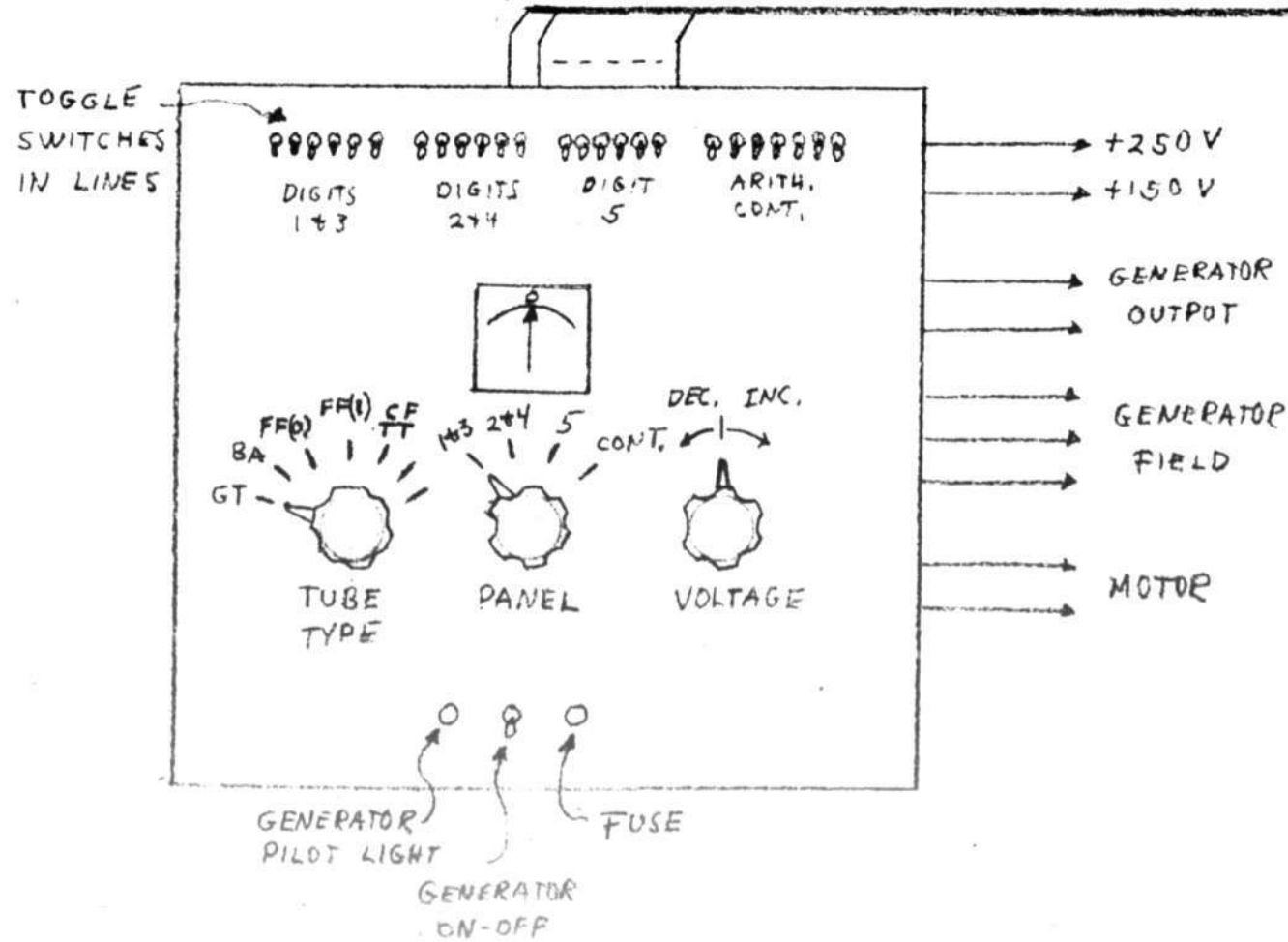
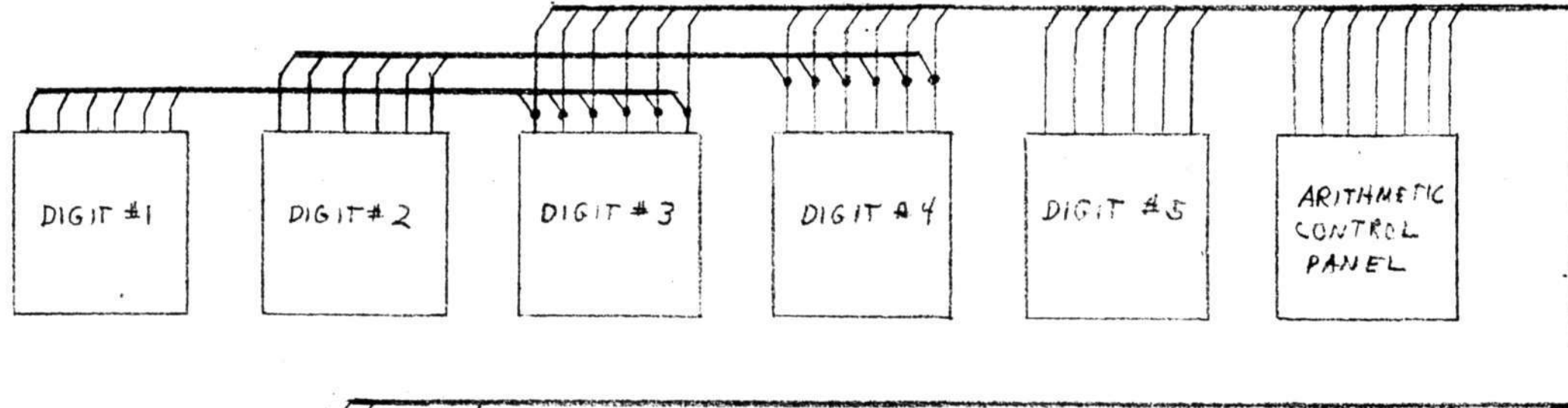
E. S. Rich
E. S. Rich

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Drawing: SB-40098
SB-40099



SERVOMECHANISMS LABORATORY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY DIVISION OF INDUSTRIAL COOPERATION PROJECT NO.		
PROPOSED MARGINAL CHECKING SWITCHING CIRCUIT FOR 5-DIGIT MULTIPLIER		
SCALE:	DR. ESRICH 7 SEPT 48	
ENG. ETR 7 Sept 48	CK.	APP.
		SB-40098



SERVOMECHANISMS LABORATORY OF THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
 DIVISION OF INDUSTRIAL COOPERATION PROJECT NO.

PROPOSED MARGINAL CHECKING CONTROL PANEL
 AND CABLING FOR 5-DIGIT MULTIPLIER

SCALE:	DRE, RICH 7 SEPT 48	SB-40099
ENG. <i>EJR</i> 7 SEPT 48	CK.	APP.