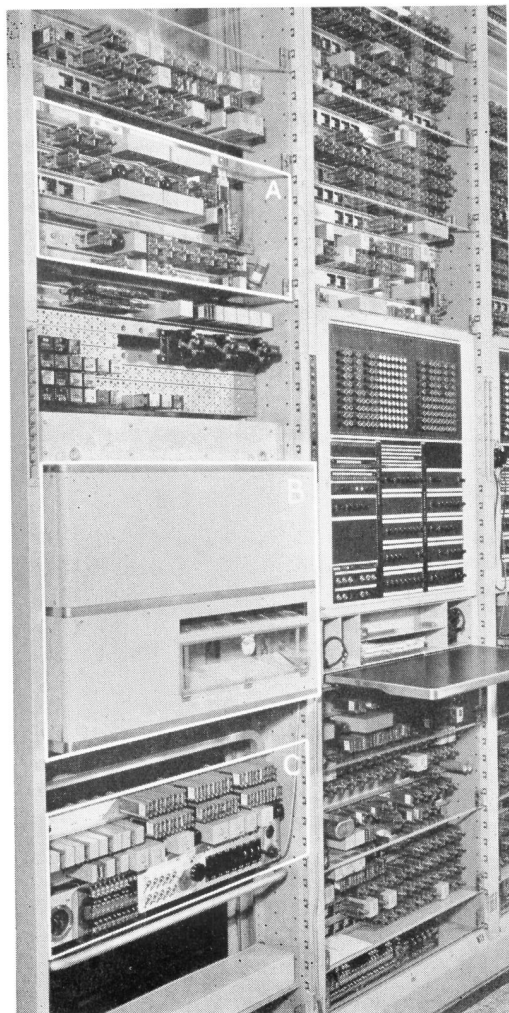


Trouble recording for the No. 5 crossbar system

A. C. MEHRING
*Switching
Systems
Development*

In the No. 1 crossbar system, trouble indicators are employed to give information that will assist the maintenance force in locating troubles as they arise. When such a condition occurs, lamps in various groups light up, and a maintenance man records the in-

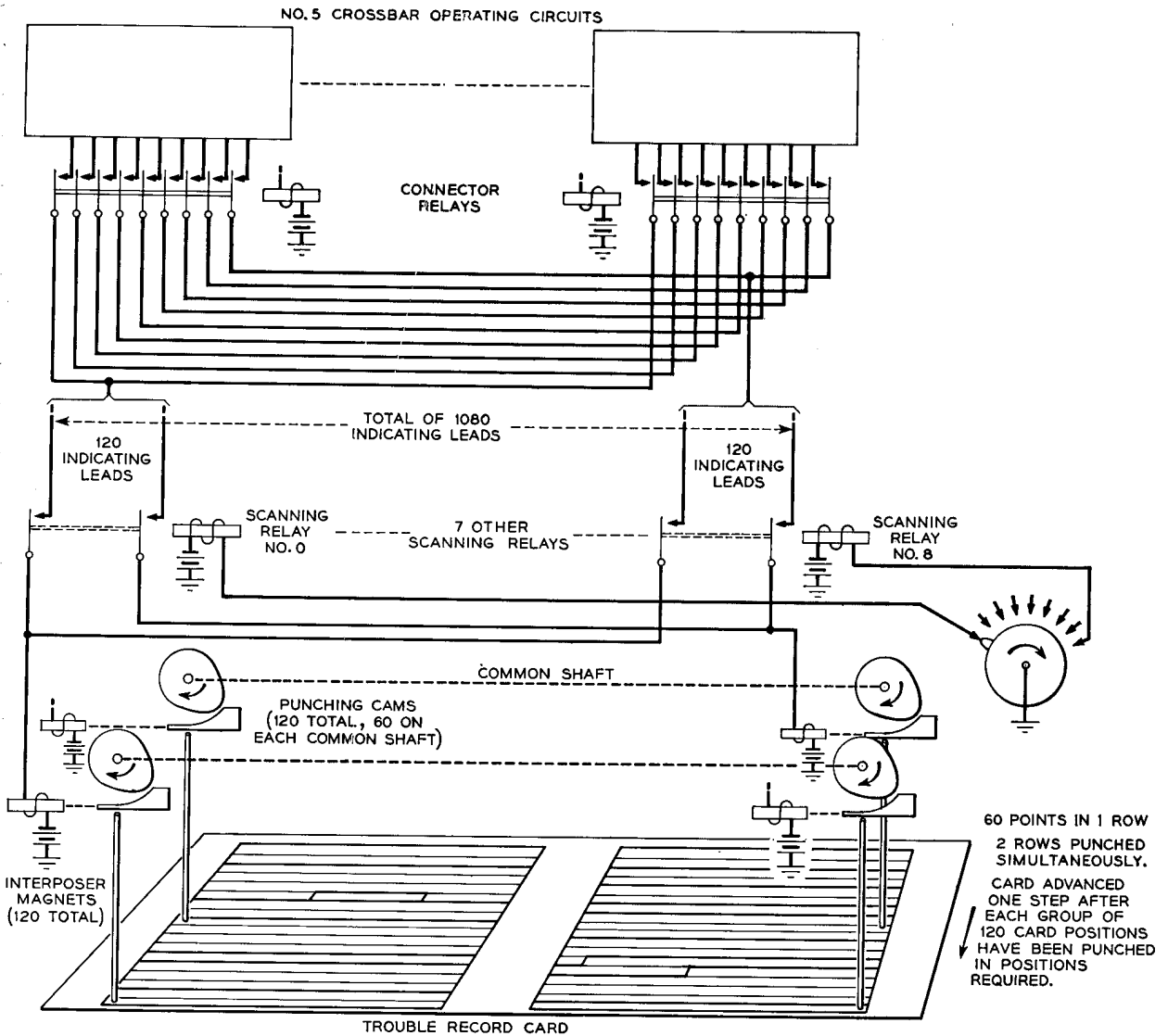
At the maintenance center in Media, the trouble recorder occupies part of the left hand bay. The trouble recorder circuit is at A, the trouble recorder unit at B, and the perforator test circuit at C.



formation they display. With continually recurring trouble conditions, this recording alone requires considerable time. When trouble conditions recur in rapid sequence, moreover, it is impossible to record all of them; under some conditions only a small percentage may be recorded. Since these records are used as a guide in clearing the trouble conditions, it has been desirable to provide a much faster recording method so that a higher percentage of the troubles would be recorded, and so that records could be made when the office was unattended. To make this possible, a trouble recorder perforator and associated circuits, shown in the accompanying illustration, have been provided as a part of the maintenance center in the No. 5 crossbar office.

For each trouble it handles, this recorder punches a trouble record card, one of which is shown on pages 114 and 115. There are 1080 positions on this card arranged in eighteen lines of sixty positions each. Those points in the central office from which an indication is required when locating troubles are given designations and assigned positions on this card. As a trouble record is being taken, all of the points associated with the circuit that indicated a trouble are tested; where a positive signal is received, the trouble recorder perforates a hole in the corresponding position on the trouble record card referred to above.

In the recorder there is a bank of 120 punches mounted in such a way that they can punch any or all of the sixty positions in each of two lines on the card. The first and the tenth lines from the bottom of the card are punched first, and then the card is shifted to permit the second and the eleventh to be punched, and so on. The complete



Simplified diagram indicating the arrangement of the trouble recorder and its associated circuit.

punching operation is thus made in nine steps to cover the eighteen lines on the card. The entire punching operation requires about one second. Which holes are punched in each operation is controlled by an interposer magnet for each of the 120 punches. These magnets act to interpose a link between the punches and the operating cams, and holes are punched simultaneously by all the punches for which the interposer magnet is operated. There is thus only a single punching operation for each two lines of the card.

The information punched on a record card consists of six major groups: (1) the equipment included in establishing the connection; (2) the type of connection being established; (3) how far the various circuit operations had progressed before the trouble occurred; (4) information as to the specific test that has indicated trouble; (5) information which is helpful or necessary in determining the source of the trouble, such as the identification of the calling line, the called line, the trunk, and the channel through which the connection is established; and in

	5										10										15										20										25										29									
9	TI	MPT	SRT	TKT	MLV	TLV	LVF	LVM	MOR	MTR	MOS	TRS	GT5	PRT	MKR	TV	RCC	TWG	DR	0	1	2	3	4	5	6	7	8	9	EMG	DR																													
8	MLF	D	MF		ITR	RV	SQG	TOG	TER	ROA	SON	NSO	NSI	FLG	SCB				DRT-DRA	0	1	2	3	4	5	6	7	8	9	EMG	DRT-DRA																													
7	FR	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	RG-HST	0	1	2	3	4	5	6	7	8	9	EMG	RG-RST																													
6	RG	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	HT	0	1	2	3	4	5	6	7	8	9	EMG	HT																													
5	IO	II	12	13	14	15	16	17	18	19		ECN	OCN	0	1	2	3	4	HT-TT	0	1	2	3	4	5	6	7	8	9	EMG	HT-TT																													
4	LT	TT	FVD	XII	II	OA	OB	PHC	THC	OR	TAN	TOL	INC	RO	TRK	TR2	CBSI	OBSI	FG	0	1	2	3	4	5	6	7	8	9	EMG	FG																													
3	PS	PD	PK	CR	SCN	SKK	MAN	2P	OBS	NOB	CNR	CM	A	B	CM	C	SD	PCK	PRL	RLK	PTR	YX	TST	M	SPL	NC	NT	NTI	MPT	NH	NN																													
2	FR	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	OSG	0	1	2	3	4	5	6	7	8	9	EMG	OSG																													
1	OSG	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	OSI	0	1	2	3	4	5	6	7	8	9	EMG	OSI																													
0	A	0	1	2	4	7	0	1	2	4	7	0	1	2	4	7	0	1	OSE	0	1	2	3	4	5	6	7	8	9	EMG	OSE																													
9	A'	0	1	2	4	7	0	1	2	4	7	0	1	2	4	7	0	1	OSK	0	1	2	3	4	5	6	7	8	9	EMG	OSK																													
8	G	0	1	2	4	7	0	1	2	4	7	0	1	2	4	7	0	1	OST	0	1	2	3	4	5	6	7	8	9	EMG	OST																													
7	G'	0	1	2	4	7	0	1	2	4	7	0	1	2	4	7	0	1	OSR	0	1	2	3	4	5	6	7	8	9	EMG	OSR																													
6	CP	0	1	2	4	7	0	1	2	4	7	0	1	2	4	7	0	1	OS2	0	1	2	3	4	5	6	7	8	9	EMG	OS2																													
5	CP'	0	1	2	4	7	0	1	2	4	7	0	1	2	4	7	0	1	OS2	0	1	2	3	4	5	6	7	8	9	EMG	OS2																													
4	NGC-TH	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	OS2	0	1	2	3	4	5	6	7	8	9	EMG	OS2																													
3	T	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	OS2	0	1	2	3	4	5	6	7	8	9	EMG	OS2																													
2	PN	TN	PTN	PBN	FNA	FNB	OV	BY	OFH	PUL	LCH	TCH	LIN	TIN	BN	RT	TBI	TBH	RSK	LI	TCKI	SRK	RCK2	RCK3	CT	TGT	PSR	CU																																
1	FT'	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	OS2	0	1	2	3	4	5	6	7	8	9	EMG	OS2																													
0	FT'	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	OS2	0	1	2	3	4	5	6	7	8	9	EMG	OS2																													

Card used for recording trouble.

some offices (6) the time the trouble occurred.

This information is derived from a number of sources but chiefly from the marker and the automatic message accounting equipment when the office includes it. In the No. 5 crossbar system the greater portion of the control of a connection is associated with a marker. Each marker circuit is provided with a system of checking features so that it can detect the presence of a trouble condition within itself or within the circuits with which it is associated. Should trouble be detected by a marker, the marker will stop its circuit operations, and request the trouble recorder to make a detailed record of the information the marker contains and also of certain information of the circuits associated with the marker. A similar process is carried out by the transverter, the recorder and the master timing circuits of the AMA equipment, and by the automatic monitor register and sender test circuit.

Connections between these operating circuits and the trouble recorder are made chiefly by multicontact relays under the control of the master test frame connector circuit. Each multicontact relay will connect sixty leads, but since a circuit such as a marker will require many more than sixty leads to record the required information, there will, in general, be several multicon-

tact relays comprising a connector to a marker or other circuit. There will be one connector for each circuit that may make a trouble record: one for each marker, one for each AMA transverter, one for each AMA recorder, and so forth. From one side of the connectors, leads run to the operating circuits that originate the trouble record, while from the other side the leads are multiplied to a set of 1080 wires—one for each specific piece of information that may be recorded. This arrangement is indicated in the diagram on page 113.

Between this set of 1080 leads and the interposer magnets of the recorder are nine scanning relays each connecting 120 of the group of 1080 leads to the 120 interposer magnets. When the recorder is seized, the proper connector is operated to connect the recorder to the circuit that has indicated a trouble condition exists. This puts the trouble information on the set of 1080 leads. The scanning relays then operate one after another in rapid sequence to extend these leads so that the perforator may punch the information on the card. After this, the connector is released and the recorder is ready to punch another card.

In general, the troubles are recorded in the order in which they occur, but a preference circuit is provided so that in the case of two simultaneous troubles, the master test frame

SYSTEM
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	30	35	40	45	50	55	59																					
	TM CKG DCK GTL TCI CHE LXPI NE TRN FCK FTCK CK FML MAKI TBK TSE LCK JCK TCHK LK RK TK FM RCY RA DTK RKI RK2 RK3 SNK																											
	CGT VTKI HTKI FTKI NR LFK HGR LB RL HMSI SL LTR HTR GLH CON GT2 DCT DCTI LKI DCT2 TRL2 TRL BT DISI MRL																											
	XCL XCR XDL XMB XCP XQB XTV XT5 XTB XTC XTB1 XTGI XJC XJG XJS XLR XTS XLC XLV XAB XF XSL XTSI XPT XRS XRSI XFT XCH XVGA XVGB																											
	XHG XLG XCS XLS XLH XLO XFTT XFUT XRCT XSS XS XSA XN XFG XPG XPTN XT XCLC XCRK XTC XTCI XTRK XTRL XBT XRL XMR XAP FCG SQA LR																											
	FUT 0 1 2 3 4 5 6 7 8 9 FUT RCT 1 2 3 4 5 6 7 8 9 10 11 12 13 14 RCT 15																											
	VGT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 VGT HGT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 VGT																											
	CS-TLR 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 CS-TLR																											
	FS-G 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 1 2 3 4 TB SF PR RF EF																											
	FS-OFF 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 0 1 2 3 4 5 6 7 8 9																											
	TG 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 TG LV FAK FBK 2 3 4 5 6 7 8																											
	RS 0 1 2 3 4 5 6 7 8 9 ONN ITB 2MB 3FB 4TT 5MT 6FT 7TP 8MP 9FP CH 0 1 2 3 4 5 6 7 8 9																											
	JC 0 1 2 3 4 5 6 7 8 9 JC JG 0 1 2 3 4 PNR PA PB PC 0 1 2 3 4 5 6 7 8 9																											
	STP1STP2 0 1 2 3 4 5 AL GPA GPB DR TWT OPR CNS CRR 0 1 2 3 RT 0 1 2 3 RT 4 NOC CLG CLTI CLT2 CLK																											
	TC CN TP TP' RP RPK NDI NDK OTT TTK TV IPA OTO PPI AT A B D E SP RT TEN ET																											
	TM CKG CR7 CK1 CK2 CK4 DNK RK IC TOK CI4 CI3 CI2 IRY CII P5 RLR RL TR TMI TM2 OF TBY EXT RB BY																											
	TEA TGR OPI ITR 2TR P DTR PTI DTN PT PAK CK PI LC DS RD TBL PTS BSP ASP DA HR SC SY NS																											
	RN MD MG SPA SKP XPL X XRST XRL XIC XICK XNL XP XRB XTL XTC XU XTKK XPI XTI XUI XCK XOF X2P XVF XET XVG																											
	QT 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7 0 1 2 4 7																											

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OFFICE
MONTH
YEAR

MADE IN U.S.A.

connector circuit will give preference to one of the requesting circuits and will exclude the others. When some unusual condition causes a number of troubles to appear in rapid sequence, all of them will not be recorded, but since a complete recording operation, including the punching of the card and recycling the perforator to the normal position, requires only a little over a second, it has been found that most of the troubles will leave a record.

In addition to providing means of recording information when a trouble condition

occurs, the trouble recorder perforator and circuits are arranged to record as well the results of certain tests initiated at the master test frame.

Besides providing information to guide the maintenance force in clearing trouble that has arisen, these trouble record cards also provide permanent records of the various trouble conditions that have existed in the No. 5 office. It will be possible by examining these trouble records and noting those troubles which continually recur to work toward their elimination.