ANALYZING AND LOCATING TROUBLES (SHORTED FERRODS) IN SCANNERS USING FERRODS TYPE 1, 2, 3, 4, or 5 NO. 1 ELECTRONIC SWITCHING SYSTEM

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1. GENERAL

1.01 This section provides an approach for analyzing and locating troubles that may occur in scanners because of shorts between the control winding and readout winding of a scanner ferrod. The type 1, 2, 3, 4, or 5 ferrods are used in the scanners throughout the system of the 2-wire and 4-wire No. 1 Electronic Switching System (ESS).

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 The types of scanners used in the No. 1 ESS are the line scanners (4 to 1 and 2 to 1 concentration), junctor scanners, universal trunk scanners, and master scanners. Each scanner consists of a ferrod sensor matrix and a controller that is duplicated. The ferrod sensors are scanned in groups of 16 at specified intervals of time, depending on what information the system desires.

1.04 The various types of scanners that are used in the No. 1 ESS are listed in Table A. Each scanner uses a ferrod sensor assembly that is listed in the table along with the ferrod matrix size. Also shown is the location of the scanner and the function it performs.

2. LOCATION OF SCANNER TYPES IN EQUIPMENT

Line Scanner (4 to 1 Concentration)

2.01 The line scanner (4 to 1 concentration) has an equipment arrangement as shown in Fig. 1. The home frame and the mate frame each contains 512 ferrods (256-type 1B assemblies). The home frame contains the controls for the ferrods in both the home and mate frames.

2.02 Each ferrod is designated by five digits based on the position of the associated line switch (see bottom of Fig. 1). From left to right, the first digit corresponds to the bay (0 or 2); the second, to the line concentrator (0 through 7); the third, to the switch number within the line concentrator (0 through 3); and the remaining two, to one of the 16 inputs (00 through 15) on the switch input. A group of 16 ferrods is associated with each line switch. One such group of line scanner ferrods is shown shaded in the upper left of Fig. 1.

Line Scanner (2 to 1 Concentration)

2.03 The location of the scanner in the line switching equipment with 2 to 1 concentration is shown in Fig. 2. Each home frame contains 512 ferrods and the controls for 1024 scan points. The associated mate frame contains 512 ferrods and uses the controls mounted in the home frame. Each line link network has cutoff contacts between its lines and the line scanner.

Junctor Scanners

2.04 Each junctor circuit has two scan points. One ferrod is used to scan the calling customer line, and the other ferrod is used to scan the called customer line. The ferrods located in junctor circuits have seven digit designations (Fig. 3). These designations are based on the location designations of the associated circuits which the ferrods scan.

Universal Trunk Scanners

2.05 The ferrod designations (Fig. 4 and 5) are based on the frame location of the associated trunk circuits. Each trunk circuit has two supervisory scan points similar to the scan points for each circuit in the junctor scanners.

Master Scanners

2.06 The master scanner is shown in Fig. 6. The ferrods are designated by four digits (Fig. 7). Master scanners provide supervisory and information access for the control unit of the system. Scan points are assigned into two areas called supervisory and directed fields. Some scan points have fixed assignments that is, the same location in the first master scanner (MS-00) of all No. 1 ESS central offices. Other scan points have group assignments that is, they are assigned to adjacent positions in a given master scaner row. Nonfixed assignments are job-engineered for each No. 1 ESS central office. Assignment of master scanner points is covered in SD-1A272-01.

3. EXAMPLE OF SHORTED FERROD

3.01 Figure 8A shows the readout circuit for one scanner bit. One of the ferrods is shown with a short between the readout winding and the control winding of a ferrod connected to a customer dial pulse receiver (CDPR). Dial pulses from the CDPR cause −48 volt to ground voltage pulses on the readout loop. The positive going −48 volt to ground transition is differentiated and coupled through the interwinding capacitance (Cps) of transformer (T1) to the base of transistor Q2 in both A50 circuit packs. This causes false "one" bits to be transmitted onto the scanner answer buses from the scanners with shorted ferrods. A positive going transition as small as 20 volts on the readout loop is sufficient to cause marginal "one" bits to be sent out on the scanner answer buses. The pulses are sent out on the buses even if the scanner with the shorted ferrod is not enabled and the strobe pulse to A50 is not present. Therefore, a false "one" received on a scan order can come from any scanner in the office as well as the scanner frame being addressed.

3.02 Shorts in line-scanner, loop-start ferrods generally cause 24-volt transitions on the readout loop which produce marginal pulses on the scanner answer buses. Because of the difference in sensitivities of the cable drivers and receivers on the scanner answer buses, the marginal pulses are frequently seen as false "one" bits by only one CC or SP when there are 24-volt transitions on the readout loop. The marginal pulses cause SP match errors and C-level interrupts whereas the larger amplitude pulses produced by the 48-volt transitions on the readout loop cause the troubles described above in 3.01.

4. TESTING FOR SHORTED FERRODS

Apparatus

4.01 The following apparatus is required when testing for shorted ferrods:

(a) Clip-on dc milliammeter, HP 428B or equivalent

(b) Oscilloscope, Tektronix 465 or equivalent

(c) 200K to 500K ohm resistor −1/4 watt.

Ferrods Shorted to Voltage Source

4.02 Shorted ferrods can be found by using an oscilloscope with DC input coupling to observe the voltage on each of the 16 readout loops. The scanner readout loops should have no DC connection to ground or to a voltage source. Either one of the input pins on the A50s or the A49 pack can be used to observe the voltage on a readout loop. If a negative or positive voltage exists on the loop (generally −48 volts or +24 volts), one or more of the ferrods on that readout loop have shorts to a voltage source.

Ferrods Shorted To Ground

4.03 To test for ferrods with shorts to ground +24 volts can be applied to the readout loop through a 200K to 500K ohm resistor as shown in Fig. 8B while observing the voltage on the loop with the oscilloscope. If the voltage does not go to +24 volts, one or more of the ferrods is shorted to ground.

5. ISOLATION OF SHORTED FERROD

5.01 The ferrod can be isolated by connecting +24 volts to the loop through a resistor as shown in Fig. 8C. Measure the current between the ferrods with a Hewlett Packard clip-on DC milliammeter (or equivalent) on the one milliampere range. As shown in Fig. 8B, the ferrod can be found since the direction of the current is always toward the short. When the current probe is moved beyond the short, the direction of the current reverses.

5.02 Since the shorted ferrods can be caused by the pins on the front or back of the ferrods being shorted together by external wiring, the wiring should be checked before attempting to use the current meter to isolate the shorted ferrod. The removal of the short can be verified by observing the oscilloscope when the wiring is moved. If it is necessary to remove the ferrod, normal use of jumpers for retaining continuity of the interrogate and readout loops should be observed.

5.03 On some scanners the wiring between ferrods is too tight to permit the DC current probe to be connected around the readout wire. On these scanners, the current probe can be attached as shown in Fig. 8C and the +24 volts applied at various points along the loop, such as point A and B. The current indicated by the meter will become less and less the closer the +24 volts is applied to the faulty ferrod. The current indicated by the meter will become less and less the closer the +24 volts is applied to the shorted ferrod. When the +24 volts is applied to the opposite side of the ferrod, the direction of the current will reverse. To obtain a measurable amount of current, it may be necessary to reduce the value of the resistor in series with the +24 volt source to 50K ohms.

5.04 If a readout loop is shorted to +24 volts, a ground instead of +24 volts should be connected to the loop through a series resistor to permit the shorted ferrod to be isolated by measuring currents.

TABLE A

TYPES OF SCANNERS

TYPE OF SCANNER	FERROD SENSOR ASSEMBLY	MATRIX SIZE	LOCATION	FUNCTION
Line (4 to 1)	1B	16 by 32 (512)	Line Switching Frame (4 to 1), home and mate	Detection of call origination by customer (off-hook)
Line (2 to 1)		16 by 32 (512)	*Line Switching Frame (2 to 1)	
Junctor	1C	16 by 32 (512)	*Junctor Frame	Supervision of intraoffice calls
Universal Trunk	1C and 1D	16 by 32 (512)	*Universal Trunk Frame	Supervision of interoffice calls
Master	1D	16 by 32 (512)	Master Scanner Frame	Monitoring of points within the electronic central office for various purposes such as routine tests, trouble diagnosis, administration, and other requirements.
	1E	16 by 64 (1024)		

*For each pair of mate and home frames, the control for both 512-point matrixes are located on the home frame.

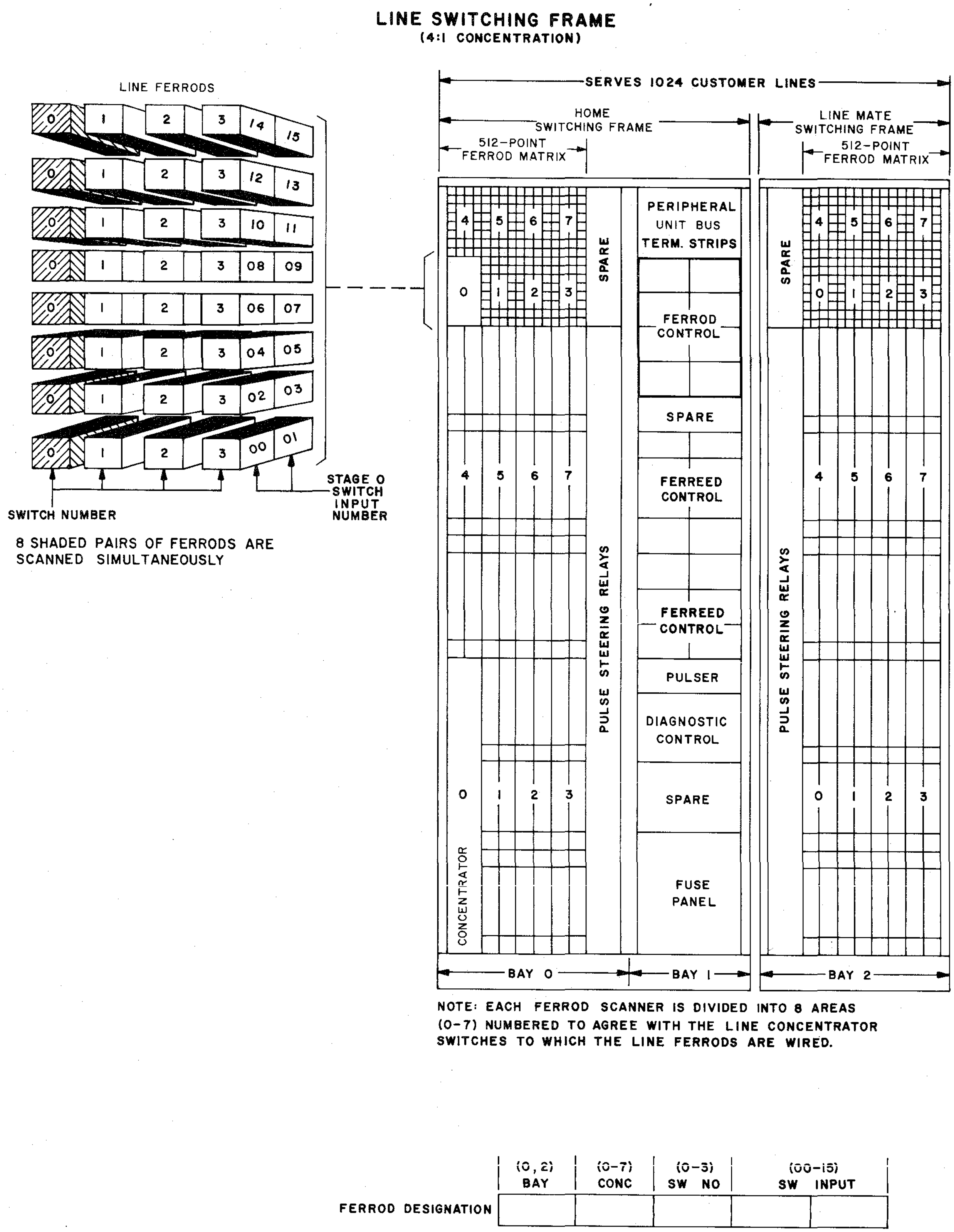


Fig. 1—Line Scanner with 4 to 1 Concentration

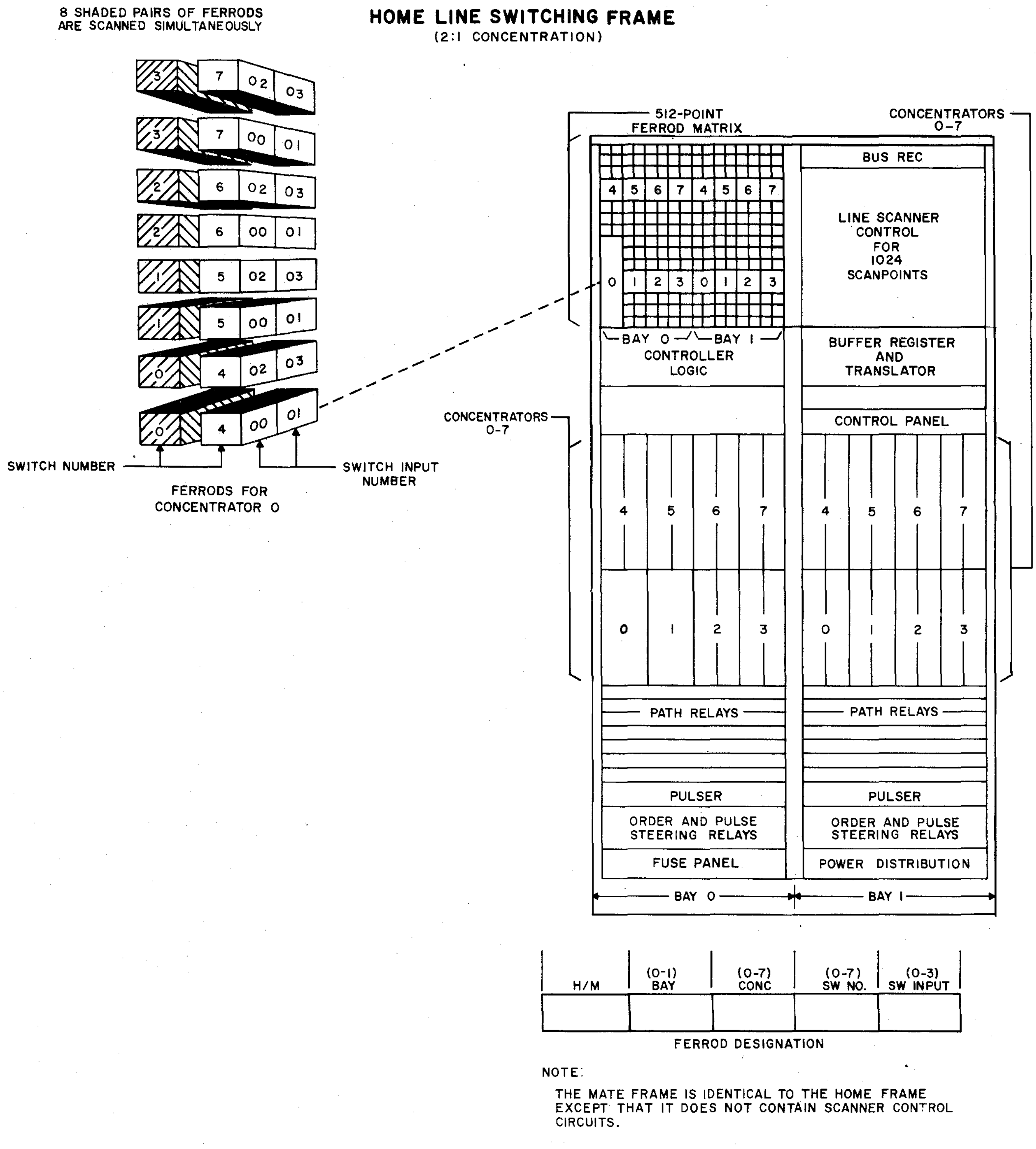
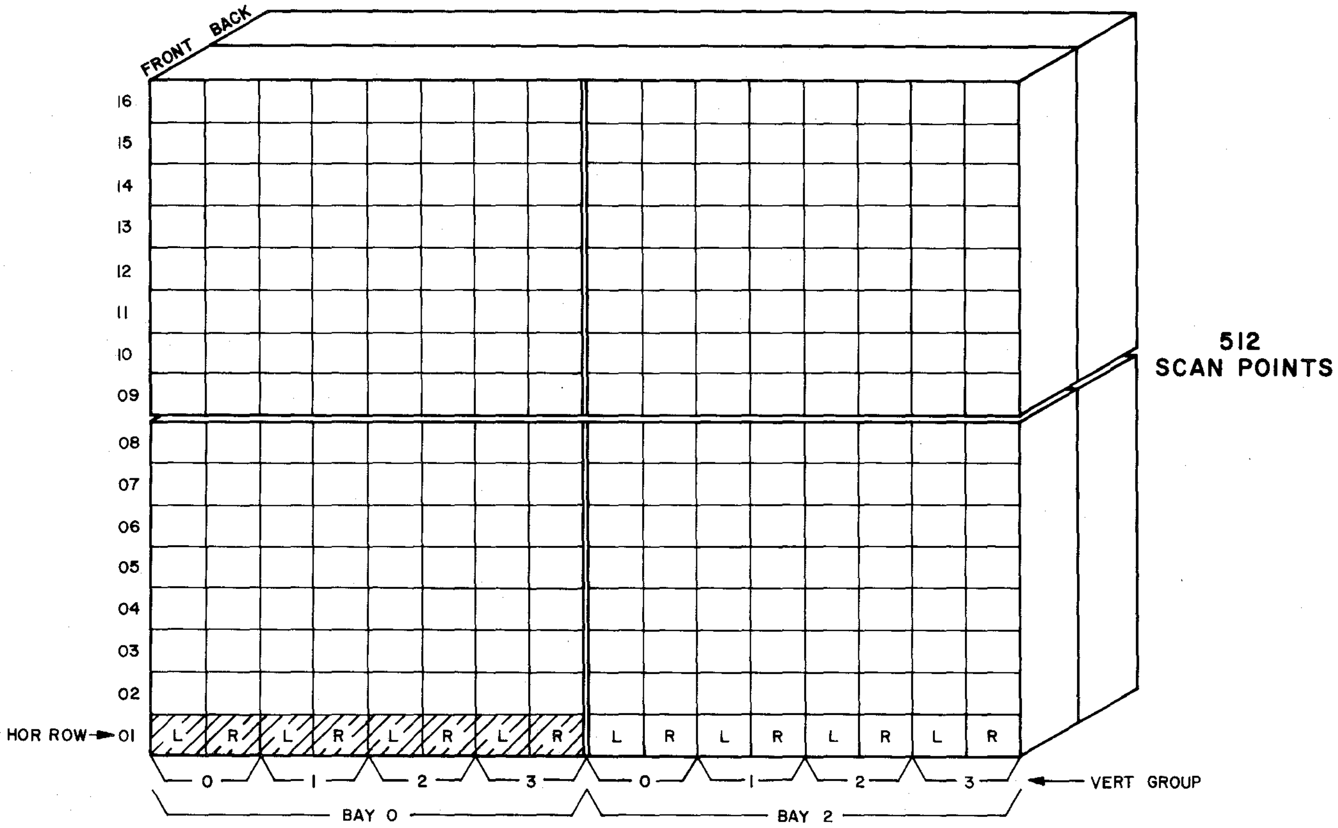


Fig. 2—Line Scanner with 2 to 1 Concentration

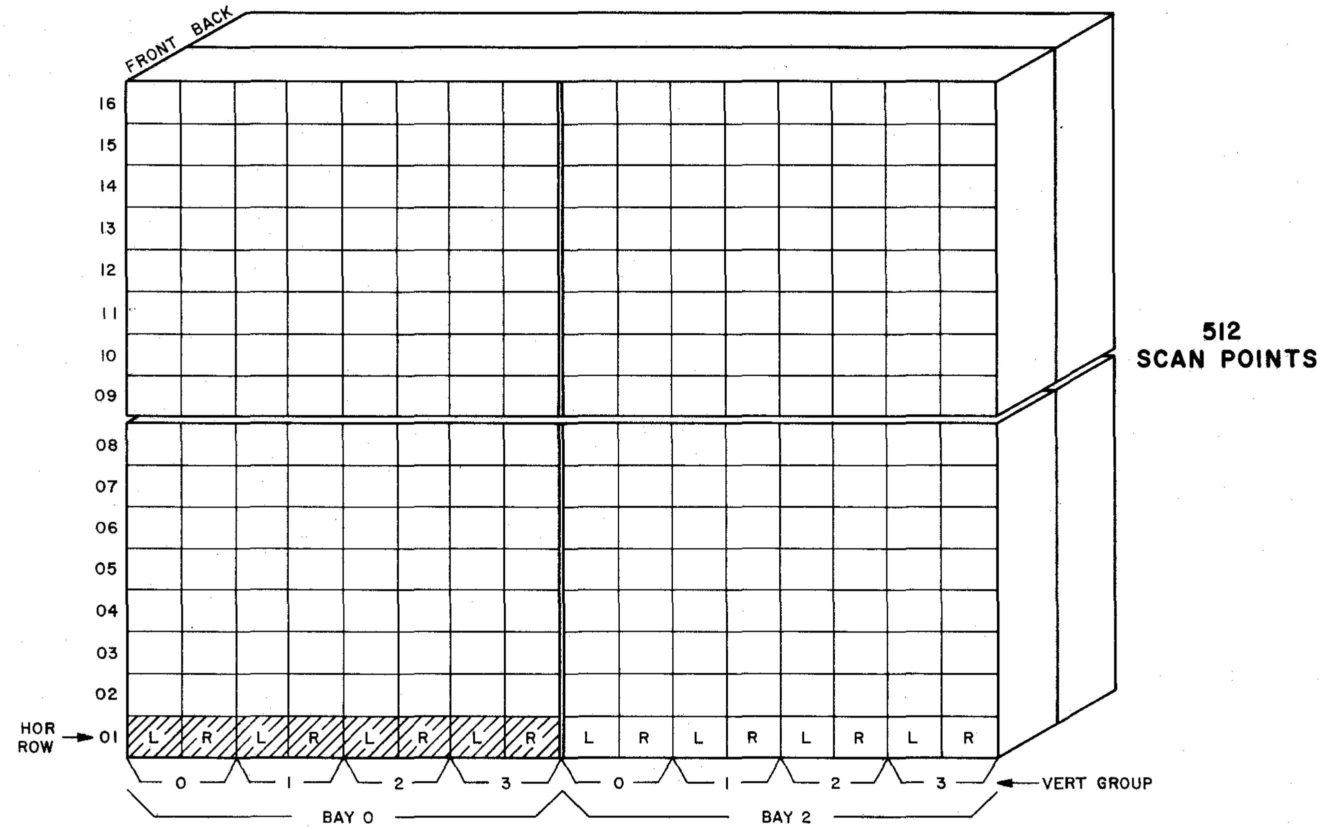


8 SHADED PAIRS OF FERRODS ARE SCANNED SIMULTANEOUSLY

L=TYPE 1C R=TYPE 1C

		(0,2)	(01-16)		(0-3) *	FRONT (0)	LEFT (L)
	H/M	BAY	HOR ROW		VERT GRP	OR BACK (1)	OR RIGHT (R)
FERROD DESIGNATION							

Fig. 3—Ferrod Designations in Junctor Scanner



8 SHADED PAIRS OF FERRODS ARE SCANNED SIMULTANEOUSLY

L=TYPE IC R=TYPE ID

	H/M	(0,2) BAY	(01-16) HOR ROW		(0-3) VERT GRP	FRONT (0) OR BACK (1)	LEFT (L) OR RIGHT (R)
FERROD DESIGNATION							

Fig. 4—Ferrod Designations in Universal Trunk Scanner

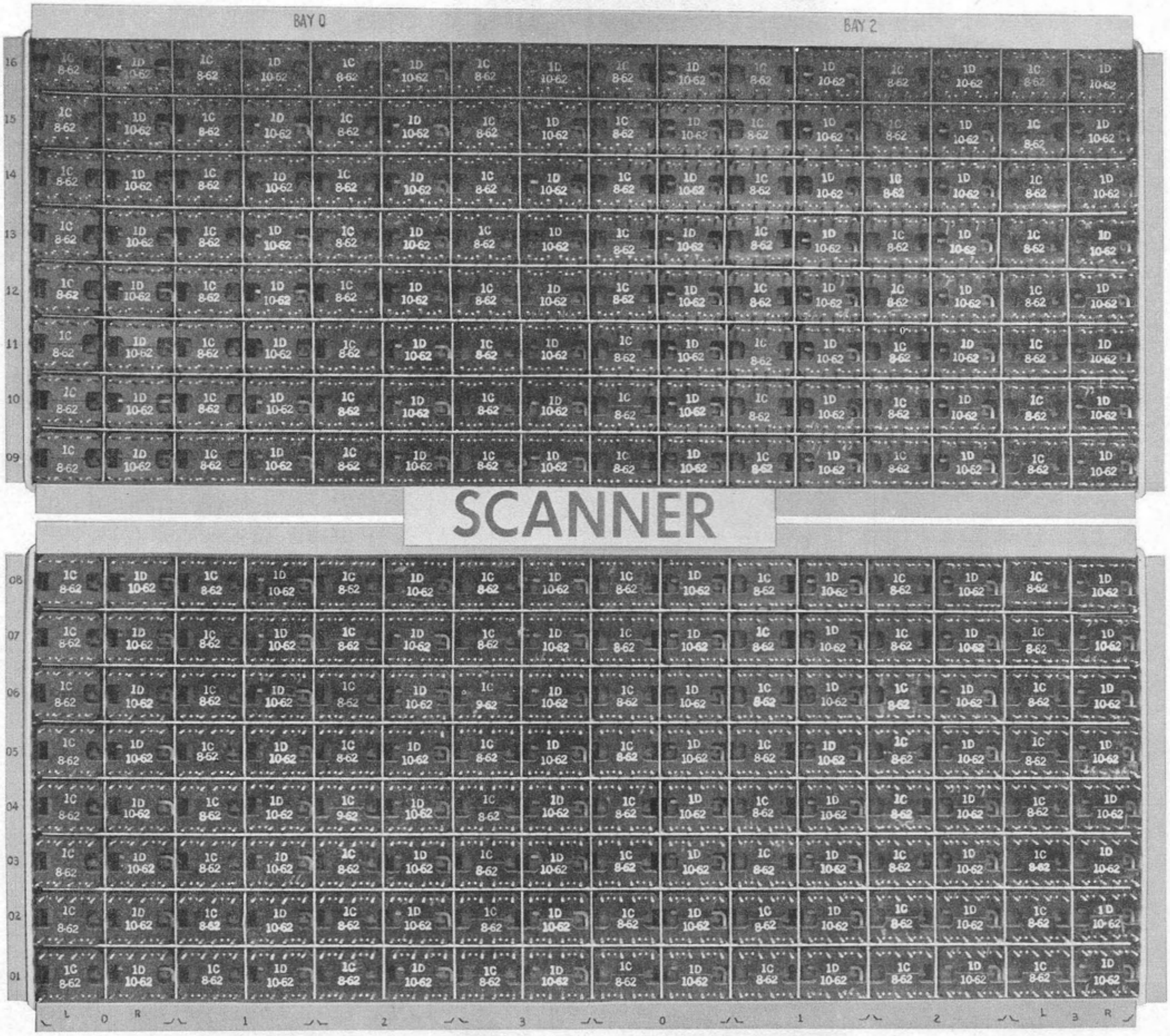


Fig. 5—Universal Trunk Frame Ferrod Matrix

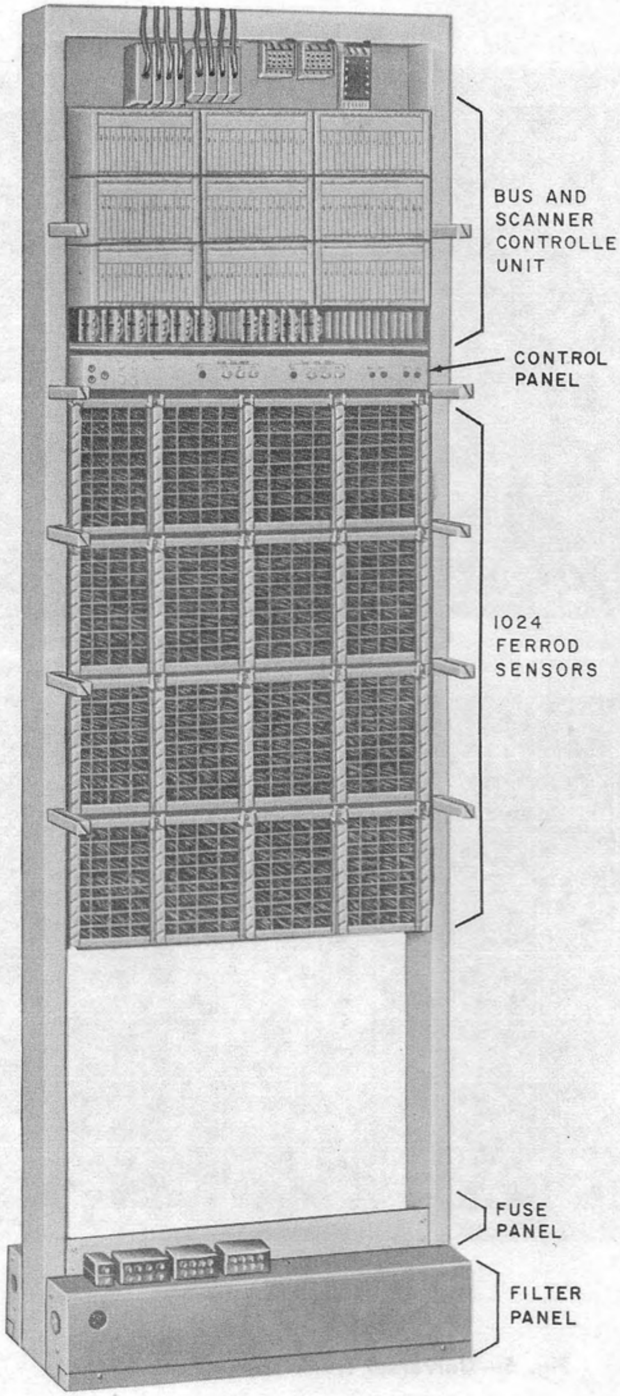


Fig. 6—Master Scanner

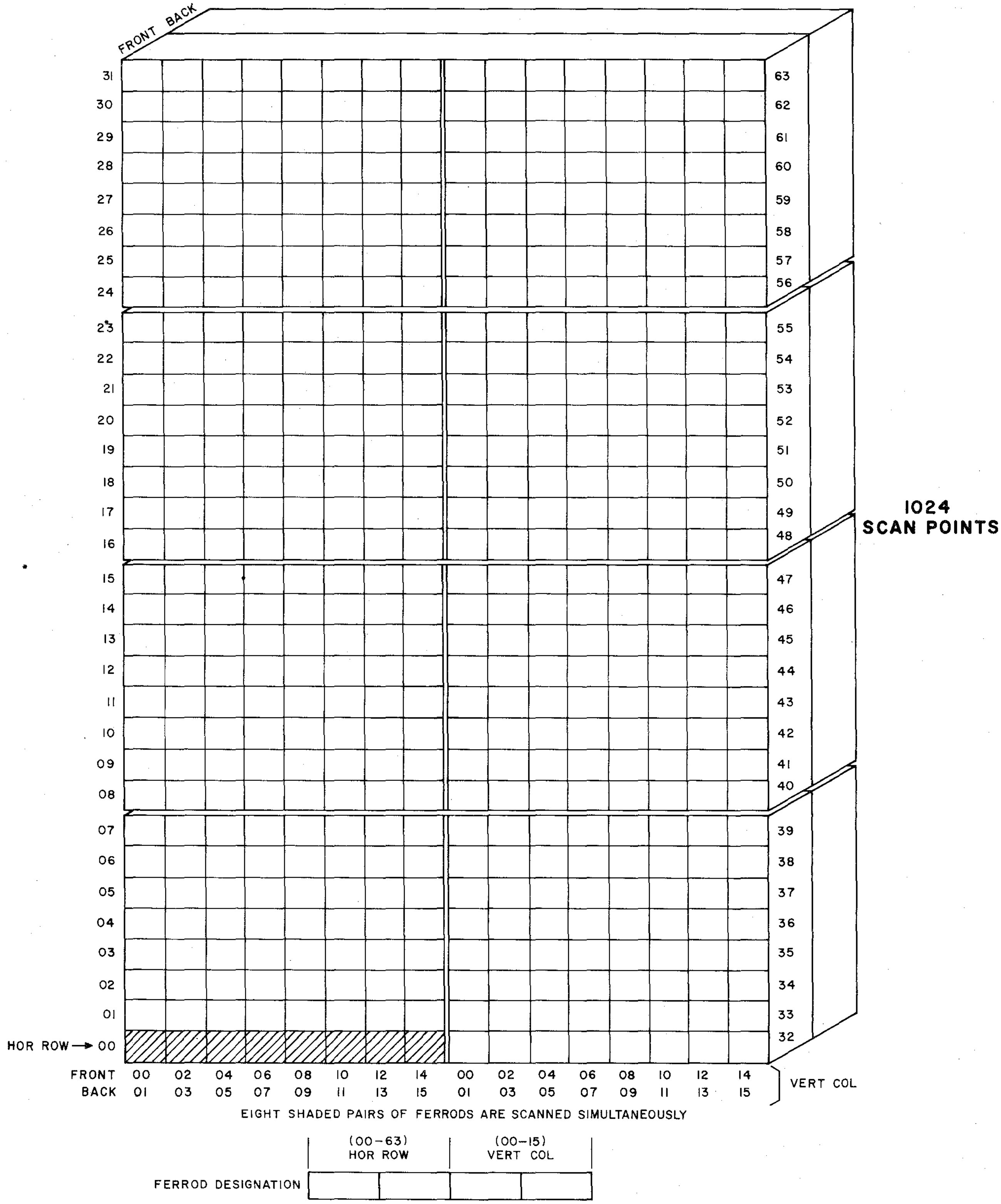


Fig. 7—Ferrod Designations in Master Scanner

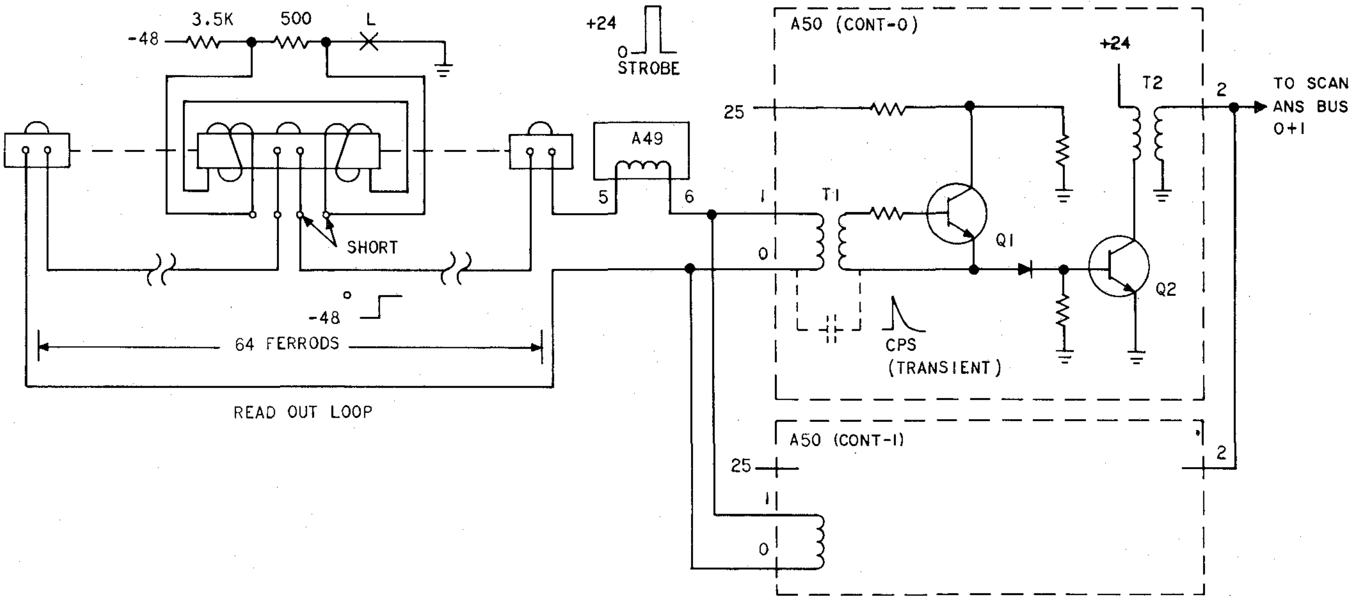


FIG. 8A

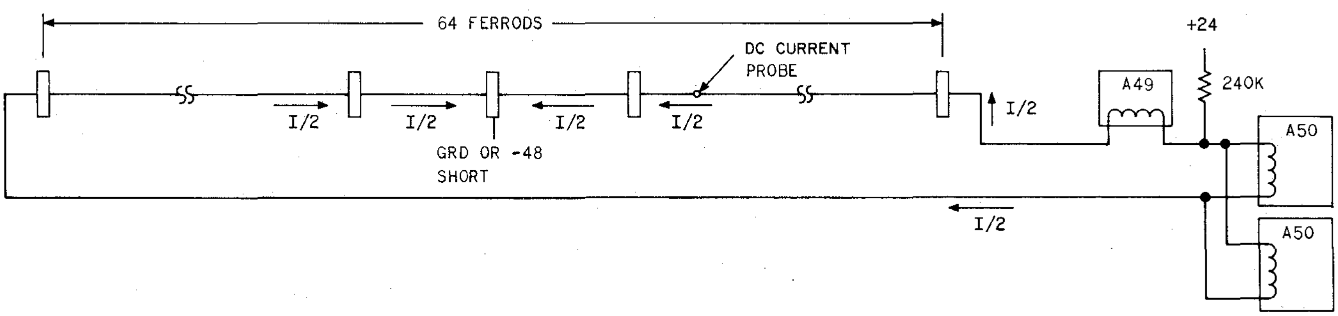


FIG. 8B

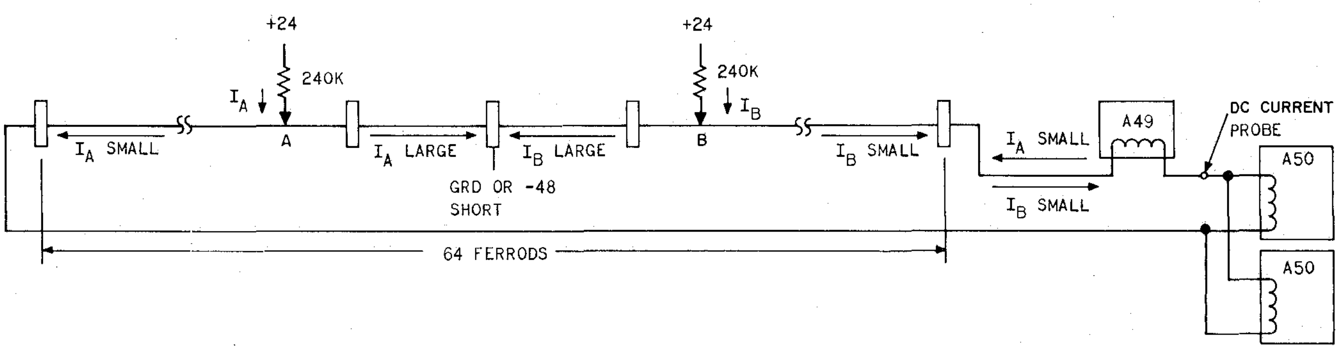


FIG. 8C

Fig. 8—Partial Schematic of Scanner Ferrod Matrix

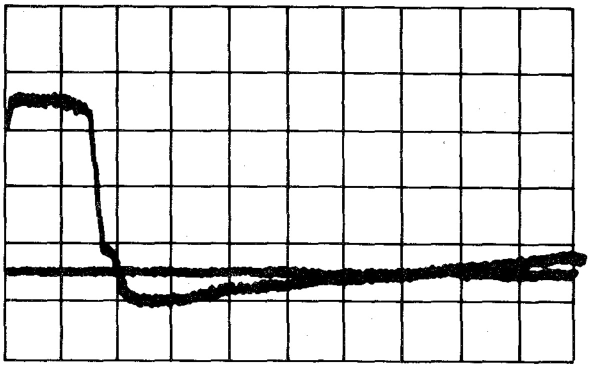


FIG. A

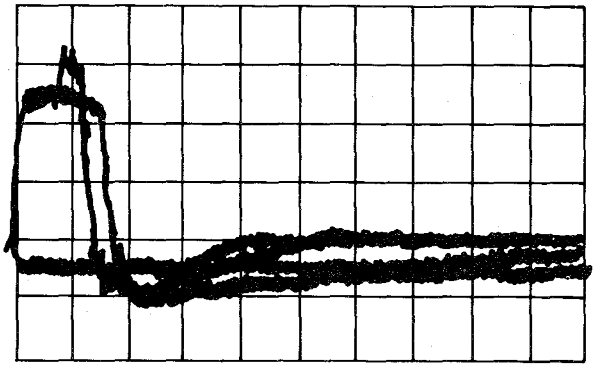


FIG. B

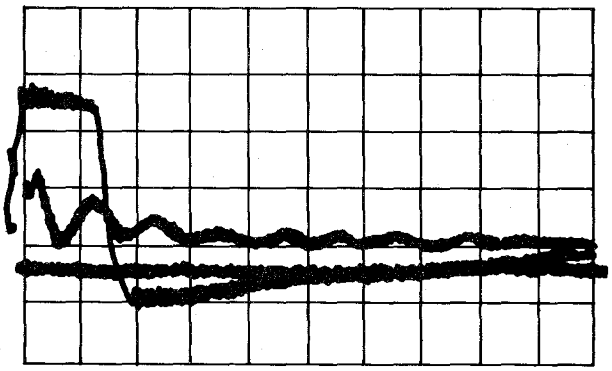


FIG. C

SCALE FOR ALL GRIDS
VERT - 2V/DIV
HORZ - 0.5 USEC/DIV

Fig. 9—Oscilloscope Tracings of A50 Output

```
47 MA16 SP INT 67
          00016670  00105673  00047740  01016670  00026430  14157777
          00000260  00034210  00000000  00010000  00400001  00026426
          11624413  21414000  27600010  00000001  04004445  00001003
          00000347  32726430  31726427  00000000  00100210  00011570


47 DR01 TEL NOS CPD 3
          ATP


47 SP12
          00016670  00105673  00047740  01016670  00026430  14157777
          00000260  00034210  00000000  00010000  31726427  32726430
          00400001  00026426  00000001  04004445  00000002  27600010
          00000347  00276000  03506141  00011570  00013213  00001003
          00026432  00130270  00047740  01016670  00000103  14000000
          00000300  00100210  00000000  00000000  00100210  00000000
          00400001  00026431  00004001  06407444  00000002  00000000
          00000347  00330000  00402141  00001564  00013214  00000003
```

Fig. 10—Sample A Printout

```
**05 DR01 TBL NOS CC 1
        ATP

**07 CT04 07 46  743  2950  0 42 25

  10 MA14A
        00000000  01667704  01413153  01670060  01562432  01674601

**10 MA16 SP INT 67
        00016300  00000000  00155740  01016300  00024402  00040000
        00000000  00177777  20000000  00040000  00400001  00024400
        11050164  21404000  27600100  00000000  04004405  00001017
        00000347  31724401  31724401  00400000  00150000  00011520

  11 SP12
        00016300  00000000  00155740  01016300  00024402  00040000
        00000000  00177777  20000000  00040000  31724401  31724401
        00400001  00024400  00000000  04004405  00000002  27600100
        00000347  00276000  03512140  00011520  00012200  00001017
        00016300  00000000  00155740  01016300  00024402  00150000
        00000000  00177777  20000000  00150000  00150000  00040000
        00400001  00024400  00000000  04004405  00000002  27600100
        00000347  00330000  00402140  00011460  00012200  00001017
```

Fig. 11—Sample B Printout

```
40 SA03 ERROR  23  44
        00000065  00000000  01735604  00076066
        00074377  00074377  01735471  00074377

40 MA14A
        00073512  01630065  01024345  01610744  01611021  01607054

40 MA16  SP INT  67
        00016514  00040055  12251740  01016514  00030324  00070157
        00001220  00107760  00000000  00000100  00400001  00030322
        01611021  21404000  27600020  00000001  04004401  00001013
        00000347  35730323  35730323  00040155  00141155  00011520

41 SP12
        00016514  00040055  12251740  01016514  00030324  00070157
        00001220  00107760  00000000  00000100  35730323  35730323
        00400001  00030322  00000001  04004401  00000002  27600020
        00000347  00276000  03512140  00011520  00014151  00001013
        00016514  00040055  12251740  01016514  00030324  00171157
        00001220  00107760  00000000  00101100  00141155  00040155
        00400001  00030322  00000001  04004401  00000002  27600020
        00000347  00330000  00402140  00011460  00014151  00001013
```

Fig. 12—Sample C Printout