July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29. 1952 110 Sheets-Sheet 1

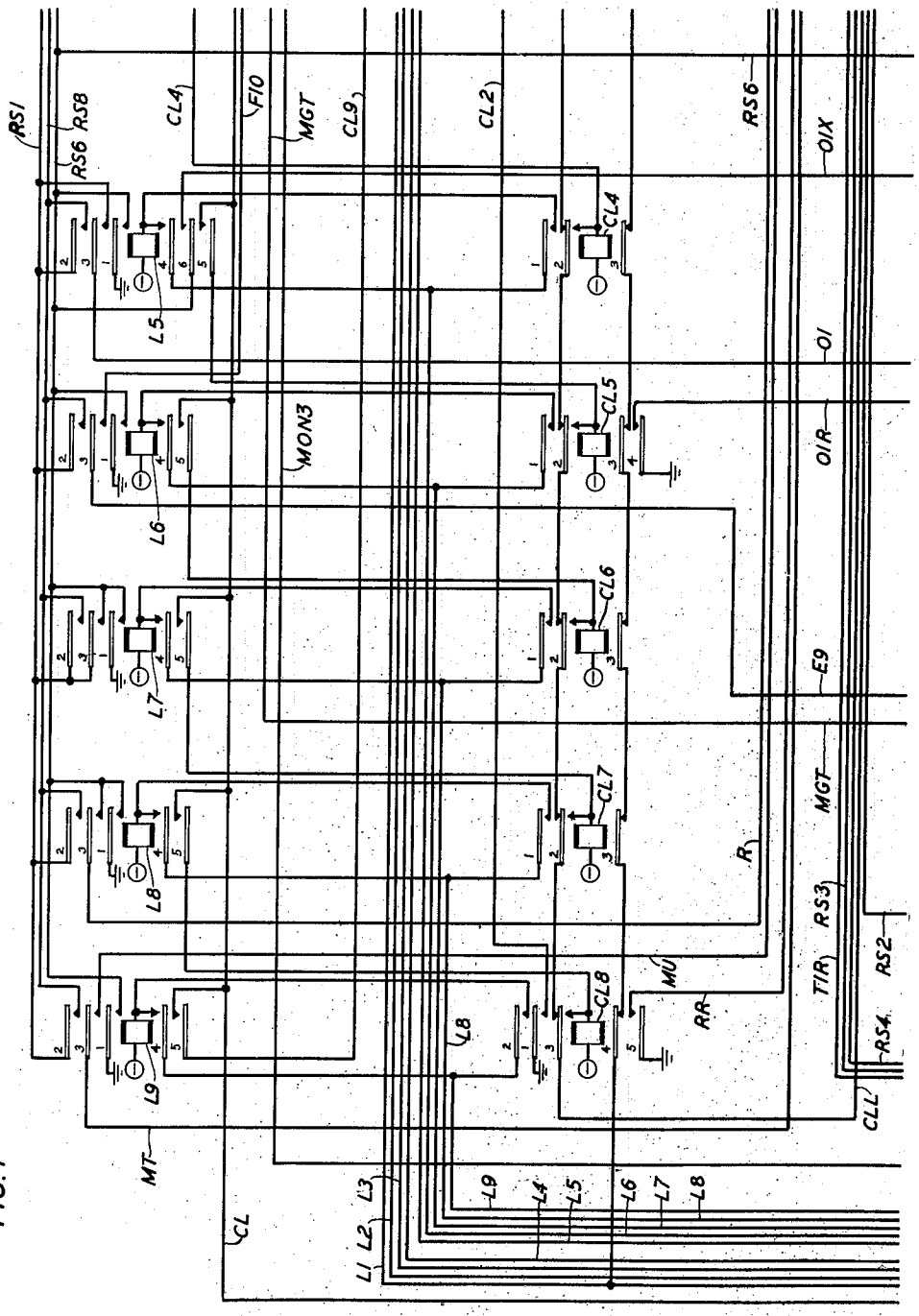


FIG. 1

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 2

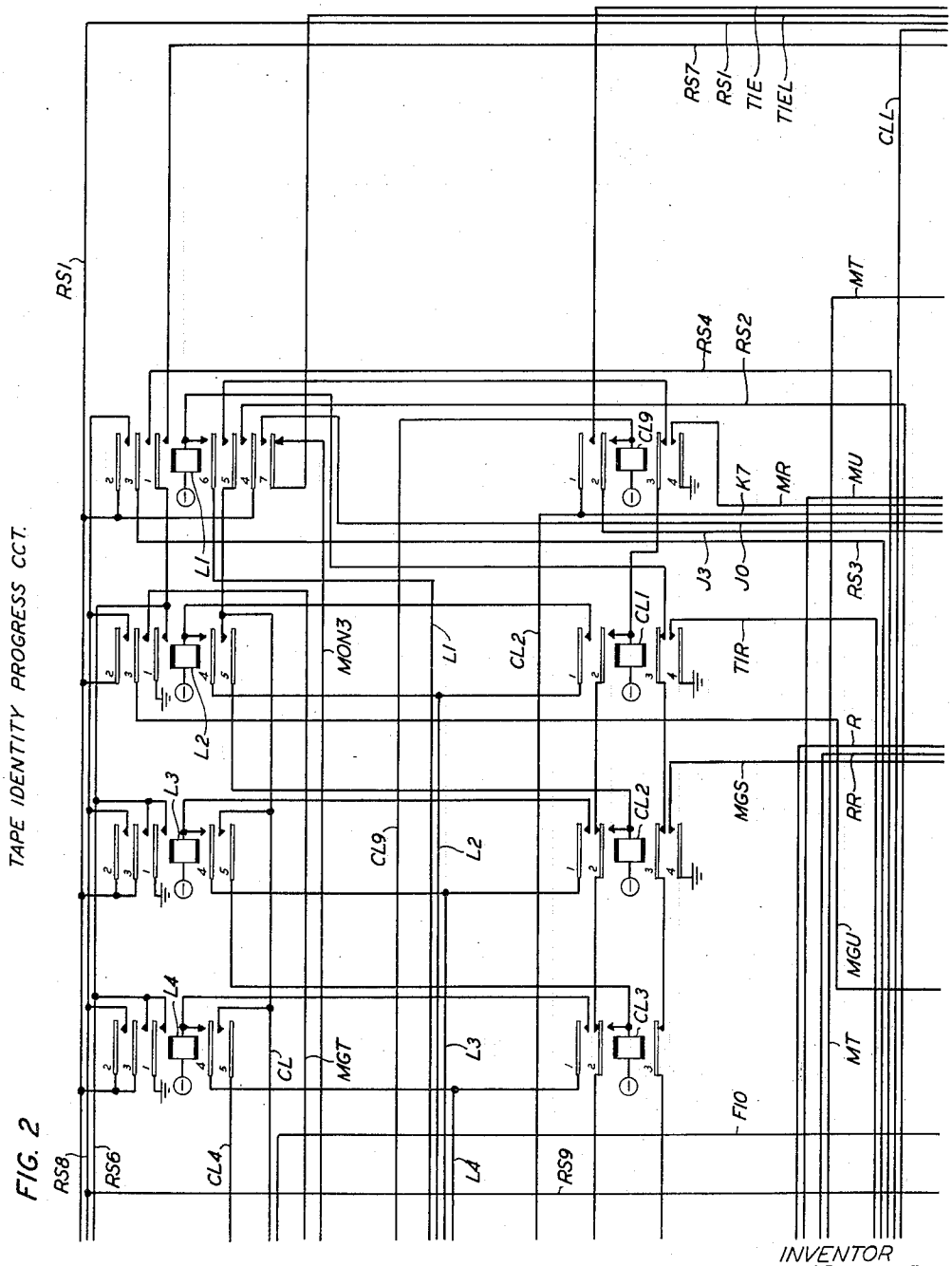


FIG. 2

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 3

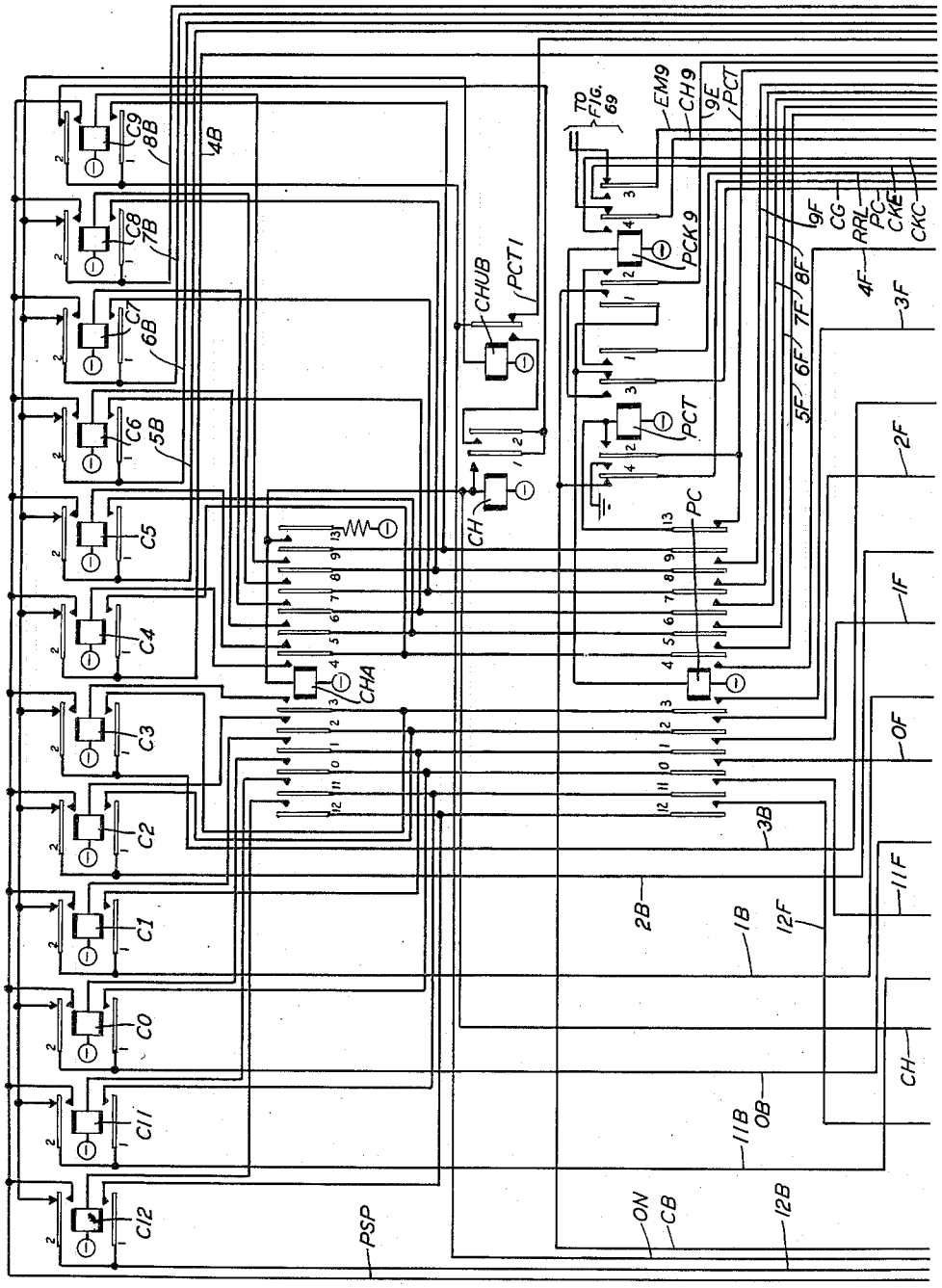


FIG. 3

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 4

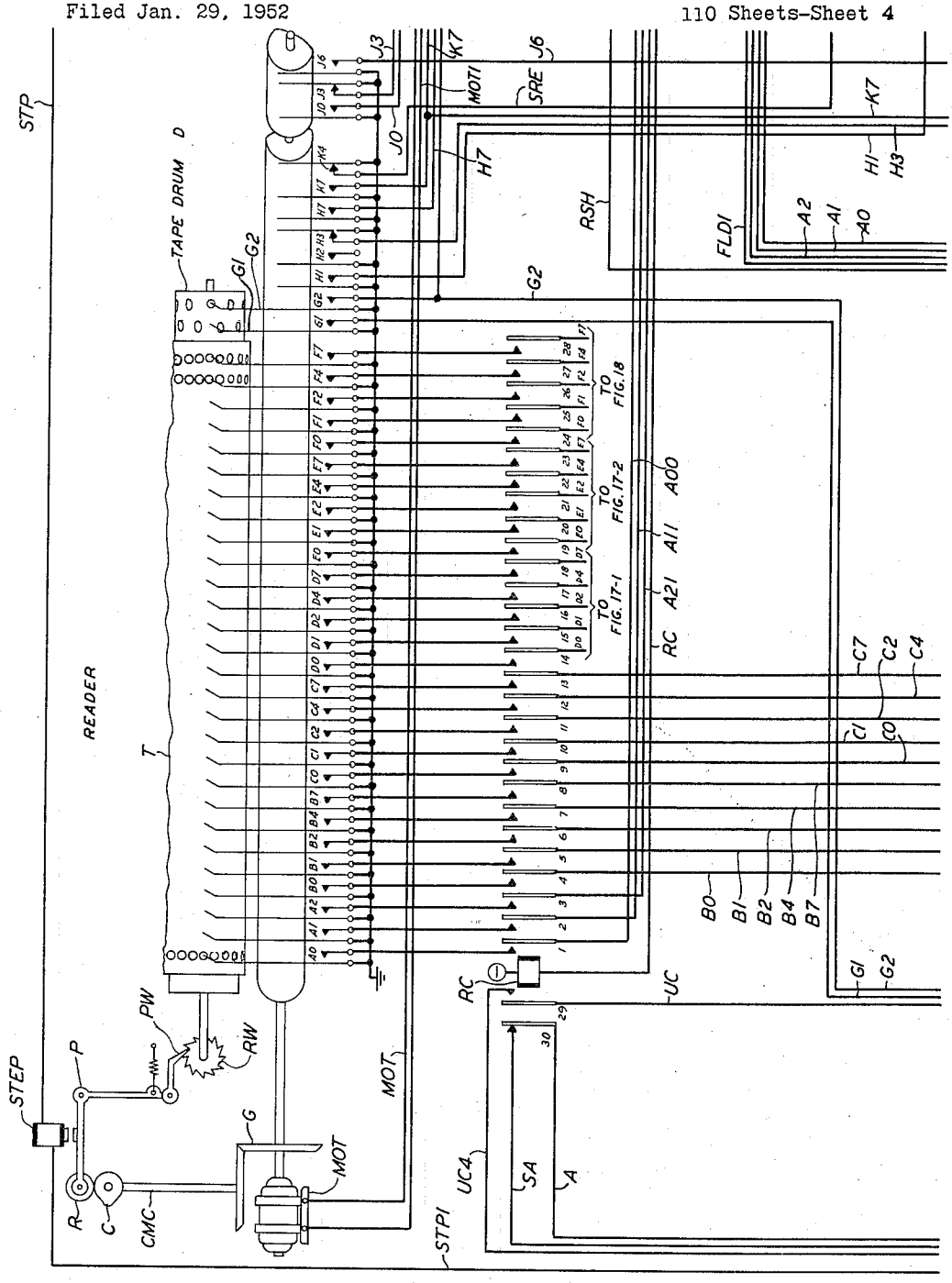


FIG. 4

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 5

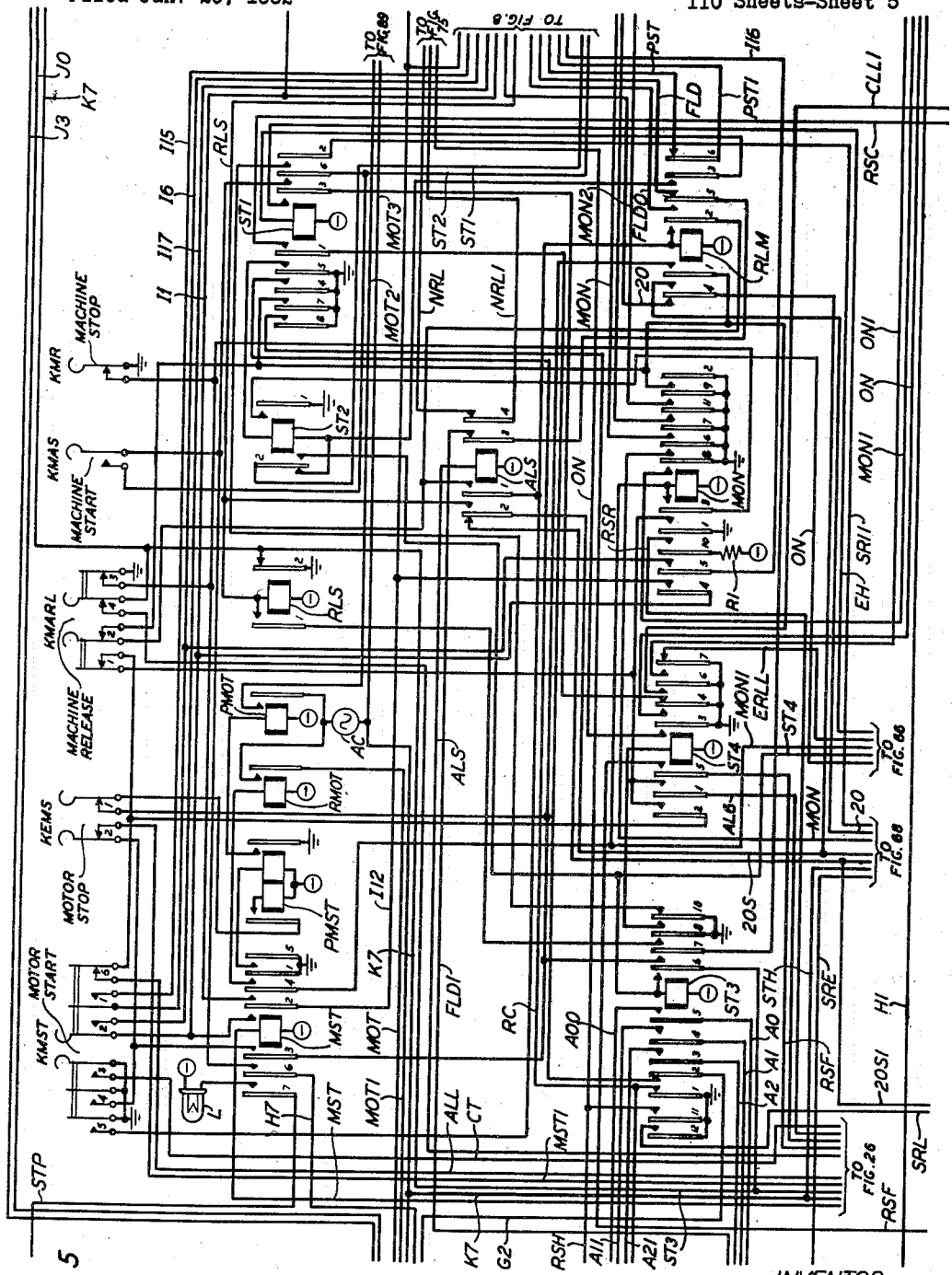


FIG. 5

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 6

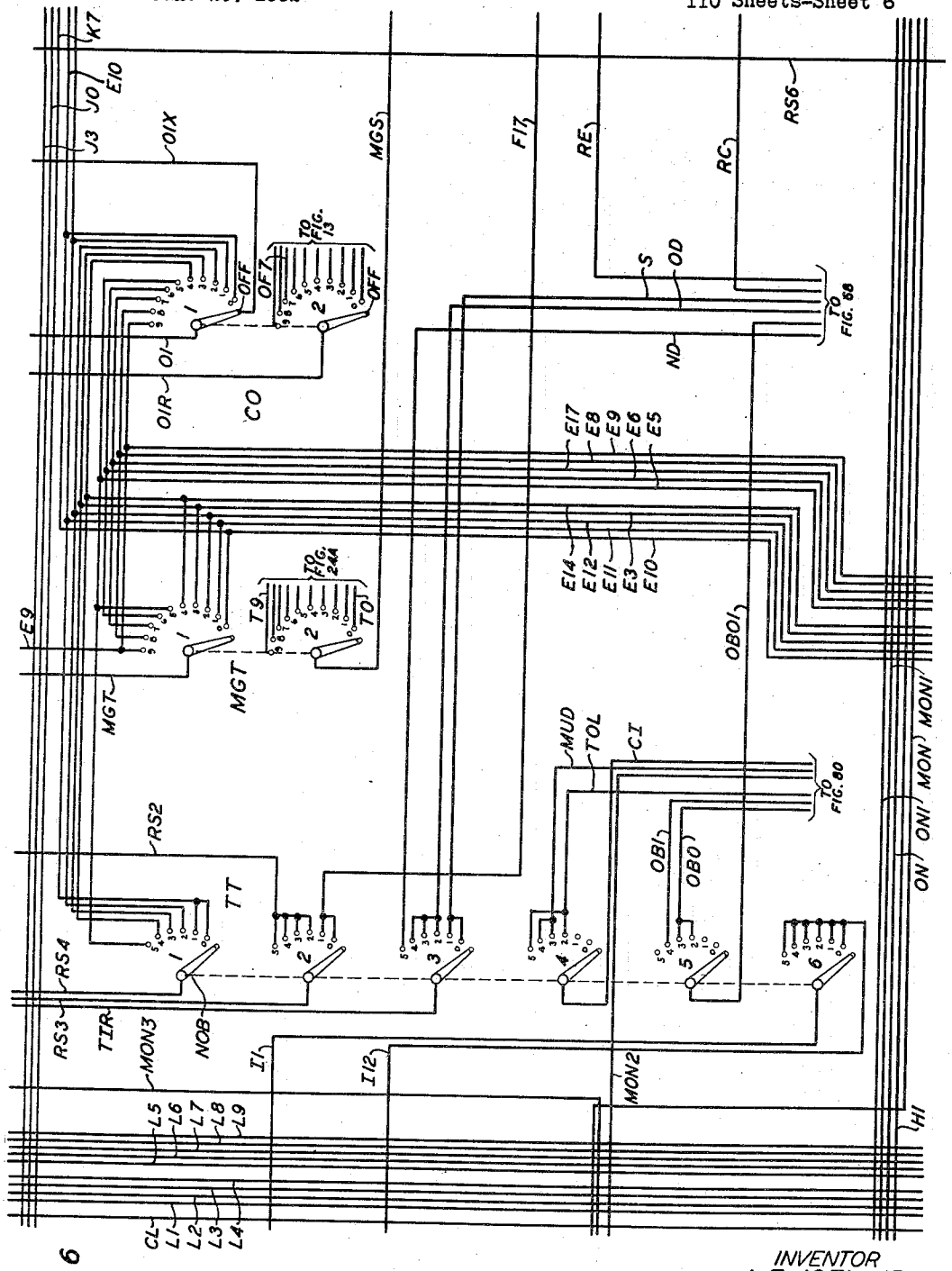


FIG. 6

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 7

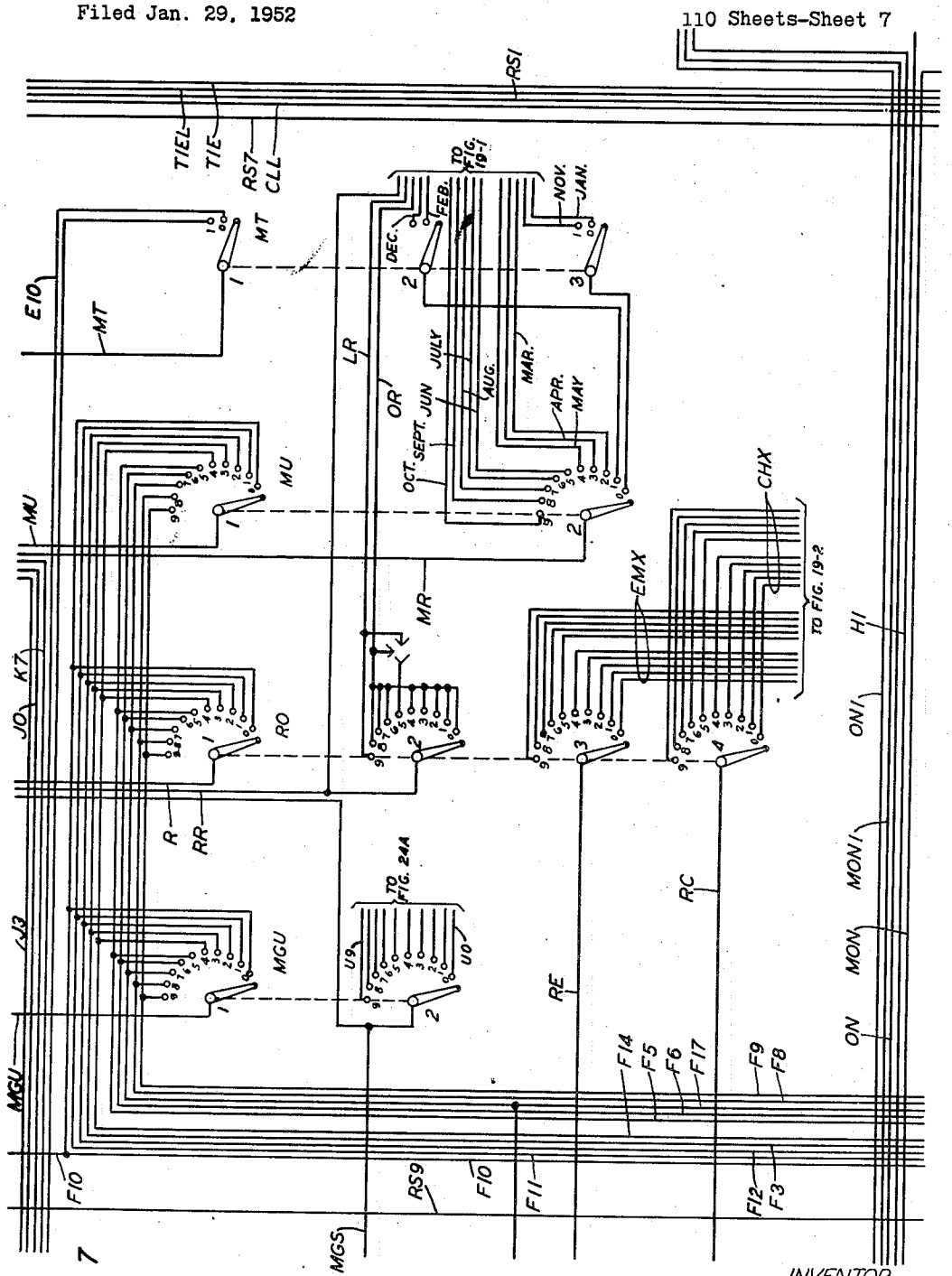


FIG. 7

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 8

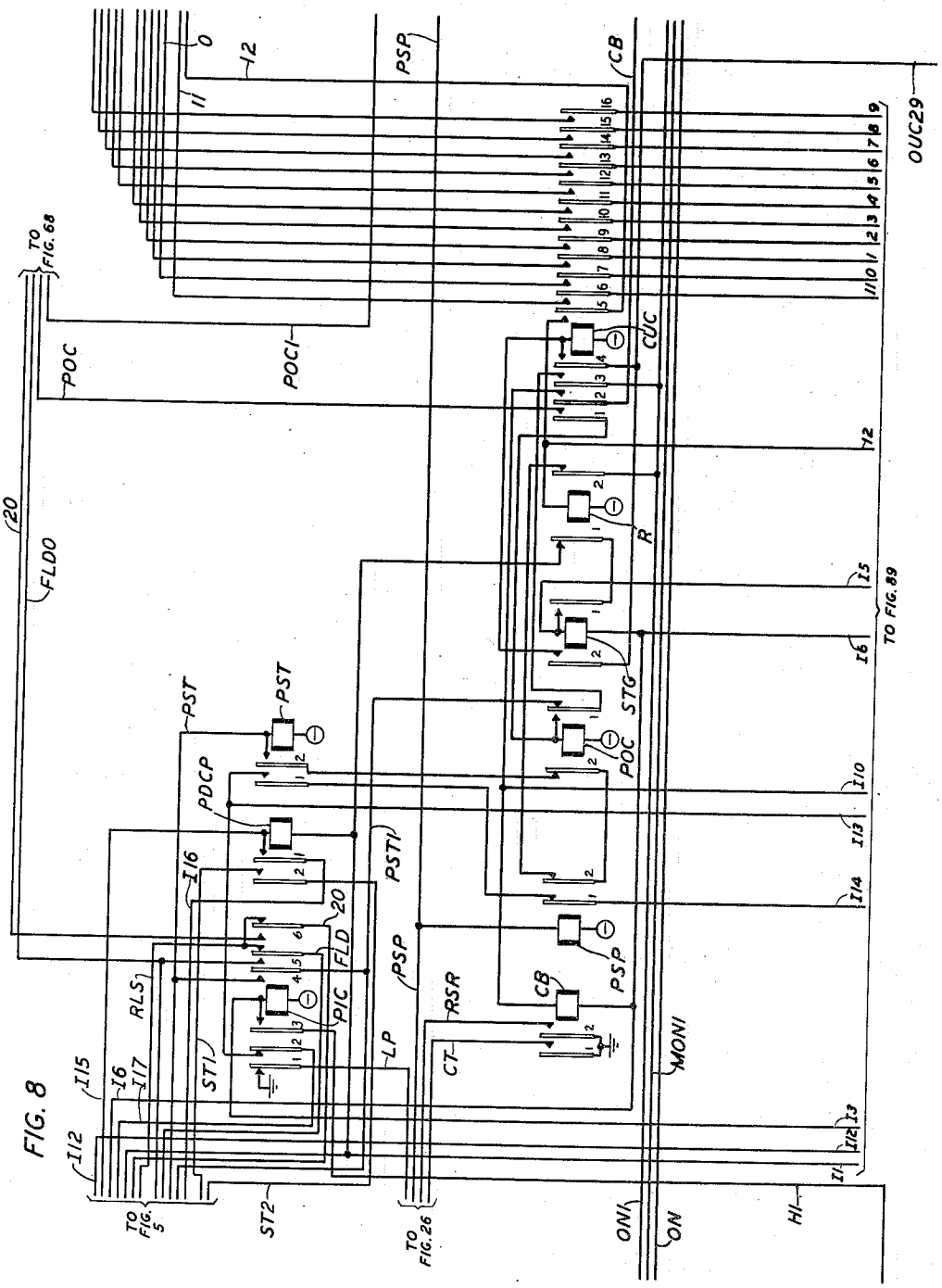


FIG. 8

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 9

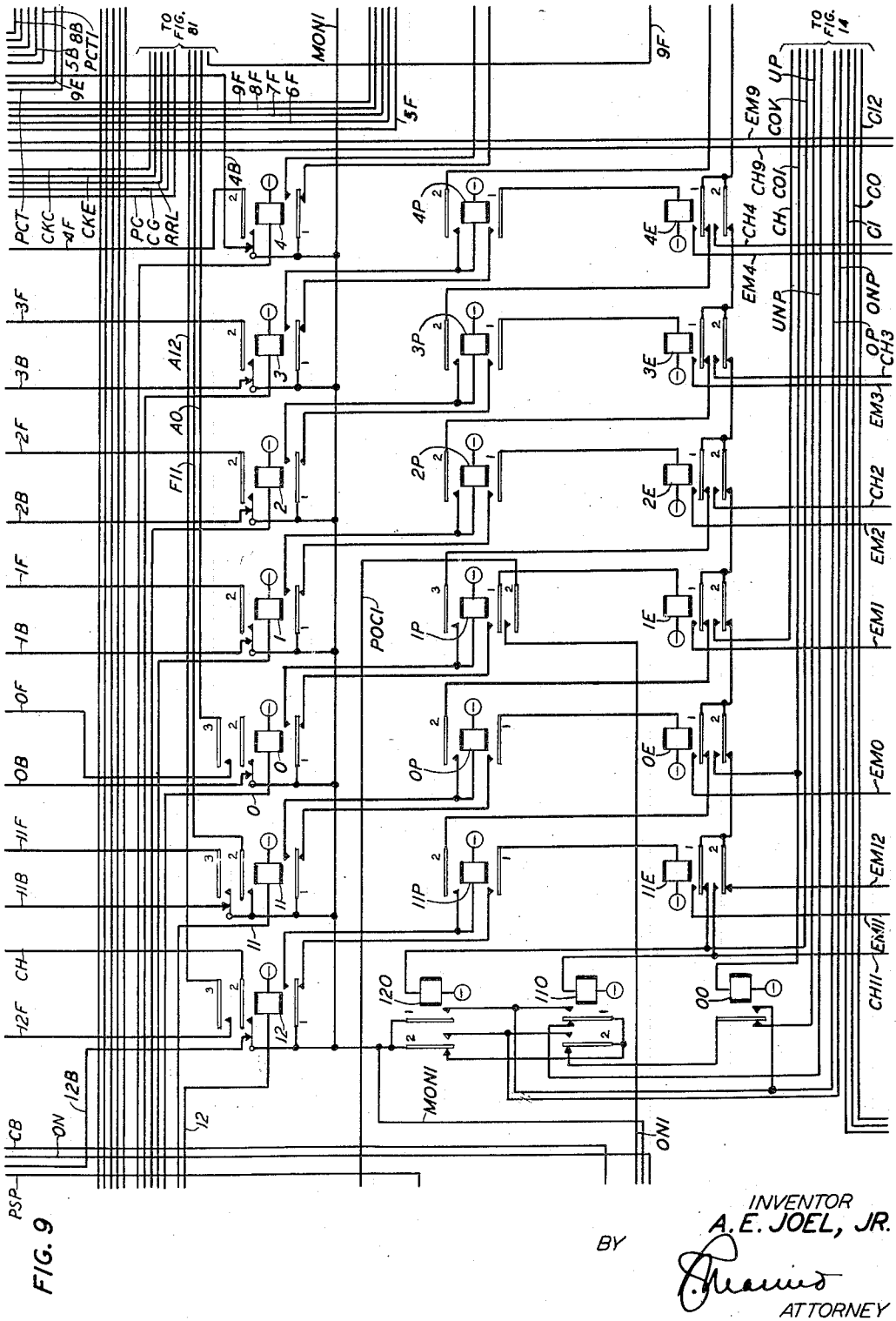


FIG. 9

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 10

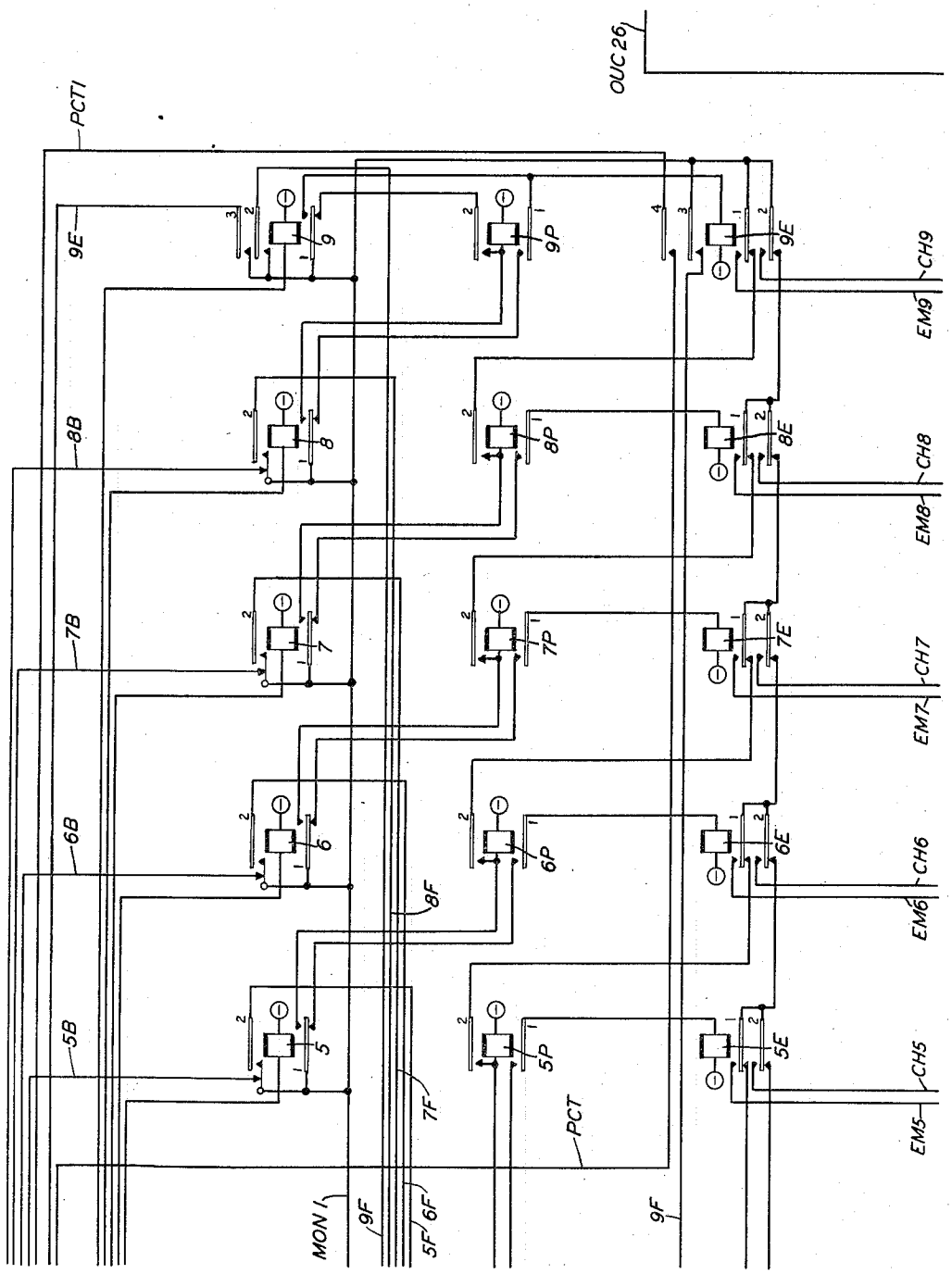


FIG. 10

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 11

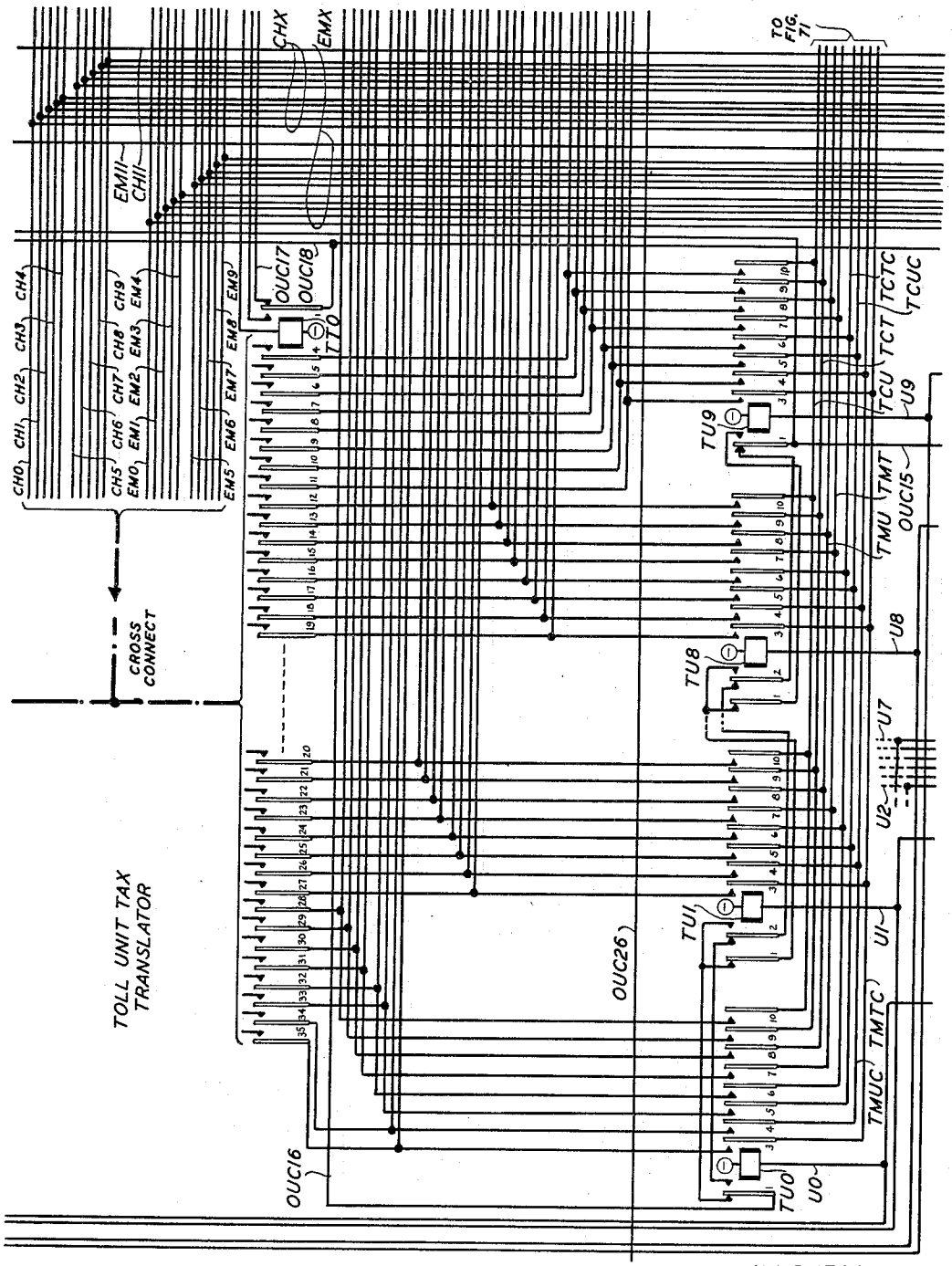


FIG. 11

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 12

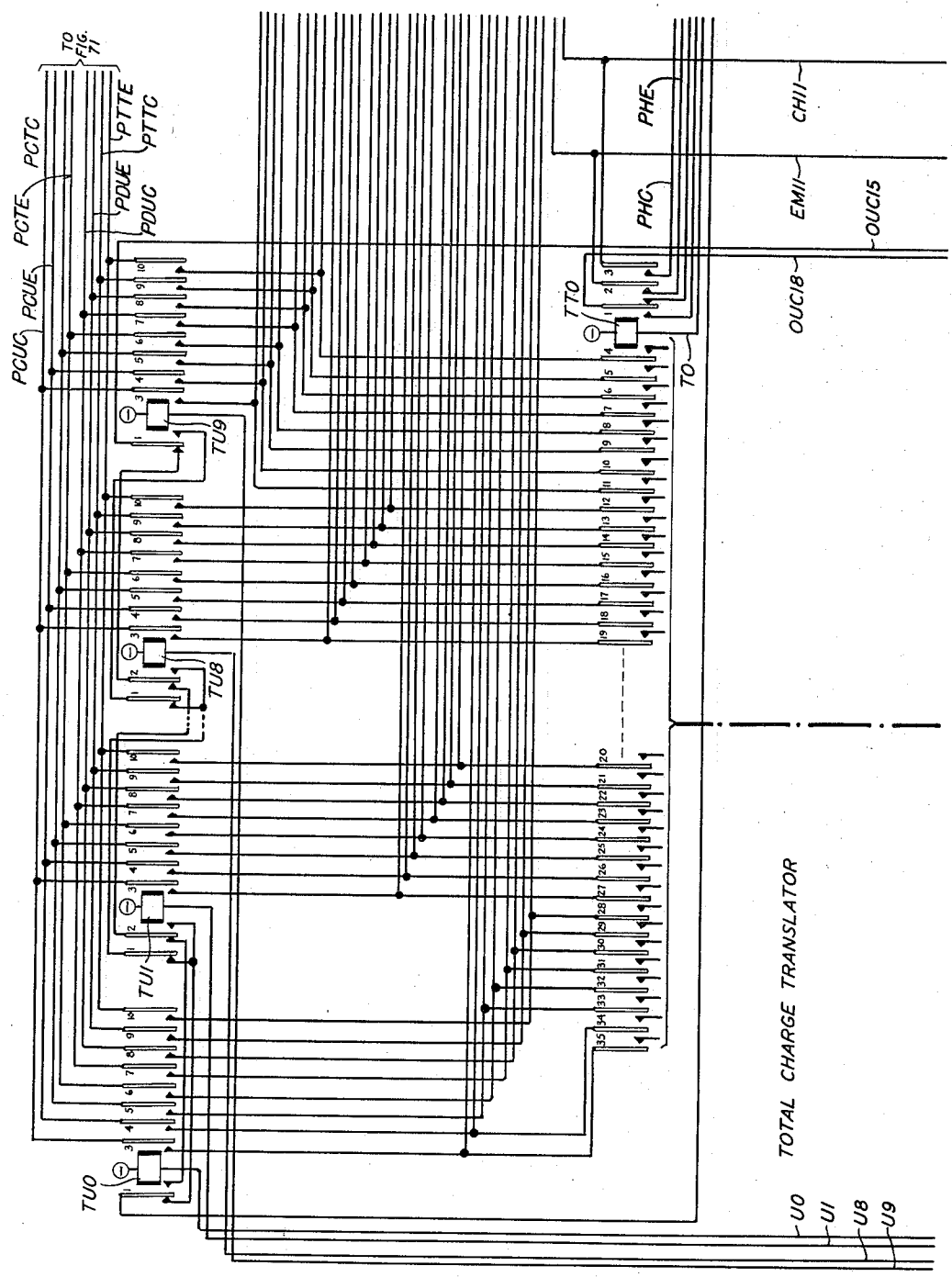


FIG. 11A

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 13

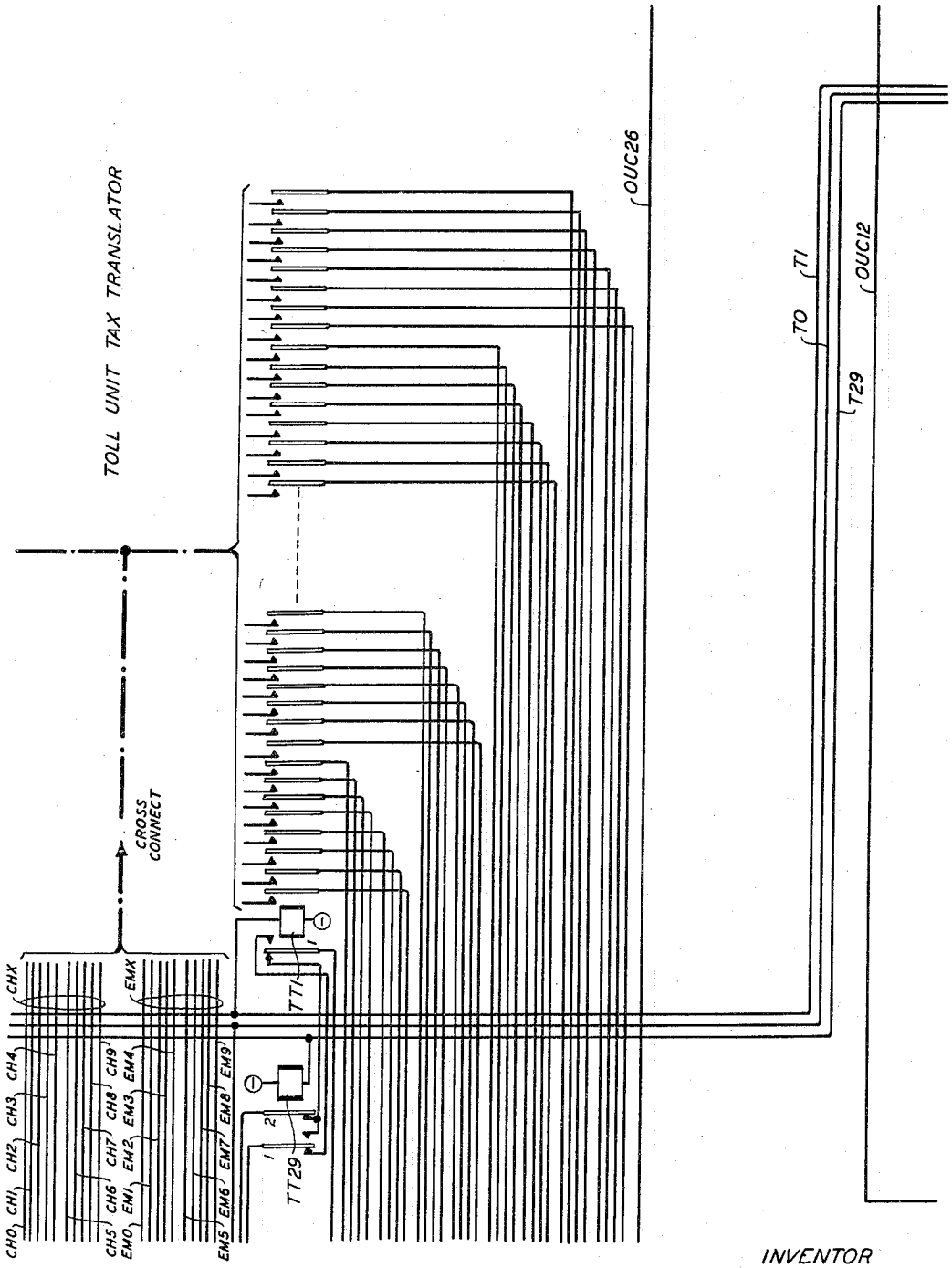


FIG. 12

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 14

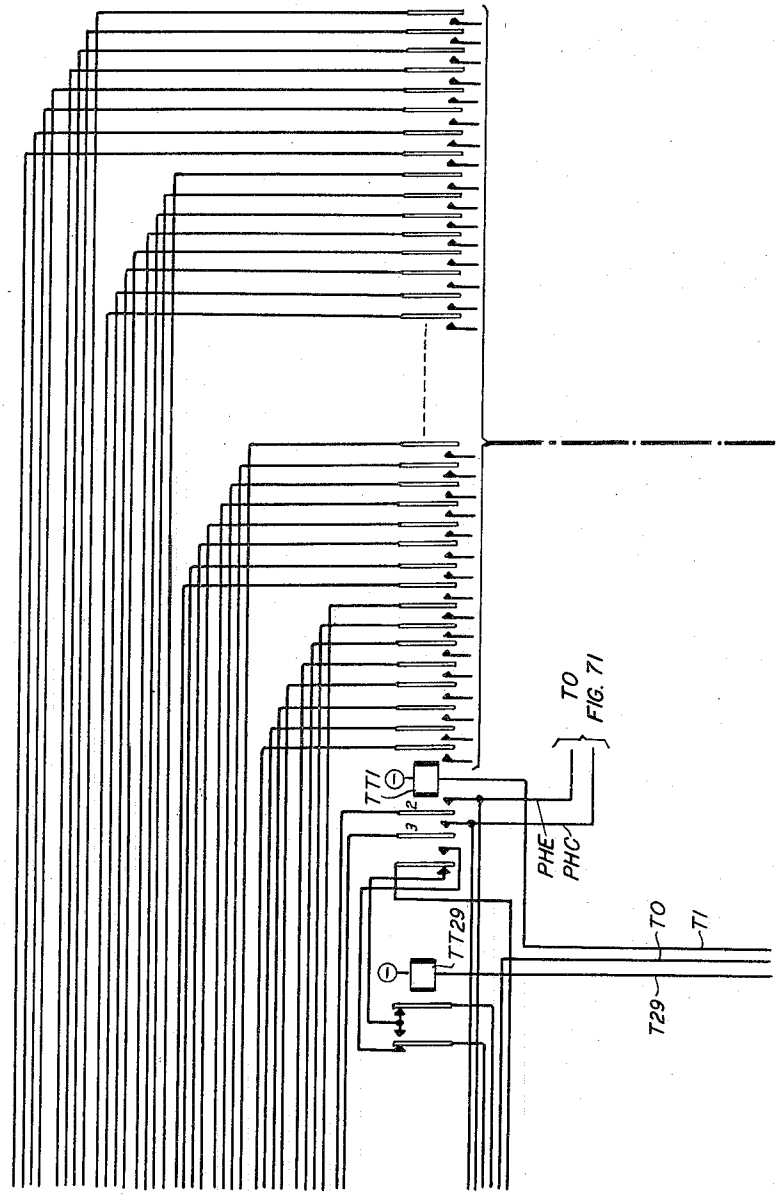


FIG. 12A

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 15

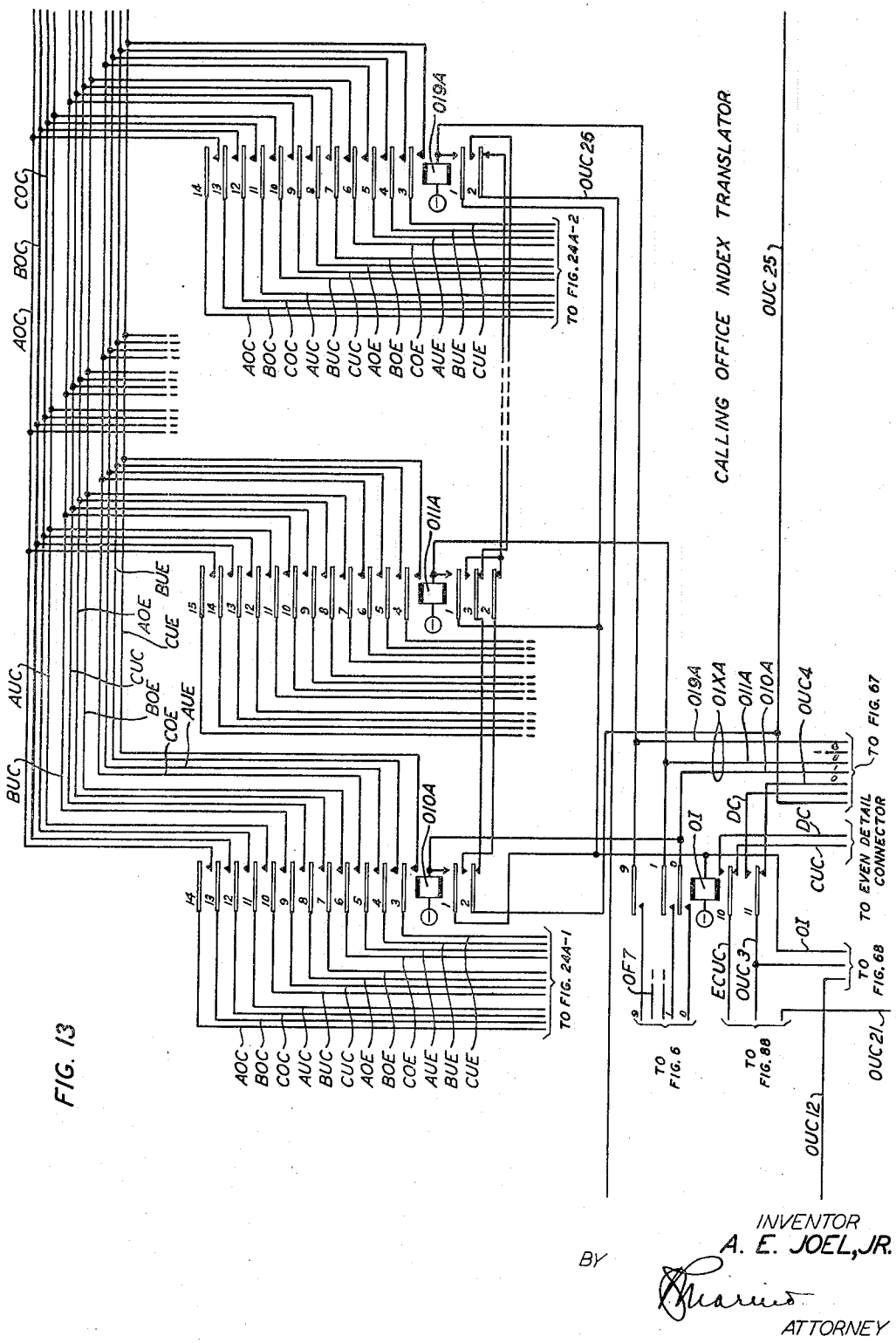


FIG. 13

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 16

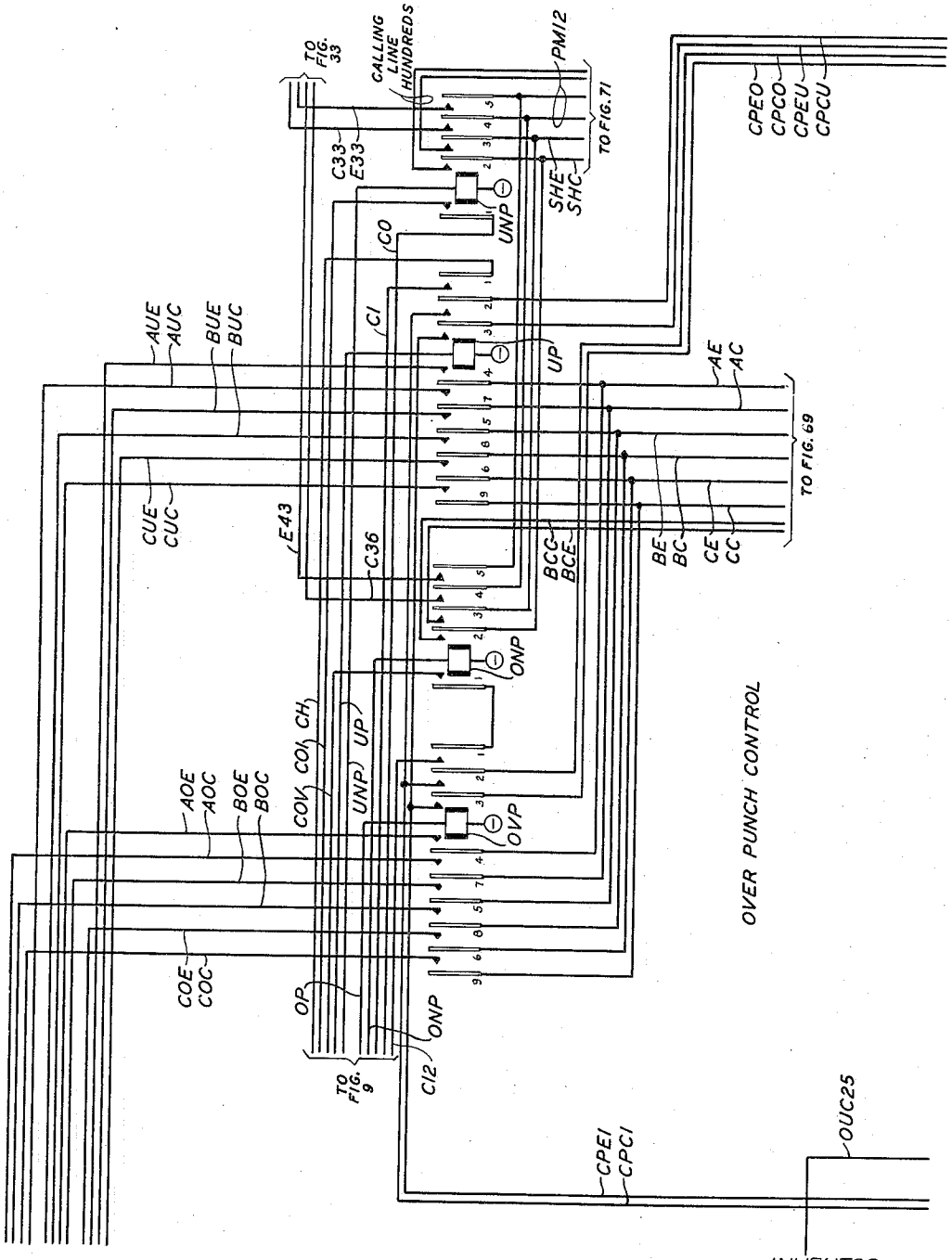


FIG. 14

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 17

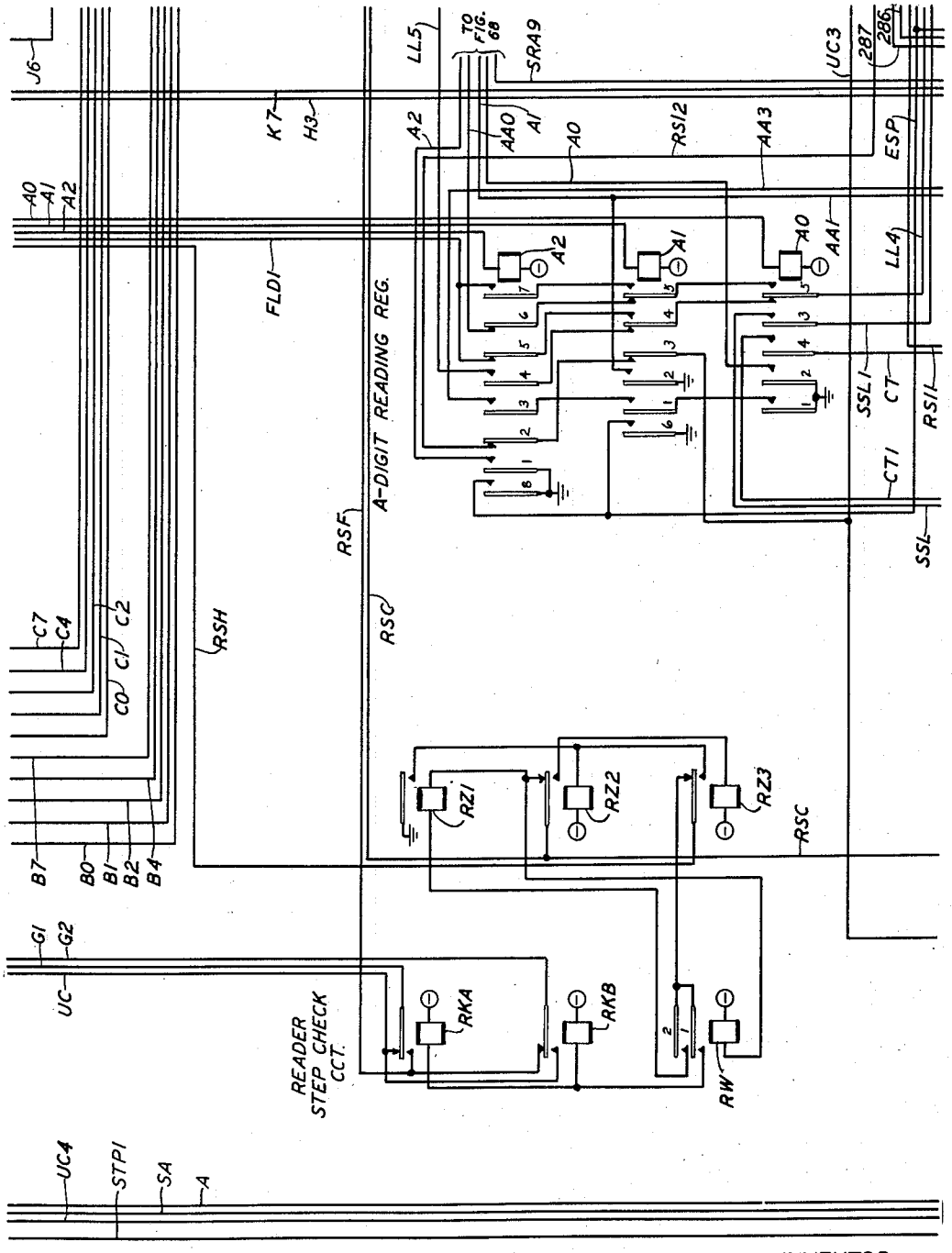


FIG. 15

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 18

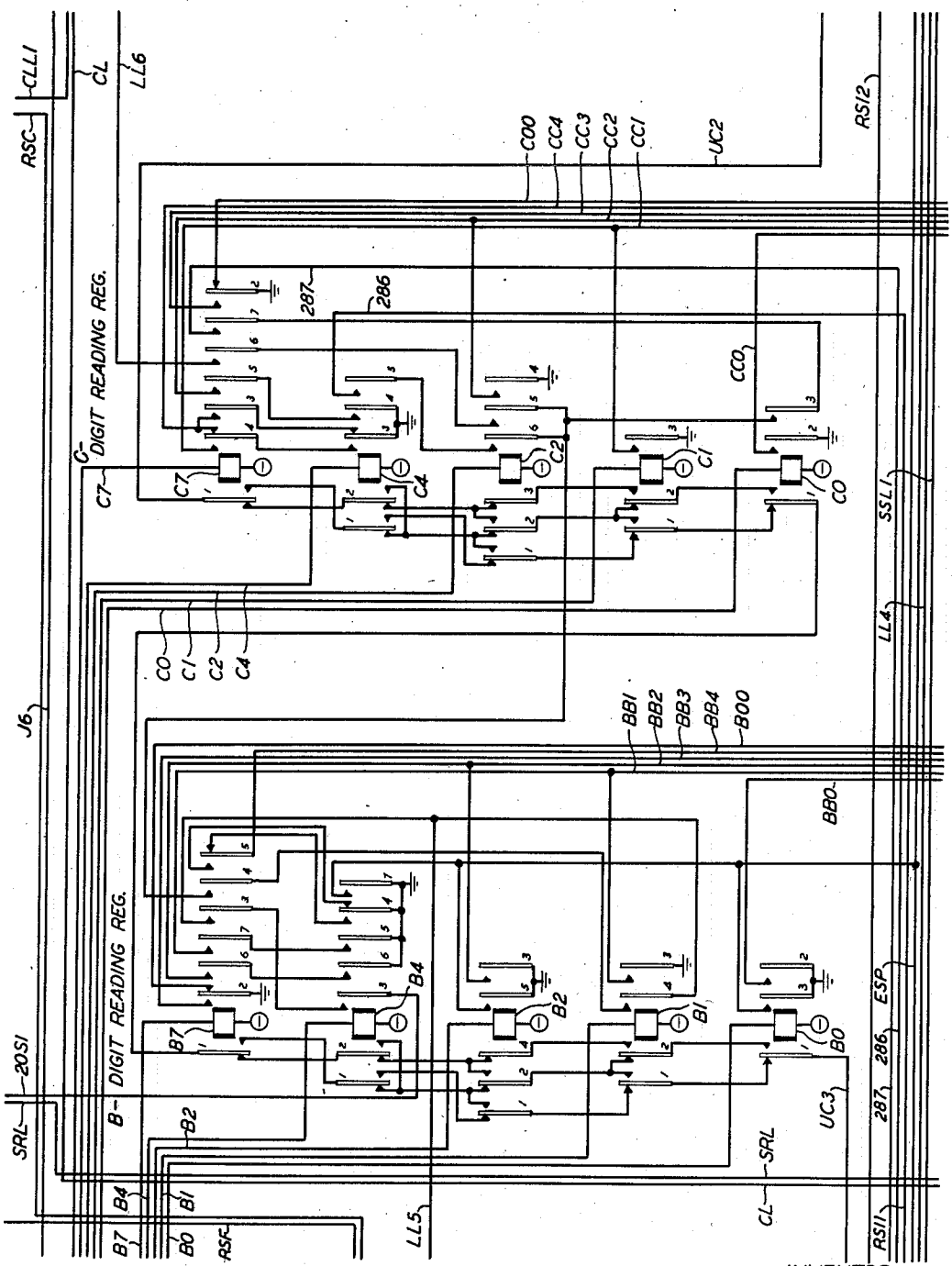


FIG. 16

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 19

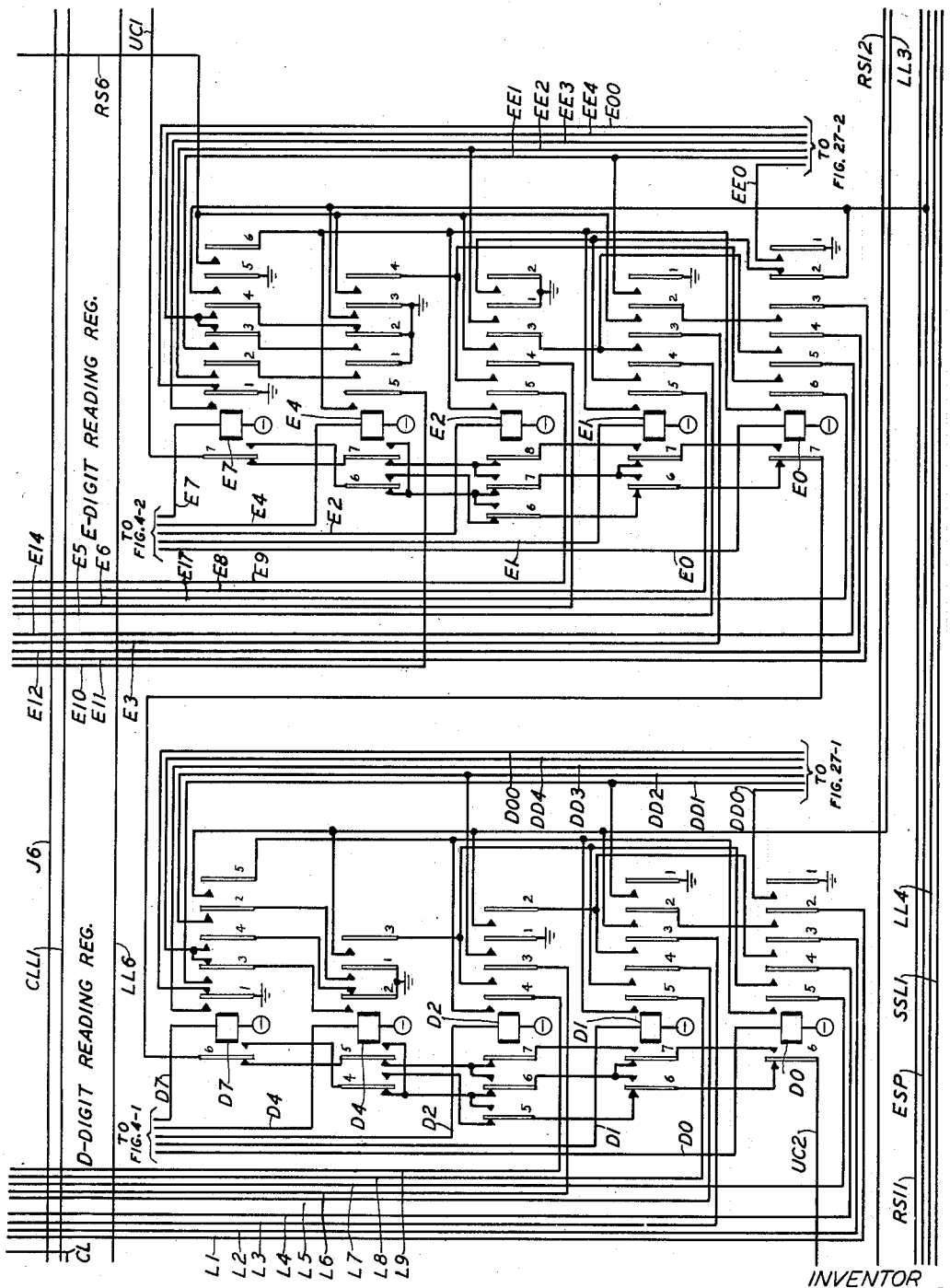


FIG. 17

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 20

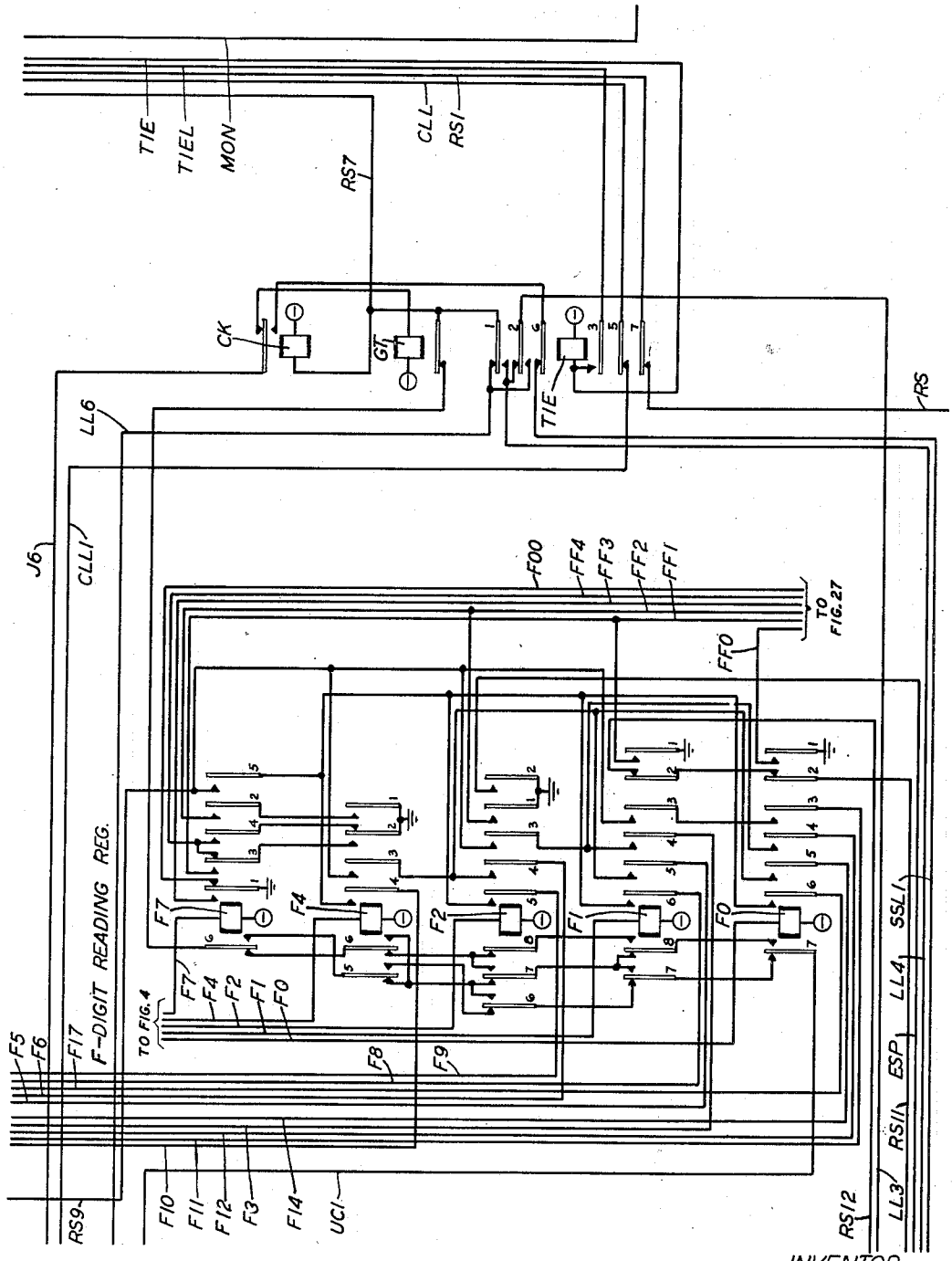


FIG. 18

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 21

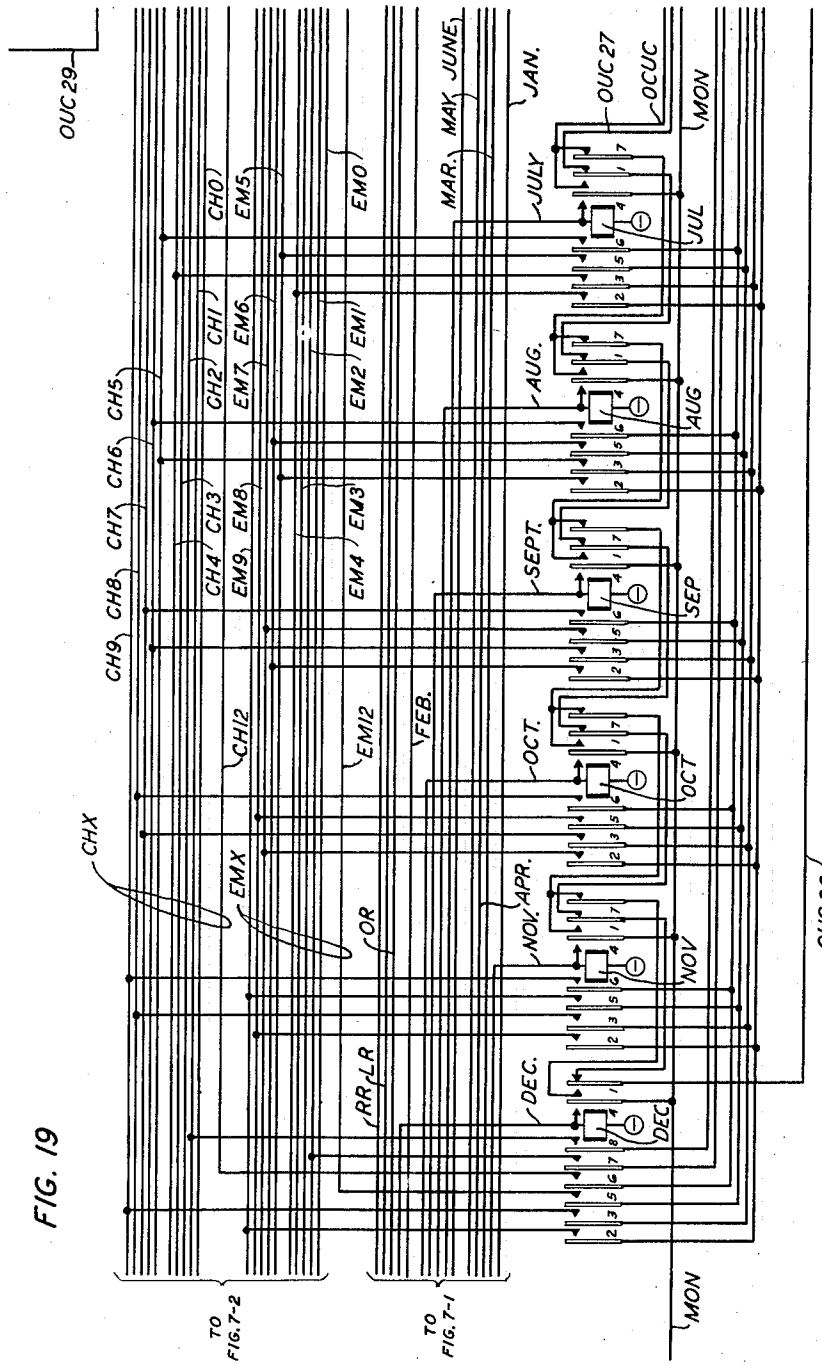


FIG. 19

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 22

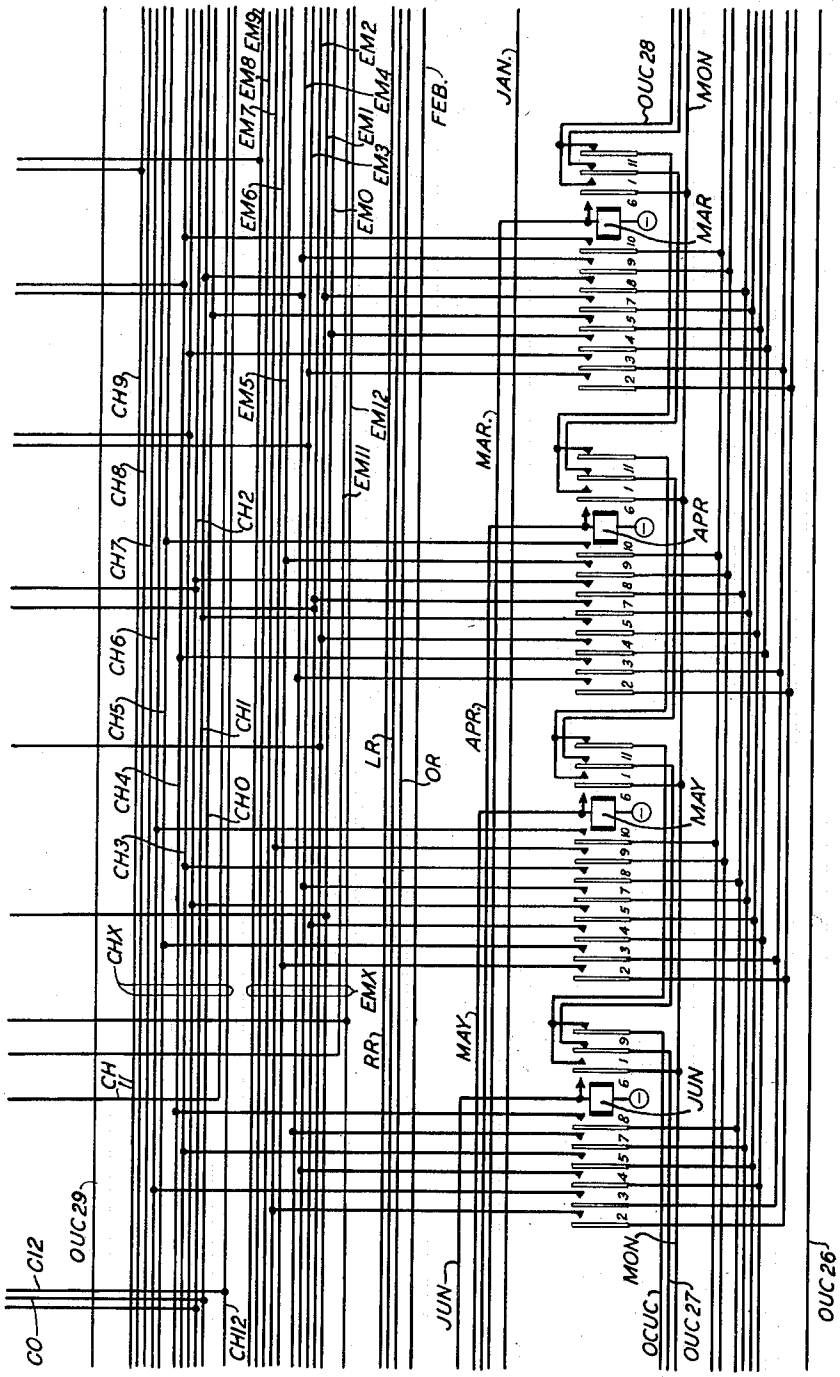


FIG. 20

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 23

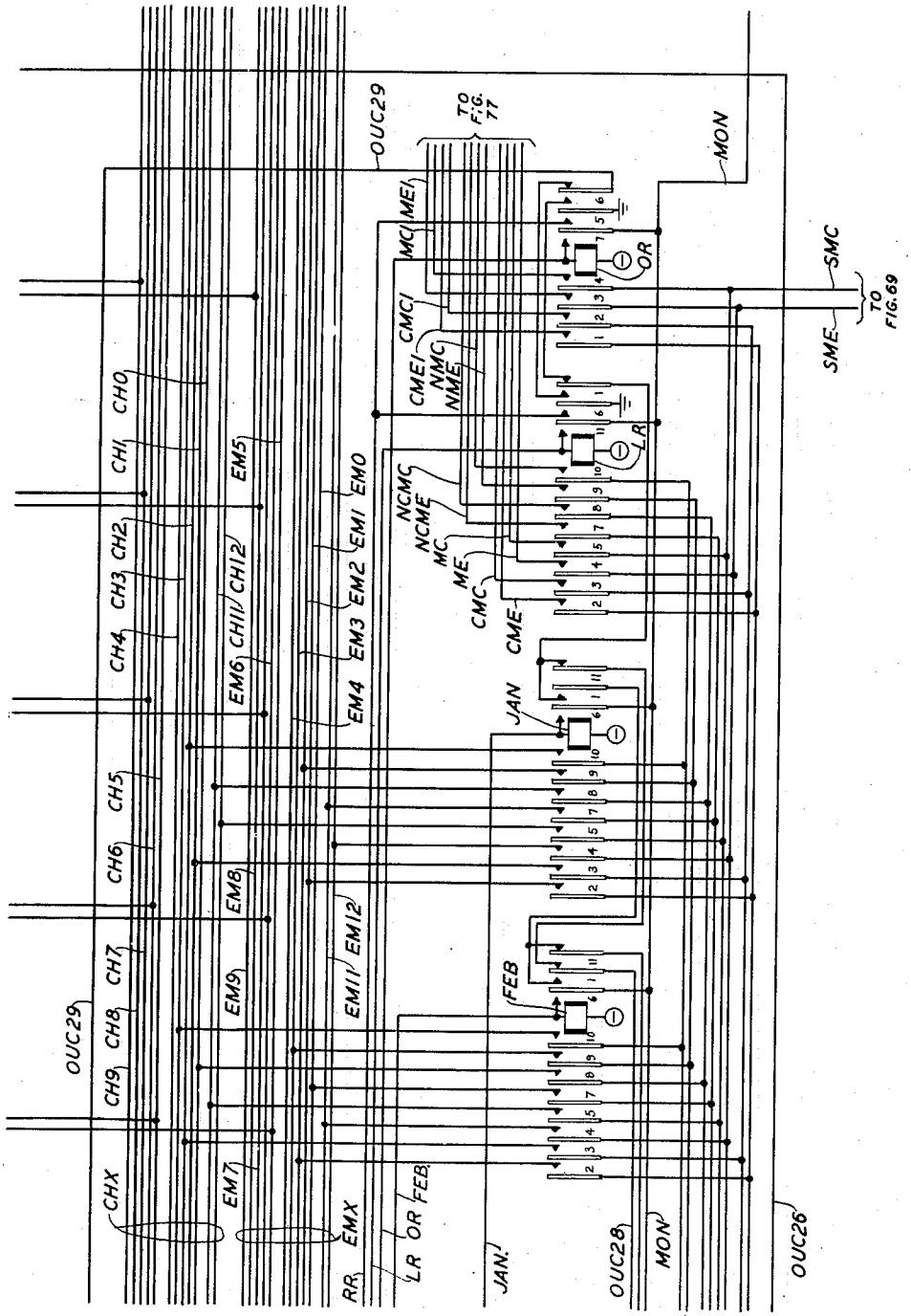


FIG. 21

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 24

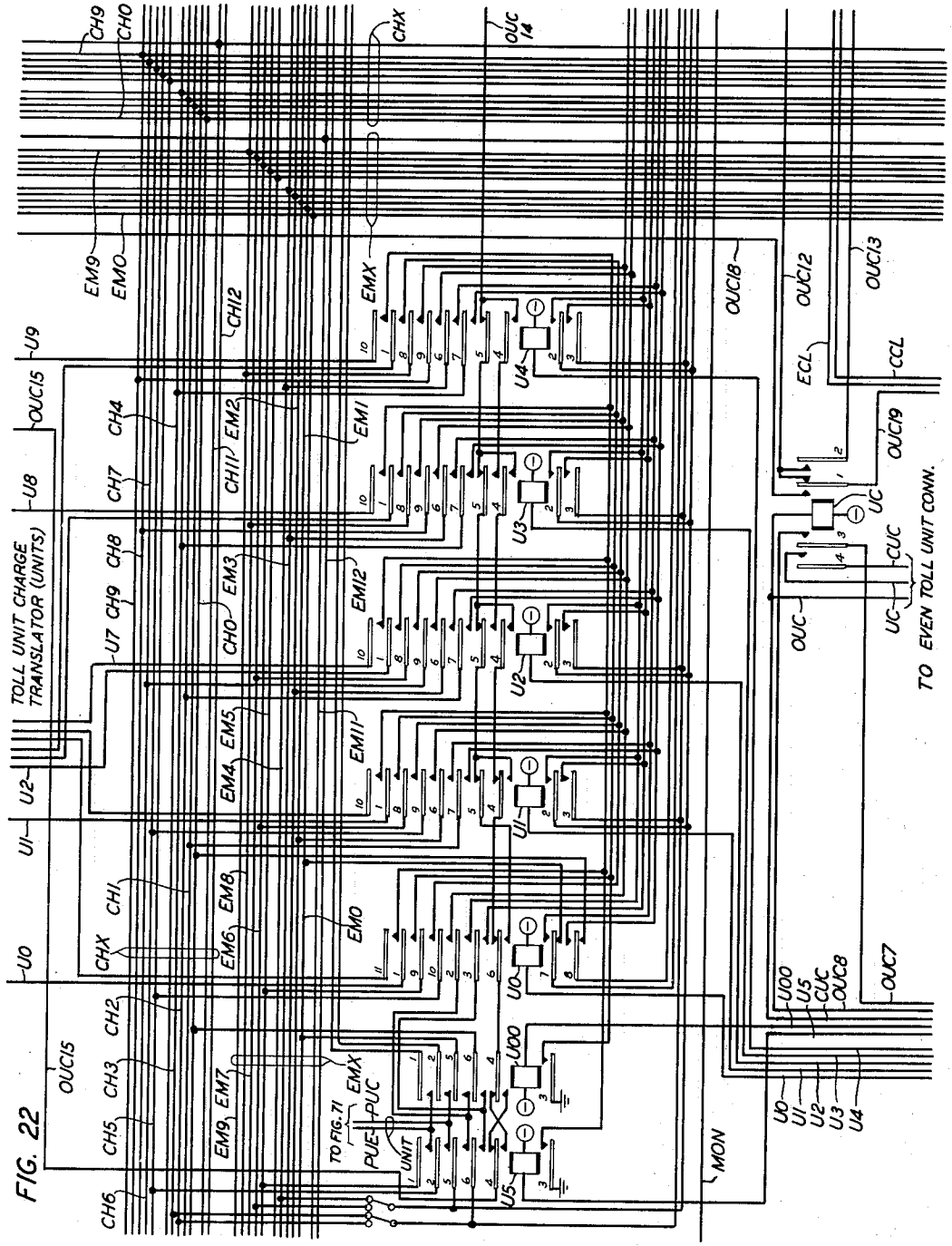


FIG. 22

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 25

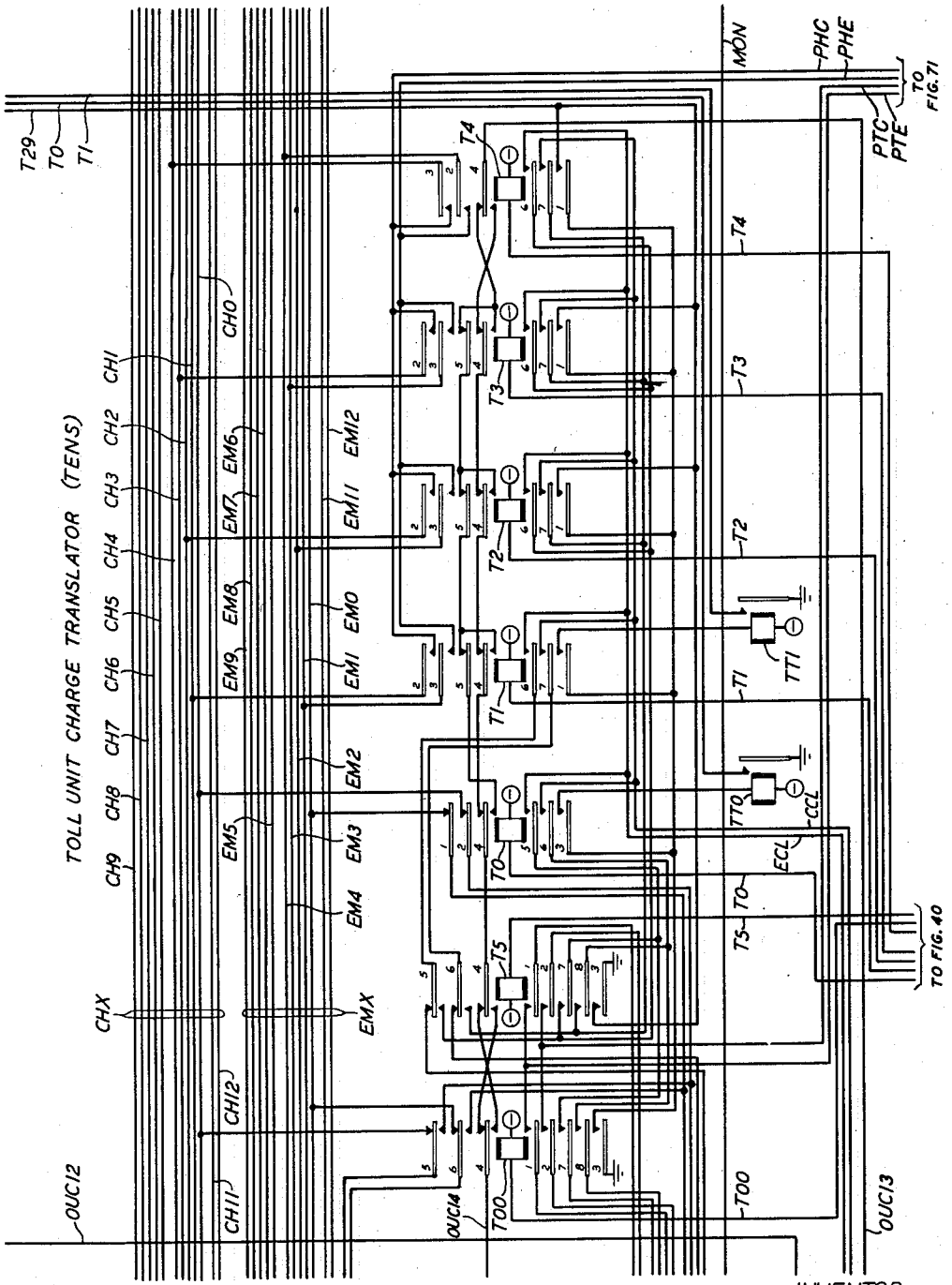


FIG. 23

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 26

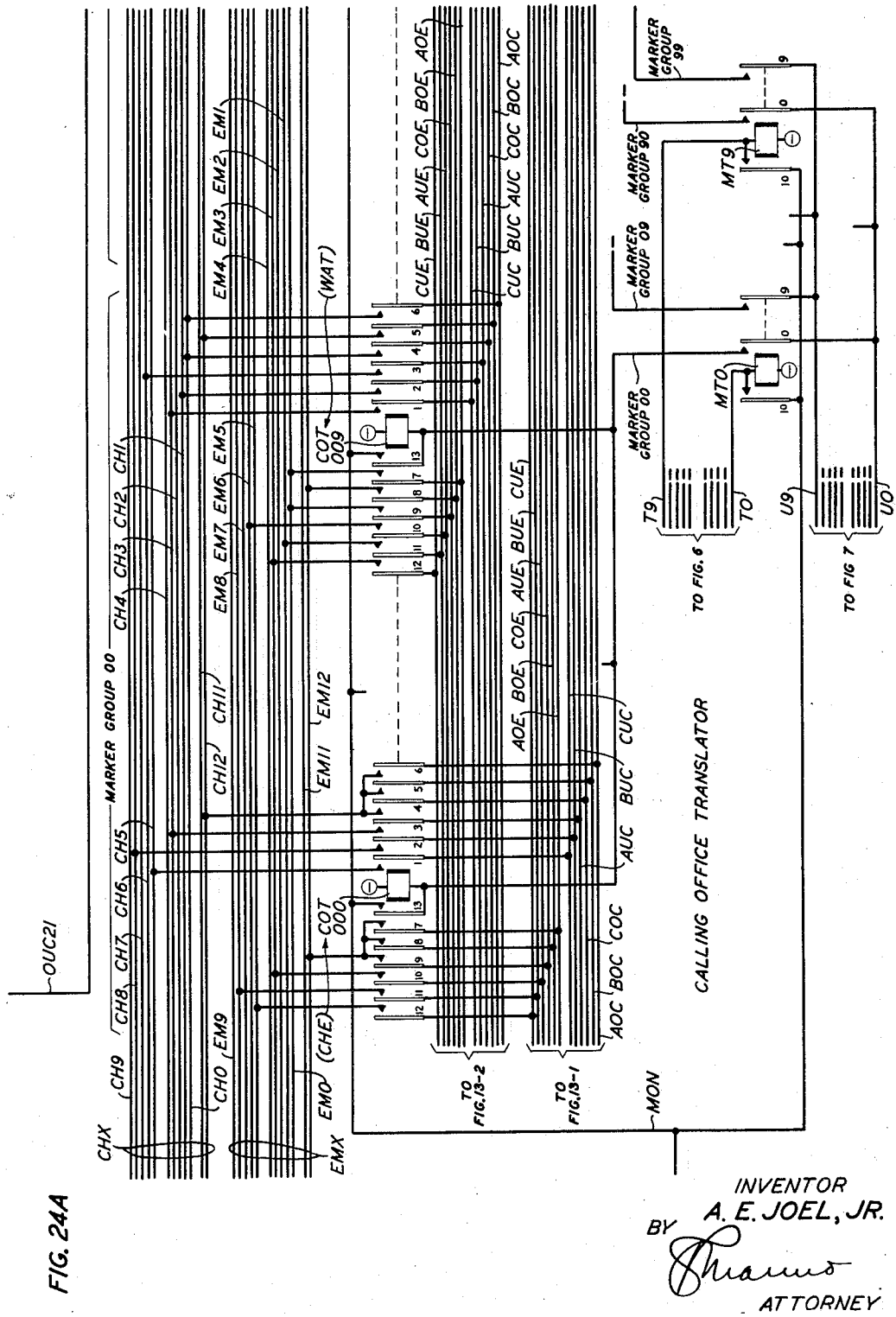


FIG. 24A

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 27

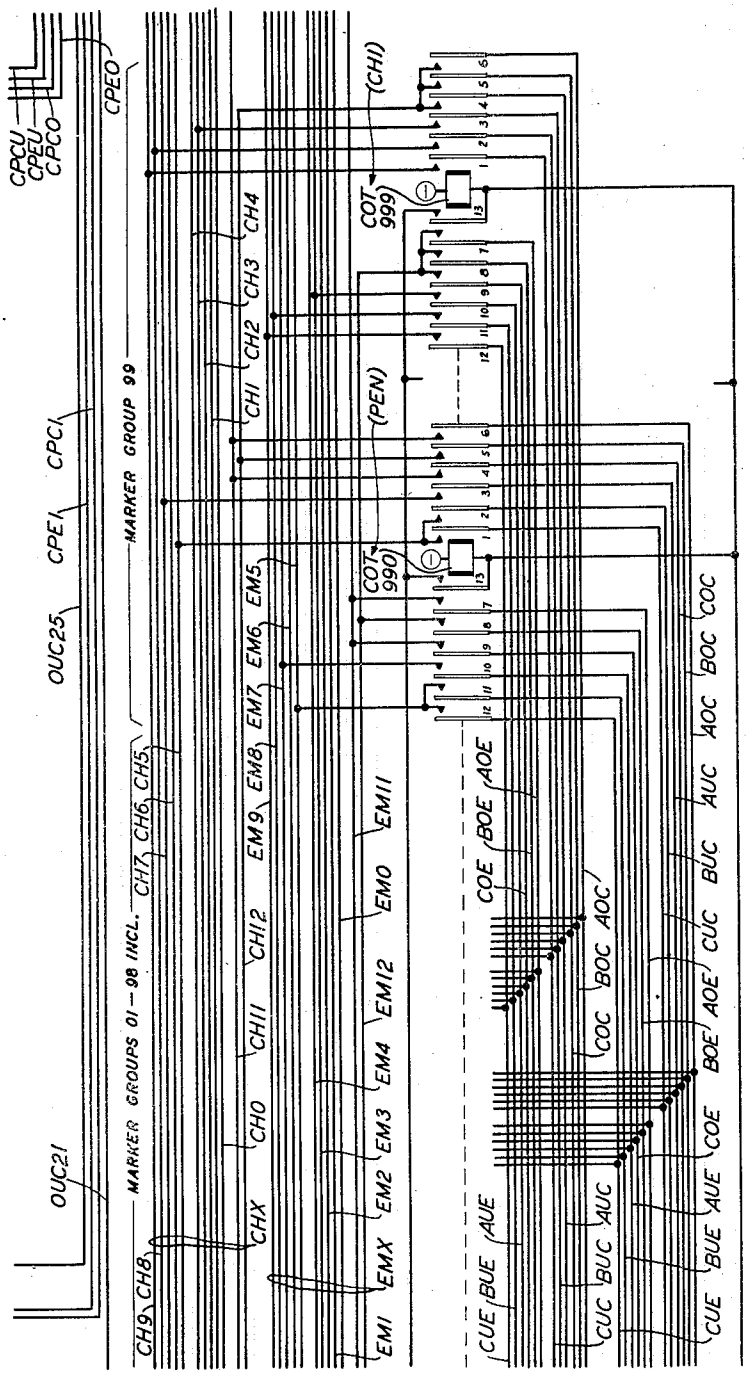


FIG. 24B

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 28

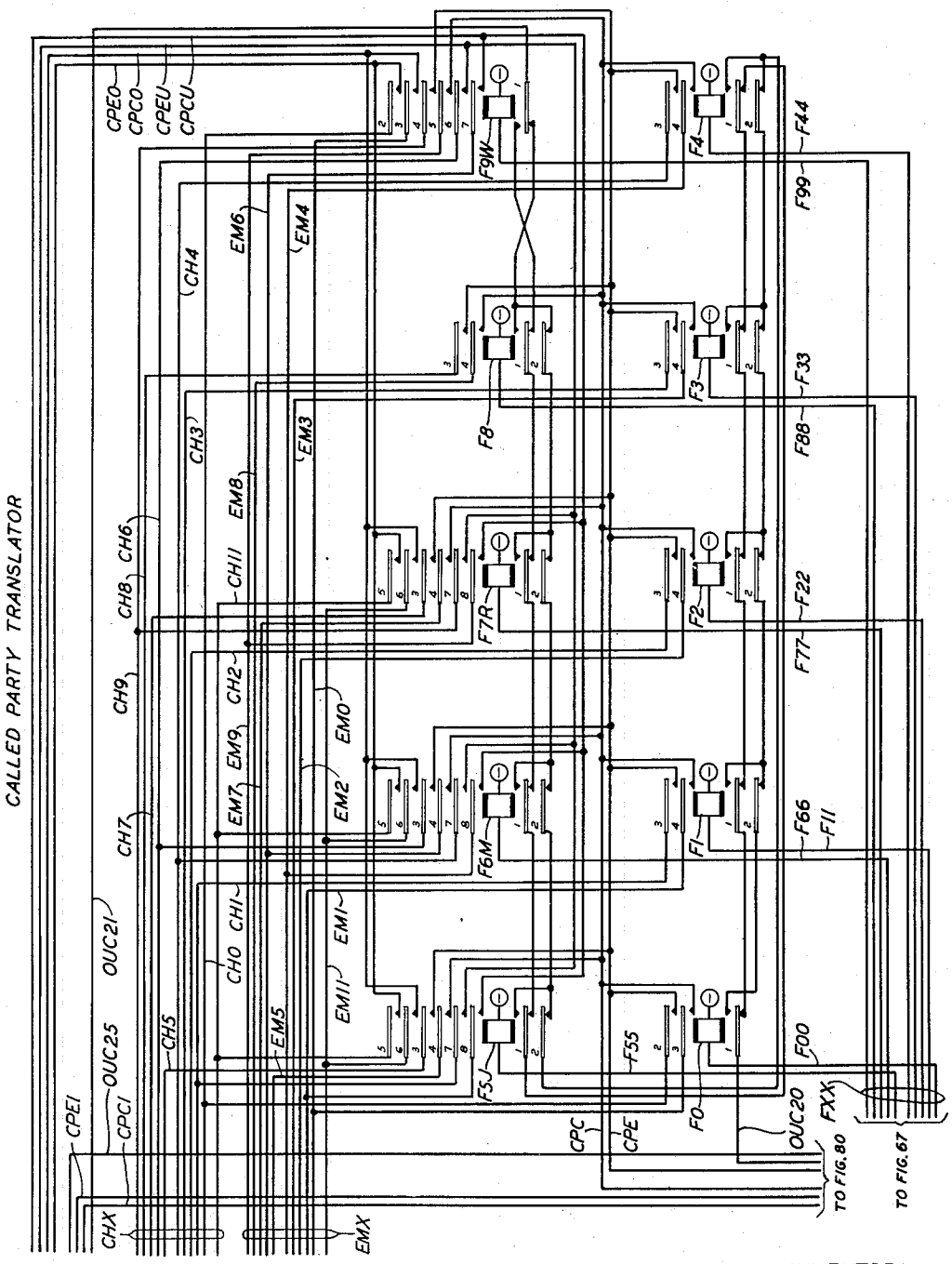


FIG. 25

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 29

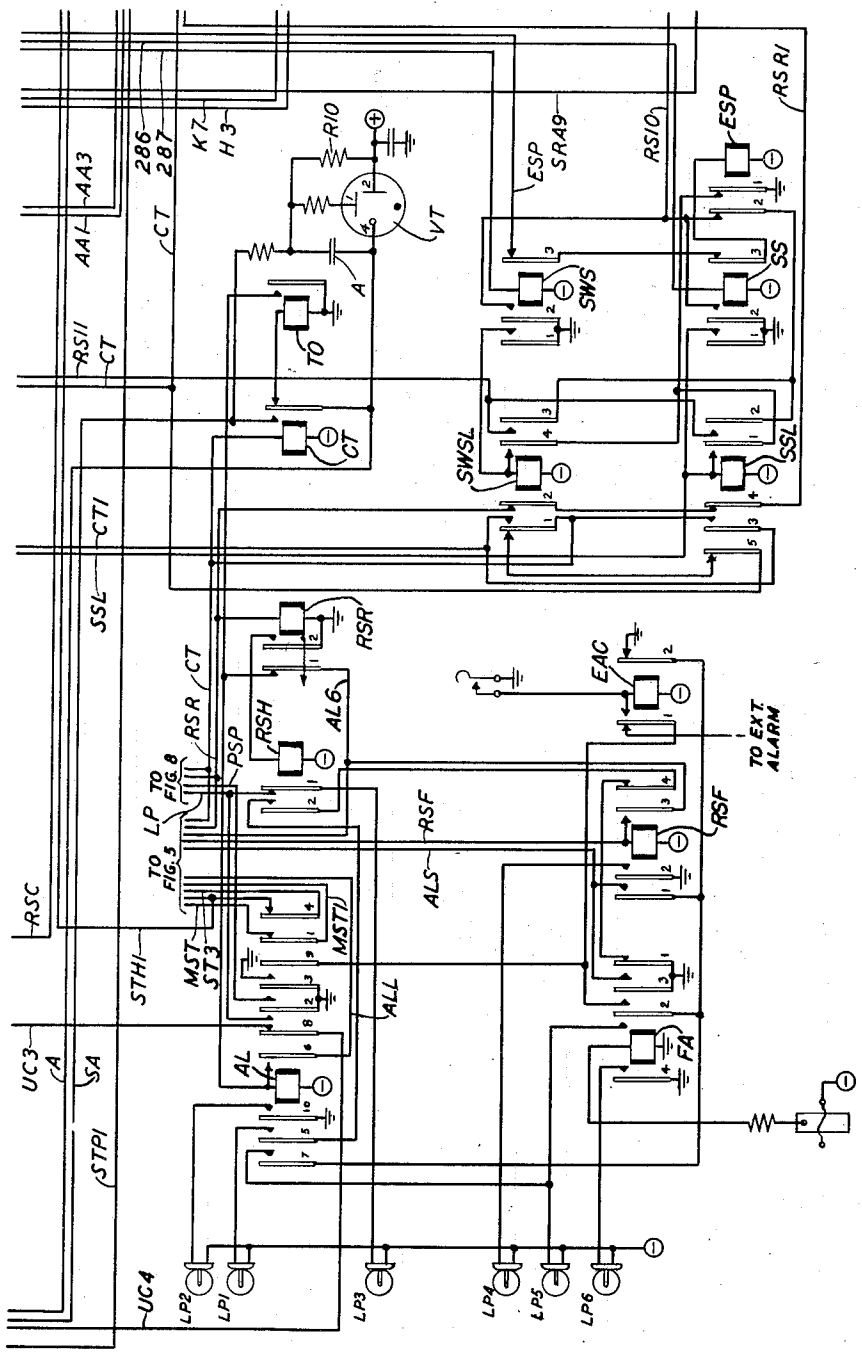


FIG. 26

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 30

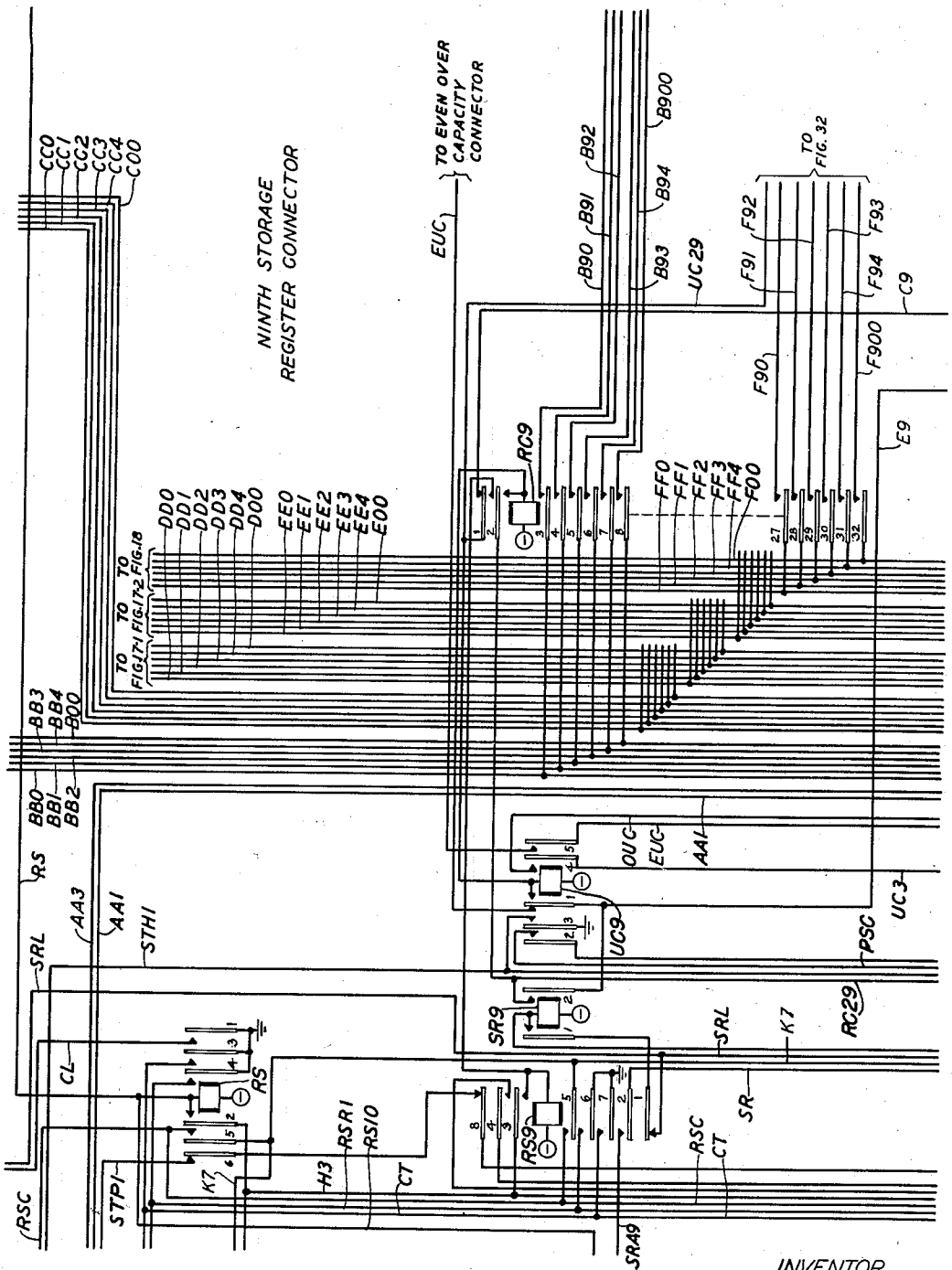


FIG. 27

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 31

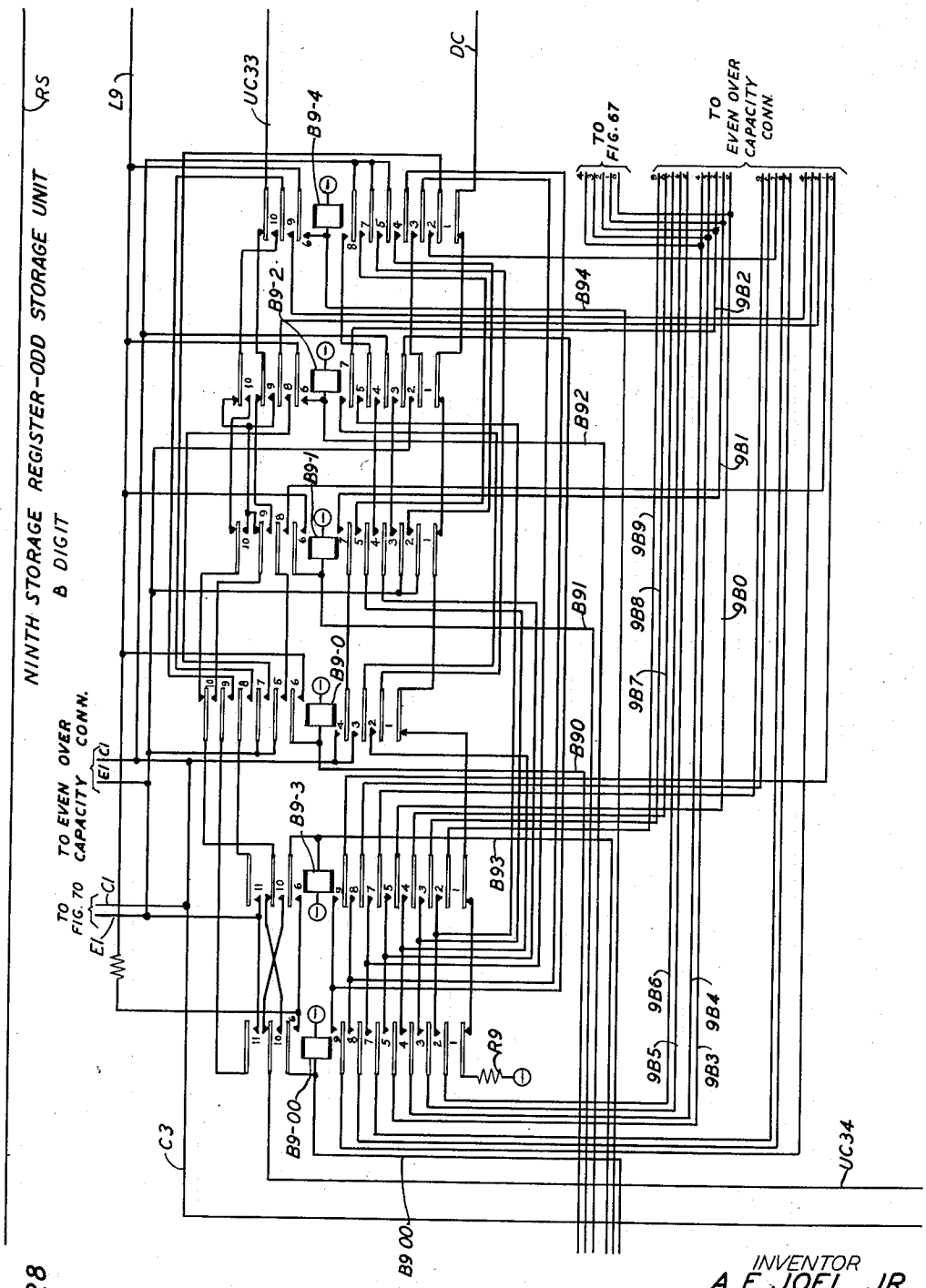


FIG. 28

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 32

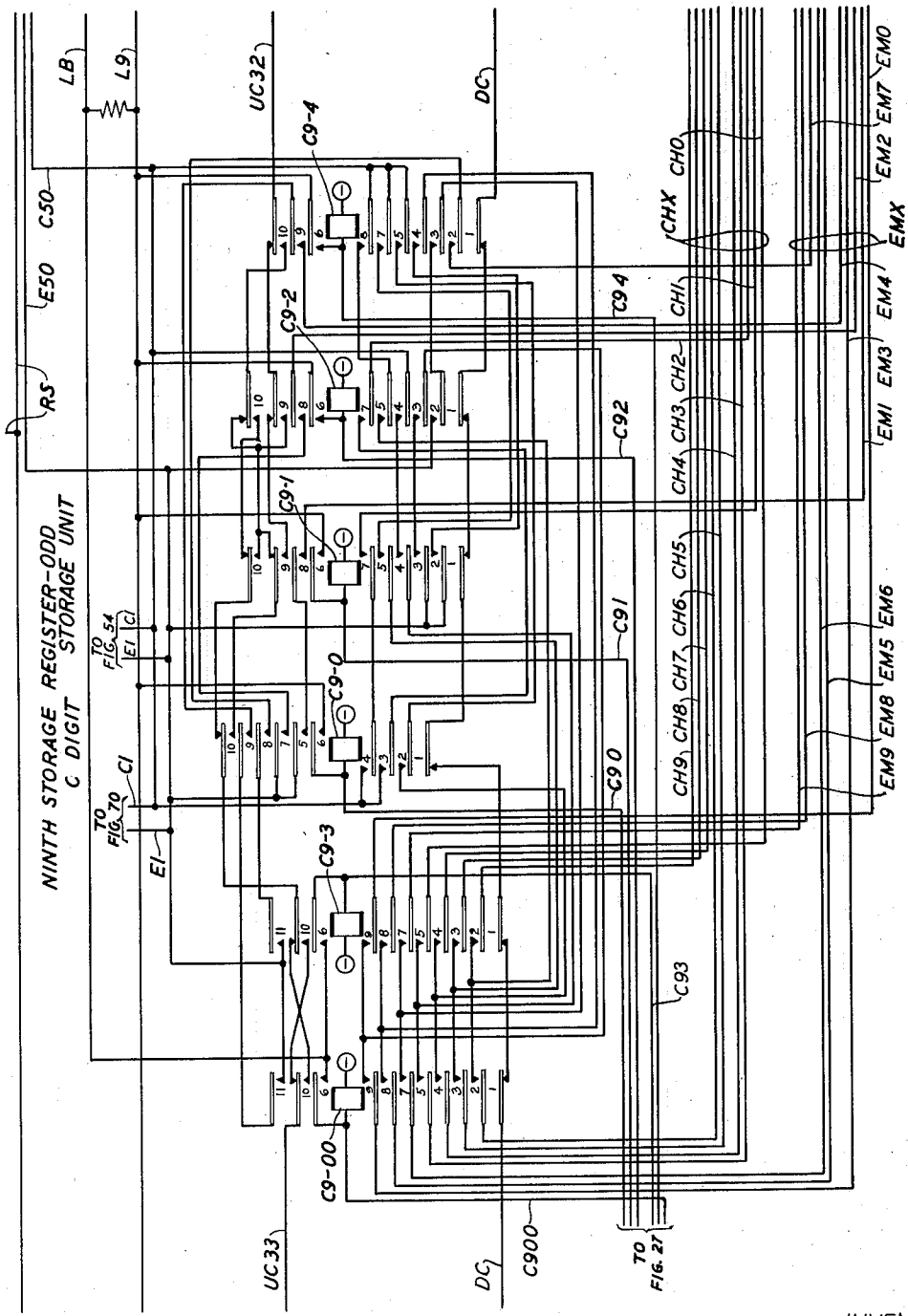


FIG. 29

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 33

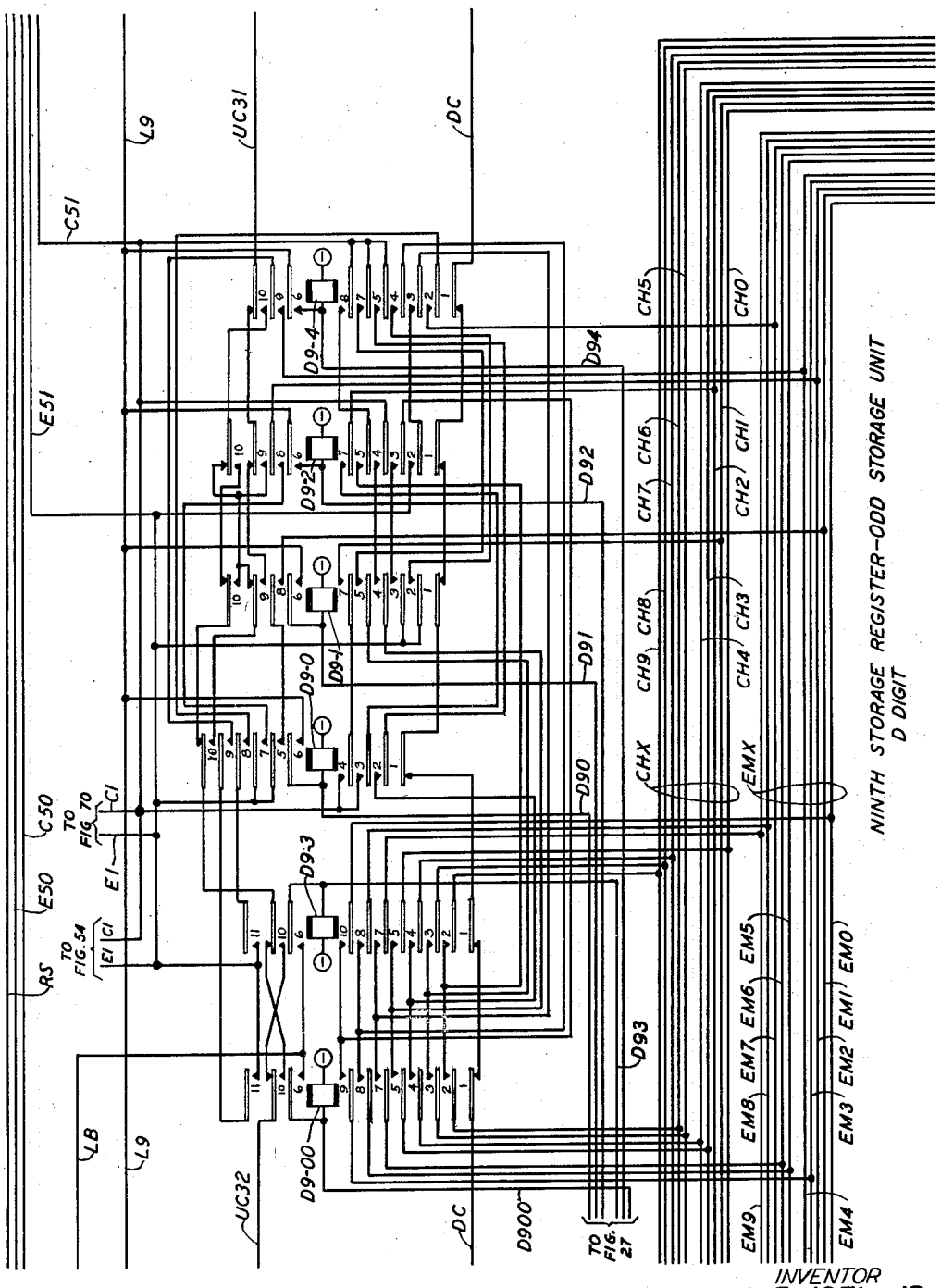


FIG. 30

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 34

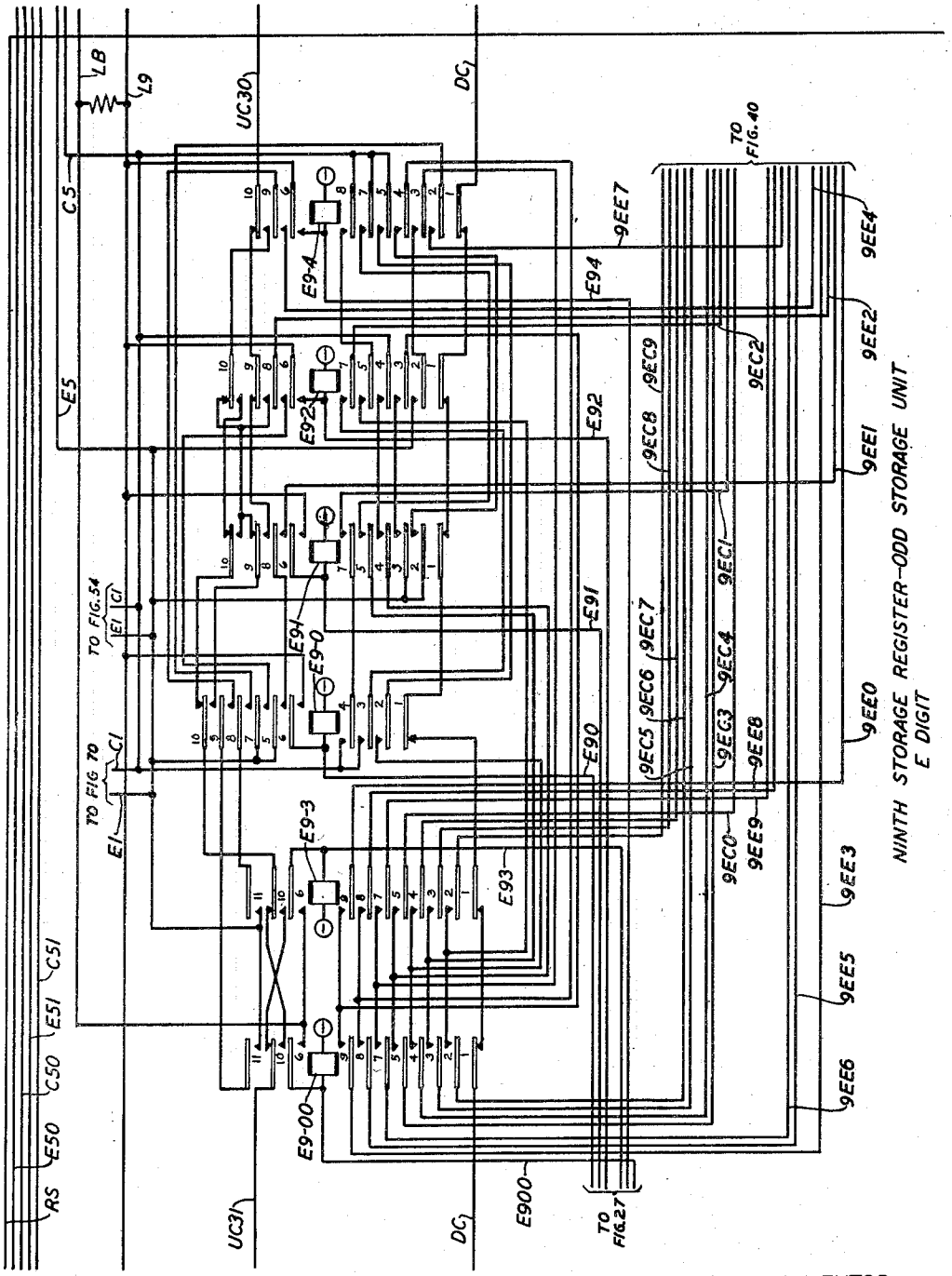


FIG. 31

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 35

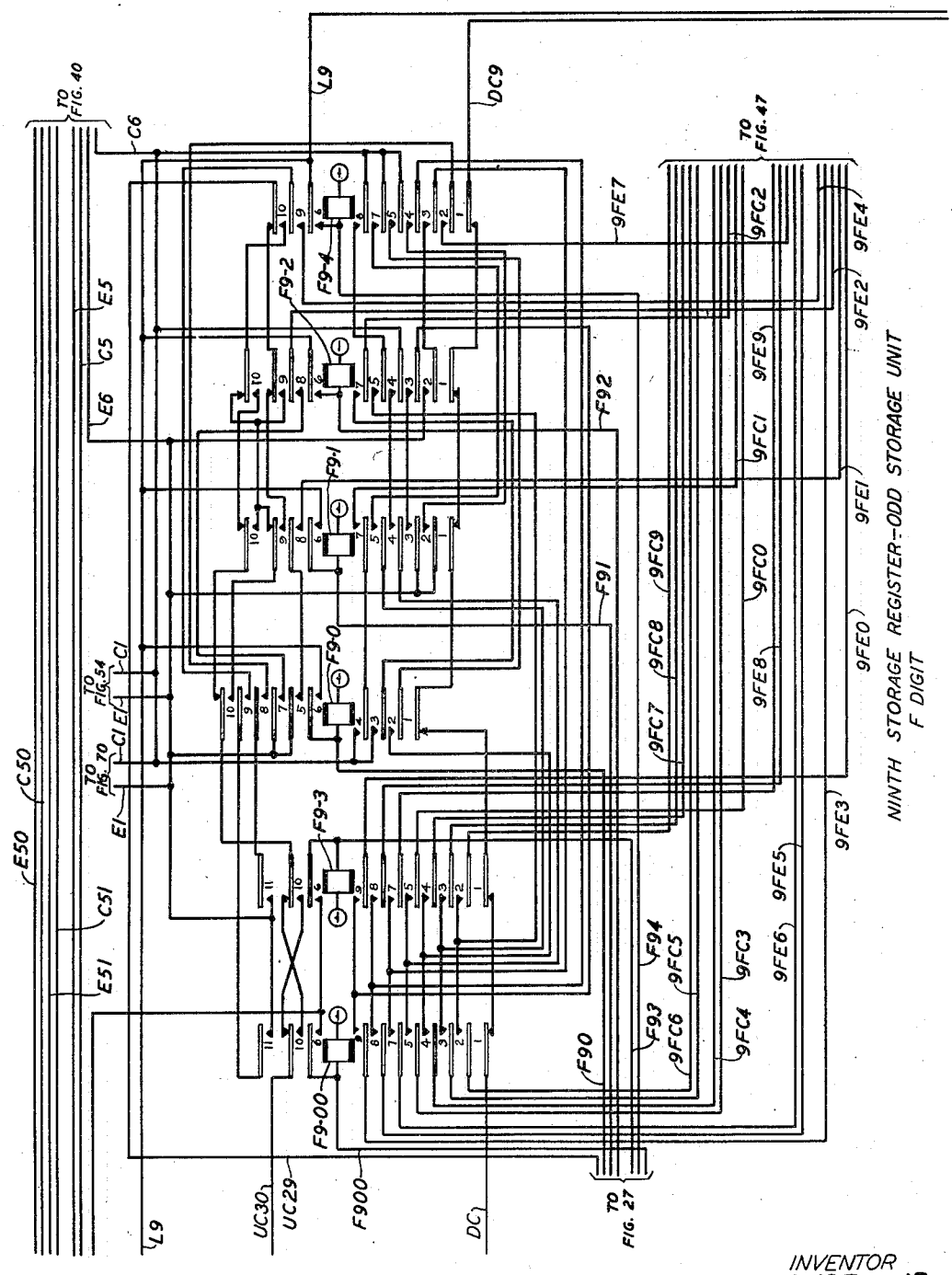


FIG. 32

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 36

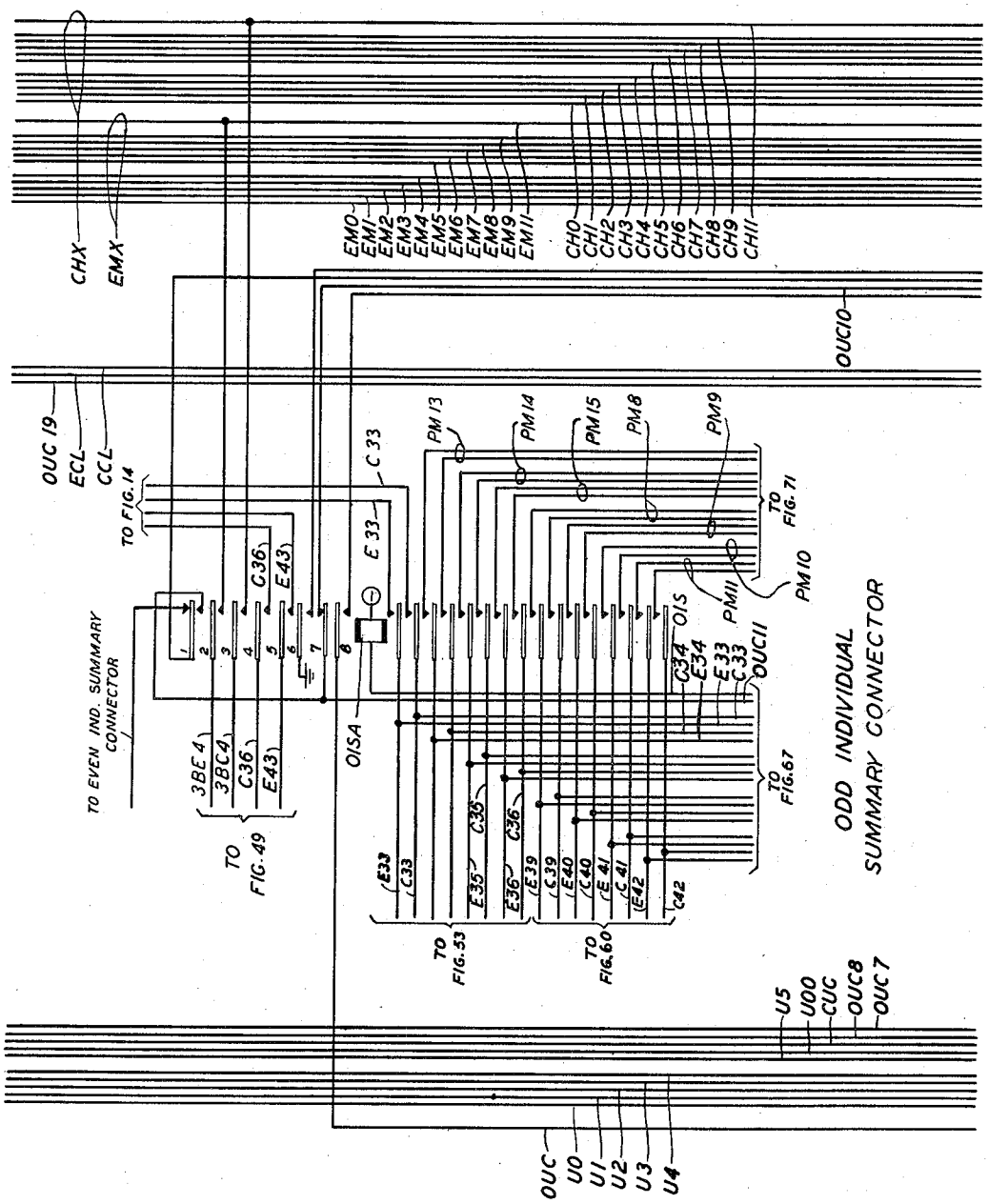


FIG. 33

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 37

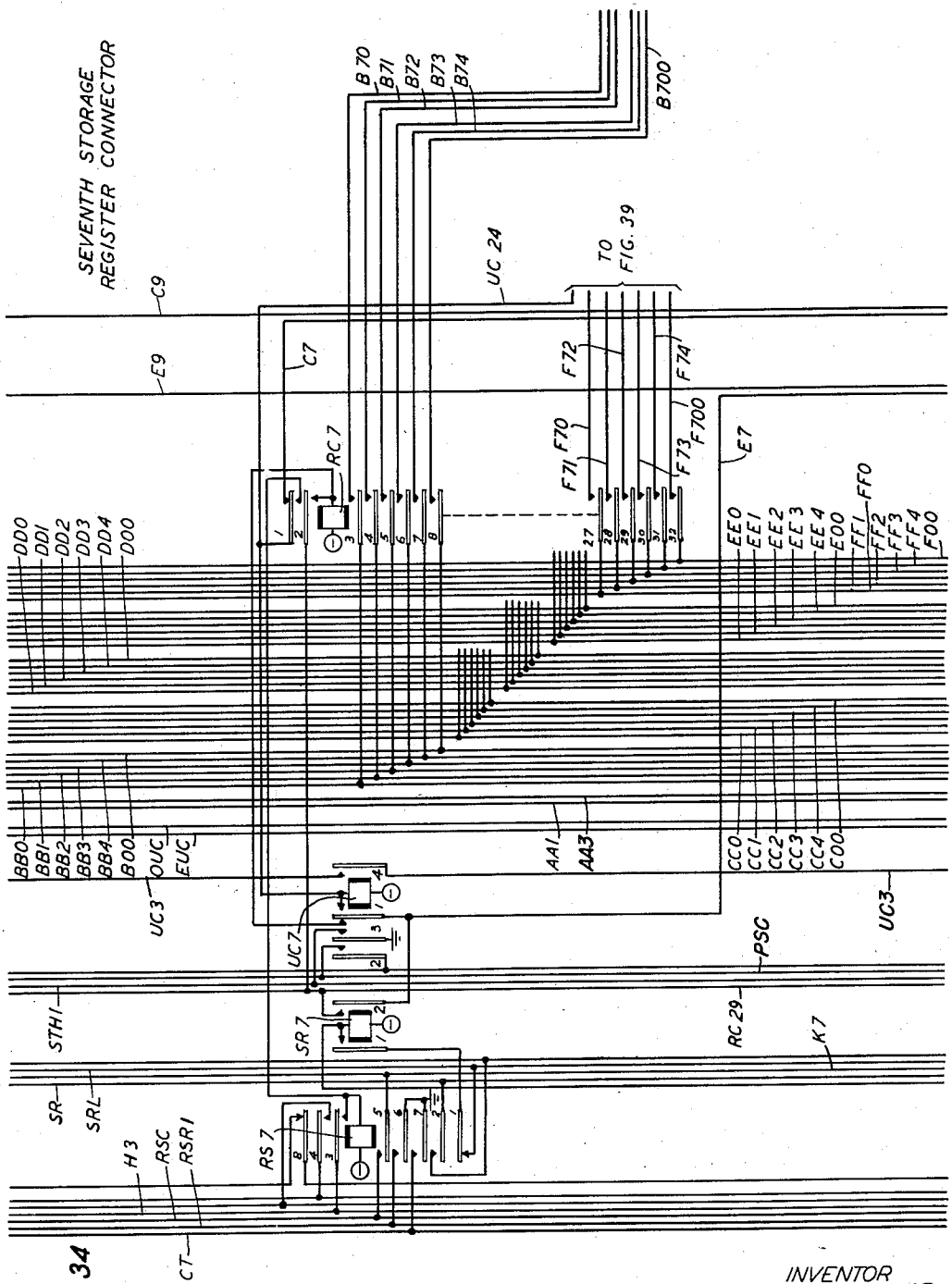


FIG. 34

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 38

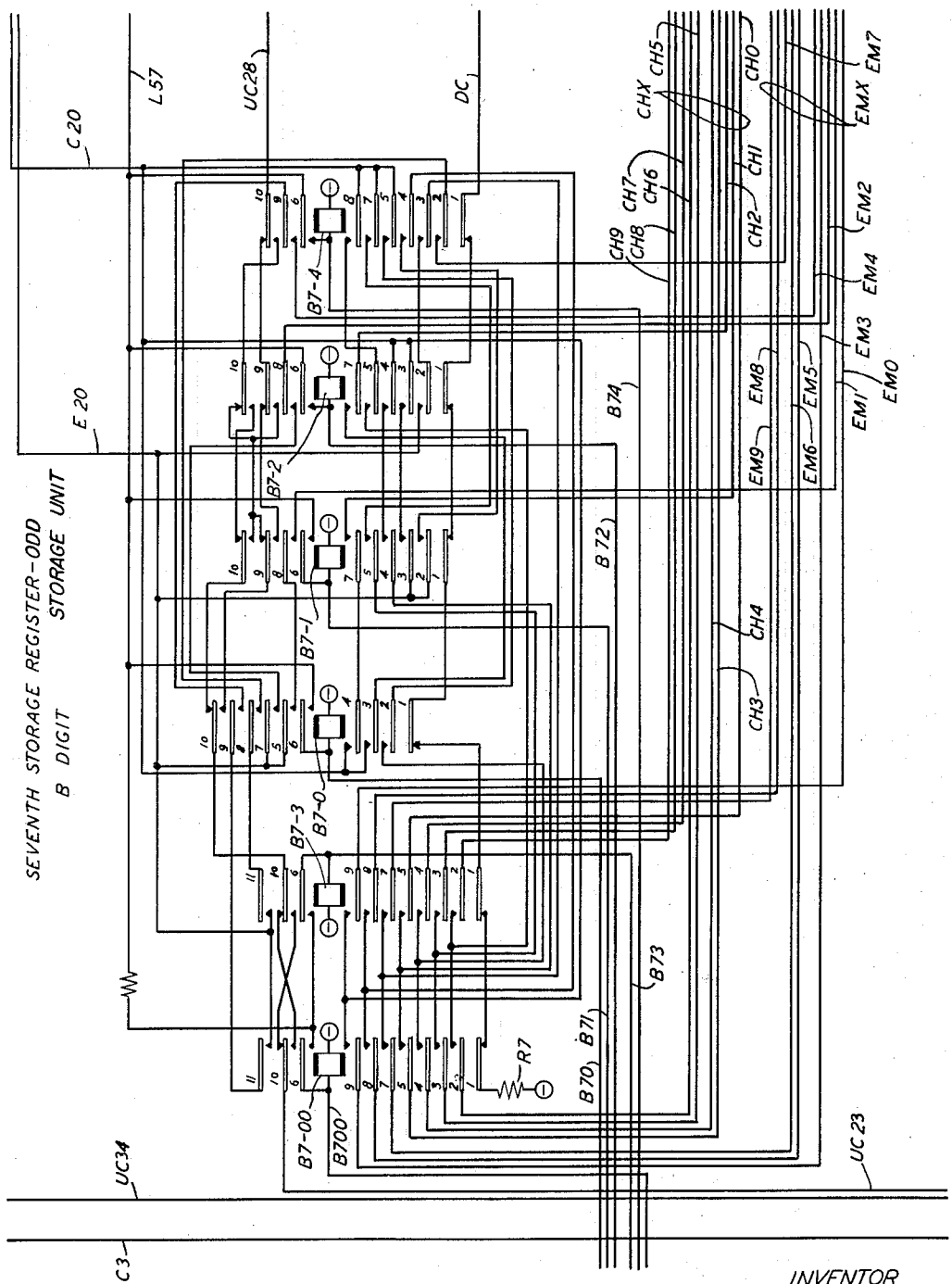


FIG. 35

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 39

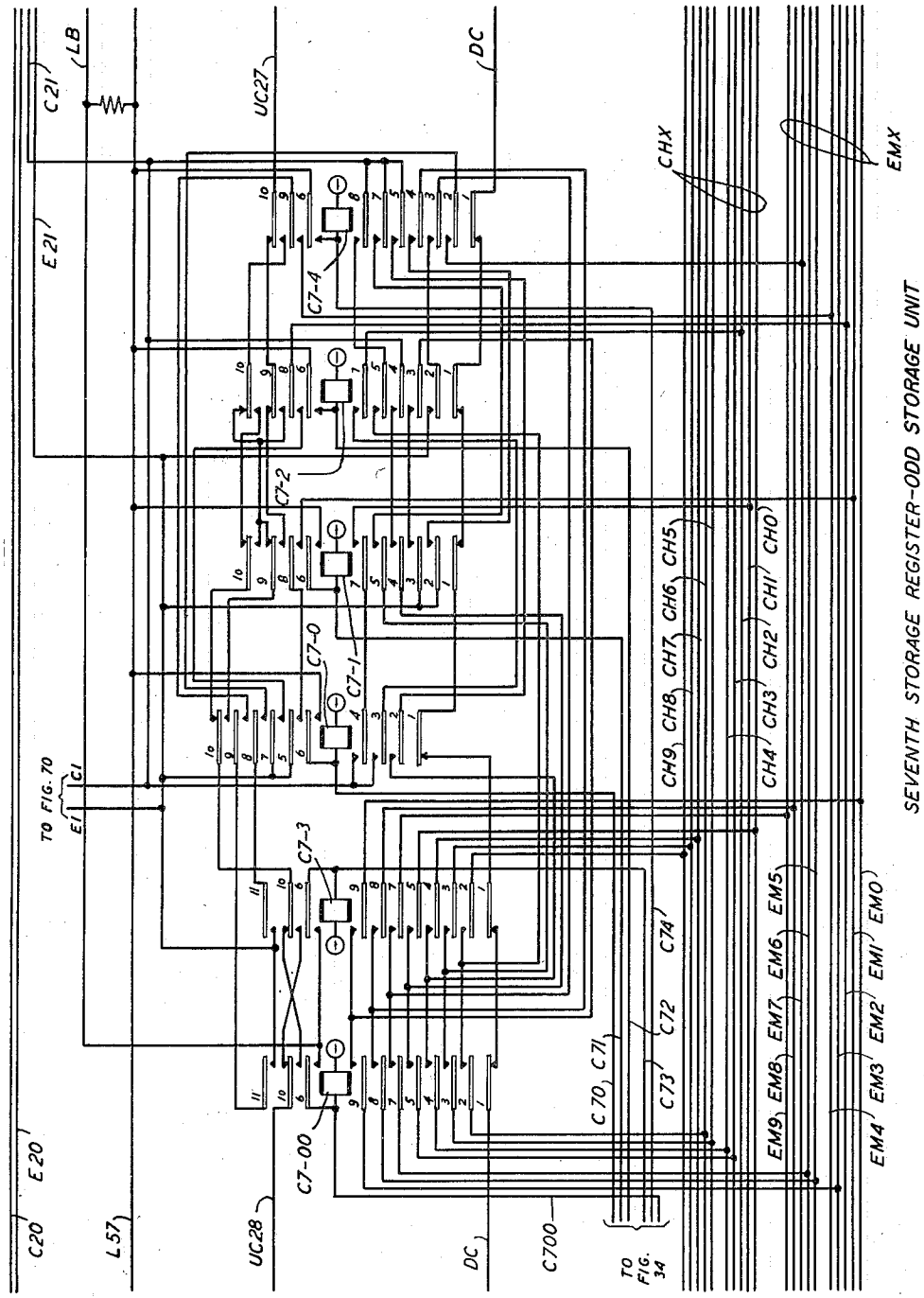


FIG. 36

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 40

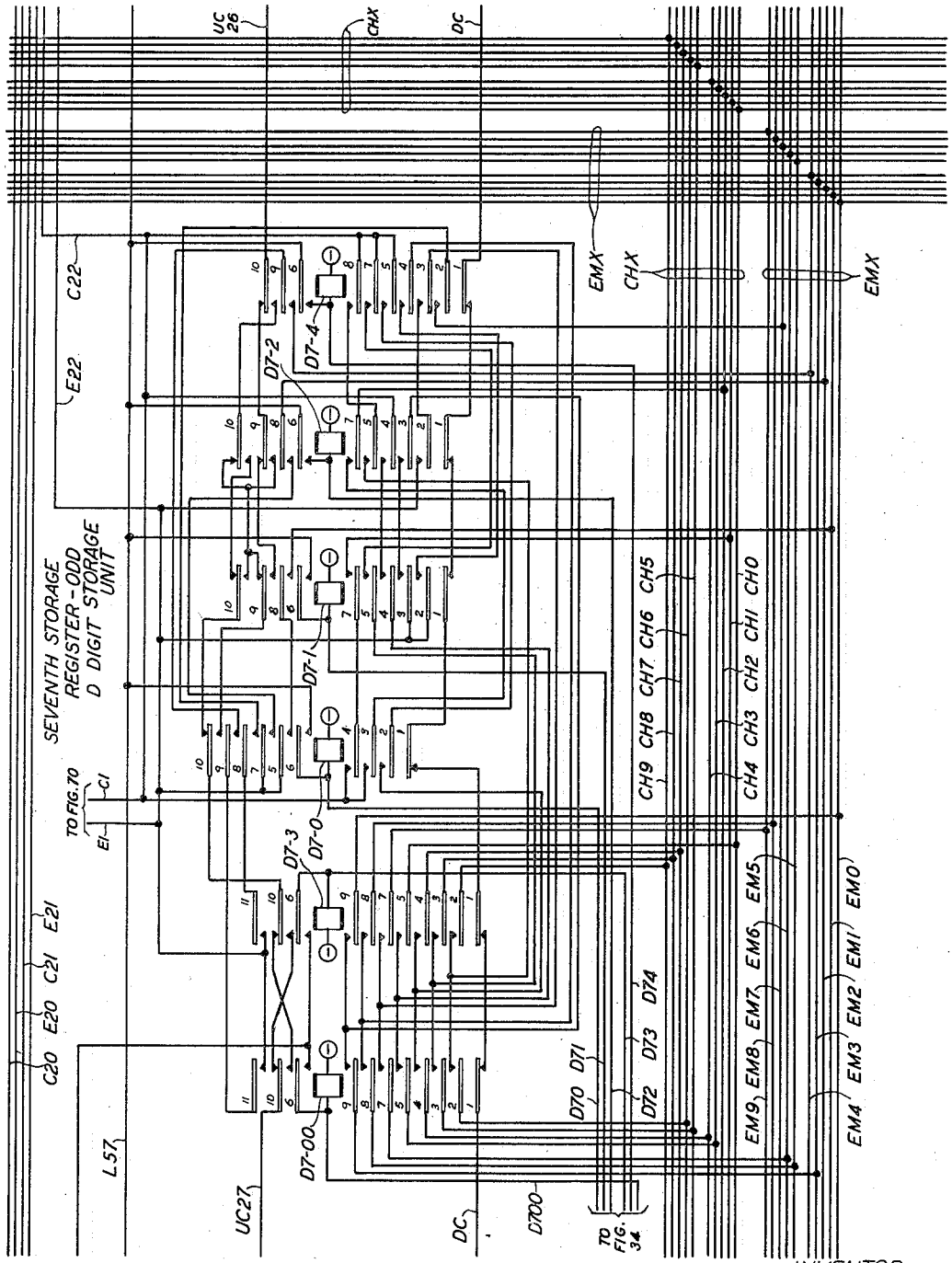


FIG. 37

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 41

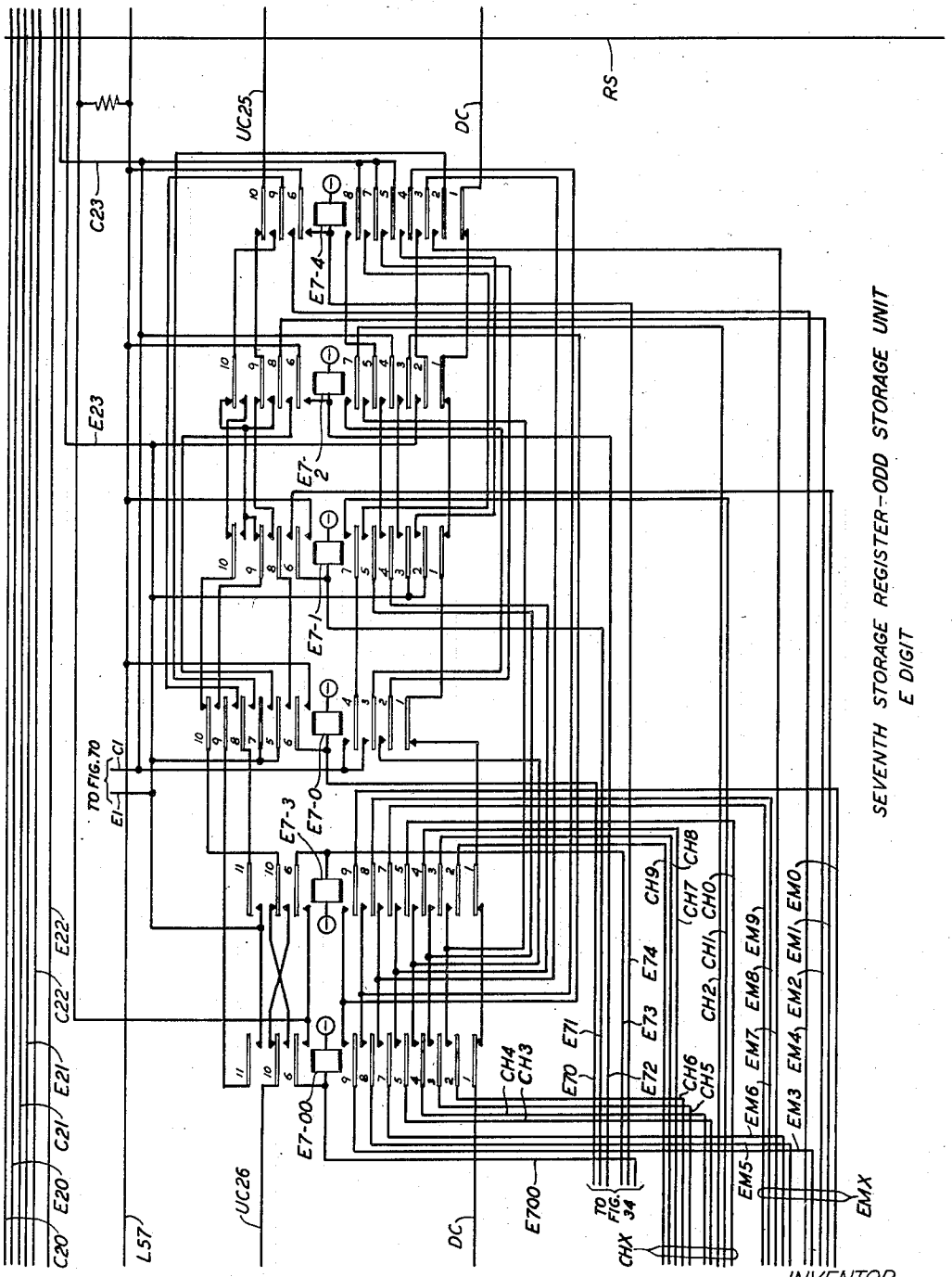


FIG. 38

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 42

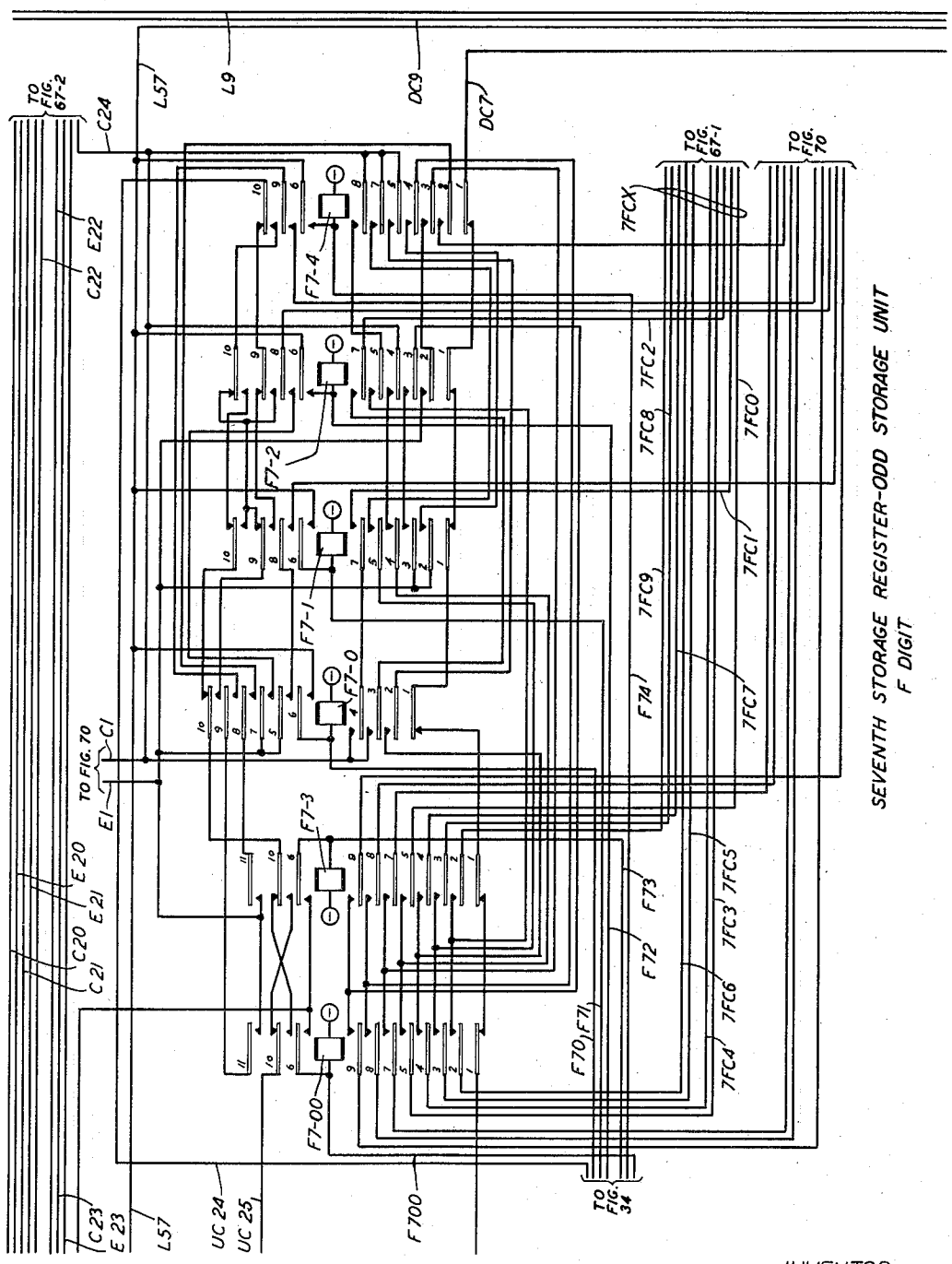


FIG. 39

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 43

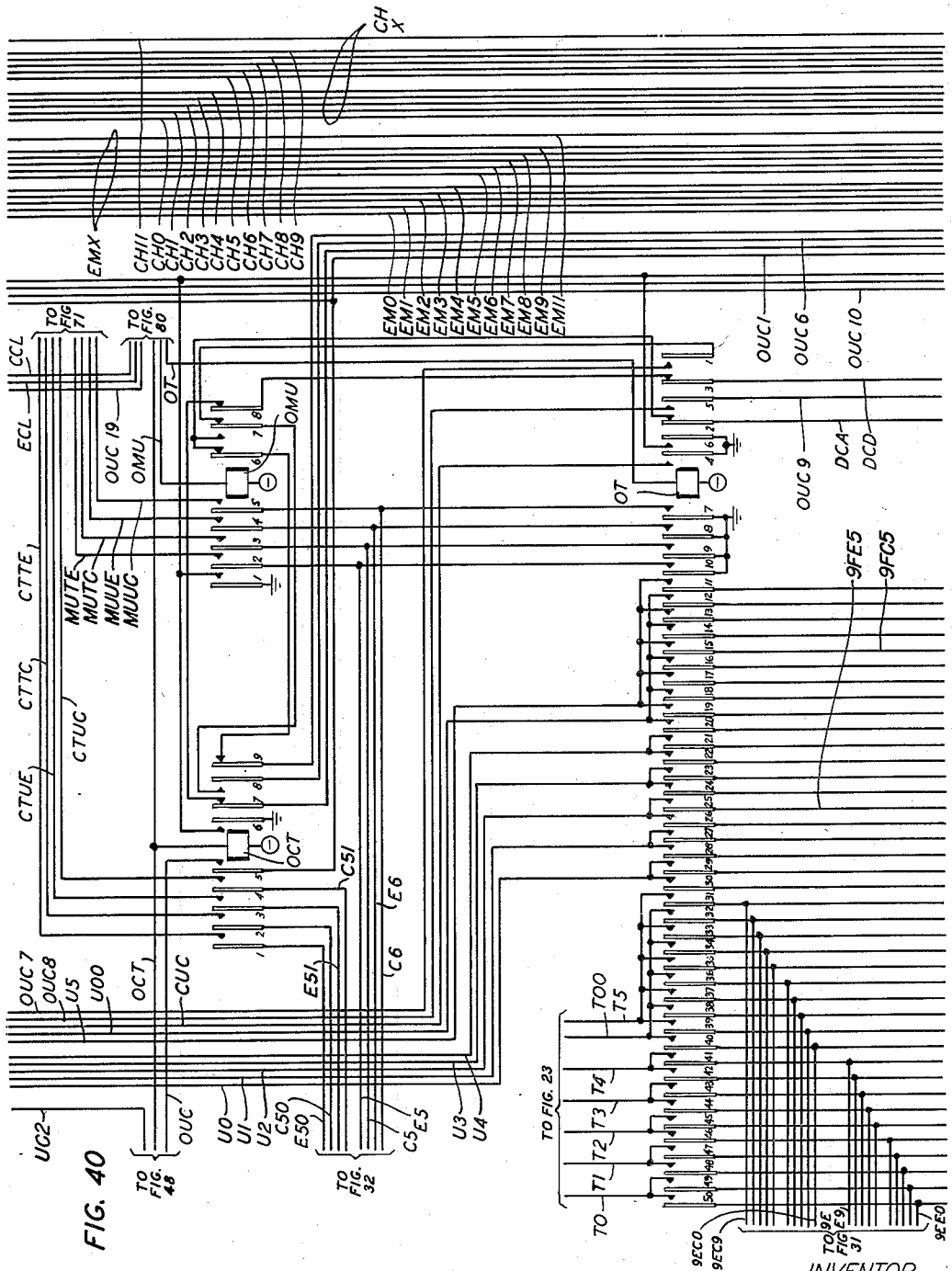


FIG. 40

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 44

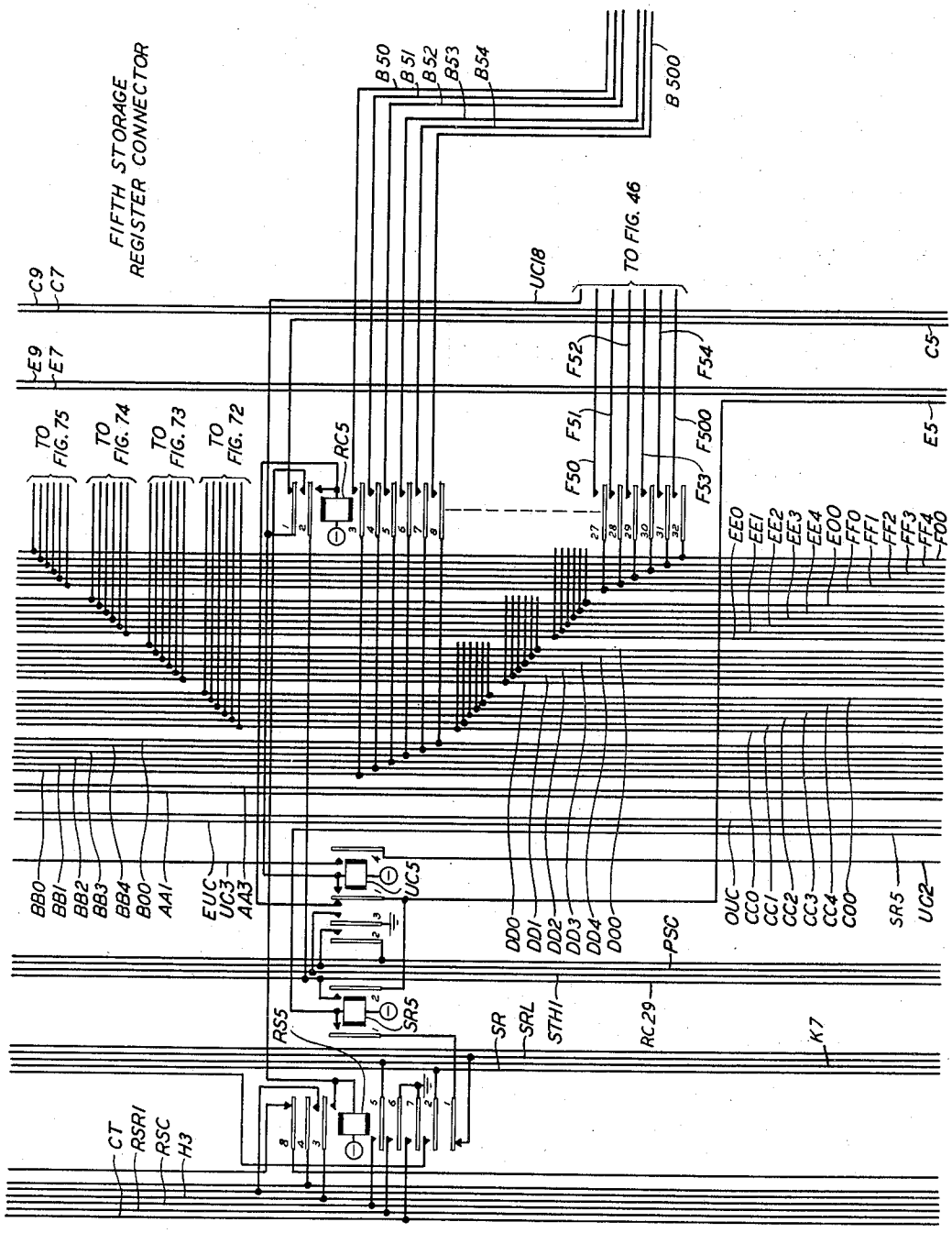


FIG. 41

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 45

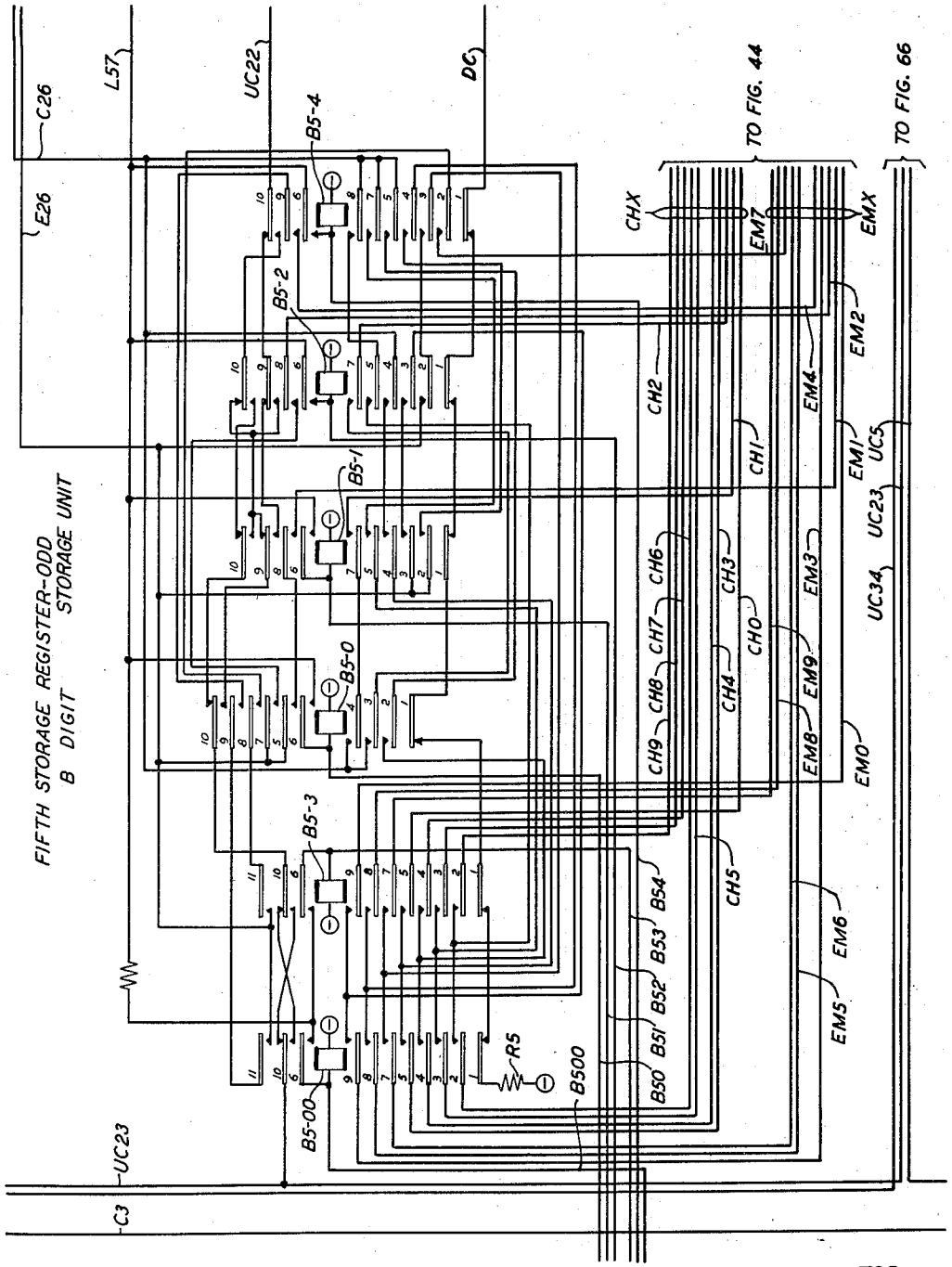


FIG. 42

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 46

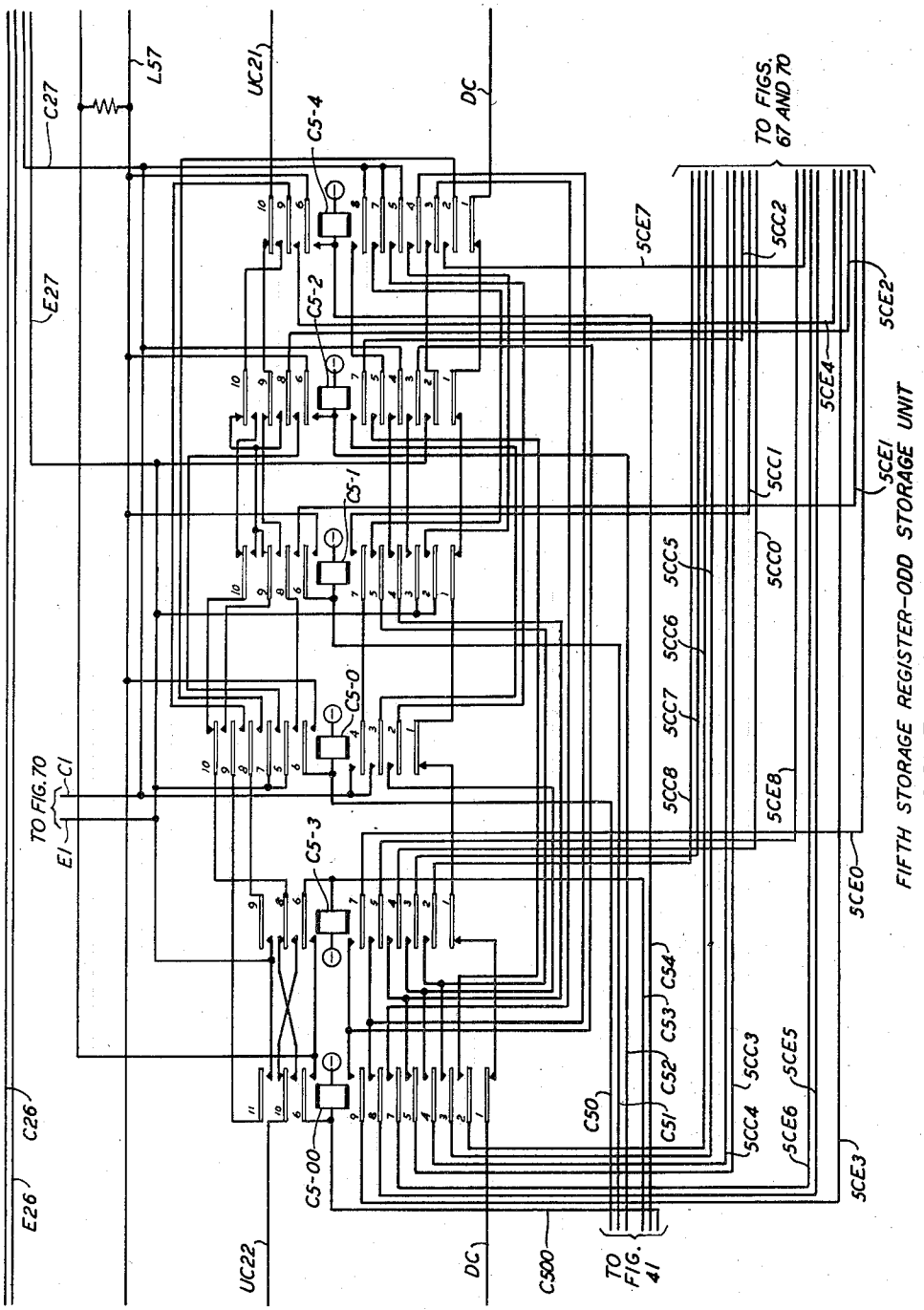


FIG. 43

BY

INVENTOR
A. E. JOEL, JR.

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 47

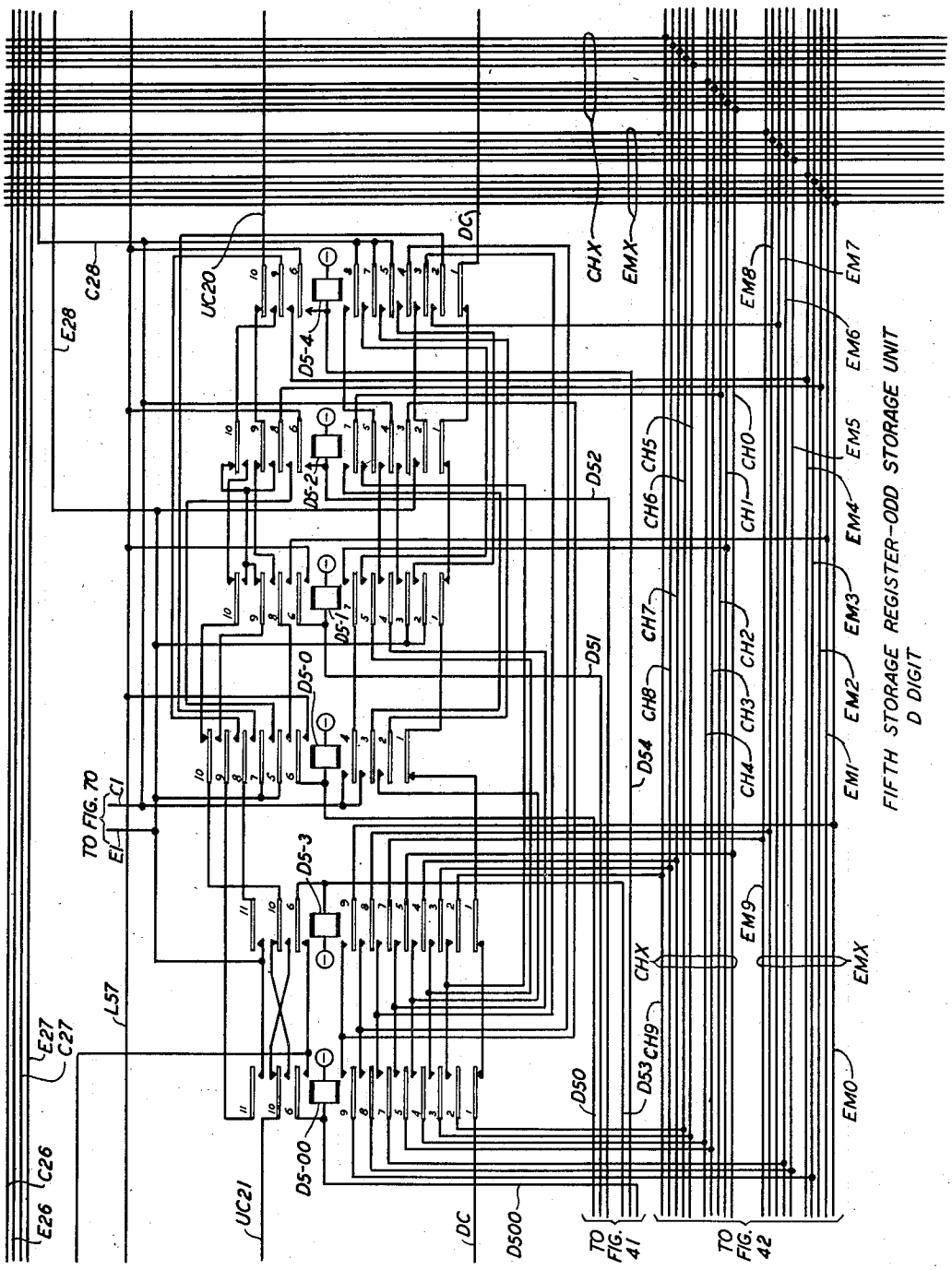


FIG. 44

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 48

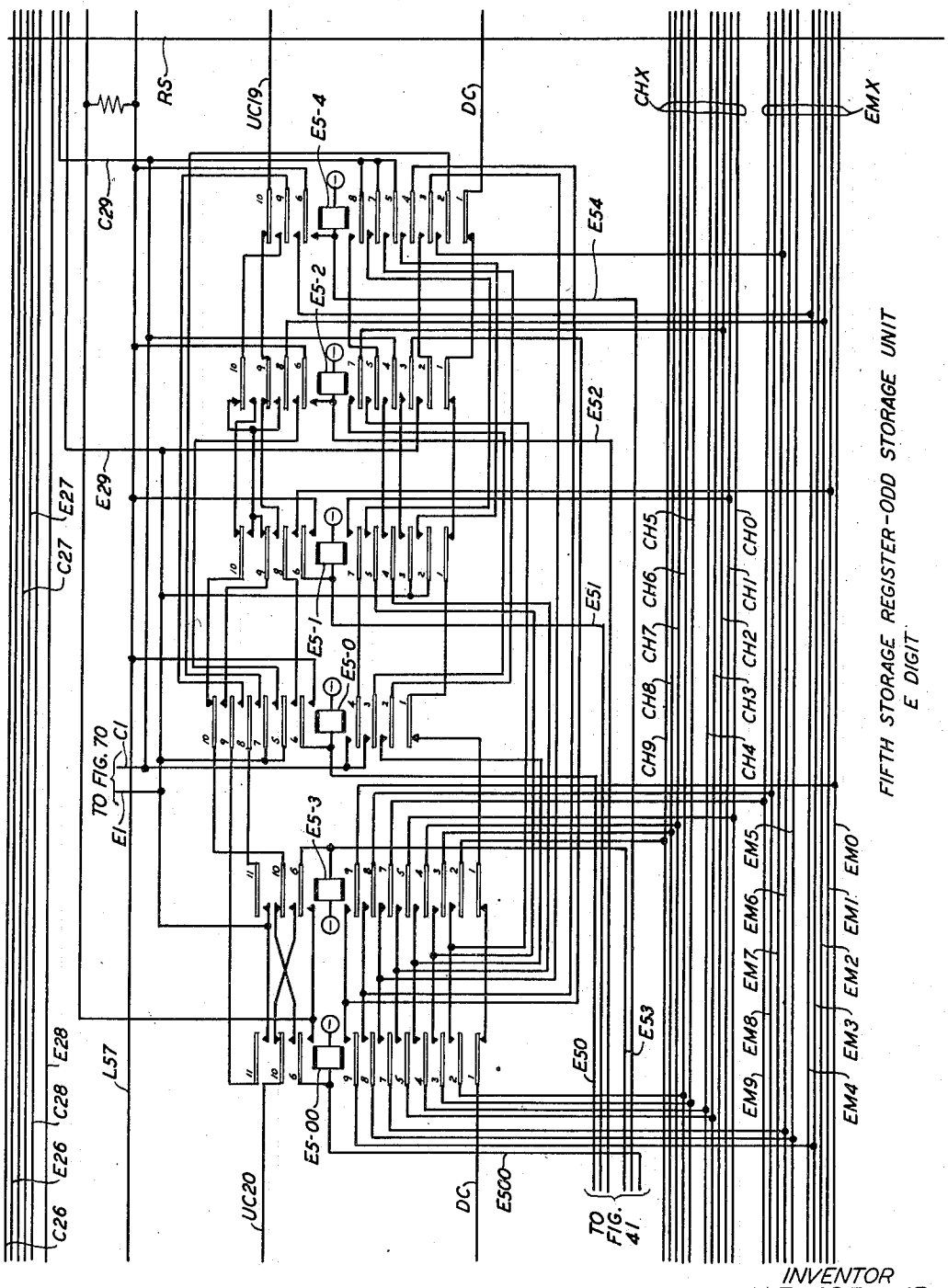


FIG. 45

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 49

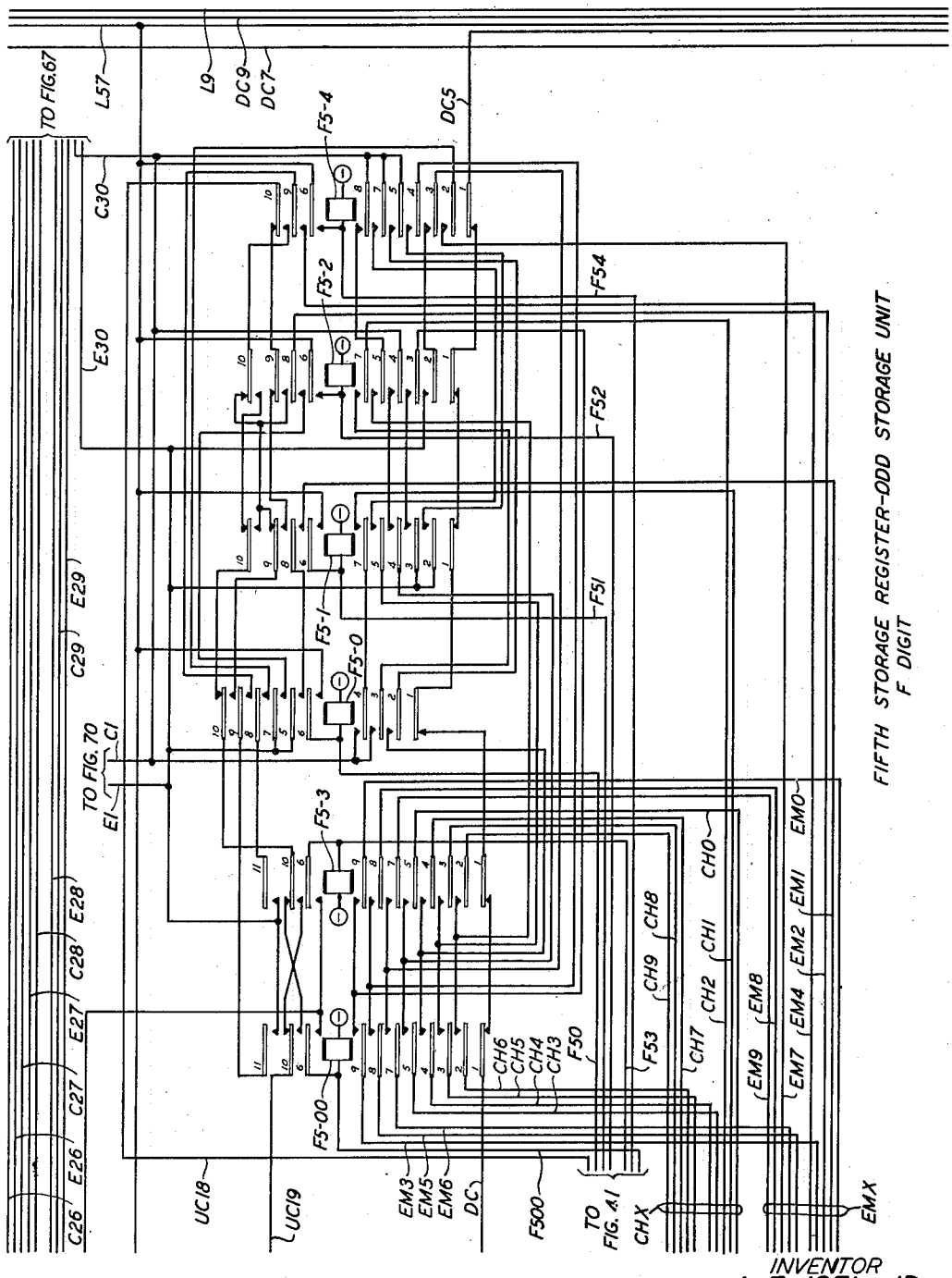


FIG. 46

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 50

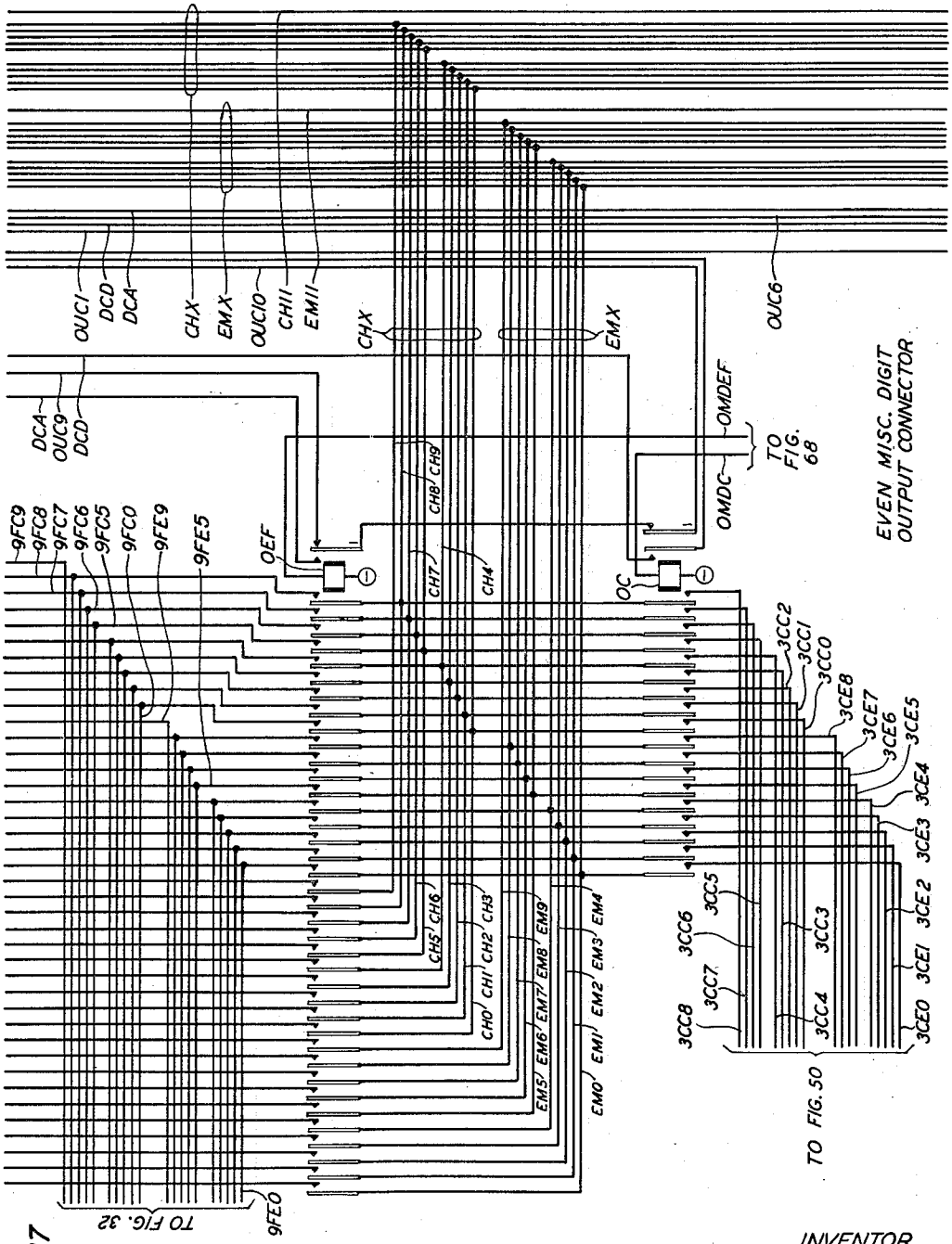


FIG. 47

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 51

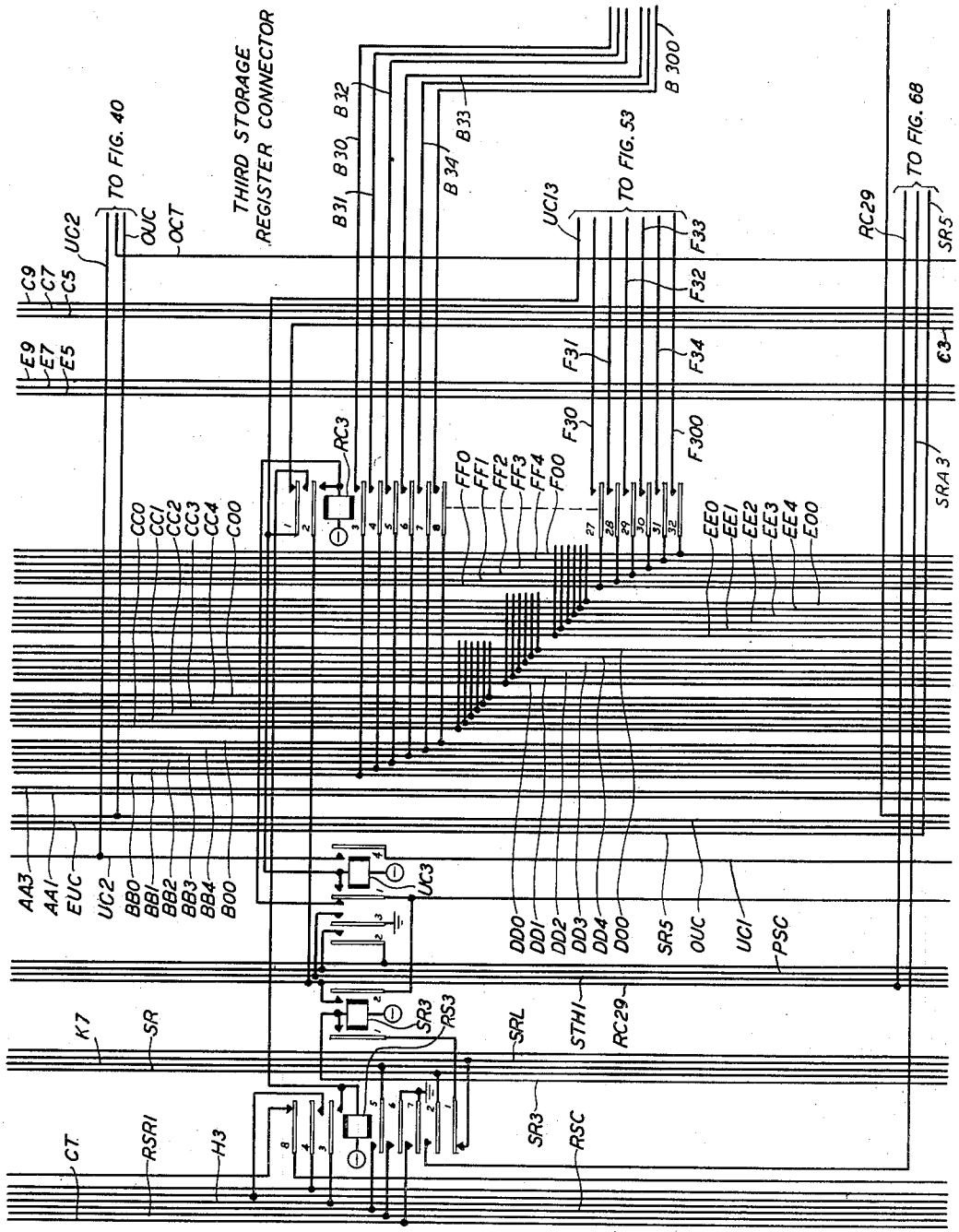


FIG. 48

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 52

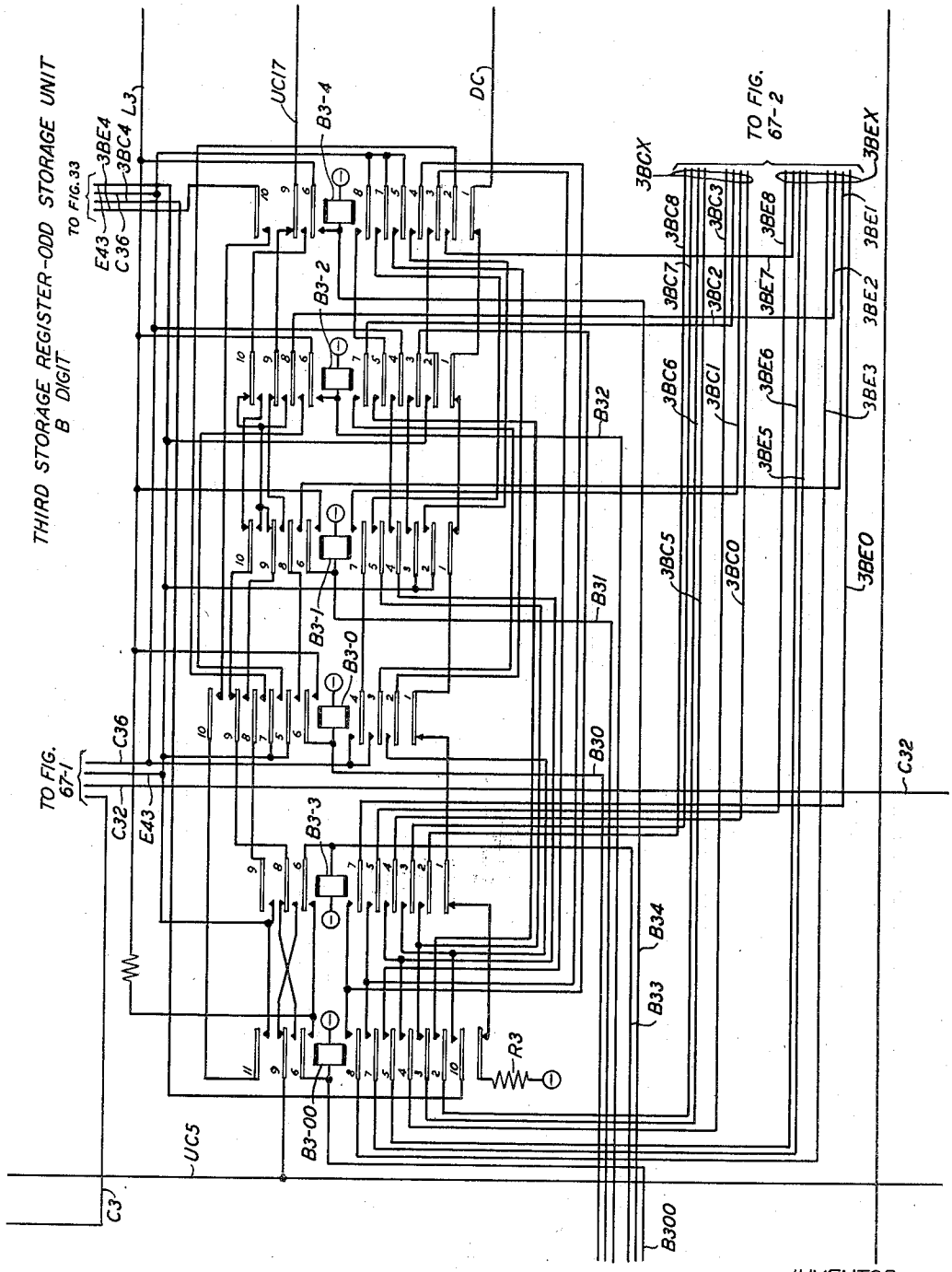


FIG. 49

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 53

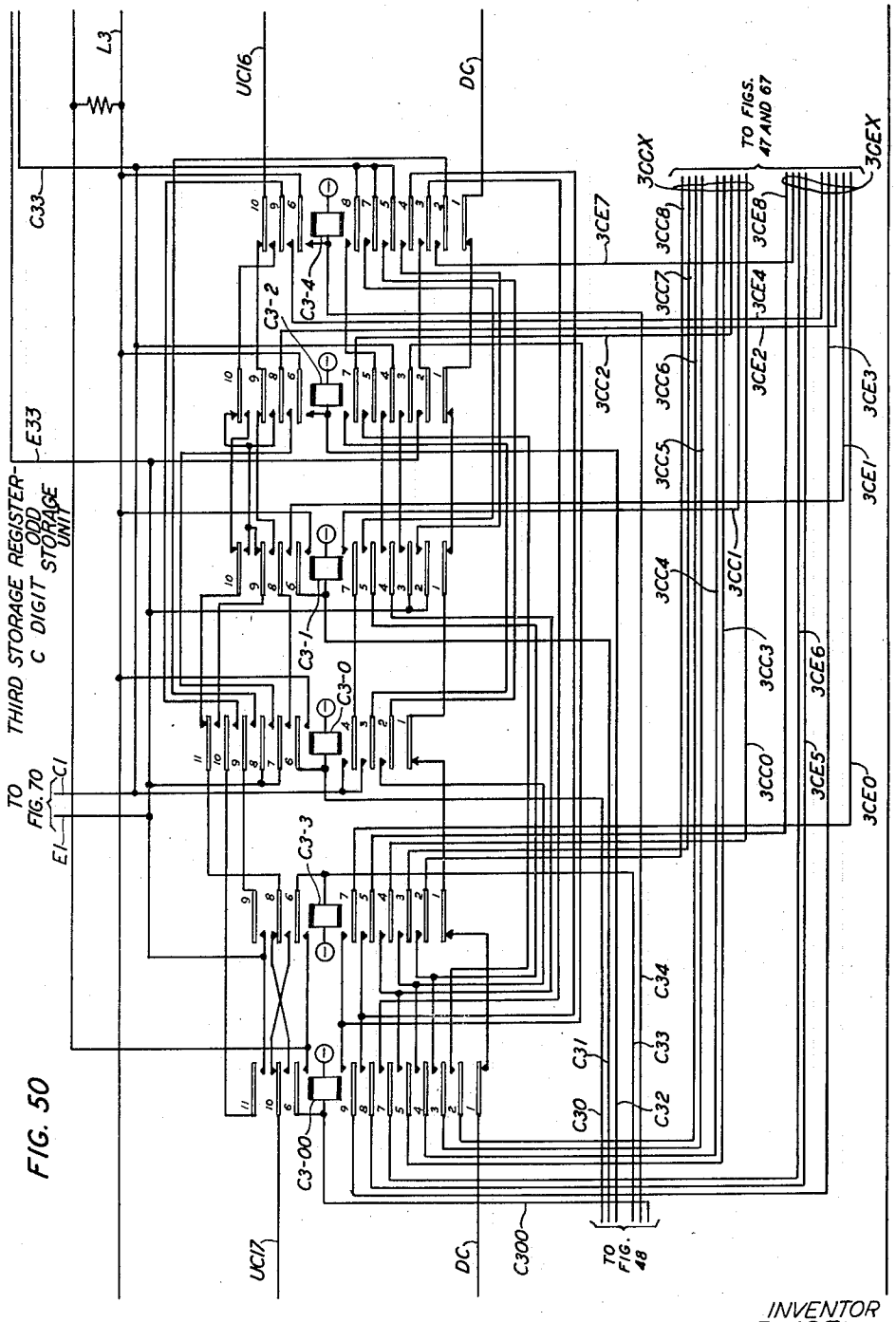


FIG. 50

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 54

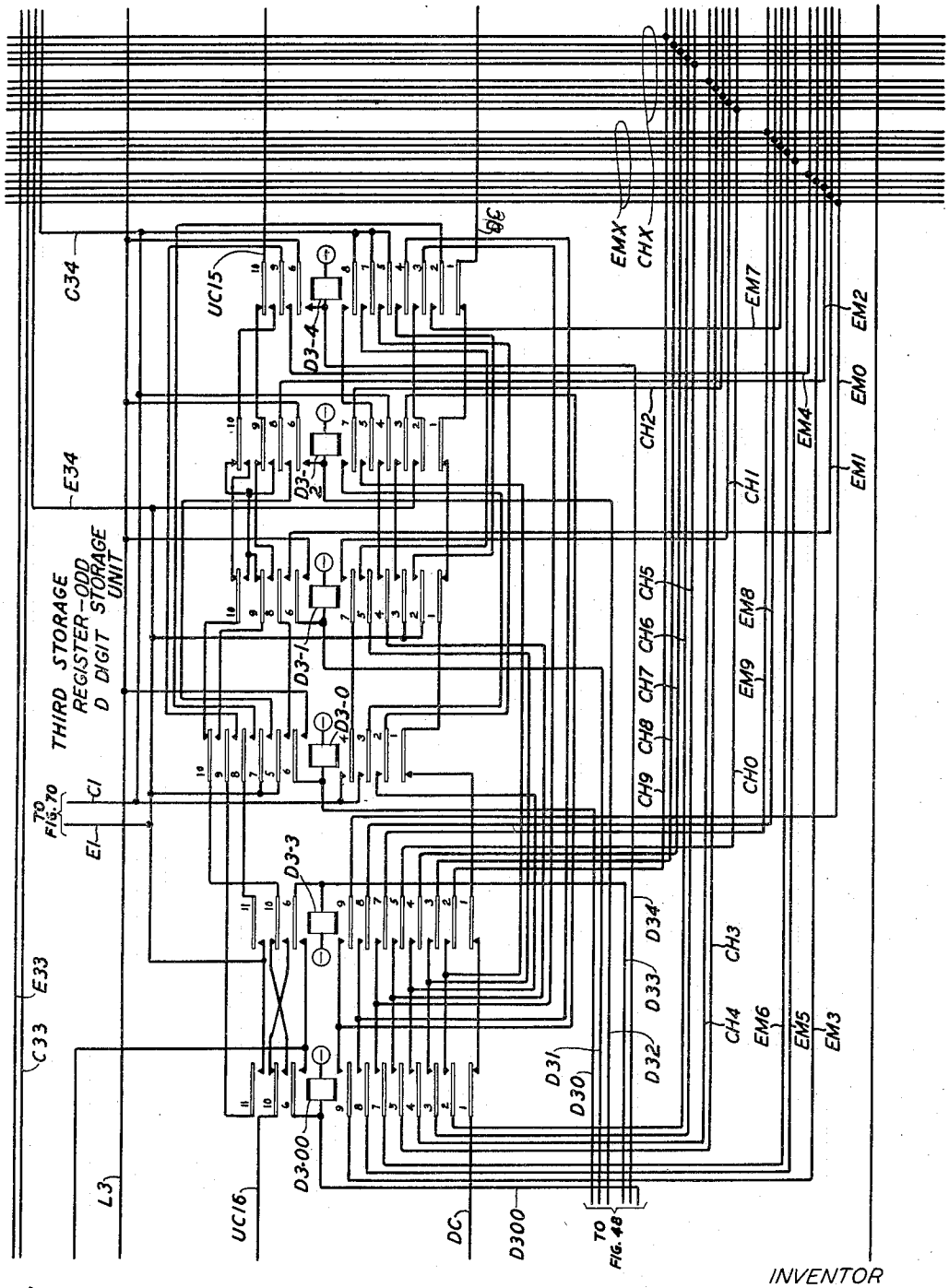


FIG. 51

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

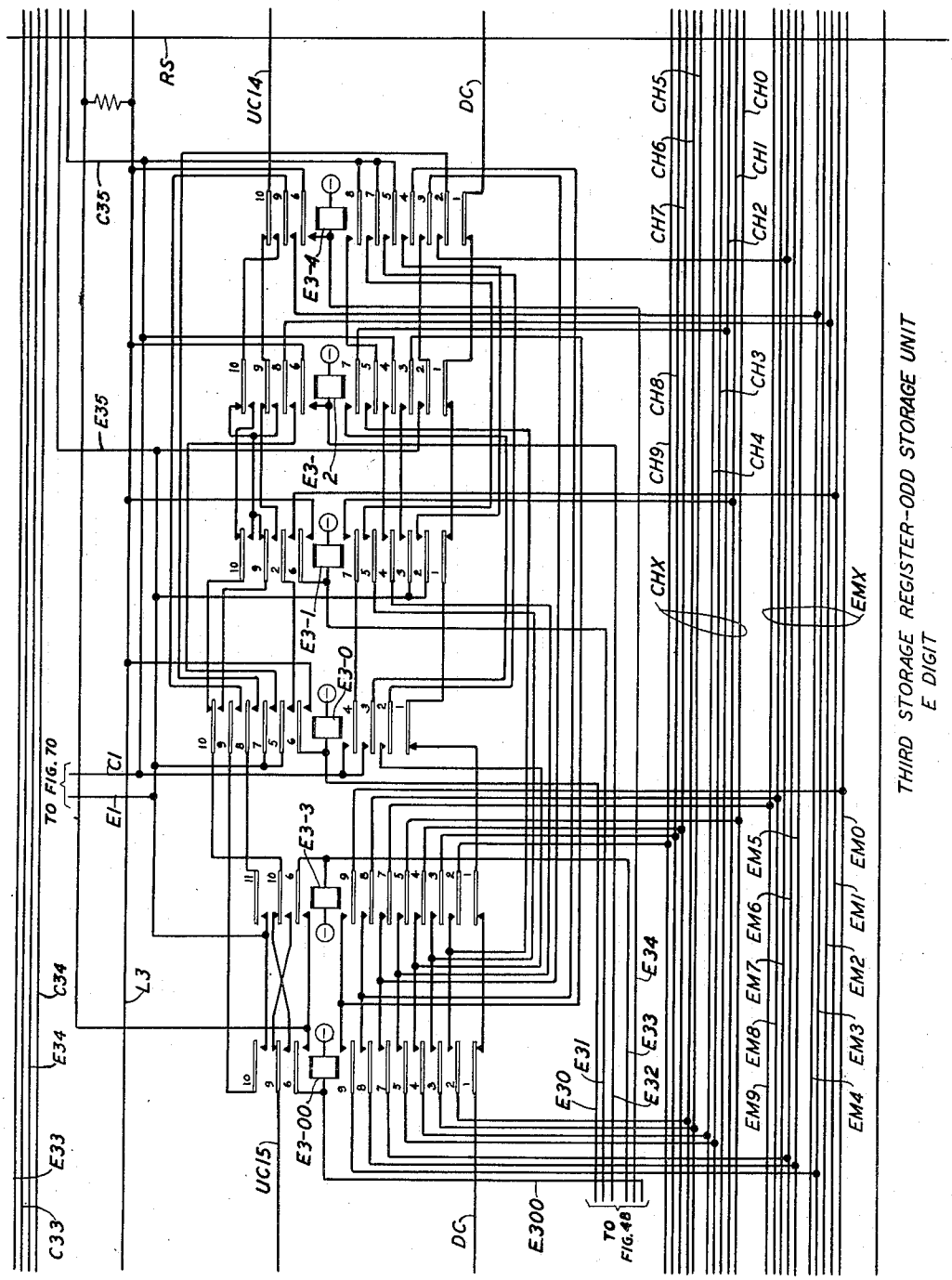


FIG. 52

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 56

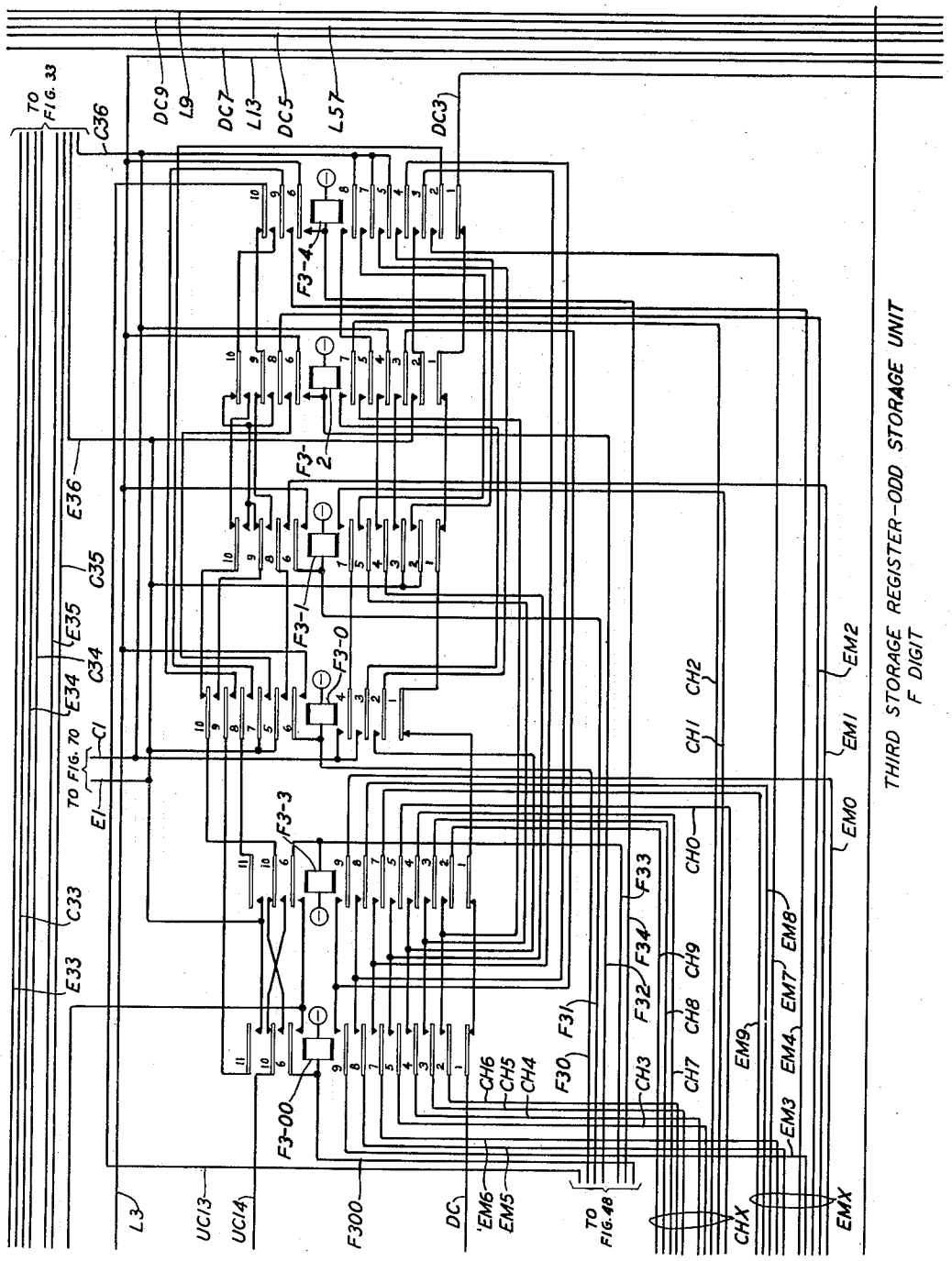


FIG. 53

INVENTOR
A.E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 57

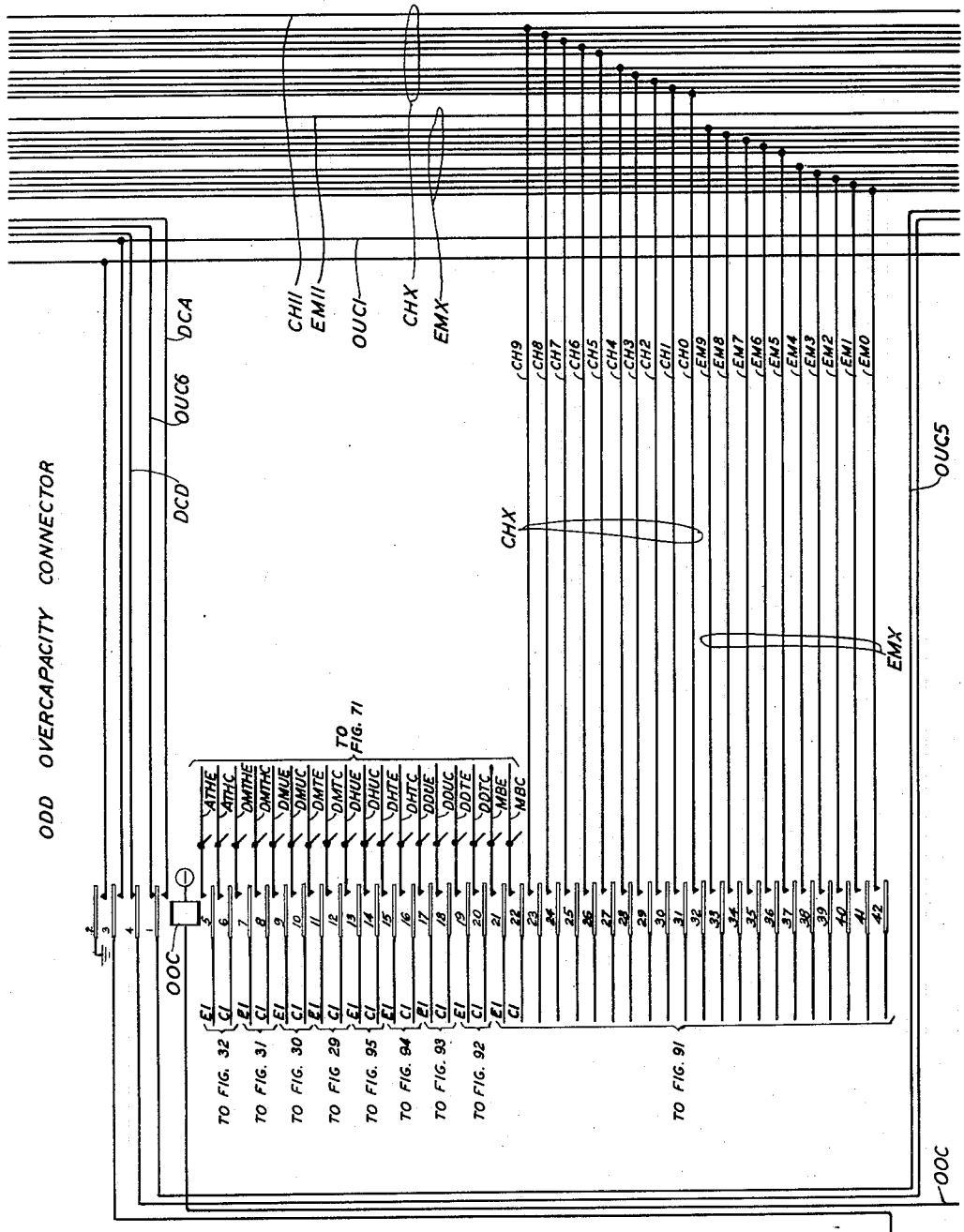


FIG. 54

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 58

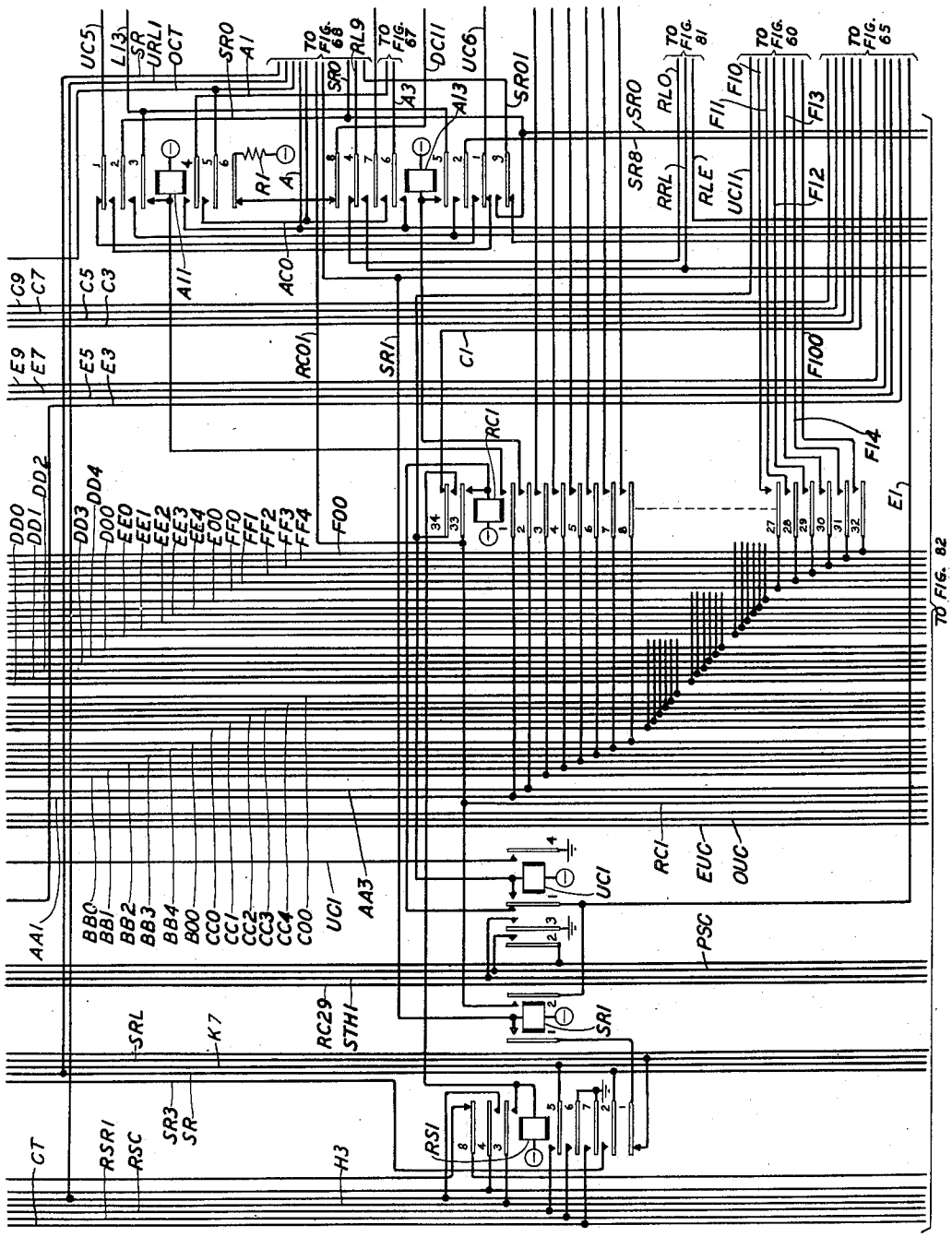


FIG. 55

FIRST STORAGE REGISTER CONNECTOR

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 59

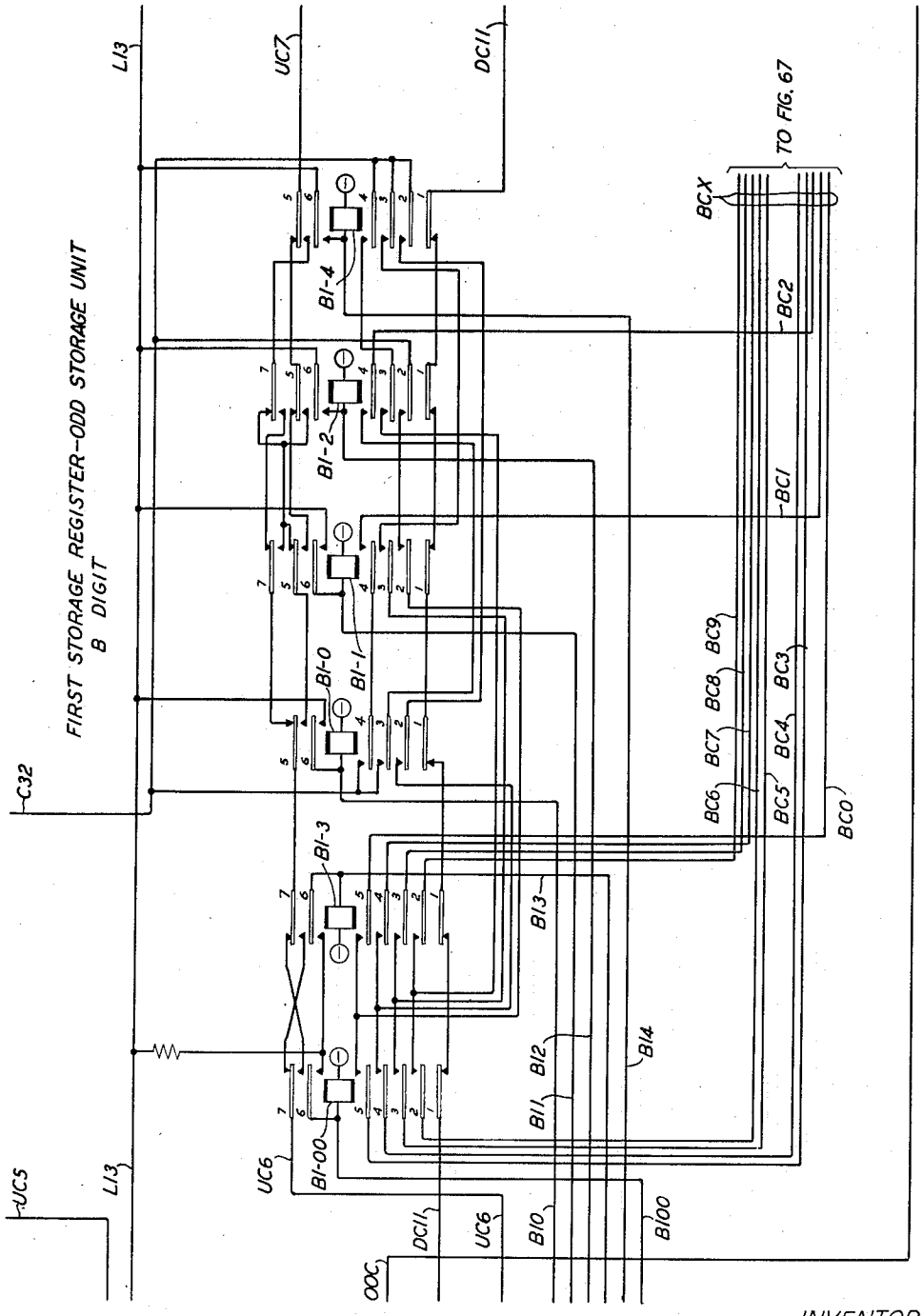


FIG. 56

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 60

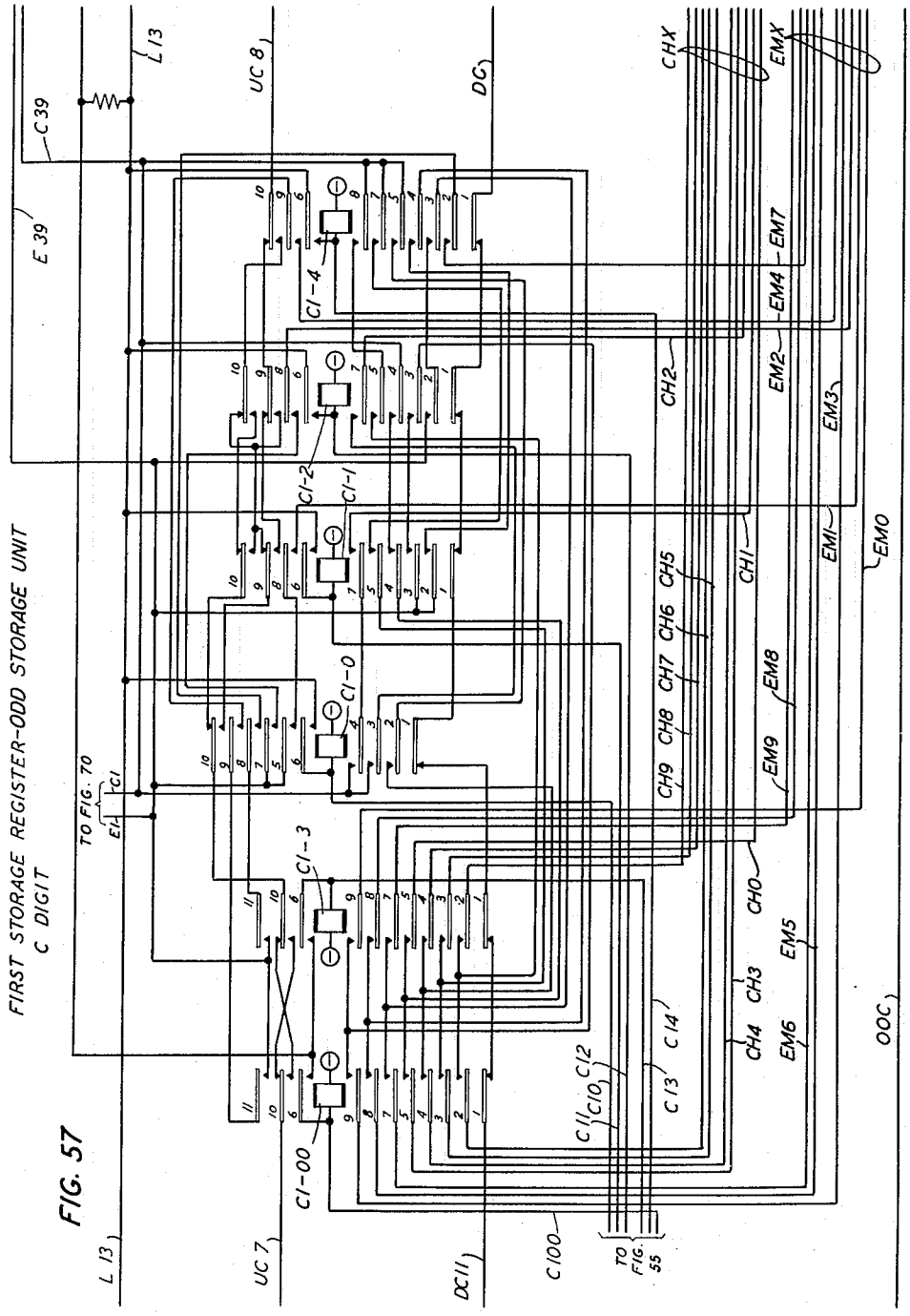


FIG. 57

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 61

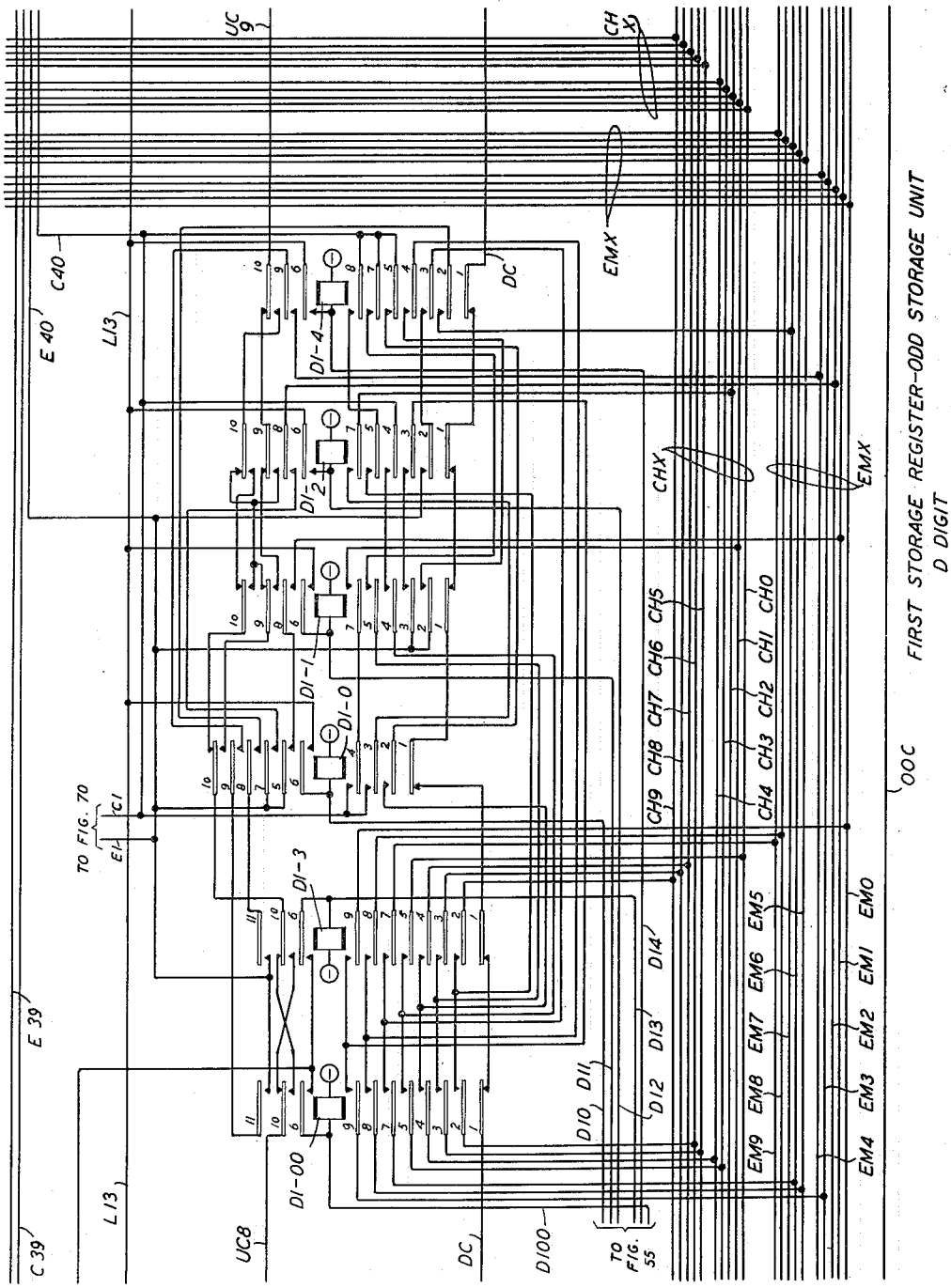


FIG. 58

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 62

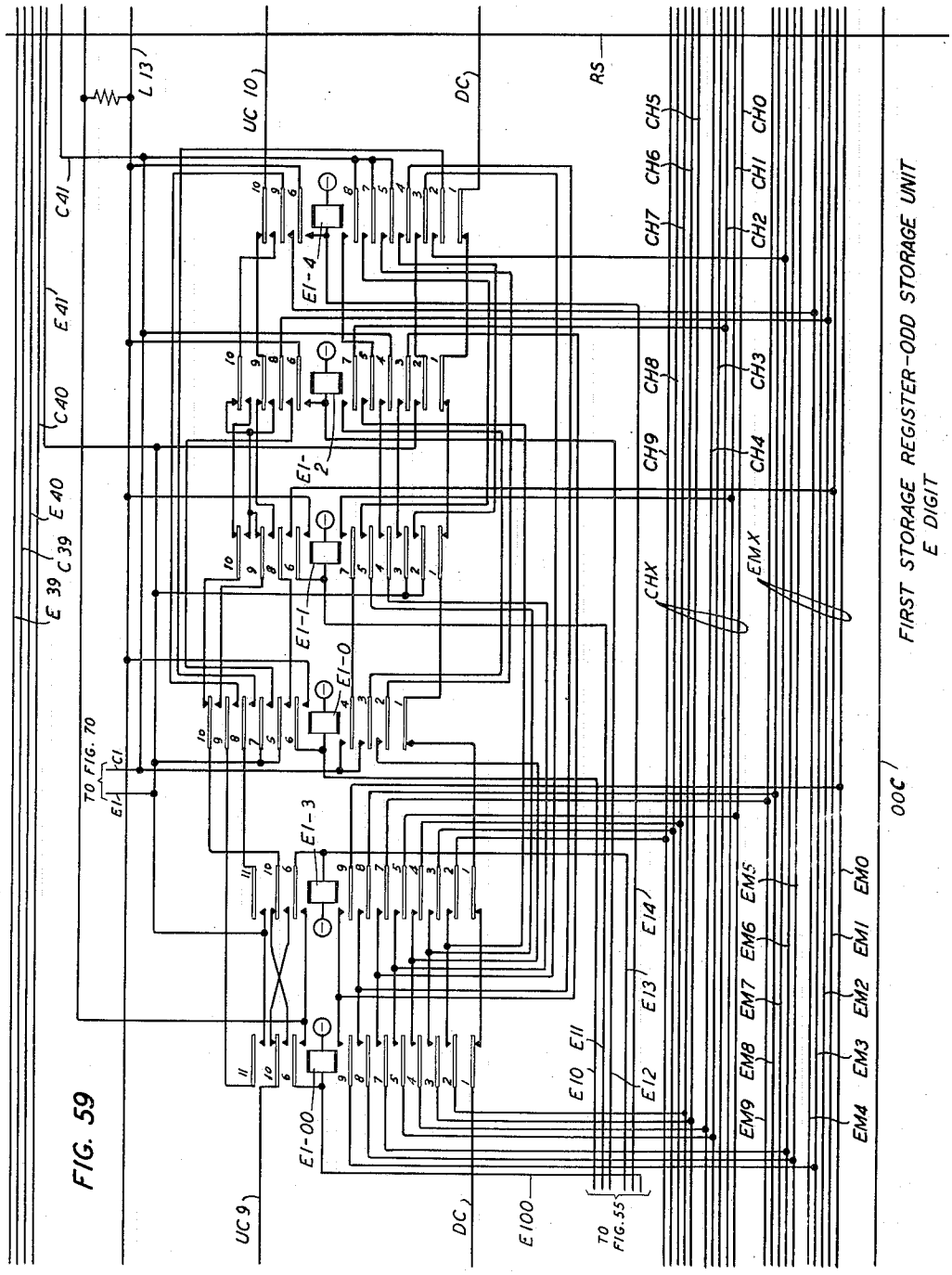


FIG. 59

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 63

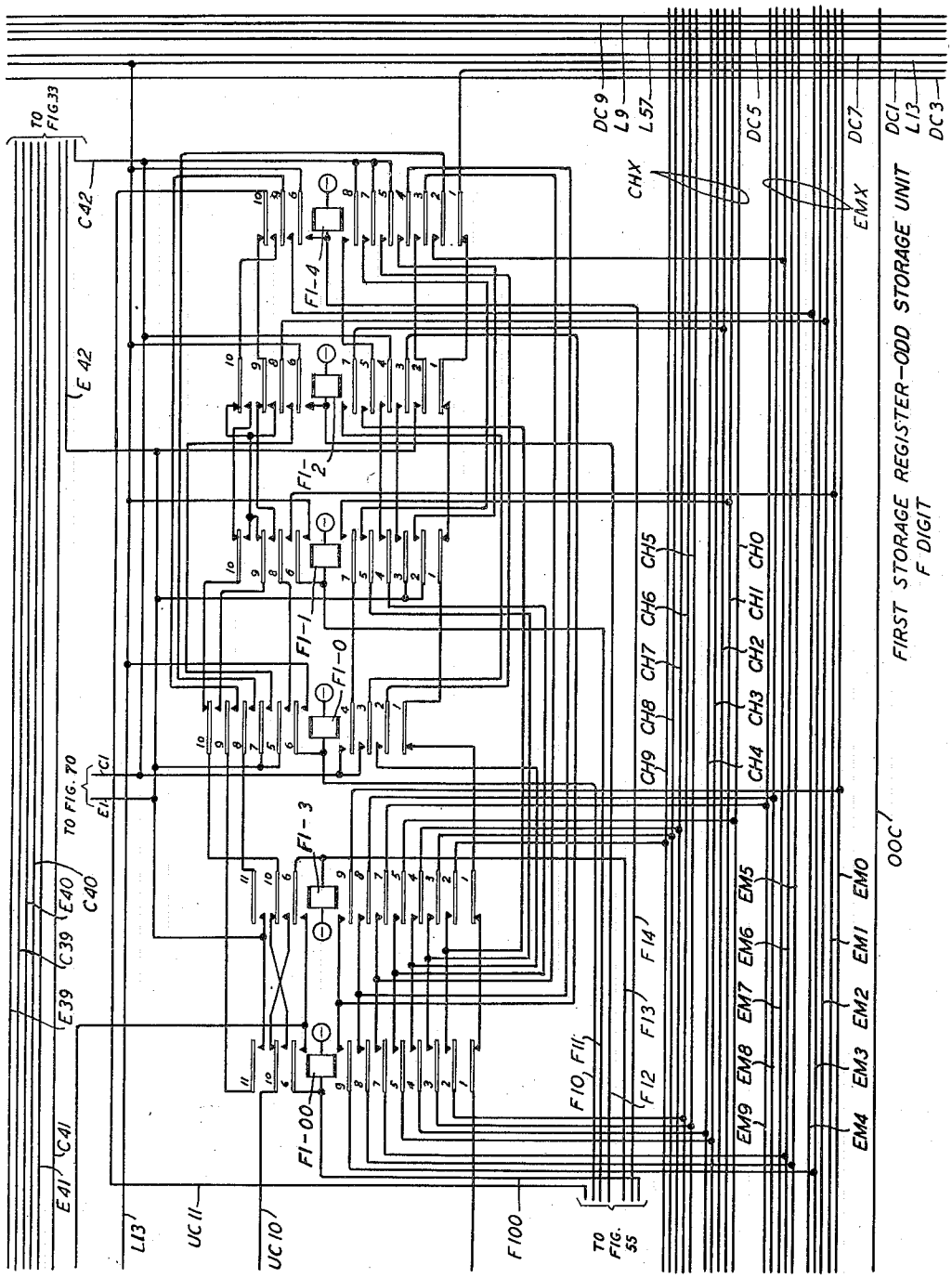


FIG. 60

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 64

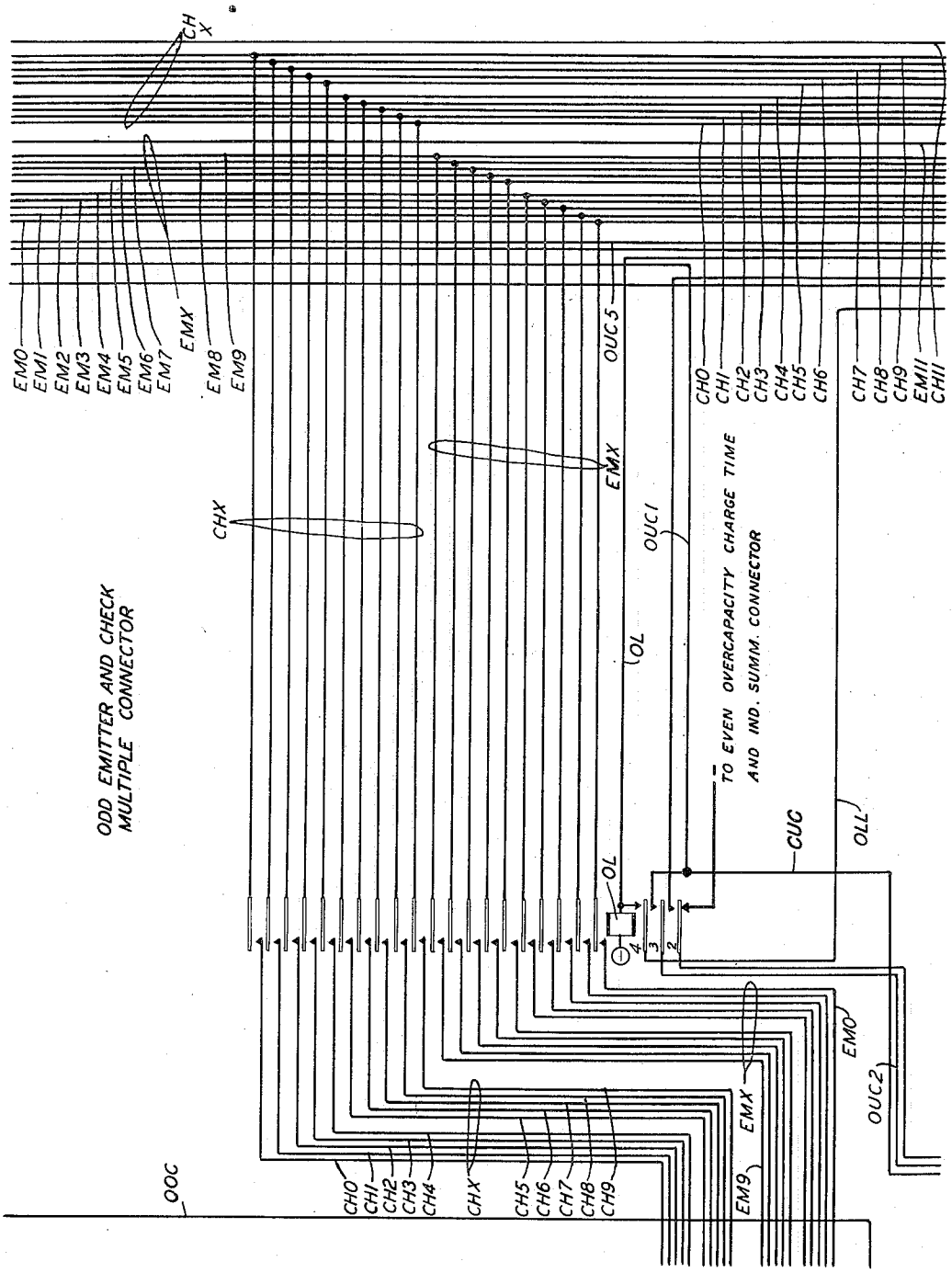


FIG. 61

INVENTOR
A. E. JOEL, JR.

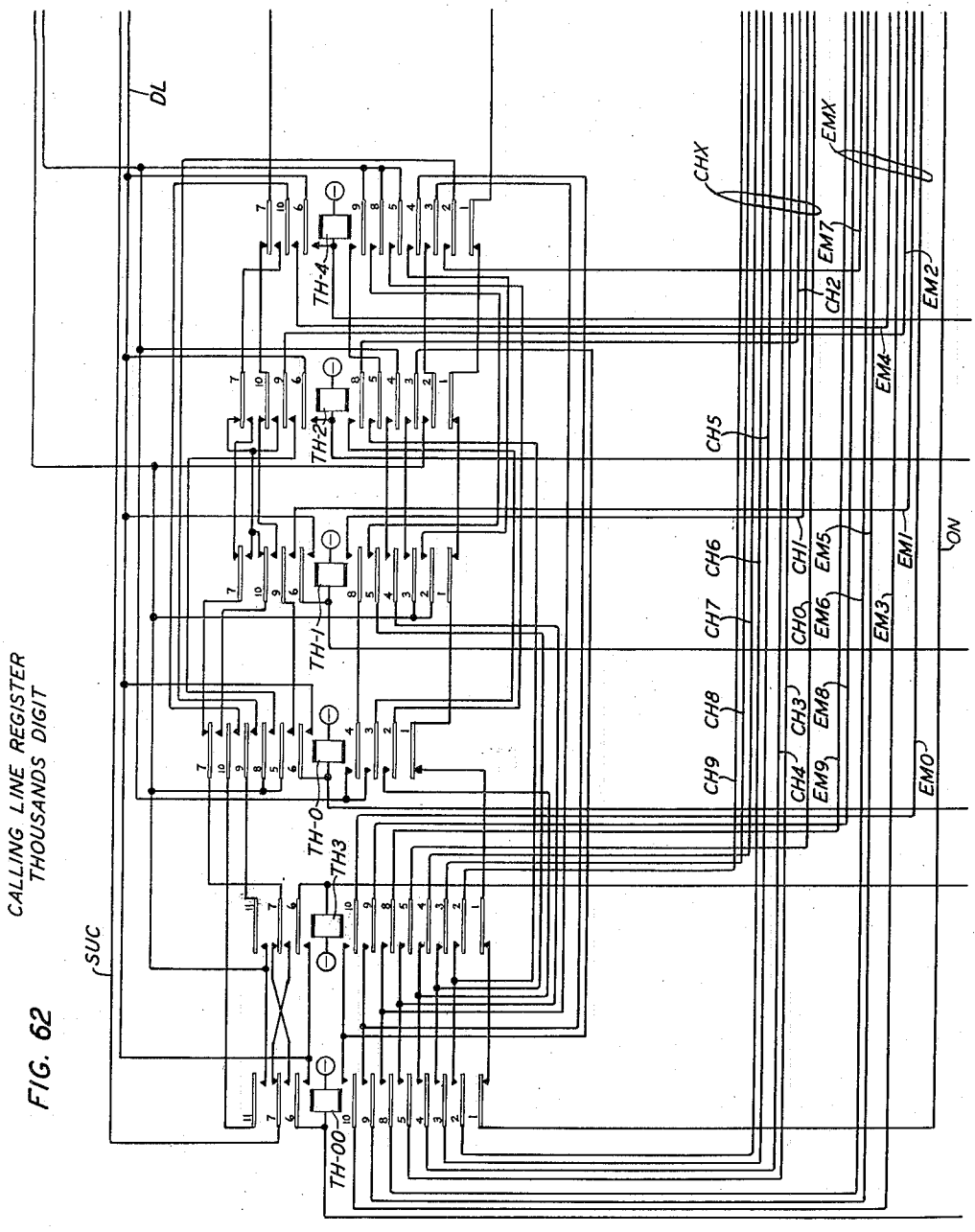
BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 65



CALLING LINE REGISTER
THOUSANDS DIGIT

FIG. 62

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY.

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 66

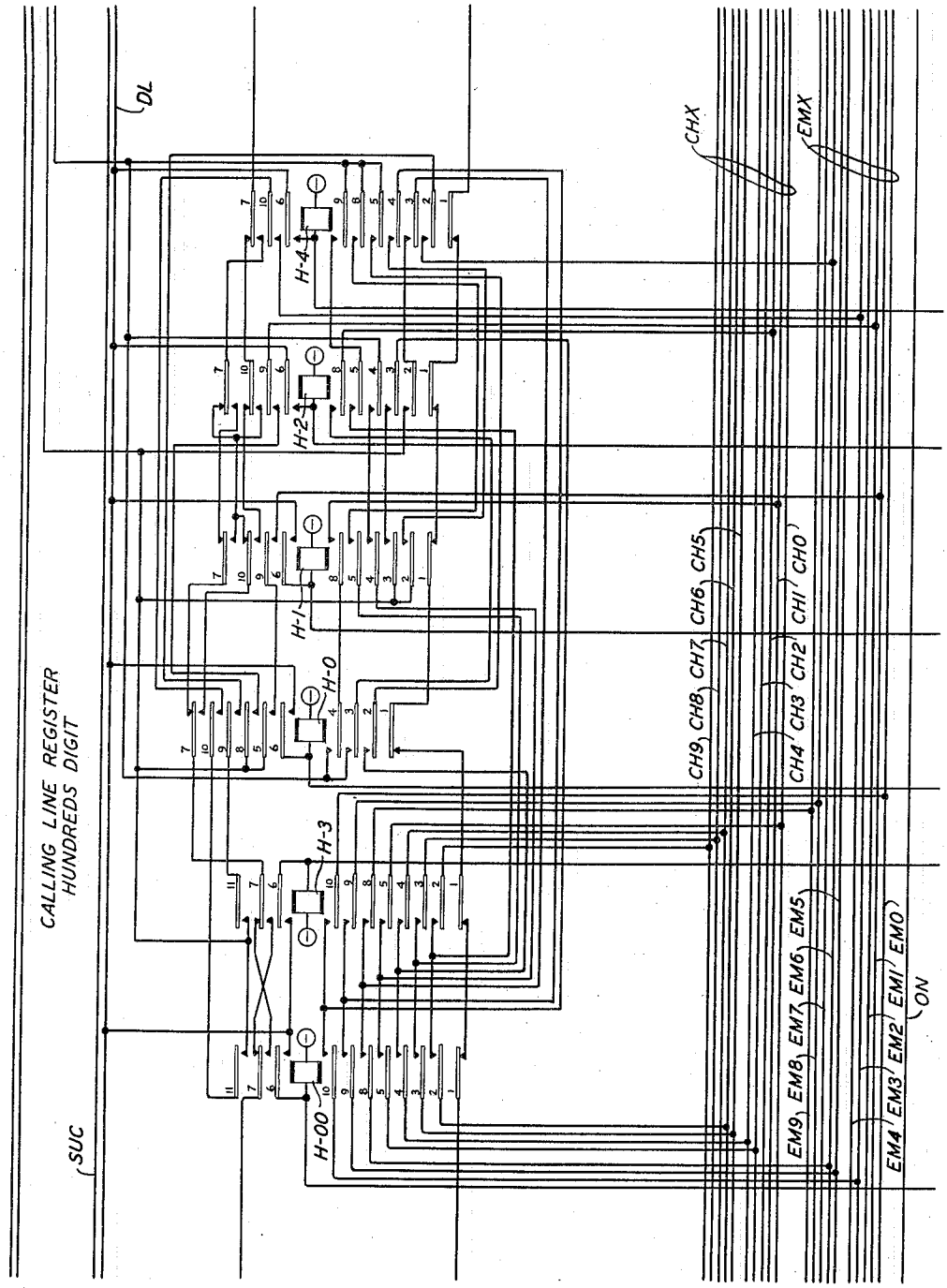


FIG. 63

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 67

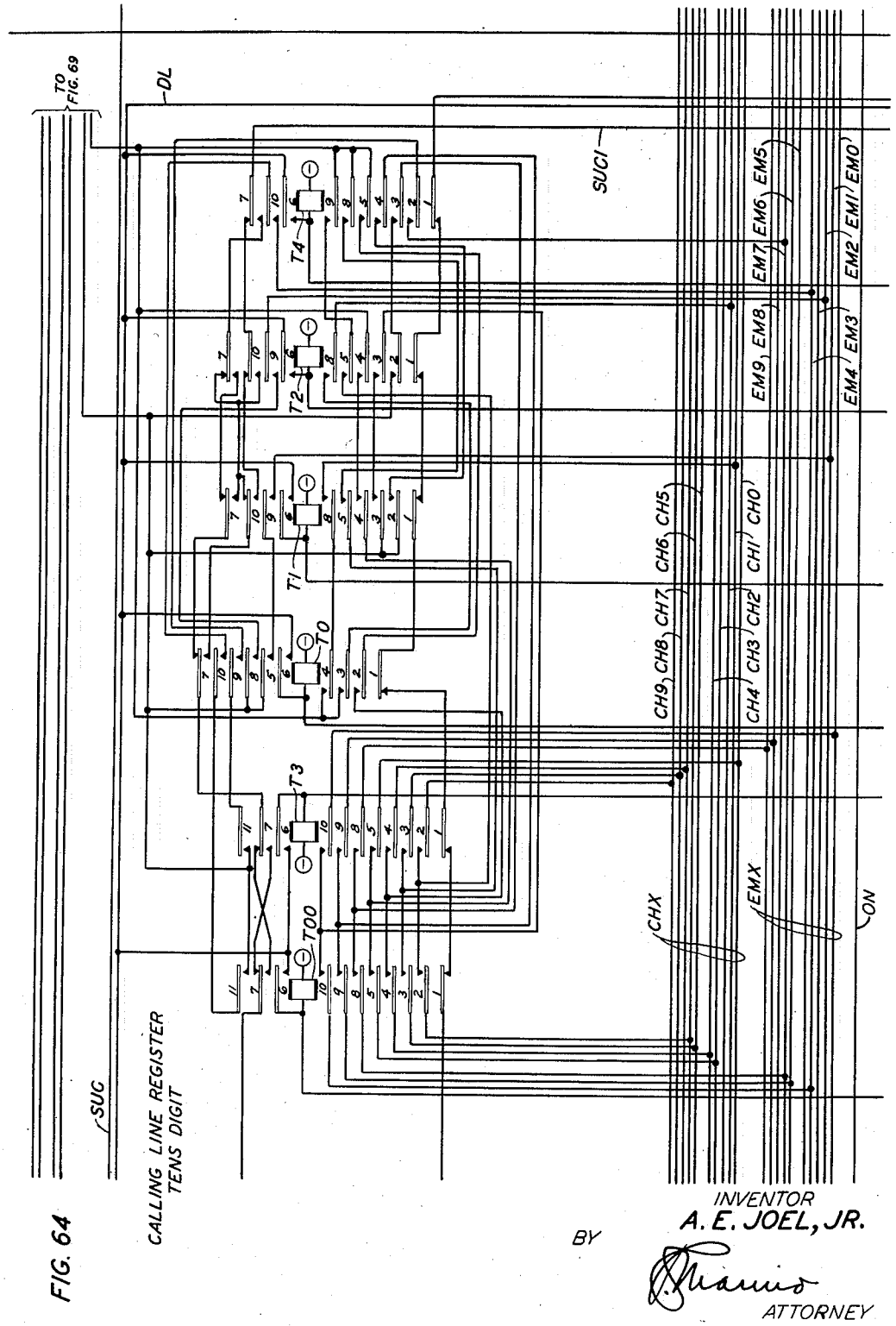


FIG. 64

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 68

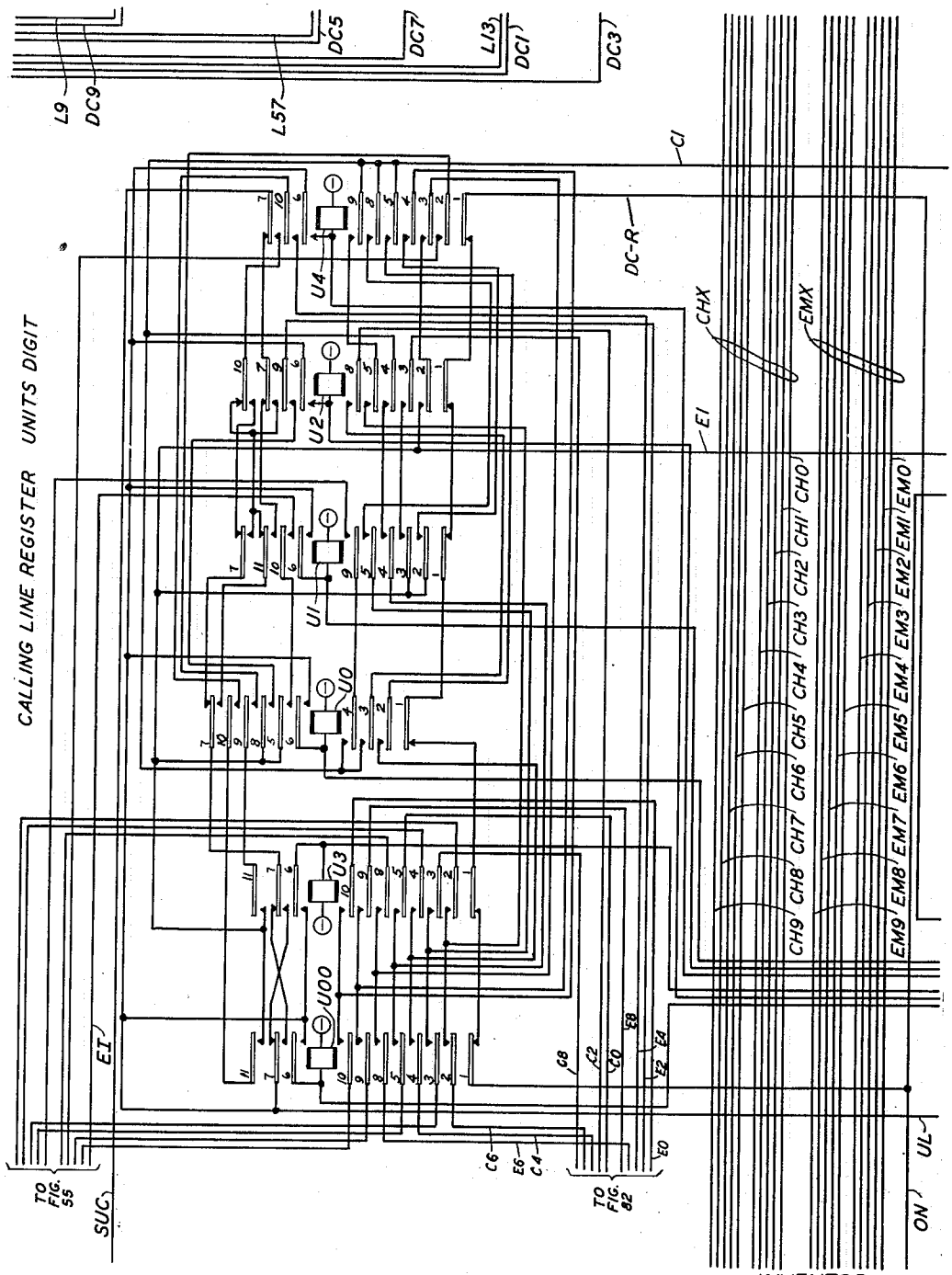


FIG. 65

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 69

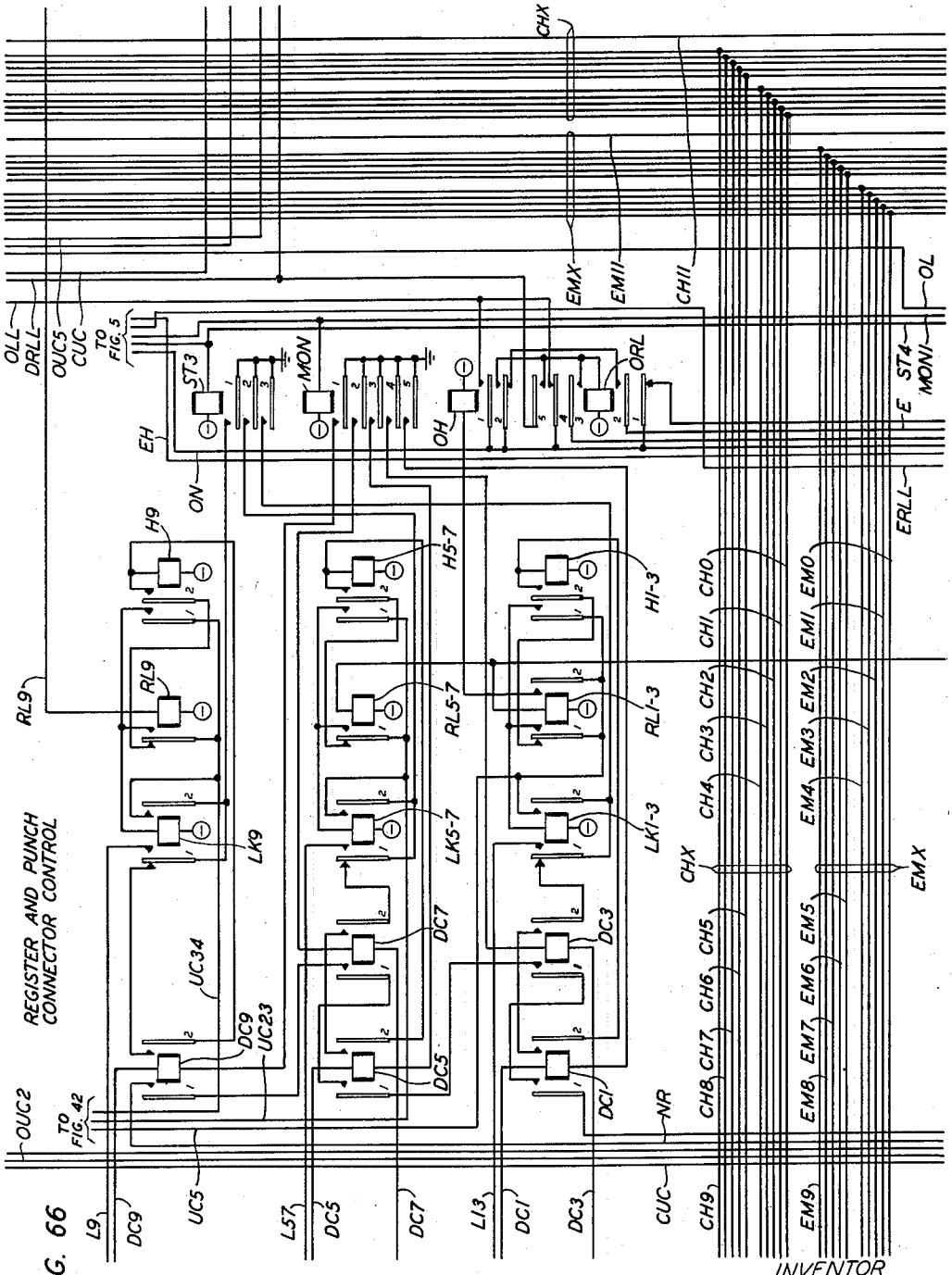


FIG. 66

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 70

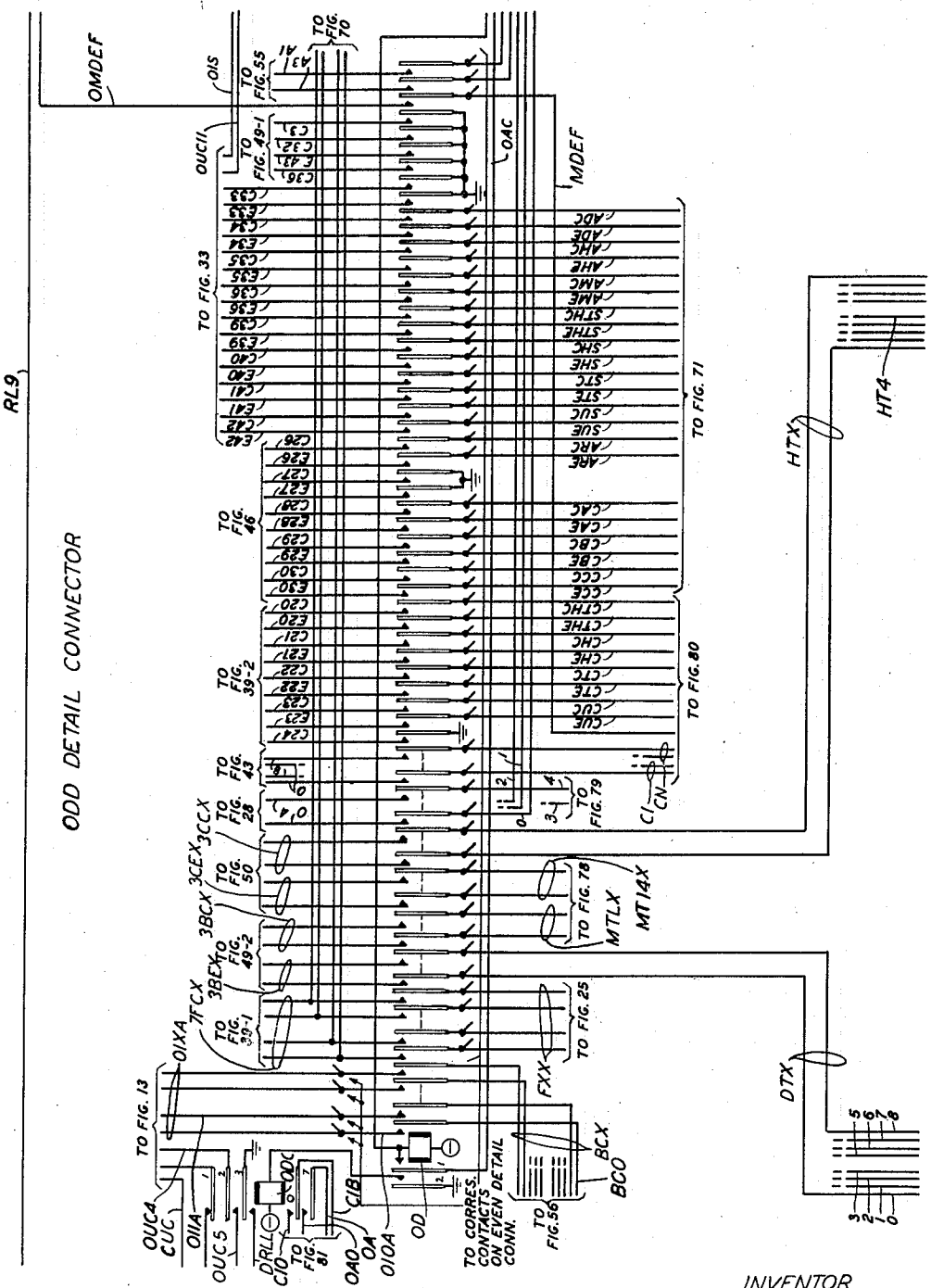


FIG. 67

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 71

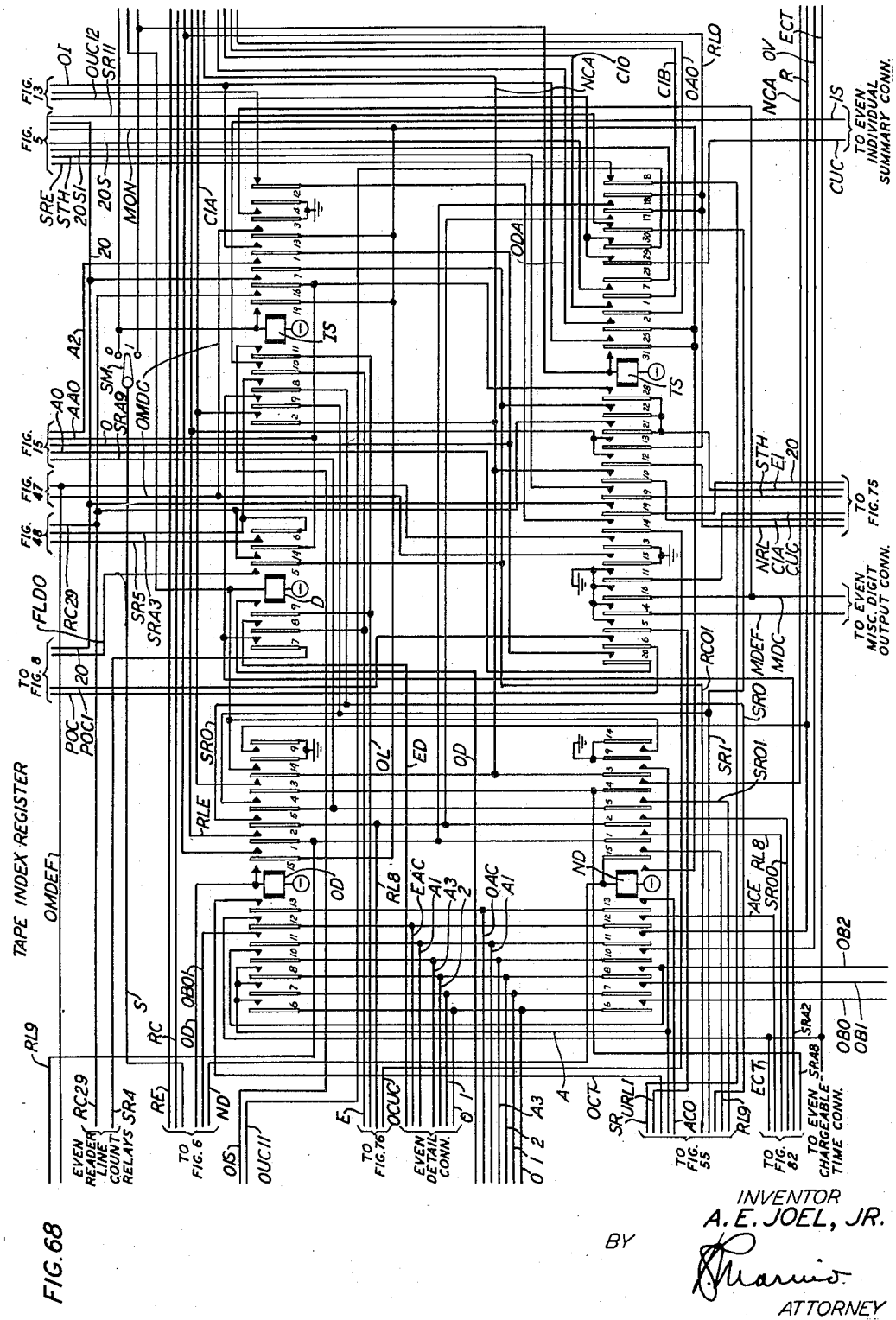


FIG. 68

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

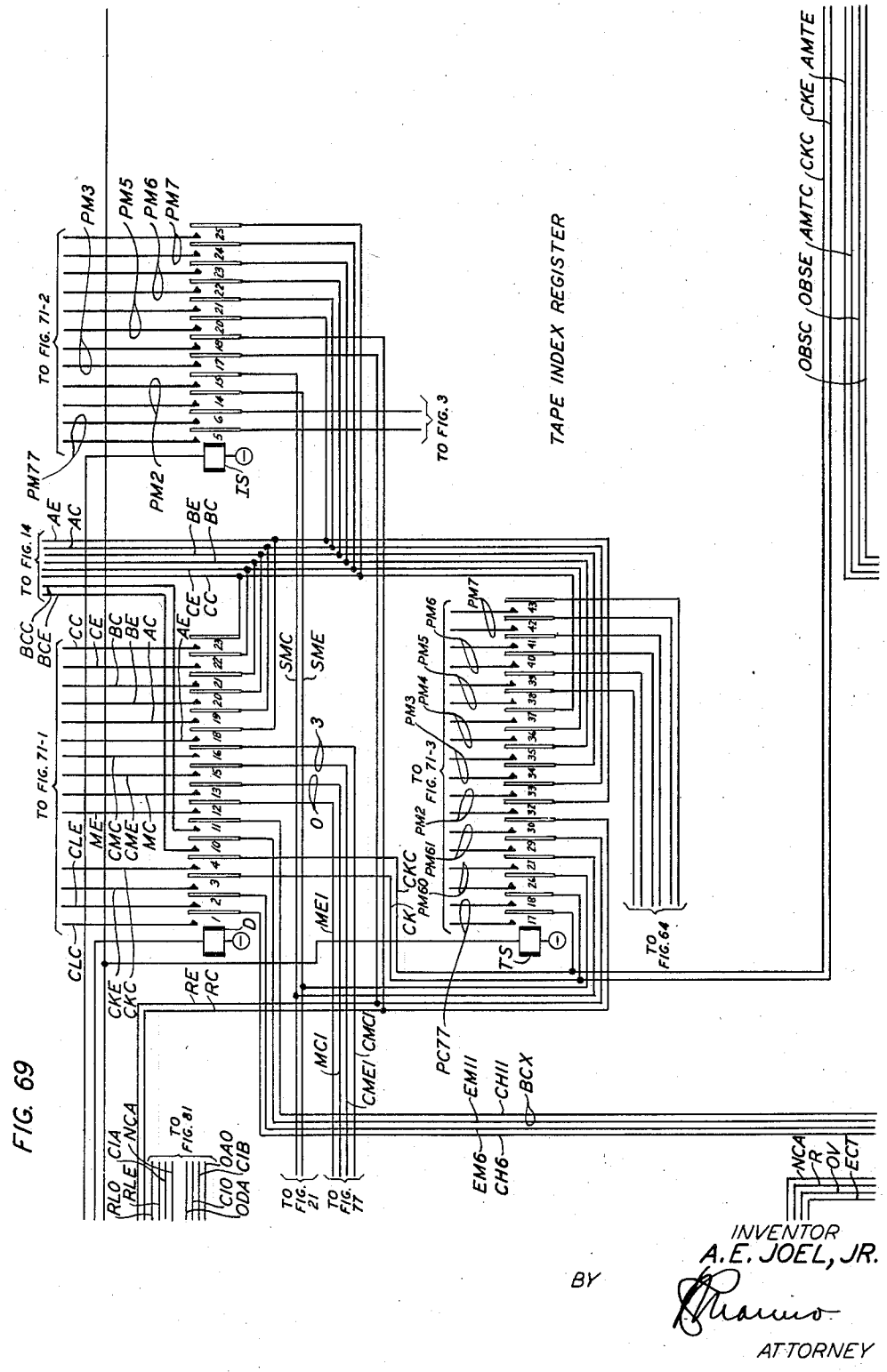


FIG. 69

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 73

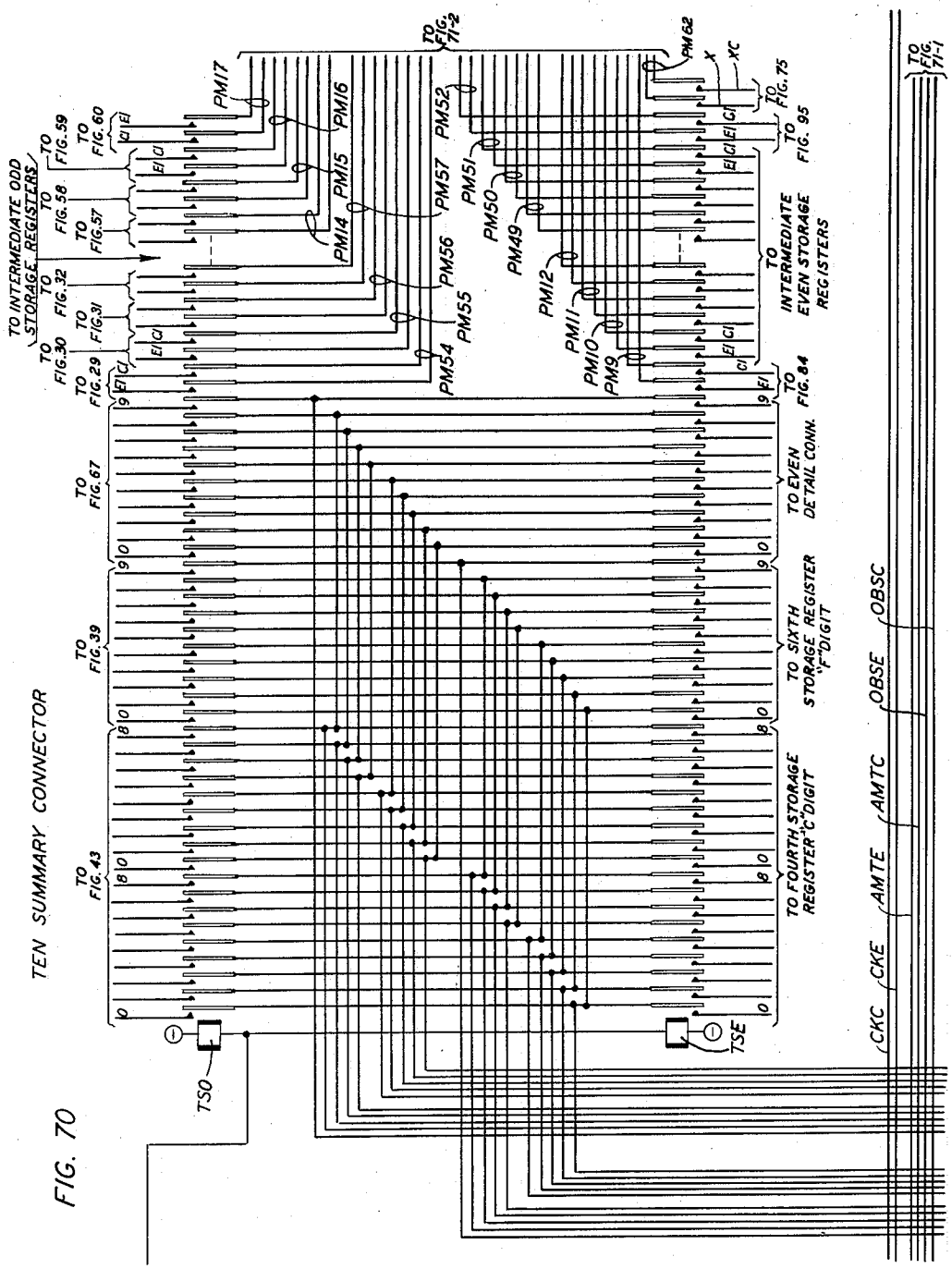


FIG. 70

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 74

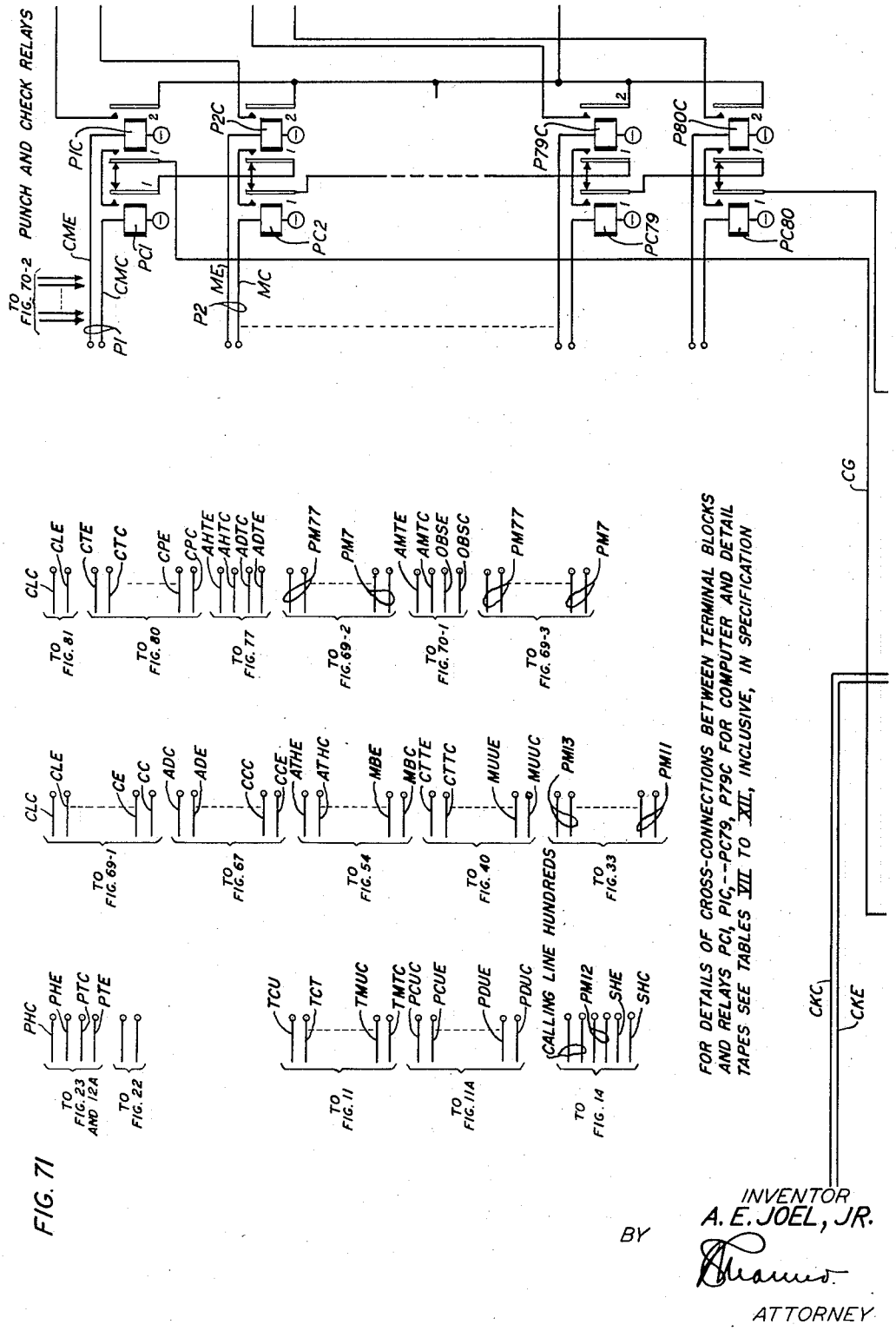


FIG. 71

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 75

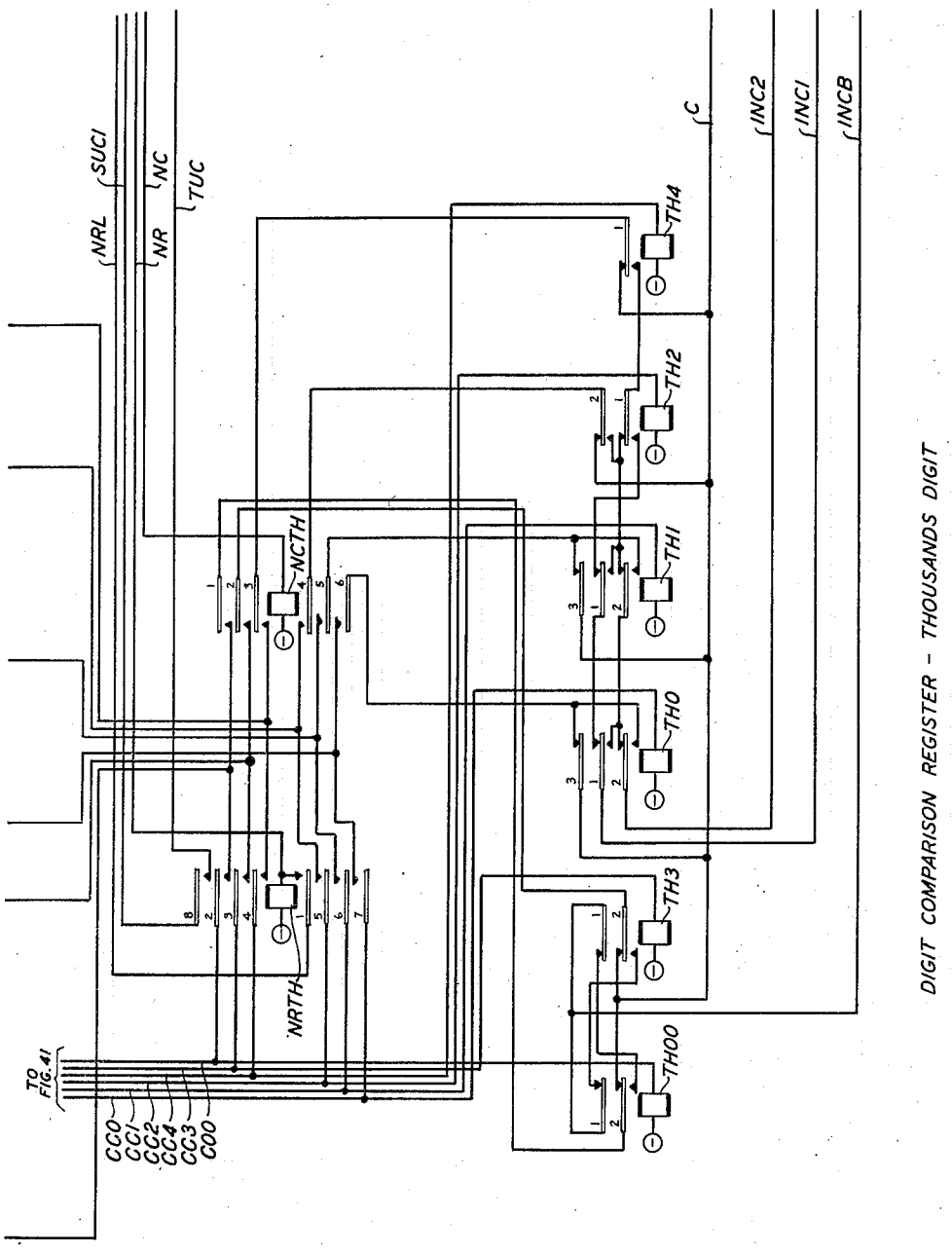


FIG. 72

BY

INVENTOR
A. E. JOEL, JR.

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 76

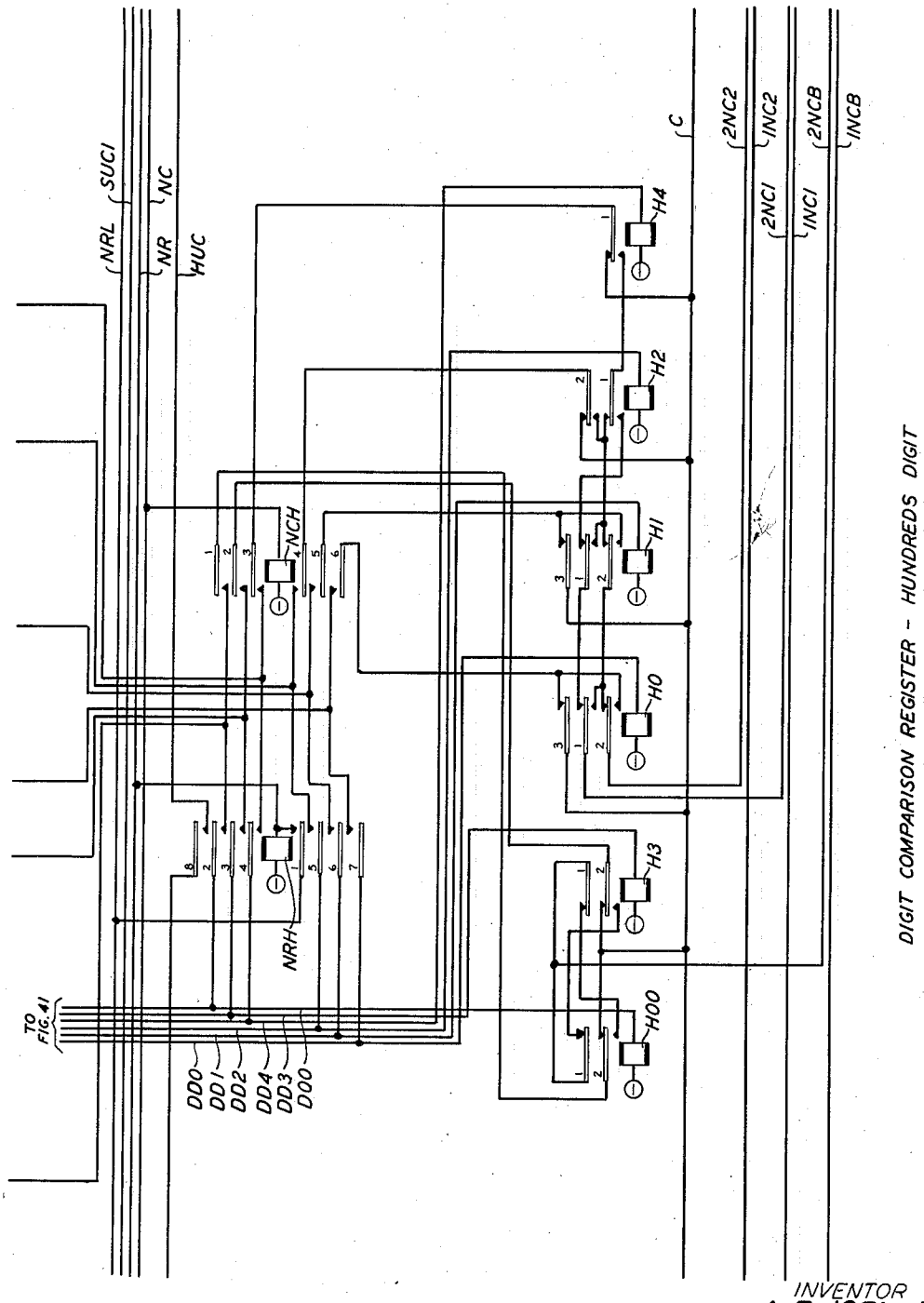


FIG. 73

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 77

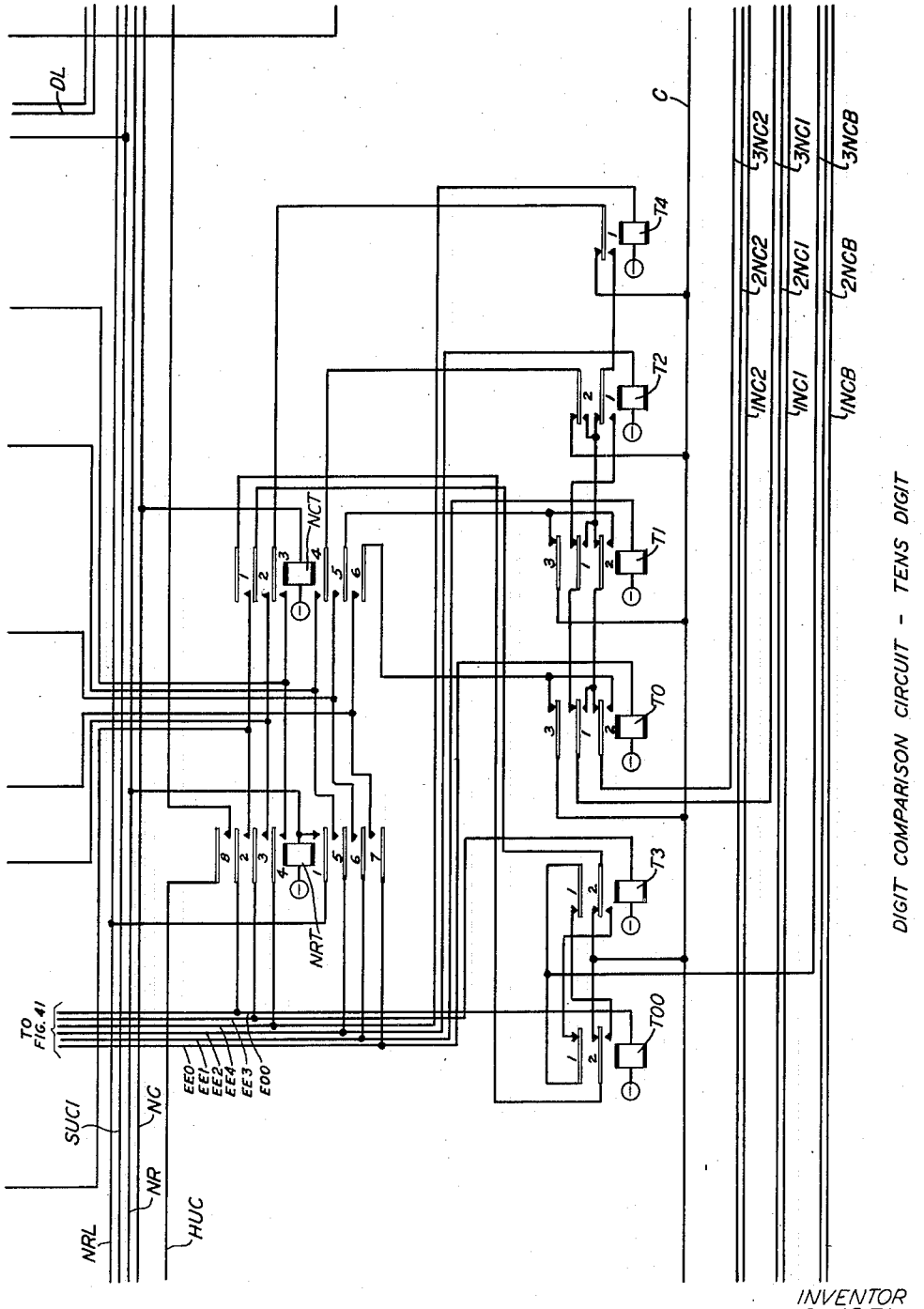


FIG. 74

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 78

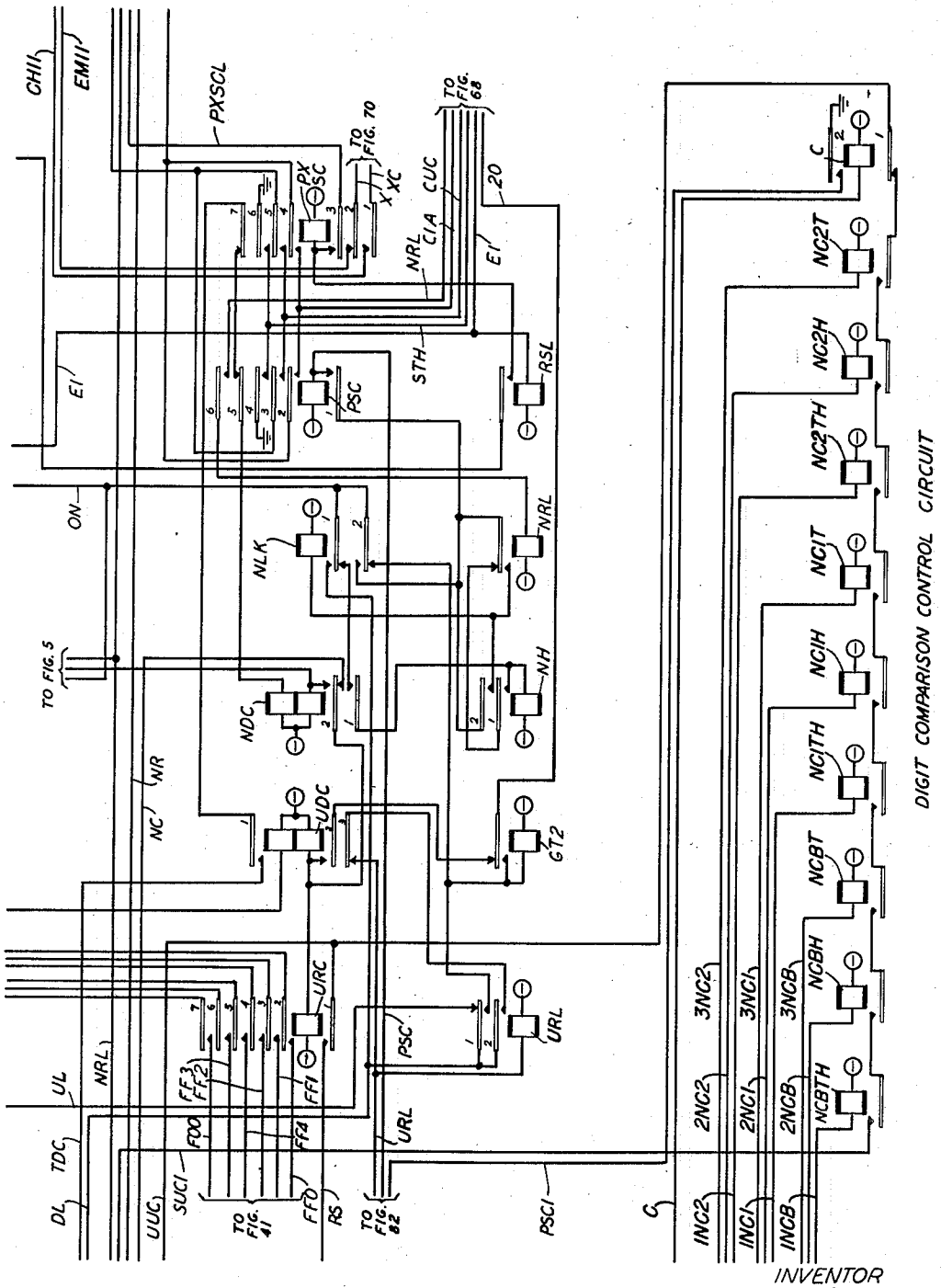


FIG. 75

BY

INVENTOR
A. E. JOEL, JR.

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 79

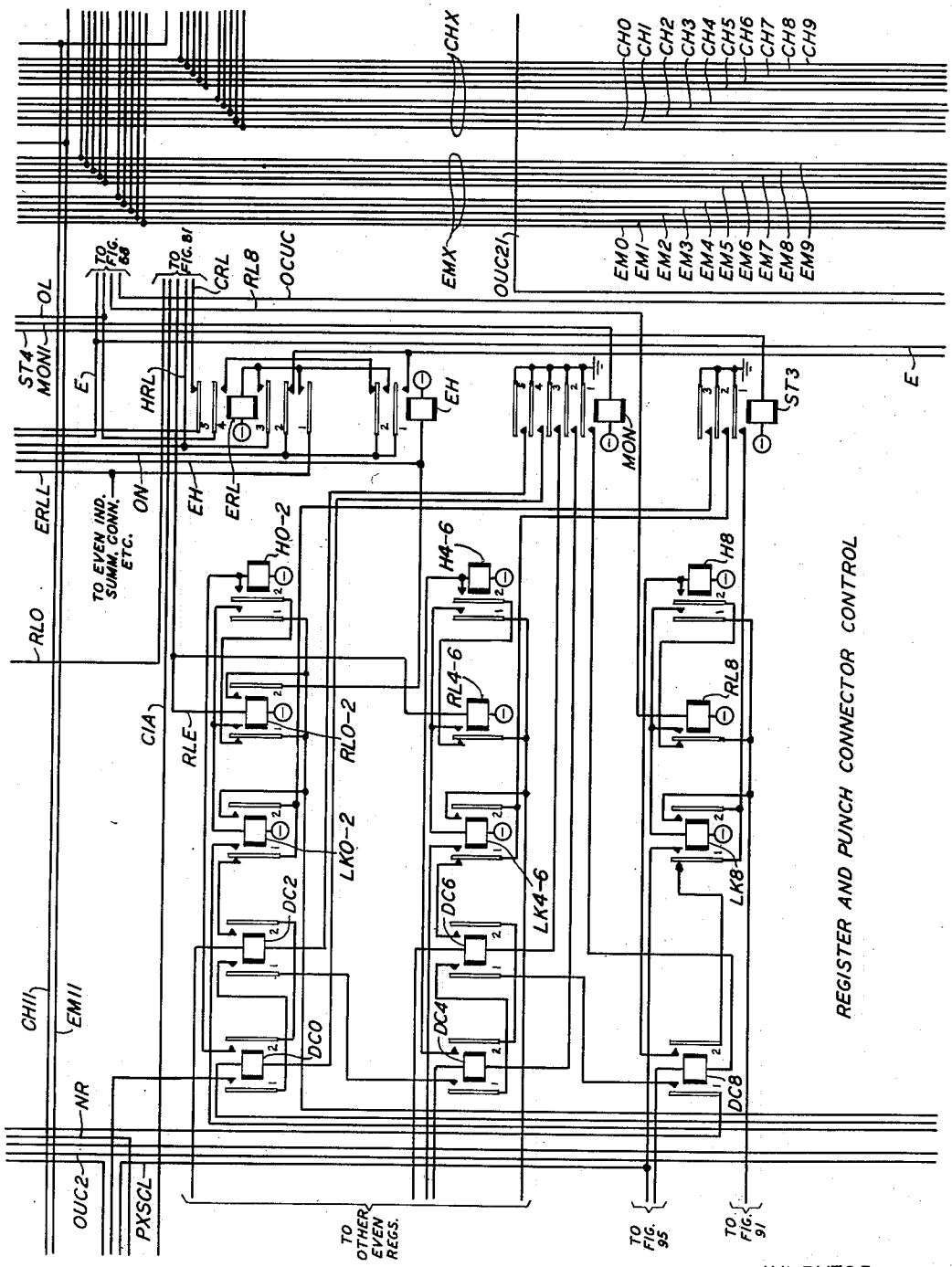


FIG. 76

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 80

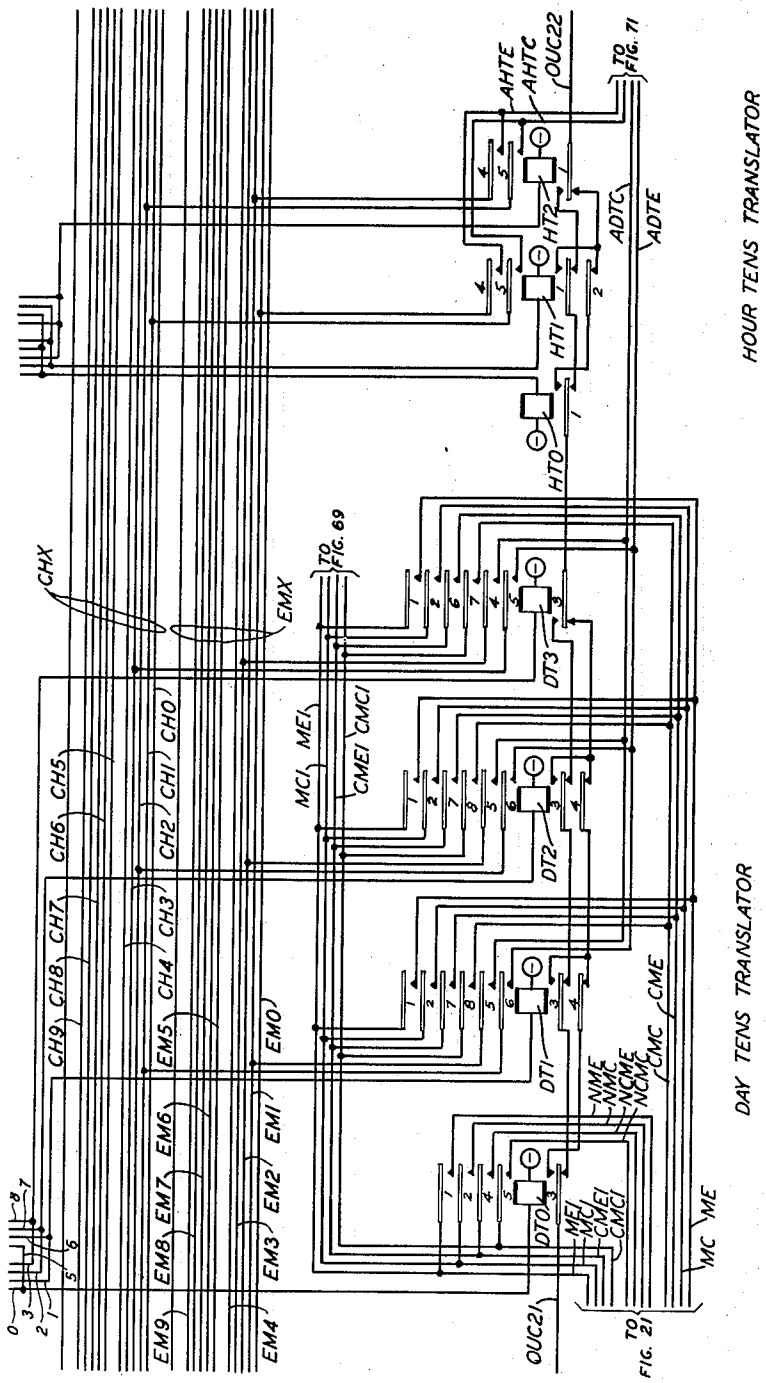


FIG. 77

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 81

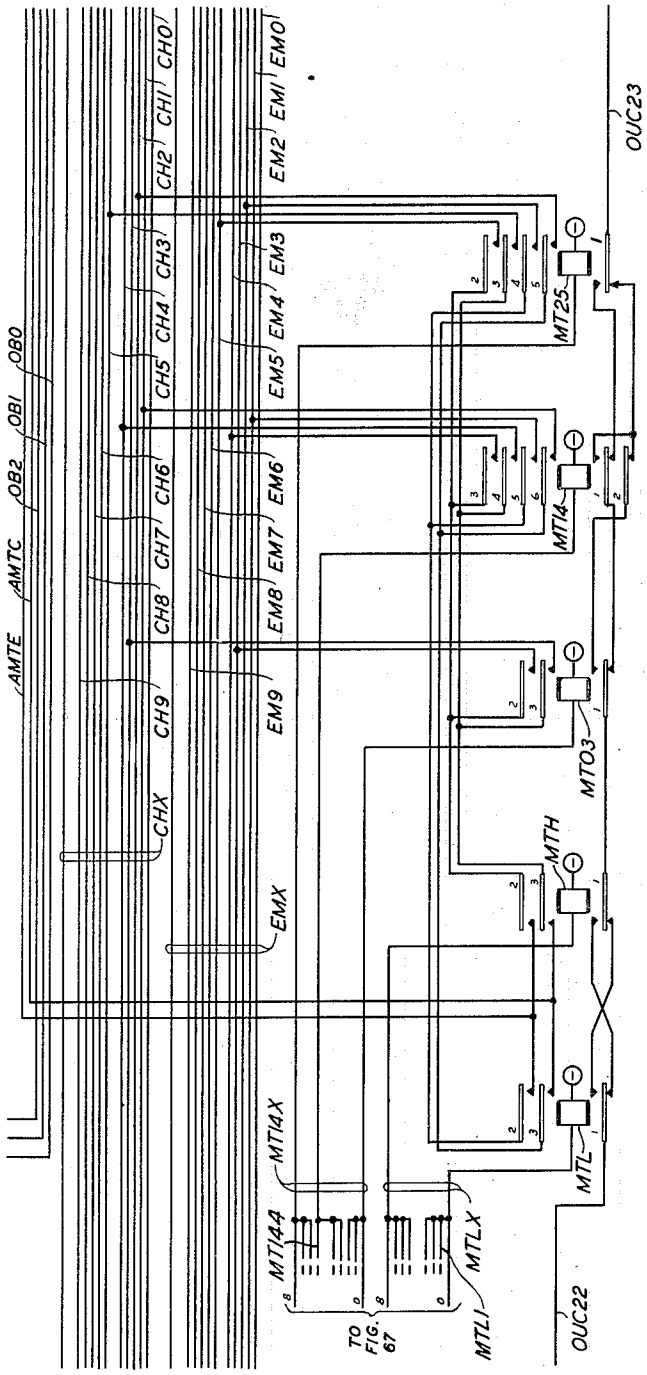


FIG. 78

BY

INVENTOR
A. E. JOEL, JR.

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 82

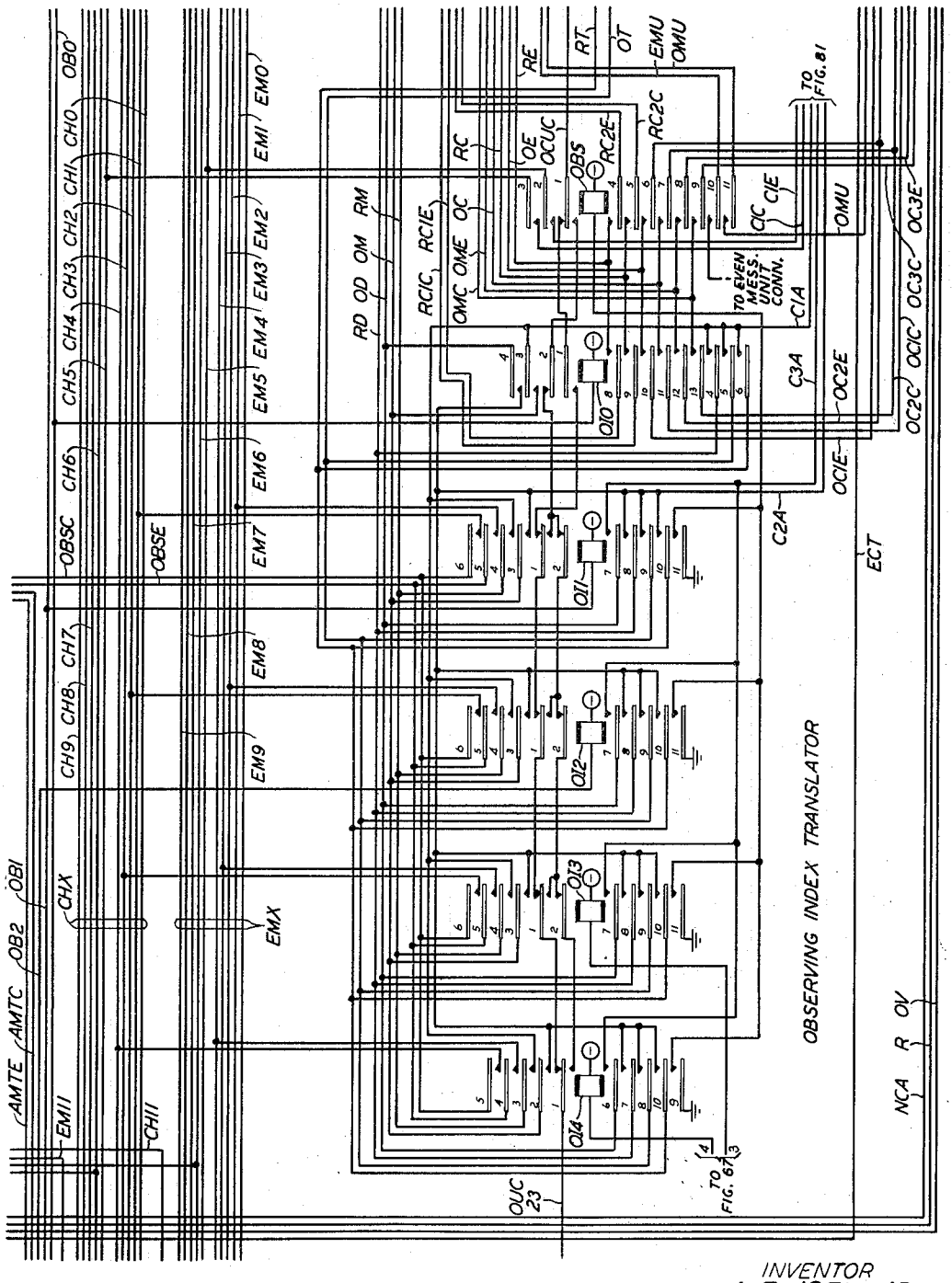


FIG. 79

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 83

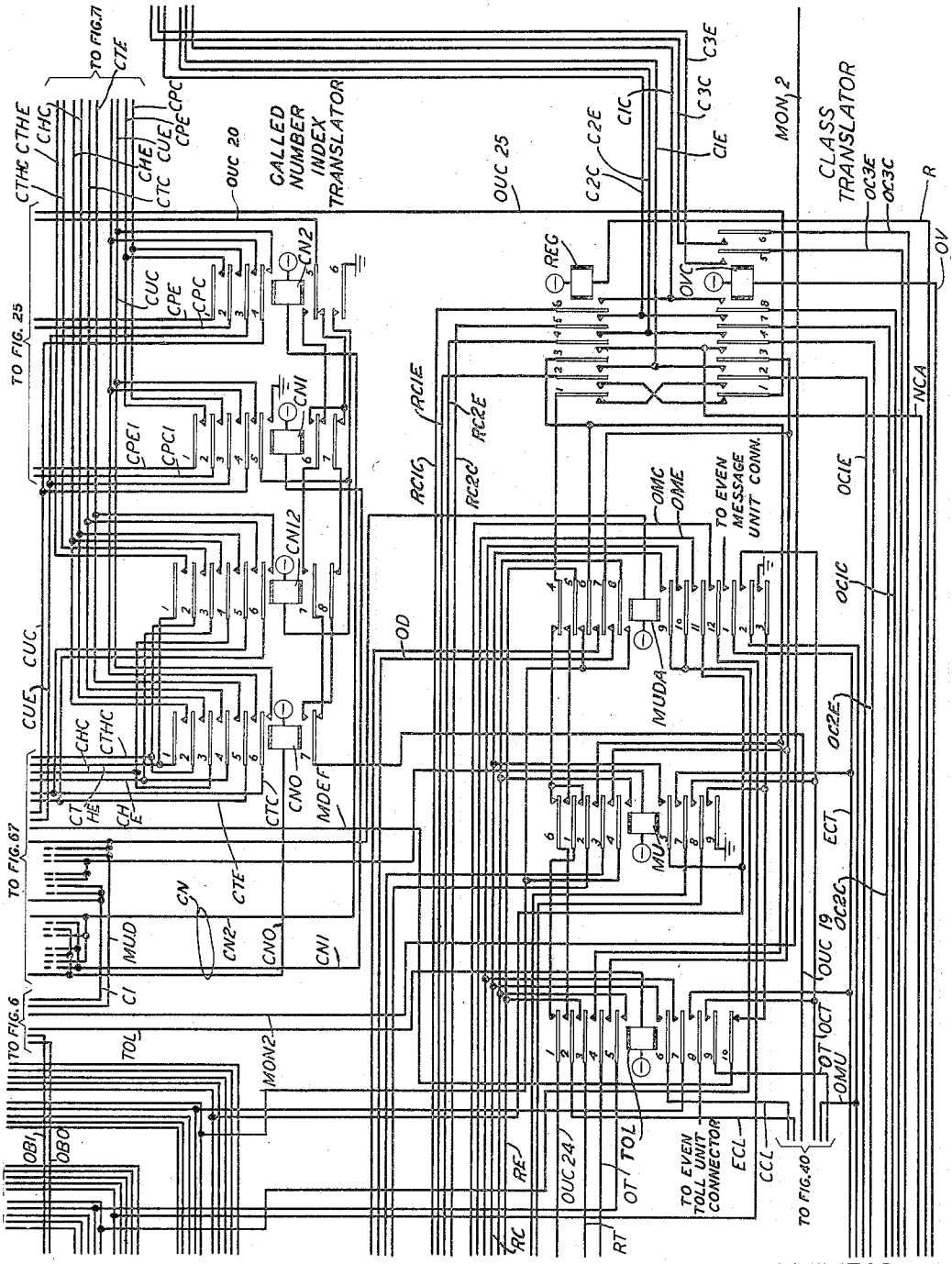


FIG. 80

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 84

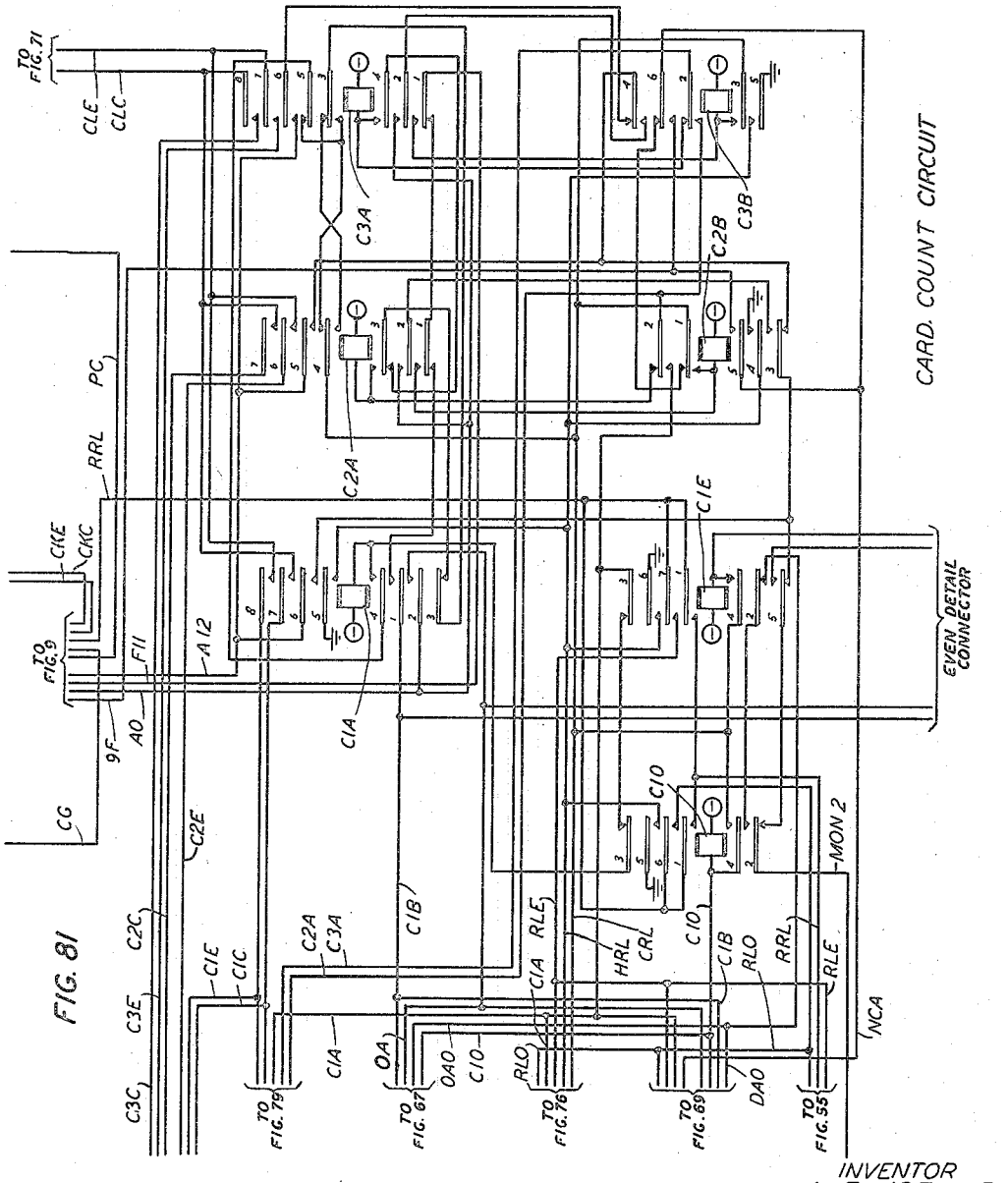


FIG. 81

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 85

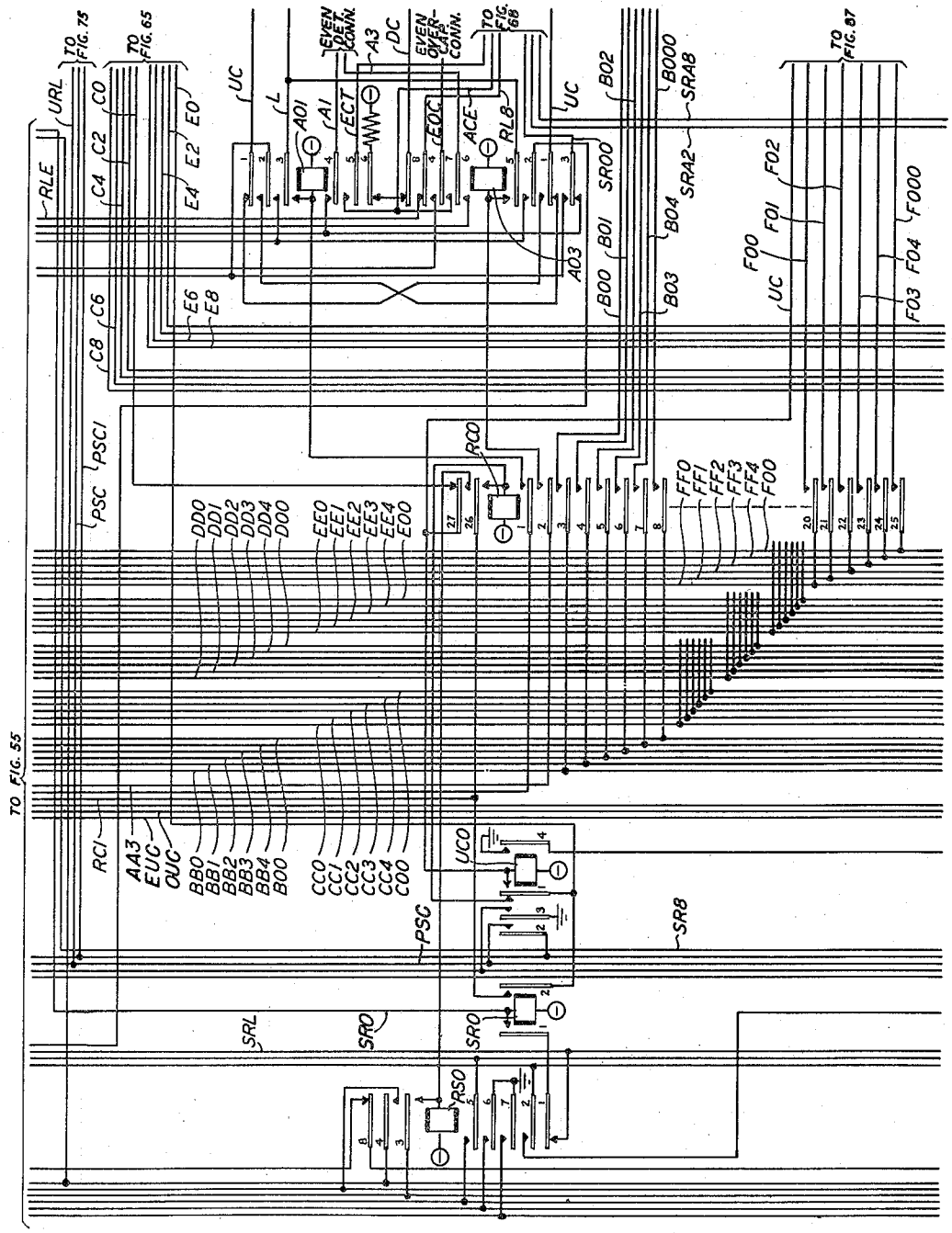


FIG. 82
ZERO STORAGE REGISTER CONNECTOR

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 86

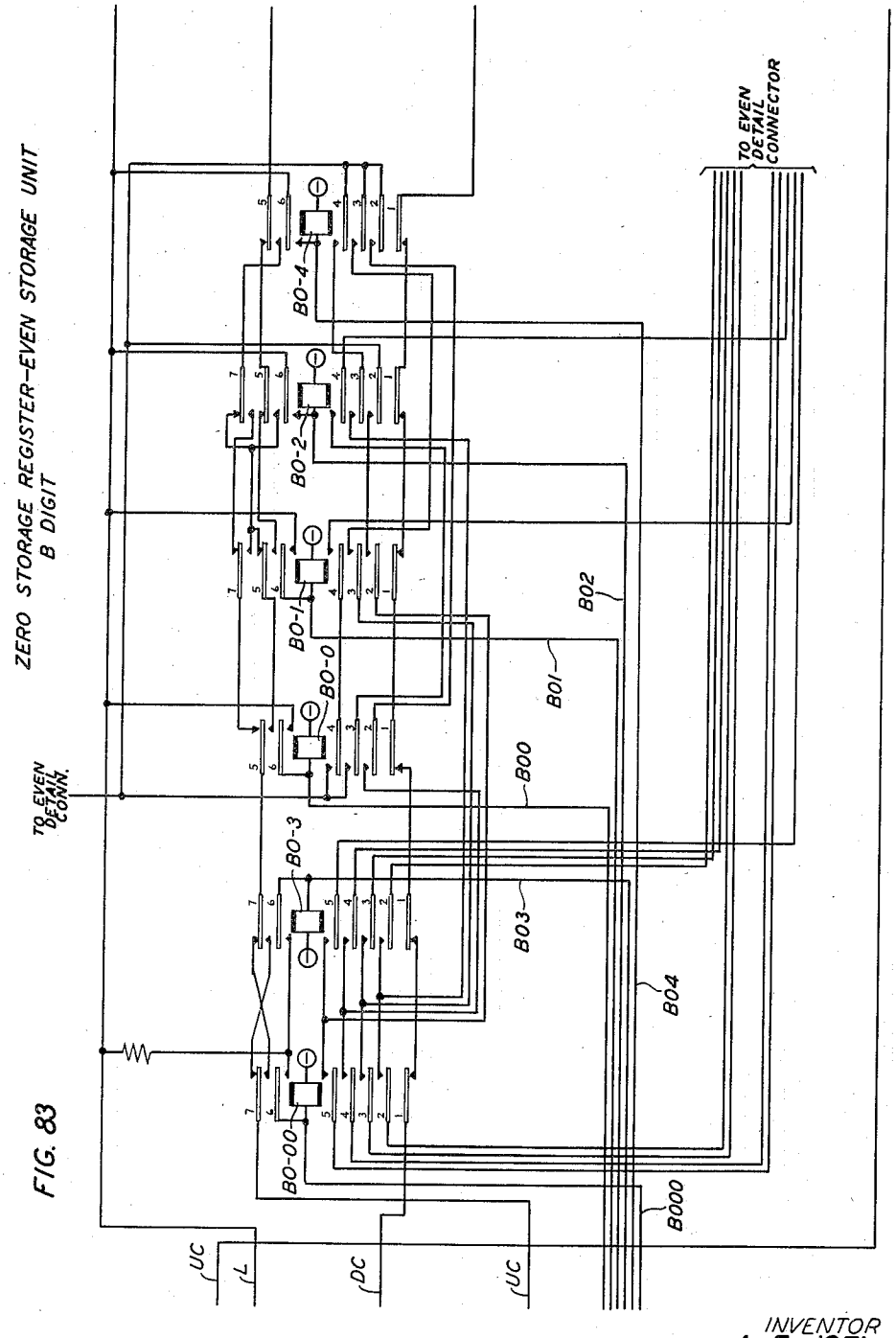


FIG. 83

INVENTOR
A. E. JOEL, JR.

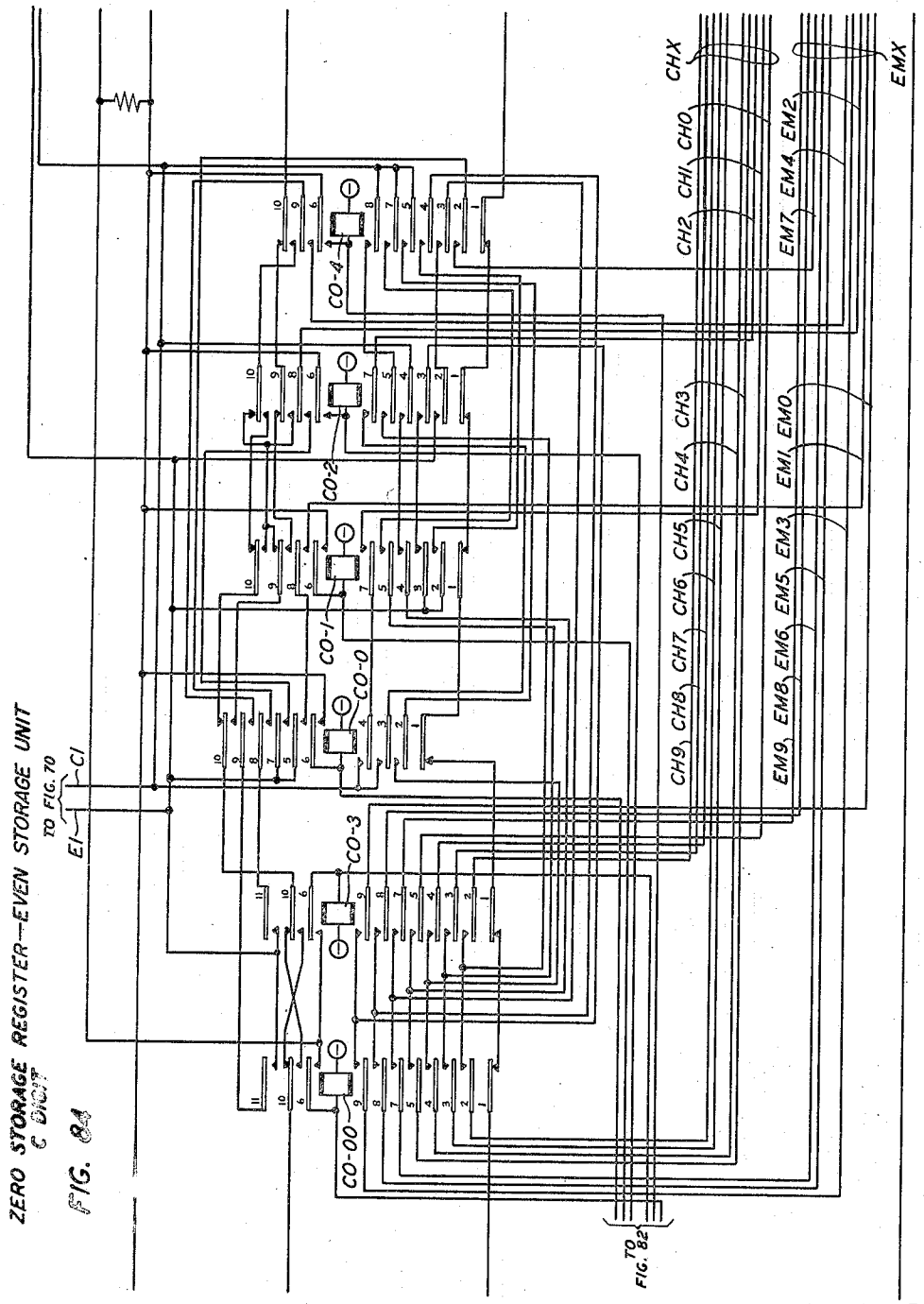
BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 87



ZERO STORAGE REGISTER—EVEN STORAGE UNIT & DIGIT

FIG. 84

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 88

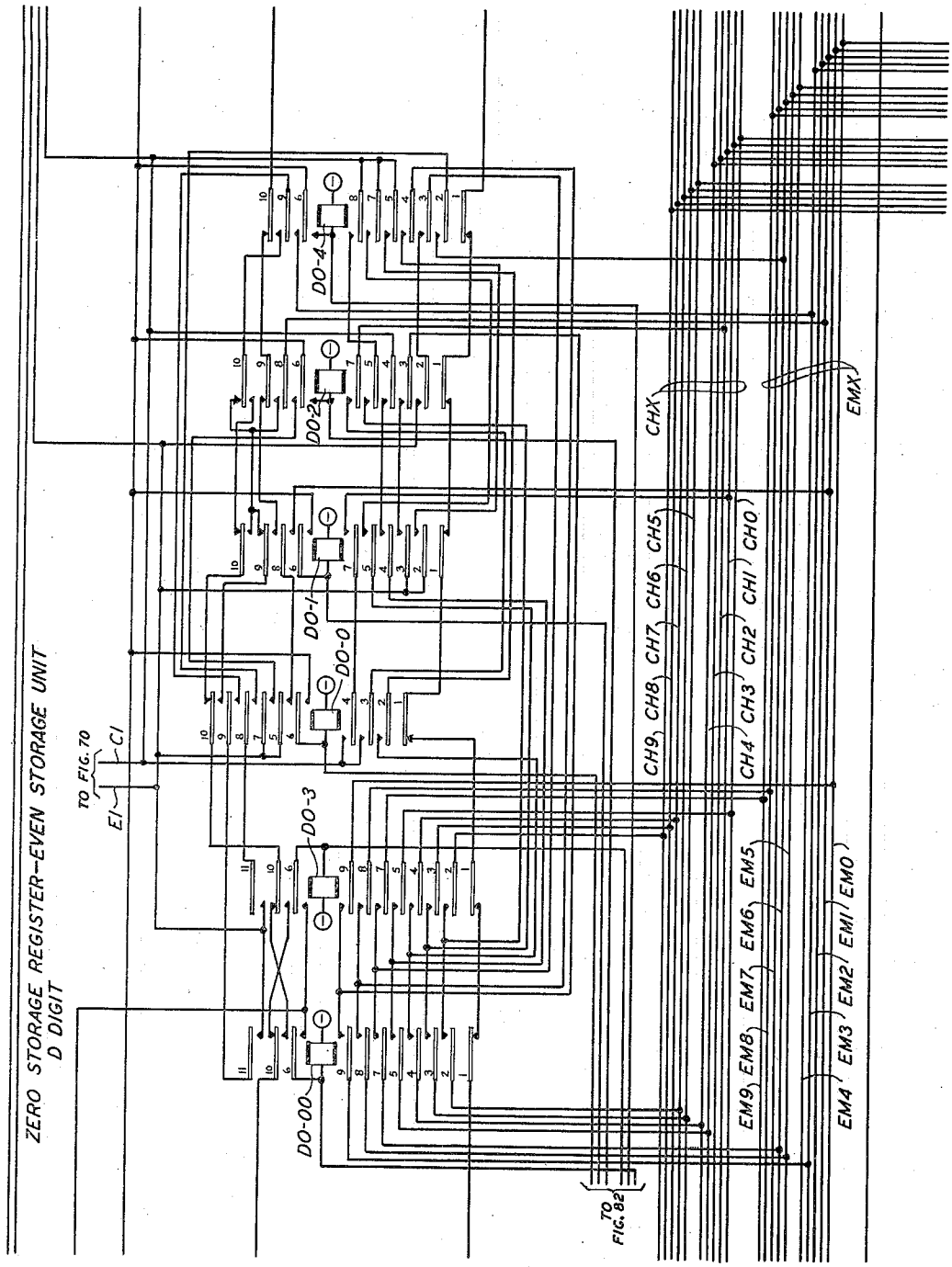


FIG. 85

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 89

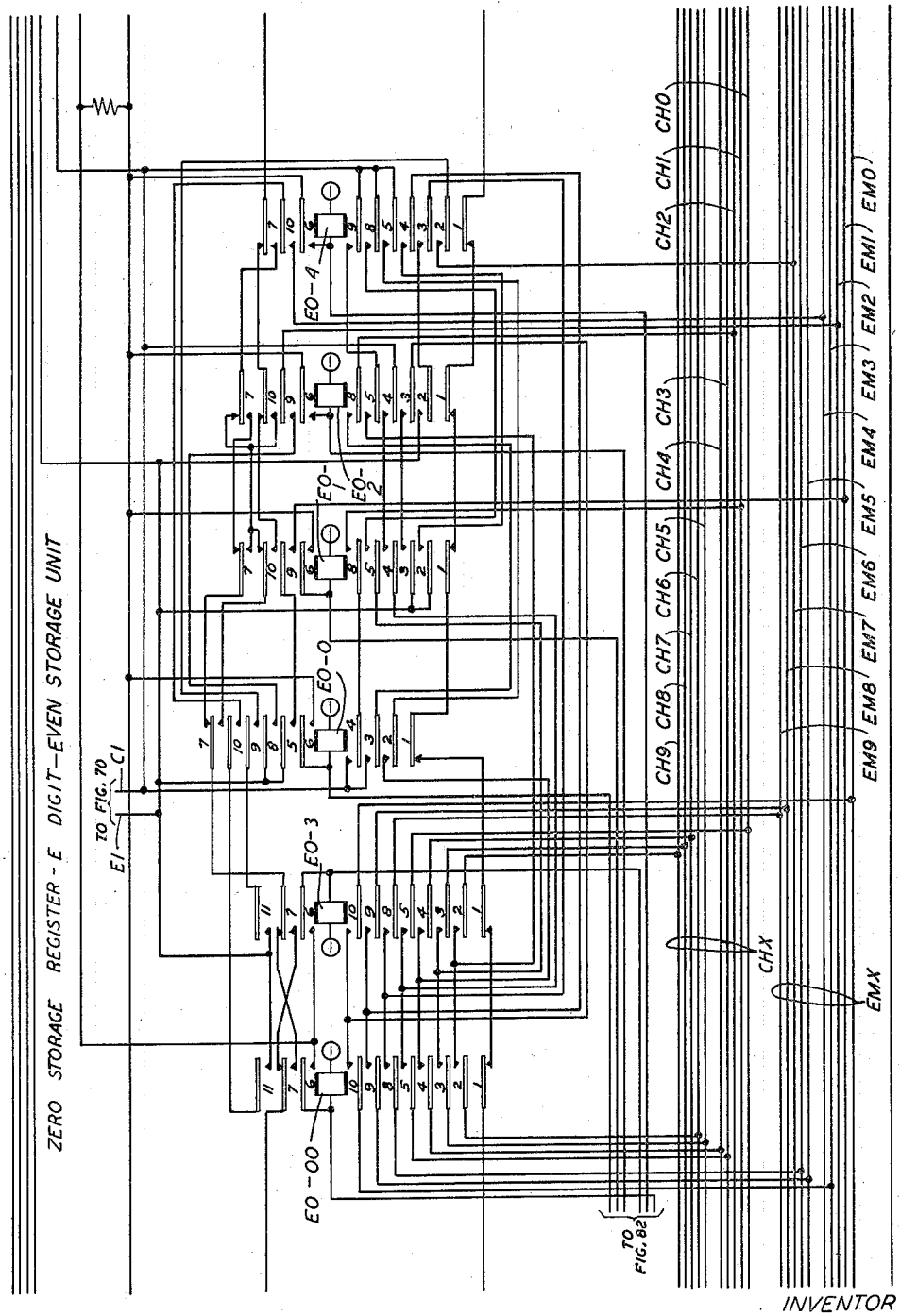


FIG. 86

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 90

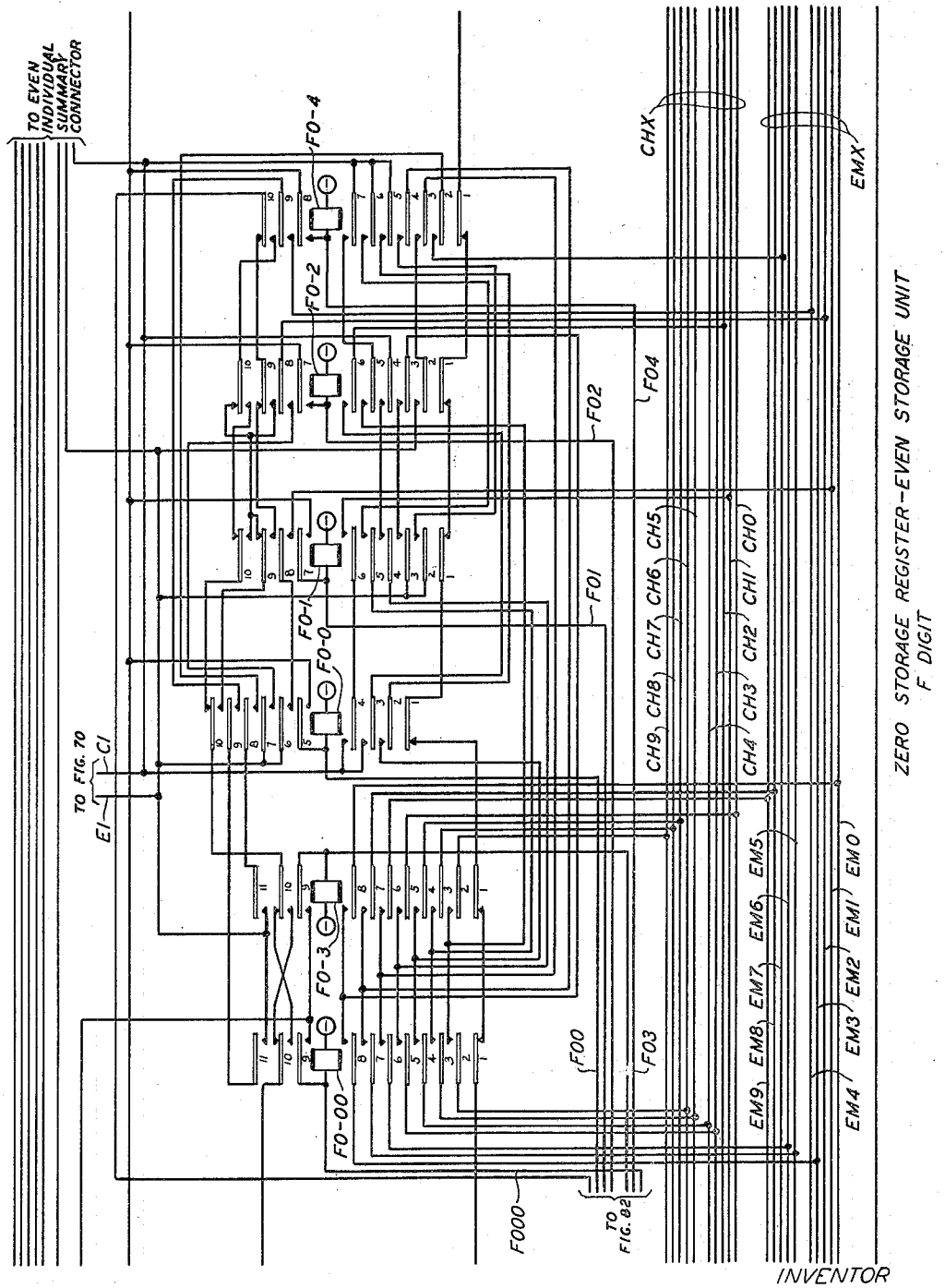


FIG. 87

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 91

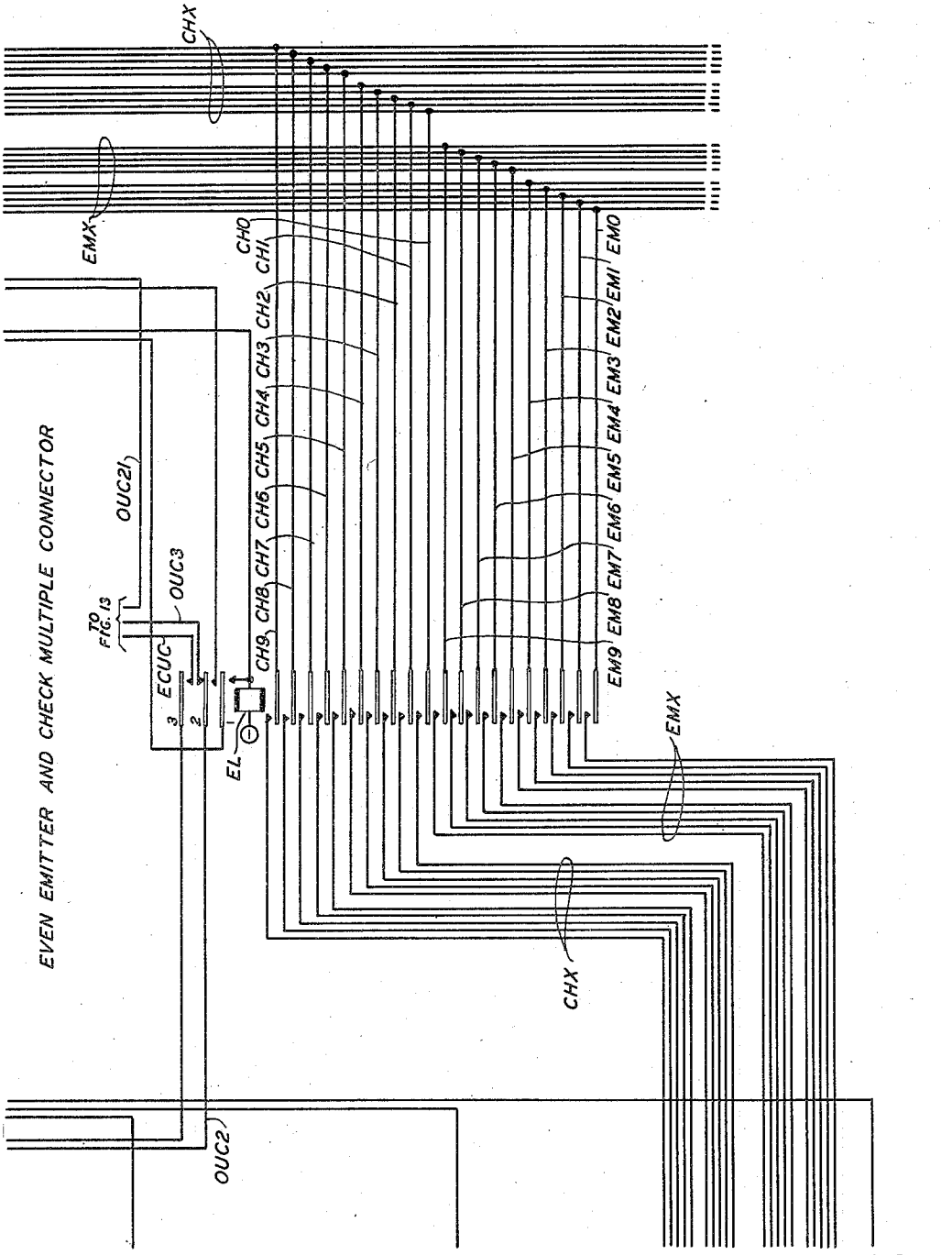


FIG. 88

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 92

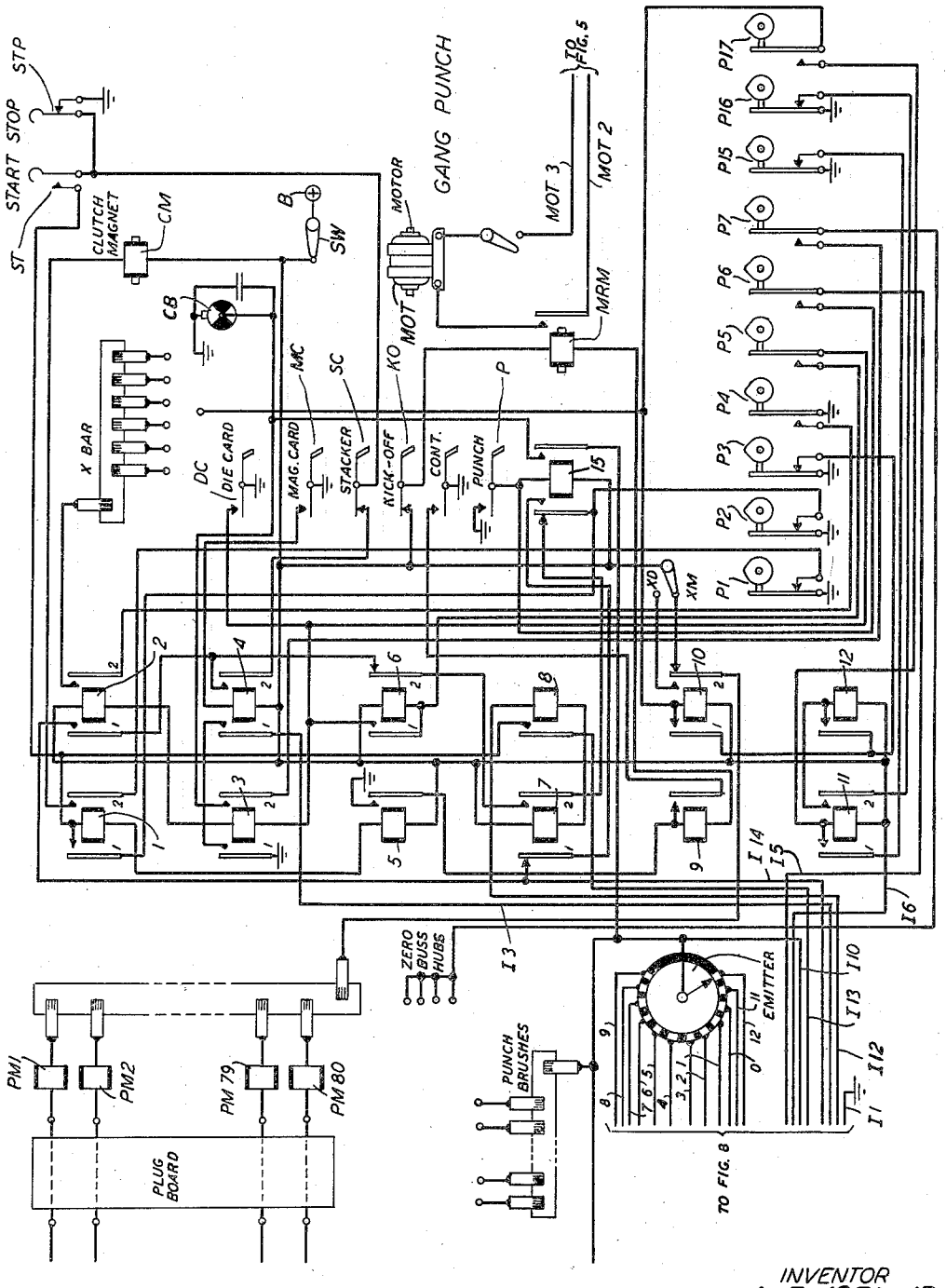


FIG. 89

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 93

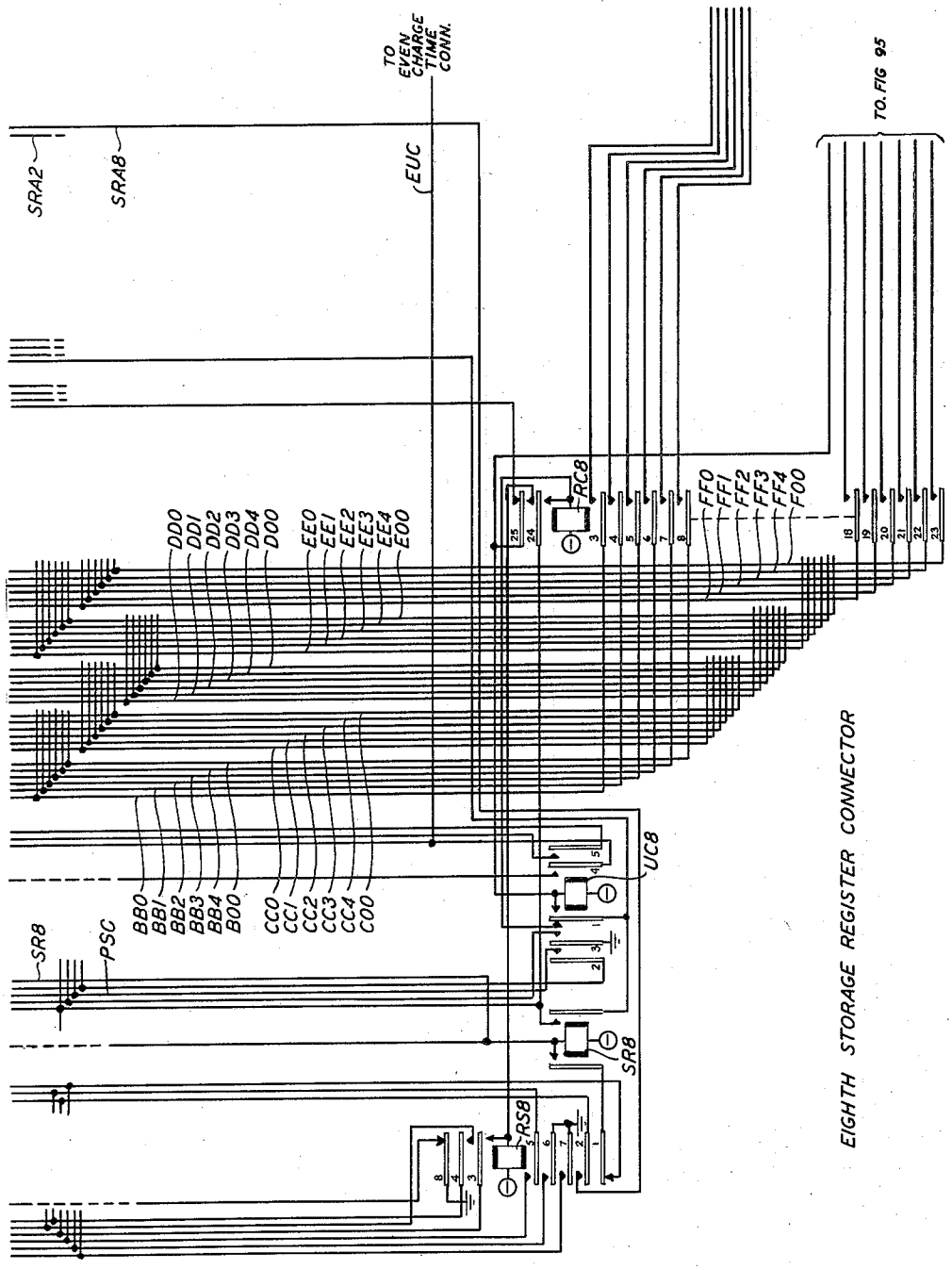


FIG. 90

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 94

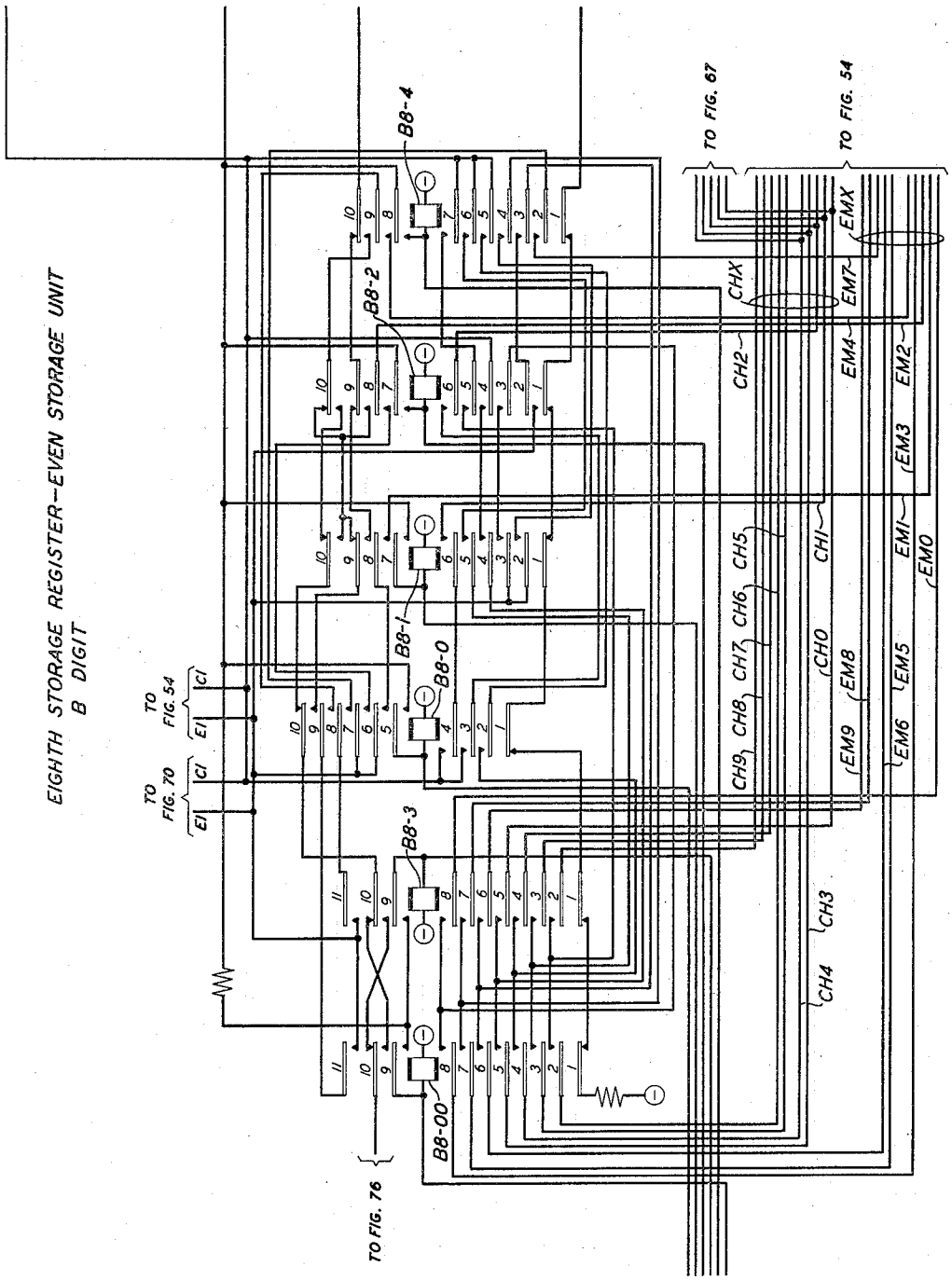


FIG. 91

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 95

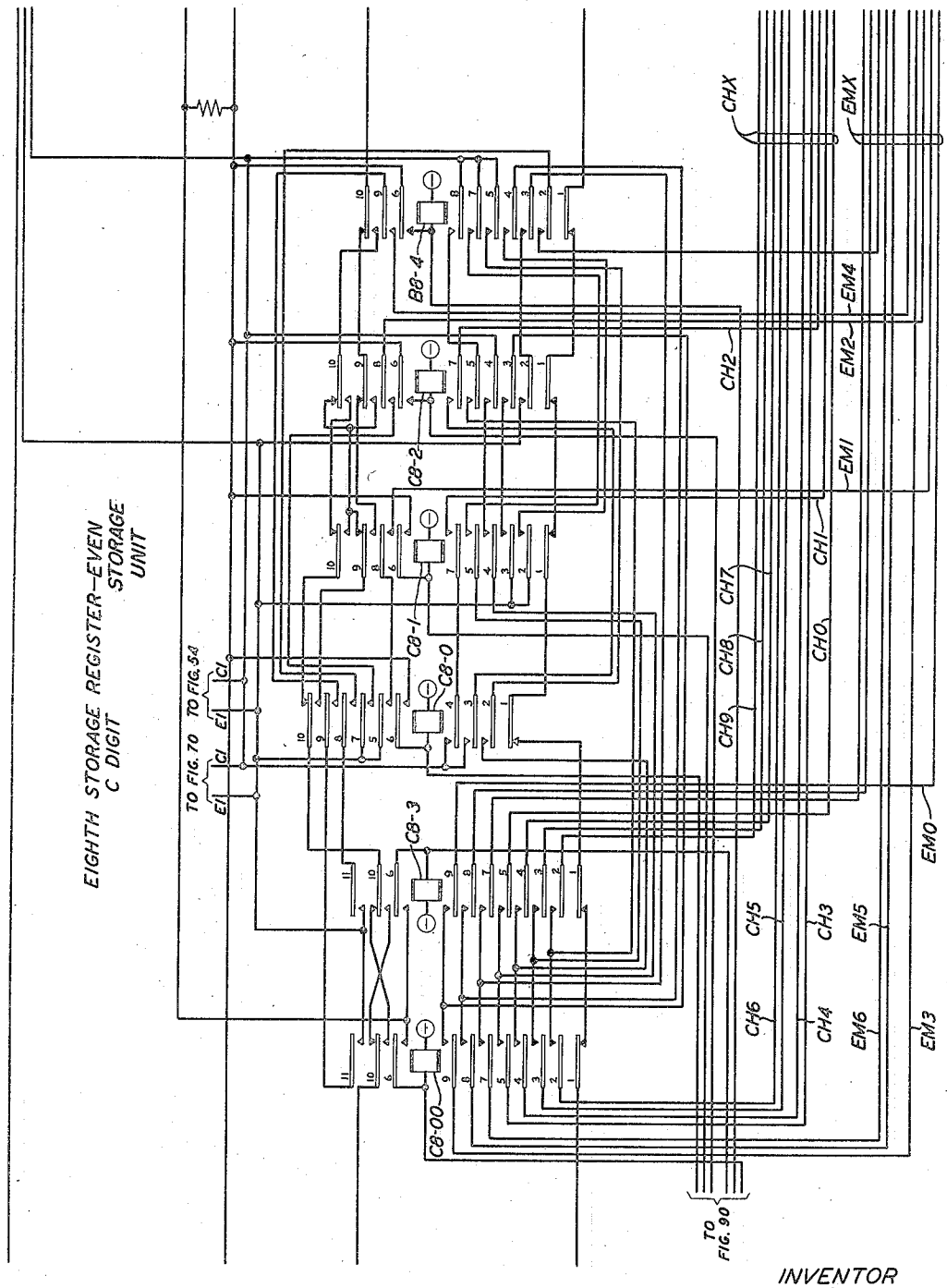


FIG. 92

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 96

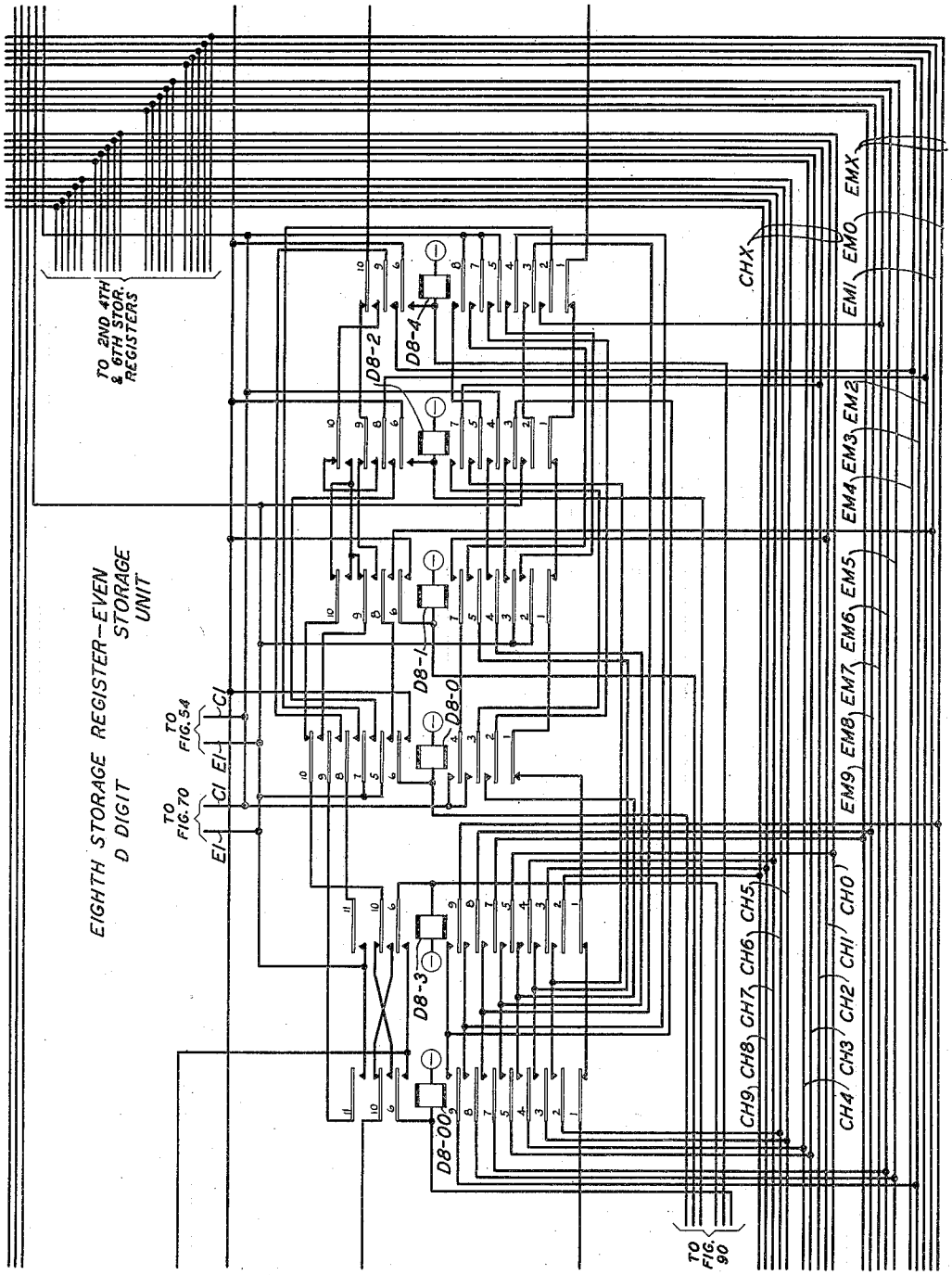


FIG. 93

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 97

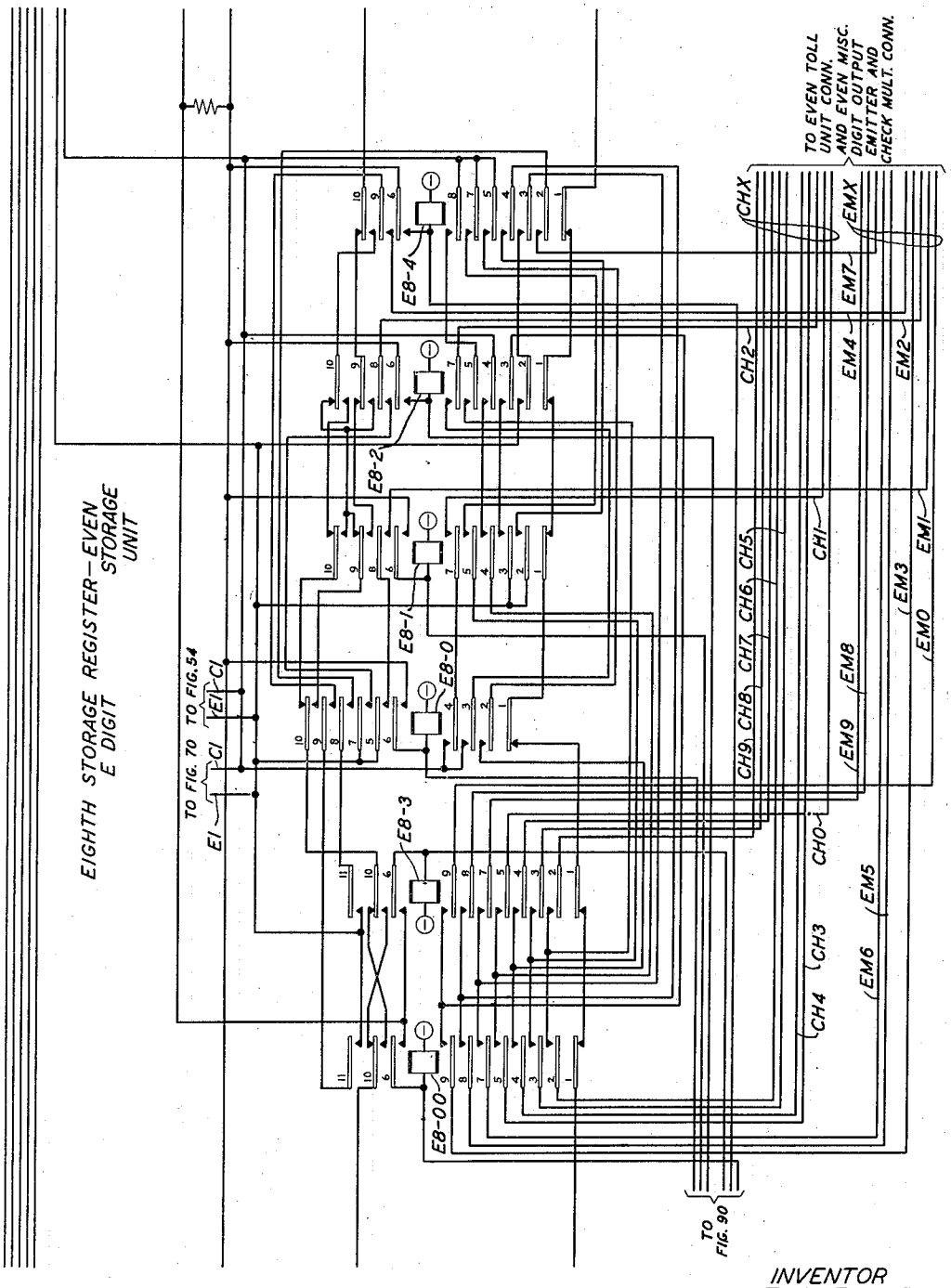


FIG. 94

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 98

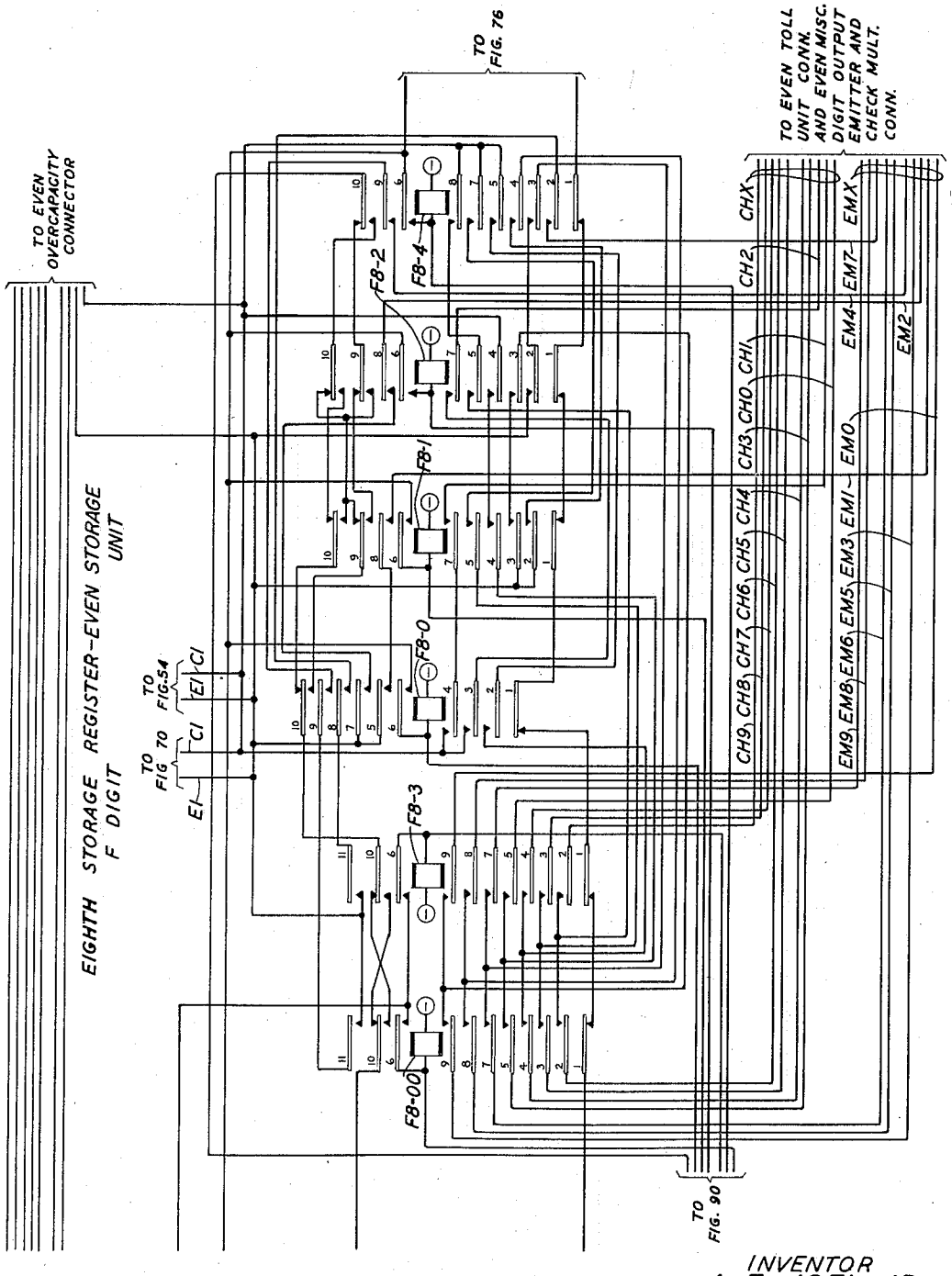


FIG. 95

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 99

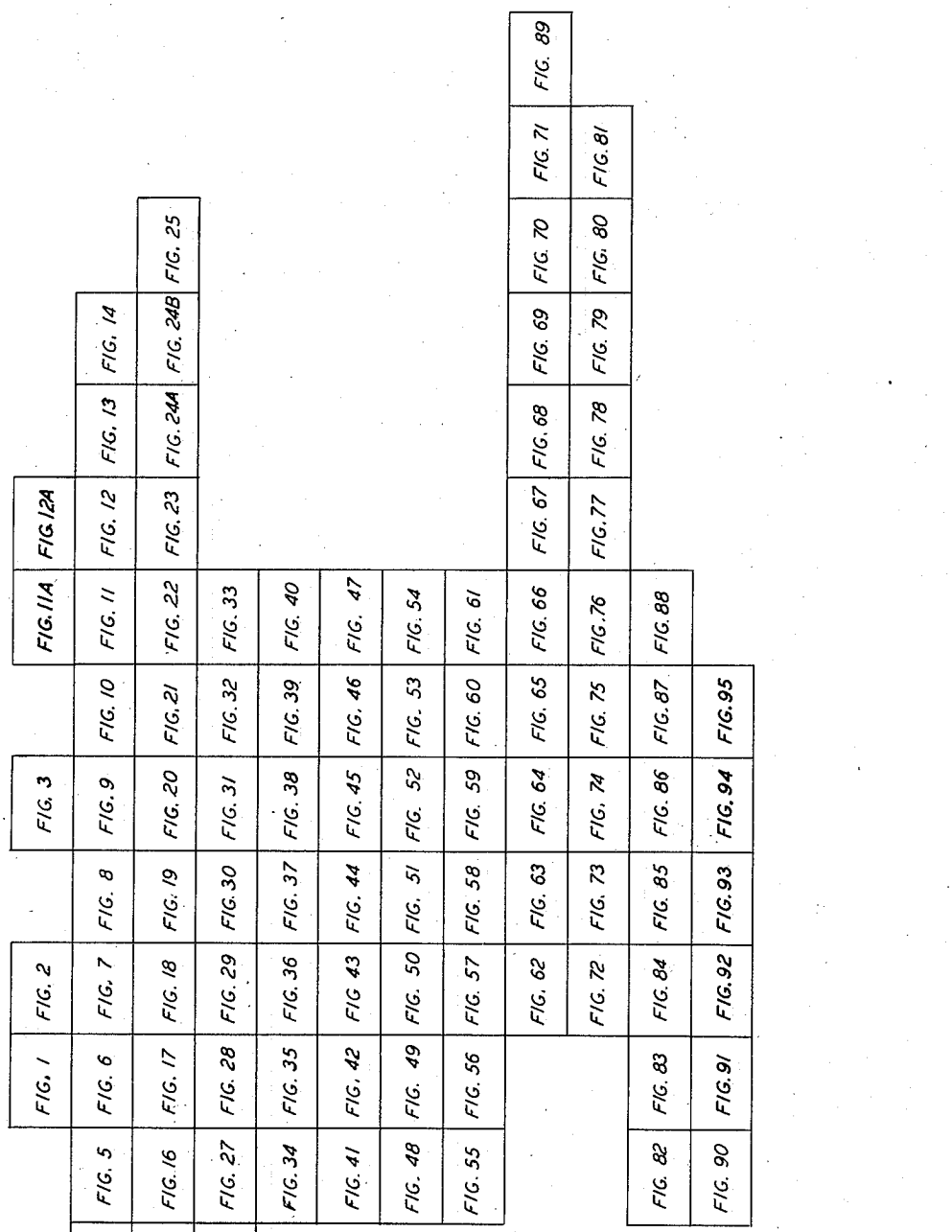


FIG. 96

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 100

FIG. 97A

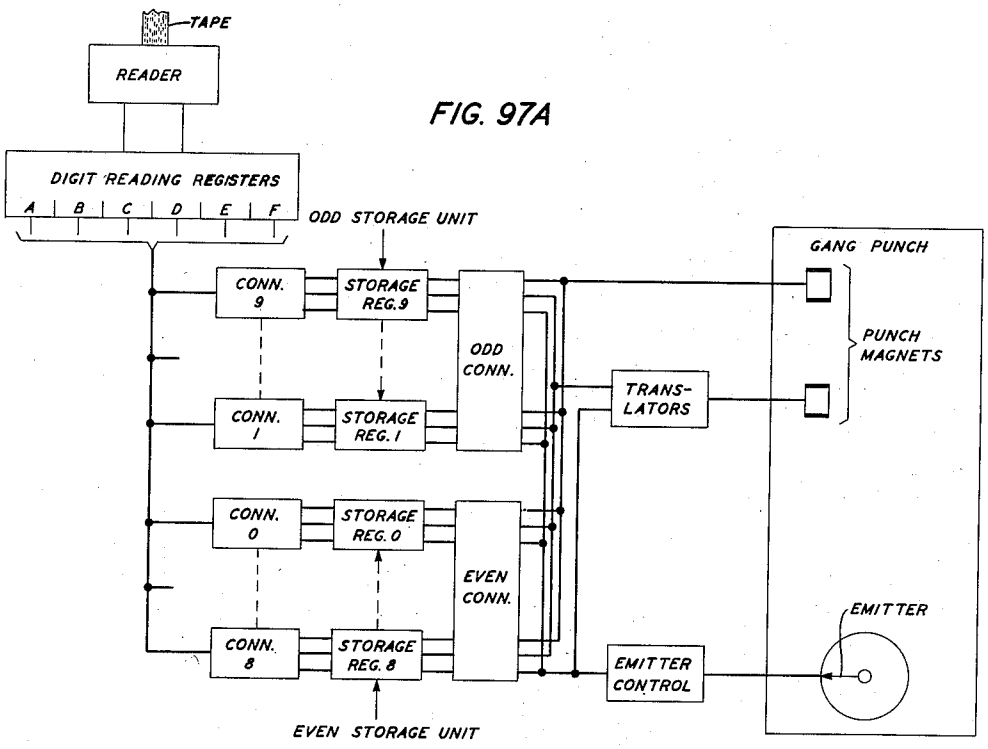


FIG. 97B

FIRST PLUG BOARD

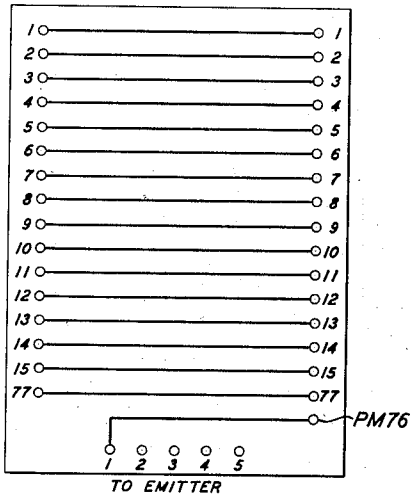
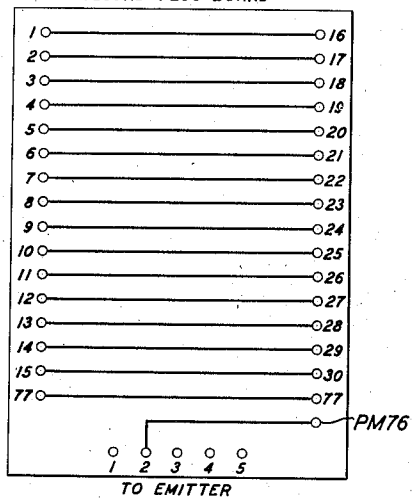


FIG. 97C

SECOND PLUG BOARD



INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

FIG. 98

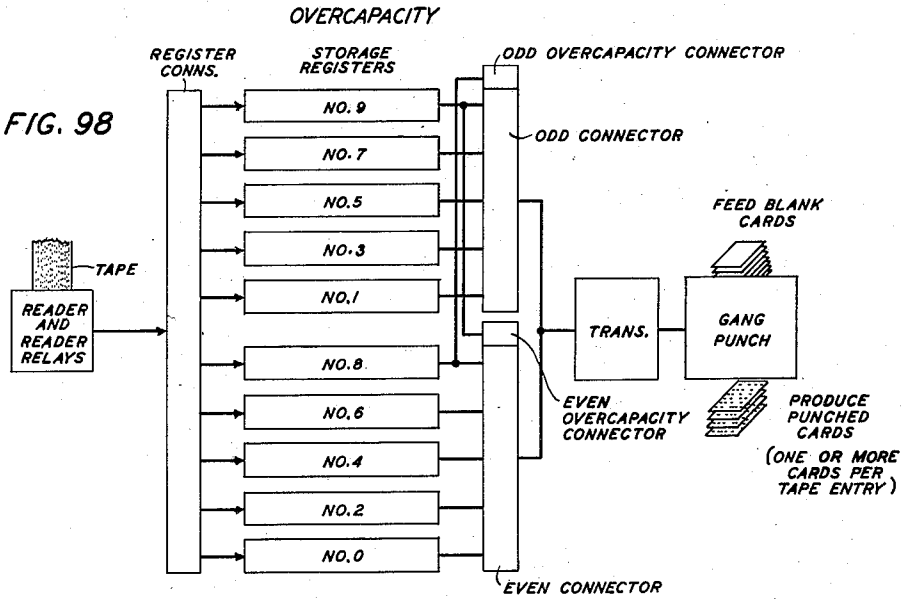
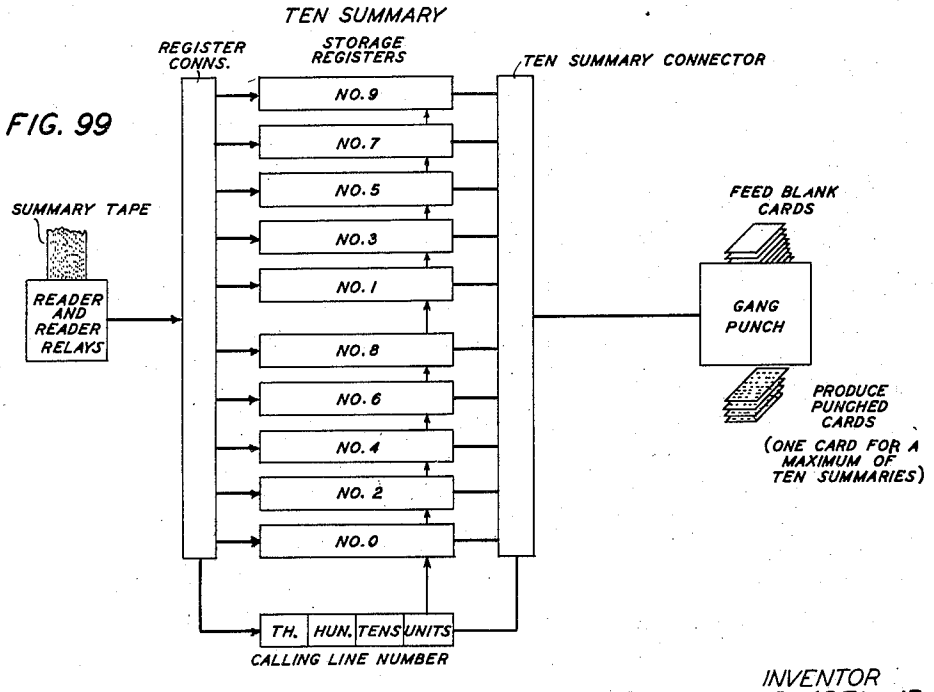


FIG. 99



INVENTOR
A. E. JOEL, JR.

BY

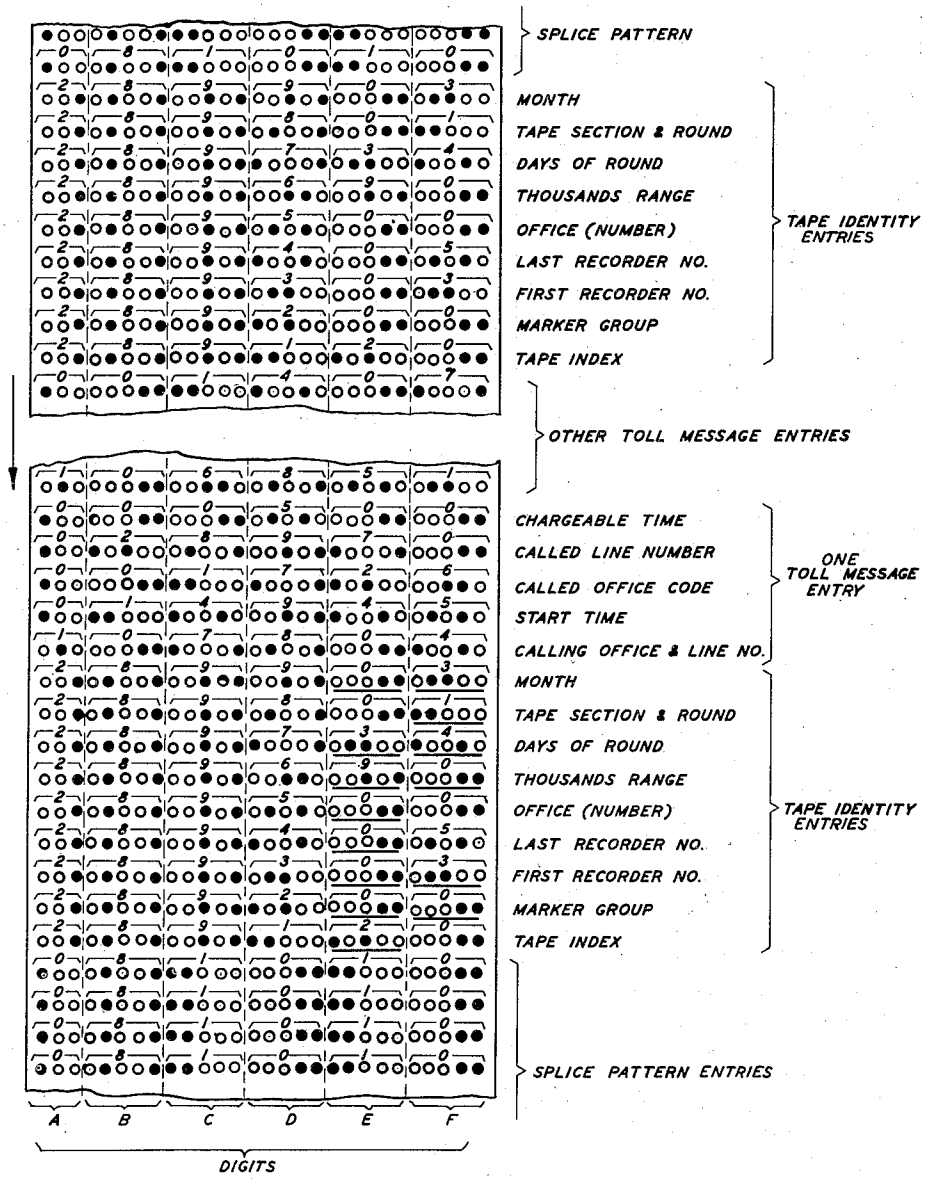
ATTORNEY

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 102

FIG. 100

COMPUTER TOLL TAPE



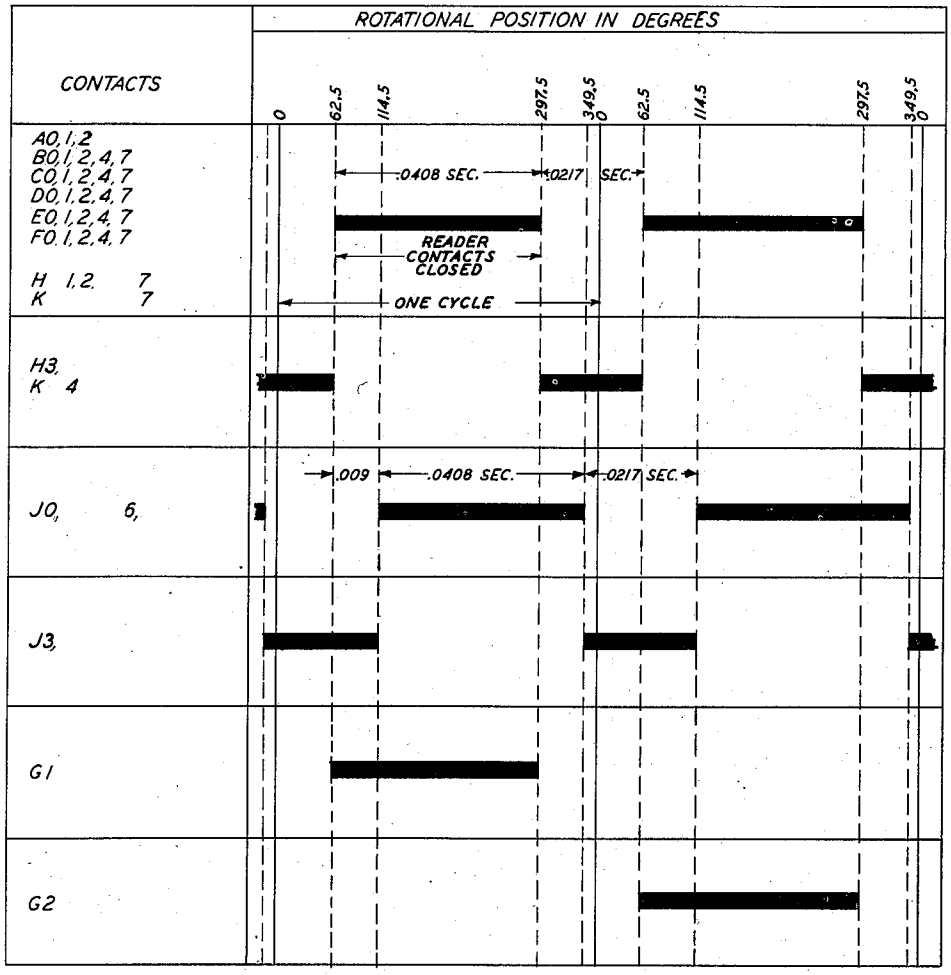
BY

INVENTOR
A. E. JOEL, JR.

ATTORNEY

FIG. 101

READER CONTACT CLOSURE INTERVALS

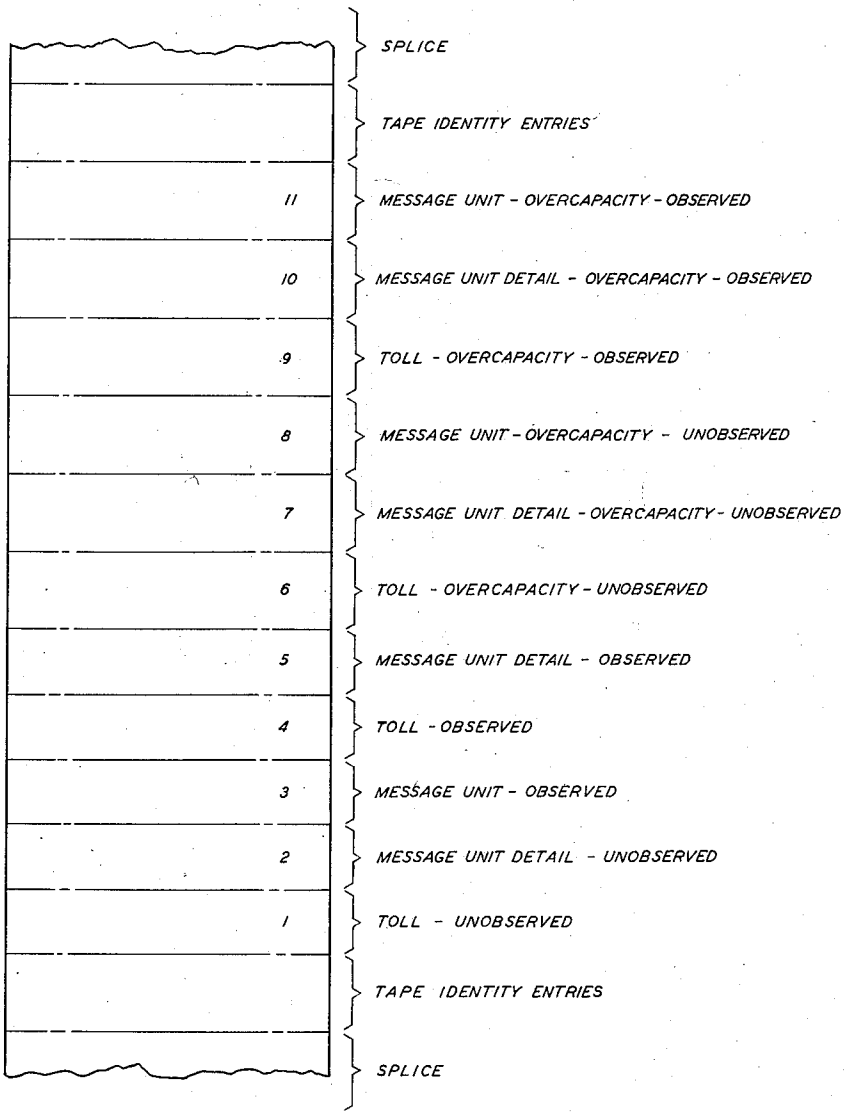


INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

FIG. 102
DETAIL TAPE ENTRIES



INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

COMPUTER TAPES INFORMATION CHART

FIG. 103A

TOLL, MESSAGE UNIT DETAIL, AND OBSERVING TAPES — DETAIL ENTRY

DIGITS					
A	B	C	D	E	F
0	MESSAGE UNIT INDEX	← CHARGEABLE TIME → TENS	UNITS	← MESSAGE UNITS → TENS	UNITS
0	← CALLED LINE NUMBER →				
0	AREA INDEX	CALLED NUMBER INDEX	← CALLED OFFICE CODE →		
0	← START TIME →				
1	OFFICE INDEX	← CALLING LINE NUMBER → THOUS	HUNDS	TENS	UNITS

FIG. 103B

OBSERVING TAPE — NON-ANSWERED OBSERVING ENTRY

0	0	0	0	0	0
0	← CALLED LINE NUMBER →				
0	AREA INDEX	CALLED NUMBER INDEX	← CALLED OFFICE CODE →		
0	← START TIME →				
3	OFFICE INDEX	← CALLING LINE NUMBER → THOUS	HUNDS	TENS	UNITS

FIG. 103C

MESSAGE UNIT INDEX	
0	LOCAL—WITH OR WITHOUT CHARGE UNITS
1	EXTENDED AREA—AREA #1 WITH CHARGE
2	EXTENDED AREA—AREA #2 WITH CHARGE
3	CANCEL CHARGE ON OBSERVING CALLS

FIG. 103D

SUMMARY AND MESSAGE UNIT TAPE — SUMMARY ENTRY

0	MESSAGE UNIT INDEX	← MESSAGE UNITS → THOUS	HUNDS	TENS	UNITS
2	0	← CALLING LINE NUMBER → THOUS	HUNDS	TENS	UNITS

FIG. 103E

START TIME LINE

B	C	D	E	F
SEE SPECIFICATION		DAY UNITS	HOUR UNITS	MINUTE UNITS

CODES FOR CLASS AND CALLED NUMBER INDEX			
CLASS	3 NUMBERS	4 NUMBERS	5 NUMBERS
TOLL, MESS. UNIT, MESS. UNIT DETAIL	0	1	2

FIG. 103F

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

DETAIL TAPES INFORMATION CHART

FIG. 104A

DETAIL TAPE - DETAIL ENTRY

DIGITS					
A	B	C	D	E	F
0	OBSERVING INDEX	CHARGEABLE TIME TENS	CHARGEABLE TIME UNITS	TOLL OR MESSAGE UNITS TENS	TOLL OR MESSAGE UNITS UNITS
0	CALLED LINE NUMBER				
0	AREA INDEX	CLASS & CALLED NO. INDEX	CALLED OFFICE CODE		
0	START TIME				
1	OFFICE INDEX	CALLING LINE NUMBER THOUS	CALLING LINE NUMBER HUNDS	CALLING LINE NUMBER TENS	CALLING LINE NUMBER UNITS

FIG. 104B

DETAIL TAPE - OVERCAPACITY ENTRY

0	MESSAGE BILLING INDEX	DISCONNECT - DAY TENS	DISCONNECT - DAY UNITS	DISCONNECT - HOUR TENS	DISCONNECT - HOUR UNITS
0	OBSERVING INDEX	DISCONNECT - MINUTE TENS	DISCONNECT - MINUTE UNITS	DISCONNECT - MINUTE TENTHS	ANSWER MINUTE TENTHS
0	CALLED LINE NUMBER				
0	AREA INDEX	CLASS & CALLED NO. INDEX	CALLED OFFICE CODE		
0	START TIME				
3	OFFICE INDEX	CALLING LINE NUMBER THOUS	CALLING LINE NUMBER HUNDS	CALLING LINE NUMBER TENS	CALLING LINE NUMBER UNITS

FIG. 104C

CODES FOR OBSERVING INDEX	
0	CALL NOT OBSERVED
1	OBSERVED CALL - ANSWERED - FULL CHARGE
2	OBSERVED CALL - NOT ANSWERED
3	OBSERVED CALL - CANCEL ALL CHARGES
4	OBSERVED CALL - CANCEL OVERTIME CHARGES

FIG. 104D

CODES FOR CLASS AND CALLED NUMBER INDEX			
CLASS	3 NUMBERS	4 NUMBERS WITH OR WITHOUT PARTY LET.	5 NUMBERS
TOLL	0	1	2
MESS. UNIT	3	4	5
M.U. DETAIL	6	7	8

FIG. 104E

START TIME LINE

B	C	D	E	F
SEE SPECIFICATION		DAY UNITS	HOUR UNITS	MINUTE UNITS

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

July 22, 1958 A. E. JOEL, JR 2,844,307

RECORD-CONTROLLED APPARATUS

Filed Jan. 29, 1952 110 Sheets-Sheet 107

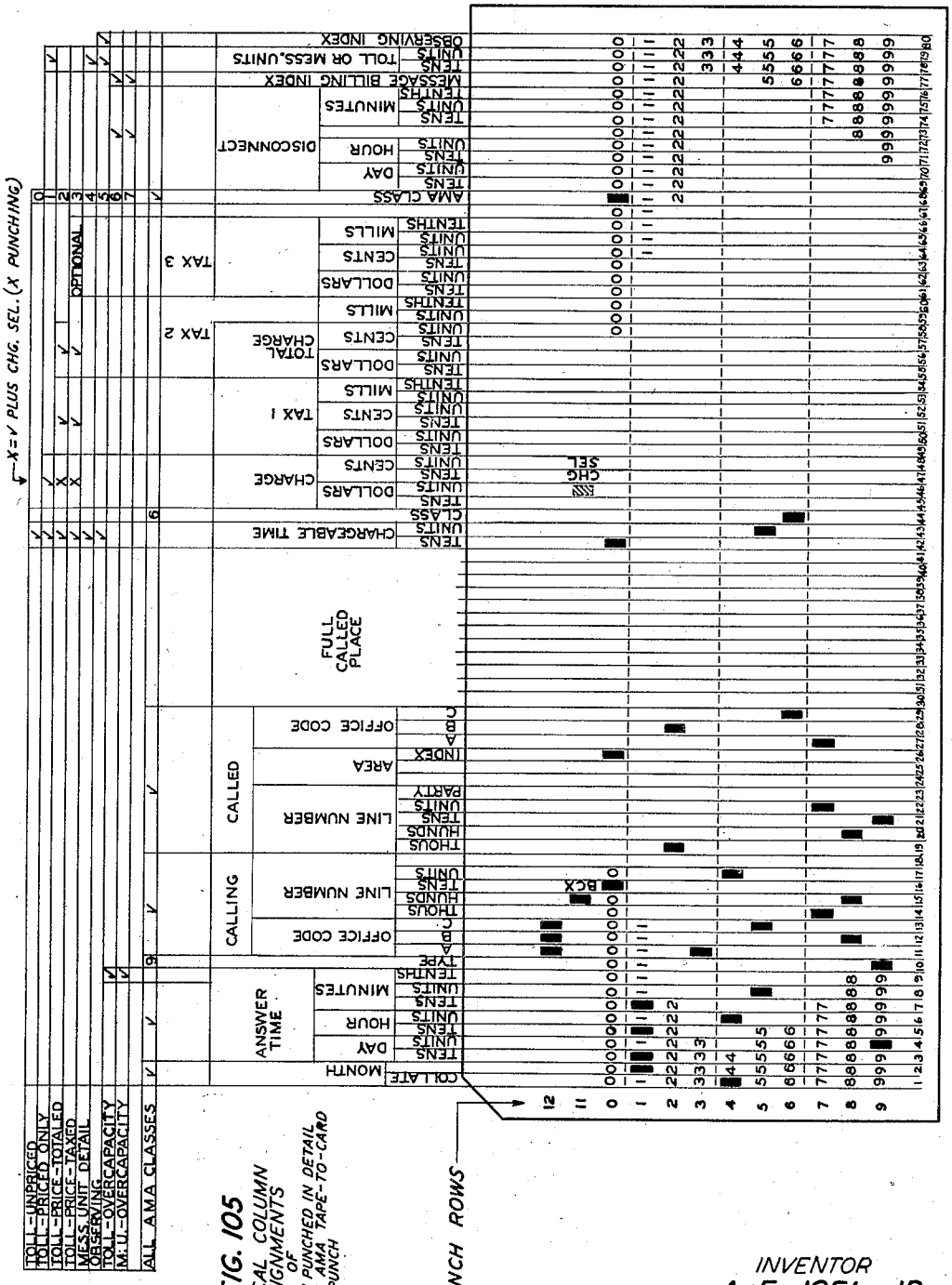


FIG. 105
TYPICAL COLUMN ASSIGNMENTS OF INFORMATION PUNCHED IN DETAIL CARDS FROM AMA TAPE-TO-CARD PUNCH

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

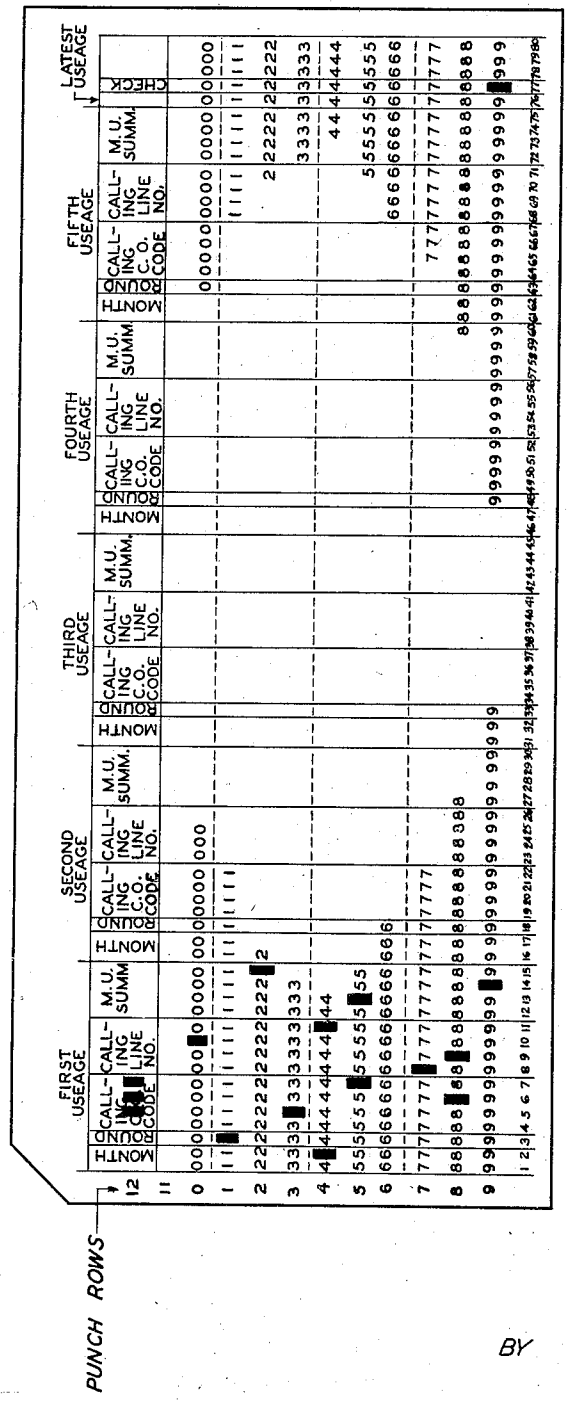


FIG. 106
INDIVIDUAL SUMMARY CARD

INVENTOR
A. E. JOEL, JR.

BY

ATTORNEY

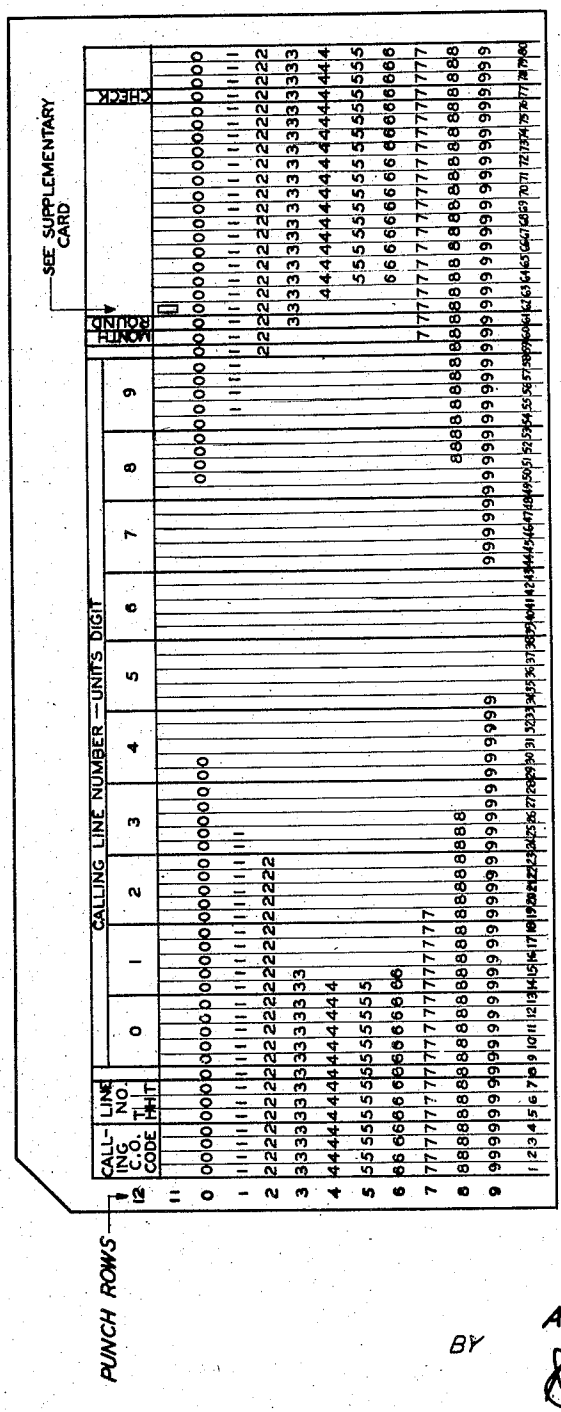
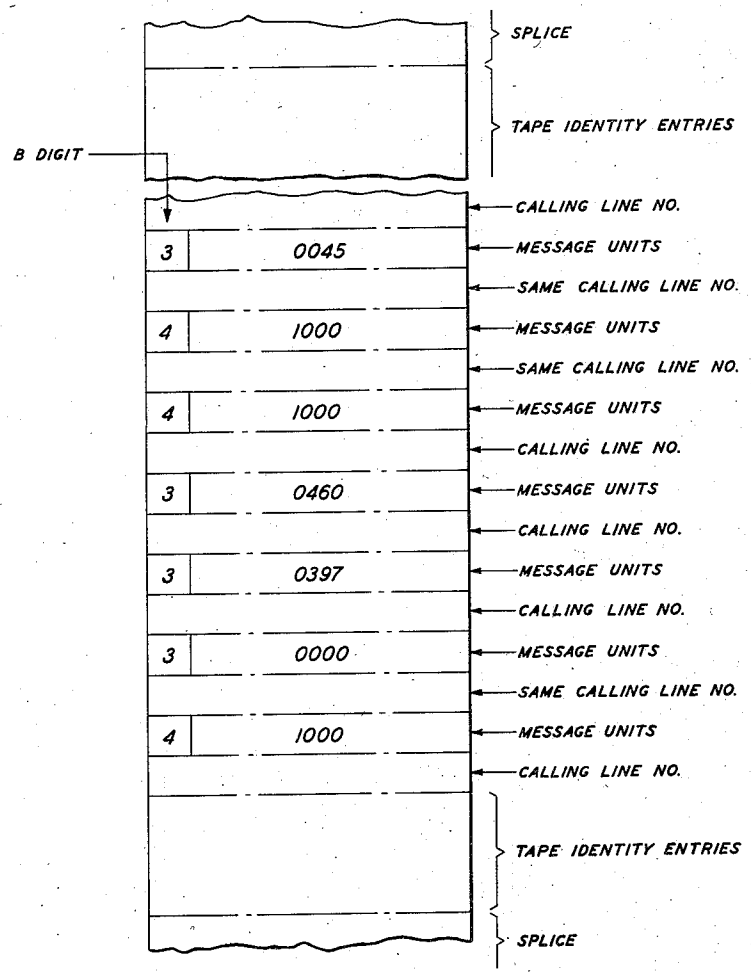


FIG. 107
TEN SUMMARY CARD

INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

FIG. 108
SUMMARY TAPE ENTRIES



INVENTOR
A. E. JOEL, JR.
BY
ATTORNEY

United States Patent Office 2,844,307 Patented July 22, 1958

2,844,307

RECORD-CONTROLLED APPARATUS

Amos E. Joel, Jr., South Orange, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application January 29, 1952, Serial No. 268,880

8 Claims. (Cl. 235—61.1)

This invention relates to record-controlled apparatus, and particularly to an apparatus for producing one or more individual record cards for each of a series of sensable entries recorded on a continuous medium, each of said record cards containing data which corresponds directly, by translation, or both directly and by translation, to the data contained in the entry.

In automatic accounting, particularly in what is called automatic message accounting for use in automatic telephony, the items of information pertaining to each completed telephone connection such as, for example, the number of the calling line, the number of the called line, the time when the conversation begins and the time when it ends (together with certain other data) are automatically recorded at the central office where the call originates, and are recorded in the form of coded perforations or embossments, across several lines of a long tape. A telephone exchange employing devices for automatically registering and recording on a continuous tape items of record information pertaining to telephone connections established from lines in the exchange, is shown in the copending application of Warren W. Carpenter and Raymond E. Collis, Serial No. 759,402, filed July 7, 1947, and now Patent No. 2,688,658. This tape, randomly containing thereon the records of many connections from said lines, or a number thereof, is subsequently forwarded to an "accounting center," where it is processed by a number of devices of which the first device operates in response to the items on the tape and all of the others operate in succession each from a tape produced by a preceding device, in consequence of which the items are correlated with respect to the connections to which they appertain, the charge for each connection is computed, and all items for each connection are then recorded as a plurality of "entries" on another continuous tape from which individual statements for each of the involved telephone subscribers may then be prepared by accounting devices suitably designed to operate in response to said latter tape.

In order to expedite the production of such statements, advantage may be taken of commercially available tabulating and accounting machines if each of the entries contained on the tape can be transferred to individual cards suitably perforated with punches in the different rows and columns thereof to correspond with the data of the entry and other data derived from the entry. Since the punches will be in accordance with a code recognized by said tabulating and accounting machines, the cards may then be automatically arranged, counted, assembled, totalized and otherwise processed by such machines to obtain the information required for each of the statements.

The principal object of the present invention is, therefore, a "tape-to-card" converting mechanism which, operating in response to the sensing of the entries on a continuous record pertaining to completed transactions exemplified by completed telephone connections, produces a punched card for each such connection.

A feature of the invention is the provision of means by which certain of the data constituting a part of an entry is translated into more usable form and recorded on the card as translated.

Yet another feature of the invention is a novel arrangement of apparatus whereby certain symbols or "indices" constituting a part of an entry of a connection are utilized to produce other data which is also recorded on the card produced for the entry.

Still another feature of the invention is provision of arrangements whereby a plurality of cards may be produced for the same transaction, each card to serve a different purpose, and each having a special indication thereon to indicate that purpose. The tape-to-card converter of my invention is adapted to process a variety of continuous records (as will later appear), and for the entries on one such record one card will suffice, for the entries of another such record two cards are required, and for the entries of still another such record, three cards are necessary. The apparatus of my invention will produce such cards as required.

Still another feature of my invention is an arrangement of devices whereby when a plurality of cards is to be produced for a single transaction, such cards are produced in succession and in the order indicated by the purpose of the individual cards.

The tape-to-card converter of my invention is also adapted to process a tape containing thereon a plurality of entries, each pertaining to an identified source of transaction and the summary of charges accumulated against the source. For the processing of such a tape, said converter, by certain novel means therein hereinafter described, operates to produce a card of each such individual summary, containing thereon the designation of source of the transaction and the charges therefor, or one card for each of ten such summaries containing thereon the designation of each of the ten sources of transaction and each of the summaries therefor. For example, certain tapes are produced by known devices, which contain a record of telephone directory numbers, each followed by a summary of charges for telephone service rendered to the subscriber identified by the number. Accordingly, it is a feature of my invention to process such a tape, and to produce therefrom either a single card for each directory number and summary of charges therefor, and/or another card for each ten of such numbers and the summary of charges for each of said ten numbers.

Parts of the tape-to-card converter of my invention comprise storage registers and translators, said registers being used to store a sensed entry, and said translators being operated to change a portion of the registered entry. Both the registers and the translators function to control a Gang Punch mechanism which, in response to the setting of the registers and translators, operates to produce a card, or cards, for the entry. It is a particular feature of my invention to "double check" the interpretation of the information either stored in the registers or translated by the translator before it is utilized by the Gang Punch to punch a card, or cards, individual to that information.

Yet another feature of the invention, somewhat closely related to the above, is the provision of novel means for indicating by the absence of a fixed punch on cards produced for certain entries, and the presence of a fixed punch for cards produced for certain other entries, that the card punching cycle was successfully concluded; that is, whether each row of the card was, in fact, selectively operated upon by the magnets of the Gang Punch in response to the registers or the translators, as the case might be. The absence of the punch in a card of the first group and the presence of the punch in a card of the second group would, by means of my arrangement, indicate a defective or incomplete card.

Yet still another feature of the invention is a novel arrangement of the tape-to-card converter by means of

which, if a charge for a transaction is recorded in terms of arbitrary units, said charge is translated into an equivalent monetary charge; if a tax is required therefor, said tax is computed, and both the charge, the tax and the total thereof are then recorded on the card both as individual items and as a total. In the application of the invention to telephone automatic message accounting, for example, charges for a telephone call may be recorded in the original tape in terms of so many local (or toll) message units. It is the purpose of the present invention to convert these units into the equivalent monetary charge therefor (having due regard to the area or zone where the connection was completed), determine the tax for the charge, and record on the card the money charge, the tax and the total of both the charge and the tax.

More specific features of my invention include a novel arrangement for automatically stopping the sensing of entries when the Gang Punch runs out of blank cards; the provision of an alarm when certain manual switches, adjusted in advance of sensing operations according to certain information contained on the tape, are disturbed in said adjustment during sensing operations, although the disturbance will in no wise affect either the accuracy of the sensing or the accuracy of the cards produced in response thereto; the use of two sets of storage registers to store two entries sensed in succession of each of said entries consisting of five lines, and the use of one of said sets of registers and a register from the other set to store an "overcapacity" six-line entry without affecting the efficacy of the latter register in storing four lines of the next entry regardless of whether the entry consists of five lines or six lines; and the use of both sets of registers as a single unit of ten consecutive registers to store ten summaries (when producing Ten Summary Cards) from ten separate lines, the register selected in each case being determined by the units digit of the line number.

These and other features of my invention will be more readily understood from the following description, appended claims, and attached drawing in which:

Figs. 1 to 95, inclusive, arranged as indicated in Fig. 96, disclose the apparatus, circuits and other essential elements of my invention as follows:

Fig. 4 shows the reader;

Fig. 5 shows the start circuit;

Figs. 6 and 7 show the set-up switches;

Figs. 1 and 2 show the tape identity progress circuit;

Figs. 15, 16 and 17 show the tape reading registers;

Figs. 27 to 60 show the five storage registers of the Odd Storage Unit together with the respective connector circuits;

Figs. 82 to 87 and 90 to 95 show, respectively, the first and last of the five storage registers of the Even Storage Unit together with their respective connector circuits, the three intermediate storage registers and connector circuits not being shown;

Figs. 3, 8, 9 and 10 show the punch control circuit;

Figs. 22 and 23 show the charge translator;

Figs. 11 and 12 show the tax unit translator;

Figs. 11A and 12A show the total charge translator;

Figs. 19, 20 and 21 show the month translators;

Figs. 13, 24A and 24B show the calling office translator;

Fig. 25 shows the called party translator;

Fig. 26 shows the alarm circuit;

Figs. 77 and 78 show the time translator;

Fig. 79 shows the observing index translator;

Fig. 80 shows the class translator;

Fig. 14 shows the overpunch and underpunch control circuit;

Fig. 33 shows the odd individual summary connector;

Fig. 40 shows the odd toll unit connector;

Fig. 47 shows the even miscellaneous connector;

Fig. 54 shows the odd overcapacity connector;

Fig. 61 shows the odd emitter and check multiple connector;

Fig. 88 shows the even emitter and check multiple connector;

Fig. 67 shows the odd detail connector;

Figs. 62 to 65 show the calling line number register;

Figs. 72 to 74 show the digit comparison circuit;

Fig. 75 shows the digit comparison control circuit;

Figs. 66 and 76 show the register and punch connector control circuit;

Figs. 68 and 69 show the tape index register;

Fig. 81 shows the card count circuit;

Figs. 71 and 89 show the circuit of the Gang Punch and terminal block cross-connecting facilities;

Fig. 98 shows a simplified schematic of the arrangement of the apparatus for producing cards for overcapacity entries;

Fig. 99 shows a simplified schematic of the arrangement of the apparatus for producing Ten Summary Cards;

Fig. 100 shows sections of the Computer tape which is used in connection with the detailed description of the operation of the invention for the production of cards for entries on Computer tapes;

Fig. 101 shows a timing chart of the contacts of the reader;

Fig. 102 shows a simplified schematic of the entries on a Detail tape;

Fig. 103A is a chart showing the significance of the entries on Computer tapes;

Fig. 103B is a chart showing the significance of the entries on a Computer Observed tape for non-answered calls;

Fig. 103C is a chart showing the different digits used for the message unit index on computer tapes and the significance thereof;

Fig. 103D is a chart showing the significance of the entries on Summary tape;

Fig. 103E is a chart indicating the significance of the start time digits, in the second line of the detail entry shown in Fig. 103A;

Fig. 103F is a chart showing the digits used for the called number index in the third line of the detail entry shown in Fig. 103A;

Fig. 104A is a similar chart showing the significance of the entries on a Detail tape;

Fig. 104B is a chart showing the significance of the entries of a Detail overcapacity entry;

Fig. 104C is a chart showing the digits used for the observing index on regular and overcapacity entries in Detail tapes and the significance thereof;

Fig. 104D is a chart showing the digits used for the class and called line number index on regular and overcapacity entries on Detail tapes and the significance thereof;

Fig. 104E is a chart indicating the significance of the start time digits in the second line of the detail and overcapacity entries which are recorded in the second line of the detail entry shown in Figs. 104A and 104B;

Fig. 105 shows the column assignments on a typical card other than Individual and Ten Summary card; said card also showing the punches produced from the entries of the call recorded on the Computer tape shown in Fig. 100;

Fig. 106 shows the column assignments for an Individual Summary card; said card showing punches produced for a summary on the first usage of the card;

Fig. 107 shows the column assignments for a Ten Summary card; while

Fig. 108 shows a simplified schematic of an Individual Summary tape from which Individual and Ten Summary cards are produced;

Fig. 97A shows a simplified schematic of the apparatus as a whole;

Figs. 97B and 97C show two of a number of Plugboards for connection between the Gang Punch mechanism and the rest of the apparatus when producing Individual Summary cards.

SECTION I.—GENERAL CONSIDERATIONS

Before proceeding with the general description of the apparatus, the general method of operation and, thereafter, with a detailed description of the operation of my

invention in connection with a specific entry, attention is first directed to Fig. 97A which schematically indicates the general arrangement of the tape-to-card converter of my invention. Broadly speaking, the tape-to-card converter comprises a reading device (reader) for sensing the different sensable lines on the tape, one or more of which lines are defined as "entries"; a group of digit-reading registers the relays of which respond selectively to each line as sensed by the reader; two groups of storage registers each consisting of five digital registers, the one group of storage registers called the Odd Storage Unit having the storage registers **1**, **3**, **5**, **7** and **9**, and the other group called the Even Storage Unit having the storage registers **0**, **2**, **4**, **6**, **8**; a group of translators; a Gang Punch mechanism of known construction, and two groups of connectors, the one group identified as the odd connectors for connecting the registers of the Odd Storage Unit to the translator and the Gang Punch and the other group identified as the even connectors for establishing a similar connection between the registers of the Even Storage Unit to the translators and the Gang Punch. Further suitable connectors (not shown in Fig. 97A) are provided by which each of the storage registers of both storage units may be connected to the digit-reading registers. The apparatus has been so arranged that when the reading registers acquire successive settings in response to the successive sensing of the lines of a five-line entry, the storage registers of the Odd Storage Unit are the first ones to be progressively connected to the reading registers beginning with storage register **1**. By a slight wiring change, however, the storage registers of the Even Storage Unit, beginning with register **0**, may be progressively connected to the digit-reading registers instead of the storage registers of the Old Storage Unit. By the sccessive connection of the storage registers of a storage unit to the digit-reading registers, each of the five lines of an entry sensed by the reader and temporarily stored in the relays of the digit-reading registers is transferred and stored in the storage registers of the unit. If the Odd Storage Unit is the first one utilized, then line 1, for example, will be stored in storage register **1**, line 2 in storage register **3**, and so on with the fifth line stored in storage register **9**.

The five storage registers of the other (or Even Storage Unit in view of the concrete arrangement) are then made available for storing the five lines of the next entry. Thus the two storage units are used in alternation, first the odd and then the even, to store successive five-line entries recorded on the tape and sensed by the reader.

However, this alternation of successive operations is made possible by the fact that when a storage unit is filled with the lines of an entry, the time during which the other storage unit is being similarly filled with the lines of the next entry is utilized to operate the Gang Punch in producing a card (or cards) for the entry stored in the first-mentioned storage unit. By the time the second storage unit is filled, the first one will have been discharged and read to be filled again. If, for some reason, the first register is not available, then further processing will wait until it is.

In the production of a card (or cards) for an entry, some of the data of the entry stored in a storage unit requires change or translation, other data will have to be produced from certain indices constituting a part of the entry, while the remainder is recorded on the card without change or translation. For this purpose a group of connectors is provided for each storage unit which is operated when the unit is filled to extend those storage registers or parts thereof directly to the Gang Punch, and to extend the remainder to the appropriate ones of the translators. The translators cooperate with the registers to change or expand the data, or to produce new data, and then, along with those registers extended directly to the Gang Punch, selectively operate the punch magnets of the said Gang Punch, in consequence of pulses transmitted from an emitter (which is a part of the Gang Punch) to produce a card containing perforations which correspond to the unchanged data, to the changed data and to the additional data.

When the Gang Punch has completed the production of a card (or cards) for the information stored in the registers of a storage unit, the translators and the registers of the storage unit are discharged, whereupon the translators and the Gang Punch are connected to the other storage unit by way of the latter's connectors to produce a similar card (or cards) for the information stored in the latter unit.

Fig. 98 shows the general arrangement of the apparatus to produce cards for "overcapacity" entries. As will be shown later, an overcapacity entry differs from a "regular" entry in the fact that it consists of six lines instead of five. Since a storage unit has five registers and the entry has six lines, I have so arranged the tape-to-card converter that, in processing an overcapacity entry, the last line of the entry will be stored in the "last" storage register of the free storage unit. From Fig. 98 it is evident that when the Odd Storage Unit is used to store the first five lines of an overcapacity entry, storage register **8** of the Even Storage Unit will be used to store the sixth line of the entry, and that when the Even Storage Unit is used to store the first five lines of the entry, storage register **9** of the Odd Storage Unit will be used to store the sixth line. By means of an overcapacity connector for each storage unit (as well as the regular connectors for such unit) the six storage registers are connected to the translators and to the Gang Punch for producing a card (or cards) for the overcapacity entry.

This arrangement avoids delays in storing at least the first five lines of the succeeding entry. For, since the storage registers of the device are arranged to accept the lines of an entry in the numerically ascending order of the designation of the registers, the first four lines of the succeeding entry will be stored in available storage registers **1**, **3**, **5** and **7** of the Odd Storage Unit in the order given if the previous overcapacity entry has been stored in the storage registers of the Odd Storage Unit and storage register **9** of the Odd Storage Unit, or in storage registers **0**, **2**, **4** and **6** of the Even Storage Unit in the order indicated if the previous overcapacity entry has been stored in the storage registers of the Odd Storage Unit and storage register **8** of the Even Storage Unit. By the time the last line, or the last two lines, of the entry are to be stored, the filled storage unit and the last storage register of the unfilled unit will have been discharged, thus permitting the storage therein of the last line or the last two lines of the succeeding entry. Should it happen that when the last line or the last two lines of the entry are to be stored, the storage registers are still tied up with the translators and the Gang Punch, then storage of the lines will wait until they are discharged.

Fig. 99 illustrates the general arrangement of the apparatus for the production of Ten Summary Cards for "two-line" entries recorded on what is called a Summary tape, each entry consisting of a first line designating a source of transaction and the second line a summary of the charges accumulated against the source over a predetermined billing period. In practicing the invention with telephone message accounting, the "source of transaction" would be the subscriber's telephone number, and the summary of charges would be the number of "message units" chargeable to the subscriber over a predetermined billing period. These telephone numbers are arranged in numerically ascending order on the tape, each followed by its charge summary, and to produce one Ten Summary Card for ten successive telephone numbers on the tape (it being assumed that the ten numbers differ from each other by "1" in the units digit thereof) the five separate storage registers of the

Odd and Even Storage Units are used as the registers of "one" unitary storage unit in which to store the ten successive summaries as indicated by the numerical designations of the registers. The first directory number of the series is stored in a calling line number register and the units digit of the number, which would be 0, routes the summary that follows it to storage register **0**. The next telephone number is then compared with the one registered in the calling line register. If the thousands, hundreds and tens digits thereof are identical, the registration of said digits is not disturbed, but the units digit register is reset for the digit "1" and will route the summary that follows to storage register **1**. This operation continues until the summaries of the ten numbers (each differing by 1 in the units digit) will have been stored in the ten storage registers, at which time, by the operation of a Ten Summary Connector, the storage registers and the calling line number registers are connected to the Gang Punch which, under the control of the registers, punches a card containing the common digits of the ten line numbers followed by the ten summaries in the ascending numerical order indicated by the several units digits of the numbers, as shown on the Ten Summary card illustrated in Fig. 107. If the telephone numbers should change in any denominational order other than the units order during the collection of the summaries, then the card will be a partial one, and only for those numbers preceding the change of digit in any of the above-mentioned denominational orders.

The tape-to-card converter of the present invention operates, as I have said, to produce a punched card (or cards) for each transaction entry recorded on a tape. Typical of these tapes in respect to the manner in which these entries as well as certain other entries which are common to all tapes are recorded, is the Computer Toll tape shown in Fig. 100. As indicated in this figure, each line of an entry consists of six base ten digits A to F recorded across the tape. Each digit with the exception of the first, or A digit, is recorded by two perforations in five perforating positions allocated to each digit, and the positions punched to record any of the ten decimal values of a digit are determined by the well-known two-out-of-five code given in the table below, each of the five positions, reading from left to right, being designated for convenience 0, 1, 2, 4 and 7:

TABLE A

Digit	Positions Perforated
0	4, 7
1	0, 1
2	0, 2
3	1, 2
4	0, 4
5	1, 4
6	2, 4
7	0, 7
8	1, 7
9	2, 7

The A digit has four usable digital values 0, 1, 2, each punched in a different position and all positions punched for the digit 3.

There are three types of entries for which tapes are prepared. There are five-line message entries for the Computer tapes in Fig. 103A and shown by the captioned entries "one toll message entry" in Fig. 100; six-line "overcapacity" entries on Detail tapes illustrated in Fig. 104A, which differ from the five-line entries by the fact that they consist of six lines instead of five; and two-lines individual summary entries shown on the Summary Tape illustrated in Fig. 108, it being understood that the lines of all entries consist of five digits (not counting the A digit). Where the data recorded in a line of any entry requires less than five digits and the remaining digital positions are "vacant," zeros are recorded in said latter positions.

All tapes have certain information in common which is recorded in nine lines of single entries called "tape-identity entries" as shown in Fig. 100, and recorded at the forward and trailing ends of each tape. These nine single-line entries, as indicated in Fig. 100 and in the underscored digital position thereof in the "forward" tape-identity entries, identify the tape by a digit indicative of its type or "index," that is, whether it is a Toll tape, an Observing tape, a Detail tape, etc. (line 1), by a number consisting of two digits termed the marker group, which identifies the group of exchanges in one of which the tape was produced (line 2); the first and last recorder number (each two digits) which includes the particular recorder operated to produce the tape (lines 3 and 4, respectively); a digit indicating the actual office in the identified marker group where the tape was produced (line 5), the thousands range (line 6) which is of no particular significance to the operation of the present invention; the "days of the round" and tape sections (lines 7 and 8, respectively); and the month (line 9) in which was produced the original central office tape from which the derived tape illustrated in Fig. 100 was subsequently produced.

Preceding the tape-identity entries at the beginning of the tape and following said entries at the trailing end of the tape, and also between tape sections (not shown) which are "spliced" together, are recorded an unspecified number of "splice pattern" lines having the code 081010. I have designed the machine to read at least one unmutilated line of splice pattern at the beginning of the tape (or section) before the tape may be processed. The machine will, however, skip all other lines of the splice pattern.

In the body of the tape a "window" splice (not shown) may occur where unperforated tape was originally spliced together. The window splice consists of a skip window entry (287020) followed by an unspecified number of lines of splice (081010) some of which are mutilated in the C and D digits by the rectangular window. The machine recognizes this window pattern and skips by it.

After the machine has passed the splice pattern entries, it processes the tape-identity entries, which are checked against certain switch settings in the machine that are adjusted to agree with certain of the information recorded in the tape identity entries. It should be noted at this point that if the switch settings agree with the entries, processing operations will take place. However, if the switch settings are disturbed after processing operations have begun, the machine will nevertheless continue to process the entries and produce the required cards for each, accurate in every detail as if the switches had not been disturbed. But when all of the message entries have been processed and the machine comes upon the trailing tape-identity entries, the discrepancy between the record and the switch settings is noted and an alarm is given.

The tape-to-card converter of the present invention is adapted to process four (4) different kinds of tape records. Three of these will be called Computer tapes, and are identified individually as Toll tapes (exemplified by Fig. 100), Message Unit Detail tapes and Observing tapes. The composition and significance of the different digits in the different lines of the entry of all such tapes are shown in Fig. 103. It will be noted that the Toll tape contains only detail entries, which is also true of Observing and Message Unit Detail tapes. However, there is an optional requirement for which provision is made in the machine, that the chargeable time on toll message entries will be formulated into "toll units." Those Toll tapes in which a detail entry thereon has "00" for the toll or message units (E and F digits of the fifth line) are not in toll unit form. Those detail entries on which these digits are not "00" are in toll unit form.

The Message Unit Detail tape also contains only detailed entries. The E and F digits of the fifth line represent message units and are never 00. The Observing

tape may contain either of two entries; detail entries as above or "non-answered" observing entries.

The machine also processes a fourth tape identified as a Detail tape. The composition and significance of the different digits in the different lines of its entries are shown in Fig. 104. The Detail tape actually combines in one tape all the entries of the three Computer tapes (though with certain difference of significance with respect to certain of the items of the entries) but, in addition, also includes "overcapacity" entries. An overcapacity entry, which has been previously and briefly discussed, is for a detail message where the number of toll or mesage units, or the chargeable time, exceeds the capacity of the digital space provided in the detail entry structure. For this reason the "disconnect time" (which makes up the sixth line of the entry) is recorded as part of the entry. The different types of entries which may appear on a Detail tape are indicated in Fig. 102.

The machine of my invention also processes a Summary tape, indicated in Fig. 108. Each entry on a Summary tape consists of two lines, in the first of which is recorded a calling line number and in the second the summary of message unit charges accumulated against the line, as indicated in Fig. 103. On the Summary tape, one summary is made for each calling line number which originates calls during the preceding portion of the billing period. The summary tape represents cumulative totals of message units for the billing period. It will be noted that in the second line of each entry on the Summary tape the B digit value of "3" and "4" is used to indicate less than and exactly 1000 message units, respectively. Where more than 1000 message units are accumulated against a line, there will be as many successive entries for the line following each other on the Summary tape as there are units of 1000 messages, and a last entry for the remainder, said last entry having, of course, the B index value of 3. When exactly 1000 units are accumulated for a line, then the entry for the 1000 units will be followed by another entry for 0000 units. It may be pointed out at this time that the machine will produce one Individual Summary card for each line entry. When more than one entry for the line appears on the tape (if the number of message units for the line is 1000 or more) a punch is made in a designated location on the first and intermediate cards to designate that the total Summary is contained on more than one card.

The general form of the card produced for all entries except the Individual Summary and Tens Summary, is shown in Fig. 105, which also has noted thereon the significance of the different columns and the types of entries for which certain of said columns are used.

The card illustrated in Fig. 105 consists of 80 columns with 12 hole positions in each column for a total of 960 hole positions. A character (base ten digit or letter) may be recorded in each column. The hole positions are numbered from top to bottom of the column as follows (indicated to the left of but within the card illustrated in Fig. 105): 12, 11, 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. Base ten numerals are represented by punching one of the hole positions 0 to 9. The letters of the alphabet are represented by punching two of the hole positions in a column. One hole is punched in positions 12, 11 or 0, being known as an "overpunch," and the other hole is punched in one position 1 to 9, known as an "underpunch." The following table shows the over and underpunch combination required to represent any letter of the alphabet:

Table B

	Underpunch								
	1	2	3	4	5	6	7	8	9
Overpunch 12	A	B	C	D	E	F	G	H	I
11	J	K	L	M	N	O	P	Q	R
0		S	T	U	V	W	X	Y	Z

A special punch may be represented by a single hole punched in position 11 or 12.

The cards to be produced for toll, overcapacity, toll message units, and observing entries are punched with a variable amount of information depending upon the specific card type. However, the columns in which the information is to be punched may be varied according to requirements of any billing system by which the cards are subsequently to be processed. The column assignment of corresponding information on all types of detail cards, however, will be the same and, therefore, only one cross-connection field need be provided for column assignments for this general type of card between the magnets of the Gang Punch and the various outlets from the rest of the machine.

Referring particularly to Fig. 105, it will be noted from the columnar designations that there are eight (8) general types of detail cards each distinguished by a digit designated as "AMA class." This digit is used for sorting the cards made from Detail tapes or Toll tapes with entries in toll unit form, immediately after they leave the punch stage in the processing. On overcapacity message unit detail and overcapacity observing cards the duration of the call is omitted and the disconnect time (day, hour and minute), answer minute tenths and message billing index are added. The AMA class remains the same; that is, the AMA class will be the digit 5 for observing cards and the digit 4 for message unit detail, both in column 68.

On these detail cards, the information punched falls into one of three categories: (A) fixed information from tape identity set-up switches such as month, BCX (billing card X punching), type 8 (AMA) and class 9 (subscriber dialed—no rate differential); (B) information copied from individual message entries, such as calling line number, answer day, hour and minute units digits, chargeable time (duration), message units, called office code, the area and the B, C and D digits of the called line number; and (C) information translated from individual message entries such as calling office code from office index and marker group, answer day, hour and minute tens digits from B and C digits of the start time line, F digit of called line number into a party letter, and class, observing, entry indices and toll units into AMA class and price, tax and/or charge total.

Fig. 106 illustrates an Individual Summary Card, and columnar assignments therefor. To reduce the number of cards used, each card is arranged for five usages, each usage involving the month, the round, the calling office code, the calling line number and the number of message units, with a punch in row 11 in the thousands digit column of the message unit summary for a punch whenever the number of message units is 1000, thus to indicate the existence of another card for the addition over 1000 if the addition is less than 1000. Each usage of the card is recorded by a punch in column 76 and in the row which numerically designates that usage.

Fig. 107 illustrates a Ten Summary Card and the columnar assignment therefor. The information punched on this card falls into four (4) categories: (A) fixed information taken directly from the tape identity switches such as month and round; (B) fixed information translated from tape identity set-up switches such as office index and marker group combined to give the calling office code; (C) information copied from message entries to give summary values and calling line numerals (thousands, hundreds and tens); and (D) the appearance of more than one summary for a given line number to cause a special X punching to appear on all cards containing these partial summaries but the last.

SECTION II.—DESCRIPTION OF APPARATUS AND GENERAL METHOD OF OPERATION

As was previously stated, Figs. 1 to 95, arranged in the manner indicated on Fig. 96, disclose the apparatus and circuit elements of the tape-to-card converter.

Before proceeding with a description of the invention

it is believed appropriate to remark that because of the numerous relays, switches and other electrical elements and mechanical parts which make up the mechanism, the designation of each unit of equipment is preceded by the number of the figure of the drawing in which the unit is located. Thus, for example, relay CB which appears in Fig. 8 is referred to in the specification as relay "8CB," thereby indicating that it is the relay CB in Fig. 8. As another example, relay RLS which is shown in Fig. 5 is referred to in the specification as relay "5RLS" thus indicating that it is relay RLS in Fig. 5. Where the designation of a relay or other unit of apparatus begins with a numeral, the figure number of the drawing in which the element appears, while preceding the designation of the unit, is separated therefrom by a hyphen. Thus, for example, relay **0** in Fig. 9 is referred to in the specification as relay **9–0**, thus indicating that the relay is the relay designated **0** in Fig. 9. Or, as another example, relay **7P** which appears in Fig. 10, is referred to in the specification as relay **10–7P**, denoting the fact that the relay is relay **7P** located in Fig. 10. There are certain instances in which the designation of a figure of the drawing ends in a digit or letter, and the designation of some unit or units of apparatus shown in the figure also begin with digit or letter, respectively. In this case, the figure designation and the unit designation are separated by a hyphen; as, for example, relay **24A–COT000**, which means relay COT**000** in Fig. 24A. By this system of designation and reference, the units of apparatus may be the more readily located in the various figures of the drawing.

Referring now to Figs. 1 to 95, I will first give a brief description of the principal parts of the apparatus and then follow it with a detailed description of the operation of the mechanism as a whole. Fig. 4 shows the reading device or "reader" by means of which the tape **4T** to be processed is operated upon by the reader to detect the perforations therein which constitute the digits of the various message entries and other data such as the tape identity entries, the splice pattern, etc. The reader illustrated in Fig. 4 is a mechanism which is adapted to sense perforations on a record, though it is obvious that in the practice of the invention the type of reader utilized will depend upon the manner in which the data is recorded on the tape. Where, for example, the entries are recorded electrically, electrostatically, magnetically or by some other means with corresponding results, reading devices adapted to sense such entries should be used, and such reading devices are within the scope of the present invention.

The reader shown in Fig. 4 and adapted to sense transverse perforations on a tape, may be of the type shown in the copending application of W. W. Carpenter, Serial No. 666,280, filed May 1, 1946. It comprises a rotatable drum **4D** mounted on a shaft which is driven clockwise step by step by a ratchet mechanism under the control of a motor MOT, power for which is supplied by the control circuit shown in Fig. 5. The drum **4D** is perforated to accommodate the perforations in the tape **4T**, and when advanced one step, moves the tape forward to bring a succeeding line of perforations underneath twenty-eight sensing fingers. These sensing fingers are continuously reciprocated against the record by a mechanism not shown, and those of the fingers which pass through perforations close respectively associated contacts **A0 . . . F7**, which complete the circuits of individual relays that operate to register perforations sensed. The control circuit is so designed that the drum **4D** is held stationary while the sensing fingers continue to sense the same line of perforations until relays corresponding to the perforations sensed will have been operated and checked, in consequence of which a circuit is then completed for operating step magnet **4STEP** which advances the drum one step to advance the tape to the next line of perforations. The sensing pins then reciprocate against this line of perforations until the circuit of step magnet **4STEP** is again completed to advance the record **4T** to the next line of perforations.

Mounted upon a shaft driven by the motor MOT are a number of timing cams (not shown) which severally control nine individual fingers each mated with a grounded contact. The latter contacts are designated **H1, H2, H3, H7, K7, K4, J0, J3** and **J6**, are referred to as the "reader contacts," and are closed or opened for certain intervals during the "reading cycle" as indicated on the timing chart shown in Fig. 101, which also shows the periods during the cycle when the reader contacts **A0 . . . F7** are closed and opened. These timing contacts control various circuit operations as will hereinafter appear. The contacts **G1** and **G2** and the functions they perform will be discussed in detail later on in connection with sensing operations. It will suffice at this point, however, merely to say that contacts **G1** and **G2** are used to operate a circuit which indicates the definite advance of the tape drum **4D** from one position to the next.

Little need be said at this point about the master control circuit shown in Fig. 5 other than the fact that it shows the various keys by which the mechanism is operated or released or stayed in its operation, and the various relays that operate in the manner later to be described for providing off-normal ground to various parts of the circuit, and also to supply power to the motor MOT of the reader as well as to the motor of the Gang Punch, the circuit of which is shown in Fig. 89.

Figs. 15 (to the right), 16, 17 and 18 show the five digit reading registers which are used to register temporarily the digits sensed in one line of perforations by the sensing fingers **A0 . . . F7**. With the exception of the reading register for the digit A shown to the right of Fig. 15, each of the other registers comprises five relays, one relay for each of the five positions allocated to a digit across the tape, the register for the A digit comprising but three relays, since there are but three perforating positions allocated to the A digit on the tape.

More particularly, Fig. 15 (to the right) shows the three relays which respond to the perforations in the three A digit positions on the tape; Fig. 16 shows the five relays of the B-Digit Reading Register and the five relays of the C-Digit Reading Register; Fig. 17 shows similar relays of the D-Digit and the E-Digit Reading Registers, while Fig. 18 shows the relays of the F-Digit Reading Register.

Two relays of each register (except the A register) are operated by circuits completed directly from the contacts controlled by two sensing pins of the five pins for each digit which penetrate the perforations recording the digital value, and these relays, by their operation, effect the temporary registration of that digit in accordance with the two-out-of-five code. This code which has been previously given in connection with the five positions for each of the five digits on a line of the tape, and is repeated below to indicate by reference to the numerical suffix of the relays of each of the digit reading registers which two relays in each of said registers operate to register the digital value indicated by the perforations that effect the operation of the relays:

TABLE C

Digit	Relay Operated
0	−7, −4
1	−1, −0
2	−2, −0
3	−2, −1
4	−4, −0
5	−4, −1
6	−4, −2
7	−7, −0
8	−7, −1
9	−7, −2

In connection with the operation of the relays of the Digit-Reading Registers it should be noted at this time that since two relays in each of the registers will be operated for each digit (except the A digit), further operation of the apparatus in response to the operation of said registers is made contingent upon a positive check through the contacts of said relays to determine that two, and only two, relays in each of the registers have operated. Should it happen that, for any reason, less than two or more than two relays are operated in any one of the registers, all further operations are suspended and an alarm will be given to indicate improper registration.

As was previously stated, the tape-to-card converter is provided with certain switches which are manually adjustable to agree with the values of certain digits in the tape identity entries. These switches are shown in Figs. 6 and 7, are of known construction, and the brushes thereof can be brought into engageable relation with corresponding terminals on their respective arcs.

The switch identified as 6TT is provided for the tape type index, and the brushes of the switch are adjusted to engage with the terminals the designations of which agree with the value of the E digit in the first line of the tape identity entries. The switch identified as 6MGT is provided for the tens digit of the marker group the brushes of which are adjusted to agree with the value of the E digit in the second line of the tape identity entries; the switch identified as 7MGU is provided for the units digit of the marker group, the brushes of which are adjusted to agree with the value of the F digit in the second line of the tape identity entries; the switch identified as 6CO is provided for the office index, and its brushes are adjusted either to an "off" position or to the value of the E digit in the fifth line of the tape identity entries; the switch identified as 7RO is provided for the "round and tape section" digit, and its brushes are adjusted to agree with the value of the F digit in the eighth line of the tape identity entries; the switch identified as 7MT is provided for the tens digit of the month designation, and its brushes are adjusted to agree with the value of the E digit in the ninth line of the tape identity entries, while the switch identified as 7MU is provided for the units digit of the month designation, and its brushes are adjusted in accordance with the value of the F digit in the ninth line of the tape identity entries.

As was previously stated, before proceeding with the processing of any tape, it is essential that the "set-up" switches shown in Figs. 6 and 7 be individually adjusted to the terminals which agree with the numerical values of the indicated digits in the different lines of the tape identity entries.

When the processing of the tape has advanced beyond the splice pattern (in the manner described below) and to the first line of the forward tape identity entries, not only are the digit-reading registers checked for the operation of two and only two relays in each (except for the A digit) according to the code given in table C, but the setting of the E-Digit Register is further checked against the setting of the set-up switch 6TT. If the two agree, then a relay is operated in the class translator (Fig. 80) in accordance with the "type" of tape, relay 80TOL being operated for a Toll tape and a Detail tape, relay 80MUDA being operated for a Message Unit Detail tape, relay 79OBS and relay 79OI1 in the observing Index Translator (Fig. 79) being operated for an Observing tape. Each of these relays, when operated, operates an appropriate relay in the tape index register (Fig. 68) by which circuits are prepared to further the operation of the mechanism. In the same manner, upon the sensing of the marker group line (second line), the setting of the E-Digit Reading Register is checked against the setting of the switch 6MGT. If the settings agree, an appropriate relay 24A–MTX is operated in the calling office translator (Fig. 24A); likewise if the setting of the F-Digit Reading Register agrees with that of the switch 7MGU, the appropriate relay 24A–COT000 . . . 24B–COT999 is operated through a set of contacts of the operated relay 24A–MTX. Finally, when the last line of the tape identity entries is sensed (the month entry) the setting of the E and F-Digit Reading Registers is checked against the setting of the switches 7MT and 7MU, respectively. If they agree, then the relay in the months translator (Figs. 20 and 21) which designates the month is operated and locked. It should be noted that as each line of the tape identity entries is processed and satisfactorily checked, the tape identity progress circuit shown in Figs. 1 and 2 is operated to register the fact. Failure of this circuit to operate in response to the processing of each line of the tape identity entries will, of course, suspend further operations and produce an alarm.

Obviously, if there is failure of agreement between the indicated digits in the tape identity entries and the settings of the switches, the involved relays will not operate, and since further progress in the operation of the mechanism depends upon the operation of the relays, the mechanism will stop, and after an appropriate interval an alarm is given. However, if there is agreement between the indicated digits in the lines of the tape identity entries and the adjustment of the switches, the relays are both operated and locked, in consequence of which any subsequent disturbance in the adjustment of the switches from their original settings will not disturb operations, except that when the tape is processed and advanced to the trailing tape identity entries, the disturbance is noted and an alarm is given.

When, after the tape identity entries have been processed, the tape is advanced to the first message entry, each line thereof is successively read by the Digit-Reading Registers and the data severally represented by their respective settings is successively transferred to the storage registers of the Odd or Even Storage Unit. Since the mechanism is arranged for the Odd Storage Unit to be given first preference, the five lines of the first entry are transferred to the storage registers 1, 3, 5, 7 and 9 of the Odd Storage Unit, which registers, together with their respective connectors, are shown in Figs. 27 to 60, inclusive; storage registers 0 and 8 of the Even Storage Unit being shown in Figs. 82 to 95, inclusive, the intermediate registers not being shown.

It will be recalled that the five digits of the line of an entry are registered in the Digit-Reading Registers by the operation therein of two out of five relays. Now each of the digit storage registers in the two Storage Units is provided with six relays instead of five, and the transference of the data stored in the Digit-Reading Registers by the operation of two out of five relays therein is effected by the operation of three out of six relays in each of the digit storage registers in accordance with the following code, as expressed by the numeral suffixes appended as part of the designation of each of the relays in each of the digit storing registers. In the following table the two-out-of-five code is also repeated by way of correlation:

TABLE D

Digit	2/5 Code	3/6 Code
0	4, 7	1, 2, 3
1	0, 1	0, 1, 00
2	0, 2	0, 2, 00
3	1, 2	1, 2, 00
4	0, 4	0, 4, 00
5	1, 4	1, 4, 00
6	2, 4	2, 4, 00
7	0, 7	0, 4, 3
8	1, 7	1, 4, 3
9	2, 7	2, 4, 3

The reason why the data is stored in the three-out-of-

six code in the digit storage registers is because a registration of the data in the two-out-of-five code in said registers would require relays with heavier spring loads. This would slow up the operation of the relays in response to the operation of the relays in the Digit-Reading Registers. Therefore, in order to increase the speed of operation and still give the relays ample time to securely operate and lock during the reading cycle, the three-out-of-six code, involving relays with lighter spring loads, has been preferred. However, if the speed of the reading cycle is decreased, or if greater power is supplied to the relays of the storage registers, the data can be transferred to registers arranged to register the data in the two-out-of-five code or any other suitable code.

Thus as each line of the message entry is read and registered by the Digit-Reading Registers, said line is transferred to a storage register of the Odd Storage Unit, the first line being transferred to storage register **1** (Figs. 27 to 32), the second line to storage register 3 (Figs. 34 to 38), the third line to storage register **5** (Figs. 41 to 46), the fourth line to storage register **7** (Figs. 48 to 53) and the fifth line to storage register **9** (Figs. 55 to 60).

The next entry to be sensed will be registered in the five storage registers **0**, **2**, **4**, **6** and **8** of the Even Storage Unit. It should be noted at this time that when the apparatus is used to process a Detail tape which contains, among other entries, "overcapacity" entries consisting of six lines, the first five lines of an overcapacity entry are registered in the five successive registers of either storage unit, but the sixth line is registered in the "last" storage register of the other storage unit. For example, if the five lines of an overcapacity entry are registered in the five registers of the Odd Storage Unit, the circuit is so arranged that the sixth line of said entry will be registered in the "eighth" storage register of the Even Storage Unit. Conversely, if the five lines of an overcapacity entry are registered in the five registers of the Even Storage Unit, then the sixth line of the entry is registered in the "ninth" register of the Odd Storage Unit. As previously stated, the reason for this arrangement is to enable the remaining registers of the Storage Unit in the last register of which was registered the sixth line of the overcapacity entry, to be used to register the four lines of the following entry, the circuit being sufficiently rapid in its operation to insure that by the time registration of the fifth line either of a regular entry or an overcapacity entry is ready to take place, the storage registers on which said lines are to be registered will have been discharged and available for the purpose.

It has been previously stated that the circuit is arranged to give the Odd Storage Unit preference in storing the first message entry. Consequently when operations are begun by operating the proper start keys in Fig. 5, the circuit shown in said figure causes the operation of the Odd Detail Connector **67OD** and certain other connectors by which certain of the storage registers of said unit are connected to appropriate translators, since the data in the involved lines of the entry may not be punched on the card as stored in the registers but must be changed or translated to the significance required. Of course, if the circuit had been arranged to give the Even Storage Unit preference in storing the first message entry, then the circuit of Fig. 5 would have caused the Even Detail Connector to be operated, in consequence of which the involved storage registers of the Even Storage Unit would be connected to the translators. Thereafter, and since the Storage Units are used in alternation to store successive entries, the respective connectors are operated in corresponding alternation to extend the involved storage registers to the translators.

It will be noted from Fig. 100 (and also from Figs. 103 and 104) that in the first line of a message entry recorded on a Toll tape is recorded the calling office index and the calling line number, which is also true of all the other tapes except observing tapes. It is obvious that the calling line number, which is recorded in the C to F digits of the line, requires no translation, and is, furthermore, stored in the C to F-Digit Registers of the storage register **1** (or storage register **0**). Consequently when the Odd Detail Connector **69OD** is operated and the calling line number is stored in storage register **1** of the Odd Storage Unit, said registers are extended through contacts of relay **69OD** to terminal blocks on Fig. 71 from which they are further extended to the Gang Punch for punching the calling line number on the card in the manner subsequently to be described.

The B digit, however, indicates the office of origin and requires translation, inasmuch as the single digit is not the code of the office, and the latter is what is to be punched on the card. Consequently, the setting of the B digit is used, through the contacts of relay **69OD**, to operate one of the ten relays **13–010A . . . 13–019A** of the calling office index translator (Fig. 13), which relay, in combination with the relays in the calling office translator (Figs. 24A and 24B) which were operated in response to the marker group and office information in the tape identity entries, translates the digit into the actual alphabetical designation of the office code. As will be shown later, the punching of the appropriate holes in the card to designate the office code as well as all other information is effected through two groups of conductors designated the EMX and CHX multiples to which the contacts of the relays of the calling office translator are selectively extended.

It will be further observed from Figs. 100, 103A and 104A, that in the second line of all entries except summary entries, and in the B to F digits thereof is recorded the "start time" of conversation. These five digits require "expansion" and translation, as will be amplified later on. Since the "start time" digits are registered in the storage register **3** (or storage register **2**), the operation of the Odd Detail Connector **69OD** connects the B-Digit Storage Register to the Day Tens translator (Fig. 77), connects the C-Digit Storage Register to the Hour Tens translator (Fig. 77), and connects both of said registers to the Minute Tens translator (Fig. 78), in consequence of which the five digits of the start time are expanded into the six digits to be recorded on the card.

In the third line of the message entry is recorded the called office code (D to F digits), the "area" index (B digit) and the "called number" index (C digit), all registered in corresponding digit registers of storage register **5** (or storage register **4**). The called office code requires no translation since said code is punched on the card according to its numerical designation. Consequently, the D, E and F storage registers are extended directly (but through contacts of the Odd Detail Connector) to terminal blocks on Fig. 71 whence they are used to control the operation of the appropriate punch magnets of the Gang Punch to punch the three digits of the called office code.

The C digit (for this type of entry) tells us how to interpret the called line number which is recorded in the fourth line of the entry and stored in the digit registers of storage register **7** (or storage register **6**). The called line number is recorded as five digits, but it may be a three-digit number, or a four-digit number with or without a party letter or a five-digit number. The value of the C digit in the third line of the entry determines which it is, as indicated by the chart of Fig. 104D, and for this purpose, the value of its setting is used to operate (through the Odd Detail Connector) one or more of the relays **80CN0 . . . 80CN2** of the called number index translator (Fig. 80), which operated relay (or relays) fixes the number of digits. When the fourth line of the entry is read and subsequently stored in storage register **7** (or storage register **6**) the F-Digit Register is extended through the Detail Connector to the called party translator shown in Fig. 25. By virtue of the relay, or relays, operated in the called number index translator, it is de-

termined whether the F digit is a party letter or a digit, in consequence of which the appropriate relay is operated for the letter or the digit. The called line number is then punched on the card under the control of the called index translator, the called party translator and the registers, in the manner to be later described in detail.

The fifth line of the entry contains the message units, if any (E and F digits), the chargeable time (C and D digits) and the Message Unit Index (B digit). The chargeable time requires no translation. Accordingly, the C and D-Digit Storage Registers are extended directly to terminal blocks in Fig. 71 to control the appropriate punch magnets of the Gang Punch. The message units, if any, may require translation into an equivalent money charge, and for this purpose when so required the E and F-Digit Storage Registers are extended through appropriate connecting relays to the Toll Unit Translator shown in Figs. 22 and 23, operating one or more relays in each to translate the number of units into an equivalent money charge. If a tax is required therefor the tax is computed by means of the Toll Unit Tax Translator shown in Figs. 11 and 12, the total of both the charge and the tax being computed by the total charge translator shown in Figs. 11A and 12A. The individual charge, the tax and the total are separately entered on the card produced for the entry in a manner later to be described in detail.

There are, of course, many variations in the operations of the mechanism, due to the different treatment to be accorded to the different digits of the different entries, as noted in Figs. 103 and 104, but the above should suffice to give a general idea of the operative relation between the registers of the storage units, the translators and the mechanism of the Gang Punch.

Figs. 71 and 89, taken together, show schematically the circuit of the Gang Punch, the relays which control the operation of its magnets, and certain blocks upon the terminals of which are connected the conductors which extend from the storage registers and the translators. These terminals are cross-connected to the "punch and check" relays of the Gang Punch as indicated by tables furnished below. The Gang Punch schematically shown in Fig. 89 and used herein to illustrate the operation of the invention is the No. 518 IBM Automatic Gang Summary Punch. This machine comprises eighty (80) punch magnets **89PM1** . . . **89PM80**, one for each column in the card, an impulser which is herein called an emitter, various control magnets and relays, and certain cam controlled contacts. Each punch magnet **89PM–** of the Gang Punch is extended to a corresponding relay **71PXC** of the pair of relays **71PXC**, **71PCX** for each magnet, which relays are shown in Fig. 71. When the machine starts a card punch cycle, the emitter, in rotating over its commutator, progressively applies a ground pulse over each of the conductors from **12** to **9**, as indicated. These impulses are transmitted to the pulse control circuit shown in Figs. 3, 8, 9 and 10, and are utilized by the latter circuit to successively apply a corresponding ground pulse to correspondingly designated conductors in the EMX and CHX multiples, coincidentally with the card being advanced to similarly designated rows. Thus when the emitter is about to transmit a pulse over conductor **12**, the card has been advanced to row 12 for punching operations in that row. Consequently, the pulse on conductor **12** is utilized by the punch control circuit to apply ground to conductors **EM12** and **CH12** in the EMX and CHX multiples, respectively, and all registers and translators which have equipment tied to those conductors will complete circuits to the appropriate relays **71PCX**, **71PXC** shown in Fig. 71, in consequence of which said relays will operate, one in each pair, completing the circuit of the punch magnet individual to it, thus causing said magnet to punch a hole in row 12 and in whatever column said magnet is fixed in relation to the card. In the same manner, when the card is advanced to row 11, the emitter arm will have advanced into engagement with conductor **11**, a pulse is transmitted over conductor **11** to the punch control circuit, and ground is applied by said circuit to conductors **EM11** and **CH11**, whereupon all of the registers and translators having electrical connections to said conductors will cause circuits to be completed therethrough to the particular relays, Fig. 71, to which the circuits therefor are completed from the terminal blocks shown in said figure. These relays will then operate and complete the circuits of the associated punch magnets, which operate to punch holes in row 11 and in the columns in which said magnets operate. In this manner, as the card is advanced from row to row and the emitter rotates to each of the correspondingly designated conductors, a pulse is applied by the emitter progressively to each of said conductors, which pulses are accepted by the punch control circuit to enable it to apply corresponding pulses to correspondingly numbered conductors in the EMX and CHX multiples. The punch magnets **89PM1** . . . **89PM80** are then selectively and repetitively operated over said conductors under the control of the registers and translators, and cause holes to be punched in the different rows and columns as called for by the data stored in said registers and translators.

Fig. 81 shows a card count circuit, and operates to control the number of cards which are to be produced for any particular entry. As was previously stated, when the apparatus processes a Detail tape, it may be necessary to produce as many as three cards per entry in accordance with information supplied by the value of the Observing Index (see Figs. 104A, 104B and 104C). The circuit shown in Fig. 81 operates to control the number of cards that will be produced, and further controls the particular digit that will be punched as the "AMA" class in column 68 of the card.

Figs. 62 to 66, inclusive, and Figs. 72 to 76, inclusive, show equipment which is used in the production of Ten Summary Cards. Figs. 62 to 65 show a calling line register circuit and Figs. 72 to 75 show a comparison circuit. In the production of Ten Summary Cards from a Summary tape of the kind indicated in Fig. 108, the calling line number registered by the digit-reading relays in response to the reading of the first line of the entry is caused to be registered in the four registers shown in Figs. 62 to 65, a similar number being registered in the comparison circuit immediately below. The value of the units digit of the registered number then controls which one of the ten storage registers of the combined Odd and Even Storage Units will be utilized to register the summary of charges contained in the second line of the entry. When the first line of the next entry is sensed, and remembering that the directory numbers on the Summary tape are numerically arranged in ascending order, the new number is checked against the preceding number registered in the comparison circuit. If the thousands, hundreds and ten digits are the same, the registrations in the registers of Figs. 62, 63 and 64 will remain undisturbed, but the setting of the units register in Fig. 65 is changed to agree with the units digit of the new number, whereupon the summary entry following said new number is caused to be registered in whichever storage register of the combined Odd and Even Storage Units is indicated by the value of the new units digit. This operation of entering summaries in the storage registers continues until a "mismatch" occurs between the thousands, hundreds or tens digit of the number registered in the comparison circuit and a corresponding digit of the new number, or all ten storage registers are filled. In the first case, a Ten Summary Card will be produced for the series of numbers less than ten before the mismatch occurs, and in the second case a Ten Summary Card will be produced for all ten numbers.

Section III—DETAILED DESCRIPTION

1. *Preliminary operations*

The detailed operation of the circuits and apparatus of my invention will now be described, it being assumed that the tape T to be analyzed is a Toll tape as defined in the previous section, that said tape has been inserted into the reader mechanism with the leading end of the splice pattern positioned to cause the embossments constituting the perforations of a number of the lines of said pattern to fit into the registering holes of the tape drum 4D, and that the set-up switches 6TT, 6MGT, 6CO, 7MGU, 7RO, 7MU and 7MT have been manually set to the several terminals indicated by the numerical values of certain of the digits in the tape identity entries. Assuming that all apparatus is otherwise normal power switch 89SW1 of the Gang Punch is operated, and motor start key 5KMST also operated. Upon the operation of said key an obvious circuit is thereby completed for relay 5RLM to ground over the No. 5 contacts of said key, and another circuit is completed for relay 5MST, the path of which extends from battery through the winding of said relay, conductor MST, No. 1 contacts of relay 26AL, conductor MST1, No. 2 contacts of key 5KEMS, No. 4 contacts of key 5KMST, to ground. Relay 5MST operates, completes an obvious circuit for reader motor relay 5RMOT over its No. 1 contacts, and completes another obvious circuit for relay 5PMST over its No. 5 contacts. Both of said latter relays operate, relay 5PMST locking over its left winding and contacts, No. 1 contacts of key 5KEMS, No. 3 contacts of relay 5MST, to ground over the No. 4 contacts of key 5KMST, and locally operates relay 5PMOT. Relay 5MST also closes a circuit for relay 5MON, the path of which extends from battery through the winding of said relay, No. 4 contacts of relay 5MST, No. 3 contacts of machine release key 5KMARL, to ground. In parallel with relay 5MON and over conductor MON1 are operated relays 66MON and 76MON. Relay 5MON, in operating, locks over its No. 3 contacts to ground on machine stop key 5KMR, locks relay 5RLM over the latter's No. 2 contacts, No. 2 contacts of key 5KMARL, to ground on the No. 2 contacts of said relay 5MON. Among its other functions, relay 5MON provides locking ground along various conductors to certain parts of the circuit system, and completes the circuit of relay 26RSR from battery, through resister R1, No. 10 contacts of relay 5MON, conductor RSR, winding of relay 26RSR, to ground. The latter relay operates, completes an obvious circuit for relay 26RSH, and opens at its No. 1 contacts one of the paths to relay 26AL, which otherwise would operate over conductor AL6 to ground on the No. 1 contacts of relay 5MON upon the operation of the latter as previously described, and upon the operation of relay 5ST4 as subsequently described.

Relay 5MST also closes a circuit for the reader step magnet 4STEP, said circuit being traced from battery through the ballast lamp 5L, No. 7 contacts of relay 5MST, conductor STP, winding of magnet 4STEP, conductor STP1, No. 6 contacts of relay 27RS, serially through the No. 8 contacts of relays 27RS9, 34RS7, 41RS5, 48RS3, 55RS1, 82RS0, XXRS2, XXRS4, XXRS6 (the relays prefixed with the designation "XX" being those of the "even" numbered registers indicated by the numerical suffix of the relays but not shown), 90RS8, to ground. Step magnet 4STEP operates. Since its armature is fixed at pin 4P, said armature tilts clockwise, clearing the roller 4R from the high point of the eccentric cam 4C, and withdrawing the pawl 4PW from the engaged ratchet wheel 4RW attached to the end of the shaft of the tape drum 4D.

When the reader motor relay 5RMOT operated, it closed an alternating-current power circuit to the reader motor 4MOT, the path of which circuit may be traced from one side of the alternating power supply source 5AC, the contacts of relay 5RMOT, conductor MOT, winding of the motor 4MOT, conductor MOT1, to the other side of said source 5AC. The motor 4MOT thereupon operates through the gearing 4G, the eccentric cam 4C driving the reciprocating mechanism (not shown) by which the timing contacts H1 . . . J6 are opened or closed for certain predetermined duration as indicated in the timing chart of Fig. 101, and sensing pins A0 . . . F7 are caused to impinge upon the tape 4T once during every reading (or sensing) cycle (also as indicated in Fig. 101), thereby to cause the contacts A0 . . . F7 of those pins which pass through perforations in the tape to be grounded. However, since step magnet 4STEP was previously operated to draw the roller 4R away from the cam 4C, the operation of the motor 4MOT will have no effect at this time on the tape drum 4D, which will remain in a stationary position so long as stepper magnet 4STEP remains energized. The sensing pins A0 . . . F7, however, will sense the tape 4T once for every reading cycle.

Relay 5PMOT similarly supplies alternating-current power to the motor 89MOT of the Gang Punch mechanism, the path over which said power is supplied being traced from one side of the supply source 5AC, contacts of relay 5PMOT, conductor MOT2, contacts of relay 89MRM (which is operated at this time as will be shown hereunder), motor 89MOT, closed switch contact, conductor MOT3, to the other side of said supply source 5AC. Motor 89MOT operates in partial preparation for the use of the Gang Punch.

Thus as a result of the operation of the motor start key 5KMST, the tape drum 4D of the reader is held stationary by the operated step magnet 4STEP, reader motor 4MOT is operated to drive the reader sensing pins A0 . . . F7 against the tape 4T, timing contacts G1 . . . J6 are variously closed or opened during the reading cycle, and motor 89MOT of the Gang Punch is operated. With the tape type set-up switch 6TT set on any terminal a circuit is completed for relays 89–8 and 89–7, said circuit extending from ground on conductor I1, brush 6 of said switch and any off-normal terminal of its arc, conductor I12, winding of relay 89–8, winding of relay 89–7, to battery +B. With relay 89–8 operated and with the motor start key 5KMST still operated, a circuit is now closed to feed the first card into the punch mechanism as follows: ground on conductor I1 is extended over the No. 2 contacts of key 5KMST, conductor 117, No. 2 contacts of relay 8PIC, conductor I13, contacts of relay 89–8 through the winding of relays 89–1 and 89–5, to battery +B. Relay 89–5, in operating, completes the circuit of relay 89–9 in series with the motor relay 89MRM (which above was said to be operated), said circuit extending from ground on the contacts of relay 89–5, winding of relay 89–9, winding of motor relay 89MRM, kick-off contacts 89KO, to battery +B. Relay 89–1, on the other hand, closes the circuit of the clutch magnet 89CM, said circuit extending from battery, winding of magnet 89CM, No. 2 contacts of relay 89–1, cam controlled contacts P1, to ground. Relay 89–1 locks over its No. 1 contacts independent of the key operation for one cycle, to ground on the cam controlled contacts P2, said relay being normally released when contacts P2 open. A card is now fed into the die card lever position, contacts 89DC are closed and relays 89–3 and 89–2 are operated from ground on said contacts, windings of said two relays in series, to battery +B. With relays 89–7 and 89–4 operated (the latter relay operating over an obvious circuit from ground on contacts 89MC if cards are in the magazine), a locking path is closed for relay 89–1 to hold it independent of contacts P2, said path extending through the No. 1 contacts of relay 89–1, back contacts of relay 89-15, No. 2 contacts of relay 89–7, No. 2 contacts of relay 89–6, No. 2 contacts of relay 89–4, stacker contacts 89SC (which are closed when there are cards in the

stack), contacts of stop key 89STP to ground. With relay 89–1 maintained operated independent of contacts P2, another card feeding cycle is taken, advancing the first card to the punch card position and a second card to the die card position. Relay 89–6 operates over an obvious circuit when cam P5 closes at the beginning of this cycle. The punch mechanism is now ready to punch the first card, contingent only upon conductor I13 being joined to conductor I14 by the operation of relay 8PST as later described. When cards are in the magazine, contacts 89MC are closed, and relay 89–4 is operated over an obvious circuit as already noted, and if a card has been advanced to the die card, relays 89–3 and 89–2 are operated as above described, in which event a circuit is completed for relay 8PIC extending from battery through the winding of said relay, conductor I3, No. 1 contacts of relay 89–4, No. 1 contacts of relay 89–3, to ground. When the first card reaches the punch position, contacts 89P will close as well as cam controlled contacts P6, whereupon a circuit is completed from ground on contacts 89P, contacts P6, conductor I5, winding of relay 8STG, conductor I6, to battery +B. Relay 8STG operates, locks over its No. 1 contacts, No. 1 contacts of relay 8R, to ground on conductor I1, and closes over its No. 2 contacts a point in the circuit of relay 8CUC, the operation of which, as will be described, is the signal for the punch mechanism to begin punching the card.

With the operation of key 5KMST a circuit is also completed for relay 8PDCP, said circuit being traced from ground on conductor I1, winding of relay 8PDCP, conductor I15, No. 1 contacts of key 5KMST, conductor I6, to battery +B. Relay 8PDCP operates, locks over its No. 1 contacts, conductor I16, No. 5 contacts of relay 5MON, conductor I6, to battery 89B. By closing its No. 2 contacts relay 8PDCP completes the circuit of relay 5ST1 (as will be shown) which is the signal provided to indicate that battery +B is available to the rest of the machine.

When relay 5RLM operated it closed a locking circuit for relay 5MST independent of key 5KMST, and a locking circuit for relay 5PMST; the locking circuit of relay 5MST extending through the winding of said relay, conductor MST, No. 1 contacts of relay 26AL, conductor MST1, No. 2 contacts of key 5KEMS, No. 3 contacts of relay 5MST, No. 1 contacts of relay 5RLM, to ground over the No. 2 contacts of relay 5MON; the locking circuit of relay 5PMST extending over the left-hand winding and contacts of said relay, No. 1 contacts of key 5KEMS, No. 1 contacts of relay 5RLM, to ground on the No. 2 contacts of relay 5MON.

With the tape T held in the stationary position by the operated step magnet 4STEP, with reader motor 4MOT and the Gang Punch motor 89MOT both operated, and with the above other preliminary operations performed, the machine is ready to process the tape 4T which, as said before, is a Toll tape. To start the processing of the tape and the production of the punched cards by the Gang Punch after the operation of key 5KMST, machine start key 5KMAS is operated, whereupon a circuit is completed for operating relay 5ST1, said circuit extending from battery through the winding of said relay, No. 3 contacts of relay 5RLM, No. 2 back contacts of relay 5ST2, conductor ST1, No. 2 contacts of relay 8PDCP, conductor ST2, contacts of key 5KMAS, No. 6 contacts of relay 5MST, conductor H7, reader contacts H7, to ground. As noted from Fig. 91, contacts H7 are closed during that portion of the reading cycle when the sensing pins A0 . . . F7 are engaging the tape 4T and, therefore, during the time when the associated contacts A0 . . . F7, respectively, are closed.

It will be noted that relay 5ST2, which is in series with relay 5ST1, is held short-circuited by ground through the No. 5 contacts of relay 5ST1 and by ground over the previously traced No. 2 back contacts of said relay 5ST2 and the contacts of key 5KMAS. Upon the release of key 5KMAS the short circuit is removed and relay 5ST2 then operates in series with relay 5ST1 over a circuit extending from battery through the winding of said latter relay, No. 3 contacts of relay 5RLM, winding of relay 5ST2, No. 5 contacts of relay 5ST1, to ground. With relays 5ST1 and 5ST2 both operated a circuit is closed for relay 5ST3, said circuit extending from battery through the winding of said relay, No. 2 front contacts of relay 5ST2, conductor ST1, No. 2 contacts of relay 8PDCP, conductor ST2, No. 6 contacts of relay 5ST1, No. 6 contacts of relay 5MST, conductor H7, reader contacts H7, to ground. In parallel with relay 5ST3, relays 66ST3 and 76ST3 are operated over conductor ST4. Relay 5ST3 operates and locks over its No. 6 contacts, conductor ST3, No. 4 contacts of relay 26AL, conductor K7, No. 2 contacts of relay 5RLS, to ground. The holding path, however, also extends to ground on reader contacts K7 directly and via the No. 4 contacts of key 5KMARL to prevent the release of relay 5ST3 in the event of a release of the machine during the closed period of the reading cycle, thus insuring that upon the operation of relay 5RLS, relay 5ST3 will not release until the end of the cycle. Relay 5ST3, in operating, controls various circuit functions that will be described later, and supplies holding ground over certain conductors. Relay 5ST4, which operates locally from the No. 10 contacts of relay 5ST3, also performs certain functions hereinafter to be described.

Relay 5ST1, upon operating, completes the circuit of relay 55SR1 of the First Storage Register Connector, said circuit being traced from battery through the winding of said latter relay, conductor SR1, No. 30 contacts of relay 68TS, conductor SR11, No. 3 contacts of relay 5ST1, No. 1 back contacts of relay 5ST4 to ground, said latter relay being normal, it will be recalled, in the interval between the operation of relays 5ST1 and 5ST2. Relay 55SR1 operates and locks over its No. 1 contacts, No. 1 contacts of relay 55RS1, conductor SRL, to ground on the No. 12 contacts of relay 5ST3 when the latter relay operates. Relay 55SR1 prepares one point in the path of a circuit which connects the First Storage Register with the Digit Reading Registers when the first line of the first message entry is sensed, as later described. Relay 5ST1 also completes the circuit of the reader cut-in relay 4RC, said circuit extending from battery through the winding of relay 4RC, conductor RC, No. 4 contacts of relay 5ST1, to ground, and also to the No. 1 contacts of relay 5ST3, to ground when said relay operates. The operation of relay 4RC connects the reader contacts B0 . . . F7 severally to the windings of the relays of the Digit Reading Registers for the B to F digits, inclusive, and connects the reader contacts A0 . . . A2 to the relays in the Digit Reading Register for the A digit via the Nos. 5, 4 and 3 contacts, respectively, of relay 5ST3.

It will be noted that the two pins G1 and G2 which make with their companion contacts G1 and G2 of the reader contact assembly extend, respectively, to two alternate series of apertures at the right end of the tape drum 4D, each aperture in each series being aligned with a row of apertures in the drum that engage a line of perforations on the tape 4T. The drum mechanism is so designed that after each step of the drum 4D by which the next line of perforations on the tape 4T is advanced into sensing engagement with the sensing pins A0 . . . F7, it will cause either the pin G1 or G2 to fall into the aperture registering therewith which is in alignment with that line, said pin engaging the aperture for the same period that the sensing pins A0 . . . F7 engage the tape 4T. In other words, both pins G1 and G2 operate in synchronism with the sensing pins A0 . . . F7, but only one of them will enter its registering aperture and ground its associated contacts for the same period that the sensing pins which enter perforations in the tape will severally ground their

associated contacts. Thus, for example, in one position of the drum 4D, the pin G1 will drop into a registering aperture for the closed period of the reading cycle, and in so doing will cause contacts G1 to close and ground conductor G1. If the drum 4D does not step between two or more successive reading cycles, there will be no change with respect to the pin G1, which will continue to drop into the same registering aperture and, consequently, continue to cause ground to be applied to conductor G1 for each closed period of the reading cycle. If, however, the drum does advance the tape 4T to the succeeding line of perforations on the next reading cycle, then the other pin (in this case pin G2) will drop in to close its contacts G2 and ground conductor G2. It will then be seen that the transference of ground from conductor G1 to conductor G2 (and from conductor G2 to conductor G1) furnishes an indication that the drum has stepped one reading position. In the next position of the drum (and on the next closed period of the reading cycle) there will be no aperture for the pin G1 to drop into, which, on this account, will not close its contacts and will not cause ground to be applied to conductor G1. However, there will be an aperture for the pin G2, whereupon said pin will drop into said aperture and close its associated contacts. So long as the drum does not advance a step, however, the same pin G1 (or G2) will continue to drop into its registering aperture and cause ground to be applied to its associated lead, G1 (or G2).

The two pins G1 and G2, and the Reader Stepcheck circuit shown in the left portion of Fig. 15, are provided to make certain that after a line of the record 4T has been analyzed as subsequently set forth, and the reader drum 4D is signaled to advance the tape 4T the next line of perforations, no further analysis of said record will take place unless and until said drum 4D has in fact advanced said record to said next line of perforations, for which a positive check is supplied by the Reader Stepcheck circuit. However, when sensing operations begin, it is necessary to bring the check circuit "in step" with the position of the drum 4D. If, for example, the drum is in a position for which contacts G2 are closed during the reading period of the sensing cycle, then a circuit is completed for relay 15RW, said circuit extending from battery through the winding of said relay, back contacts of relay 15RZ2, conductor RSC, No. 1 contacts of relay 5ST1, No. 2 contacts of relay 5ST3 (which has not yet operated at this time), conductor G2, contacts G2, to ground. Relay 15RW operates, holds relay 15RZ1 short-circuited by the above-traced operating ground on one side of the winding of said relay 15RZ1 and by ground supplied on the other side over the No. 2 contacts of relay 15RW, back contacts of relay 15RZ3, conductor RSH, to ground on the No. 8 contacts of relay 5ST1, or to ground on the No. 11 contacts of relay 5ST3 when the latter relay operates. Relay 15RW further operates relays 15RKA and 15RKB over a circuit extending from battery through the respective windings of said latter relays, No. 1 contacts of relay 15RW, back contacts of relay 15RZ3, to aforetraced ground on conductor RSH. When contacts G2 open on the open period of the reading or sensing cycle of the reader and ground is thereby removed from conductor G2, the short circuit around relay 15RZ1 is removed and this relay then operates in series with relay 15RW over a circuit extending from battery through the winding of said relay 15RW, winding of relay 15RZ1, No. 2 contacts of relay 15RW, back contacts of relay 15RZ3, to aforetraced ground on conductor RSH. Relay 15RZ1, on operating, completes an obvious circuit for relay 15RZ2 which operates. With the operation of the latter relay, the check circuit is "in step" with the reader drum 4D, and it should be noted that with relays 15RW, 15RKA, 15RKB, 15RZ1 and 15RZ2 operated, repeated applications of ground to conductor G2 (due to the closure of contacts G2 during the reading period of each subsequent sensing cycle in the event that drum 4D remains in the same position) will have no further effect upon the Reader Stepcheck circuit. Ground on conductor G2, however, will be supplied upon each reading cycle to the "up-check" conductor UC over the front contacts of relay 15RKB. It should further be noted that if the drum 4D is initially in a position for which the spring G1 drops into a registering aperture, the Reader Stepcheck circuit is normally "in step" with the drum, one of the above relays will operate and ground on conductor G1 will be the one that will be applied to conductor UC over the back contacts of relay 15RKA. It will be shown that when a line of perforations has been analyzed during the closures of contacts G2, ground will be supplied over conductor RSC to complete the circuit of relay 15RZ3 over the front contacts of relay 15RZ2, causing the operation of the former relay. Relay 15RZ2 is then held to ground on conductor RSH over the front contacts of relay 15RZ3, the latter relay, by the opening of its back contacts, releasing relays 15RW, 15RKA, 15RKB and 15RZ1. When ground is removed from conductor RSC, relays 15RZ3 and 15RZ2 are released. If the drum 4D will have advanced one step, ground will be available on conductor G1 and applied to conductor UC. On the other hand, if the drum has failed to step, ground will continue to be applied to conductor G2. However, since relay 15RKB is now released, ground on conductor G2 cannot be applied to conductor UC, but will be applied to conductor RSF which, over the No. 4 contacts of relay 5ST4, operates relay 26RSF to perform certain functions later to be described. Moreover, since the further operation of the machine is made contingent upon ground being supplied to conductor UC, operations are suspended and, in due time, an alarm will be given, as subsequently described.

On the next reading cycle, after the one for which ground was applied to conductor G1 by contacts G1, pin G2 will again enter a registering aperture if the drum 4D has successfully advanced one step. In this case, when ground is applied to conductor RSC (as subsequently set forth), a circuit is completed for relay 15RW extending from battery through the winding of said relay, back contacts of relay 15RZ2, to ground on conductotr RSC. Relay 15RW operates, holds relay 15RZ1 short-circuited and operates relays 15RKA and RKB, thus causing ground on conductor G2 to be applied to conductor UC. The subsequent removal of ground from conductor RSC will cause relay 15RZ1 to operate in series with relay 15RW, which then locally operates relay 15RZ2, thus preparing for the release of relays 15RW, 15RZ1, 15RKA and 15RKB when, upon the subsequent application of ground to conductor RSC, relay 15RZ3 is operated as previously described in preparation for the next checking cycle. It should be obvious from the above description that if the drum 4D fails to advance after a reading cycle for which ground was applied to conductor G1, no ground will be applied to conductor UC inasmuch as the operated condition of relay 15RKA consequent to the application of ground on conductor RSC, will disconnect conductor G1 from conductor UC.

It will be assumed for the purpose of further description that the drum 4D is in that position for which contacts G2 are closed for the first reading cycle and that, therefore, relays RKA and RKB of the Reader Stepcheck circuit will have been operated as above described.

Mention has been made of the fact that relay 5ST2 operates when the reader timing contacts H7 are opened after the operation of relay 5ST1. The opening of said contacts indicates the end of a reading cycle. The closure thereof indicates the beginning of the next reading cycle. Consequently when the contacts H7 reclose after the operation of relay 5ST2, relay 5ST3 operates, locks and locally operates relay 5ST4, as previously described. As previously stated, relay 5ST3 is so designed that its No. 12 contacts close before its No. 1 contacts open, thus

insuring the locking circuit of relay 55SR1 which was operated over the No. 1 contacts of relay 5ST3 and locked over its No. 12 contacts. Over its Nos. 5, 4 and 3 contacts, respectively, relay 5ST3 connects the reader contacts A0, A1 and A2 for the A digit sensing to the windings of relays 15A0, 15A1 and 15A2, respectively, of the A-digit Reading Register.

At this juncture it should be pointed out that when relays 66MON and 76MON operated, and if the relays of the odd and even Storage Units are normal, that is, the relays of the Zero, Second, Fourth, Sixth and Eighth Storage Registers (comprising the "even" Storage Unit) and the relays of the First, Third, Fifth, Seventh and Ninth Storage Registers (comprising the "odd" Storage Unit), circuits will be completed for the relays 76DC0, 76DC2, 76DC4, 76DC6, 76DC8, 66DC1, 66DC3, 66DC5, 66DC7 and 76DC9. In view of the fact that only the Zero and Eighth Registers of the Even Storage Unit are shown in Figs. 83 to 87, inclusive, and the remainder of storage registers of the Even Storage Unit are only indicated in Fig. 90, while all of the storage registers of the Odd Storage Unit are shown: (Figs. 28 to 32, inclusive Ninth Storage Register); 35 to 39, inclusive (Seventh Storage Register); 42 to 46 inclusive (Fifth Storage Register); 49 to 53 inclusive (Third Storage Register); and 56 to 60, inclusive (First Storage Register), only the circuits of the relays 66DC– etc., pertaining to the registers of the Odd Storage Unit are traced below, it being evident that the circuits of relays 76DC– etc., pertaining to the relays of the Even Storage Unit will following an identical pattern.

Assuming, then, that the relays in the registers of the Odd Storage Unit are normal when relays 66ST3 and 66MON are operated, the circuit path of relay 66DC1 may be traced from ground through the No. 5 contacts of relay 66MON, winding of relay 66DC1, conductor DC1, serially through the No. 1 contacts of relays 60F1–4 . . . 56B1–00, conductor DC between said registers, conductor DC11, No. 8 contacts of relay 55A13, No. 6 contacts of relay 55A11, resistor R1, to battery. The circuit path of relay 66DC3 may be traced from ground on the No. 4 contacts of relay 66MON, winding of relay 66DC3, conductor DC3, serially through the No. 1 contacts of relays 53F3–4 . . . 49B3–00, conductor DC between said registers, resistor R3, to battery. The circuit path of relay 66DC5 may be traced from ground through the No. 3 contacts of relay 66MON, winding of relay 66DC5, conductor DC5, serially through the No. 1 contacts of relays 46F5–4 . . . 42B5–00, conductor DC between registers, resistor R5, to battery. The circuit of relay 66DC7 may be traced from ground through the No. 2 contacts of relay 66MON, winding of relay 66DC7, conductor DC7, serially through the No. 1 contacts of relay 39F7–4 . . . 35B7–00, conductor DC between registers, resistor R7, to battery. The circuit of relay 66DC9 may be traced from ground through the No. 1 contacts of relay 66MON, winding of relay 66DC9, conductor DC9, serially through the No. 1 contacts of relays 32F9–4 . . . 28B9–00, conductor DC between registers, resistor R9, to battery. Relays 66DC1, 66DC3, 66DC5, 66DC7, and 66DC9 operate over the above circuits.

In the same manner and over similar circuit paths traced from ground on the contacts of relay 76MON, relays 76DC0, 76DC2, 76DC4, 76DC6 and 76DC8 operate if the relays of the Even Storage Unit are normal.

Upon the operation of relays 66DC1 and 66DC3, a circuit is completed for relay 66H1–3, which may be traced from battery through the winding of said relay, No. 2 contacts of relay 66DC1, No. 2 contacts of relay 66DC3, No. 1 back contacts of relay 66LK1–3, No. 3 contacts of relay 66ST3, to ground. Relay 66H1–3 operates and closes a circuit for relay 66LK1–3, extending from battery through the winding of the latter relay, No. 1 contacts of relay 66H1–3, No. 1 contacts of relay 66RL1–3, No. 2 contacts of relay 66H1–3, No. 2 contacts of relay 66DC1, No. 2 contacts of relay 66DC3, to ground in the No. 3 contacts of relay 66ST3. Relay 66LK1–3 is so constructed and adjusted that it closes its No. 2 contacts before it opens its No. 1 back contacts, whereupon the operating circuit of said relay is transferred to the No. 2 contacts. Relay 66LK1–3 operates to perform a function that will be presently described. Similarly, relay 66H5–7 operates over a path extending from battery through the winding of said relay, No. 2 contacts of relay 66DC5, No. 2 contacts of relay 66DC7, No. 1 back contacts of relay 66LK5–7, No. 2 contacts of relay 66ST3, to ground, operating said relay 66H5–7 and completing a circuit for relay 66LK5–7, said circuit extending from battery through the winding of said latter relay, No. 1 contacts of relay 66H5–7, No. 1 back contacts of relay 66RL5–7, No. 2 contacts of relay 66H5–7, No. 2 contacts of relay 66DC5, No. 2 contacts of relay 66DC7, No. 1 back contacts of relay 66LK5–7, to ground on the No. 2 contacts of relay 66ST3. Relay 66LK5–7, being similar in construction and adjustment to relay 66LK1–3, operates to close its No. 2 contacts before it breaks its No. 1 back contacts, whereupon the operating path is transferred to its No. 2 contacts. Relay 66LK5–7 operates to perform a function that will also be presently described. In the same manner, the operation of relay 66DC9 completes the circuit path of relay 66H9, said circuit extending from battery through the winding of said latter relay, No. 2 contacts of relay 66DC9, No. 1 back contacts of relay 66LK9, No. 1 contacts of relay 66ST3 to ground. Relay 66H9 operates and closes the circuit of relay 66LK9 (which is similar in construction and adjustment to relays 66LK5–7 and 66LK1–3), said circuit being traced from battery through the winding of said relay 66LK9, No. 1 contacts of relay 66H9, back contacts of relay 66RL9, No. 2 contacts of relay 66H9, No. 2 contacts of relay 66DC9, No. 1 back contacts of relay 66LK9, No. 1 contacts of relay 66ST3, to ground. When the No. 2 contacts of relay 66LK9 are closed, the operating circuit is transferred from the No. 1 back contacts to the No. 2 contacts, thereupon causing said relay to complete its operation and perform functions which are later described.

In view of the operation of relays 66H1–3, 66H5–7 and 66H9, and the subsequent operation of relays 66LK1–3, 66LK5–7 and 66LK9 as a consequence of the normal condition of the register relays of the Odd Storage Unit, it is not believed necessary to describe the operation of relays 76H– – and 76LK– – in Fig. 76 as a consequence of the normal condition of the register relays of the Even Storage Unit. Suffice it to say that said latter relays are operated over correspondingly similar circuit paths to those of the relays in Fig. 66.

2. *Sensing and skipping the splice pattern*

The tape 4T is normally so positioned on the drum 4D that the first line (or some subsequent line) of the splice pattern is made coincident with the reader sensing pins A0 . . . F7, ready to be sensed by said pins. Accordingly, when relays 5ST3 and 4RC have operated, and remembering that each line of the splice pattern consists of the number "081010," with the first or A digit thereof represented by one perforation in the A0 sensing position and each of the remaining five digits B to F, inclusive, by two perforations according to the two-out-of-five code given in Table C, the impingement of the sensing pins A0 . . . F7 upon the first line of the splice pattern will cause sensing pins A0, B1, B7, C0, C1, D4, D7, E0, E1, F4 and F7 to pass through said perforations. The passage of the pin A0 into the registering perforation will cause the associated reader contacts thereof to close and complete a circuit for relay 15A0 of the A-Digit Reading Register, said circuit extending from battery through the winding of relay 15A0, conductor A0, No. 5 contacts of

relay 5ST3, conductor A00, No. 1 contacts of relay 4RC, to ground through the reader contacts A0. Similarly, when the pins B1 and B7 pass through the registering perforation of the B digit "8" in the tape 4T, circuits are completed for relays 16B1 and 16B7 of the B-Digit Reading Register, the circuit of relay 16B1 extending from battery through the winding of said relay, conductor B1, No. 5 contacts of relay 4RC, reader contacts B1, to ground; the circuit of relay 16B7 may be traced from battery through the winding of said relay, conductor B7, No. 8 contacts of relay 4RC, reader contacts B7, to ground. Similarly, when the sensing pins C0 and C1 pass through the registering perforations of the C digit "1" in the tape 4T, circuits are closed for relays 16C0 and 16C1 of the C-Digit Reading Register, the circuit of relay 16C0 extending from battery through the winding thereof, conductor C0, No. 9 contacts of relay 4RC, the reader contacts C0, to ground; the circuit of relay 16C1 may be traced from battery through the winding thereof, conductor C1, No. 10 contacts of relay 4RC, reader contacts C1, to ground. Also, when the sensing pins D4 and D7 pass through registering perforations of the D digit "0" in the tape 4T, circuits are closed for relays 17D4 and 17D7 of the D-Digit Reading Register; the circuit of relay 17D4 being traced from battery through the winding thereof, conductor D4, No. 17 contacts of relay 4RC, reader contacts D4, to ground; the circuit of relay 17D7 being traced from battery through the winding of said relay, conductor D7, No. 18 contacts of relay 4RC, reader contacts D7, to ground. Also, when the sensing pins E0 and E1 pass through registering perforations of the E digit "1," circuits are closed for relays 17E0 and 17E1 of the E-Digit Reading Register; the circuit of relay 17E0 being traced from battery through the winding thereof, conductor E0, No. 19 contacts of relay 4RC, reader contacts E0, to ground; the circuit of relay 17E1 being traced from battery through the winding thereof, conductor E1, No. 20 contacts of relay 4RC, reader contacts E1, to ground. In the same manner, when the sensing pins F4 and F7 pass through the registering perforations of the F digit "0" in the tape 4T, circuits are closed for relays 18F4 and 18F7; the circuit of said relay 18F4 being traced from battery through the winding of said relay, conductor F4, No. 27 contacts of relay 4RC, reader contacts F4, to ground; the circuit of relay 18F7 being traced from battery through the winding of said relay, conductor F7, No. 28 contacts of relay 4RC, reader contacts F7, to ground. Thus as a result of the sensing pins A0 . . . F7 selectively sensing the first line "081010" of the splice pattern, relays 15A0, 16B1, 16B7, 16C0, 16C1, 17D4, 17D7, 17E0, 17E1, 18F4 and 18F7 of the Digit Reading Registers are operated.

A circuit is thereupon completed for relay 18CK which extends from battery through the winding of said relay, contacts of relay 18GT, No. 6 front contacts of relay 18F7, No. 5 front contacts of relay 18F4, No. 6 back contacts of relay 18F2, No. 7 back contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 back contacts of relay 17E7, No. 7 back contacts of relay 17E4, No. 8 back contacts of relay 17E2, No. 7 front contacts of relay 17E1, No. 7 front contacts of relay 17E0, No. 6 front contacts of relay 17D7, No. 4 front contacts of relay 17D4, No. 5 back contacts of relay 17D2, No. 6 back contacts of relay 17D1, No. 6 back contacts of relay 17D0, conductor UC2, No. 1 back contacts of relay 16C7, No. 2 back contacts of relay 16C4, No. 3 back contacts of relay 16C2, No. 2 front contacts of relay 16C1, No. 1 front contacts of relay 16C0, No. 1 front contacts of relay 16B7, No. 1 back contacts of relay 16B4, No. 2 back contacts of relay 16B2, No. 1 front contacts of relay 16B1, No. 1 back contacts of relay 16B0, conductor UC3, No. 8 back contacts of relay 26AL, conductor UC4, No. 29 contacts of relay 4RC, conductor UC, front contacts of relay 15RKB, conductor G2, to ground on contact G2. Relay 18CK operates.

It should be noted that the circuit path for relay 18GT is controlled through the back contacts of relay 18CK to ground on the reader contacts J6 over conductor J6. The circuit of relay 18GT constitutes a "guard" which insures that the selective penetration by the sensing pins A0 . . . F7 of the holes in a line of the tape 4T being analyzed does not take too long a portion of the reading cycle. Hence the circuit is so arranged that a certain predetermined time interval is allowed for the sensing pins to penetrate the holes and cause the operation of the involved relays in each of the Digit Reading Registers, and further cause the operation of relay 18CK, all as above described. As indicated on the chart of Fig. 101, contacts J6 close approximately .009 second after the reader contacts close, and consequently will remain closed for the same interval after the termination of the reading cycle. Therefore, the sensing of the line of perforation begins before contacts J6 close and relay 18CK should have operated before relay 18GT can operate. However, if relay 18GT does operate, nothing occurs during the particular reading cycle in which it is operated, and it may be that on the succeeding reading cycle, or cycles, relay 18CK will operate, thereby indicating that the reading relays of the Digit Register have operated in time, in which event the tape 4T will be advanced to the next line, as subsequently described. However, if repeated sensing of the same line produces the same result, that is, produces an operation of relay 18GT before relay 18CK has operated, the circuit will fail to progress and ultimately will operate an alarm, as will be subsequently described.

The operation of relay 18CK, as will have been noted, is dependent upon the operation of two relays in each of the five Digit Reading Registers B to F, inclusive. Since each of the digits B to F, inclusive is represented on the tape 4T in the two-out-of-five code by two perforations in the five perforating positions reserved for each of said digits, and since those perforations, if correctly sensed, will cause the operation of the corresponding two-out-of-five relays in each of the Digit Reading Registers, the above checking arrangement insures a positive guard against the operation, for any reason, of more or less than two relays in each of the registers. For if more or less than two relays operate in each of the registers, the above-traced check path over which relay 18CK operates will not close, thereby suspending further operations and causing an alarm to be given, as will be subsequently described.

Assuming, however, that relay 18CK does operate, thereby indicating the successful sensing of the line of the splice pattern, a circuit is completed for relay 26SSL, the path of which may be traced from battery through the winding of said relay, conductor SSL, No. 3 contacts of relay 15A0, conductor SSL1, No. 6 back contacts of relay 18TIE, front contacts of relay 18CK, conductor J6, reader contacts J6, to ground. Relay 26SSL operates, locks over its No. 1 contacts to ground on the No. 1 contacts of relay 26ESP, and completes a circuit for relay 27RS, the path of which extends from battery through the winding of relay 27RS, conductor RS10, No. 2 contacts of relay 26ESP, No. 2 contacts of relay 26SSL, conductor RS11, No. 2 contacts of relay 18F0, No. 2 contacts of relay 18F1, conductor RS12, No. 2 contacts of relay 15A2, No. 3 contacts of relay 15A1, and thence to ground as previously traced over conductors UC3, UC4, UC to ground on conductor G2. Relay 27RS operates, locks over its No. 2 contacts, conductor H3, to ground on the reader contacts H3 (during the open period of the reading cycle), applies ground on reader contacts K7 and conductor K7 (during the closed period of the reading cycle) over its No. 5 contacts to conductor RSC, thereby to complete the circuit of relay 15RZ3 which, upon operating, initiates the above-described cycle of circuit operations in the Reader Step-check circuit by which, if the reader drum 4D successfully advances one step as described below, conductor

UC is switched out of connection with conductor G2 and into connection with conductor G1; over its No. 3 contacts it grounds conductor CT thereby to complete a circuit for relay 26CT over the No. 4 contacts of relay 15A0, conductor CT1, No. 3 contacts of relay 26SSL, winding of relay 26CT to battery, causing said relay to operate and cancel time for operating an alarm device as subsequently set forth, and over its No. 6 back contacts opens the previously traced circuit for the reader step magnet 4STEP which, upon releasing, causes drum 4D automatically to be advanced one step by the cam 4C, thereby to advance the tape 4T to the next line of the splice pattern, and causing contacts G1 repetitively to close and ground conductor G1. When, at the end of the closed period of the sensing cycle, the sensing fingers A0 . . . F7 are withdrawn from the perforations in the tape that constitute the line of the splice pattern which has been sensed, the relays in the various Digit Reading Registers which were operated as a result of the sensing of said line are released, in consequence of which relay 18CK is also released.

When the open period of the sensing cycle comes to an end, contacts H3 are opened and ground is thereby removed from conductor H3, thus causing relay 27RS to release, in turn releasting relay 26CT, and reclosing the previously described circuit for step magnet 4STEP whereupon said magnet reoperates to hold the drum 4D in a stationary position with the tape 4T advanced to the next line of the splice pattern. The sensing of said next line of the splice pattern then takes place in the same manner as already described for the first line, whereupon the relays of the Digit Reading Registers are reoperated in the same manner as before to cause the operation of relay 18CK, except that in this case and since ground is now applied to conductor G1, the ground for operating said relay is now applied to conductor UC from conductor G1 over the back contacts of relay 15RKA instead of from conductor G2 over the front contacts of relay 15RKB. The previously described circuit of relay 27RS is then reclosed to reoperate relay 26CT to cancel timing, and to release the step magnet 4STEP, thereby to cause the drum 4D to advance the tape T to the next line of the splice pattern.

Each line of the splice pattern is thus sensed in the manner indicated, and the tape T is advanced in consequence thereof to the next line until the entire splice pattern has thus been processed.

3. *Checking tape identity entries*

It will be noted from Fig. 100 that following the splice pattern entries are nine (9) entries which, collectively, designate the identity of the tape and are known as the "tape identity entries." Certain of these nine entries (in the E and/or F digits thereof) correspond, respectively, to certain terminal positions on the set-up switches shown in Figs. 6 and 7, the brushes of which, before the processing of the tape 4T is initiated, are manually brought into engagement with terminals on the several switch arcs which correspond to the digits of said entries. The digits in the tape identity entries which correspond to the terminal positions of certain of the set-up switches in the given example are underscored in the sample tape shown in Fig. 90. As pointed out in the previous section, the reason for providing the set-up switches and for adjusting them into correspondence with certain of the digits in the tape identity entries is to make certain that the tape 4T which is being processed is the one that it is intended to be processed.

3.1. *Tape Type Entry—first line*

The first of the "tape identity" entries which appears on the tape T following the last line of the splice pattern is an entry which identifies the "type" of tape, that is, whether the tape is a Toll tape, or a Message Unit tape, or an Observing tape, etc. Since there are five (5) different tapes with which the machine of the present invention is designed to operate, each of said tapes is separately identified in respect to its type by a "tape index" digit in the fifth or E digit of the entry. All of the nine tape identity entries have the same A, B and C digits, namely, "289"; the "tape index" entry is identified by the value "1" in the D digit for all five tapes, while each of the five separate tapes is, as previously noted, distinctly characterized by a special value of the E digit. The specific values of the various digits in each line of the tape identify entries for all tapes is shown in Table I given below, the numbers on the line with the "Group Entries" representing the digits across the tape, and where "X" is "0."

TABLE I.—TAPE IDENTIFICATION

Tape Identity Group Entries	ABCD	Toll EF	Message Unit Detail EF	Observing EF	Detail EF	Summary EF	All Tapes EF	Set-up Switches	Used in Output
Month	2899						TU	TU	√.
Tape Section and Round	2898						XR	Round	√ (Summary only).
Days of Round	2897						XX		
Thousands Range	2896						90		
Office	2895						I*O	Office*	√ (Summary only).
Last Recorder No	2894	TU	TU	TU	TU	90		TU	
First Recorder No	2893	TU	TU	TU	TU	90		TU	
Marker Group	2892						TU	TU	√.
Tape Index	2891	2X	3X	4X	5X	17		Tape Type	√.
								11 Switches Total.	

*If a toll, message unit detail, observing or detail tape contains calls for more than one office this digit 0 and the office set-up switch is in the "off" position. If a summary tape, set-up switches are set for the particular office represented on the tape.

X=any value—not checked.
T=tens digit as set up on corresponding switch—checked.
U=units digit as set up on corresponding switch—checked.
I=office index as set up on office switch—checked.
R=round value as set up on round switch—checked.

In the case of the Toll tape the E digit is a "2." The F digit may be any value though generally where no digital value is required in any one of the digital spaces of an entry, said space is given the value "0," the reason being that a space cannot be left a blank since, if it is a blank, there would be no response, on the sensing of the entry, of the involved Digit Reading Register, thereby causing a failure of relay 18CK to operate. Hence the tape index entry of the Toll tape with which the operation of the invention is being illustrated consists of the number "289120," and this is the entry to which the tape 4T, assumed to be a Toll Tape, is advanced for sensing by the sensing pins A0 . . . F0 after the last line of the splice entry has been sensed, and for which the tape identity switch 6TT is set on terminal 2.

When the sensing pins A0 . . . F7 impinge upon the tape index entry, and remembering that each of the digits B to F, inclusive, has been recorded on the tape 4T by perforations in the two-out-of-five code, while the A digit is represented by one perforation, the sensing of the entry will cause the selective operation of one relay in the A-Digit Reading Register, and two relays in each of the other Reading Registers B to F, inclusive. The relays which are operated in response to the tape index line 289120 are relays 15A2, 16B7, 16B1, 16C7, 16C2, 17D1, 17D0, 17E2, 17E0, 18F7 and 18F4.

The circuits of relays 16B7, 16B1, 17E0, 18F7 and 18F4 have been previously traced in connection with the sensing of a line of the splice pattern. The circuits of other relays in the Digit Reading Registers which are operated in response to the sensing of the tape index entry are traced as follows: The circuit of relay 15A2 may be traced from battery through the winding of relay 15A2, conductor A2, No. 3 contacts of relay 5ST3, conductor A21, No. 3 contacts of relay 4RC, to ground on the reader contacts A2; the circuit of relay 16C2 may be traced from battery through the winding of said relay, conductor C2, No. 11 contacts of relay 4RC, reader contacts C2, to ground; the circuit of relay 16C7 may be traced from battery through the winding of said relay, conductor C7, No. 13 contacts of relay 4RC, reader contacts C7, to ground; the circuit of the relay 17D0 may be traced from battery through the winding of said relay, conductor D0, No. 14 contacts of relay 4RC, reader contacts D0, to ground; the circuit of relay 17D1 may be traced from battery through the winding of said relay, conductor D1, No. 15 contacts of relay 4RC, reader contacts D1, to ground; the circuit of relay 17E2 may be traced from battery through the winding of said relay, conductor E2, No. 21 contacts of relay 4RC, reader contacts E2 to ground.

With the operation of two relays in each of the B to F Digit Reading Registers, inclusive, in accordance with the two-out-of-five code, and the operation of relay 15A2 in the A-Digit Reading Register, a circuit is completed for relay 2L1 in the Tape Identity Progress Circuit, the path of which may be traced from battery through the winding of said relay, No. 3 contacts of relays 2CL1, 2CL2, 2CL3, 1CL4, 1CL5, 1CL6, 1CL7, No. 4 contacts of relay 1CL8, conductor L1, No. 2 contacts of relay 17D0, No. 2 contacts of relay 17D1 (thereby checking that these two relays, registering the special index digit "1," have in fact been operated), conductor LL3, No. 2 back contacts of relay 18TIE, conductor LL4, No. 5 back contacts of relay 15A0, No. 4 back contacts of relay 15A1, No. 4 contacts of relay 15A2, conductor LL5, No. 4 contacts of relay 16B1, No. 4 contacts of relay 16B7 (thereby checking that these two relays, registering the B digit "8," have operated), No. 5 contacts of relay 16C2, No. 6 contacts of relay 16C7 (thereby checking that these two relays, registering the C digit "9," have operated), conductor LL6, No. 1 contacts of relay 18TIE, back contacts of relay 18GT, No. 6 front contacts of relay 18F7, No. 5 front contacts of relay 18F4, No. 6 back contacts of relay 18F2, No. 7 back contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 back contacts of relay 17E7, No. 7 back contacts of relay 17E4, No. 7 front contacts of relay 17E2, No. 7 back contacts of relay 17E1, No. 7 front contacts of relay 17E0, No. 6 back contacts of relay 17D7, No. 5 back contacts of relay 17D4, No. 7 back contacts of relay 17D2, No. 7 front contacts of relay 17D1, No. 6 front contacts of relay 17D0, conductor UC2, No. 1 front contacts of relay 16C7, No. 1 back contacts of relay 16C4, No. 1 front contacts of relay 16C2, No. 1 back contacts of relay 16C1, No. 1 back contacts of relay 16C0, No. 1 front contacts of relay 16B7, No. 1 back contacts of relay 16B4, No. 2 back contacts of relay 16B2, No. 1 front contacts of relay 16B1, No. 1 back contacts of relay 16B0, conductor UC3, No. 8 back contacts of relay 26AL, conductor UC4, No. 29 contacts of relay 4RC, conductor UC, to ground on conductor G1 or G2, depending upon which of said conductors is grounded, as previously described. Relay 2L1 operates and locks over its No. 6 contacts, conductor L1, to operating ground on conductor G1 or G2.

With relay 2L1 operated, a circuit is completed for relay 27RS over a path which extends from battery through the winding of said relay, conductor RS, No. 7 contacts of relay 18TIE, conductor RS1, No. 4 contacts of relay 2L1, conductor RS2, terminal 2 and brush 2 of switch 6TT (which, it will be remembered, was set to the terminal 2 for the E digit "2" of the tape index entry for a Toll tape), conductor RS3, No. 3 contacts of relay 2L1, conductor RS4, brush 1 and terminal 2 of switch 6TT, conductor E12, No. 4 contacts of relay 17E0, No. 3 contacts of relay 17E2 (thereby checking that the valve "2" for the E digit as registered agrees with the setting 2 of the set-up switch 6TT), conductor RS6, No. 1 contacts of relay 2L1, conductor RS7, back contacts of relay 18GT, thence as previously traced through the F-Digit Reading Register for the "0" digit, conductor UC1, No. 7 back contacts of relay 17E7, No. 7 back contacts of relay 17E4, No. 7 front contacts of relay 17E2, No. 7 back contacts of relay 17E1, No. 7 front contacts of relay 17E0, No. 6 back contacts of relay 17D7, No. 5 back contacts of relay 17D4, No. 7 back contacts of relay 17D2, No. 7 front contacts of relay 17D1, No. 6 front contacts of relay 17D0, conductor UC2, No. 1 front contacts of relay 16C7, No. 2 back contacts of relay 16C4, No. 2 front contacts of relay 16C2, No. 1 back contacts of relay 16C1, No. 1 back contacts of relay 16C0, No. 1 front contacts of relay 16B7, No. 1 back contacts of relay 16B4, No. 2 back contacts of relay 16B2, No. 1 front contacts of relay 16B1, No. 1 back contacts of relay 16B0, conductor UC3 and thence as previously traced to ground on conductor G1 or G2. Relay 27RS operates, locks to previously traced ground on reader contacts H3 (available between closed periods of reading cycles), completes the previously traced circuit path for operating relay 26CT thereby to cancel alarm timing, opens the circuit of the step magnet 4STEP which releases to cause drum 4D to advance the tape 4T to the next line, which in this case is an entry, and closes a circuit for relay 2CL1, the path of which extends from battery through the winding of said relay, No. 3 contacts of relay 2CL9, No. 5 contacts of relay 2L1, conductor CL, No. 1 front contacts of relay 27RS, to ground. Relay 2CL1, on operating, locks over its No. 2 contacts serially through the No. 2 back contacts of relays 2CL2, 2CL3, 1CL4, 1CL5, 1CL6, 1CL7, No. 3 back contacts of relay 1CL8, conductor CLL, No. 5 contacts of relay 18TIE, conductor CLL1, No. 6 contacts of relay 5ST4 to ground, and completes a circuit for relay 68OD extending from ground through the No. 4 contacts of relay 2CL1, conductor TIR, No. 3 brush and No. 2 terminal of switch 6TT, conductor OD, winding of relay 68OD to battery. Relay 68OD operates, locks over its No. 15 contacts, conductor MON to ground on the No. 6 contacts of relay 5MON, and locally operates relays 68D and 69D from ground on its No. 14 contacts. Relays 68OD, 68D and 69D, though operated, perform no functions at this time, except that a circuit is completed for relay 81CIA of the card count circuit (Fig. 81) from ground on the No. 1 contacts of relay 5ST2, conductor ON, No. 1 contacts of relay 66ORL, No. 5 contacts of relay 76ERL, conductor CRL, No. 1 back contacts of relay 81C2B, No. 6 back contacts of relay 81C3B, conductor NCA, No. 3 contacts of relay 68OD, conductor C1A, No. 3 contacts of relay 81C1E, No. 3 contacts of relay 81C10, winding of relay 81C1A to battery. The latter relay operates and locks to operating ground over its No.

4 contacts, No. 5 contacts of relay 81C3A, No. 4 back contacts of relay 81C2A, conductor CRL, and to ground previously traced thereto. Relay 81C1A performs certain functions to be noted hereinafter. Another circuit is also closed for relay 80REG, extending from battery through the winding of said relay, conductor R, No. 9 contacts of relay 68OD, to ground. Relay 80REG operates but performs certain functions which are also pointed out hereinafter.

At this point it should be noted that if the tape being processed were a Message Unit Detail Tape for which the E digit of its tape index is "3," as noted in Table I, the brushes of the set-up switch 6TT would be set on their respective terminals 3, in which event the ground on the No. 4 contacts of relay 2CL1, effective over conductor TIR, would similarly cause the operation of relay 68OD, as would also be the case if the tape being processed were an Observing Tape for which the E digit of its tape index is "4," assuming of course that in the latter event the brushes of the set-up switch 6TT would be set on their respective terminals 4. If the tape being processed is a Detail Tape for which the E digit of its tape index is "5," and the brushes of the set-up switch 6TT are accordingly set on their respective terminals 5, the ground on the No. 4 contacts of relay 2CL1 would complete the circuit of relay 68ND over a path extending from said ground, conductor TIR, No. 3 brush and terminal 5 of switch 6TT, conductor ND, winding of relay 68ND, to battery, causing said relay to operate and locally pull up relays 68D and 69D over the former relay's No. 14 contacts.

If the tape being processed is a Summary Tape for which the E digit of its tape index is "1" and its F digit is "7," the brushes of switch TT would be set to their respective terminals "1," whereupon the ground on conductor TIR is effective to complete the circuit of relays 68IS and 69IS if the tape is an Individual Summary Tape or relays 68TS, 69TS, 70TS1 and 70TS2 if the tape is a Tens Summary Tape. In the former case, the arm of switch SM (Fig. 68) would be set on terminal 0, thereby causing the ground on conductor TIR to complete the circuit of relays 68IS and 69IS over the No. 3 brush and terminal 1 of switch TT, conductor S, brush of switch SM and terminal 0, winding of relay 68IS and 69IS to battery. In the latter case the brush of switch SM would be set on terminal 1, and the ground on conductor S would be effective over the brush of switch SM and terminal 1 to complete the circuit of relay 68TS to battery, relay 69TS to battery and relays 70TSO and 70TSE, to battery. The effect of the registration of the digit 7 in the F Digit Register for Summary Tapes will be described later in connection with the description of the processing of said tapes.

At the termination of the open period of the reading cycle, contacts H3 open and cause relay 27RS to release which, in turn, reestablishes the circuit of step magnet 4STEP, whereupon the drum 4D is held stationary on the next line of perforations to which the tape 4T was advanced by the release of said magnet.

3.2. *Marker group entry—second line*

The second entry of the tape identity group of entries is the "marker group" entry for which the value of the D digit is fixed at "2," as noted in Table I, the E and F digits defining the particular marker group, or building, containing the central office in which the tape 4T was produced. It is assumed for the purpose of this description that the number of marker groups is limited to one hundred and that, therefore, the digits E and F may have any values from 00 to 99. It will be further assumed that the marker group in which tape 4T was produced in area No. 00 and that, accordingly the E and F digits of the marker group entry will be 00, and that, in correspondence therewith, the brushes of the marker group tens switch 6MGT are set to their respective terminals 0 and the brushes of the marker group units switch 7MGU are set to their respective terminals 0. Thus the marker group entry on the tape 4T will consist of the number "289200" and the marker set-up switches 6MGT and 7MGU are accordingly positioned terminal positions 00, respectively.

The sensing of the marker group entry in the manner previously described for the skip splice pattern entries and the tape index entry will cause the relays in the various Digit Reading Registers to be selectively operated as follows: the sensing of the A digit perforations results in the operation of relay 15A2 over a previously described circuit; the sensing of the B digit perforations results in the operation of relays 16B7 and 16B1 as before described; the sensing of the C digit perforations results in the operation of relays 16C7 and 16C2 also as before described; the sensing of the D digit perforations results in the operation of relays 17D0 and 17D2, the former relay over a previously described path, and the latter relay over a circuit which may be traced from battery through the winding of said relay, conductor D2, No. 16 contacts of relay 4RC, reader contacts D2 to ground; the sensing of the E digit perforations results in the operation of relays 17E7 and 17E4 over the following circuit paths: for relay 17E7 from battery through the winding of said relay, conductor E7, No. 23 contacts of relay 4RC, reader contacts E7, to ground; for relay E4 from battery through the winding of said relay, conductor E4, No. 22 contacts of relay 4RC, reader contacts E4 to ground; the sensing of the F digit perforations results in the operation of relays 18F7 and 18F4 over previously traced circuits.

With the above relays in the Digit Reading Registers operated, a circuit is closed for relay 2L2, extending from battery through the winding of said relay, No. 1 contacts of relay 2CL1, conductor L2, No. 3 contacts of relay 17D0, No. 2 contacts of relay 17D2 (thereby checking the marker group index "2"), conductor LL3, No. 2 contacts of relay 18TIE, conductor LL4, thence as previously traced to the back contacts of relay 18GT, No. 6 front contacts of relay 18F7, No. 5 front contacts of relay 18F4, No. 6 back contacts of relay 18F2, No. 7 back contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 front contacts of relay 17E7, No. 6 front contacts of relay 17E4, No. 6 back contacts of relay 18E2, No. 6 back contacts of relay 17E1, No. 7 back contacts of relay 17E0, No. 6 back contacts of relay 17D7, No. 5 back contacts of relay 17D4, No. 6 front contacts of relay 17D2, No. 7 back contacts of relay 17D1, No. 6 front contacts of relay 17D0, and thence as previously traced to ground on conductor G1 or G2. Relay 2L2 operates in the above circuit, locks over its No. 4 contact to operating ground over conductor L2, and completes the circuit of relay 27RS over a path which may be traced from battery through the winding of said relay, conductor RS, No. 7 contacts of relay 18TIE, conductor RS1, No. 2 contacts of relay 2L2, conductors RS8 and RS9, No. 5 contacts of relay 18F7, No. 4 contacts of relay 18F4, conductor F10, No. 1 brush and No. 0 terminal of set-up switch 7MGU (thereby checking the setting of the marker group units set-up switch 7MGU for the digit "0" against the same digit registered on the relays of the F-Digit Reading Register), conductor MGU, No. 3 contacts of relay 2L2, conductor MGT, No. 1 brush and terminal 0 of switch MGT (thereby checking the setting of the marker group tens set-up switch 6MGT for the digit "0" against the same digit registered on the relays of the E-Digit Reading Register), conductor E10, No. 5 contacts of relay 17E4, No. 6 contacts of relay 17E7 (thus checking the registration of the marker units digit 0 in the E-Digit Reading Register), conductor RS6, No. 1 contacts of relay 2L2, to ground. Relay 27RS operates and, as before, operates relay 26CT to cancel timing, opens the circuit of step magnet 4STEP which, upon releasing, enables the

drum 4D to advance the tape 4T to the next line, or entry, locks up as before to ground on the contacts H3 for the duration of the open period of the reading cycle and, further, completes the circuit for relay 2CL2, said circuit extending from battery through the winding of said relay, No. 5 contacts of relay 2L2, conductor CL, No. 1 contacts of relay 27RS, to ground. Relay 2CL2 operates, locks over its No. 2 front contacts serially through the No. 2 back contacts of relays 2CL3, 1CL4, 1CL5, 1CL6, 1CL7, No. 3 back contacts of relay 1CL8, conductors CLL, No. 5 contacts of relay 18TIE, conductor CLL1, to ground on the No. 6 contacts of relay 5ST4, and its No. 2 back contacts opens the locking circuit of relay 2CL1, which thereby releases. Relay 2CL2 completes the circuit for relay 24AMT0 in the group of ten relays 24A–MT0 . . . 24A–MT9 comprising the Calling Office Translator, said circuit extending from ground on the No. 4 contacts of relay 2CL2, conductor MGS, No. 2 brush and No. 0 terminal of the set-up switch 6MGT, conductor T0, winding of relay 24AMT0 to battery. Relay 24A–MT0 operates, locks over its No. 10 contacts to ground on conductor MON (applied thereto by the No. 7 contacts of relay 5MON) and closes ten paths to the windings of the one hundred relays 24A–COT000 . . . 24A–COT099, of which the ten relays 24A–COT000 . . . 24A–COT009 are operated from said ground on conductor MGS, No. 2 brush and terminal 0 of set-up switch 7MGU, conductor U0, No. 0 contacts of relay 24A–MT0, windings of relay 24A–COT000 . . . 24A–COT009, to battery. The latter relays operate, lock to ground on conductor MON over their respective No. 13 contacts and, with relay 24A–MT0 operated, serve with other equipment later to be described to decipher the name of the calling office. Had the marker group tens designation (E digit) been 1 . . . 9, the brushes of the set-up switch 6MGT would have been set to the corresponding and respective terminals, to cause the above circuit traced to the No. 2 brush of said switch to be completed to relays 24A–MT1 . . . 24A–MT9, respectively. Similarly, if the marker group units designation (F digit) had been 1 . . . 9, the brushes of the set-up switch 7MGU would have been set to the corresponding and respective terminals, to cause the above circuit traced to the No. 2 brush of said switch 7MGU to be completed over the appropriate relay 24A–MTX operated in response to the marker group tens digit, to the appropriate group of ten relays 25A–COT0XX . . . 25B–COT999 indicated by the value of the marker group units digit.

At the termination of the open period of the reading cycle, contacts H3 open and release relay 27RS which thereupon closes the circuit of the step magnet 4STEP thereby to hold the tape 4T to the next entry to which said tape was advanced by drum 4D on the release of relay 27RS, and releases relay 26CT to restart counting alarm time. The removal of ground on either contacts G1 or G2 in consequence of the step taken by drum 4D, similarly removes ground from all branches of the up-check lead UC, thereby to cause the release of the relays of the Digit Reading Registers, and further removes ground from conductor L2 with which it is connected, thereby to cause the release of relay 2L2, relay 2L1 having previously released on the removal of ground from conductor L1 at the termination of the tape-index check.

3.3. *First recorder number—third line*

The next entry after the marker group entry is that of the first recorder number the D digit for which is "3" as noted in Table I. As explained in the previous section, the various tapes in the central office are produced by a number of perforators, each of which has access to a group of trunks. Where there is a large number of perforators in an office, said perforators are themselves divided into groups of which the first and last designated for each group are recorded on the tape made by one of the perforators in that group, and successively re-recorded on the tapes subsequently produced from the original tape, including the Toll tape 4T which herein is assumed to be processed by the apparatus of the present invention.

It will be assumed that the group of perforators involved in this particular case is the group for which the first recorder thereof has the designation 03 and the last has the designation number 05. Consequently (and as shown in Fig. 100) the first recorder number entry will be "289303" and the last recorder number entry immediately following it will be "289405." Hence when the Toll tape 4T has been advanced to the first recorder number entry and the sensing pins A0 . . . F7 impinge upon the perforations that constitute the entry, the relays in the A, B and C Digit Reading Registers that were previously operated to register the digits "289" for each of the previous entries except the splice pattern are now reoperated. The D or fourth digit is now a "3," in consequence of which relays 17D2 and 17D1 will be operated in the D-Digit Reading Register; the E or fifth digit is "0," which results in the operation of relays 17E7 and 17E4 in the E-Digit Reading Register, while the F, or sixth digit, being a "3," results in the operation of relays 18F1 and 18F2 in the F-Digit Reading Register. The circuits of all of said relays except that of relay 18F1 have been previously traced. The circuit of said relay 17F1 may be traced from battery through the winding of said relay, conductor F1, No. 25 contacts of relay 4RC, contacts F1 to ground.

When the above relays have operated, a circuit is closed for relay 2L3 over a path which extends from battery through the winding of said relay, No. 1 contacts of relay 2CL2, conductor L3, No. 3 contacts of relay 17D1, No. 2 contacts of relay 17D2, conductor LL3, No. 2 contacts of relay 18TIE, conductor LL4, thence as traced to the No. 6 back contacts of relay 18F7, No. 6 back contacts of relay 18F4, No. 7 front contacts of relay 18F2, No. 7 front contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 front contacts of relay 17E1, No. 6 front contacts of relay 17E4, No. 6 back contacts of relay 17E2, No. 6 back contacts of relay 17E1, No. 7 back contacts of relay 17E0,, No. 6 back contacts of relay 17D7, No. 5 back contacts of relay 17D4, No. 6 front contacts of relay 17D2, No. 6 front contacts of relay 17D1, No. 6 back contacts of relay 17D0, conductor UC2, and thence as previously traced through the relays of the C and B Digit Reading Registers to ground on conductor G1 or G2. Relay 2L3 operates, locks to operating ground over conductor L3, and completes the circuit of relay 27RS, which circuit may be traced from battery through the winding of said relay, thence as previously traced to conductor RS1, No. 3 and No. 1 contacts of relay 2L3 to ground. Relay 27RS, upon operating, locks to ground on reader contacts H3, closes the circuit of relay 26CT to cancel alarm timing, opens the circuit of step magnet 4STEP to enable the drum 4D to advance the tape T to the next entry, and closes a circuit for relay 2CL3, the path of which extends from battery through the winding of said relay, No. 5 contacts of relay 2L3, conductor CL, to No. 1 contacts of relay 27RS, to ground as previously traced. Relay 2CL3, upon operating, locks to ground over its No. 2 front contacts to a previously traced ground on conductor CLL, applied thereto by the No. 6 contacts of relay 5ST4, and unlocks relay 2CL2 which releases. Upon the opening of contacts H3 at the termination of the open period of the reading cycle, relay 27RS unlocks, releases relay 26CT to cancel alarm timing, and reestablishes the circuit of step magnet 4STEP which reoperates to hold the drum 4D to the step to which it has advanced to bring the next entry on the tape T into position for sensing. When ground is removed from conductor G1 or G2, relay 2L3 releases.

3.4. *Last recorder number—fourth line*

The next entry is that of the last recorder number for which the basic digits are 2894 as noted in Table I, and the E and F digits have been assumed to be 05. The selective operation of the relays of the Digit Reading Registers, in response to the sensing of this entry, is the same as that for the sensing of the first recorder number entry above described, the circuit paths of the several involved relays in each of the registers having been previously detailed. Accordingly, when these relays have operated, a circuit is completed for relay 2L4, said circuit extending from battery through the winding of said relay, No. 1 contacts of relay 2CL3, conductor L4, No. 4 contacts of relay 17D0, No. 3 contacts of relay 17D4, conductor LL3, thence as traced to the No. 6 back contacts of relay 18F7, No. 6 front contacts of relay 18F4, No. 7 back contacts of relay 18F2, No. 7 front contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, thence as traced to the No. 6 back contacts of relay 17D7, No. 5 front contacts of relay 17D4, No. 6 back contacts of relay 17D2, No. 6 front contacts of relay 17D1, No. 6 back contacts of relay 17D0, conductor UC2 and thence as traced to ground on conductor G1 or G2. Relay 2L4 operates in the above circuit, locks to operating ground over conductor L4, and completes the circuit of relay 27RS over a path extending through the winding of said relay, thence as traced to conductor RS1, No. 3 and No. 2 contacts of relay 2L4, to ground. Relay 27RS operates, locks under the control of ground on contacts H3, reoperates relay 26CT to cancel alarm timing, opens the circuit of step magnet 4STEP which, upon releasing, enables the drum 4D to advance the tape 4T to the next entry, and completes a circuit path for relay 1CL4, said path extending from battery through the winding of said relay, conductor CL4, No. 5 contacts of relay 2L4, conductor CL, the No. 1 contacts of relay 27RS to ground, causing relay 1CL4 to operate, to lock over its No. 2 front contacts to previously traced ground on conductor CLL, and to open the locking circuit of relay 2CL3 which releases. At the end of the open period of the reading cycle, contacts H3 open, relay 27RS releases to reclose the circuit of the step magnet 4STEP which, on reoperating, holds the drum 4D to the next entry to which it advanced tape 4T, and to release relay 26CT thereby to begin alarm timing. When ground is removed from conductor G1 or G2, relay 2L4 releases.

3.5. *Calling office—fifth line*

The next or fifth entry is that of the office number for which the basic digits are 2895 as noted in Table I. This number is indicated by the value of the E digit of said line if the tape being processed contains call entries only from the office indicated by the digit. However, if the tape being processed contains call entries from other offices as well, which would be the usual case for any marker group, the E digit is given the value "0," the F digit being given the value "0" in all cases, and the set-up switch 6CO would be left in its "off" position. Assuming that the tape of the present example is one containing call entries from a plurality of offices, the fifth line would read 289500. Accordingly, when the sensing pins impinge upon tape 4T and selectively penetrate the perforations constituting the office entry, the relays of Reading Registers A to F, inclusive, will be selectively operated as before, and over circuits previously traced for the registration of the digits of the previous tape identity entries. When said relays have been operated, a circuit is completed for relay 1L5 over a path extending from battery through the winding of said relay, No. 1 contacts of relay 1CL4, conductor L5, No. 4 contacts of relay 17D1, No. 3 contacts of relay 17D4, conductor LL3, No. 2 contacts of relay 18TIE, thence as previously traced to the No. 6 front contacts of relay 18F7, No. 5 front contacts of relay 18F4, No. 6 back contacts of relay 18F2, No. 7 back contacts of relay 17F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 front contacts of relay 17E7, No. 6 front contacts of relay 17E4, No. 6 back contacts of relay 17E2, No. 6 back contacts of relay 17E1, No. 6 back contacts of relay 17E0, No. 6 back contacts of relay 17D7, No. 5 front contacts of relay 17D4, No. 6 back contacts of relay 17D2, No. 6 front contacts of relay 17D1, No. 6 back contacts of relay 17D0, conductor UC2, and thence as previously traced to ground on conductor G1 or G2. Relay 1L5 operates, locks over its No. 4 contacts to operate ground over conductor L5 and completes a circuit for relay 27RS, extending from battery through the winding of said relay as previously traced to conductor RS1, No. 3 contacts of relay 1L5, conductor O1, brush No. 1 and "off" terminal of the set-up switch 6CO, conductor OIX, No. 6 contacts of relay 1L5, conductor RS6, to ground on the No. 1 contacts of relay 1L5. Relay 27RS operates, locks under the control of the reader contact H3 until the end of the open period of the reading cycle, opens the circuit of the step magnet 4STEP thereby to release said magnet and enable the drum 4B to advance the tape 4T to the next entry, releases relay 26CT to cancel alarm timing, and completes a circuit for relay 1CL5 over a path which may be traced from battery through the winding of said relay, No. 5 contacts of relay 1L5, conductor CL, to ground on the No. 1 contacts of relay 27RS. Relay 1CL5 operates over the above circuit, locks over its No. 2 front contacts and the No. 2 contacts of relays 1CL6 and 1CL7, No. 3 back contacts of relay 1CL8, to previously traced ground on conductor CLL. It will be noted that the ground on the No. 4 contacts of relay 1CL5 is applied over conductor OIR to the No. 2 brush of the set-up switch 6CO. Since the brushes of the switch are in the "off" position due to the fact that the tape being processed is a multioffice tape, the ground is ineffective. However, if the tape were for a single office and for a Summary Tape in that office, the E digit of the fifth line would contain a value designating the office, the brushes of the switch 6CO would be set to the terminal corresponding to the value of the digit, and the above-mentioned ground would be effective over the No. 2 brush of switch 6CO and the terminal corresponding in designation to the value of the E digit, to complete the circuit of the appropriate one of the ten relays 13OIOA . . . 13OI9A over the contacts of relay 13OI which will be operated for the processing of a Summary Tape, as will be later explained. Relay 1CL5, upon operating, further releases relay 1CL4.

Upon the termination of the open period of the reading cycle, when ground is removed from reader contacts H3, relay 27RS is released, causing thereby a reclosure of circuit of step magnet 4STEP, thereby to hold the drum 4D to the next position to which the drum (and tape 4T) were advanced upon the release of said relay, and releasing relay 26CT, thereby to begin once more the alarm timing. When ground is removed from conductor G1 or G2, relay 1L5 releases.

3.6. *Thousands range—sixth line*

The next entry in the tape T is the "thousands range" entry. For one tape which is to be processed by one machine, it has the fixed numerical value "289690" where the digits 2896 are fixed for the entry as noted in Table I, and the E and F digits discriminate between a tape which is to be processed by one machine and a tape which is to be processed by a plurality of machines. This entry, therefore, is of significance only when the call load on the tape 4T is so heavy that, in order to speed up processing by having different machines handle different portions of the load, the call entries are split into various thousands in accordance with the thousands digit of the subscribers' directory numbers. Where there is no split, and one machine is to handle all processing as we are assuming in the present example, the arbitrary designa-

tion "90" is entered in the E and F digit positions of the entry.

In response to the sensing of the entry "289690," the relays of the Reading Registers A to F, inclusive, are selectively operated as before and over previously described paths, and when said relays are operated, a circuit is completed for relay 1L6, the path of which extends from battery through the winding of said relay, No. 1 contacts of relay 1CL5, conductor L6, No. 3 contacts of relay 17D2, No. 3 contacts of relay 17D4, thence as previously traced to the No. 6 front contacts of relay 18F7, No. 5 front contacts of relay 18F4, No. 6 back contacts of relay 18F2, No. 7 back contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 front contacts of relay 17E7, No. 6 back contacts of relay 17E4, No. 6 front contacts of relay 17E2, No. 6 back contacts of relay 17E1, No. 7 back contacts of relay 17E0, No. 6 back contacts of relay 17D7, No. 5 front contacts of relay 17D4, No. 5 front contacts of relay 17D2, No. 6 back contacts of relay 17D1, No. 6 back contacts of relay 17D0, and thence as traced to ground on conductors G1 or G2. Relay 1L6 operates in this circuit, locks to operating ground on conductor L6, and completes a circuit for relay 27RS, said circuit extending from battery through the winding of said relay, thence as traced to conductor RS1, No. 2 contacts of relay 1L6, conductor RS8, conductor RS9, No. 5 contacts of relay 18F7, No. 4 contacts of relay 18F4, conductor F10, No. 3 contacts of relay 1L6, conductor E9, No. 5 contacts of relay 17E2, No. 6 contacts of relay 17E7, conductor RS6, No. 1 contacts of relay 1L6, to ground. Relay 27RS operates in this circuit, locks to ground on conductor H3, operates relay 26CT to cancel alarm timing, releases step magnet 4STEP which enables drum 4D to advance the tape 4T to the next entry, and closes a circuit for relay 1CL6, the path of which extends from battery through the winding of said relay, No. 5 contacts of relay 1L6, conductor CL, No. 1 contacts of relay 27RS, to ground. Upon operating, relay 1CL6 locks over its No. 2 contacts to previously traced ground on conductor CLL, and opens the locking circuit of relay 1CL5 which releases. At the termination of the open period of the reading cycle, ground is removed from conductor H3, thereby releasing relay 27RS which, in turn, releases relay 26CT to begin alarm timing, and reestablishes the circuit of the step magnet 4STEP which thereupon operates to hold the drum 4D stationary in the next step to which it has advanced the tape 4T. The subsequent removal of ground from conductor G1 or G2 releases relay 1L6 and, of course, the relays of the Reading Registers.

3.7. *Days of round—seventh line*

The next or seventh entry is that of the "days of round," which, as explained in the previous section, means the days of some particular round (designated in the succeeding entry) for which the calls appear on the tape 4T. Thus if the E and F digits of the days of round entry are 3 and 4, respectively, it means that the calls recorded on the tape 4T being analyzed are those of the third and fourth day of the "round" the number of which is indicated in the succeeding entry. The entry of the days of the round has the basic digits A, B, C and D fixed permanently at "2897" as noted in Table I, and if the E and F digits are 3 and 4, respectively, to indicate the days of the "round" number appearing in the next entry, the entry will consist of the six digits "289734," as here assumed.

Upon the sensing of the entry "289734," the relays of the A . . . F Reading Registers, inclusive, will be selectively operated as before and over circuit paths previously traced for all relays except for the relay 18F0, the circuit for which has not yet been traced, and which traces from battery through the winding of said relay, conductor F0, No. 24 contacts of relay 4RC, reader contacts F0, to ground. Upon the operation of said relays, a circuit path is completed for relay 1L7, which extends from battery through the winding of said relay, No. 1 contacts of relay 1CL6, conductor L7, No. 5 contacts of relay 17D0, No. 5 contacts of relay 17D7, conductor LL3, thence as previously traced to the No. 6 back contacts of relay 18F7, No. 6 front contacts of relay 18F4, No. 7 back contacts of relay 18F2, No. 8 back contacts of relay 18F1, No. 7 front contacts of relay 18F0, conductor UC1, No. 7 back contacts of relay 17E7, No. 7 back contacts of relay 18E4, No. 7 front contacts of relay 17E2, No. 6 front contacts of relay 17E1, No. 7 back contacts of relay 17E0, No. 6 front contacts of relay 17D7, No. 4 back contacts of relay 17D4, No. 6 back contacts of relay 17D2, No. 7 back contacts of relay 17D1, No. 6 front contacts of relay 17D0, thence as traced to ground on conductor G1 or G2. Relay 1L7 operates in the above circuit, locks to operating ground over conductor L7, and completes a circuit for relay 27RS, said circuit extending from battery through the winding of said relay, thence as traced to conductor RS1, No. 3 and No. 1 contacts of relay 1L7, to ground. Relay 27RS operates, locks to ground on conductor H3, closes the circuit of relay 26CT which operates to cancel alarm timing, opens the circuit of step magnet 4STEP which, upon releasing, enables the drum 4D to advance the tape 4T to the next entry, and closes a circuit for relay 1CL7, said circuit extending from battery through the winding of said relay, No. 5 contacts of relay 1L7, conductor CL, No. 1 contacts of relay 27RS, to ground. Relay 1CL7, upon operating, locks over its No. 2 contacts to previously traced ground on conductor CLL, and opens the locking circuit of relay 1CL6 which releases. Upon the termination of the open period of the reading cycle when contacts H3 open, relay 27RS releases to release relay 26CT which thereupon begins again to measure alarm timing, and to reestablish the circuit of step magnet 4STEP, thereby to hold the tape 4T to the next entry to which said tape was advanced by said drum 4D upon the previous release of said magnet. The removal of ground from conductor G1 or G2 then releases relay 1L7 and, of course, the operated relays in the A . . . F Reading Registers.

3.8. *Tape section and round—eighth line*

The next or eighth entry is that of the Tape Section and Round, which, as previously explained, identifies the particular round within the billing month. This entry has the four basic digits "2898" as noted in Table I, the E digit of which may be any value and hence assumed to be "0," while the F digit identifies the numerical indication of the particular round, which herein will be assumed to be the first round and therefore having the value "1." Accordingly, the entire "tape section and round" entry will consist, as an example, of the six digits "289801." For this entry, the set-up switch 7RO is provided, and the brushes of the latter will be set to their respective No. 1 terminals.

Upon the sensing of the entry "289801" the relays of the A . . . F Reading Registers will be selectively operated as for previous entries and over circuits previously traced. When said relays are operated, a circuit is closed for relay 1L8 over a path extending from battery through the winding of said relay, No. 1 contacts of relay 1CL7, conductor L8, No. 5 contacts of relay 17D1, No. 5 contacts of relay 17D7, conductor LL3, thence as previously traced to the No. 6 back contacts of relay 18F7, No. 6 back contacts of relay 18F4, No. 8 back contacts of relay 18F2, No. 8 front contacts of relay 18F1, No. 7 front contacts of relay 18F0, conductor UC1, thence as traced to the No. 6 front contacts of relay 17D7, No. 4 back contacts of relay 17D4, No. 6 back contacts of relay 17D2, No. 6 front contacts of relay 17D1, No. 6 back contacts of relay 17D0, and thence as previously traced to ground on conductor G1 or G2. Relay 1L8 operates

over this circuit, locks to operating ground over conductor L8, and completes an operating path for relay 27RS, said path extending from battery through the winding of said relay, to conductor RS1 as previously traced, No. 2 contacts of relay 1L8, conductor RS8, conductor RS9, No. 3 contacts of relay 18F1, No. 3 contacts of relay 18F0, conductor F11, No. 1 terminal and No. 1 brush of the round set-up switch 7RO, conductor R, No. 3 and No. 1 contacts of relay 1L8, to ground, thus checking the value of the F digit against the setting of switch 7RO. Relay 27RS operates, locks to ground on conductor H3, completes the circuit of relay 26CT which operates to cancel alarm timing, opens the circuit of the step magnet 4STEP which releases to advance the tape 4T to the next entry, and completes a circuit for relay 1CL8, said circuit extending from battery through the winding of said relay, No. 5 contacts of relay 1L8, conductor CL, No. 1 contacts of relay 27RS, to ground. Relay 1CL8 operates, locks over its No. 3 contacts to previously traced ground on conductor CLL, and opens the locking circuit of relay 1CL7 which releases. Over its No. 5 contacts, relay 1CL8 completes a circuit for relay 21OR, extending from ground on said contacts, conductor RR, brush No. 2 and terminal No. 1 of set-up switch 7RO, conductor OR, winding of relay 21OR to battery. Relay 21OR operates and locks over its No. 7 contacts to ground on conductor MON.

It should be noted in this connection that the invention is adaptable for operation either with accounting centers the offices of which are computed on six rounds per month or those which are computed on ten rounds per month. If the machine is to be used in an accounting area operating on a six-rounds-per-month basis then the conductor on terminal 5 of the No. 2 arc of switch 7RO is connected to the No. 9 terminal, and both terminals are connected to conductor LR. In this event, if the round recorded is 1 . . . 4, relay 21OR would be operated as above described. On the other hand, if the round recorded is the last or round 5, the circuit would be completed over conductor LR to relay 21LR which would operate and lock to ground on conductor MON. If the machine is used in an area which operates on a ten-rounds-per-month basis, then the terminal 5 would be strapped to conductor OR. In this event, relay 21OR will operate if the round recorded is 0 . . . 8, and relay 21LR will operate if the round recorded is the last or round 9.

Upon the termination of the reading cycle, when ground is removed from conductor H3, relay 27RS releases to release relay 26CT which thereupon begins to measure alarm timing and to reestablish the circuit of step magnet 4STEP which operates to hold the tape 4T to the next and last of the tape identity entries to which said tape was advanced by drum 4D on the previous release of said relay. When ground is removed from conductor G1 or G2, relay 1L8 releases, as do the relays of the Digit Reading Registers.

3.9. *Month—ninth line*

The next and last of the tape identity entries is the record of the month. This entry has the four basic digits "2899" as noted in Table I. The month of the year is designated by a "0" or "1" in the E digit, and by any one of the values from "0" to "9" in the F digit, depending upon the month. It will be assumed that the month is April, and that, accordingly, the designation of the month will be by the digits "03." The entire entry, therefore, will consist of the number "289903" in the given example of the tape shown in Fig. 100, for which the month tens set-up switch 7MT will be set to terminals 0, and the month units set-up switch 7MU will be set to terminals 3.

Upon the sensing of the month entry, the relays of the Reading Registers A . . . F will be selectively operated as before and over previously traced paths, whereupon a circuit is completed for relay 1L9 over a path that extends from battery through the winding of said relay, No. 2 contacts of relay 1CL8, conductor L9, No. 4 contacts of relay 17D2, No. 5 contacts of relay 17D7, conductor LL3, thence as previously traced to the No. 6 front contacts of relay 17D7, No. 4 back contacts of relay 17D4, No. 5 front contacts of relay 17D2, No. 6 back contacts of relay 17D1, No. 6 back contacts of relay 17D0, thence as previously traced to ground on conductor G1 or G2. Relay 1L9 operates in this circuit, locks over its No. 4 contacts to operating ground on conductor L9, and completes a circuit for relay 27RS, which extends from battery through the winding of said relay, thence as previously traced to conductor RS1, No. 2 contacts of relay 1L9, conductors RS8 and RS9, No. 3 contacts of relay 18F2, No. 4 contacts of relay 18F1, conductor F3, No. 3 terminal and No. 1 brush of the month units set-up switch 7MU, conductor MU, No. 3 contacts of relay 1L9, conductor MT, No. 0 terminal and No. 1 brush of the month tens set-up switch 7MT, conductor E10, No. 5 contacts of relay 17E4, No. 6 contacts of relay 17E7, conductor RS6, No. 1 contacts of relay 1L9, to ground. Relay 27RS operates, locks to ground on conductor H3, completes the circuit of relay 26CT which operates to cancel alarm timing, opens the circuit of the step magnet 4STEP which releases to advance the tape 4T to the next line of perforations, and closes the circuit of relay 2CL9, said circuit extending from battery through the winding of said relay, conductor CL9, No. 5 contacts of relay 1L9, and thence as previously traced to ground on the No. 1 contacts of relay 27RS. Relay 2CL9 operates, locks over its No. 2 contacts and conductor J3 to contacts J3 which, as shown from the timing chart on Fig. 101, are closed during the open period of the sensing cycle, and completes a circuit for relay 18TIE, which circuit extends from ground on the No. 1 contacts of relay 1CL8, conductor CL2, No. 1 contacts of relay 2CL9, conductor TIE, winding of relay 18TIE, to battery. The latter relay operates and locks over its No. 3 contacts, conductor TIEL, No. 7 back contacts of relay 2L1, conductor MON, ground on the No. 11 contacts of relay 5MON. Relay 18TIE performs certain functions that will be described later on. Over its No. 4 contacts, relay 2CL9 further completes the circuit of relay 20APR, said circuit being traced from ground on said contacts, conductor MR, No. 3 terminals and No. 2 brush of set-up switch 7MU, conductor APR, winding of relay 20APR, to battery. Relay 20APR operates and locks over its No. 6 contacts to ground on conductor MON.

It will be observed that the month Tens switch 7MT has two positions; namely, a position "0" and a position "1." Both the above switch and the Months unit switch 7MU are respectively set in accordance with the tens and units numerical indication of the calendar month; for instance, "00" for January, "01" for February, etc. and the path for the involved "month" relay in Figs. 19 and 20 will be closed from ground on conductor MR through the No. 2 brush of switch 7MU and then either directly to the winding of the involved relay, or through the No. 2 or No. 3 brush of the Tens switch 7MT, to the winding of said relay.

4. *Reading and registering the toll message entries*

The entries on the several tapes which the apparatus of my invention is adapted to process are schematically indicated as information charts on Figs. 103A . . . 103F and 104A . . . 104E, those on Figs. 103A . . . 103F being the entries that are recorded on tapes produced by a device called the computer, and those on Figs. 104A . . . 104E being those that are recorded on tapes produced by another device called the assembler-computer. This section of my description is confined to the operation of the apparatus in response to the sensing of the entries on computer tapes, for all of which the operation of said apparatus in response to the entries that are

common to all tapes, such as the tape identity entries and splice code entries, has already been described. The individual message entries which make up the body of the several tapes differ from each other either in the number of lines per entry and/or in the significance of the digits that comprise the entry. Each type of message entry for each tape will be briefly and separately discussed before describing the operation of the apparatus in response thereto.

Referring to Fig. 103A, it will be observed that the message entries (detail entries) for Toll, Message Unit Detail and Observing tapes are the same. That is to say, the entry in each case consists of five lines, each line having the A to F digit positions filled with digital numerical values which are significant to the entry, or otherwise filled with zeros. As will be seen from Fig. 103A, the first line (reading from the bottom up) has "1" for the A digit, which indicates said line to be the first line of the entry. Each of the other four lines has "0" for said digit, and indicates that the line on which "0" appears is a part of the same entry as the first line. The legends in each line indicate what is recorded in the line, the arrow marks therein demarking the number of digits (and which digits) are involved in the item of information included within the arrows.

As previously stated, the tape is driven through the reader in the direction indicated by the arrow in Fig. 100, so that, after the Toll tape of the present example has been processed beyond the last, or month, entry of the tape identity entries, the first line thereafter to be encountered by the sensing pins of the reader will be the first line of the first message entry, which will be that containing the calling line number and an "office index," the significance of which will later appear. It is assumed by way of illustration that the first message entry will be the one indicated on the tape illustrated in Fig. 100, and that the numerical values therein shown constitute the various digits of the entry. The operation of the invention in response to the sensing of each successive line of the message entry shown in Fig. 100 follows, the significance of the charts on Figs. 103 and 104 other than the chart on Fig. 103A which has already been described, will be described later and in the order of their pertinence to the operation of the invention.

4.1. *Calling office and calling line number—first line*

As noted from Fig. 103A, the first line of the first message entry contains the "office index" in the B digit of the line (designating the office of origin in the group of offices indicated by the marker group designation in the tape identity entries) and the calling line number in the C to F digits, inclusive, of the line, while the A digit has the arbitrary value "1," indicating thereby that for a Toll tape, the line is the first of the message entry. In accordance with Fig. 100, it is assumed that the office index consists of the digit "0" and that the calling line number is "7804." The entire first line therefore reads "107804." Accordingly, when the sensing pins A0 . . . F7 of the reader impinge upon the perforations of the first line of the message entry, said pins will selectively engage the perforations on said line and cause the operation of the corresponding relays in all the Digit Reading Registers over circuits previously described, or over circuits similar to those so described.

For the A digit "1," relay **15A1** is operated, as are relays **16B7** and **16B4** for the B digit "0"; relays **16C7** and **16C0** for the C digit "7"; relays **17D7** and **17D1** for the D digit "8"; relays **17E7** and **17E4** for the E digit "0," and relays **18F4** and **18F0** for the F digit "4." When said relays have operated, and remembering that relay **55SR1** of the First Storage Register Connector was previously operated, a circuit is then completed for relay **55RC1** of said connector, the circuit path of said relay **55RC1** being from battery through the windings of said relay, No. 1 back contacts of relay **55UC1**, No. 2 contacts of relay **55SR1**, conductor RCO1, No. 5 contacts of relay **68D** (which was previously operated), conductor FLD0, No. 5 contacts of relay **5RLM**, No. 3 contacts of relay **5ALS**, conductor FLD1, No. 5 contacts of relay **15A2**, No. 4 front contacts of relay **15A1**, No. 5 back contacts of relay **15A0**, conductor LL4 No. 1 front contacts of relay **18TIE**, and thence as previously traced through the contacts of the relays **18F7** . . . **16B0** of the Digit Reading Registers, conductor UC3, and thence as traced to ground on either conductor **G1** or **G2**. Relay **55RC1** operates in the above circuit, locks over its No. 33 contacts and conductor RCO1 to operating ground on conductor **G1** or **G2** and, over its No. 1 to No. 32 contacts, inclusive, extends certain leads from each of the Digit Reading Register relays to the windings of the relays of the First Storage Register, shown in Figs. 56 to 60, inclusive, and also to relays **55A11** and **55A13** in Fig. 55. More particularly, and since relay **15A1** is operated, a circuit is closed for relay **55A11**, the path of which extends from battery through the winding of said relay, No. 1 contacts of relay **55RC1**, conductor AA1, No. 2 contacts of relay **15A1** to ground. Relay **55A11** operates and locks over its No. 3 contacts, conductor **L13**, No. 1 front contacts of relay **66LK1–3**, No. 3 contacts of relay **66ST3**, to ground. The operation of relay **55A11** opens, at its No. 6 contacts, the battery path for the "down check" circuit over which relay **66DC1** was operated at the time when relay **66MON** operated, causing said relay **66DC1** to release at this time, or at some earlier time if a relay in one of the First Storage Registers should operate before relay **55A11** operates, as subsequently described. Relay **55A11** performs certain other functions in connection with the processing of certain other kinds of tapes, or preparing certain types of cards, as will hereinafter be described.

The various relays in each of the other Digit Reading Registers in which have been registered the different values of the B to F digits, inclusive, in the two-out-of-five code, are now transferred into relays of a corresponding digit register of the First Storage Register in Figs. 56 to 60, inclusive of the Odd Storage Unit. However, said transference does not take place on the basis of the two-out-of-five code which is used in transferring information directly from the digits sensed on the tape into the Digit Reading Registers, but in a "three-out-of-six" code in which, for every value of a digit, three relays, and only three, are operated in accordance with the code given in the following Table II. In said table, the column on the left indicates the ten values of a digit, the column in the middle the numerical suffixes of the two relays in each of the Digit Reading Registers which are operated to register the value of the digit in the two-out-of-five code, while the column on the right indicates the numerical suffixes of the three relays in each of the Digit Storage Registers of both the Odd and Even Storage Unit, which are operated to register the value of the same digit:

TABLE II

Digit Value 0 to 9	Two-out-of-Five Code	Three-out-of-Six Code
0	−4, −7	−1, −2, −3
1	−0, −1	−0, −1, −00
2	−0, −2	−0, −2, −00
3	−1, −2	−1, −2, −00
4	−0, −4	−0, −4, −00
5	−1, −4	−1, −4, −00
6	−2, −4	−2, −4, −00
7	−0, −7	−0, −4, −3
8	−1, −7	−1, −4, −3
9	−2, −7	−2, −4, −3

The operation of relays **16B7** and **16B4** in the B-Digit Reading Register for the B digit "0" completes the circuits for relays **56B1–1**, **56B1–2** and **56B1–3** over the following paths: The path for relay **56B1–1** extends from battery through the winding of said relay, conductor

B11, No. 4 contacts of relay 55RC1, conductor BB1, No. 7 contacts of relay 16B7, No. 5 contacts of relay 16B4, to ground; the path of relay 56B1–2 extends from battery through the winding of said relay, conductor B12, No. 5 contacts of relay 55RC1, conductor BB2, No. 6 contacts of relay 16B7, No. 6 contacts of relay 16B4, to ground; the path of relay 56B1–3 extends from battery through the winding of said relay, conductor B13, No. 6 contacts of relay 55RC1, conductor BB3, No. 2 front contacts of relay 16B7, to ground.

The operation of relays 16C7 and 16C0 in the C-Digit Reading Register for the C digit "7" completes circuit paths for relays 57C1–0, 57C1–3 and 57C1–4 over the following paths: the path of relay 57C1–0 extends from battery through the winding of said relay, conductor C10, No. 9 contacts of relay 55RC1 (not shown), conductor CC0, No. 2 contacts of relay 16C0, to ground; the path of relay 57C1–3 extends from battery through the winding of said relay, conductor C13, No. 12 contacts of relay 55RC1 (not shown), conductor CC3, No. 2 front contacts of relay 16C7, to ground; the path of relay 57C1–4 extends from battery through the winding of said relay, conductor C14, No. 14 contacts of relay 55RC1 (not shown), conductor CC4, No. 3 front contacts of relay 16C7, No. 3 back contacts of relay 16C4, to ground.

The operation of relays 17D7 and 17D1 in the D-Digit Reading Register for the D digit "8" completes circuits for relays 58D1–1, 59D1–3 and 58D1–4 over the following paths: the circuit path of relay 58D1–1 extends from battery through the winding of said relay, conductor D11, No. 16 contacts of relay 55RC1 (not shown), conductor DD1, No. 1 contacts of relay 17D1 to ground; the path of relay 58D1–3 extends from battery through the winding of said relay, conductor D13, No. 19 contacts of relay 55RC1 (not shown), conductor DD3, No. 1 front contacts of relay 17D7 to ground; the circuit path of relay 58D1–4 extends from battery through the winding of said relay, conductor D14, No. 20 contacts (not shown) of relay 55RC1, conductor DD4, No. 4 contacts of relay 17D7, No. 2 back contacts of relay 17D4, to ground.

The operation of relays 17E7 and 17E4 in the E-Digit Reading Register for the E digit "0" completes circuits for relays 59E1–1, 59E1–2 and 59E1–3 over the following paths: The path for relay 59E1–1 extends from battery through the winding of said relay, conductor E11, No. 22 contacts (not shown) of relay 55RC1, conductor EE1, No. 3 front contacts of relay 17E7, No. 2 front contacts of relay 17E4, to ground; the operating path for relay 59E1–2 extends from battery through the winding of said relay, conductor E12, No. 23 contacts (not shown) of relay 55RC1, conductor EE2, No. 2 contacts of relay 17E7, No. 1 contacts of relay 17E4, to ground; the operating path for relay 59E1–3 extends from battery through the winding of said relay, conductor E13, No. 24 contacts (not shown) of relay 55RC1, conductor EE3, No. 1 front contacts of relay 17E7 to ground.

The operation of relays 18F–4 and 18F–0 in the F-Digit Reading Register for the F digit "4" completes circuits for relays 60F1–00, 60F1–0 and 60F1–4 over the following paths: The path for relay 60F1–00 extends from battery through the winding of said relay, conductor F100, No. 32 contacts of relay 55RC1, conductor F00, No. 1 back contacts of relay 18F7 to ground; the operating path for relay 60F1–0 extends from battery through the winding of said relay, conductor F10, No. 27 contacts of relay 25RC1, conductor FF0, No. 1 contacts of relay 18F0, to ground; the path for relay 60F1–4 extends from battery through the winding of said relay, conductor F14, No. 31 contacts of relay 55RC1, conductor FF4, No. 3 back contacts of relay 18F7, No. 2 front contacts of relay 18F4, to ground.

All of the above relays in the First Storage Register in the Odd Storage Unit operate to register, in the three-out-of-six code, the various digits which were registered in the Reading Register relays in the two-out-of-five code. The register relays so operated in the First Storage Register all lock over their respective No. 6 contacts, conductor L13, No. 1 front contacts of relay 66LK1–3, No. 3 contacts of relay 66ST3, to ground. It should be noted that the operation of any relay in any of the digital registers of the First Storage Register will open the circuit of relay 66DC1 (as already mentioned), which thereupon releases if it has not already released upon the operation of relay 55A11.

As in the case of the digits registered in the relays of the Digit Reading Register, a check is made in the First Storage Register to insure that three relays, and only three, out of the six relays in each of its digital registers have been operated. This check is made by completing a circuit for relay 55UC1 from a ground supplied from the contacts of relay 66ST3 as follows: ground on the No. 3 contacts of relay 66ST3, No. 2 contacts of relay 66LK1–3, conductor UC5, No. 1 front contacts of relay 55A11, No. 1 back contacts of relay 55A13, conductor UC6, No. 7 back contacts of relay 56B1–00, No. 7 front contacts of relay 56B1–3, No. 5 back contacts of relay 56B1–0, No. 7 front contacts of relay 56B1–1, No. 5 front contacts of relay 56B1–3, No. 5 back contacts of relay 56B1–4, conductor UC7, No. 10 back contacts of relay 57C1–00, No. 10 front contacts of relay 57C1–3, No. 10 front contacts of relay 57C1–0, No. 9 back contacts of relay 57C1–1, No. 10 back contacts of relay 57C1–2, No. 10 front contacts of relay 57C1–4, conductor UC8, No. 10 back contacts of relay 58D1–00, No. 10 front contacts of relay 58D1–3, No. 10 back contacts of relay 58D1–0, No. 10 front contacts of relay 58D1–1, No. 10 back contacts of relay 58D1–2, No. 10 front contacts of relay 58D1–4, conductor UC9, No. 10 back contacts of relay 59E1–00, No. 10 front contacts of relay 59E1–3, No. 10 back contacts of relay 59E1–0, No. 10 front contacts of relay 59E1–1, No. 9 front contacts of relay 59E1–2, No. 10 back contacts of relay 59E1–4, conductor UC10, No. 10 front contacts of relay 60F1–00, No. 10 back contacts of relay 60F1–3, No. 10 front contacts of relay 60F1–0, No. 9 back contacts of relay 60F1–1, No. 10 back contacts of relay 60F1–2, No. 10 front contacts of relay 60F1–4, conductor UC11, the winding of relay 55UC1, to battery. It should be observed that ground on conductor UC11 is also carried through the No. 34 front contacts of relay 55RC1, the winding of relay 55RS1, to battery. Relay 55UC1 operates and remains operated to operating ground for as long as the relays of the First Storage Register remain operated, applies ground over its No. 4 contacts to conductor OUC which continues as a chain through corresponding contacts on other relays –UC–, to complete a circuit when all the lines of the entry are read, opens the operating path of relay 55RC1 which, however, remains locked over conductor RCO1 until the end of the reading cycle, and applies ground to conductor STH1 over its No. 3 contacts to provide a supplemental holding circuit for relay 5ST3, said circuit passing through the No. 4 contacts of relay 26AL, conductor ST3, No. 6 contacts of relay 5ST3, to the winding of said relay. Relay 55RS1, upon operating, locks over its No. 3 contacts to ground on conductor H3, supplied thereto by the reader contacts H3 during the open period of the reading cycle, opens its No. 8 contacts to release the step magnet 4STEP, thereby to cause the advance of the tape 4T to the next line of the entry, opens its No. 1 contacts to release relay 55SR1, closes its No. 2 contacts to extend ground on conductor SR3 (applied thereto over conductor SR, No. 8 contacts of relay 68TS, conductor SRE, to ground on contacts K4 during the open period of the sensing cycle) thereby to complete the circuit of relay 48SR3 which operates and locks over its No. 1 contacts, No. 1 contacts of relay 48RS3, to ground on conductor SRL.

The other contacts on relay 55RS1, though closed by the operation of the relay, perform no function at this time.

The removal of ground from conductor G1 or G2 causes the release of the operated relays in the Digit Reading Registers. This, however, will have no effect on those relays in the First Storage Register (including relay 55A11) which were operated in consequence thereof to register therein the identical digits B . . . F, since the latter relays are locked to ground on conductor L13, as previously described. The removal of ground from conductor G1 or G2 will, however, cause the removal of ground also from conductor RCO1, thereby to effect the release of relay 55RC1 of the First Storage Register Connector, and to disconnect the relays of the First Storage Register from the common leads extending to the relays of the Digit Reading Register. When the reading cycle has completed its open period and contacts H3 are opened, ground is removed from conductor H3 and relay 55RS1 is released, whereupon the previously traced circuit for step magnet 4STEP is reestablished to operate said magnet and hold the drum 4D to the next line of perforations to which the tape 4T was advanced thereby. The apparatus is now in a position to sense and register the digits of the second line of the call entry on the Digit Reading Register, and to transfer said digits from said Digit Reading Register to the Third Storage Register of the Odd Storage Unit.

4.2. *Start time—second line*

As shown in Figs. 100 and 103A, the second line of the message entry records the beginning of conversation time or "start time," the A digit for the line being "0" to indicate that it is a supplementary line of the entry, while the B to F digits, inclusive, are assumed as an example in the tape shown on Fig. 100 to be "14945." As will be pointed out in a subsequent section, the five digits (B to F) of the start time entry are a "compression" of the total number of digits actually required to express the start time in terms of the tens and units digits of the day, the hour and the minute when the call was answered. For the present, however, it suffices to say that the start time "14945" recorded on the second line of the message entry will be registered in the Third Storage Register of the Odd Storage Unit.

Accordingly, when the sensing pins A0 . . . F7 impinge upon the second line of the message entry, the digit relays of the Digit Reading Register are selectively operated over previously described paths to register therein the digits recorded in the line. Thus, relay 15A0 will register the A digit "0"; relays 16B0 and 16B1 will register the B digit "1"; relays 16C0 and 16C4 will register the C digit "4"; relays 17D2 and 17D7 will register the D digit "9"; relays 17E0 and 17E4 will register the E digit "4"; while relays 18F1 and 18F4 are operated to register the F digit "5."

With the above-mentioned relays in the Digit Reading Register operated to register the number "14945," a circuit is completed for operating relay 48RC3, said circuit extending from battery through the winding of said relay, No. 1 back contacts of relay 48UC3, No. 2 contacts of relay 48SR3, conductor RC29, No. 14 contacts of relay 68D, conductor AA0, No. 6 contacts of relay 15A2, No. 5 back contacts of relay 15A1, No. 5 front contacts of relay 15A0, conductor LL4, No. 1 front contacts of relay 18TIE, contacts of relay 18GT, No. 6 back contacts of relay 18F7, No. 6 front contacts of relay 18F4, No. 7 back contacts of relay 18F2, No. 7 front contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 back contacts of relay 17E7, No. 7 front contacts of relay 17E4, No. 7 back contacts of relay 17E2, No. 7 back contacts of relay 17E1, No. 7 front contacts of relay 17E0, No. 6 front contacts of relay 17D7, No. 4 back contacts of relay 17D4, No. 5 front contacts of relay 17D2, No. 6 back contacts of relay 17D1, No. 6 back contacts of relay 17D0, conductor UC2, No. 1 back contacts of relay 16C7, No. 2 front contacts of relay 16C4, No. 2 back contacts of relay 16C2, No. 2 back contacts of relay 16C1, No. 1 front contacts of relay 16C0, No. 1 back contacts of relay 16B7, No. 2 back contacts of relay 16B4, No. 4 back contacts of relay 16B2, No. 2 front contacts of relay 16B1, No. 1 front contacts of relay 16B0, conductor US3, and thence as traced to ground on conductor G1 or G2. Relay 48RC3 operates in the above circuit, locks over its No. 2 contacts to operating ground on conductor RC29, and closes its No. 3 to No. 32 contacts, inclusive, to connect the common conductors from the Digit Reading Register to the relays of the Third Storage Register of the Odd Storage Unit, whereby the digits of the number "14945" registered in the Digit Reading Register in the two-out-of-five code are transferred and registered in said Third Storage Register in the three-out-of-six code given in Table II. Accordingly, when relay 48RC3 is operated, thus insuring that two, and only two, relays for each of the B to F digits were operated in the Digit Reading Register, the common leads from said Digit Reading Register are extended to the relays of the Third Storage Register, and circuits are selectively completed thereover as follows to transfer said digits to said Third Storage Register.

For the B digit "1," relays 49B3–0, 49B3–1 and 49B3–00 are operated over the following paths: the circuit path for relay 49B3–0 extends from battery through the winding of said relay, conductor B30, No. 3 contacts of relay 48RC3, conductor BB0, No. 2 contacts of relay 16B0, to ground; the path for relay 49B3–1 may be traced from battery through the winding of said relay, conductor B31, No. 4 contacts of relay 48RC3, conductor BB1, No. 3 contacts of relay 16B1, to ground; the path of relay 49B3–00 extends from battery through the winding of said relay, conductor B300, No. 8 contacts of relay 48RC3, conductor B300, No. 2 back contacts of relay 16B7, to ground.

For the digit "4" relays 50C3–00, 50C3–0 and 50C3–4 are operated over the following paths: the circuit path for relay 50C3–0 is traced from battery through the winding of said relay, conductor C30, No. 9 contacts of relay 48RC3 (not shown), conductor CC0, No. 2 contacts of relay 16C0, to ground; the path for relay 50C3–4 may be traced from battery through the winding of said relay, conductor C34, No. 13 contacts (not shown) of relay 48RC3, conductor CC4, No. 4 back contacts of relay 16C7, No. 3 front contacts of relay 16C4, to ground; the path for relay 50C3–00 may be traced from battery through the winding of said relay, conductor C300, No. 14 contacts (not shown) of relay 48RC3, conductor C00, No. 2 back contacts of relay 16C7, to ground.

For the D digit "9" relays 51D3–2, 51D3–3 and 51D3–4, are operated over the following paths: the circuit path for relay 51D3–2 may be traced from battery through the winding of said relay, conductor D32, No. 17 contacts (not shown) of relay 48RC3, conductor DD2, No. 1 contacts of relay 17D2, to ground; the path for relay 51D3–3 may be traced from battery through the winding of said relay, conductor D33, No. 18 contacts (not shown) of relay 48RC3, conductor DD3, No. 1 front contacts of relay 17D–7, to ground; the circuit path of relay 51D3–4 may be traced from battery through the winding of said relay, conductor D34, No. 19 contacts (not shown) of relay 48RC3, conductor DD4, No. 4 front contacts of relay 17D7, No. 2 back contacts of relay 17D4, to ground.

For the E digit "4" relays 52E3–00, 52E3–0 and 52E3–4 are operated over the following paths: the path for relay 52E3–0 may be traced from battery through the winding of said relay, conductor E30, No. 21 contacts (not shown) of relay 48RC3, conductor EE0, No. 1 contacts of relay 17E0, to ground; the path for relay 52E3–4 may be traced from battery through the winding of said relay, conductor E34, No. 25 contacts (not

shown) of relay 48RC3, conductor EE4, No. 3 back contacts of relay 17E7, No. 2 front contacts of relay 17E4, to ground; the path for relay 52E3–00 may be traced from battery through the winding of said relay, conductor E300, No. 26 contacts (not shown) of relay 48RC3, conductor E00, No. 1 back contacts of relay 17E7, to ground.

For the F digit "5" relays 53F3–00, 53F3–1 and 53F3–4 are operated over the following paths: the path for relay 53F3–1 may be traced from battery through the winding of said relay, conductor F31, No. 28 contacts of relay 48RC3, conductor FF1, No. 1 contacts of relay 18F1, to ground; the circuit path for relay 53F–4 may be traced from battery through the winding of said relay, conductor F34, No. 31 contacts of relay 48RC3, conductor FF4, No. 3 back contacts of relay 18F7, No. 2 front contacts of relay 18F4, to ground; the circuit path for relay 53F3–00 may be traced from battery through the winding of said relay, conductor F300, No. 32 contacts of relay 48RC3, conductor FF100, No. 1 back contacts of relay 18F7, to ground.

All of the above relays, operated as above described, lock over their respective No. 6 contacts to aforetraced ground on conductor L13. A circuit is also completed for relay 48UC3, which may be traced from battery through the winding of said relay, conductor UC13, No. 10 front contacts of relay 53F3–4, No. 10 back contacts of relay 53F3–2, No. 10 front contacts of relay 53F3–1, No. 10 back contacts of relay 53F3–0, No. 10 back contacts of relay 53F3–3, No. 10 front contacts of relay 53F3–00, conductor UC14, No. 10 front contacts of relay 52E3–4, No. 10 back contacts of relay 52E3–2, No. 9 back contacts of relay 52E3–1, No. 9 front contacts of relay 52E3–0, No. 10 back contacts of relay 52E3–3, No. 9 front contacts of relay 52E3–00, conductor UC15, No. 10 front contacts of relay 51D3–4, No. 10 front contacts of relay 51D3–2, No. 10 back contacts of relay 51D3–1, No. 10 back contacts of relay 51D3–0, No. 10 front contacts of relay 51D1–3, No. 10 back contacts of relay 51D3–00, conductor UC16, No. 10 front contacts of relay 50C3–4, No. 10 back contacts of relay 50C3–2, No. 9 back contacts of relay 50C3–1, No 11 front contacts of relay 50C3–0, No. 8 back contacts of relay 50C3–3, No. 10 front contacts of relay 50C3–00, conductor UC17, No. 9 back contacts of relay 49B3–4, No. 9 back contacts of relay 49B3–2, No. 9 front contacts of relay 49B3–1, No. 9 front contacts of relay 49B3–0, No. 8 back contacts of relay 49B3–3, No. 9 front contacts of relay 49B3–00, conductor UC5, and thence to ground as previously traced thereto. It will be noted that the ground on conductor UC13, just traced thereto, is further applied over the No. 1 front contacts of relay 48RC3 to the winding of relay 48RS3, completing the circuit of the latter relay.

Relays 48UC3 and 48RS3 both operate, relay 48UC3 locking over the No. 2 contacts of relay 48SR3 to ground on conductor G1 or G2, previously traced thereto from conductor RC29. Relay 48UC3 applies ground over its No. 3 contacts to conductor STH1, thereby to furnish supplementary locking ground to relay 5ST3, and opens the operating circuit of relay 48RC3 at its No. 1 contacts, said relay 48RC3, however, remaining locked to ground on conductor G1 or G2, previously traced thereto over conductor RC29 until the end of the reading cycle. Relay 48RS3, in operating, locks to ground on conductor H3, opens the circuit of the step magnet 4STEP at its No. 8 contacts, thereby allowing the drum to advance the tape 4T to the next line, opens the locking circuit of relay 48SR3 at its No. 1 contacts, which releases, the latter then releasing relay 48UC3, and completes the circuit of relay 41SR5, said circuit extending from battery through the winding of said relay 41SR5, conductor SR5, No. 6 contacts of relay 68D, conductor SRA3, No. 2 contacts of relay 48RS3, conductor SR, No. 8 contacts of relay 68TS, conductor SRE, to ground on the K4 reader contacts, which contacts, as shown in the chart of Fig. 101 are closed during the open period of the reading cycle. Said relay 41SR5 operates and locks over its No. 1 contacts, No. 1 contacts of relay 41RS5, to previously traced ground on conductor SRL.

When the reading cycle has passed through its open period, contacts H3 release, remove ground from conductor H3, and cause relay 48RS3 to release, in consequence of which the circuit of step magnet 4STEP is released, thereby energizing said magnet to hold the tape 4T to the third line of the entry to which the reader has advanced the tape. The relays of the Digit-Reading Registers release in the manner previously described when, on the advance of drum 4D, ground is removed from conductor G1 or G2.

4.3. *Called office code—third line*

The third line of the message entry contains the called office number (consisting of three digits) in the D, E, and F digit positions of the line (see Fig. 103A), and is here assumed by way of example to be "726" (see Fig. 100). The A digit has the arbitrary value "0," and the "B" digit is known as the "area index"; that is, the area in which the call was completed, the purpose of the index being to enable the accounting office to determine the area containing the number of the office in which the call was completed, since it is possible that different contiguous areas may have offices having the same codes, which fact makes it necessary to distinguish one from the other by the identity of the areas in which they severally appear. In the present example it will be assumed that the area index (B digit) has the value "0." The C digit is designated as the "class and called number index," and furnishes the key to the number of digits in the called line number (recorded in the succeeding or fourth line of the entry). As noted in Fig. 103F, if the called line number consists of three numerals, the C digit will have the value "0"; if it consists of four numerals with or without a party letter it will have the value "1," while if it consists of five numerals, it will have the value "2." For our present purpose it will be assumed that the called line number consists of four numerals without a party letter; hence the C digit will have the value "1." The third line of the message entry, therefore, consists of the number "001726."

The impingement of the sensing pins A0 . . . F7 upon the perforations of the third line of the entry causes, in the manner and over paths previously described, the operation in the Digit-Reading Register of relay 15A0 for the A digit "0," relays 16B7 and 16B4 for the B digit "0," relays 16C0 and 16C1 for the C digit "1," relays 17D0 and 17D7 for the D digit "7," relays 17E0 and 17E2 for the E digit "2" and relays 18F2 and 18F4 for the F digit "6."

As soon as the above digit-reading relays are operated, a circuit is completed for relay 41RC5 of the Fifth Storage Register Connector over the following path: Battery through the winding of said relay 41RC5, No. 1 back contacts of relay 41UC5, No. 2 contacts of relay 41SR5, conductor RC29, No. 14 contacts of relay 68D, conductor AA0, No. 6 contacts of relay 15A2, No. 5 back contacts of relay 15A1, No. 5 front contacts of relay 15A0, conductor LL4, No. 1 front contacts of relay 18TIE, contacts of relay 18GT, No. 6 back contacts of relay 18F7, No. 6 front contacts of relay 18F4, No. 6 front contacts of relay 18F2, No. 7 back contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 back contacts of relay 17E7, No. 7 back contacts of relay 17E4, No. 7 front contacts of relay 17E2, No. 7 back contacts of relay 17E1, No. 1 front contacts of relay 17E0, No. 6 front contacts of relay 17D7, No. 4 back contacts of relay 17D4, No. 6 back contacts of relay 17D2, No. 7 back contacts of

relay 17D1, No. 6 front contacts of relay 17D0, conductor UC2, No. 1 back contacts of relay 16C7, No. 2 back contacts of relay 16C4, No. 3 contacts of relay 16C2, No. 2 front contacts of relay 16C1, No. 1 front contacts of relay 16C0, No. 1 front contacts of relay 16B7, No. 1 front contacts of relay 16B0, No. 1 back contacts of relay 16B2, No. 1 back contacts of relay 16B1, No. 1 back contacts of relay 16B0, conductor UC3, and thence as traced to ground on conductor G1 or G2. Relay 41RC5 operates, locks over its No. 2 contacts to previously traced operating ground, and connects the conductors from the relays of the B . . . F Digit-Reading Registers to the relays of the Fifth Storage Register, over which the digits B . . . F registered in the Digit-Reading Register in the two-out-of-five code are transferred to the relays of said Fifth Storage Register in the three-out-of-six code.

The operation of relays 16B7 and 16B4 in the B-Digit Reading Register for the registration of the digit "0" therein completes circuits for relays 42B5–1, 42B5–2 and 42B5–3 of the Fifth Storage Register over the following circuit paths: The path for relay 42B5–1 may be traced from battery through the winding of said relay, conductor B51, No. 4 contacts of relay 41RC5, conductor BB1, No. 7 contacts of relay 16B7, No. 5 contacts of relay 16B4 to ground; the circuit path for relay 42B5–2 may be traced from battery through the winding of said relay, conductor B52, No. 5 contacts of relay 41RC5, conductor BB2, No. 6 contacts of relays 16B7 and 16B4, to ground; the path for relay 42B5–3 may be traced from battery through the winding of said relay, conductor B53, No. 6 contacts of relay 41RC5, conductor BB3, No. 2 front contacts of relay 16B7, to ground.

The operation of relays 16C0 and 16C1 in the C-Digit Reading Register for the digit "1" completes circuits for relays 43C5–0, 43C5–1 and 43C5–00 of the Fifth Storage Register over the following circuit paths; the path for relay 43C5–0 may be traced from battery through the winding of said relay, conductor C50, No. 9 contacts (not shown) of relay 41RC5, conductor CC0, No. 2 contacts of relay 16C0, to ground; the path for relay 43C5–1 may be traced from battery through the winding of said relay, conductor C51, No. 10 contacts (not shown) of relay 41RC5, conductor CC1, No. 3 contacts of relay 16C1, to ground; the path for relay 43C5–00 may be traced from battery through the winding of said relay, conductor C500, No. 14 contacts (not shown) of relay 41RC5, conductor C00, No. 2 back contacts of relay 16C7, to ground.

The operation of relays 17D0 and 17D7 in the D-Digit Reading Register for the digit "7" completes circuits for relays 44D5–0, 44D5–3 and 44D5–4 in the Fifth Storage Register over the following circuit paths: The path for relay 44D5–0 may be traced from battery through the winding of said relay, conductor D50, No. 15 contacts (not shown) of relay 41RC5, conductor DD0, No. 1 contacts of relay 17D0, to ground; the path for relay 44D5–3 may be traced from battery through the winding of said relay, conductor D53, No. 18 contacts (not shown) of relay 41RC5, conductor DD3, No. 1 front contacts of relay 17D7, to ground; the path for relay 44D5–4 may be traced from battery through the winding of said relay, conductor D54, No. 19 contacts (not shown) of relay 41RC5, conductor DD4, No. 4 contacts of relay 17D7, No. 2 back contacts of relay 17D4, to ground.

The operation of relays 17E0 and 17E2 in the E-Digit Reading Register for the digit "2" completes circuits for relays 45E5–0, 45E5–2 and 45E5–00 of the Fifth Storage Register over the following circuit paths: The path for relay 45E5–0 may be traced from battery through the winding of said relay, conductor E50, No. 21 contacts (not shown) of relay 41RC5, conductor EE0, No. 1 contacts of relay 17E0, to ground; the path for relay 45E5–2 may be traced from battery through the winding of said relay, conductor E52, No. 23 contacts (not shown) of relay 41RC5, conductor EE2, No. 1 contacts of relay 17E2, to ground; the circuit for relay 45E5–00 may be traced from battery through the winding of said relay, conductor E500, No. 26 contacts (not shown) of relay 41RC5, conductor E00, No. 1 back contacts of relay 17E7, to ground.

The operation of relays 18F2 and 18F4 in the F-Digit Reading Register for the digit "6" completes circuits for relays 46F5–2, 46F5–4 and 46F5–00 of the Fifth Storage Register over the following circuit paths; the path for relay 46F5–2 may be traced from battery through the winding of said relay, conductor F52, No. 29 contacts of relay 41RC5, conductor FF2, No. 1 contacts of relay 18F2 to ground; the path for relay 46F5–4 may be traced from battery through the winding of said relay, conductor F54, No. 31 contacts of relay 41RC5, conductor FF4, No. 3 back contacts of relay 18F7, No. 2 front contacts of relay 18F4, to ground; the path for relay 46F5–00 may be traced from battery through the winding of said relay, conductor F500, No. 32 contacts of relay 41RC5, conductor F00, No. 1 back contacts of relay 18F7, to ground.

All of the above relays in the Fifth Storage Register operate, release relay 66DC5, and lock over their respective No. 6 contacts, conductor L57, No. 1 front contacts of relay 66LK5–7, No. 2 contacts of relay 66ST3, to ground. A circuit is thereupon completed for the upcheck relay 41UC5, which may be traced from battery through the winding of said relay, conductor UC18, No. 10 front contacts of relay 46F5–4, No. 10 front contacts of relay 46F5–2, No. 10 back contacts of relay 46F5–1, No. 10 back contacts of relay 46F5–0, No. 10 back contacts of relay 46F5–3, No. 10 front contacts of relay 46F5–00, conductor UC19, No. 10 back contacts of relay 45E5–4, No. 9 front contacts of relay 45E5–2, No. 9 back contacts of relay 45E5–1, No. 10 front contacts of relay 45E5–0, No. 10 back contacts of relay 45E5–3, No. 10 front contacts of relay 45E5–00, conductor US20, No. 10 front contacts of relay 44D5–4, No. 10 back contacts of relay 44D5–2, No. 9 back contacts of relay 44D5–1, No. 10 front contacts of relay 44D5–0, No. 10 front contacts of relay 44D5–3, No. 10 back contacts of relay 44D5–00, conductor UC21, No. 10 back contacts of relay 43C5–4, No. 9 back contacts of relay 43C5–2, No. 9 front contacts of relay 43C5–1, No. 10 front contacts of relay 43C5–0, No. 8 back contacts of relay 43C5–3, No. 10 front contacts of relay 43C5–00, conductor UC22, No. 10 back contacts of relay 42B5–4, No. 9 front contacts of relay 42B5–2, No. 10 front contacts of relay 42B5–1, No. 10 back contacts of relay 42B5–0, No. 10 front contacts of relay 42B5–3, No. 10 back contacts of relay 42B5–00, conductor UC23, No. 2 contacts of relay 66LK5–7, No. 2 contacts of relay 66ST3 to ground. The ground thus traced, it will be observed, not only completes the circuit of relay 41UC5 and checks thereby that no more nor less of three out of six relays have operated in each of the Digit Storage Registers, but also completes the circuit of relay 41RS5 through the No. 2 front contacts of relay 41RC5.

Relay 41UC5 operates and remains operated to operating ground. At its No. 3 contacts, it applies ground on conductor STH1 to hold relay 5ST3 and at its No. 1 back contacts opens the operating path of relay 41RC5, which, however, remains locked over its No. 2 contacts to ground on conductor RC29, applied thereto and maintained thereon by conductor G1 or G2 until the appropriate one of said conductors is opened, as before described, at the end of the reading cycle.

Relay 41RS5, upon operating, locks over its No. 3 contacts to reader ground on conductor H3 until the end of the open period of the reading cycle, opens the locking circuit of relay 41SR5 at its No. 1 contacts, completes the circuit of relay 34SR7 at its No. 2 contacts to ground on contacts K4 via conductor SR7, said relay 34SR7 operating and locking over its own No. 1 contacts, No. 1 contacts of relay 34RS7 to aforetraced ground on conductor SRL. Relay 41RS5 opens the circuit of step mag-

net 4STEP at its No. 8 contacts, thereby causing said magnet to release and advance the tape 4T to the next or fourth line of the message entry. At the termination of the open period of the reading cycle (for the third line of the entry) the removal of ground from conductor H3 causes the release of relay 41RS5 and the reclosure of the circuit of step magnet 4STEP, thereby operating said magnet and causing it to hold the tape 4T in the position wherein the perforations of the fourth line of the message may be sensed by the pins A0 . . . F7.

The removal of ground from conductor G1 or G2, at the termination of the reading cycle, releases the relays in the Digit Reading Registers, and the removal of ground from conductor RC29, releases relay 41RC5, thus disconnecting the common leads of the Digit Register Relays from the relays of the Fifth Storage Register.

4.4. *Called subscriber's number—fourth line*

The fourth line of the message contains the called subscriber's number, as shown on Fig. 103A, the four digits of which are recorded in the B to E digit positions, the A digit being "0," to indicate that the line is a part of the message entry but not the first line thereof, and the F digit being "0" when the number contains no party letter. Accordingly, assuming the called subscriber's number to be "2897," the six digits of the fourth line will read "028970," as shown on Fig. 100.

When the sensing pins A0 . . . F7 impinge upon the record, and the appropriate ones of said pins engage depressions therein in the manner previously described for similar operations, relay 15A0 is operated for the A digit "0," relays 16B0 and 16B2 are operated for the B digit "2," relays 16C1 and 16C7 are operated for the C digit "8," relays 17D2 and 17D7 are operated for the D digit "9," relays 17E0 and 17E7 are operated for the E digit "7," and relays 18F4 and 18F7 are operated for the F digit "0." A circuit is thereby completed for relay 34RC7 of the Seventh Storage Register Connector, which extends from battery through the winding of said relay, No. 1 back contacts of relay 34UC7, No. 2 contacts of relay 34SR7, thence as previously traced via conductor RC29, to conductor AA0, No. 6 contacts of relay 15A2, No. 5 back contacts of relay 15A1, No. 3 front contacts of relay 15A0, conductor LL4, No. 1 front contacts of relay 18TIE, contacts of relay 18GT, No. 6 front contacts of relay 18F7, No. 5 front contacts of relay 18F4, No. 6 back contacts of relay 18F2, No. 7 back contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 front contacts of relay 17E7, No. 6 back contacts of relay 17E4, No. 7 back contacts of relay 17E2, No. 7 back contacts of relay 17E1, No. 7 front contacts of relay 17E0, No. 6 front contacts of relay 17D7, No. 4 back contacts of relay 17D4, No. 5 front contacts of relay 17D2, No. 6 back contacts of relay 17D1, No. 6 back contacts of relay 17D0, conductor UC2, No. 1 front contacts of relay 16C7, No. 1 back contacts of relay 16C4, No. 2 back contacts of relay 16C2, No. 1 front contacts of relay 16C1, No. 1 back contacts of relay 16C0, No. 1 back contacts of relay 16B7, No. 2 back contacts of relay 16B4, No. 2 front contacts of relay 16B2, No. 2 back contacts of relay 16B1, No. 1 front contacts of relay 16B0, conductor UC3, and thence as traced to ground on either conductor G1 or G2.

Relay 34RC7 operates in the above-traced circuit, locks to operating ground over its No. 2 contacts, and connects the common leads from the Digit Reading Register relays to the relays of the Seventh Storage Register, over which the digits registered in the Digit Reading Register in the two-out-of-five code are transferred into the Seventh Storage Register in the three-out-of-six code.

The operation of relays 16B0 and 16B2 in the B-Digit Reading Register for the digit "2" completes circuits for relays 35B7–0, 35B7–2 and 35B7–00 of the Seventh Storage Register over the following paths: the path for relay 35B7–0 may be traced from battery through the winding of said relay, conductor B70, No. 3 contacts of relay 34RC7, conductor BB0, No. 2 contacts of relay 16B0 to ground; the path for relay 35B7–2 may be traced from battery through the winding of said relay, conductor B72, No. 5 contacts of relay 34RC7, conductor BB2, No. 3 contacts of relay 16B2, to ground; the path for relay 35B7–00 may be traced from battery through the winding of said relay, conductor B700, No. 8 contacts of relay 34RC7, conductor B00, No. 2 back contacts of relay 16B7 to ground.

The operation of relays 16C–7 and 16C–1 in the C-Digit Reading Register for the digit "8" completes circuits for relays 36C7–1, 36C7–3 and 36C7–4 in the Seventh Storage Register over the following paths; the path for relay 36C7–1 may be traced from battery through the winding of said relay, conductor C71, No. 10 contacts (not shown) of relay 34RC7, conductor CC1, No. 3 contacts of relay 16C1, to ground; the path for relay 36C7–3 may be traced from battery through the winding of said relay, conductor C73, No. 12 contacts (not shown) of relay 34RC7, conductor CC3, No. 2 front contacts of relay 16C7, to ground; the path for relay 36C7–4 may be traced from battery through the winding of said relay, conductor C74, No. 13 contacts (not shown) of relay 34RC7, conductor CC4, No. 3 front contacts of relay 16C7, No. 3 back contacts of relay 16C4, to ground.

The operation of relays 17D2 and 17D7 in the D-Digit Reading Register for the digit "9" completes circuits for relays 37D7–2, 37D7–3 and 37D7–4 in the Seventh Storage Register over the following paths: the path for relay 37D7–2 may be traced from battery through the winding of said relay, conductor D72, No. 17 contacts (not shown) of relay 34RC7, conductor DD2, No. 1 contacts of relay 17D2, to ground; the path for relay 37D7–3 may be traced from battery through the winding of said relay, conductor D73, No. 18 contacts (not shown) of relay 34RC7, conductor DD3, No. 1 front contacts of relay 17D7, to ground; the path for relay 33D7–4 may be traced from battery through the winding of said relay, conductor D74, No. 19 contacts (not shown) of relay 34RC7, conductor DD4, No. 4 contacts of relay 17D7, No. 2 back contacts of relay 17D4, to ground.

The operation of relays 17E7 and 17E0 in the E-Digit Reading Register for the digit "7" completes circuits for relays 38E7–0, 38E7–3 and 38E7–4 in the Seventh Storage Register over the following circuit paths: the path for relay 38E7–0 may be traced from battery through the winding of said relay, conductor E70, No. 24 contacts (not shown) of relay 34RC7, conductor EE0, No. 1 contacts of relay 17E0, to ground; the path for relay 38E7–3 may be traced from battery through the winding of said relay, conductor E73, No. 24 contacts (not shown) of relay 34RC7, conductor EE3, No. 1 front contacts of relay 17E7, to ground; the path for relay 38E7–4 may be traced from battery through the winding of said relay, conductor E74, No. 25 contacts (not shown) of relay 34RC7, conductor EE4, No. 4 contacts of relay 17E7, No. 2 back contacts of relay 17E4, to ground.

The operation of relays 18F4 and 18F7 in the F-Digit Reading Register for the digit "0" completes circuits for relays 39F7–1, 39F7–2 and 39F7–3 in the Seventh Storage Register over the following circuit paths: the path for relay 39F7–1 may be traced from battery through the winding of said relay, conductor F71, No. 28 contacts of relay 34RC7, conductor FF1, No. 3 front contacts of relay 18F7, No. 2 front contacts of relay 18F4, to ground; the path for relay 39F7-2 may be traced from battery through the winding of said relay, conductor F72, No. 29 contacts of relay 34RC7, conductor FF2, No. 2 contacts of relay 18F7, No. 1 contacts of relay 18F4 to ground; the path for relay 39F7–3 may be traced from battery through the winding of said

relay, conductor F73, No. 30 contacts of relay 34RC7, conductor FF3, No. 1 front contacts of relay 18F7 to ground.

All of the above relays operate, lock over their respective No. 6 contacts, conductor L57, No. 1 front contacts of relay 66LK5–7, No. 2 contacts of relay 66ST3, to ground. Upon the operation of any one of the relays in the Seventh Storage Register, the circuit of relay 66DC7 is opened, causing said latter relay to release.

When the three relays in each of the digit registers of the Seventh Storage Unit have operated, a circuit is completed for the up-check relay 34UC7, the path of which circuit extends from battery through the winding of said relay, conductor UC24, No. 10 back contacts of relay 39F7–4, No. 9 front contacts of relay 39F7–2, No. 10 front contacts of relay 39F7–1, No. 10 back contacts of relay 39F7–0, No. 10 front contacts of relay 39F7–3, No. 10 back contacts of relay 39F7–00, conductor UC25, No. 10 front contacts of relay 38E7–4, No. 10 back contacts of relay 38E7–2, No. 9 back contacts of relay 38E7–1, No. 10 front contacts of relay 38E7–0, No. 10 front contacts of relay 38E7–3, No. 10 back contacts of relay 38E7–00, conductor UC26, No. 10 front contacts of relay 37D7–4, No. 10 front contacts of relay 37D7–2, No. 10 back contacts of relay 37D7–1, No. 10 back contacts of relay 37D7–0, No. 10 front contacts of relay 37D7–3, No. 10 back contacts of relay 37D7–00, conductor UC27, No. 10 front contacts of relay 36C7–4, No. 10 back contacts of relay 36C7–2, No. 10 front contacts of relay 36C7–1, No. 10 back contacts of relay 36C7–0, No. 10 front contacts of relay 36C7–3, No. 10 back contacts of relay 36C7–00, conductor UC28, No. 10 back contacts of relay 35B7–4, No. 9 front contacts of relay 35B7–2, No. 9 back contacts of relay 35B7–1, No. 10 front contacts of relay 35B7–0, No. 10 back contacts of relay 35B7–3, No. 10 front contacts of relay 35B7–00, conductor UC23, No. 2 contacts of relay 66LK5–7, No. 2 contacts of relay 66ST3, to ground. The ground above traced is also applied over the No. 1 front contacts of relay 34RC7 to complete the circuit of relay 34RS7.

Relay 34UC7 operates, remains operated to operating ground, and applies ground over its No. 3 contacts to conductor STH1, thereby to supply relay 5ST3 with a supplementary locking circuit. Relay 34RS7 operates, locks over its No. 3 contacts to ground on conductor H3 until the termination of the open period of the reading cycle, opens at its No. 1 contacts the locking circuit of relay 34SR7 which releases, completes a circuit for relay 27SR9 over its No. 2 contacts, conductor SR and thence as previously traced to ground on reader contacts K4, said relay then locking over its No. 1 contacts, No. 1 contacts of relay 27RS9 to aforetraced ground on conductor SRL, and opens at its No. 8 contacts the circuit of the step magnet 4STEP, thereby to release said magnet and advance the tape 4T to the last or fifth line of the message entry. When the open period of the reading cycle is terminated and ground is removed from conductor H3, relay 34RS7 releases, whereupon the previously traced circuit for the step magnet 4STEP is reestablished to cause said magnet to reoperate and hold the tape 4T to the fifth or last line of the message entry. When ground is removed from conductor G1 or G2, the relays of the Digit Reading Register are released. Relay 34RC7 is also released (when ground is removed from said conductor G1 or G2) to disconnect the common leads of the relays of the Digit Reading Register from the relays of the Seventh Storage Register. The mechanism is now ready to sense and store in the Ninth Storage Register the information contained in the fifth or last line of the message.

4.5. *Chargeable time—fifth line*

This line of the message entry, as shown in Fig. 103A, contains, for all computer tapes, the record of the chargeable time expressed by the values of the C and D digits as the tens and units digits thereof, the number of toll or message units, if any, in the E and F digits thereof, and a message unit index in the B digit; the A digit being, of course, 0. The message unit index may be 0, 1, 2 or 3 depending upon the character of the call, as indicated in Fig. 103C. Assuming that the total chargeable time is 5 minutes, that there are no toll or message units and that the Message Unit Index is 0, the fifth line of the message entry will read "000500."

When the sensing pins A0 . . . F7 impinge upon the fifth line of the entry and the involved sensing pins engage the depressions therein, relay 15A0 is operated for A digit "0," relays 16B4 and 16B7 are operated for the B digit "0," relays 16C4 and 16C7 are operated for the C digit "0," relays 16D1 and 16D4 are operated for the D digit "5," relays 16E4 and 16E7 are operated for the E digit "0," and relays 18F4 and 18F7 are operated for the F digit "0," all of said relays being operated in the manner and over paths which have been previously described. When said relays have operated, a circuit is completed for relay 27RC9 of the Ninth Storage Register Connector, said circuit extending from battery through the winding of said relay, No. 1 back contacts of relay 27UC9, No. 2 contacts of relay 27SR9, conductor RC29, and thence as previously traced to conductor AA0, No. 6 contacts of relay 15A2, No. 5 back contacts of relay 15A1, No. 5 front contacts of relay 15A0, conductor LL4, No. 1 front contacts of relay 18TIE, contacts of relay 18GT, No. 6 front contacts of relay 18F7, No. 5 front contacts of relay 18F4, No. 6 back contacts of relay 18F2, No. 7 back contacts of relay 18F1, No. 7 back contacts of relay 18F0, conductor UC1, No. 7 front contacts of relay 17E7, No. 6 front contacts of relay 17E4, No. 6 back contacts of relay 17E2, No. 6 back contacts of relay 17E1, No. 7 back contacts of relay 17E0, No. 6 back contacts of relay 17D7, No. 5 front contacts of relay 17D4, No. 6 back contacts of relay 17D2, No. 6 front contacts of relay 17D1, No. 6 back contacts of relay 17D0, conductor UC2, No. 1 front contacts of relay 16C7, No. 1 front contacts of relay 16C4, No. 1 back contacts of relay 16C2, No. 1 back contacts of relay 16C1, No. 1 back contacts of relay 16C0, No. 1 front contacts of relay 16B7, No. 1 front contacts of relay 16B4, No. 1 back contacts of relay 16B2, No. 1 back contacts of relay 16B1, No. 1 back contacts of relay 16B0, conductor UC3, and thence as traced to ground on conductor G1 or G2. Relay 27RC9 operates, locks over its No. 2 contacts to operating ground, and connects the common conductors from the Digit Reading Registers to the relays of the Ninth Storage Register, over which the digits registered in said Digit Reading Register in the two-out-of-five code are transferred to said Ninth Storage Register in the three-out-of-six code.

The operation of relays 16B7 and 16B4 for the registration of the B digit "0" in the B-Digit Reading Register completes circuit paths for relays 28B9–1, 28B9–2 and 28B9–3 in the Ninth Storage Register. The path for relay 28B9–1 may be traced from battery through the winding of said relay, conductor B91, No. 4 contacts of relay 27RC9, conductor BB1, No. 7 contacts of relay 16B7, No. 5 contacts of relay 16B4, to ground; the path for relay 28B9–2 may be traced from battery through the winding of said relay, conductor B92, No. 5 contacts of relay 27RC9, conductor BB2, No. 6 contacts of relay 16B7, No. 6 contacts of relay 16B4, to ground; the path for relay 28B9–3 may be traced from battery through the winding of said relay, conductor B93, No. 6 contacts of relay 27RC9, conductor BB3, No. 2 front contacts of relay 16B7, to ground.

The operation of relays 16C7 and 16C4 to register the C digit "0" in the C-Digit Reading Register completes circuit paths for relay 29C9–1, 29C9–2 and 29C9–3 in the

Ninth Storage Register. The path for relay 29C9–1 may be traced from battery through the winding of said relay, conductor C91, No. 10 contacts (not shown) of relay 27RC9, conductor CC1, No. 4 front contacts of relay 16C7, No. 3 front contacts of relay 16C4 to ground; the path for relay 29C9–2 may be traced from battery through the winding of said relay, conductor C92, No. 11 contacts (not shown) of relay 27RC9, conductor CC2, No. 5 contacts of relay 16C7, No. 4 contacts of relay 16C4, to ground; the path for relay 29C9–3 may be traced from battery through the winding of said relay, conductor C93, No. 12 contacts (not shown) of relay 27RC9, conductor CC3, No. 2 front contacts of relay 16C7, to ground.

The operation of relays 17D4 and 17D1 to register the D digit "5" in the D-Digit Reading Register completes circuit paths for relays 30D9–1, 30D9–4 and 30D9–00 in the Ninth Storage Register. The path for relay 30D9–1 extends from battery through the winding of said relay, conductor D91, No. 16 contacts (not shown) of relay 27RC9, conductor DD1, No. 1 contacts of relay 17D1, to ground; the path for relay 30D9–4 extends from battery through the winding of said relay, conductor D94, No. 19 contacts (not shown) of relay 27RC9, conductor DD4, No. 3 back contacts of relay 17D7, No. 2 front contacts of relay 17D4, to ground; the path for relay 30D9–00 extends from battery through the winding of said relay, conductor D900, No. 20 contacts (not shown) of relay 27RC9, conductor D00, No. 1 back contacts of relay 17D7, to ground.

The operation of relays 17E4 and 17E7 to register the E digit "0" in the E-Digit Reading Register completes circuit paths for relays 31E9–1, 31E9–2 and 31E9–3 in the Ninth Storage Register. The path for relay 31E9–1 may be traced from battery through the winding of said relay, conductor E91, No. 22 contacts (not shown) of relay 27RC9, conductor EE1, No. 3 front contacts of relay 17E7, No. 2 front contacts of relay 17E4, to ground; the path for delay 31E9–2 may be traced from battery through the winding of said relay, conductor E92, No. 23 contacts (not shown) of relay 27RC9, conductor EE2, No. 2 contacts of relay 17E7, No. 1 contacts of relay 17E4, to ground; the path for relay 31E9–3 may be traced from battery through the winding of said relay, conductor E93, No. 24 contacts (not shown) of relay 27RC9, conductor EE3, No. 1 front contacts of relay 17E7 to ground.

The operation of relays 18F4 and 18F7 to register the F digit "0" in the F-Digit Reading Register completes circuit paths for relays 32F9–1, 32F9–2 and 32F9–3 in the Ninth Storage Register. The path for relay 32F9–1 may be traced from battery through the winding of said relay, conductor F91, No. 28 contacts of relay 27RC9, conductor FF1, No. 3 front contacts of relay 18F7, No. 2 front contacts of relay 18F4, to ground; the path for relay 32F9–2 may be traced from battery through the winding of said relay, conductor F92, No. 29 contacts of relay 27RC9, conductor FF2, No. 2 contacts of relay 18F7, No. 1 contacts of relay 18F4, to ground; the path for relay 32F9–3 may be traced from battery through the winding of said relay, conductor F93, No. 30 contacts of relay 27RC9, conductor FF3, No. 1 front contacts of relay 18F7 to ground.

All of the above relays, when operated, lock over their respective No. 6 contacts, conductor L9, No. 1 front contacts of relay 66LK9, No. 1 contacts of relay 66ST3, to ground. It should be noted that when any one of said relays operate, the circuit of relay 66DC9 is opened, causing said relay to release. Further, a circuit is completed for the up-check relay 27UC9, which circuit extends from battery through the winding of said relay, conductor UC29, No. 10 back contacts of relay 32F9–4, No. 9 front contacts of relay 32F9–2, No. 10 front contacts of relay 32F9–1, No. 10 back contacts of relay 32F9–0, No. 10 front contacts of relay 32F9–3, No. 10 back contacts of relay 32F9–00, conductor UC30, No. 10 back contacts of relay 31E9–4, No. 9 front contacts of relay 31E9–2, No. 10 front contacts of relay 31E9–1, No. 10 back contacts of relay 32E9–0, No. 10 front contacts of relay 31E9–3, No. 10 back contacts of relay 31E9–00, conductor UC31, No. 10 front contacts of relay 30D9–4, No. 10 back contacts of relay 30D9–2, No. 10 front contacts of relay 30D9–1, No. 10 back contacts of relay 30D9–0, No. 10 back contacts of relay 30D9–3, No. 10 front contacts of relay 30D9–00, conductor UC32, No. 10 back contacts of relay 29C9–4, No. 9 front contacts of relay 29C9–2, No. 10 front contacts of relay 29C9–1, No. 10 back contacts of relay 29C9–0, No. 10 front contacts of relay 29C9–3, No. 10 back contacts of relay 29C9–00, conductor UC33, No. 10 back contacts of relay 28B9–4, No. 9 front contacts of relay 28B9–2, No. 10 front contacts of relay 28B9–1, No. 10 back contacts of relay 28B9–0, No. 10 front contacts of relay 28B9–3, No. 10 back contacts of relay 28B9–00, conductor UC34, No. 2 contacts of relay 66LK9, No. 1 contacts of relay 66ST3, to ground. Relay 27UC9 operates and locks to ground on conductor G1 or G2 via conductor RC29. The same ground, applied through the No. 1 front contacts of relay 27RC9 completes the circuit of relay 27RS9, which operates, locks to ground on conductor H3 until the end of the reading cycle, opens the circuit of the reader step magnet 4STEP, thereby enabling the reader mechanism to advance the Tape 4T to the next line of perforations (which would be the first line of the next call entry) and performs other functions previously noted in connection with other –RS– relays.

It will thus be noted that all the five lines of the entry are severally registered in the five storage registers of the Odd Storage Unit. The next entry is now sensed and registered in the five storage registers of the Even Storage Unit. The Zero Storage Registers of said latter unit are shown in Figs. 82 . . . 87, inclusive, while the connector circuit for the last or Eighth Storage Registers of said Even Storage Unit is shown in Fig. 90, all intermediate registers and connectors not being shown as they are but repetitions of those shown in Figs. 83 . . . 87, inclusive.

The sensing of the first line of the next entry will cause the operation of relays 82A01, 82RC0, 82UC0 and 82RS0 in the manner previously described for similar relays of the individual registers of the Odd Storage Unit, and the storage of the various digits of said line in the Zero Storage Registers shown in Figs. 83 . . . 87 takes place in the manner previously described. Succeeding lines are, of course, registered in the second, fourth, sixth and eighth Storage Registers of the Even Storage Unit.

Now when, after the second entry has been stored in the Even Storage Unit, the third entry on the tape is advanced for processing, the lines thereof will be stored in the digital registers of the Odd Storage Unit, provided, however, that said unit is available for such use. As will be described later, the time during which the second entry is being sensed and stored in the Even Storage Unit is utilized in translating certain of the data stored in the Odd Storage Unit, and in operating the Gang Punch mechanism, shown in Fig. 89, to punch a card containing a record of the first entry, partly as translated and partly as registered in the Odd Storage Unit. It may be, however, that said translating and punching operations may not have been finished by the time that the tape 4T has been advanced for the processing of the third entry, in which event the Odd Storage Unit will not be available and the processing of said entry will have to be delayed until it is so available.

Consequently, when the tape 4T is advanced to the first line of the third successive entry, said line will be processed and stored in the First Storage Register of the Odd Storage Unit if said register is available, which it will be if the First Storage Registor Connector shown in Fig. 55 is normal. In the event that the First Storage

Register still has a record stored therein, relay 55UC1 remains operated over the check path previously traced to conductor UC11 and beyond, to ground on the No. 3 contacts of relay 66ST3. With relay 55UC1 operated, and relay 55RC1 released (said relay releasing after a reading cycle, owing to the removal of ground at that time from conductor RC01 is traced to conductor FLD1), no path is available for reoperating relay 55RC1 to reconnect the reading relays to the First Register, since said path is open at the No. 1 back contacts of relay 55UC1, and will remain open so long as said register is filled and the above-mentioned operating ground is maintained for relay 55UC1. Under these circumstances, and because relay 55RS1 is normal, two things happen, the first of which is that the first line of the third entry is not stored in the First Register of the Odd Storage Unit, or any other register, and the second is that the tape 4T is not advanced, the sensing pins of the reader merely operating to sense the same line of the entry without effect.

It may be that the First Storage Register will release during a reading cycle rather than at the beginning of the cycle, in which event it would be undesirable to connect the Register to the reading relays, since the remainder of the cycle for which the connection would be effective might not be of sufficient duration to cause the storing of the sensed line of information. Provision is made, therefore, to insure that the connection is not made until the beginning of the succeeding reading cycle, and this provision consists in causing relay 55UC1 to remain locked after the operating path of said relay is opened by the release of the register to keep open the operating path for relay 55RC1. Thus if the disconnection occurs while a reading cycle is taking place, ground is present on conductor RC01, and since relay 55SR1 is operated, a locking circuit is provided for relay 55UC1 over its No. 1 front contacts, No. 2 contacts of relay 55SR1, to ground on said conductor RC01. Relay 55UC1, therefore, will remain locked until the reading cycle is over, at which time ground will be removed from conductor RC01 and relay 55UC1 will release to reestablish a previously described operating path for relay 55RC1, which, in operating, will connect the relays of the First Storage Register to the reading relays, and cause the first line of the third entry, when sensed, to be stored therein.

5. Translations

5.1. Calling office translation

With the digit registers of the Odd Storage Unit set in accordance with the five lines of the sensed message entry, the apparatus proceeds in operating to punch a card individual to the entry, and containing thereon certain of the items of the entry as registered and certain of the items as translated, and also including other data derived from certain items of the entry.

Broadly speaking, the production of a card involves two antecedent operations, one being the direct marking of certain conductors from those digit registers of the Storage Unit for which the digits registered therein are to be punched on the card as registered. These conductors, marked in accordance with the value of the digits registered, extend to the terminal blocks shown in Fig. 71, and from said terminal blocks to the punch and check relays 71P1C . . . 71PC80 of the Gang Punch mechanism, thereby to cause the selective operation of said relays and the operation of the corresponding punch magnets. The other operation is the translation of certain of the registered digits in certain lines of the message entry prior to the punching thereof, in translated form, upon the cord. The latter function involves the operation of certain translating relays in response to some digit, or certain of the digits, registered in particular registers of the Storage Unit, and the marking by said relays of conductors extending to the terminal blocks of Fig. 71 and thence to the involved punch and check relays in accordance with the translation.

I will now describe those operations of my mechanism by which, after the registers of the Storage Unit are set, appropriate equipment is operated to translate certain of the registered digits into the digit, or digits, which are to be punched on the card.

When relay 5ST1 operated, a circuit was completed for relay 76EH, said circuit being traced from battery through the winding of said relay, conductor EH, No. 2 contacts of relay 5ST1, No. 2 back contacts of relay 5ST3 (which is normal at the time) to ground. After relay 5ST2 has operated in the manner previously described and relay 76EH has also operated, a circuit is completed for relay 76ERL, the path of which extends from battery through the winding of said relay, No. 2 front contacts of relay 76EH, conductor ON, No. 1 contacts of relay 5ST2, to ground. Relay 76ERL, upon operating, locks over its No. 3 contacts, conductor HRL, No. 5 contacts of relay 81CIA, to ground. When relay 5ST3 operates, relay 76EH releases, but during the interval between the operation of relay 5ST3 and the operation of relay 5ST4, and with relay 76EH released and relay 76ERL operated as above described, a circuit is closed for the Odd Emitter and Check Multiple Connector relay 61OL and also for the Odd Detail Connector relay 67OD. These two relays which are individual to the Odd Storage Unit (and relay 88EL and -OD, not shown, which are individual to the Even Storage Unit) serve to connect their associated Storage Units to the various elements of translating equipment, and to the conductors connecting with the Gang Punch when the involved Storage Unit has been set to the registration of a message entry, each of the Units being connected alternately to the Gang Punch by the operation of their involved connector relays. Since the operation of the machine begins with the use of the Odd Storage Unit in registering a message entry (though by a slight wiring change the operation can be made to begin with the Even Storage Unit), the odd connector relays 61OL and 67OD are operated. The circuit of relay 61OL is traced from battery through the winding of said relay, conductor OL, No. 4 contacts of relay 76ERL, No. 2 back contacts of relay 76EH, conductor ON, No. 2 contacts of relay 5ST2 to ground. Relay 61OL locks over its No. 4 contacts, conductor OLL, No. 4 contacts of relay 66ORL, conductor ON and thence as traced to ground on the No. 2 contacts of relay 5ST2. The circuit of relay 67OD is traced from ground on conductor OL, No. 9 contacts of relay 68D (which operated locally from relay 68OD when the latter operated in response to the sensing of the tape type index entry, the first of the tape identity entries), winding of said relay 67OD, to battery. The operation of relay 67OD also completes an obvious circuit for relay 67ODC which operates, and further closes a circuit of relay 40OCT from operating ground as above traced, No. 1 contacts of relay 67OD, conductor OAC, No. 13 contacts of relay 68OD, conductor OCT, winding of relay 4OCT to battery, operating said last-mentioned relay and performing certain functions that will be noted hereinafter. Relay 67OD further completes the circuit of relay 86TOL, the circuit thereof tracing from battery through the winding of said relay, conductor TOL, terminal 2 and brush 4 of the Tape Index 7TT (set to the terminal 2 for a toll tape), conductor CI, a pair of contacts on relay 67OD, conductor 5CE0, or 5CE1 or 5CE2 of the Fifth Storage Register depending upon whether the register, for a toll tape, is set for the digit 0, 1 or 2 (see Figs. 103A and 103F), through contacts on relays of said register as set, conductor E27, contacts on relay 67OD to ground. Relay 80TOL operates and completes the circuit of relay 40OT, said latter circuit tracing from battery through the winding of said relay, conductor OT, No. 9 contacts of relay 80TOL, conductor OCT, to ground previously traced

thereto. Relay 40OCT operates and performs certain functions that will be noted hereinafter. Relay 40OT, upon operating, grounds its No. 4 contacts and completes the circuit of relay 22UC over conductor CUC, said latter relay operating to perform certain functions which will also be noted hereinafter.

It will be recalled that the first line of the message entry consists of the calling line number in the C to F digit positions thereof, and of the "calling office index" in the B digit position (see Fig. 103A). It is obvious, of course, that the calling line number requires no change or translation for punching on the card, since the digits of said number, as contained on the tape and registered on the digit registers of the First Storage Unit, are those that make up the directory number of the calling line. The B digit, however, may have a value from "0" to "9," and indicates a particular office unit of a number of such units in the building identified by the marker group indication in the second line of the tape identity entries. In the present example the first line of the message entry is "107804," of which the B digit "0" indicates office No. 0 in the building identified by the marker group number "00" (see Fig. 100). It is necessary to determine from the B digit value "0" and the marker group number "00" the actual directory code of the involved calling office, and to punch this code on the card. The first line of the message entry, it will be recalled, was registered in the First Storage Register, and that the B digit register thereof was set for the value "0," meaning thereby that relays 56B1–1, 56B1–2 and 56B1–3 were operated and locked therein. Accordingly, when relay 67OD operates, a circuit is closed for relay 13010A of the Office Index Relays, said circuit extending from battery through the winding of relay 13010A, conductor 010A in the group of conductors designated OIXA, a pair of contacts on relay 67OD, thence to conductor BC0 in the group of conductors indicated as BCX, No. 5 contacts of relay 56B1–3, No. 2 contacts of relay 56B1–2, No. 2 contacts of relay 56B1–3, conductor C32, a set of contacts on relay 67OD, to battery. Relay 13010A operates to perform certain functions noted hereinafter.

It should be noted that if the B digit of the first line of the message entry, instead of having the value "0," has any other value, the B-Digit First Storage Register will have been set accordingly, and the corresponding one of the ten relays 13011A . . . 13019A will be operated over a circuit similar to the one above traced, except that said circuit would be traced over the appropriate one of the ten conductors in the group OIXA. In other words, no matter which one of the conductors BC0 . . . BC9 is closed through by the different digital settings of the B-Digit First Storage Register, said conductor would be connected through the contacts of said digit register to conductor C32, thereby to complete the circuit of the involved office index relay in the group of relays 13010A . . . 13019A.

It is desirable to punch on the card the actual code of the office (as for instance "CHE" for Chelsea") represented by value of the B digit in the first line of the message entry, located in the building identified by the marker group number.

It will be further recalled that as a result of the sensing of the marker group entry of the tape identity entries, and remembering that the marker group designation in the specific example is "00," that relay 24A–MT0 was operated in response to the sensing of the marker group tens digit "0" and that, through the contacts of said relay, the one hundred relays 24A–COT000 . . . 24A–COT099 were operated in response to the sensing of the marker group units digit "0." Had the marker group tens digit been any other value than 0, then a corresponding relay in the group of relays 24A–MT1 . . . 24A–MT9 would have been operated over a circuit similar to the one traced for relay 24A–MT0, and had the marker group units digit been any other value than 0, then the corresponding group of one hundred relays 24(A or B)–COT100 . . . 24(A or B)–COT999 would have been operated through the contacts of said operated 24AMTX relay, it being assumed, of course, that the marker set-up switches 6MGT and 7MGU will have been appropriately set for the involved marker group number.

Each of the thousand relays 24A–COT000 . . . 24B–COT999 represents a specific directory number (or letter) code, and the stationary contacts of said relays are severally connected to the two groups of twelve emitter conductors EM0 . . . EM12 and twelve check conductors CH0 . . . CH12 in accordance with the three-letter designation of said codes required for the production of punches on the card to represent said letters thereon.

As previously indicated, the Gang Punch utilized as part of the present invention by way of example is the commercially available IBM End Printing Reproducing Punch, Type 519, the schematic representation of which is shown in Fig. 89. It includes 80 punch magnets 89PM1 . . . 89PM80 for the production of a corresponding number of 80 holes across a single row of the card. This card, as shown in Fig. 105, consists of 80 columns with 12 hole positions in each column for a total of 960 hole positions. A character (base ten digit or letter) may be recorded in each column. The hole positions are numbered from top to bottom as follows: 12 (sometimes designated R), 11 (sometimes designated X), 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. Base numerals are represented by rectangular punches in one of the hole positions 0 to 9. The letters of the alphabet, on the other hand, are represented by the rectangular punches in two hole positions in a column. One hole is punched in positions 12, 11 or 0, being known as an "overpunch," and the other hole is punched in one position 1 to 9, and known as an "underpunch." The following table is used to indicate the over and underpunch combination required to represent any letter of the alphabet:

TABLE III

Letter	Overpunch	Underpunch
A	12	1
B	12	2
C	12	3
D	12	4
E	12	5
F	12	6
G	12	7
H	12	8
I	12	9
J	11	1
K	11	2
L	11	3
M	11	4
N	11	5
O	11	6
P	11	7
Q	11	8
R	11	9
S	0	2
T	0	3
U	0	4
V	0	5
W	0	6
X	0	7
Y	0	8
Z	0	9

As noted above, the overpunch positions 0, 11 and 12 are used in combination with the underpunch positions 0 to 9 to express the letters of the alphabet. Since the underpunch positions, when used singly, indicate the base ten digits, the overpunch positions 11 and 12 may be used singly to indicate special symbols or characters.

For convenience of description, and because the conductors EM0 . . . EM12 and the conductors CH0 . . . CH12 (referred to as the EMX and CHX conductor groups, respectively) are the conductors which, for the columns on the card, determine the positions which are to be punched to record a digit or character thereon, the numerical suffix of each of said conductors has been made identical with the punch position is represents.

As previously stated, each one of the thousand code

relays 24A–COT000 . . . 24B–COT999 represents a specific directory number (or name) the three digits (or first three letters) of which are to be punched on the card. The translation of the office index and marker group number to the directory number or name of the office is effected by connecting the stationary contacts of said code relays severally to the groups of conductors EM0 . . . EM12 and CH0 . . . CH12 in accordance with the above code for each digit or letter of the number or name, respectively. Thus, for example, it is intended that relay 24A–COT000 shall represent the office name "Chelsea," whose dial abbreviation CHE is to be punched on the card. Accordingly, the stationary contacts of the six pairs of contacts to the left of the relay are connected to the conductors of the EMV group in accordance with the code designation of the three letters CHE, two of said contacts being connected to conductors EM3 and EM12, respectively, for the letter "C," two of said contacts being connected to conductors EM8 and EM12, respectively, for the letter "H," and two of said contacts being connected, respectively, to conductors EM5 and EM12 for the letter "E." In the same manner, the stationary contacts of the six pairs of contacts to the right of the relay are connected to the CHX group of conductors in accordance with the code designation of the above letters. Each of the other relays 24A–COT001 . . . 24B–COT999, representing specific directory names, are similarly wired; relay 24A–COT009, for example, being wired for the office "Watkins" (which will be punched on the card in the code for the three letters WAT), relay 24B–COT990 being wired for the office "Pennsylvania" (which will be punched on the card in the code for the three letters PEN), while relay 24B–COT999 is wired for the office "Chickering" (which will be punched on the card in the code for the three letters CHI).

The armatures of the different code relays are connected severally to multiples which extend between corresponding relays in each group of ten code relays for each marker group, there being a submultiple of six conductors for the armatures on the right side of the relays and another submultiple of six conductors for the armatures on the left side of the relays. Thus there are ten multiples in all, the one extending between the first relay in each first group of ten, that is to say, relays 24A–COT000, 24B–COT010 . . . 24B–COT090, and the one extending between the first relay in each last group of ten, that is to say, relays 24A–COT009, 24B–COT019 . . . 24B–COT099, being shown in Figs. 24A and 24B. The twelve conductors of each of the ten multiples are connected to the armatures of the ten relays 13010A . . . 13019A of the Calling Office Index Translator, the multiple for the code relays 24A–COT000 . . . 24B–COT090 being connected to the armatures of relay 13010A, the multiple for the code relays 24A–COT001 . . . 24B–COT091 being connected to the armatures of relay 13011A, and so on for each of the remaining relays of the Calling Office Index Translator, with the ninth or last multiple for the code relays 24A–COT009 . . . 24B–COT999 being connected to the armatures of relay 13019A.

It should now be readily apparent why an identical Calling Office Index (B digit in the first line of a message entry) in different message entries can be made to yield a different office name, or code, for different marker group entries (E and F digits in the marker group entry of the tape identity entries). For, since each of the ten relays 13010A . . . 13019A of the Calling Office Index Translator is connected to one of the ten multiples, each of the latter, extending to a corresponding code relay in each group of ten code relays, the operation of the same relay 1301XA, in combination with a different group of ten code relays the operation of which is determined by the operation of relay 24A–MTX in response to the tens digit of the marker group and by the circuit completed over a set of contacts on said relay 24A–MTX in response to the units digit of said marker group, will yield a different code relay for the same Calling Office Index. Thus, for example, it has been assumed that the Calling Office Index of the message entry under discussion is "0" for the marker group "00," and it has been further assumed that the code relay 24A–COT000 is wired to express the three letters CHE for the office "Chelsea," which has been further assumed to be the name of the calling office characterized by the digit "0," in the marker group "00." Relay 13010A is operated in response to the Calling Office Index "0," relay 24A–MT0 is operated in response to the tens digit "0" of the marker group, and the ten code relays 24A–COT000 . . . 24A–COT009 are operated in response to units digit "0" of said marker group, all as previously described. Since the armatures of relay 13010A are connected only to the armatures of the code relay 24A–COT000 of the group of ten operated code relays 24A–COT000 . . . 24A–COT009, said armatures of relay 13010A being also connected, as said before, to the armatures of the corresponding relays in each of the other 99 groups of ten code relays, it follows that punch and check impulses subsequently to be transmitted over the contacts of relay 13010A will pass to the emitter and check conductors EMX and CHX, respectively, only over the contacts of relay 24A–COT000 expressing the name Chelsea. For, although the remaining nine code relays 24A–COT001 . . . 24A–COT009 are operated, they will be ineffective to transmit punch and check pulses to the emitter and check conductors EMX and CHX, since their contacts are severally connected to multiples other than the multiple that extends to the armature of the one operated relay 13010A.

The above arrangement makes it possible to translate the same basic office code in different marker groups (or office areas) and characterized by the same Calling Office Index digit, into different office names. This is necessary since the same numerical code may be used in different areas to designate the different offices. For example, the basic dial numerical code "243" identifies the office "Chelsea" in the office area identified by the marker group "00." But the same numerical code could be used to identify another office, for instance the office named "Bidwell" in an office area identified by a different marker group number, and it goes to the utility of the invention that each card representing a call shall have recorded thereon the name of the office from which the call was placed. In the event of an identical Calling Office Index in different marker groups, the operation of the same office index relay, for instance relay 13010A, in response to said index, and the operation of the appropriate group of ten code relays called for by the marker group number, will cause the paths through the contacts of relay 13010A to be effective only through that one of the operated code relays which corresponds to the same one in another group operated for a different marker group area. In the case above assumed of the same basic code "243" being used in common for the office "Chelsea" in one area and the office "Bidwell" in another, it has already been shown how the code relay 24A–COT000 wired to the EMX and CHX groups of conductors for the letters CHE is effective in combination with relay 13010A to express such letters. If we assume that the office "Bidwell" is located, for example, in the area defined by the marker group number "09," relay 24A–MT0 would operate in response to the marker group tens digit "0" and the group of ten code relays 24A–COT090 . . . 24A–COT099 (not shown) would operate in response to the marker group units digit "9," in which relay group relay 24A–COT090 would be assigned to the office "Bidwell" having the same numerical code "243" as the office "Chelsea" and therefore having the same Calling Office Index "0," and stationary contacts of which relay would accordingly be connected to the EMX and CHX conductors for the three letters BID. The armatures of this

relay 24A–COT090, however, are connected to the same multiple as the armatures of the relay 24A–COT000, which multiple is, in turn, connected to the armatures of relay 13010A responding to the Calling Office Index digit "0." Hence, upon the operation of the latter relay for a message entry having the Calling Office Index "0," and the operation of the ten code relays 24A–COT090 . . . 24A–COT099 in response to the marker group "09," the punch and check pulses subsequently to be transmitted over the contacts of relay 13010A will be applied to the EMX and CHX conductors over the contacts of code relay 24A–COT090 to cause the punching of the codes for the letters BID of the office "Bidwell" instead of over relay 24A–COT000 for the letters CHE of the office "Chelsea." Thus the Calling Office Index "0" would represent the office "Chelsea" in marker group "00" below and the office "Bidwell" in marker group "09." In the same manner, the numerical code "243," for instance, could be used to designate other office names in other marker group areas.

5.2—Start time translation

It will be recalled that the start time of the connection was registered in the third register of the Odd Storage Unit, and it will further be recalled that this start time, expressed by the five digits B to F of the second line of the message entry, was stated to be a "compression" of the number of digits actually required to express said time in terms of the day, the hour and the minute when the connection was answered by the called subscriber.

The start time involves three components, namely, the day, the hour and the minute, each being expressed by a tens and units digit, thus making six digits in all. Since the start time is recorded by five digits only (the A digit not being used for this purpose) it is evident that a sixth digit is "phantomed" upon the five, a fact that makes it necessary to "translate" the five digits into the six that actually express the time. The reason why the six digits are compressed into five is because the record tape utilized in the central office is only wide enough to accommodate five digits, not counting the A digit. Consequently the sixth digit is phantomed upon two of the digits, in this case upon the B and C digits. When the subscriber answers the connection the time actually recorded on the central office tape is the minute of the answer. Devices provided at the central office also record periodically on said tape the hours of the day, while the days and months are also recorded at appropriate times on said tape or successive tapes as part of the tape identity entries. The central office tape is then processed by certain other devices to produce the tapes to be sensed by the apparatus of the present invention, in consequence of which recorded day, the recorded hour and the recorded minute when the connection was answered are combined into one entry of five digits for each message (the second line of the entry) which expresses the "six" digits of the answer time. Since the individual card to be made for each message entry by the apparatus of the present invention must contain the start (or answer) time in terms of the six digits that represent the day, hour and minute when the call was answered, it becomes necessary to decipher the five digits into the six digits, two digits to designate the tens and units digits of the day, two digits to designate the tens and units digits of the hour, and two digits to designate the tens and units digits of the minute.

In this deciphering operation, the D, E and F digits, as recorded in the second line of the message entry, always designate the Day Units, the Hour Units and the Minute Units digits, respectively, of the start time. The B and C digits, between them as recorded, contain the Day Tens, the Hour Tens and the Minute Tens digits. The B and C digits as recorded, therefore, must be translated into the Day, Hour and Minute Tens digits.

To aid in the understanding of how the translation is effected, attention is directed to the following table in which the days of the month, the hours of the day and the minutes of the hour are separately listed.

TABLE IV

Days	Minutes		Hour
	Low Category	High Category	
01	00	30	00
02	01	31	01
03	02	32	02
04	03	33	03
05	04 Low	34	04
06	05 Division	35	05
07	06	36	06
08	07	37	07
09	08	38	08
10	09	39	09
11			10
12	10	40	11
13	11	41	12
14	12	42	13
15	13	43	14
16	14 Middle	44	15
17	15 Division	45	16
18	16	46	17
19	17	47	18
20	18	48	19
21	19	49	20
22			21
23	20	50	22
24	21	51	23
25	22	52	--------
26	23	53	--------
27	24 High	54	--------
28	25 Division	55	--------
29	26	56	--------
30	27	57	--------
31	28	58	--------
	29	59	--------

It will be noted that in the above chart the minutes are divided into two columns, the left column called the "Low Category" containing minutes 00 . . . 29, and the right column called the "High Category" containing minutes 30 . . . 59. Both columns are also divided into three divisions, as shown, minutes 00 . . . 09 and 30 . . . 39 constituting the "Low Division," minutes 10 . . . 19 and 40 . . . 49 constituting the "Middle Division," while minutes 20 . . . 29 and 50 . . . 59 constitute the "High Division."

In deciphering the B and C digits, and understanding that said digits as recorded represent the tens digits of the day, hour and minute, advantage is taken of the fact that the tens digit of a calendar day can never be higher than 3, it being either 0, 1, 2 or 3 depending upon the day involved; that the tens digit of the hour can never be higher than 2, it being either 0, 1 or 2 depending upon the actual hour involved; and that the tens digit of the minute can never be higher than 5, it being either 0, 1, 2, 3, 4 or 5 depending upon the minute when the call was answered. Remembering that the D, E and F digits are fixed to designate the Day Units, Hour Units and Minute Units digits, respectively, the deciphering involves only the B and C digits which, between the two, contain the Day Tens, Hour Tens and Minute Tens digits.

In the translation, the B digit is the composite of the Day Tens digit and Minute Tens digit, while the C digit is indicative of the Hour Tens digit. For this purpose, and considering the above chart, it is arbitrarily assumed that

(*a*) When the B digit is 0, 1, 2, or 3, that is the value of the Day Tens digit exactly, and the Minute Tens digit is then in the Low Category and is either 0, 1 or 2.

It is apparent, however, that provision must be made for the condition when the call will be answered between 30 and 59 minutes after the hour, at which time the Day Tens digit would still be 0, 1, 2 or 3, but cannot be so represented inasmuch as said latter digits have been reserved for the time when the call is answered between 00 and 29 minutes after the hour. Accordingly, to take care of the condition when the call is answered

between 30 and 59 minutes past the hour, the digit 5 is added to the Day Tens digit, so that

(*b*) When the B digit has any value from 5 to 8, inclusive, said digit is equal to the Day Tens digit "plus" 5, and the Minute Tens digit is in the High Category, and is either 3, 4 or 5.

It now becomes necessary to determine the "actual" value of the Minute Tens digit, and this is done by means of the C digit in combination with the significance of the recorded value of the B digit. For this purpose, when the C digit is 0, 1 or 2, it designates the actual Hour Tens digit, and it is arbitrarily assumed that, in this event, the Minute Tens digit will be in the Low Division of the High and Low Categories. Differently expressed:

(*c*) When the C digit has any value from 0 to 2, inclusive, it designates the Hour Tens digit exactly, and the Minute Tens digit is in the Low Division of the High and the Low Categories and is either 0 or 3.

It is evident that under condition (*c*) above, the actual value of the Minute Tens digit is determined by the recorded values of the B digit. If, for example, the B digit is 0, 1, 2 or 3, which confines the selection of the Minute Tens digit to the High Category (that is, to minutes 00 . . . 29) and the value of the C digit is 0, 1 or 2, which further confines it to the low division of the Low or High Category, the actual value of the Minute Tens digit must be 0, since it must be selected from the High Category column. On the other hand, if the B digit is 5 to 8, inclusive, thus limiting the selection of the Minute Tens digit to the High Category column (that is, to 30 . . . 59 minutes), a C digit value of 0, 1 or 2, further confining it to the Low Division of the Low and High Category, pins the Minute Tens digit to the value 3.

Provision must now be made for the condition when, in relation to the value of the C digit, the call is answered in those minutes which occur in the Middle and the High Divisions of both the High and Low Categories. For this purpose, when the call is answered in any one of the minutes which occur in the Middle division, the actual value of the C digit is increased by 3, and the determination of the Minute Tens digit may be stated thus:

(*d*) When the C digit has any value from 3 to 5, inclusive, it indicates the Hour Tens digit "plus" 3, and the Minute Tens digit is in the Middle Division in either the Low or High Category having either the value 1 or 4 depending upon the value of the B digit.

Thus if the value of the C digit is 3, the actual value thereof is 0. Whether the Minute Tens digit is 1 or 4 then depends upon the value of the B digit which, if it is 0, 1, 2 or 3 will make the Tens digit 1, and if it is 5 to 8, inclusive, will make said digit 4.

In the same manner, when the minute that the call was answered occurs in the High Division of the High and Low Categories, the C digit will have any value from 6 to 8 and the determination of the Minute Tens digit is determined thus:

(*e*) When the C digit has any value from 6 to 8, inclusive, it indicates the Hour Tens digit "plus" 6, and the Minute Tens digit is in the High Division of the Low or High Category, and is either 2 or 5 depending upon the value of the B digit.

Thus, if the value of the C digit is 8, its actual value will be 2 (the Hour Tens digit), and the Minute Tens digit will be 2 if the value of the B digit is 0 to 3, inclusive, or 5 if the value of the B digit is 5 to 8, inclusive.

Applying the above empirical rules to the specific value of the start time "14945" recorded in the second line of the message entry, and remembering that the D, E and F digits 945 actually record the Day Units, Hour Units and Minute Units digits of the start time, the B digit "1" which indicates the Day Tens digit exactly) immediately limits the value of the Minute Tens digit to the value 0, 1 or 2. Since the C digit has the value "4," the Hour Tens digit will be "1." But a C digit value of 4 limits the choice of the Minute Tens digit to the Middle Division of the High and Low Categories (4 or 1, respectively) and since the selection in said Division is limited to the Low Category by the B digit value of "1," the Minute Tens digit must be "1." Accordingly, the translation of the start time 5-digit number "14945" will be that the call was started on

(*a*) 19 day of the month
(*b*) 14 hour (or 2 P. M.)
(*c*) 15 minutes past the hour

With the above understanding of the principles of start time translation in mind, the circuits I have devised for giving its effect may be readily followed. After the five lines of the message entry are stored in the registers of the Odd Storage Unit, and the odd detail connector relay **67OD** has been operated as already described, certain circuits are completed whereby the B and C digits of the start time, recorded in the second line of the entry, are translated into the Tens digits of day, hour and minute, it being understood that the D, E and F digits as recorded express the Units digits thereof in the order given. Consequently upon the operation of relay **67OD**, and remembering that the B digit of the start time is "1" and is registered in the Third Storage Register of the Odd Storage Unit, a circuit is completed for relay **77DT1**, said circuit being traced from battery through the winding of said relay, conductor **1** in the group of conductors designated DTX, a set of contacts on relay **67OD**, conductor **3BE1** in the group of conductors designated **3BEX**, the No. 8 contacts of relay **49B3–1**, the No. 5 contacts of relay **49B3–0**, conductor **E43**, to ground on a set of contacts on relay **67OD**.

It will be noted that the conductor connected to the winding of relay **77DT1** is paralleled to both the conductor **1** and conductor **6** in the group of conductors **3BEX**. This means that relay **77DT1** operates not only when the B digit has the value 1, but also when it has the value 6, the circuit for said relay being traced in either event to conductor **E43** and to ground thereon over conductors **3BE1** and **3BE6**, and through the relays of the B-Digit Register of the Odd Storage Unit when selectively operated for either value. Had the value of the B digit been 0 or 5, the B-Digit Storage Register would have been set accordingly, and relay **77DT0** would be operated instead of relay **77DT1**, the circuit of said former relay being completed to ground on conductor **E43**, over conductor **0** or **5**, respectively, and conductors **3BE0** or **3BE5**, respectively, depending on the value of the digit, and over the contacts of the relays of the B-Digit Storage Register set for the value 0 or 5. Had the B digit been 2 or 7, the B-Digit Storage Register would have been set accordingly, and relay **77DT2** would be operated over a circuit completed to ground on conductor **E43**, over conductors **2** or **7**, respectively, and conductor **3BE2** or **3BE7**, respectively, depending on the valve of the digit, and over the contacts of the relays of the B-Digit Storage Register set for the value 2 or 7. Had the value of the B digit been 3 or 8, the B-Digit Storage Register would have been set accordingly, and relay **77DT3** would operate over a circuit completed to ground on conductor **E43**, over conductors **3** or **8**, respectively, and conductors **3BE3** or **3BE8**, respectively, depending upon the value of the digit, and over the contacts of the relays of the B-Digit Storage Register set for the value 3 or 8. Thus when the B digit is 0 or 5, relay **77DT0** of the Day Tens Translator operates; when the digit is 1 (present example) or 6, relay **77DT1** operates; when the digit is 2 or 7, relay **77DT2** operates, and when the digit is 3 or 8, relay **77DT3** operates.

In response to the registration of the C digit in the Third Storage Register of the Odd Storage Unit, and remembering that the value of said digit in the given example is 4, a circuit is completed for relay **77HT1** of

the Hour Tens Translator, said circuit being traced from battery through the winding of said relay, conductor HT4 in the group of conductors designated HTX, a set of contacts on relay 67OD, conductor 3CC4 in the group of conductors designated 3CCX, No. 4 contacts of relay 50C3–00, No. 2 contacts of relay 50C3–0, No. 5 contacts of relay 54C3–4, conductor C33, a set of contacts on relay 67OD, to ground. Had the C digit been 1 or 7, and the C-Digit Register of the Third Storage Unit been set accordingly, said relay 77HT1 would again be operated through a circuit completed over conductor HT1 or HT7, respectively, conductors 3CC1 or 3CC7, respectively, through the relays of the C-Digit Register of the Third Storage Unit set for the value 1 or 7, to ground on conductor C33. Had the value of the C digit been 0, 3 or 6 and the C-Digit Register of the Third Storage Unit been set accordingly, relay 77HT0 would operate over conductors HT0, HT3 or HT6, respectively, conductors 3CC0, 3CC3 or 3CC6, respectively, through the relays of the C-Digit Register of the Third Storage Unit set for the value 0, 3 or 6, to ground on conductor C33. Similarly, if the C digit had the value 2, 5 or 8, then relay 77HT2 would operate over conductors HT2, HT5 or HT8, respectively, conductors 3CC2, 3CC5 or 3CC8, respectively, through the relays of the C-Digit Register of the Third Storage Unit set for the value 2, 5 or 8, to ground on conductor C33. Thus if the C digit, designating the Hour Tens digit, has the value 0, 3 or 6, relay 77HT0 operates; if said digit has the value 1, 4 or 7, relay 77HT1 operates, and if said digit has the value 2, 5 or 8 relay 77HT2 operates.

Also, depending upon the registered value of the C digit, two relays will be operated in the Minute Tens Translator, shown in Fig. 78. In the example assumed, in which the B digit is 1, thus indicating that the value of the Minute Tens digit must be in the Low Category, a circuit is completed for relay 78MTL, which circuit may be traced from battery through the winding of said relay, conductor MTL1 within the group of conductors designated MTLX, a set of contacts on relay 67OD, conductor 3BC1 in the group of conductors designated 3BCX, No. 7 contacts of relay 49B3–1, No. 4 contacts of relay 49B3–0, conductor C36, a set of contacts of relay 67OD, to ground. It will be noted that the same relay 78MTL will operate if the B digit has the value 0, 2 or 3 since, under such circumstances, the Minute Tens Digit would be in the Low Category. The circuit of said relay 78MTL when the value of the B digit is 0, 2 or 3 is traced over conductors MTL0, MTL1 or MTL3, respectively, in the group of conductors designated MTLX, conductors 3BC0, 3BC2 or 3BC3, respectively, in the group of conductors designated 3BCX, and through the contacts of the relays of the B register of the Odd Storage Unit set for the appropriate one of the above values, to aforetraced ground on conductor C36. If the B digit has the value 5, 6, 7 or 8, thereby indicating that the Minute Tens digit would be in the High Category, then relay 78MTH would be operated over a circuit traceable over conductors MTL5, MTL6, MTL7 or MTL8, respectively, conductors 3BC5, 3BC6, 3BC7 or 3BC8, respectively, and through the contacts of the B-Digit Register of the Odd Storage Unit set for the appropriate one of the above values, to aforetraced ground on conductor C36.

In the same manner and because the value of the C digit in the given example is 4, thereby indicating that the Minute Tens digit is in the Middle Division of either the High or Low Categories, a circuit is completed for relay 78MT14, said circuit being traced over a path extending from battery through the winding of relay 78MT14, conductor MT144 in the group of conductors designated MT14X, a pair of conductors on relay 67OD, conductor 3CE4 in the group of conductors designated 3CEX, No. 9 contacts of relay 50C3–4, No. 10 contacts of relay 50C3–4, No. 11 contacts of relay 50C3–00, conductor E33, a set of contacts on relay 67OD, to ground. It should be noted that the same relay will be operated if the value of the C digit is 3 or 5, since said values also call for a Minute Tens digit in the Middle Division of the High and Low Categories. If the C digit has the value 0, 1 or 2, indicating that the Minute Tens digit would be in the Low Division of the Low and High Categories, relay 78MT03 will be operated by a circuit completed over conductor MT140 or MT141 or MT142, respectively, through the contacts of the relays of the C-Digit Third Storage Register set for the values 0, 1 or 2, respectively, to ground on conductor E33. If the C digit has the value 6, 7 or 8, indicating that the Minute Tens digit will be found in the High Division of the Low and High Categories, then relay MT25 will be operated by a circuit completed over conductor MT146, MT147 or MT148, respectively, through the relays of the C-Digit Third Storage Register set for the values 6, 7 or 8, respectively, to ground on conductor E33.

For the purpose of the present description, in which it is assumed that the recorded start time is "14945" as recorded on the second line of the message entry and registered in the third register of the Odd Storage Unit, relays 77DT1, 77HT1, 78MTL and 78MT14 will have been operated as above described. Each of the relays 77DT1, 77DT2 and 77DT3 has an armature connected to that conductor in each of the CHX and EMX groups which characterizes in the punch code of Table III the particular digit indicated by the relay. Thus relay 77DT1 has its No. 6 armature connected to the CH1 conductor and its No. 5 armature connected to the EM1 conductor to indicate the numeral "1;" relay 77DT2 similarly has its armatures 6 and 5 connected to conductors CH2 and EM2, respectively, to indicate the numeral "2;" relay 77DT3 has its Nos. 5 and 4 armatures connected to the CH3 and EM3 conductors, respectively, to indicate the numeral "3." Relay 77DT0 has no cross-connection to any of the conductors of the CHX and EMX group because no punches are produced on the card when the Day Tens digit is "0."

Similarly, the Hour Tens relays 77HT1 and 77HT2 have their armatures 5 and 4 connected to conductors CH1 and EM1, CH2 and EM2, respectively, to indicate the numerals "1" and "2" when the Hour Tens digit is 1 or 2, respectively. As in the case of relay 77DT0, relay 77HT0 has no connections to the CHX and EMX conductors because when the Hour Tens digit is "0" no punches therefor are produced on the card.

In the same manner and for a similar reason, relays 78MT03, 78MT14 and 78MT25 have connections to the CHX and EMX conductors. Relay 78MT03, which is operated when the Minute Tens digit is either 0 or 3, has its Nos. 3 and 2 stationary contacts connected to conductors CH3 and EM3, respectively, to indicate the numeral "3," there being no connection for the numeral "0;" relay 78MT14, which operates when the Minute Tens digit is 1 or 4, has its Nos. 6 and 5 stationary contacts connected to conductors CH1 and EM1, respectively, to designate the numeral "1," and its Nos. 4 and 3 stationary contacts connected to conductors CH4 and EM4, respectively, to designate the numeral "4." Likewise with relay 78MT25 which, operating when the Minute Tens digit is 2 or 5, has its stationary contacts 5 and 4 connected to conductors CH2 and EM2, respectively, to designate the numeral "2," and its stationary contacts 3 and 2 connected to conductors CH5 and EM5 to designate the numeral "5." As will be explained more fully in a subsequent section, the paths through all of the above contacts are effective to establish a pulse circuit to the involved punch magnets of the punch mechanism, thereby to cause said magnets to operate and punch holes on the card to express in the IBM code the digits of the start (or answer) time.

5.3. *Called number translation*

The called line number, recorded in the fourth line

of the entry and registered in the Seventh Storage Register of the Odd Storage Unit requires, of course, no translation. However, the called line number may consist of three digits, or four digits with or without a party letter, or five digits. Since no digit space in the record is left blank and, therefore, must either have a significant numeral or a zero recorded therein, it becomes necessary to determine which and how many of the numerals in the fourth line of the entry (exclusive of the A digit) constitute the called line number. Obviously the number 28970 recorded in the fourth line of the entry may constitute the whole of a five-digit number; again, it might be a four-digit number with a zero in the F digit position, inserted therein to fill up the line. Or, as another example, the number recorded might be 89700, which would mean that the called line number might be a five-digit number, or a four-digit number with or without a party letter, or three-digit number with zeros for the E and F digits.

The key as to the number of digits that make up the called line number, and whether the fifth or F digit constitutes a party letter is furnished by the value of the C digit in the third line of the message entry. For all tapes emanating from what has been called the computer and processed by the apparatus, the relationship between the value of the C digit in the third line of the entry and the number of digits in the called line number recorded in the fourth line of the entry is shown in Fig. 103F. For all tapes produced by what has been called the assembler-computer, the same relationship is shown in Fig. 104D, the relationship of all C digits to the called line number for all tapes being combined in table V.

TABLE V

Class of Tape	Value of C Digit	Called Line Number
Toll	0	3 numerals.
Do	1	4 numerals with or without party letter.
Do	2	5 numerals.
Message Unit	3	3 numerals.
Do	4	4 numerals with or without party letter.
Do	5	5 numerals.
Message Unit Detail	6	3 numerals.
Do	7	4 numerals with or without party letter.
Do	8	5 numerals.

For a Toll Message Unit Tape, therefore, the C digit in the third line of the entry may have the value 0, 1 or 2, depending upon whether the called line number consists of three digits, four digits with or without a party letter, or five digits, respectively. Since, in the present example, the value of the C digit is 1, the called line number is a four-digit number with or without a party letter.

At the time that relay **67OD** operated, and due to the fact that the digit is registered in the B digit register of the Fifth Storage Register, relay **30CN1** of the called number index translator is operated, the circuit of said relay being traced from battery through the winding of said relay, conductor **CN1** in the group of conductors designated CN, a pair of contacts on relay **67OD**, conductor **SCE1**, No. 8 contacts of relay **43C5–1**, No. 5 contacts of relay **435–0**, conductor **E27**, a pair of contacts on relay **67OD** to ground, said relay also operating if the numeral registered is **407** to conform with the relationship given in Table V in respect to message unit and message unit detail tapes, respectively.

Now when the Seventh Storage Register is operated to register therein the "called line number" 28970, and relay **67OD** is operated, one of the relays in the called party translator, shown in Fig. 25, is operated in accordance with the value of the F digit. For the value 0, relay **25F0** is operated over the following path: battery through the winding of said relay, conductor **F00** in the group of conductors designated FXX, a set of contacts on relay **67OD**, conductor **7FC0** in the group of conductors designated 7FCX, the No. 5 contacts of relay **39F7–3**, No. 4 contacts of relay **F7–1**, No. 4 contacts of relay **39F7–2**, conductor **C24**, a set of contacts of relay **67OD**, to ground. Similarly, if the F digit had the value 1, relay **25F1** would have been operated over conductor **F11** to the same ground through the contacts of the F-Digit Register, set for the value 1. If the value of the digit had been 2, then relay **25F2** would have been operated over conductor **F22** to the same ground over the contacts of the relays of the F-Digit Register, set for the value 2. The same would be true of relay **25F3**, operated to the same ground over conductor **F33**; relay **25F4** operated to the same ground over conductor **F44**; relay **25F5J** operated to the same ground over conductor **F55**; relay **25F6M** operated to the same ground over conductor **F66**; relay **25F7R** operated to the same ground over conductor **F77**; relay **25F8** operated to the same ground over conductor **F88**; and relay **25F9W** operated to the same ground over conductor **F99**.

It will be observed that relays **25F5J**, **25F6M**, **25F7R** and **25F9W** have been given a letter suffix corresponding to party letters usually used in telephone practice to designate one of the four stations on a four-party line. It would follow, therefore, that if relay **25F5J** is operated in response to the F digit being a 5 instead of 0 as assumed, the called line number, if it is a four-digit number with a party letter, would be 2897J, and would have to be so recorded on the card. Similarly, if relay **25F6M** is operated in response to the F digit being 6, and the called line number is a four-digit number with a party letter, said number would be 2897M, and would have to be so recorded on the card, as would also be the case if relay **25F7R** were to be operated to make the number 2897R, and relay **25F9W** were to be operated to make the number 2897W.

However, the called line number might be a five-digit number (if so indicated by the C digit of the third line of the entry being 2, 5 or 8) with the F digit being any value from 0 to 9. It becomes necessary, therefore, when the F digit of the called line number is 5, 6, 7 or 9 to distinguish between whether the digit signifies its decimal value or its corresponding letter designation.

Before describing the manner in which the above distinction is made, attention is called to the fact that the two upper armatures of relays **25F0** to **25F4**, inclusive, and relay **25F8**, are severally connected to the appropriate conductors in the CHX and the EMX groups of conductors in accordance with the value of the digit they represent. Relay **25F5J**, however (because its operation may signify either the digit 5 or the party letter J), has its No. 5 and No. 6 armatures connected to the conductors **CH11** and **EM11**, respectively, and its No. 7 and No. 8 armatures connected to conductors **CH1** and **EM1**, respectively, to give effect to the operation of the relay when it indicates the party letter J, and further has its No. 3 and No. 4 armatures connected to conductors **CH5** and **EM5**, respectively, to give effect to its operation when said operation is to signify the decimal value 5. In the same manner, relays **25F6M**, **25F7R** and **25F9W** also have, as shown in Fig. 25, appropriate ones of their armatures connected to the appropriate overpunch conductors **CH12**, **CH11**, **CH0** and **EM12**, **EM11** and **EM0**, together with other armatures connected to the appropriate underpunch conductor to signify their appropriate letters as indicated, and another group of armatures connected to conductors **CH6**, **EM6**, **CH7**, **EM7** and **CH9**, **EM9**, respectively, to give effect to the operation of said relays to express the decimal values 6, 7 and 9, respectively.

The manner in which the distinctions are made in the significance of the various digits of the fourth line of the message entry (called line number) will now be described. If the called line number consists of three numerals, the digits thereof will be in the B, C and D digit positions on

the fourth line of the message entry, and the E and F digits of said line will be zeros. Since for a three-digit number the C digit of the third line of the entry will be 0, 3 or 6 as indicated in the above table, relay **80CN0** will be operated as above described. Let it now be assumed that the called line number is 289. The fourth line of the message entry therefore will read 028900. This means that in the card to be produced for the message entry (see Fig. 105) the digit 2 will be punched in the "hundreds" column of the called line number (by the operation of punch magnet **89PM20** of the punching device as will be later described), the digit 8 will be punched in the "tens" column of the called line number (by the operation of punch magnet **89PM21**) and the digit 9 will be punched in the "units" column of the called line number (by the operation of punch magnet **89PM22**). Consequently upon operation of relay **80CN0**, and remembering that the digit 2 is registered in the B-Digit Register of the Seventh Storage Register, conductors **C20** and **E20** from the relays of the B-Digit Register are extended over the contacts of relay **67OD** to conductors CTHC and CTHE, respectively. Because of the operation of relay **80CN0**, said latter conductors are transferred, in turn, over the No. 2 and No. 1 contacts, respectively, of said relay to conductors CHC and CH, respectively. For the production of cards for toll message entries (present example) the latter two conductors severally extend in the manner to be described to the windings of relays **71P20C** and **71PC20**, respectively, which relays, will effect the operation of punch magnet **80PM20**. Also, as will be later described, when the card is being punched, the digit 2 registered in the B-Digit Storage Register will be punched in the "called hundreds" column of the card by the operation of punch magnet **89PM20**.

The digit 8 is stored in the C-Digit Register of the Seventh Storage Register. Upon the operation of relay **67OD**, and because relay **80CN0** is operated, conductors **C21** and **E21** from said C-Digit Register are extended over the contacts of relay **67OD** to conductors CHC and CHE, respectively. Over the No. 4 and No. 5 contacts of relay **80CN0**, said conductors are respectively extended in turn to the conductors CTC and CTE. For a toll type card (present example) said latter conductors are connected (as will be shown) to relays **71P21C** and **71PC21**, both of which relays control the operation of punch magnet **29PM21** for the "called tens" column on the card so that, at the appropriate time as hereinafter pointed out, the digit 8 stored in the C-Digit Register will be punched in said "called tens" column.

The digit **9** is stored in the D-Digit Register of the Seventh Storage Register. Upon the operation of relay **67OD**, and due to the operation of relay **80CN0**, the two conductors **C22** and **E22** from said digit register are extended over the contacts of relay **67OD** to conductors CTC and CTE, respectively. Over the No. 6 and No. 5 contacts of relay **80CN0**, however, the latter conductors are connected to conductors CUC and CUE, respectively, which, for a toll entry, are extended to relays **71P22C** and **71PC22**, respectively. These relays, as will hereinafter be pointed out, control the operation of punch magnet **29PM22** in the "called units" column of the called line column on the card.

Thus it is seen that for a three-digit number, relay **80CN0** is operated in order to shift the "punch" conductors from the B, C and D-Digit Registers to the hundreds, tens and units columns of the card, respectively, so that when the card is produced in the manner hereinafter set forth, the three digits of the number recorded in the fourth line of the entry and in the B, C and D digit positions thereof will be properly recorded in the called hundreds, tens and units columns, respectively, of the card.

It will be noted that the punch leads **C23** and **E23** of the E-Digit Register (in which it is assumed that the zero digit is registered for a three-digit number) are extended by the operation of relay **67OD** to conductors CUC and CUE, respectively. However, the latter conductors can be extended to conductors CUC and CUE, respectively, only from the contacts of relays **80CN1** or **80CN2** which are normal for a three-digit number. Hence the zero digit registered in the E-Digit Register will have no effect.

As was previously described, the setting of the F-Digit Register of the Seventh Storage Unit will cause the operation of one of the relays of the called party translator (Fig. 25), depending upon the digital setting of the register for a three-digit number. The F-Digit Register, being set for 0, relay **25F0** will be operated as previously described. The operation of the latter relay, however, will have no effect, since the pulse ground subsequently to be transmitted over the **CH0** and **EM0** conductors for operating a punch magnet controlled over the contacts of said relay will have no circuit to said punch magnet since conductors CPC and CPE connecting with the other stationary contacts of relay **25F0** are open at relay **80CN0** which is already normal for a three-digit number.

When the called line number consists of four digits with or without a party letter, said digits will occupy the B, C, D and E digit positions in the fourth line of the entry, and the F digit will be 0 if the number contains no party letter, or 5, 6, 7 and 9 if it does contain a party letter. Also, relays **80CN1** and **80CN12** are operated as above described. Consequently conductors **C20** and **E20** from the B-Digit Register, which are connected to conductors CTHC and CTHE, respectively, by the operation of relay **67OD**, are further extended over the No. 2 and No. 1 contacts, respectively, of relay **80CN12** to conductors CTHC and CTHE that are connected to the relays **71P19C** and **71PC19** controlling the operation of the punch magnet **89PM19** in the "called thousands" column of the card; the conductors **C21** and **E21** from the C-Digit Register, connected to conductors CHC and CHE, respectively, by the operation of relay **67OD**, are further extended over the No. 4 and No. 3 contacts of relay **80CN12** to conductors CHC and CHE, respectively connected to relays **71P20C** and **71PC20** controlling the operation of punch magnet **89PM20** in the "called hundreds" column of the card; conductors **C22** and **E22** from the D-Digit Register, connected to conductors CTC and CTE, respectively, by the operation of relay **67OD**, are further extended over the No. 5 and 6 contacts, respectively, of relay **80CN12** to conductors CTC and CTE connected, respectively, to relays **71P21C** and **71PC21** which control the operation of punch magnet **89PM21** in the "called tens" column of the card; conductors **C23** and **E23** from the E-Digit Register, connected respectively to conductors CUC and CUE by the operation of relay **67OD**, are further extended over the Nos. 4 and 3 contacts, respectively, of relay **80CN1** to conductors CUC and CUE connected to relays **71P22C** and **71PC22** controlling the operation of magnet **89PM22** in the "called units" column of the card. If, now, the F digit is 0, as it would be if the called number has no party letter, then, as above described in connection with a three-digit called line number, relay **25F0** will operate without effect. But if the called line number does contain a party letter, then the F digit will be 5, 6, 7 or 9 depending upon the letter, and relay **25F5J**, **25F6M**, **25F7R** or **25F9W** will operate respectively as above described. If we assume by way of example that the party letter is "J," then the F digit will be 5 and relay **25F5J** will operate. Under this condition and since relay **80CN1** is operated, conductors **CPC1** and **CPE1** extending from the overpunch and underpunch relays **14OVP** and **14UP** are extended to conductors CPC and CPE, respectively, which extend to relays **71P23C** and **71PC23**, respectively, controlling the operation of punch magnet **89PM23** in the "party" column of the called line number. As will be shown, when the card

for a toll entry having a called number with four numerals and a party letter is being punched, relay **14OVP** will be operated and will cause the magnet **89PM23** to punch two punches in the party column of the card depending upon the code of the letter as above given in Table III.

If the called number consists of five numerals, then the F digit may have any value, and the appropriate one of the relays in the called party translator (Fig. 25) will operate. Relay **80CN2** will also operate as above described. On this occasion, however, the operation of the latter relay will connect conductors CPC and CPE to the extension thereof that connect with relays **71P23C** and **71PC23**. When, at the time the card is being punched, relay **14UP** will operate to cause the punch magnet **89PM23** to produce but one punch in the party column of the card depending upon the numerical value of the F digit.

5.4. Service observation index translator

The B digit in the fifth line of the message entry is known as the "message unit index" (see Fig. 103A) for Computer tapes, and as the "observing index" for Detail tapes (see Fig. 104C). Its significance in relation to the disposition of the chargeable time appearing in the C and D digits, and the message units which appear in the E and F digits of both tapes is to be considered with respect to whether the tape which is being processed is a Computer tape or a Detail tape. In connection with the Computer tapes (one of which, the Toll tape, is herein being used in connection with illustrating the detailed operation of the invention) the B digit may have any value from 0 to 3, inclusive, as noted in Fig. 103C. Thus in connection with any of the Computer tapes, the value 0 indicates that the chargeable time appearing in the C and D digits is to be recorded on the card as registered in the Ninth Storage Register, and also that the toll or message units, if any, appearing in the E and F digits are also to be recorded on the card as registered. If the B digit has the value "1," then the message units shown in the E and F digits are those which apply to a particularly designated extended area which, for example, we may say is the "extended area No. 1" wherein the message charge unit has a different monetary value than it has for a local call. If the B digit has the value "2," it has the same significance as when it has the value "1" except that the message units shown in the E and F digits are those which apply to another extended area which, for the sake of illustration, may be designated as extended area No. 2, the latter differing from extended area No. 1 by the fact that the monetary value of its message unit differs from the one which applies to the extended area No. 1 and, of course, also differs from the value for the unit on local calls. If the B digit has the value "3," it means that the call was an observed call and that the charges appearing in the fifth line of the message entry should be canceled.

When, however, we are dealing with a Detail tape, the B digit of the fifth line of the entry may have any value from 0 to 4, inclusive, as shown in Fig. 104C, and it will there be noted that when the B digit has the value 1, 2, 3 and 4 it pertains to an observed call, whereas if it has the value of "0" it has the same significance as it has for a Computer tape. The effect of these digits in respect to observed calls will be described later in connection with the operation of the apparatus in response to observed entries.

In accordance with Figs. 103A, 103C, and by way of illustrating the operation of the Observing Index Translator shown in Fig. 79, it has been assumed that the B digit of the fifth line of the message entry has the value "0" as shown on Fig. 100. Consequently when the Ninth Storage Register, and particularly the B-Digit Register thereof, has been set to the value of "0," a circuit is completed for relay **79OI0**, the path of which extends from battery through the winding of relay **79OI0**, conductor **OB0**, the No. 2 terminal and fifth brush of the tape type switch **6TT** which, it will be recalled, has its brushes set on terminal **2** for the processing of a Toll tape, conductor **OB01**, No. 11 contacts of relay **68OD**, conductor **A1**, the last set of contacts of relay **67OD**, continuation of said conductor **A1** to the No. 4 contacts of relay **55A11**, conductor A, No. 6 contacts of relay **68OD**, conductor **0**, a set of contacts on relay **67OD**, conductor **0**, conductor **9B0**, No. 5 contacts of relay **28B9–3**, No. 4 contacts of relay **28B9–1**, No. 4 contacts of relay **28B9–2**, conductor **C3**, set of contacts of relay **67OD**, to ground. Relay **79OI0** operates in said circuit and performs certain functions that are noted hereinafter.

It should be observed that if the value of the B digit is 0 or 1 or 2, the same relay **79OI0** would be operated, inasmuch as its path is traced from conductor A to the No. 6 contacts of relay **68OD** in succession depending upon the value of the digit, then either through the No. 7 contacts of said relay or the No. 8 contacts of said relay depending upon whether the value of the digit is 1 or 2, respectively, and then through conductors **1** or **2**, contacts of relay **67OD**, through conductors **9B1** or **9B2**, through the setting of relays **28B–**, over conductor **C3**, to ground on a set of contacts of relay **67OD**.

If the digit is for an Observed call on a Detail Tape, then the value of the B digit will be 3, and since the tape type switch **6TT** will be set upon terminals **4** (see Table I), relay **79OI1** will be observed over a path extending from battery through the winding of said relay, conductor **OB1**, switch **6TT** set on terminal **4**, conductor **OB01**, and thence as traced over said conductor to ground on conductor **C3**. A further function of relay **79OI1** will be described in connection with the processing of Service Observing tapes. For the present, however, and assuming that the Toll tape is being processed, the value of the B digit in the fifth line of the entry is 0, relay **79OI0** will be operated to perform certain functions hereinafter noted.

5.5. Toll units translation

As previously stated, the E and F digits in the fifth line of the entry may contain the number of "message units' to be charged for the call, each of these units, for the sake of illustration, having the arbitrary monetary value of five cents per unit. Where there are no such message units digits recorded, then the E and F digits are each 0. However, if there are such units recorded, then the same are to be translated into their equivalent monetary value together with the tax thereon, if any tax applies.

For the purpose of this translation, the Toll Unit Charge Translator shown in Figs. 22 and 23, the Toll Units Tax Translator shown in Figs. 11 and 12, and the Total Charge Translator shown in Figs. 11A and 12A are provided.

When the E and F digits of the fifth line of the entry are 00, relay **23T0** and relay **23T00** are operated as a consequence of the fact that the E-Digit Register of the Ninth Storage Register is set for 0, and relays **22U0** and **22U00** are operated as a consequence of the fact that the F-Digit Register of the Ninth Storage Register is set for 0. The circuit path of relay **23T0** is traced from battery through the winding of said relay, conductor **T0**, No. 50 contacts of relay **40OT**, conductor **9EE0**, No. 9 contacts of relay **31E9–3**, No. 3 contacts of relay **31E9–2**, No. 3 contacts of relay **31E9–1**, conductor **E5**, No. 10 contacts of relay **40OT**, to ground. The circuit of relay **23T00** may be traced from battery through the winding of said relay, conductor **T00**, No. 40 contacts of relay **40OT**, conductor **9EC0**, No. 5 contacts of relay **31E9–3**, No. 4 contacts of relay **31E9–1**, No. 4 contacts of relay **31E9–2**, conductor **C5**, to ground on the No. 9 contacts of relay **40OT**. The circuit path of relay **22U0** extends from battery through the winding of said relay, conductor **U0**, No. 30 contacts of relay **40OT**, conductor

9FE0, No. 9 contacts of relay 32F9–3, No. 3 contacts of relay 32F9–2, No. 3 contacts of relay 32F9–1, conductor E6, No. 8 contacts of relay 40OT, to ground. The path of relay 22U00 may be traced from battery through the winding of said relay, conductor U00, No. 20 contacts of relay 40OT, conductor 9FC0, No. 5 contacts of relay 32F9–3, No. 4 contacts of relay 32F9–1, No. 4 contacts of relay 32F9–2, conductor C6, No. 7 contacts of relay 40OT, to ground. All of said relays operate, and in so doing open their contacts connecting with the conductors EM0 and CH0 in the EMX and CHX groups of conductors, so that at the time that operations have proceeded to the point in the production of the card when the charge in dollars and cents is to be punched thereon, pulse ground will not pass to the punch and check relays 71PC46, 71P46C . . . 71PC48, 71P48C (which control punch magnets 89PM46 . . . 89PM48, punch magnet 89PM45 not being used). In this case, therefore, no charge will be punched on the card.

Let it be supposed, however, that the E and F digits have recorded therein five toll units; that is, the E digit is 0 and the F digit is 5. This means that the charge for the call is 25 cents. When, therefore, the E digit is 0 and the F digit is 5 as assumed, relays 23T0 and 23T00 will operate as before from the setting of the E-Digit Register. In the case of the F digit, however, the setting of the F-Digit Register for the digit 5 will cause ground from the contacts of relay 40OT to be applied to conductors E6 and C6, and said grounds are then applied through the contacts of the register to conductors 9FE5 and 9FC5, respectively. The ground on conductor 9FE5 is applied over the No. 25 contacts of relay 40OT to conductor U2, thereby to complete the circuit of relay 22U2, while the ground on conductor 9FC5 is applied over the No. 15 contacts of relay 40OT, to conductor U5, thereby to complete the circuit of relay 22U5. Both relays 22U5 and 22U2 operate. Since relays 23T1 and 23T4 are normal, and since certain of their contacts are multipled to conductors PHC and PHE connecting with punch and check relays 71P46C and 71PC46 controlling the punch magnet 89P46 for the "Units" dollar column (as will be shown), it is evident that this magnet will not operate to punch a hole in said column, agreeing with the fact that there is no dollar charge. Moreover, since relays 23T00 and 22U2 are both operated, conductors PTC and PTE which extend to relays 71P47C and 71PC47 controlling the operation of punch magnet 89PM47 in the "Tens" column of the cents charge, are advanced over the No. 1 and No. 2 contacts of relay 23T00, and the No. 7 and No. 6 contacts of relay 22U2 to conductors CH2 and EM2 of the CHX and EMX conductor groups, so that when pulse ground is applied to said two conductors at the time that the card is being punched in row 2 thereof, punch magnet 89PM47 will operate in the manner subsequently to be described to punch said card in the 47th column at row 2, to indicate that the tens digit of the cents charge is 2. In the same manner, and considering the fact that relay 22U5 is operated, conductors PUE and PUC connected to the No. 1 and No. 2 contacts thereof and extending to relays 71P48C and 71PC48 which control punch magnet 89PM48 in the units column of the cents charge, are extended directly over said contacts to conductors CH5 and EM5 of the CHX and EMX multiples, so that when the card is being punched in row 5 thereof pulse ground over said conductors CH5 and EM5 will cause the operation of relays 71P48C and 71PC48, thereby to cause the operation of punch magnet 89PM48, which will punch a hole in row 5 in the cents "Units" column of the card.

Where provision is made to include a tax on the card, the Toll Unit Tax Translator in Figs. 11 and 12 is provided. The relation between the charges and the tax is, of course, governed by the tax structure. In the present case, and by way of illustration, ten relays 11TU0 . . . 11TU9 are provided, which operate locally in accordance with which relay 22U0 . . . 22U4 and which relay 22U5 or 22U00 are operated, relay 22U5 operating when the F digit is odd and relay 22U00 operating when said digit is even. The armatures of the relays 11TU0 . . . 11TU9 extend to terminal block indicated in Fig. 71, and from tables included below, further showing specific cross-connections to appropriate punch and check relays 71P1C, 71PC1 . . . 71P80C, the appropriate punch magnets 89PM1 . . . 89PM80 are operated to punch holes in the "cents" and "mills in the tax columns of the card. The particular values to be punched, however, are controlled by relays 11TT0 . . . 12TT1, each of which operates locally from a relay 23T–. The stationary contacts of the various relays 11TT0 . . . 12TT1 are connected to the conductors of the CHX and EMX multiples in accordance with the monetary value of the tax. When a particular relay 11TU0 . . . 11TU9 operates, and the involved relay 11TT0 . . . 11TT1 is operated, the appropriate ones of the conductors in the CHX and EMX multiples are extended to the conductors connecting with the terminal blocks in Fig. 71. For instance, when relay 22U1 operates, relay 11TU1 is operated over the No. 1 contacts of relay 22U1 to ground on the No. 3 contacts of relay 22U00. If the E digit is "1," relay 23TT1 operates over the No. 1 contacts of relay 23T1 to ground on the No. 3 contacts of relay 23T00, whereupon relay 12TT1 operates over a local circuit from the contacts of relay 23TT1. If the E digit is "0," relay 23TT0 operates to ground on the No. 3 contacts of relay 23T00, whereupon relay 11TT0 then operates in a local circuit from the contacts of relay 23TT0. Since the stationary contacts of relays 11TT0 and 12TT1 are connected to conductors in the CHX and EMX multiples, the operation of either relay will then connect said conductors as applicable in accordance with whichever relay 11TU0 . . . 11TU9 has been operated, to cause the punch magnets 89PM51 . . . 89PM54 to punch the tax on the card.

In the event that any relay 23T2 . . . 23T5 operates, relay 12TT29 is operated, whereupon no tax is then included, the tax in such event being too large to be handled by the mechanical tax structure herein provided by way of example.

Provision is also made for punching holes in columns 55 . . . 58 of the card to indicate the total charge; that is, the charge for the call plus the tax thereon. This provision is in the form of a total charge translator shown in Figs. 11A and 12A. The relays 11A–TU0 . . . 11A–TU9 are companion relays to relays 11TU0 . . . 11TU9, and operate severally in parallel with them. Relays 11A–TT0 . . . 12A–TT1 are companion relays to relays 11TT0 . . . 12TT1 and operate severally in parallel with them. Relays 11A–TT0 . . . 12A–TT2 have their several stationary contacts connected to the CHX and EMX multiples in accordance with the values of the total charge and when the appropriate one of the relays 11A–TU0 . . . 11A–TU9 operates, appropriate ones of the conductors in the CHX and EMX multiples are connected through the contacts thereof (depending upon which relay 11A–TT0 . . . 12A–TT1 has operated) to conductors extending to terminal blocks in Fig. 71, whence they extend to punch and check relays 71P55C, 71PC55 . . . 71P58C, 71PC58 (as shown in tables below) which control the operation of punch magnets 89PM55 . . . 89PM58 in columns 55 . . . 58 of the card, reserved for the total charge.

In continuing with the description of the operation of the invention, it will be assumed that for the message entry being sensed and processed, the E and F digits in the fifth line of the entry are 00, in response to which relays 22U0 and 22U00 are operated, as well as 23T00 and 23T0. As a consequence, relay 23TT0 operates over a circuit from battery through its winding, No. 3 contacts of relay 23T0, No. 3 contacts of relay 23TT0, to ground; and relay 11A–TT0 operates from battery through its winding, conductor T0, to ground on the con-

tacts of relay 23TT0. Relays 11A–TU0 and 11–TU0 also operate from battery over conductor U0, No. 1 contacts of relay 22U0, No. 3 contacts of relay 22U0, to ground.

6. *Card punching*

6.1. *Operation of the punch and punch check control circuit*

When all of the various registers and translators have been set in preparation for punching the card, the check relay 8CUC is operated over a path involving all of said translators and registers to make certain that the one or more relays which are to be operated in said translators and said registers have operated in consequence of the circuit performances above-described, and all connectors are operated or normal, as the case may be. The path of relay 8CUC is as follows: Battery through the winding of relay 8CUC, No. 2 contacts of relay 8STG, conductor OUC29, No. 6 front contacts of relay 21OR, No. 1 back contacts of relay 21LR, No. 11 contacts of relay 21JAN, No. 1 back contacts of relay 21FEB, conductor OUC28, No. 1 contacts of relay 20MAR, No. 1 front contacts of relay 20APR, No. 1 back contacts of relay 20MAY, No. 1 back contacts of relay 20JUN, conductor OUC27, No. 1 back contacts of relays 19JULY, 19AUG, 19SEPT, 19OCT, 19NOV, 19DEC, conductor OUC26, No. 2 back contacts of relay 13–019A serially through similar contacts on relays 13–018A . . . 011A, No. 2 front contacts of relay 13–010A, conductor OUC25, No. 1 back contacts of relay 80OBC, No. 1 front contacts of relay 80REG, No. 4 back contacts of relay 80MUDA, No. 6 back contacts of relay MU, No. 1 front contacts of relay 80TOL, conductor OUC24, No. 1 back contacts of relay 79OBS, No. 1 contacts of relay 79OI0, No. 1 back contacts of relays 79OI1 . . . OI4, conductor OUC23, No. 1 back contacts of relay 78MT25, No. 1 front contacts of relay 78MT14, No. 1 back contacts of relay 78MT03, No. 1 back contacts of relay 78MTH, No. 1 front contacts of relay 78MTL, conductor OUC22, No. 1 back contacts of relay 77HT2, No. 1 front contacts of relay 77HT1, No. 1 back contacts of relay 77HT0, No. 3 back contacts of relay 77DT3, No. 4 contacts of relay 77DT2, No. 3 front contacts of relay 77DT1, No. 3 contacts of relay 77DT0, conductor OUC21, No. 1 back contacts of relay 25F9W, No. 2 contacts of relays 25F8, 25F7R, 25F6M, 25FSJ, 25F4, 25F3, 25F2, 25F1, No. 1 front contacts of relay 25F0, conductor OUC20, No. 5 back contacts of relay 80CN2, No. 6 front contacts of relay 80CN1, No. 7 contacts of relay 80CN12, No. 7 back contacts of relay 80CN0, conductor OUC19, No. 1 front contacts of relay 22UC, conductor OUC18, No. 1 back contacts of relay 11TT0, conductor OUC17, No. 1 contacts of relay 12TT29, No. 1 front contacts of relay 12TT1, conductor OUC16, No. 1 back contacts of relay 11TU0, No. 1 back contacts of relay 11TU1 serially through the No. 1 back contacts of relays 20TU2 . . . TU8, No. 1 back contacts of relay 11TU9, conductor OUC15, No. 4 back contacts of relay 22U5, No. 4 front contacts of relay 22U00, No. 6 front contacts of relay 22U0, No. 5 contacts of relays 22U1, 22U2, 22U3 and 22U4, conductor OUC14, No. 4 front contacts of relay 23T00, No. 4 back contacts of relay 23T5, No. 4 front contacts of relay 23T0, No. 5 contacts of relays 23T1, 23T2 and 23T3, No. 4 back contacts of relay 23T4, conductor OUC13, No. 2 contacts of relay 22UC, conductor OUC12, No. 12 contacts of relay 68IS, No. 30 contacts of relay 68TS, conductor OUC11, No. 8 contacts of relay 33O1SA, conductor OUC10, No. 1 contacts of relay 47OC, No. 1 back contacts of relay 47OEF, conductor OUC9, No. 5 contacts of relay 40OT, conductor OUC8, No. 3 contacts of relay 22UC, conductor OUC7, No. 1 contacts of relay 40OT, No. 7 back contacts of relay 40OMU, No. 8 contacts of relay 40OCT, conductor OUC6, No. 1 back contacts of relay 54OOC, conductor OUC5, No. 2 contacts of relay 67ODC, conductor OUC4, No. 11 back contacts of relay 13OI, conductor OUC3, No. 3 back contacts of relay 88EL1, conductor OUC2, No. 2 front contacts of relay 61OL, conductor OUC1, No. 5 contacts of relay 40OCT, conductor OUC, No. 5 contacts of relay 27UC9, conductor UC3, No. 4 contacts of relay 41UC5, conductor UC2, No. 4 contacts of relay 48UC3, conductor UC1, No. 4 contacts of relay 55UC1, to ground.

Upon the operation of relay 8CUC, a circuit is completed for relay 8PST over a path extending from battery through the winding of said relay, No. 4 contacts of relay 8PIC (which operated over conductor I3 to ground on the contacts of relay 89–3), No. 1 back contacts of relay 8POC, No. 3 contacts of relay 8CUC, to ground on conductor ON1. With relay 8PST operated and relay 8PSP normal, a path is closed between conductors I13 and I14 extending from the Gang Punch to operate relays 89–1 and 89–5 therein in the manner previously described, thereby to start a punch card cycle. Relay 89–5 completes the circuit of magnet 89MRM which starts the Gang Punch motor. Relay 89–1 operates the clutch magnet 89CM to start the card punch cycle, which means that the card to be punched will be positioned in row 12 for punches to be produced therein, if any, by the punch magnets, and the emitter arm (hereafter called the emitter) is given one revolution. Relay 89–15 operated when the first card reached the punch card position. As a result, during the succeeding card cycles the circuit breaker CB which closes for approximately 13 milliseconds in each punch position, is closed to the emitter, and ground from the circuit breaker CB is passed along to the emitter and from the latter to each of the conductors 12, 11, 0 . . . 9 as the emitter sweeps over the commutator associated therewith.

When relay 5MON operated, it applied ground to conductor MON1, in consequence of which a circuit is completed for relay 9–120 over a path extending from ground on said conductor MON1, serially through the No. 2 contacts of relay 10–9E . . . 10–5E, 9–4E . . . 9–OE, No. 1 back contacts of relay 9–11E, winding of relay 9–120, to battery. At the same time said ground on conductor MON1 is applied over the No. 2 back contacts of relay 9–11E to conductor EM12 in the EMX multiple. Upon the operation of relay 9–120, a circuit is completed for relay 14ONP, said circuit extending from battery through the winding of said relay, conductor ONP, No. 2 front contacts of relay 9–120, to ground on conductor MON1. Also, a circuit is closed for relay 14OVP, extending from battery through the winding of said relay, conductor OP, No. 1 contacts of relay 9–120, to ground on conductor MON1. The operation of relays 14OVP and 14ONP causes ground on conductor MON1 to be applied over the No. 1 back contacts of relay 9–11E, conductor COV, No. 1 contacts of relay 14ONP, No. 1 contacts of relay 14OVP, conductor C12, to conductor CH12 in the CHX multiple.

Thus when the Gang Punch is ready to punch a card at the beginning of a punching cycle, and prior to the emitter engaging the segment 12 to apply ground to conductor 12, ground will have been applied to conductors CH12 and EM12 for use in operating punch magnets in row 12 of the card. It should be noted that the emitter, while connected to the circuit breaker CB is also connected to conductor I10. Consequently when the Gang Punch starts on a card cycle, the ground applied to the emitter is also applied to conductor I10. Now when the emitter reaches segment 12 and applies ground to conductor 12, the ground on said conductor 12 completes a circuit for relay 9–12, said circuit extending from ground on said conductor 12 applied thereto by the emitter, winding of relay 8R, to battery, and in parallel therewith over the No. 5 contacts of relay 8CUC, conductor 12, winding of relay 9–12 to battery. The operation of relay 8R unlocks relay 8STG which releases to insure that the circuit of relay 8CUC will not be reclosed unless

relay 8STG is reoperated at the beginning of the next card cycle. Relay 9–12, in operating, completes a circuit for relays 3CH and 3CHA from ground on conductor MON1, No. 2 front contacts of relay 9–12, conductor CH, winding of relay 3CH, to battery, and in parallel therewith, winding of relay 3CHA to battery. The latter two relays operate and lock over the No. 2 back contacts of relay 3C9 to ground on conductor ON.

It should be noted at this time that when ground was applied to conductors EM12 and CH12 prior to the transmission of the pulse over conductor 12, whatever punch magnets 89PM1 . . . 89PM80 should be operated to produce punches in row 12 in the various columns of the card, are operated by the operation of the control relays 71PIC, 71PCT . . . 71P8OC, 71PC80, one in each pair of which completes the circuit of the punch magnet it controls. The manner in which the relays and the magnets are operated will be later described in connection with actual punching of the card, but at this point it will suffice to assume the operation, the signal for which is the completion of a circuit for relay 3PC, said circuit extending from battery through the winding of said relay, No. 3 back contacts of relay 3PCT, conductor PC, the No. 1 back or No. 1 front contacts of the different pairs of relays 71PIC, 71PCI . . . 71P80C, 71PC80, depending upon whether said pairs are operated or normal, conductor CG, No. 4 back contacts of relay 3PCT, conductor CB, No. 2 contacts of relay 8CUC, conductor 110, to ground on the circuit breaker CB. The operation of relay 3PC indicates that the magnet control relays are operated or normal in pairs for a punching operation, relay 3PC releasing at the end of the pulse from circuit breaker CB and reoperating on the next pulse.

To check the 12th pulse, the operation of relay 9–12 closes a circuit for relay 3C12, said circuit extending from battery through the winding of said latter relay, No. 12 contacts of relay 3CHA, No. 12 contacts of relay 3PC, conductor 12F, No. 3 contacts of relay 9–12, conductor A12, No. 6 contacts of relay 81C1A, No. 5 back contacts of relay 81C1E, No. 2 back contacts of relay 81C10, conductor MON2, to ground thereon supplied over the No. 9 contacts on relay 5MON. The operation of relay 3C12 checks the fact that a pulse has been applied to conductor 12 by the emitter. Over its No. 1 front contacts, relay 9–12 completes an obvious circuit for relay 9–11P which operates and then locks over its No. 2 contacts to ground on conductor MON1 over the previously traced chain path beginning with the No. 1 back contacts of relay 9–OE. When the emitter is disengaged from conductor 12, relay 9–12 releases. However, due to the fact that its No. 2 contacts are "continuity" contacts (the back contact making with the armature before the front contact opens) the relay completes a locking circuit for relay 3C12, said circuit extending from battery through the winding of said relay, No. 12 contacts of relay 3CHA, No. 1 contacts of relay 3C12, conductor 12B, No. 2 back contacts of relay 9–12, to ground on conductor MON1. Over its No. 1 back contacts, relay 9–12 completes a circuit for relay 9–11E, said circuit being traced from battery through the winding of said relay, No. 1 contacts of relay 9–11P, No. 1 back contacts of relay 9–12, to ground on conductor MON1. Thus, while the emitter is on an insulating segment between conductor 12 and conductor 11, relay 9–11E is operated. When said relay operates, the ground on conductor MON1 which is applied to its No. 1 and No. 2 armatures is now extended over its No. 1 front contacts to conductor EM11 in the EMX multiple and over its No. 2 front contacts to conductor CH11 in the CHX multiple. Now when the emitter is between segments 11 and 12, the card is advanced to row 11 for punching and, as will be shown later, when ground is applied to conductors CH11 and EM11, all relays of the system which are operatively connected to said conductors will cause the appropriate circuits to be closed to the involved relays 71PC1, 71P1C . . . 71PC80, 71P80C for causing the operation of whichever punch magnets 89PM1 . . . 89PM80 are to be energized thereby to punch holes in the various columns of the card in row 11. It should be noted that the No. 2 front contacts of relay 9–11E not only apply ground to conductor CH11 in the CHX multiple, but also completes the circuit of relay 9–110 while, at the same time, the breaking of its No. 1 back contacts will cause the release of relay 9–120. Relays 14OVP and 14ONP, however, will not release with the release of relay 9–120 inasmuch as holding circuits therefor are supplied over the No. 2 front contacts of relay 9–110, the No. 2 back contacts of relay 9–120, to ground on conductor MON1.

When the emitter advances to the 11th segment, ground is applied to conductor 11, whereupon a circuit is completed for relay 9–11 over a path from ground on said conductor 11, No. 6 contacts of relay 8CUC, winding of relay 9–11 to battery. This relay operating, completes a circuit from ground on conductor MON1, over its No. 3 front contacts, conductor 11F, No. 11 contacts of relays 3PC and 3CHA, winding of relay 3C11, to battery. Relay 3C11 operates to check when the 11th pulse has been transmitted and, as before, when the pulse is terminated and relay 9–11 is released, said relay 3C11 locks over the No. 11 contacts of relay 3CHA, No. 1 contacts of relay 3C11, conductor 11B, No. 3 back contacts of relay 9–11, to ground on conductor MON1. Over its No. 2 contacts, relay 9–11, when operated, completes a circuit for relay 81C10, said circuit extending from ground on conductor MON1, No. 2 contacts of relay 9–11, conductor F11, No. 1 back contacts of relay 81C3A, No. 1 back contacts of relay 81C2A, No. 1 contacts of relay 81C1A, conductor C1B, No. 6 contacts of relay 67ODC, conductor C10, winding of relay 81C10 to battery, said relay operating and locking to ground on conductor ON. The operation of relay 81C10 is an indication that the processing of a card is in progress, just as when relay 81C1A operated it indicated that the circuit was preparing for a card (and also indicating that one card is to be produced for the entry). Over its No. 1 front contacts, relay 9–11 completes an obvious circuit for relay 9–OP which, upon operating, locks over its No. 2 contacts and No. 1 back contacts of relay 9–1E, to ground on conductor MON1 previously traced thereto. When the emitter advances into the insulating section between commutating segments 11 and 0, relay 9–11 releases, completing a circuit for relay 9–OE over the No. 1 contacts of relay 9–OP. Relay 9–OE operates, unlocks relay 9–11P which, in turn, releases relay 9–11E which, in turn, releases relay 9–110. Over its No. 1 front contacts, relay 9–OE applies ground to conductor EM0 in the EMX multiple, and over its No. 2 front contacts it completes an obvious circuit for relay 9–00 which operates to complete the circuit of relay 14OVP over conductor OP, its front contacts, No. 2 back contacts of relays 9–110 and 9–120, to ground on conductor MON1. Relay 9–OE also applies ground over its No. 2 front contacts, conductor CO1, No. 1 contacts of relay 14UNP (which operated to ground through the No. 1 back contacts of relay 9–110 and No. 2 back contacts of relay 9–120 when both of said relays are released), conductor CO, to conductor CHO in the CHX multiple. Since the card has been advanced in the meanwhile to row 0, the presence of ground on conductors CH0 and EM0 will cause the operation in the manner to be described of all punch magnets whose circuits are completed by way of the control relays 71PC1, 71P1C . . . 71PC80, 71P80C which are operated from ground on said conductors.

When the emitter reaches segment 0 and applies ground to conductor 0, a circuit is completed for relay 9–0, said circuit extending from ground on said conductor 0, No. 7 contacts of relay 8CUC, conductor 0, winding of relay 9–0 to battery. Relay 9–0 operates. Over its No. 3 contacts it completes a circuit from battery through the

winding of relay 3C0, No. 0 contacts of relay 3CHA, No. 0 contacts of relay 3PC, conductor OF, No. 3 contacts of relay 9–0, conductor A0, No. 2 contacts of relay 81C1A, conductor OA, No. 7 contacts of relay 67ODC, conductor OA0, No. 2 contacts of relay 81C1E, No. 2 front contacts of relay 81C10 (thus checking that the latter relay is operated) to ground on conductor MON2. The No. 2 contacts on relay 9–0 are continuity contacts, so that the No. 3 contacts make before the No. 2 contacts break. Hence at the end of the pulse when relay 9–0 releases, a locking circuit is established for relay 3C0 over the No. 0 contacts of relay 3CHA, No. 1 contacts of relay 3C0, conductor OB, No. 2 contacts of relay 9–0 to ground on conductor MON1.

Over its No. 1 front contacts, the operated relay 9–0 completes an obvious circuit for relay 9–1P which operates and locks over its No. 3 contacts and the No. 1 back contacts of relay 9–2E to previously traced ground on conductor MON1. There is no circuit through the No. 2 contacts of this relay at this time since the relay 68TS, which operates on the production of Ten Summary Cards as will be described, is normal at this time. When the emitter disengages segment 0 and thereby removes ground from conductor 0, relay 9–0 releases, locking relay 3C0 as above described and completing a circuit for relay 9–1E over the No. 1 back contacts of relay 9–1P. Relay 9–1E, on operating, unlocks relay 9–OP which, in turn, releases relay 9–OE to release relay 9–00, the latter releasing relay 14OVP to disconnect certain conductors from the magnet control relays 71P1C . . . 71PC80 and thereby to prevent the operation of certain punch magnets over said conductors beyond rows 12, 11 and 0; relay 14UP having operated on the release of relays 9–120 and 9–110 to connect certain other conductors to enable punch control circuits for rows 1 to 9 of the card. Relay 9–1E further applies ground from conductor MON1 traced to its No. 1 front contacts, to conductor EM1 in the EMX multiple, and the same ground through its No. 2 front contacts, conductor CH, No. 1 contacts of relay 14UP, conductor C1, to conductor CH1 in the CHX multiple. As before, the card will not have advanced at this time to row 1. Therefore, all registers, translators and other circuits which at this time are operatively connected to conductors EM1 and CH1, will complete circuits to the appropriate ones of relays 71PC1, 71P1C . . . 71PC80, 71P80C which, in turn, cause the operation of the involved punch magnets 89PM1 . . . 89PM80 to punch in row 1 of the card the various punches in the different columns as indicated by the punch magnets operated.

It is not believed necessary to trace any further the progression of circuits with respect to the relays shown in Figs. 9, 10 and 3, except to state that at each pulse from the emitter, one relay in the group of relays 9–12 . . . 9–4 and 10–5 . . . 10–9 is operated at the beginning of the pulse and released at the termination thereof, while a corresponding relay in the group of relays 3C12 . . . 3C9 is operated to check the transmission of the pulse. At the termination of a pulse, one of the relays 911E . . . 94E, 10–5E . . . 10–9E is operated to ground the next pair of conductors in the CHX and EMX multiples, thereby to operate the punch magnet control relays 71PC1, 71P1C . . . 71PC80, 71P80C for operating the punch magnets in the indicated columns of the card as the latter is advanced by the Gang Punch to succeeding rows of said card.

In connection with the operation of the Punch and Check Control circuit above described, it should be noted that when relay 3C9 operates to check the ninth pulse, the locking circuit of relays 3CH and 3CHA is opened at the No. 2 back contacts of relay 3C9. Relay 3CHUB operates over the No. 2 back contacts of the relays 3C12 . . . 3C8 to ground on conductor MON1, and will hold so long as any of said relays remain normal, thus providing relays 3CH and 3CHA a direct path to ground through the Nos. 1 and 2 contacts of relay 3CH, the front contacts of relay 3CHUB, to ground on conductor ON. Due to the low resistance shunt through the No. 13 contacts of relay 3CHA, said relay 3CHA will hold up long enough to insure the release of said relay 3CH by holding relay 3C9 locked. As soon as relay 3C12 operates, a circuit is completed for relay 8PSP from battery through the winding of said relay, conductor PSP, No. 2 front contacts of relay 3C12, conductor 12B, No. 2 back contacts of relay 9–12, to ground on conductor MON1. Relay 8PSP, in operating, opens the punch control circuit to prevent a succeeding card cycle. It will be noted that the circuit of relay 8PSP is similarly controlled through the No. 2 front contacts of relays 3C12 . . . . 3C8. Now if all of said relays fail to operate and successfully check the setting of the punch magnet control relays 71P1C . . . 71PC80, relay 3CHUB will remain operated and hold relays 3CHA and 3CH, thus preventing relay 8PSP from releasing and reclosing the clutch magnet control circuit of the Gang Punch. On the other hand, if all the relays 3C12 . . . 3C8 do operate, relay 3CHUB will release which, releasing relays 3CHA and 3CH, releases relays 3C12 . . . 3C9, thus causing relay 8PSP to release and reclose the clutch control circuit by joining conductors I13 and I14.

The operation of the punch and control circuit following the release of relay 3CHUB is continued in Section 7 in connection with the release of the registers.

6.2. *Card punching operations*

Having described how, with each card punching cycle, the emitter of the Gang Punch, in making one revolution for each cycle, applies in succesion a pulse to conductors 12, 11, 0 . . . 9 in the order indicated, I will now describe in detail how the card is punched, having due regard for the fact that the various digital registers of the Odd Storage Unit have been set in response to the operation of the Digit Reading Registers responding to the sensing of the message entry, and having due regard for the further fact that various translators have been set to translate information locked in certain of said digital registers in conformity with the "meaning" of the information as it is to be actually punched on the card in the punch code shown in Table III. Particularly, I will describe in detail how a card is punched for the message entry shown in the Toll Tape of Fig. 100, and used throughout this section to describe in detail the operation of the involved parts of the apparatus.

As previously stated, when the emitter, at the start of the card cycle, is ready to apply ground to conductor 12, the card will have been advanced in the die card to the row 12 punching position, and ground will have been previously applied to conductors CH12 and EM12 in the CHX and EMX multiples as already described, the ground on said latter two conductors being maintained for as long as ground is maintained by the emitter on conductor 12. While the card is in the punching position for the 12th row, and conductors CH12 and EM12 are thus grounded, whatever punches are to be made in row 12 of the card will be made, subsequent to which the punch magnets are released and the card is advanced to row 11 when, during the succeeding punch cycle, a similar operation will take place in said row 11, such operations thereafter similarly taking place for each successive row of the card until the entire field of said card is covered.

When the card is in the row 12 punching position, punches will be produced in the appropriate columns for whatever data in said column calls for a punch in that row, as will also be the case for each of the remaining eleven rows 11 . . . 9. Since the operation of the magnets for the different columns is selective, and the character of the operations is the same for each row, no attempt will be made to describe in detail operations for each row and column individually. However, each column (or plurality of columns) will be separately considered, it

being understood that punches will be produced in said columns when the card will have been advanced to the required row therefor, and ground will have been applied for that row to the involved conductors CH– and EM– individual for that row in the CHX and EMX multiples.

6.21. *Collate month and month*

For the entry being processed, it will be recalled that the month recorded in the ninth line of the tape identity entries is April, and that relay **20**APR was operated and locked in consequence thereof. However, the fact that the call was made in April does not necessarily mean that the month of April will be recorded on the card by punching a hole in row 3, column 2 thereof (see Fig. 105). The month, as it appears on the set-up switches **7**MU and **7**MT, may not be the month punched if a call occurs during the last "round" of the month, but has a "Tens" digit 0. In this case, the call was made on the first entry of the succeeding month between the hours of 12 midnight and 3 A. M. and, therefore, one month in advance of that indicated on the set-up switches. Both the collate month and the month, as above translated from the month checked on the set-up switches MT and MU, are given in the following table:

TABLE VI

Name	Month Set-Up Switches		Detail Cards				Summary Cards
			As is		Plus One [1]		
	Tens	Units	Collating Month	Month	Collating Month	Month	
January	0	1	1	12	2	11	12
February	0	2	2	11	3	0	11
March	0	3	3	0	4	1	0
April	0	4	4	1	5	2	1
May	0	5	5	2	6	3	2
June	0	6	6	3	0	4	3
July	0	7	0	4	0	5	4
August	0	8	0	5	0	6	5
September	0	9	0	6	0	7	6
October	1	0	0	7	0	8	7
November	1	1	0	8	0	9	8
December	1	2	0	9	1	12	9

[1] Use when Day Tens digit is 0 on last round of calendar month.

From the above table it is seen that when the month recorded on the entry is April, the collate month is 4 and the month is 1, which means that a punch will be produced in the card in the first column, row 4 thereof, and another punch will be produced in the second column, row 1.

Referring to Figs. 20 and 21, and remembering that relays **20**APR and **21**OR are operated therein respectively, it will be noted that the stationary contacts of the No. 2 and No. 3 contacts of the No.2 and No. 3 contacts of relay **20**APR are connected to conductors **EM4** and **CH4** respectively, and that the stationary contacts of the Nos. 4 and 5 contacts are connected to conductors **EM1** and **CH1**, respectively. The armatures paired with the above contacts are extended to the armatures of the Nos. 1 and 2 and 3 and 4 contacts of relay **21**OR, whence the conductors connected to the associated stationary contacts are extended as conductors **CME1** and **CMC1** and conductors **ME1** and **MC1**, respectively, to armatures on the operated relay **69**D, and continue therefrom as conductors CME, CMC and ME, MC respectively, whence the latter are cross-connected on a terminal block indicated in Fig. 71 and thence to relays **72**P2C and **72**PC2 (for conductors ME and MC).

In view of the fact that the cross-connections between the terminal blocks indicated on Fig. 71 and the relays **71**P1C, **71**PC1 . . . **71**P80C, **71**PC80 are numerous, the details of such cross-connections for the processing of a computer tape are indicated in the tables which follow. Table VII below gives the details of cross-connections for relays **71**P1C, **71**PC1 . . . **71**P8C, **71**PC8 and for punch magnets **89**PM1 . . . **89**PM8.

TABLE VII

	Relays	Magnets	Significance	
From Fig. 69:				
CME	71P1C	89PM1	Collate Month.	
CMC	71PC1			
ME	71P2C	89PM2	Month.	
MC	71PC2			
From Fig. 67:				
ADTE (From Fig. 77)	71P3C	89PM3	Day Tens	Answer Time.
ADTC (From Fig. 77)	71PC3			
ADE	71P4C	89PM4	Day Units	
ADC	71PC4			
AHTE (From Fig. 77)	71P5C	89PM5	Hour Tens	
AHTC (From Fig. 77)	71PC5			
AHE	71P6C	89PM6	Hour Units	
AHC	71PC6			
AMTE (From Fig. 78)	71P7C	89PM7	Minute Tens	
AMTC (From Fig. 78)	71PC7			
AME	71P8C	89PM8	Minute Units	
AMC	71PC8			

Accordingly, when the card is advanced to row 3, ground on conductor **EM4** will complete a cricuit for relay **71**P1C extending from ground on said conductor **EM4**, No. 2 contacts of relay **20**APR, No. 1 contacts of relay **21**OR, conductor **CME1**, No. 15 contacts of relay **69**D, conductor CME indicated, terminal block in Fig. 71, winding of relay **71**P1C to battery. Ground on conductor **CH4** will complete a circuit for relay **71**PC1 extending from ground on said conductor **CH4**, No. 3 contacts of relay **20**APR, No. 2 contacts of relay **21**OR, conductor **CMC1**, No. 16 contacts of relay **69**D, conductor CMC, indicated terminal block in Fig. 71, winding of relay **71**PC1, to battery. Both relays **71**P1C and **71**PC1 operate. Relay **71**P1C, in operating, completes the circuit of punch magnet **89**PM1 extending from ground through the circuit breaker CB, right contacts of relay **89–15**, No. 2 contacts of relay **71**P1C, through the Plug Board, winding of magnet **89**PM1, commutator connection, No. 2 back contacts of relay **89–10**, switch XM adjusted as shown, switch **89**SW, to battery, causing said punch magnet to operate and punch a hole in column 1 at row 4. In the same manner, when the card has been advanced to row 1, and ground is applied to conductors **EM1** and **CH1**, a circuit is completed from ground on said conductor **EM1**, No. 4 contacts of relay **20**APR, No. 3 contacts of relay **21**OR, conductor **ME1**, No. 12 contacts of relay **69**D, conductor ME, winding of relay **71**P2C, to battery. Ground on conductor **CH1** completes a circuit over the No. 5 contacts of relay **20**APR, No. 4 contacts of relay **21**OR, conductor **MC1**, No. 13 contacts of relay **69**D, winding of relay **PC2**, to battery. Both relays **71**P2C and **71**PC2 operate. Relay **71**P2C, in operating, completes the circuit of punch magnet **89**PM2 over a path similar to the one previously described for punch magnet **89**PM1.

Thus in response to the operation of relays **20**APR and **21**OR, the former indicating that the call was made during the month of April and the latter indicating that it was made in a "round" other than the last, a hole is punched in column 1 (collate month) at row 4 when the card is advanced to row 4, and a hole is punched in column 2 (month) at row 1 when the card is advanced to row 1.

It should be noted that if the call was made on the "last round" of the month, then relay **21**LR would have operated instead of relay **21**OR. In the latter case, the collate month and month that would be recorded would be determined by which one of the four relays **77**DT0 . . . **77**DT3 of the Day Tens Translator would be operated, each of which switches the involved pair of conductors from the stationary contacts of relay **21**LR to the two pairs of conductors **CME1**, **CMC1** and **ME1**, **MC1** to punch in columns 1 and 2, respectively, holes in the rows indicated by conductors EM– and CH– to which the stationary conductors making with the armatures of the Nos.

5, 4, 3 and 2 contacts of relay **20APR** are connected. The recording of the collate month and month for any other month would be similar to that above described for the month of April.

6.22. *Answer time*

It will be recalled that the start time recorded in the second line of the message entry as 14945 (see Fig. 100) was translated into the 19th day of the month, 14th hour (2 P. M.) of the day and 15 minutes past the hour, and that, because such translation involved the operation of relays **77DT1**, **71HT1**, **78MT1** and **77MT14**, the entire start time was translated into 191415, distributed in respect to the tens and units digits of the involved time as follows:

Day		Hour		Minutes	
Tens	Units	Tens	Units	Tens	Units
1	9	1	4	1	5

Remembering what was previously said in respect to the fact that the D, E and F digits of the second line of the entry record the Day Units, the Hour Units and the Minutes Units of the start time as shown, the entire answer time as above indicated is then punched on the card by the operation of the involved punch magnets for columns 3 to 8, inclusive, of the card as follows.

In view of the fact that relay **77DT1** is operated, and noting that the Nos. 6 and 5 armatures of said relay are connected to conductors CH1 and EM1 in the CHX and EMX multiples, respectively, then when ground is applied to said conductors at the time that the card is in the row 1 punching position, a circuit is closed from ground on said conductor **EM1**, No. 5 contacts of relay **77DT1**, conductor ADTC, extended to a terminal block indicated on Fig. 71, thence to the winding of relay **71P3C**, to battery. Another circuit is completed from said ground on conductor **CH1**, No. 6 contacts of relay **77DT1**, conductor ADTE extended to a terminal block indicated on Fig. 71, the winding of relay **71PC3**, to battery. Both of these relays operate. Relay **71P3C** completes a circuit to punch magnet **89PM3** which, from the contacts of relay **71P3C**, is similar to circuits previously described for other magnets except for the fact that the circuit is completed through the winding of magnet **89PM3**. Since the card is in row "1," a punch will be made in said row on column 3, thus indicating that the tens digit of the day answer time is "1."

The Day Units, as will be remembered, is obtained directly from the setting of the D Digit Third Storage Register in the Odd Storage Unit (or D Digit Second Storage Register of the Even Storage Unit). Since the D Digit Storage Register has been operated for the digit "9" involving thereby the operation of relays **51D3–2**, **51D3–3** and **51D3–4**, a circuit is completed from ground on conductor **EM9**, No. 7 contacts of relay 51D3–3, No. 3 contacts of relay **51D3–4**, No. 2 contacts of relay **D3–2**, conductor **E34**, a pair of contacts on relay **67OD**, conductor ADE extended to a terminal block indicated on Fig. 71, winding of relay **71P4C**, to battery. Another circuit is completed from ground on conductor **CH9**, No. 2 contacts of relay **51D3–3**, No. 5 contacts of relay **51D3–2**, No. 8 contacts of relay **51D3–4**, conductor **C34**, a pair of contacts on relay **67OD**, conductor ADC extended to a terminal block indicated on Fig. 71, winding of relay **71PC4**, to battery. Both of these relays operate, relay **71P4C** then completing the circuit of magnet **89PM4** when the card has been advanced to the 9th row, thus causing a punch to be made in the card in the 4th column of the 9th row to indicate that the units digit of the day is "9."

The Hour Tens digit is "1" which, as previously described, resulted in the operation of relay **77HT1**. Accordingly, when the card is advanced to row 1, a circuit is completed from ground on conductor **EM1**, No. 4 contacts of relay **77HT1**, conductor AHTE extended to a terminal block indicated on Fig. 71, winding of relay **71P5C**, to battery. Another circuit is completed from ground on conductor **CH1**, No. 5 contacts of relay **77HT1**, conductor AHTC extended to a terminal block indicated on Fig. 71, winding of relay **71PC5**, to battery. Both of the latter two relays operate, relay **71PC5** completing the circuit of magnet **89PM5** in the manner previously described, causing said magnet to operate and punch a hole in row 1, column 5 of the card to indicate that the tens digit of the answer time hour is "1."

The Hour Units digit is obtained directly from the E digit register of the Third Register of the Odd Storage Unit, which register, it will be recalled, was operated to register therein the digit "4" by the operation of relays **52E3–00**, **52E3–0** and **52E3–4** therein. Accordingly, when the card is in row 4 and ground is applied to conductors EM4 and CH4, ground from said conductor **EM4** completes a circuit over the No. 9 contacts of relay **52E3–4**, No. 9 contacts of relay **52E3–0**, No. 10 contacts of relay **52E3–00**, conductor **E35**, a pair of contacts on relay **67OD**, conductor AHE extended to a terminal block indicated on Fig. 71, winding of relay **71P6C**, to battery Another circuit is completed from ground on said conductor **CH4**, No. 4 contacts of relay **52E3–00**, No. 2 contacts of relay **52E3–0**, No. 5 contacts of relay **52E3–4**, conductor **C35**, a pair of contacts on relay **67OD**, conductor AHC extended to a terminal block indicated on Fig. 71, winding of relay **71PC6**, to battery. Both relays **71P6C** and **71PC6** operate, relay **71PC6** completing the circuit of magnet **89PM6**, causing said magnet to operate and punch a hole in row 4, column 6 of the card to record that the Hour Units digit is "4."

The Minutes Tens Translation, as described in Section 5.2, resulted in the operation of relays **78MTL** and **78MT14**. Accordingly, when the card is in row 1, ground on conductor **EM1** causes a circuit to be completed from said ground, No. 5 contacts of relay **78MT14**, No. 2 contacts of relay **78MTL**, conductor AMTE as extended to a terminal block indicated on Fig. 71, winding of relay **71P7C**, to battery. Another circuit is completed from ground on conductor **GH1**, No. 6 contacts of relay **78MT14**, No. 3 contacts of relay **78MTL**, conductor AMTC as extended to a terminal block indicated on Fig. 71, winding of magnet **71PC7**, to battery. Both of said relays operate, relay **71P7C** completing the circuit of punch magnet **89PM7** which operates to punch a hole in row 1, column 7 of the card to record that the Minute Tens of the answer time is 1.

The Minute Units digit of the answer time is obtained directly from the F-Digit register of the Third Register of the Odd Storage Unit which, it will be recalled, was set to register the digit "5" by the operation therein of relays **53F3–00**, **53F3–1**, and **53F3–4**. Accordingly, when the card has been advanced to row 5 and ground is applied to conductors EM5 and CH5, a circuit is completed from said ground on conductor **EM5**, No. 8 contacts of relay **53F3–00**, No. 4 contacts of relay **53F3–4**, No. 2 contacts of relay **53F3–1**, conductor **E36**, a set of contacts on relay **67OD**, conductor AME as extended to a terminal block indicated on Fig. 71, relay **71P8C**, to battery. Another circuit is completed from ground on said conductor **CH5**, No. 3 contacts of relay **53F3–00**, No. 5 contacts of relay **53F3–1**, No. 7 contacts of relay **53F3–4**, conductor **C36**, a set of contacts of relay **67OD**, conductor AMC as extended to a terminal block indicated on Fig. 71, the winding of relay **71PC8**, to battery. Both relays **71P8C** and **71PC8** operate, the former relay completing the circuit of punch magnet **89PM8** which operates to punch a hole in row 5, column 8 of the card to indicate that the Months Unit digit is 5.

6.23. *Check and calling office*

The following table gives the list of cross-connections

at a terminal block indicated in Fig. 71 for the punch magnets **89PM10** . . . **89PM17**, of which punch magnet **89PM10** is utilized for punching a hole in row 9, column 10 to indicate, for this type of card, that a complete card cycle was successfully concluded, and magnets **89PM11** . . . **89PM17** are utilized to record the letter characters of the calling office code and the four digits of the calling line number.

TABLE VIII

	Relays	Magnets	Significance
From Fig. 69:			
CKE	71P10C	89PM10	Type.
CKC	71PC10		
AE	71P11C	89PM11	First Letter of Office Code.
AC	71PC11		
BE	71P12C	89PM12	Second Letter of Office Code.
BC	71PC12		
CE	71P13C	89PM13	Third Letter of Office Code.
CC	71PC13		
From Fig. 67:			
STHE	71P14C	89PM14	Thousands Digit.
STHC	71PC14		
SHE	71P15C	89PM15	Hundreds Digit BCX Index.
SHC	71PC15		
STE	71P16C	89PM16	Tens Digit.
STC	71PC16		
SUE	71P17C	89PM17	Units Digit.
SUC	71PC17		

As is explained in Section 7 below in connection with the release of the registers and the end of a card punching cycle, a punch is produced in row 9, column 10, of the card to indicate that the cycle was successfully completed. This fact is evidenced by the operation of relay **3PCK9**. When this relay operates, the card wil lhave been advanced to row 9 and ground will be applied to conductors **EM9** and **CH9** of the EMX and CHX multiple. Under these circumstances the ground on conductor **EM9** establishes a circuit over the No. 3 front contacts of relay **3PCK9**, conductor CKE, No. 3 contacts of relay **69D**, winding of relay **71P10C** to battery. The ground on conductor **CH9** establishes a circuit over the No. 4 front contacts of relay **3PCK9**, conductor CKC, No. 4 contacts of relay **69D**, winding of relay **71PC10**, to battery. Both of said relays operate, relay **71P10C** completing the circuit of punch magnet **89PM10** which operates and punches the card in row 9, column 10 to indicate the successful conclusion of the card cycle. Obviously, a failure to punch the card in this row and column would be an indication of faulty operation, and the card should be discarded.

It will be recalled that as a result of the operations which have taken place in translating the calling office digit 0 in the B digit position of the first line of the message entry, in combination with the marker group entry 00 in the second line of the tape identity entries, relay **24A–COT000** was operated to indicate that the name of the calling office was Chelsea, and that its abbreviated notation would be CHE as indicated by said relay. From the punch card code given in Table III, it will be noted that to punch the letters CHE on the card an overpunch 12 and an underpunch 3 will be required for the letter C, an overpunch 12 and an underpunch 8 will be required for the letter H, and an overpunch 12 and an underpunch 5 will be required for the letter E. Consequently when the card is in row 12, ground applied to conductor **EM12** will complete three separate circuits as follows: one from ground on said conductor **EM12**, No. 7 contacts of relay **24A–COT000**, No. 8 contacts of relay **13–010A**, conductor AOE, No. 4 contacts of relay **14OVP**, conductor AE, No. 18 contacts of relay **69D**, conductor AE extending to a terminal block indicated on Fig. 71, winding of relay **71P11C**, to battery. Another circuit is completed from said ground, No. 8 contacts of relay **24A–COT000**, No. 7 contacts of relay **13010A**, conductor BOE, No. 5 contacts of relay **14OVP**, conductor BE, No. 20 contacts of relay **69D**, continuation of said conductor BE as extended to a terminal block indicated on Fig. 71, winding of relay **71P12C**, to battery. A third circuit is completed from said ground over the No. 9 contacts of relay **24A–COT000**, No. 6 contacts of relay **13010A**, conductor COE, No. 5 contacts of relay **14OVP**, conductor CE, No. 22 contacts of relay **69D**, continuation of said conductor CE to a terminal block indicated on Fig. 71, winding of relay **71P13C**, to battery. The ground on conductor **CH12** likewise closes three separate circuits as follows: ground on said conductor through the No. 6 contacts of relay **24A–COT000**, No. 14 contacts of relay **13010A**, conductor AOC, No. 7 contacts of relay **14OVP**, conductor AC, No. 19 contacts of relay **69D**, the continuation of said conductor to a terminal block indicated on Fig. 71, winding of relay **71PC11**, to battery. A second circuit extends from said ground through the No. 5 contacts of relay **24A–COT000**, No. 13 contacts of relay **13–010A**, conductor BOC, No. 8 contacts of relay **14OVP**, conductor BC, No. 21 contacts of relay **69D**, continuation of said conductor BC to a terminal block indicated on Fig. 71, winding of relay **71PC12**, to battery. A third circuit extends from said ground on conductor **CH12**, No. 4 contacts of relay **24A–COT000**, No. 12 contacts of relay **13010A**, conductor COC, No. 9 contacts of relay **14OVP**, conductor CC, No. 23 contacts on relay **69D**, continuation of said conductor CC to a terminal block indicated on Fig. 71, winding of relay **71PC13**, to battery. All of said relays **71P11C**, **71PC11**, **71P12C**, **71PC12**, **71P13C** and **71PC13** operate over the above circuits and complete circuits for punch magnets **89PM11**, **89PM12** and **89PM13** in the manner previously described for other punch magnets, to punch in row 12, columns 11, 12 and 13 punches called for by the code of the letters C, H and E.

When the card has been advanced in due course to row 8 and ground is applied to conductors **EM8** and **CH8**, a circuit is completed from ground on conductor **EM8**, No. 11 contacts of relay **24A–COT000**, No. 4 contacts of relay **13–010A**, conductor BUE, No. 5 contacts of relay **14UP**, conductor BE, and thence as previously traced to the winding of relay **71P12C**. Another circuit is closed from ground on conductor **CH8**, No. 2 contacts of relay **24A–COT000**, No. 10 contacts of relay **13–010A**, conductor BUC, No. 8 contacts of relay **14UP**, conductor BC, and thence as traced to the winding of relay **71PC12**. Relays **71P12C** and **71PC12** operate and complete a circuit to punch a hole in row 8, column 12, thus completing the punching of the code for the letter H as the second letter of the office code.

When the card is advanced in due course to row 5 and ground is applied to conductors **EM5** and **CH5**, a circuit is completed from said ground on conductor **EM5**, No. 12 contacts of relay **24A–COT000**, No. 3 contacts of relay **13–010A**, conductor CUE, No. 6 contacts of relay **14UP**, conductor CE, and thence as traced to the winding of relay **71P13C**. Another circuit is closed from ground on conductor **CH5**, No. 1 contacts of relay **24A–COT000**, No. 9 contacts of relay **13–010A**, conductor CUC, No. 9 contacts of relay **14UP**, conductor CC and thence as traced to the winding of relay **71PC13**. Relays **71P13C** and **71PC13** operate and complete the circuit to magnet **89PM13**, which operates to punch a hole in row 5, column 13 as the second punch required for the code of the letter E as the third letter of the calling office code.

When the card is advanced in proper course to row 3 and ground is applied to conductors **EM3** and **CH3**, a circuit is completed from ground on conductor **EM3**, No. 10 contacts of relay **24A–COT000**, No. 5 contacts of relay **13–010A**, conductor AVE, No. 4 contacts of relay **14UP**, conductor AE, and thence as traced to the winding of relay **71P11C**. Another circuit is completed from ground on conductor **CH3**, No. 3 contacts of relay **24A–COT000**, No. 11 contacts of relay **13–010A**, conductor AUC, No. 7 contacts of relay **14UP**, conductor AC, and thence as traced to the winding of magnet **71PC11**. Relays **71P11C** and **71PC11** both operate, the former completing the circuit of punch magnet **89PM11**

which operates to punch a hole in the 11th column at row 3 to complete the code of the letter C, the first letter of the calling office code.

6.24. *BCX index*

In column 15, row 11, a punch is made on the card which is designated as the "BCX" index. This punch is placed in this column and row (or any other desired column and row) to differentiate individual billing cards from all other cards with which the individual cards may be merged in the subsequent processing of all cards in the Billing System. Consequently, when the card is advanced to row 11 and pulse ground is applied to conductors EM11 and CH11, ground on said conductor EM11 completes the circuit of relay 71P15C over conductor EM11, No. 10 contacts of relay 69D, conductor BCE, No. 3 contacts of relay 14ONP, conductor SHE as extended to a terminal block indicated on Fig. 71, to battery. Ground on conductor CH11 completes another circuit over the No. 11 contacts of relay 69D, conductor BCC, No. 2 contacts of relay 14ONP, conductor SHC as extended to a terminal block indicated on Fig. 71, winding of relay 71PC15, to battery. Both of said relays operate, the former completing the circuit of punch magnet 89PM15 which operates to punch a hole in row 11, column 15, as the BCX index.

6.25. *Calling line number*

The calling line number, it will be recalled, is recorded in the C to F digits of the first line of the message entry, and according to Fig. 100 is assumed to be, by way of example, 7804 which, as previously described, has been registered in the C to F Digit Registers, inclusive, of the First Storage Register in the Odd Storage Unit. Accordingly, when the card has been advanced to row 0 and ground is applied to conductors EM0 and CH0, a circuit is completed from ground on said conductor EM0, No. 9 contacts of relay 59E1–3, No. 3 contacts of relay 59E1–2, No. 3 contacts of relay 59E1–1, conductor E41, a set of contacts on relay 67OD, conductor STE as extended to a terminal block indicated on Fig. 71, winding of relay 71P16C, to battery. Another circuit is completed from ground on said conductor CH0, No. 5 contacts of relay 59E1–3, No. 4 contacts of relay 59E1–1, No. 4 contacts of relay 59E1–2, conductor C41, a set of contacts on relay 67OD, conductor STC as extended to a terminal block indicated on Fig. 71, winding of relay 71PC16, to battery. Relays 71P16C and 71PC16 both operate, the former completing the circuit of punch magnet 89PM16 which operates to punch a hole in row 0, column 16 to record the digit 0 as the tens digit of the calling line number.

When the card has been advanced to row 8 and ground has been applied to conductors EM8 and CH8, a circuit is completed from ground on conductor EM8, No. 8 contacts of relay 58D1–3, No. 4 contacts of relay 58D1–4, No. 2 contacts of relay 58D1–1, conductor E40, contacts of relay 67OD, conductor SHE extended to a terminal block indicated in Fig. 71, winding of relay 71P15C, to battery. Another circuit is completed from ground on conductor CH8, No. 3 contacts of relay 58D1–3, No. 5 contacts of relay 58D1–1, No. 7 contacts of relay 58D1–4, conductor C40, contacts on relay 67OD, conductor SHC extended to a terminal block indicated in Fig. 71, winding of relay 71PC15 to battery. Relays 71P15C and 71PC15 both operate, the former completing the circuit of punch magnet 89PM15 to punch a hole in row 8, column 15 to record the digit 8 as the hundreds digit of the calling line number.

When the card has been advanced to row 7 and ground is applied to conductors EM7 and CH7, a circuit is completed from said ground on conductor EM7, No. 2 contacts of relay 57C1–4, No. 8 contacts of relay 57C1–0, No. 11 contacts of relay 57C1–3, conductor E39, a set of contacts on relay 67OD, conductor STHE extended to a terminal block indicated on Fig. 71, winding of relay 71P14C, to battery. Another circuit is completed from ground on conductor CH7, No. 4 contacts of relay 57C1–3, No. 2 contacts of relay 57C1–0, No. 5 contacts of relay 57C1–4, conductor C39, a set of contacts on relay 67OD, conductor STHC extended to a terminal block indicated on Fig. 71, winding of relay 71PC14, to battery. Relays 71P14C and 71PC14 operate, the latter completing the circuit of punch magnet 89PM14, causing it to operate and punch a hole in row 7, column 14 of the card to record the digit 7 as the thousands digit of the calling line number.

When the card has been advanced to position 4 and ground is applied to conductors EM4 and CH4, a circuit is completed from ground on said conductor EM4, No. 9 contacts of relay 60F1–4, No. 9 contacts of relay 60F1–0, No. 11 contacts of relay 60F1–00, conductor E42, a set of contacts on relay 67OD, conductor SUE as extended to a terminal block indicated on Fig. 71, winding of relay 71P17C, to battery. Another circuit is completed from ground on conductor CH4, No. 4 contacts of relay 60F1–00, No. 2 contacts of relay 60F1–0, No. 5 contacts of relay 60F1–4, conductor C42, a set of contacts on relay 67OD, conductor SUC as extended to a terminal block indicated on Fig. 71, winding of relay 71PC17, to battery. Relays 71P17C and 71PC17 operate, the former completing the circuit of punch magnet 89PM17 which operates to punch a hole in row 4, column 17 thus to record the digit 4 as the units digit of the calling line number.

6.26. *Called line number*

The following table gives the details of the cross-connections at the indicated terminal blocks in Fig 71 between designated conductors of the circuit which are indicated in the table and the punch and check relays 71P19C, 71PC19 . . . 71P23C, 71PC23, 71P26C, 71PC26 . . . 71P29C, 27PC29 which control the operation of punch magnets 89PM19 . . . 89PM29 in the columns of which holes are punched to express the called line number, the area, and the called office code.

TABLE IX

From Fig. 80	Relays	Magnets	Significance	
CTHE	71P19C	89PM19	Thousands Digit	Called Line Number.
CTHC	71PC19			
CHE	71P20C	89PM20	Hundreds Digit.	
CHC	71PC20			
CTE	71P21C	89PM21	Tens Digit	
CTC	71PC21			
CUE	71P22C	89PM22	Units Digit	
CUC	71PC22			
CPE	71P23C	89PM23	Party	
CPC	71PC23			
ARE (from Fig. 67)	71P26C	89PM26	Area Index.	
ARC (from Fig. 67)	71PC26			
CAE	71P27C	89PM27	A Digit	Called Office Code (Numerical).
CAC	71PC27			
CBE	71P28C	89PM28	B Digit	
CBC	71PC28			
CCE	71P29C	89PM29	C Digit	
CCC	71PC29			

The called line number, it will be remembered, is recorded in the fourth line of the message entry, is registered in the Seventh Storage Register of the Odd office unit, and has been assumed to consist of 2897 so recorded in the B to E digit positions inclusive of the entry (see Fig. 100). It has been further assumed from the description of the invention given in Section 5.3 that the number is a 4-digit number without a party letter. Accordingly, when the card has been advanced to row 9 and ground is applied to conductors EM9 and CH9, a circuit is completed from ground on said conductor EM9, No. 7 contacts of relay 37D7–3, No. 3 contacts of relay 37D7–4, No. 2 contacts of relay 37D7–2, conductor E22, a set of contacts on relay 67OD, conductor CTE, No. 6 contacts of relay 80CN12, conductor CET as extended to a terminal block indicated on Fig. 71,

winding of magnet 71P21C to battery. Another circuit is completed from ground on conductor CH9, No. 2 contacts of relay 37D7–3, No. 5 contacts of relay 37D7–2, No. 8 contacts of relay 37D7–4, conductor C22, a set of contacts on relay 67OD, conductor CTC, No. 5 contacts of relay 80CN12, conductor CTC as extended to a terminal block indicated on Fig. 71, winding of relay 71PC21, to battery. Relays 71P21C and 71PC21 both operate, the former completing the circuit of punch magnet 89PM21 which operates to punch a hole in row 9, column 29, to record thereby the digit 9 as the tens digit of the called line number.

Thereafter when the card is advanced to row 8 and ground is accordingly applied to conductors EM8 and CH8, a circuit is completed from ground on said conductor EM8, No. 8 contacts of relay 36C7–3, No. 4 contacts of relay 36C7–4, No. 2 contacts of relay 36C7–1, conductor E21, a set of contacts on relay 67OD, conductor CHE as extended to a terminal block indicated on Fig. 71, winding of relay 71P20C, to battery. Another circuit is completed from ground on said conductor CH8, No. 3 contacts of relay 36C7–3, No. 5 contacts of relay 36C7–1, No. 7 contacts of relay 36C7–4, conductor C21, a set of contacts on relay 67OD, conductor CHC as extended to a terminal block indicated on Fig. 71, winding of relay 71PC20, to battery. Relays 71P20C and 71PC20 both operate, the former completing the circuit of punch magnet 89PM20 which operates to punch a hole in column 20, row 8, to record the digit 8 as the hundreds digit of the called line number.

When the card is advanced to the next or row 7 and ground is applied to conductors EM7 and CH7, a circuit is completed from ground on said conductor EM7, No. 2 contacts of relay 38E7–4, No. 8 contacts of relay 38E7–0, No. 11 contacts of relay 38E7–3, conductor E23, a set of contacts on relay 67OD, conductor CUE as extended to a terminal block indicated on Fig. 71, winding of relay 71P22C, to battery. Another circuit is completed from ground on said conductor CH7, through the No. 4 contacts of relay 38E7–3, No. 2 contacts of relay 38E7–0, No. 5 contacts of relay 38E7–4, conductor C23, a set of contacts on relay 67OD, conductor CUC as extended to a terminal block indicated on Fig. 71, winding of relay 71PC22, to battery. Relays 71PC22 and 71P22C both operate, the latter completing the circuit of punch magnet 89PM22 which operates to punch a hole in the 22nd column, row 7, to record the digit 7 as the units digit of the called line number.

When the card has been advanced to position 2 and ground is applied to conductors EM2 and CH2, a circuit is completed from ground on said conductor EM2, No. 8 contacts of relay 35B7–2, No. 7 contacts of relay 35B7–0, conductor E20, a set of contacts on relay 67ODC, conductor CTHE as extended to a terminal block indicated on Fig. 71, winding of relay 71P19C, to battery. Another circuit is completed from ground on said conductor CH2, No. 7 contacts of relay 35B7–2, No. 3 contacts of relay 35B7–0, conductor C20, a set of contacts on relay 67OD, conductor CTHC as extended to a terminal block indicated on Fig. 71, winding of relay 71PC19, to battery. Both relays 71P19C and 71PC19 operate, the former completing the circuit of punch magnet 89PM19 which operates to punch a hole in column 19, row 2, to record the digit 2 as the thousands digit of the called line number.

6.27. *Area index*

It will be remembered that the B digit of the third line of the entry is known as the "area index," and that this digit is registered in the B digit, Fifth Storage Register of the Odd Storage Unit, and it will be seen from Fig. 100 that this digit is shown as 0 on the message entry by way of illustration. Accordingly, when the card is advanced to row 0 and ground is applied to conductors EM0 and CH0, a circuit is completed from ground on conductor EM0, No. 9 contacts of relay 42B5–3, No. 3 contacts of relay 42B5–2, No. 3 contacts of relay 42B5–1, conductor E26, a set of contacts on relay 67OD, conductor ARE as extended to a terminal block indicated on Fig. 71, winding of relay 71P26C, to battery. Another circuit is completed from ground on conductor CH0, No. 5 contacts of relay 42B5–3, No. 4 contacts of relay 42B5–1, No. 4 contacts of relay 42B5–2, conductor C26, a set of contacts on relay 67OD, conductor ARC as extended to a terminal block indicated in Fig. 71, to the winding of relay 71P26C. Relays 71P26C and 71PC26 both operate, the former completing the circuit of punch magnet 89PM26 which operates to punch a hole in column 26, row 0, to record thereby the digit 0 as the area index.

6.28. *Called office code*

The called office code, in digit form, is recorded as the last three digits in the third line of the message entry (see Figs. 100 and 103A), and is registered in the D, E and F digit Fifth Storage Register of the Odd Storage Unit. Somewhat different from the manner of recording the calling office code, the called office code is recorded on the card in terms of numerals rather than the corresponding letters, so that if the called office code is 726, as shown on the message entry of Fig. 100 by way of example, then the digits 726 will be recorded in the appropriate columns of the card reserved for the called office code, as shown in Fig. 105. Accordingly, when the card is advanced to row 7 and ground is applied to conductors EM7 and CH7, a circuit is completed from ground on said conductor EM7, No. 2 contacts of relay 44D5–4, No. 8 contacts of relay 44D5–0, No. 11 contacts of relay 44D5–3, conductor E28, a set of contacts on relay 67OD, conductor CAE as extended to a terminal block indicated in Fig. 71, winding of relay 71P27C, to battery. Another circuit is completed from ground on conductor CH7, No. 4 contacts of relay 44D5–3, No. 2 contacts of relay 44D5–0, No. 5 contacts of relay 44D5–4, conductor C28, a set of contacts on relay 67OD, conductor CAC as extended to a terminal block indicated in Fig. 71, winding of relay 71PC27, to battery. Both of said latter relays operate, relay 71P27C completing the circuit of punch magnet 89PM27 which operates to punch a hole in column 27, row 7, to record the digit 7 as the first digit of the called office code.

When the card is advanced to the 6th row and ground is accordingly applied to conductors EM6 and CH6, a circuit is completed from ground on said conductor EM6, No. 7 contacts of relay 46F5–00, No. 3 contacts of relay 46F5–4, No. 2 contacts of relay 46F5–2, conductor E30, a set of contacts on relay 67OD, conductor CCE as extended to a terminal block indicated in Fig. 71, winding of relay 71P29C, to battery. Another circuit is completed from ground on conductor CH6, No. 2 contacts of relay 46F5–00, No. 5 contacts of relay 46F5–2, No. 8 contacts of relay 46F5–4, conductor C30, a set of contacts on relay 67OD, conductor CCC as extended to a terminal block indicated in Fig. 71, winding of relay 71PC29, to battery. Both of said latter relays operate, relay 71P29C completing the circuit of punch magnet 89PM29 which operates to punch a hole in column 29, row 6, thereby to record the digit 6 as the third digit of the called office code.

When the card is advanced to row 2 and ground is thereupon applied to conductors EM2 and CH2, a circuit is completed from ground on said conductor EM2, No. 8 contacts of relay 45E5–2, No. 7 contacts of relay 45E5–0, conductor E29, a set of contacts on relay 67OD, conductor CBE as extended to a terminal block indicated in Fig. 71, winding of relay 71P28C, to battery. Another circuit is completed from ground on conductor CH2, No. 7 contacts of relay 45E5–2, No. 3 contacts of relay 45E5–0, conductor C29, a set of contacts on relay

67OD, conductor CBC as extended to a terminal block indicated in Fig. 71, winding of relay **71PC28**, to battery. Relays **71P28C** and **71PC28** both operate, the former completing the circuit of punch magnet **89PM28** which operates to punch a hole in column 28, row 2, thereby to record the digit 2 as the second digit of the called office code.

6.29. *Chargeable time*

The following table gives the details of the cross-connections at the indicated terminal block in Fig. 71 between designated conductors of the circuit which are indicated in the table and the punch and check relays **71P42M**, **71PM42** . . . **71P48M**, **71PM48** which control the operation of punch magnets **89PM42** . . . **89PM48** in the columns of which are punched holes to record the chargeable time, the class and the charge.

TABLE X

	Relays	Magnets	Significance	
From Fig. 40:				
CTTE	71P42C	89PM42	Tens	Chargeable Time.
CTTC	71PC42			
CTUE	71P43C	89PM43	Units	
CTUC	71PC43			
CLE (From Fig. 69)	71P44C	89PM44	Class.	
CLC (From Fig. 69)	71PC44			
From Fig. 23:				
Not Used	71P45C	89PM45	Dollars—Tens Digit	Charge.
Not Used	71PC45			
PHE (From Fig. 12A)	71P46C		"Chg. Sel" Index	
PHC (From Fig. 12A)	71PC46			
PTE	71P47C	89PM47	Cents—Tens Digit	
PTC	71PC47			
From Fig. 22:				
PUE	71P48C	89PM48	Cents—Units Digit	
PUC	71PC48			

The chargeable time, it will be remembered, is recorded as two digits in the C and D digit positions of the fifth line of the message entry, and is consequently registered in the C and D registers of the Ninth Storage Register of the Odd Storage Unit. And it will be further recalled (and as shown in Fig. 100) that the chargeable time assumed for the message entry which is being processed is five minutes, that is to say, a 0 for the tens digit of chargeable time and a 5 for the units digit of chargeable time. Consequently when the card is advanced to row 0 and ground is applied to conductors **CH0** and **EM0**, a circuit is completed extending from ground on said conductor **EM0**, No. 9 contacts of relay **29C9–3**, No. 3 contacts of relay **29C9–2**, No. 3 contacts of relay **29C9–1**, conductor **E50**, No. 1 contacts of relay **40OCT**, conductor CTTE as extended to a terminal block indicated in Fig. 71, winding of relay **71P42C**, to battery. Another circuit is completed extending from ground on said conductor **CH0**, No. 5 contacts of relay **29C9–3**, No. 4 contacts of relay **29C9–1**, No. 4 contacts of relay **29C9–2**, conductor **C50**, No. 2 contacts of relay **40OCT**, conductor CTTC as extended to a terminal block indicated in Fig. 71, winding of relay **71PC42**, to battery. Relays **71P42C** and **71PC42** operate, the former completing a circuit of punch magnet **89PM42** which operates to punch a hole in row 0, column 42 as the tens digit of the chargeable time.

When the card is advanced to row 5 and ground is applied to conductors **CH5** and **EM5**, a circuit is completed from ground on said conductor **EM5**, No. 8 contacts of relay **30D9–00**, No. 4 contacts of relay **30D9–4**, No. 2 contacts of relay **30D9–1**, conductor **E51**, No. 3 contacts of relay **40OCT**, conductor CTUE as extended to a terminal block indicated in Fig. 71, winding of relay **71P43C**, to battery. Another circuit is completed from ground on conductor **CH5**, No. 3 contacts of relay **30D9–00**, No. 5 contacts of relay **30D9–1**, No. 7 contacts of relay **30D9–4**, conductor **C51**, No. 4 contacts of relay **40OCT**, conductor CTUC as extended to a terminal block indicated in Fig. 71, winding of relay **71P43C**, to battery. Relays **71P43C** and **71PC43** both operate, the former completing the circuit of punch magnet **89PM43** which operates to punch a hole in row 5, column 43 to record the units digit 5 of the chargeable time.

6.30. *Class*

In column 44, row 6, a punch is placed on all cards with respect to subscriber dialed calls for which no rate distinction is made for day, night, holidays and Sundays service from the various classes of station-to-station and person-to-person connections. Consequently when the card is advanced to row 6 and ground is applied to conductors **EM6** and **CH6**, a circuit is completed from ground on said conductor **EM6**, No. 2 contacts of relay **69D**, conductor CLE as extended to a terminal block indicated in Fig. 71, winding of relay **71P45C**, to battery. Another circuit is closed from ground on conductor **CH6**, No. 1 contacts of relay **69D**, conductor CLC as extended to a terminal block indicated in Fig. 71, winding of relay **PC44**, to battery. Both of said relays operate, the former completing the circuit of punch magnet **89PM44** which operates to punch a hole in row 6, column 44 as an indication of the class.

6.31. *Charge*

When charge units are recorded in the E and F digit positions of the fifth line of the entry, such digits are registered in the E and F digit registers of the Ninth Storage Registers of the Odd Storage Unit, as previously explained. Also, these units are translated into the equivalent money charge by the operation of the Toll Charge Translator shown in Figs. 22 and 23, as explained under Section 5.5, and that such charge, if there is one, will be recorded by appropriate punches in columns 45 to 48, inclusive, by the operation of punch magnets **89PM46** . . . **89PM48**, also as explained in the above section. However, in view of the fact that no charge units are recorded in the E and F digit positions of the fifth line in the entry of the given example there are, of course, no such units to be translated and recorded. Consequently those columns of the card which are assigned for the charge and the tax and the total charge will be unused for the particular example inasmuch as no circuits are completed for the magnets operating in such columns.

It should be observed that in row 11 in the dollar units column (column 46) a punch is indicated to distinguish cards which have been "totally" priced from those which have not been, the distinction being made in the fact that calls for which the total number of message units is 19 or less the message is totally priced both as to charge and tax, whereas messages which involve a charge of 20 message units or more are not priced. In the former case the "Chg Sel" punch is placed in row 11, column 46, whereas in the latter case it is omitted.

Whether or not the punch is made in said row and column depends upon whether the Total Charge Trans-

lator shown in Figs. 11A and 12A has operated. If it has operated, thus indicating that the total number of message units does not exceed 19, then, when the card has been advanced to row 11 and ground is applied to conductors EM11 and CH11, a circuit is completed from ground on said conductor EM11, No. 2 contacts of one of the relays 11A–TT0 . . . 12A–TT29 whichever is operated in response to the value of the tax, conductor PHE as extended to a terminal block shown on Fig. 71, winding of relay 71P46C, to battery. Another circuit is completed from ground on said conductor CH11, No. 3 contacts of said operated relay in the group of relays 11A–TT0 . . . 12A–TT29, conductor PHC as extended to a terminal block indicated in Fig. 71, winding of relay 71PC46, to battery. These relays operate in the manner previously described to cause a punch to be produced in row 11, column 46 as the "Chg Sel" index. The card illustrated in Fig. 105 has no such punch inasmuch as no charge units are recorded in the E and F digits of the fifth line of the entry shown in Fig. 100.

6.32. *Tax*

The following table gives the details of the cross-connections at the indicated terminal block in Fig. 71 between designated conductors of the circuit which are indicated in the table and the punch and check relays 71P51C, 71PC51 . . . 71P60C, 71PC60 which control the operation of punch magnets 89PM51 . . . 89PM60 in the columns of which are punched holes to express the amount of the tax and the total charge; that is, the charge for the call plus the tax thereon.

TABLE XI

	Relays	Magnets	Significance	
From Fig. 11:				
TCTC	71P51C	89PM51	Tens—Cents	Tax.
TCT	71PC51			
TCUC	71P52C	89PM52	Units—Cents	
TCU	71PC52			
TMTC	71P53C	89PM53	Units—Mills	
TMT	71PC53			
TMUC	71P54C	89PM54	Tenths—Mills	
TMU	71PC54			
From Fig. 11A:				
PDTE	71P55C	89PM55	Dollars—Tens	Total Charge.
PTTC	71PC55			
PDUE	71P56C	89PM56	Dollars—Units	
PDUC	71PC56			
PCTE	71P57C	89PM57	Cents—Tens	
PCTC	71PC57			
PCUE	71P58C	89PM58	Cents—Units	
PCUC	71PC58			
PMTE (not used).	71P59C	89PM59	Mills—Tens	
PMTC (not used).	71PC59			
PMME (not used).	71P60C	89PM60	Mills—Units	
PMUC (not used).	71PC60			

As indicated in Section 5.5, certain calls are taxable, and for this purpose the Toll Unit Tax Translator shown in Figs. 11 and 12 is provided. The tax assessed for each call depends upon the total number of charge units therefor, and may vary according to the tax structure. The operation of one of the relays 11TT0 . . . 12TT29 as described extends the stationary contacts thereof to the EMX and CHX groups of conductors, to which said conductors are connected (not shown but indicated) in accordance with the monetary value of the tax, as further determined by the operation of the appropriate one of the relays 11TU0 . . . 11TUP. The operation of the appropriate one of the latter relays then extends the involved conductors in the EMX and CHX multiples to punch magnet control relays 71P51C, 71PC51 . . . 71P54C, 71PC54 (dollars being omitted) over conductors TCTC . . . TMU as extended to a terminal block indicated in Fig. 71, which relays then operate to complete the circuits of punch magnets 89PM51 . . . 89PM54 which operate at the rows indicated by the tens and units values of the cents and mills denomination of the tax to punch holes in said row to record said tax.

In Fig. 105, the sample card, punches have been omitted since the call is not priced.

6.33. *Total charge*

As previously explained, whenever the total number of charge units for the call is 19 or less, the call is priced by converting said units into the equivalent money value, computing the tax therefor, adding the total thereof and recording the latter in columns 55 to 58, inclusive, of the card. The total charge involves, as said before, the operation of one of the relays 11A–TT0 . . . 12A–TT29 depending upon the number of charge units. The stationary contacts of said relays are connected to the EMX and CHX multiples in accordance with the money value of the total charge represented by each of said relays, while the armatures of the relays 11A–TU0 . . . 11A–TU9 are connected as shown to conductors PDTE . . . PMUC extending to a terminal block indicated in Fig. 71. When the card is advanced to the successive rows which indicate the various digits of the total charge, and ground is accordingly and successively applied to the corresponding conductors in the EMX and CHX multiples, circuits are completed for relays 71P55C . . . 71PC60 over said conductors, which relays operate to complete circuits for the punch magnets 89PM55 . . . 89PM60 severally controlled thereby, causing said magnets to operate in their respective columns and on the different rows indicated by the digits of the total charge, to record said total charge by the punching of holes at the involved cross-points of the rows and columns.

The card illustrated in Fig. 105 does not show these punches inasmuch as the call illustrated is a "non-priced" call.

6.34. *AMA class*

The following table gives the details of the cross-connections at the indicated terminal block in Fig. 71 between designated conductors of the circuit which are indicated in the table and the punch and check relays 71P68C, 71PC68, 71P77C, 71PC77 . . . 71P80C, 71PC80 in the columns of which are punched holes to express the AMA class, the Message Billing Index, the number of Toll Units and the Observing Index.

TABLE XII

	Relays	Magnets	Significance
From Fig. 81:			
CLE	71P68C	89PM68	AMA Class.
CLC	71PC68		
From Fig. 40:			
	71P77C	89PM77	Message Billing Index.
	71PC77		
MUTE	71P78C	89PM78	Toll Units—Tens.
MUTC	71PC78		
MUUE	71P79C	89PM79	Toll Units—Units.
MUUC	71PC79		
From Fig. 70:			
OBSE	71P80C	89PM80	Observing Index.
OBSC	71PC80		

Column 68 on the card is reserved for what is termed as the AMA class, the digits from 0 to 7 being recorded in said column depending upon whether the call is priced or unpriced, etc. as indicated in Fig. 105. In view of the fact that the mesesage of the given example is "unpriced," due to the absence of message units in the E and F digit positions in the fifth line of the message entry (see Fig. 100), the digit to be recorded for the AMA class is "0."

Consequently when the card is advanced to row 0, and ground is applied to conductors EM0 and CH0, ground on said conductor EM0 completes a circuit over the No. 5 contacts of relay 22U00, No. 2 contacts of relay 22U0, No. 7 contacts of relay 23T00, No. 5 contacts of relay 23T0, conductor ECL, No. 2 contacts of relay 80TOL, conductor RE, No. 8 contacts of relay

79–OI0, conductor RCIE, No. 2 contacts of relay 80REG, conductor CIE, No 8 contacts of relay 81C1A, conductor CLE as extended to a terminal block indicated in Fig. 71, winding of relay 71P68C, to battery. Another circuit is closed from ground on said conductor CH0, No. 6 contacts of relay 22U00, No. 3 contacts of relay 22U0, No. 8 contacts of relay 23T00, No. 6 contacts of relay 23T0 conductor CCL, No. 6 cointacts of relay 80TOL, conductor RC, No. 9 contacts of relay 79–OI0, conductor RCIC, No. 6 contacts of relay 80REG, conductor C1C, No. 7 contacts of relay 81C1A, conductor CLC as extended to a terminal block indicated in Fig. 71, winding of relay 71PC68, to battery. Both of said relays operate, the former completing the circuit of punch magnet 89PM68 which operates to punch a hole in row 0, column 68, to indicate that the call is unpriced.

6.35. *Disconnect time*

Disconnect time is punched on cards produced for "overcapacity" entries on Detail tapes and will be described below in connection therewith.

6.36. *Message billing index*

The recording of this digit will be discussed in connection with the processing of "overcapacity" entries.

6.37. *Toll message units*

Columns 78 and 79 are reserved for recording the number of message or toll units on Message Unit Detail and Observing tapes. When toll messages are provided in toll unit forms (E and F digits in the fifth line of the entry, present example), but the pricing facilities shown in Figs. 11, 11A, 12 and 12A are not provided, these units are punched into the above assigned columns to simplify the card rating arrangement.

In this case, conductors E5 and C5 of the E register and conductors E6 and C6 of the F register (Ninth Storage Register) are connected through the contacts of relay 40OMU to conductors MUTE . . . MUUC, which extend to a terminal block indicated in Fig. 71 and thence to punch magnet control relays 71P78C . . . 71PC79. When ground is applied to the appropriate conductors in the EMX and CHX multiples and the card is advanced to the involved rows, the above relays operate to severally complete the circuits of the punch magnets 89PM78 and 89PM79 controlled thereby, which magnets then operate to punch in the appropriate rows and in the above designated columns to record to tens and units digits of the number of toll or message units.

6.38. *Observing index*

As indicated on Fig. 105, this digit is punched on observed calls only and will be described in connection therewith.

7. *Release of the registers for detail and individual summary cards*

When the card cycle is completed, that is, when row 9 of the card is punched, the registers are released. Preparation for release, however, precedes punching operations in row 9. When the eleventh pulse is transmitted and relay 9–11E operates in consequence thereof, a circuit is completed for relay 81C10, the path of which may be traced from battery through the winding of said relay, conductor C10, No. 6 contacts of relay 67ODC, conductor C1B, No. 1 contacts of relay 81C1A, No. 1 back contacts of relays 81C2A and 81C3A, conductor F11, No. 2 contacts of relay 9–11, to ground on conductor MON1. Relay 81C10 operates and locks over its No. 4 contacts, conductor CRL, No. 5 contacts of relay 76ERL, No. 1 contacts of relay 66ORL, to ground on conductor ON. It should be noted at this time that if the Even Storage Unit had control of the Gang Punch, relay 81C1E would have been operated instead of relay 81C10, and would have been operated over essentially a similar path. It should also be noted that the above-described operation of relay 81C10 is contingent upon relay 81C1A being operated. This, however (and as explained below) is only true if but one card is being produced for an entry. If two or more cards are to be produced for an entry, relay 81C1A will not be operated until relays 81C2A and 81C2B will have been operated, thus delaying the release of the registers until the appropriate number of additional cycles have been taken to produce the required number of cards.

When relay 10–9E operates between the eighth and ninth pulses, circuits are completed for relays 3PCT and 3PCK9. The circuit of relay 3PCT is traced from battery through the winding of said relay, No. 13 contacts of relay 3PC, conductor PCT, No. 4 contacts of relay 10–9E, conductor PCT1, back contacts of relay CHUB, to ground on conductor ON. When relay 3PCT has operated, the circuit of relay 3PCK9 is completed from battery through the winding of said relay, No. 3 front contacts of relay 3PCT, conductor PC serially through the No. 1 front or back contacts of the punch magnet, control relays 71PC1, 71P1C . . . 71PC80, 71P80C, conductor CG, No. 4 front contacts of relay 3PCT, to ground. When the ninth or last pulse is received and relay 10–9 operates, a circuit is completed for the release relays 66RL9, 66RL5–7 and 66RL7–3, the circuit of said latter two relays extending from ground on conductor MON1, No. 3 contacts of relay 10–9, conductor 9E, No. 2 contacts of relay 3PCK9, No. 1 contacts of relay 3PCT, conductor RRL, No. 6 contacts of relay 81C10, conductor RL0, winding of relay 66RL5–7 and winding of relay 66RL1–3, to battery. Another branch of said grounded conductor RL0 extends over the No. 1 contacts of relay 68OD, conductor RL9, winding of relay 66RL9, to battery. All these relays operate and release relays 66H57, 66H13 and 66H9, respectively, which hold relays 66LK5–7, 66LK1–3 and 66LK9, respectively, over separate locking circuits; for instance the locking circuit of relay 66LK9 being traced from battery through the winding of said relay, front contacts of relay 66RL9, No. 2 contacts of relay 66LK9, to ground over the No. 1 contacts of relay 66ST3. The locking circuit of the other relays mentioned are similar and evident from Fig. 66.

Relay 66RL1–3, in operating, completes the circuit of relay 76OH to prepare for the operation of the "Even" output connectors for the next entry which was registered during the succeeding card cycle. The path of relay 76OH extends from battery through the winding of said relay, No. 2 contacts of relay 66RL1–3, No. 2 contacts of relay 66LK1–3, to ground on the No. 3 contacts of relay 66ST3. Relay 66OH operates and besides other functions, holds locked to ground on conductor ON, thereby maintaining the integrity of the CHX and EMX multiples to permit punching of row 9. However, ground is removed from conductor CRL, when relay 66ORL operates, thereby opening the locking circuit of relays 81C10 and 81C1A, which relays, however, holding over their original operating circuit during the punch in row 9. With the operation of relay 66OH, relay 66ORL operates over an obvious circuit to ground on conductor ON, and locks over its No. 5 contacts and conductor DRLL to ground on the No. 3 contacts of relay 67ODC.

When relay 10–9 releases, the card count relays 81C10 and 81C2A release directly, as do relays 66RL1–3, 66RL5–7 and 66RL9, in turn releasing relays 66LK1–3, 66LK5–7 and 66LK9. Relay 66OH also releases. Relays 66LK1–3, 66LK5–7 and 66LK9, in releasing, release the digit registers of the Odd Storage Unit and their associated UC– relays. These registers are now "down-checked" in the manner previously described, resulting in the operation of relays 66DC1, 66DC3, 66DC5, 66DC7 and 66DC9, in consequence of which relays 66H1–3, 66H1–7 and 66H9 are reoperated as previously described.

Relay 66OH, on releasing, operates the even con-

nectors, connector relay 88EL thereof being shown and operated over a circuit completed from ground on conductor ON, No. 2 contacts of relay 66OH, No. 2 contacts of relay 66ORL, conductor E, winding of relay 88EL to battery. Another branch of conductor E extends over the No. 8 contacts of relay 68D, conductor ED, to the Even Detail Connector EDC (not shown). Relay 8CUC which is locked over the upcheck conductor OUC29 to ground on relay 55UC1, releases upon the release of the latter relay. Relay 8STG then reoperates at the end of the card cycle from ground on interrupter contacts P6 of the Gang Punch, and the operation of said relay prepares a path for relay 8CUC for the start of the next card cycle.

The motor of the Gang Punch continues to run, and the clutch magnet must be reoperated before the emitter reaches position 13.5. Under this condition only approximately 50 milliseconds will be available for the operation of the connector translator and punch control relays after the circuit breaker CB opens on the pulse for row 9, which may not be sufficient time for these operations. However, 115 milliseconds are available before the closure of the circuit breaker CB for row 12 of the next card if the emitter is not allowed to stop at position 13.5. For this reason relay 8PST is locked operated once the Gang Punch is started, over its No. 2 contacts the No. 2 contacts of relay 8POC, No. 2 contacts of relay 8PSP, No. 2 contacts of relay 8R, to ground on conductor ON1, said relay 8PST not releasing until one of the latter relays releases. Therefore, the Gang Punch actually continues into the next cycle before the control circuit is completely ready. The operating path of relay 8STG opens in position 13.4 of the emitter, but the relay locks through the No. 1 contacts on relay 8R to ground on conductor I1. When the emitter pulse occurs over conductor 12, relay 8R operates, releasing relay 8STG and preventing the operation of relay 8CUC until the next cycle. Relay 8R, in operating, also releases relay 8PST, so that the Gang Punch will make no further cycles for any prior operation of relay 8CUC. Relay 66ORL is held operated until all the connectors and card count relays (Fig. 81) used on the previous card cycle have released.

8. *Normal release (no more cards in card magazine)*

The machine may be made to stop automatically at the end of an input card stack by operating the machine release key 5KMARL while the machine is running. If this key is operated, relay 5RLM is released, but relay 8PIC which holds to the reader contacts H1 and over conductor I3 to ground on the No. 1 contacts of relay 89–3, will release at the end of the reading cycle if, in the meanwhile, the card magazine is exhausted and contacts 89MC open to release relay 89–4. In this event and upon the reading of the subsequent entry, a circuit is completed over relay 5RLS, said circuit being traced from battery through the winding of said relay, conductor RLS, No. 5 back contacts of relay 8PIC, conductor FLD, No. 5 back contacts of relay 5RLM, No. 3 contacts of relay 5ALS, conductor FLD1, No. 5 contacts of relay 15A2, No. 4 front contacts of relay 15A1 (which is operated on the sensing of said subsequent entry inasmuch as the A digit therefore is "1," as shown in Fig. 103A), No. 5 contacts of relay 15A0, conductor LL4 and thence as previously traced to ground on conductor G1 or G2 as for a regular sensing cycle. Relay 5RLS operates and locks over its No. 1 contacts to ground on the No. 8 contacts of relay 5ST3. In the meantime, the entry already registered must be placed on the card which is by this time in the die punch position. With relay 5RLM released, a circuit is closed for relay 8PST upon the operation of relay 8CUC, which operates again and starts the punch cycle even though the released condition of relay 8PIC indicates that no cards are available in the magazine, said circuit tracing from battery through the winding of relay 8PST, conductor PST, No. 6 contacts of relay 8RLM, conductor PST1, No. 1 back contacts of relay 8POC, No. 3 contacts of relay 8CUC, to ground on conductor ON1. As a result, all information registered in the machine is released before the operation of relay 8RLS is effective. With all relays UC– normal and relay 5RLS operated, relay 5MST releases at the No. 1 front contacts of relay 5RLM, to release the reader motor and the reading relays.

9. *Skipping intermediate splice and window pattern*

Several tape sections may be spliced together to form one continuous tape, which may then be continuously fed through the machine without interruption. When several tape sections are so spliced, the splice pattern joining the two sections is preceded by the code 286000. In response to the reading of said line, reading relays 15A2, 16B7, 16B1, 16C4, 16C2, 17D7, 17D4, 17E7, 17E4, 18F7 and 18F4 operate in the manner described. A circuit for relay 26SS is thereupon completed from battery through the winding of said relay, conductor 286, No. 5 contacts of relay 16C4, No. 6 contacts of relay 16C2, No. 4 contacts of relay 16B7, No. 4 contacts of relay 16B1, conductor LL5, No. 4 contacts of relay 15A2, No. 4 back contacts of relay 15A1, No. 5 back contacts of relay 15A0, conductor LL4, and thence as previously traced through the relays of the Digit Reading Registers for other digits, to ground on conductor G1 or G2. Relay 26SS operates, completing an obvious circuit for relay 26SSL which operates and locks to the No. 1 contacts of relay 26ESP. Relay 26SS also completes the circuit of relay 27RS over conductor RS10 to ground on the No. 2 contacts of relay 26SS, operating said relay 27RS and causing it to advance the tape 4T to the next line in the manner previously described, which would be the first line of the splice pattern 081010. On the release of the reading relays following the reading of the line 286000, relay 26SS releases. Relay 27RS, however, is repeatedly operated for each splice line to advance the tape, the circuit therefore being over the No. 2 contacts of relay 26ESP, No. 2 contacts of relay 26SSL, conductor RS11, No. 2 contacts of relay 18F0, No. 2 contacts of relay 18F1 (both of the latter relays remaining normal over a splice code), conductor RS12, No. 2 contacts of relay 15A2, No. 3 contacts of relay 15A1, conductor UC3, and thence as previously traced to ground on conductor G1 or G2. On operating, relay 27RS locks to ground on contacts H3 of the reader as previously described. In this manner, the tape is progressively advanced through the splice pattern by the repeated operations of relay 27RS. Upon the sensing of the first line of an entry immediately after the splice pattern which, of necessity, will cause the operation of relay 15A1 or 15A2 and certain of the relays in the other Digit Reading Registers, a circuit is completed for relay 26ESP from battery through its winding, No. 3 contacts of relay 26SS, No. 3 contacts of relay 26SWS, conductor ESP, No. 8 contacts of relay 15A2, or No. 6 contacts of relay 15A1, to ground connected to said conductor ESP by other operated relays of the Digit Reading Registers. The operation of relay 26ESP unlocks relay 26SSL which, in turn, prevents the reoperation of relay 27RS, thus causing the tape to advance again under the control of the message entry being sensed.

A "window splice" is preceded by the code 287020 the reading of which causes relays 26SWS and 26SWSL to operate in the same manner as relays 26SS and 26SSL. Thus, on reading the code 287020, a circuit is completed for relay 26SWS, extending from battery through the winding of said relay, conductor 287, No. 7 contacts of relay 16C7, No. 3 contacts of relay 16C0, No. 4 contacts of relay 16B7, No. 4 contacts of relay 16B1, conductor LL5, and thence as previously traced therefor to ground. Relay 26SWS operates, completes an obvious circuit for relay 26SWSL, which locks to ground on the No. 1 contacts of relay 26ESP, and completes the circuit

of relay **27RS** over its No. 2 contacts and conductor **RS10**. Relay **27RS** now operates repeatedly as before to advance the tape over the window splice, relay **26SWS** releasing after the tape has advanced beyond the line 287020.

It should be noted at this time that the operation of relay **27RS** opens the time leads from the reader step control. Also that the operation of the reading relay **15A0** over each splice pattern code cancels the timing of each line of the splice or window pattern.

10. *Skipping trailing tape identity entries*

As shown in Fig. 100, each tape to be processed contains nine lines of tape identity entries at the forward end and the same number of lines with identical entries at the trailing end, with, as previously explained, one or more splice or "window" (not shown) entries in between.

When all the entries on the tape have been processed in the manner described, the tape is advanced to the first line of the trailing end of the tape identity entries. The operation of the circuit then proceeds as described in Section 3, except that on sensing the first tape identity line, and remembering that relay **18TIE** was locked to ground on conductor MON over the No. 7 back contacts of relay **2L1**, the operation of said latter relay will release relay **18TIE** to permit the previously described circuit functions depending upon the released condition of this relay to be performed.

It should be pointed out, however, that the successful skipping of the trailing tape identity entries is contingent upon the identity of the specific entries therein with those on the forward entries, and upon the set-up switches in Figs. 6 and 7 remaining undisturbed between the processing of both. If, for example, the switches, or any of them, are disturbed by setting them to different terminals from those to which they were originally set, circuits set up by the reading relays in response to the digits of the entries will not be completed over the terminals called for by the digits, and the apparatus will block and sound an alarm, as will be described.

11. *Computer message unit detail tape*

A computer Message Unit Detail tape is essentially the same in respect to the entries therein as the Toll tape above described, except that:

(*a*) The tape index digit of the Message Unit Detail tape is "3" (see Table I);

(*b*) The E and F digits of the fifth line of each entry in said tape always contain the number of message units, which must be recorded in columns 78 and 79 of the card (see Fig. 105);

(*c*) The AMA class digit of the entries in said tape is "4" (see Fig. 105).

The Message Unit Detail tape is processed in the same manner as the Toll tape, and no attempt will be made here to repeat previously described circuits and functions, the description that follows being limited to those circuit features and operations which are distinct and individual to the Message Unit Detail tape and the processing thereof.

After the Storage Unit (Odd or Even, but herein referred to as Odd because it is shown in the drawing and has been fully described above) has been set in accordance with a message entry, and remembering that the C digit of the third line of the entry is 0, 1 or 2 (see Fig. 103F), causing the C digit of the Fifth Storage Register to be set accordingly, a circuit is completed for relay **80MUDA**, said circuit being traced from battery through the winding of said relay, conductor MUD, terminal **3** and brush **4** of switch **6TT**, conductor CI, a set of contacts on relay **67OD**, thence through the relays of the C-Digit Fifth Storage Register, conductor **E27**, another set of contacts on relay **67OD**, to ground. Relay **80MUDA**, in operating, closes conductors CLC and CLE controlling the operation of punch magnet **89PM68**, previously described, to conductors **CH4** and **EM4** in the group of CHX and EMX multiples, thus insuring that when the card is advanced to row 4, a punch will be made in said row in column 68 to record the digit 4 for the AMA class. The path from conductor CLE to **EM4** is as follows: conductor CLE as previously traced to the No. 8 contacts of relay **79–O10**, No. 5 contacts of relay **80MUDA**, to conductor **EM4**; the path from conductor CLC to conductor **CH4** is as follows: conductor CLC as previously traced to the No. 9 contacts of relay **79–OI0**, No. 9 contacts of relay **80MUDA**, to conductor **CH4**.

Relay **80MUDA** further completes the circuit of relay **47OEF** from ground on the No. 3 contacts of relay **80MUDA**, No. 10 contacts of relay **80TOL**, conductor MDEF, a set of contacts on relay **67ODC**, conductor OMDEF, winding of relay **47OEF** to battery. The latter relay operates; over its No. 1 front contacts it advances the "upcheck" lead **OUC9** to the No. 1 back contacts of relay **40C** so that when the previously traced circuit of relay **8CUC** is being prepared, said circuit will trace through the No. 1 front contacts of relay **47OEF**. Through its other contacts, relay **47OEF** extends the CHX and EMX multiples to the contacts of the E and F Digit Ninth Registers (fifth line of the message entry) thus to enable the digits designating the number of message units recorded therein to be punched in columns 78 and 79 of the card at the time when the latter is advanced to the rows which are indicative of the tens and units digits of the numerical value of said units.

12. *Observing tapes*

Observing tapes may be of two kinds. The first kind is essentially similar to the Toll tape, the composition of which is shown in Fig. 103A, and the processing of which has been described above. There is no difference in the entries of either tape, but there is a difference in the tape "type" entry in the first line of the tape identity entries, the E digit of which for a Toll tape is "2" and for an Observing tape is "4" (see Table I).

The second kind of Observing tape is the one which is made for "non-answered" calls, and besides distinguishing from the Toll tape by the value "4" of the E digit of the tape identity entry, further distinguishes from it by the fact that the A digit of each entry is a "3" instead of "1" (see Fig. 103B).

On both kinds of Observing tapes, the E and F digits in the fifth line of the message entry, though representing toll units or message units on the Toll tape, are treated as message units in the production of cards from Observing tapes. Where the chargeable time digits 00 are recorded in the C and D digits of the fifth line of the message entry, said digits either represent a "cancel all charges" indication or charges for overtime. On all Observing tapes, a message unit index value of "3" indicates all charges are to be canceled, while a message unit index of 0, 1, 2 or 4, in combination with 00 chargeable time, indicates cancel overtime charges to be canceled. The following table indicates the relation between the various indices:

TABLE XIII

Types of Calls	On Observing Tape		On Observing Card, Observing Index
	A Digit 1st Line	Mess. Unit Index	
Not observed	do not appear		no card
Observed—Full Charge	1	0, 1, 2, 4	1
Observed—Not Answered	3	0, 1, 2, 4	2
Observed—Cancel all Charges	1	3	3
Observed—Cancel Overtime Charges	1	0, 1, 2, 4	1

NOTE.—On calls with overtime charges canceled, Message Unit Index 1 is used. Chargeable time 00, in combination with Message Unit Index 1, indicates that overtime charges are canceled.

On the sensing of the tape type entry for an Observing tape (either kind), and due to the fact that the E digit thereof is 4, and the tape type switch 6TT is accordingly adjusted to terminal 4, a previously described circuit is completed for relay 68OD which, in turn, operates relays 68D and 69D over obvious circuits. When the first line of the first message entry is read (assuming the tape to be an "answered" Observing tape), a circuit is completed for relay 79–OI0 of the Observing Index, Translator, which circuit may be traced from battery through the winding of said relay, conductor OB1, No. 4 terminal and brush 5 of switch 6TT, conductor OB01, No. 11 contacts of relay 68OD, conductor A1, and thence as previously traced to ground, causing said relay 79–OI1 to operate. In the event that the Observing tape is of the "non-answered" variety, for which the A digit of the first line of each message entry is 3 thus causing relay 55A13 of the First Storage Register to operate and lock (the operation of said relay being over a circuit similar to the one previously traced for relay 55A11), then the circuit of relay 79–OI2 is completed, said circuit being traced from battery through the winding of said relay, conductor OB2, No. 10 contacts of relay 68OD, conductor A3, a set of contacts on relay 67OD (operated in the previously described manner), conductor A3, No. 6 contacts of relay 55A13, conductor A, No. 8 contacts of relay 68OD, conductor 2, a set of contacts on relay 67OD, conductor 2 extending to Fig. 28, to conductor 9B2. If the B digit of the Ninth Storage Register has been operated for the Message Unit Index "2" as would be the case for an observed—"not answered" call (see Table XIII), then the above path continues through the contacts of the relays of said register, conductor C3, a set of contacts on relay 67ODC, to ground. It should be noted that relays 79–OI3 and 79–OI4 will operate if the value of the Message Unit Index is 3 or 4, inasmuch as the setting of the B-Digit Register of the Ninth Storage Unit causes all of the circuits traced thereto (including those of relays 79–OI3 and 79–OI4) to unite at conductor C3 and thence to ground. Relay 79OBS is locally operated whenever any relay 79–OI1, 79–OI2, 79–OI3 or 79–OI4 is operated.

The operation of relay 79–OI1 . . . 79–OI2 controls the value of the observing index which will be punched in column 80 of the card produced from a message entry on an Observing tape. Thus if the call is observed and a full charge is to be made thereof, the value of the observing index to be punched on the card is 1. Accordingly, when the card is advanced to row 1 and ground is applied to conductors EM0 and CH0, and remembering that relay 79–OI1 is operated, a circuit is completed from ground on said conductor EM0, No. 5 contacts of relay 79–OI1, conductor OBSE, as extended to a terminal indicated on Fig. 71 (see Table XII), winding of relay 71P80C, to battery. Another circuit is also completed from ground on said conductor CH0, No. 6 contacts of relay 79–OI1, conductor OBSC as extended to a terminal block indicated on Fig. 71 (see Table XII), winding of relay 71PC80, to battery. Both of said relays operate, the former completing a circuit to the punch magnet 89PM80, which operates to punch a hole in row 1, column 80 of the card, to indicate that, although the call is observed, a full charge is to be made therefor in accordance with the answer time and the number of charge units registered in the Ninth Storage Register.

If the call was not answered, then relay 79–OI2 is operated, and a hole is punched in row 2, column 80, of the card. Accordingly, conductors OBSE and OBSC are switched to conductors EM2 and CH2, respectively, over the Nos. 5 and 6 contacts of relay 79–OI2, to cause said punch to be made in row 2, column 80, when the card is advanced to row 2 and ground is applied to conductors EM2 and CH0.

In the same manner, if the call is observed and all charges should be canceled, the B-Digit Register of the Ninth Storage Register is set for the registration of the digit 3 (see Table XIII) and relay 79–0I3 is operated, which relay switches conductors OBSE and OBSC to conductors EM3 and EM4, respectively, to cause a punch to be produced in row 3, column 80, of the card.

If the call is observed and overtime charges are to be canceled, the value of the observing index that will be punched on the card will be 1. As stated in the note below Table XIII, this index, in combination with chargeable time 00, indicates that overtime charges are to be canceled. As previously noted, the Message Unit Index 1 results in the operation of relay 79–OI1, and will cause digit 1 to be punched in row 1, column 80, of the card in the manner described.

It will be noted from Fig. 105 that cards made for observed entries require the punching of the digit 5 for the AMA class (column 86). Due to the fact that relay 79OBS is operated, conductors CLE and CLC that control the punching in the AMA column are switched to conductors EM5 and CH5, respectively, when the card is advanced to row 5 and ground is applied to said conductors EM5 and CH5. The extension of conductor CLE to conductor EM5 is traced from said conductor CLE to conductor CIE as already described, No. 2 contacts of relay 79OBS, to conductor EM5; the extension of conductor CLC to conductor CH5 is traced from said conductor CH5 to conductor CIC as already described, No. 3 contacts of relay 79OBS to conductor CH5.

Other operations of the apparatus in response to the sensing of an Observing tape are the same as described for the Toll tape.

13. *Detail tape*

What is herein called the Detail tape differs from the Computer tapes by the fact that it contains the different types of message entries which are severally recorded on the different computer tapes above described. Thus on one and the same Detail tape will be found Message Unit Detail entries, both observed and unobserved, and Toll message entries both observed and unobserved. In addition to such entries, it contains also what is herein called "overcapacity" message entries; that is, entries for which no chargeable time or message or toll units are recorded therefor but for which, instead, the "disconnect" time of the connection is recorded. An overcapacity entry differs from all other entries on both Computer and Detail tapes in that it occupies six lines on the record to be sensed instead of five.

Figs. 104A . . . 104E show in schematic form the significance of the various lines of detail entries, while Fig. 102 indicates the total number of the different types of entries that may appear on a Detail tape, it being understood that said tape, in construction and composition, does not differ in any essential particular from the Toll tape shown in Fig. 100. It is also understood that the different entries as shown in Fig. 102 are, in fact, randomly recorded on the tape, the entries having been indicated as shown merely to disclose the total number of different message entries which are contained on the tape, but not necessarily the order in which they are recorded and presented for sensing. In the description that follows, reference is made to Figs. 104A . . . 104E for the values and significance of the different indices which appear on the different lines of the several message entries.

Thus the Detail tape contains different types of entries randomly recorded thereon, and it is the function of the apparatus of my invention to treat each individually according to its requirements.

One of these requirements is that for each entry one or more cards may have to be punched. For instance, an observed Toll entry will require the production of two cards, one for the use by the accounting departments, and the other for the use of the Traffic division or other organization of the Telephone Service. Or again, in the

case of an overcapacity, observed, Message Unit Detail entry, three (3) cards shall have to be produced, including an "overcapacity" card. The following table indicates the relation between the different entries, the number of cards to be produced for the entry and the "order" in which the cards are produced by the apparatus, the numerals under the different columns, except the last, indicating the order in which the cards are produced.

TABLE XIV.—NUMBER AND SEQUENCE OF CARDS PRODUCED FROM DETAIL TAPES

Entry	Type	Observing	Toll	Toll Over-capacity	Mu Over-capacity	MUD	Observing	Number of Cards
Detail	Toll	No						1
Do	Toll	Yes	1				2	2
Do	MUD	No						1
Do	MUD	Yes				1	2	2
Do	MU	Yes						1
Over-capacity	MU	No						1
Do	Toll	No						1
Do	Toll	Yes		1			2	2
Do	MUD	No			1	2		2
Do	MUD	Yes			1	2	3	3
Do	MU	Yes			1		2	2

13.1. *Detail entries other than overcapacity entries—unobserved*

When a Detail tape is to be processed, the tape type switch **6TT** is adjusted to terminal **5** since, as shown on Table I, the E digit of the tape type entry (first line) of the tape identity entries is 5. Accordingly, in response to sensing of the first line of the tape identity entries, a circuit is completed for relay **68ND**, the path of which extends from battery through the winding of said relay, conductor ND, No. 5 terminal and brush **3** of switch **6TT**, conductor TIR to ground as previously traced thereto. Relay **68ND** operates, locks over its No. 15 contacts to ground on conductor MON, and locally operates relays **68D** and **69D**. The latter relays function as previously described, while relay **68ND** functions similarly to relay **69OD**, except that relay **80REG** is now operated by ground on the No. 9 contacts of relay **68ND**, conductor A, No. 4 contacts of relay **55A11**, conductor A1, a pair of contacts on relay **67OD**, conductor A1, No. 11 contacts of relay **68ND**, conductor R, winding of relay **80REG** to battery.

If the entry is a toll entry, the class and called number index (C digit, third line—C-digit Fifth Storage Register) is either 0, 1 or 2 depending upon the composition of the called line number, whereupon a circuit is completed for relay **80TOL**, the path of said relay being in this case through terminal **5** and brush **4** of switch **6TT**, and thence to ground through the contacts of the relays of the C-Digit Fifth Storage Register. Further, since the entry is for an unobserved call, the value of the observing index is 0, in which event relay **79–OI0** operates over conductor **OB0**, No. 6 contacts of relay **68ND**, conductor **0**, a set of contacts on relay **68OD**, to ground as previously traced through the setting of the B-Digit Ninth Storage Register. The circuit now operates as for a computer toll entry to produce a card in the manner previously described.

If the entry is for a Message Unit call, the C digit in the third line of the message entry is 3, 4 or 5 (see Fig. 104D) and the C-Digit Register of the Fifth Storage Register is set accordingly. Consequently, a circuit is completed for relay **80MU** over a path extending from battery through the winding of said relay, through the C-Digit Register of the Fifth Storage Register and thence to ground as previously traced thereto. Relay **80MU** functions like relay **80TOL** to control card punching to produce a card required for this type of entry.

If the entry is for a Message Unit Detail call, the C digit of the third line of the message entry is 6, 7 or 8 (see Fig. 104D) and the C-Digit Register of the Fifth Storage Register is set accordingly. Consequently, a circuit is completed for relay **80MUDA** over a path extending from battery through the winding of said relay, through the C-Digit Register of the Fifth Storage Register, and thence to ground as previously traced thereto. Relay **80MUDA** operates and functions to control card punching operations to produce a card required for this type of entry.

13.2. *Detail entries other than overcapacity entries—observed*

An observed Toll entry will require the production of two cards, the first for accounting purposes and the second for "observing" purposes, as indicated in Table XIV. As further indicated in Fig. 104C, an observed toll entry will have an observing index of 1, 2, 3 or 4 (B digit, fifth line of the entry) and for which the B–Digit, Ninth Register of the Odd Storage Unit will be set accordingly, to result in the operation of relays **79–OI1**, **79–OI2**, **79–OI3** and **79–OI4**, respectively, as previously described. Now it will be remembered that relay **81C10** (or **81C1E**) is operated upon the transmission of the pulse for punching a card in row 11, and that relay **81C1A** is operated on all computer record entries. The reason for the operation of the relay **81C1A**, however, is because all such latter record entries require the production of but one card per entry. However, where two or three cards are to be produced, as with some of the entires on the Detail tape, relay **81C2A** or **81C3A** will be operated instead of relay **81C1A**, depending upon the number of cards to be produced. When, as in the present example of an observed Toll entry, two cards are to be produced, relay **81C2A** will be operated, the circuit path of said relay being from battery through the winding of said relay, No. 2 back contacts of relay **81C2B**, conductor C2A, thence through the No. 10 contacts of relay **79–OI1**, **79–OI2**, **79–OI3** or **79–OI4** depending upon which one is operated in response to the value of the observing index, conductor RT, No. 3 contacts of relay **80TOL**, No. 3 contacts of relay **80REG**, conductor NCA, No. 3 contacts of relay **68ND**, conductor NCA, No. 6 back contacts of relay **81C3B**, No. 1 back contacts of relay **81C2B**, conductor CRL, and thence to ground as previously traced thereto on conductor ON. Relay **81C2A** operates and locks over its No. 3 contacts, No. 3 contacts of relay **81C1A**, No. 3 back contacts of relay **81C3A**, No. 4 front contacts of relay **81C2A**, to ground on conductor CRL.

If three cards are to be produced for the call, as would be the case for a Message Unit Detail "overcapacity" entry (see Table XIV), then relay **80MUDA** will be operated instead of relay **80TOL**, and a circuit will be completed for relay **81C3A**, said circuit being traced from battery through the winding of said relay, No. 2 back contacts of relay **81C3B**, conductor C3A, thence through the No. 7 contacts of relay **79–OI1** . . . **79–OI4** depending upon which one of said relays is operated, conductor OD, No. 7 contacts of relay **80MUDA**, No. 3 contacts of relay **80–OVC** (which will be operated on an overcapacity entry, as will be described), conductor NCA and thence as described to ground on conductor ON. Relay **81C3A**

operates and then locks over its No. 4 contacts, No. 3 back contacts of relay 81C2A, No. 3 contacts of relay 81C1A, No. 3 front contacts of relay 81C3A, No. 4 back contacts of relay 81C2A to previously traced ground on conductor CRL.

Referring again to operations pertaining to the production of two cards, when relay 9–11 operates on the punching of row 11 of the first card, a circuit is completed for relay 81C2B, said circuit extending from battery through the winding of said relay, No. 1 front contacts of relay 81C2A, No. 1 back contacts of relay 81C3A, conductor F11, No. 2 contacts of relay 9–11, to ground on conductor MON1. Relay 81C2B, on operating, locks over No. 1 front contacts to ground on conductor CRL, and cuts off the operate path of relay 81C2A at the No. 2 back contacts of said relay 81C2B. When the last or row 9 of the card is being prepared for punching and relay 10–9E operates in the manner described, a circuit is completed for relay 81C1A, said circuit extending from battery through the winding of said relay, No. 3 contacts of relays 81C10 and 81C1E, No. 2 front contacts of relay 81C2B, conductor C2A, and thence to ground as previously described for relay 81C2B. Relay 81C1A, upon operating, locks over its No. 4 contacts, No. 5 contacts of relay 81C3A, No. 4 back contacts of relay 81C2A, to ground on conductor CRL. When the eleventh pulse is transmitted during the production of the last card, relay 81C10 is operated over a previously described circuit to effect the operation of relays 66RL1–3, 66RL5–7 and 66RL9, and the release of the registers in the manner described. It should be noted that relays 81C1A, 81C10, 81C1E, 81C2B and 81C3B severally apply ground to conductor HRL, which serves to hold relay 66ORL (or 76ERL) when either of said relays operate in the process of releasing the registers. The latter relays, however, when either operates, disconnects ground from conductor CRL to which the relays of the Card Count circuit are locked, causing the latter to release. However, if said relays or any of them do not release, then ground applied to conductor CRL by the unreleased relay or relays of the Card Count circuit will hold relay 66ORL (or 76ERL) and thus prevent the registers from releasing.

In the event that three cards are to be produced, the operation of relay 81C10 is delayed by the time taken to produce the third card, controlled by the operation of relays 81C3A and 81C3B as above described, relay 81C3B operating and performing the same function as relay 81C2B, above described.

It will be noted that with relay 81C2A operated, the AMA class digit punched on the first card (column 68) depends upon the AMA class digit assigned for the type of entry for which the card is produced (see Table XIV and Fig. 105). If, for example, the entry is a Toll entry, the AMA class digit punched may be 0 . . . 3 depending upon the "price" disposition of the call represented by the entry, as noted in Fig. 105. For instance, if the Toll entry is for an "unpriced" call for which the AMA class is "0," conductors CLE and CLC controlling the operation of punch magnet 89PM68 are extended over the Nos. 6 and 7 contacts of relay 81C2A, conductors C2E and C2C, Nos. 4 and 5 contacts of relay 80REG, conductors RC2E and RC2C, Nos. 4 and 5 contacts of relay 79OBS, conductors RE and RC, Nos. 2 and 6 contacts of relay 80TOL, conductors ECL and CCL, and thence as previously traced to conductors EM0 and CH0 to which, when ground is applied thereto at the time the card is in row 0, will cause a punch to be made in said row at column 68 in the manner previously described. In the same manner, each of the other values of the AMA class digit will be punched on the "first" card of the two cards to be produced, depending on the value of said digit as defined by the setting of the price and tax translators, shown in Figs. 11, 11A, 12 and 12A.

In the same manner, if three cards are to be punched (for an observed call) as, for example, for an Observing Message Unit Detail overcapacity entry, the first card to be produced will be for the "overcapacity" class, the second will be for the Message Unit Detail class (MUD) and the third will be for the Observing class (see Table XIV). The first card requires the AMA class digit 7, the second requires the digit 4 and the third requires the digit 5. Since, for an overcapacity Message Unit Detail entry, relays 80MUDA and 80–OVC will be operated, the fact that relay 81C3A is initially operated when three cards are to be produced causes AMA class conductors CLE and CLC to be switched over its Nos. 7 and 8 contacts to conductors C3E and C3C, thence through the Nos. 5 and 6 contacts of relay 80–OVC, conductors OC3E and OC3C, the Nos. 8 and 9 contacts of relay 79OBS, conductors OME and OMC, Nos. 11 and 12 contacts of relay 80MUDA, to conductors EM7 and CH7, causing a punch to be produced in row 7, column 68, of the first card when the latter is advanced to row 7 and ground is applied to said conductors EM7 and CH7 in the manner described.

When the second card is to be punched, relay 81C3A will have been released and relay 81C2A will have been operated. Accordingly, conductors CLE and CLC will be switched to conductors C2E and C2C, thence over the Nos. 4 and 7 contacts of relay 80–OVC, conductors OC2E and OC2C, Nos. 12 and 13 contacts of relay 79–OI0, conductors OME and OMC, Nos. 11 and 12 contacts of relay 80MUDA, to conductors EM4 and CH4, thereby to cause a punch to be produced in row 4, column 68 of the "second" card when the latter is advanced to row 4 and ground is applied to said conductors EM4 and CH4 in the manner described.

When the third card is to be punched, relay 81C2A will have been released and relay 81C1A will have been operated. Accordingly, conductors CLE and CLC will be switched to conductors C1E and C1C, and thence over the Nos. 2 and 8, contacts of relay 80–OVC, conductors OCIE and OCIC, Nos. 10 and 11 contacts of relay 79–OI1, conductors OE and OC, Nos. 8 and 10 contacts of relay 80MUDA to conductors EM5 and CH5, thereby to cause a punch to be produced in row 5, column 68 of the "third" card when the latter is advanced to row 5 and ground is applied to said conductors EM5 and CH5 in the manner described.

Thus when more than one card is to be produced, said cards are produced in the order given in Table XIV, and each card will have punched thereon the appropriate AMA class digit for the classification in which the card is to be used.

13.3. *Overcapacity entries*

Overcapacity entries are the same as the Toll, Message Unit and Message Unit Detail entries previously described, except that the disconnect time is furnished as part of the entry. Additionally, the "tenths of minutes" of the answer time is also furnished and recorded in the F digit position of the fifth line of the entry. The composition of an overcapacity entry is shown in Fig. 104B. As indicated in said figure, the entry occupies six lines on the record tape instead of five, and is characterized by the fact that the A digit of the first line is "3" instead of "1." Therefore, in processing an overcapacity entry, and because the Odd and Even Storage Units are each composed of five individual storage registers, it becomes necessary to store the sixth line of the entry in an individual register of whichever Storage Unit is not being used. This is indicated in Fig. 98.

On sensing the first line of an overcapacity entry, and because the A digit of the first line thereof is "3" (recorded on the tape with three perforations, one in position "1," another in position "2" and still another in position "3," thus causing the reading relays 15A0, 15A1 and 15A2 to operate when the first line is sensed) a circuit is completed for relay 55A13, which circuit extends from battery through the winding of said relay, No. 2 contacts of relay 55RC1, conductor AA3, No. 3 con-

tacts of relay 15A2, No. 1 contacts of relay 15A1, No. 1 contacts of relay 15A2, to ground. Relay 55A13 operates in the above circuit, and locks over its No. 5 contacts to previously traced ground on conductor L13. Relay 55A13 performs the same general functions as relay 55A11 but, in addition, completes the circuit of the Odd Overcapacity Connector relay 54–OOC, which circuit extends from battery through the winding of said relay, conductor OOC, No. 7 contacts of relay 55A13, conductor AC0, No. 13 contacts of relay 68ND, conductor OAC, locking contacts of relay 67OD, conductor OD, to ground previously traced thereon. Relay 54–OOC operates and, among other things, extends the CHX and EMX multiples to the B-Digit Eighth Storage Register, and further connects the E1 and C1 conductors of each digital register of said Eighth Storage Register to terminals indicated on Fig. 71, from which said conductors are further extended to the punch and check relays of the punch magnets indicated on Fig. 71 and described below. Relay 55A13, in operating, further insures that after the fifth line of the entry has been stored in the Ninth register of the Odd Storage Unit, the "sixth" line of the entry is registered in the Eighth Storage Register of the Even Storage Unit (see Fig. 98). Consequently, when the fifth line has been stored, and because relay55A13 is operated, a circuit path is completed for relay 90SR8 of the Eighth Storage Register Connector, the path of said latter relay extending from battery through its winding, conductor SR8, No. 2 contacts of relay 55A13, No. 3 back contacts of relay 82A03, conductor SR00, No. 5 contacts of relay 68ND, conductor SRA9, No. 2 contacts of relay 27RS9, conductor SR, No. 8 contacts of relay 68TS, conductor SRE, reader contacts K4, to ground. Relay 90SR8 operates during the open period of the reading cycle and functions to cause the operation of relay 90RC8 which, upon operating, extends the conductors connecting with the contacts of the reading relays to the winding of the relays in the Eighth Storage Registers.

When relays 68ND, 67OD and 55A13 operate in the manner described, a circuit is also completed for relay 80–OVC, said circuit extending from battery through the winding of said relay, conductor OV, No. 10 contacts of relay 68ND, conductor A3, a pair of contacts on relay 67OD, No. 6 contacts of relay 55A13, conductor A, No. 9 contacts of relays 68ND, to ground. Relay 80-OVC operates and functions like relay 80REG in controlling conductors CLE and CLC to punch the appropriate AMA class digit in column 68 of the card, said control being also, of course, exercised by the relays 80TOL, 80MU and 80MUDA, depending upon whether the entry is a Toll entry, a Message Unit entry or a Message Unit Detail entry, said latter mentioned relays operating in the same manner as previously described for said entries, and also further controlled by the relays of the Observing Index Translator (Fig. 79) one or more of which operates in the manner previously described depending upon the value of the Observing Index, as indicated in Fig. 104C.

Assuming that five lines of an overcapacity entry are registered in the five storage registers of the Odd Storage Unit, the sixth line is registered in the Eighth Storage Register of the Even Storage Unit. Conversely, if five lines are registered in the five storage registers of the Even Storage Unit, then the sixth line is registered in the Ninth Storage Register of the Odd Storage Unit (see Fig. 98). The advantage of this arrangement (and it is one of the features of my invention) is that the four succeeding lines of the next entry, whether it be an overcapacity entry or any other entry, may be registered successively and without delay in the zero, second, fourth and sixth registers of the Even Storage Unit, or vice versa, during the time that the operated Storage Unit, including the last storage register of the other Storage Unit, are occupied with the Gang Punch in producing a card, or cards, for the entry registered therein. By the time said card, or cards, are produced, the operated Storage Unit and the operated register of said other Storage Unit will be released, thus permitting the registration of the remaining line of the entry (if it is a five-line entry) to be registered in the single register just released, and the sixth line (if it is another overcapacity entry) in the last register of the Storage Unit that was operated to capacity. By this arrangement, no time is lost in processing entries by the connection of a filled Storage Unit and a single register of the Storage Unit with the Gang Punch.

Assuming, however, that the sixth line of an overcapacity entry is registered in the Eighth Storage Register of the Even Storage Unit, the production of a card, or cards, therefor proceeds in the manner previously described for other entries, except that the disconnect or "answer time" is punched on the card in columns 69 to 76 thereof.

It will be noted from Fig. 104B that the day and the hour of the disconnect time is recorded in the C to F digits of the sixth line of the entry, the disconnect minutes being recorded in the C to E digits of the fifth line and the tenths of minutes of said disconnect time being recorded as the F digit in said line. Since the disconnect day and hour are registered in the Eighth Storage Register of the Even Storage Unit (that is, in the C to F digit registers thereof), the Message Unit Index is registered in the B-Digit Register of the Eighth Storage Register, and the disconnect minutes and tenths of minute are registered in the Seventh Storage Register of the Odd Storage Unit, then when the card, or cards, are produced for the overcapacity entry, that which is registered in said Eighth Storage Register and the Seventh Storage Register is punched on the card in the columns allocated therefor. The following table indicates the involved cross-connections at a terminal block indicated in Fig. 71 between conductors connected to certain of the stationary contacts of relay 54–OOC and the punch and check relays controlling the punch magnets which are operated to punch the Message Unit Index and the answer time of the connection.

TABLE XV

From Fig. 54	Relays	Magnets	Significance	
MBE	71P77C	89PM77	Message Billing Index.	
MBC	71PC77			
DDTE	71P69C	89PM69	Day Tens	Disconnect Time.
DDTC	71PC69			
DDUE	71P70C	89PM70	Day Units	
DDUC	71PC70			
DHTE	71P71C	89PM71	Hour Tens	
DHTC	71PC71			
DHUE	71P72C	89PM72	Hour Units	
DHUC	71PC72			
DMTE	71PC74	89PM74	Minute Tens	
DMTC				
DMUE	71P75C	89PM75	Minute Units.	
DMUC				
DMTHE	71P76C	89PM76	Minute Tenths.	
DMTHC				
ATHE	71P9C	89PM9	Tenths of Minute—Answer Time.	
ATHC	71PC9			

The additional entries recorded on the card during the production thereof for an overcapacity entry take place as follows:

Depending upon the setting of the B-Digit Register of the Eighth Storage Register for the Message Billing Index, conductors E1 and C1 of said register are grounded by the two conductors in the EMX and CHX multiples which are expressive of the index digit. Ground on conductor E1, applied thereto by grounded conductor E–, is extended over the No. 21 contacts of relay 54–OOC to conductor MBE, while ground on conductor C1, applied thereto by grounded conductor CH–, is extended over the No. 22 contacts of relay 54–OOC to conductor MBC. The two grounded conductors operate relays 71P77C and 77PC77, respectively, the latter causing the operation of punch magnet 89PM77 to punch a hole in column 77 and the particular row indicated by the setting of the B register to record the Message Billing Index.

Depending upon the setting of the C-Digit Register of the Eighth Storage Register for the Day Tens, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 19 contacts of relay 54–OOC to conductor DDTE and thence to the winding of relay 71P69C; conductor C1 extends over the No. 20 contacts of relay 54–OOC to conductor DDTC and thence to the winding of relay 71PC69. When ground is applied to conductors E1 and C1 of the C-Digit Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM69 to cause a perforation to be made in column 69 and in whatever row corresponds to the setting of the C-Digit Register to express the Day Tens digit of the disconnect time.

Depending upon the setting of the D-Digit Register of the Eighth Storage Register for the Day Units, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 17 contacts of relay 54–OOC to conductor DDUE and thence to the winding of relay 71P70C; conductor C1 extends the No. 18 contacts of relay 54–OOC to conductor DDUC and thence to the winding of relay 71PC70. When ground is applied to conductors E1 and C1 of the D-Digit Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM70 to cause a perforation to be made in column 70 and in whatever row corresponds to the setting of the D-Digit Register to express the Day Tens digit of the disconnect time.

Depending upon the setting of the E-Digit Register of the Eighth Storage Register for the Hour Tens of the disconnect time, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 15 contacts of relay 54–OOC to conductor DHTE, and thence to the winding of relay 71P71C; conductor C1 extends to the No. 16 contacts of relay 54–OOC to conductor DHTC, and thence to the winding of relay 71PC71. When ground is applied to conductors E1 and C1 of the E-Digit Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM71 to cause a perforation to be made in column 71 and in whatever row corresponds to the setting of the E-Digit Register to express the Hour Tens digit of the disconnect time.

Depending upon the setting of the F digit of the Eighth Storage Register for the Hour Units of disconnect time, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 13 contacts of relay 54–OOC to conductor DHUE and thence to the winding of relay 71P72C; conductor C1 extends over the No. 14 contacts of relay 54–OOC to conductor DHUC, and thence to the winding of relay 71PC72. When ground is applied to conductors E1 and C1 of the F-Digit Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM72 to cause a perforation to be made in column 70 and in whatever row corresponds to the setting of the F-Digit Register to express the Hour Units digit of the disconnect time.

The minutes and tenths of minutes of the disconnect time are registered in the C to E digits of the Ninth Storage Register and the tenths of minutes of the answer time is registered in the F-Digit Register. Depending upon the setting of the C-Digit Register for the Minute Tens of the disconnect time, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 11 contacts of relay 54–OOC to conductor DMTE and thence to the winding of relay 71P74C; conductor C1 extends to the No. 12 contacts of relay 54–OOC to conductor DMTC and thence to the winding of relay 71PC74. When ground is applied to conductors E1 and C1 of the C-Digit Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM74 to cause a perforation to be made in column 74 and in whatever row corresponds to the setting of the C-Digit Register to express the Minute Tens digit of the disconnect time.

Depending upon the setting of the D-Digit Register of the Ninth Storage Register for the Minutes Units of the disconnect time, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 9 contacts of relay 54–OOC to conductor DMUE, and thence to the winding of relay 71P75C. Conductor C1 extends to the No. 10 contacts of relay 54–OOC to conductor DMUC, and thence to the winding of relay 71PC75. When ground is applied to conductors E1 and C1 of the D-Digit Register of the Ninth Storage Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM75 to cause a perforation to be made in column 75 and in what ever row corresponds to the setting of the D-Digit Register to express the Minute Tens digit of the disconnect time.

Depending upon the setting of the E-Digit Register of the Ninth Storage Register for the Minute Tenths of the disconnect time, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 7 contacts of relay 54–OOC to conductor DMTHE, and thence to the winding of relay 71P76C. Conductor C1 extends to the No. 8 contacts of relay 54–OOC to conductor DMTHC and thence to the winding of relay 71PC76. When ground is applied to conductors E1 and C1 of the E-Digit Register of the Ninth Storage Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM75 to cause a perforation to be made in column 76 and in whatever row corresponds to the setting of the E-Digit Register to express the Minute Tenths digit of the disconnect time.

Depending upon the setting of the F-Digit Register of the Ninth Storage Register for the tenths of minutes of the disconnect time, conductors E1 and C1 of said register are grounded by the two involved conductors in the EMX and CHX multiples. Conductor E1 extends over the No. 5 contacts of relay 54–OOC to conductor ATHE and thence to the winding of relay 71P9C. Conductor C1 extends to the No. 6 contacts of relay 54–OOC to conductor ATHC and thence to the winding of relay 71PC9. When ground is applied to conductors E1 and C1 of the F-Digit Register of the Ninth Storage Register by the involved two conductors in the EMX and CHX multiples, said relays are operated, the former operating punch magnet 89PM9 to cause a perforation to be made in column 9 and in whatever row that corresponds to the setting of the F-Digit Register to express the tenths of minutes of the disconnect time.

The remainder of punching on a card for an over-capacity entry is made in the manner previously described for entries on a Computer Toll tape.

14. *Individual summary cards*

The apparatus of my invention also processes entries contained on what is called a Summary Tape which, as schematically indicated in Fig. 108, is a tape the entries of which comprise directory numbers arranged in ascending numerical order, with each such number followed in the succeeding line by the total number of message units accumulated against the station identified by the number over the "round" period indicated in the seventh line of the tape identity entries. The tape also includes a group

of tape identity entries (not shown) at its forward and trailing ends. Fig. 103D shows the general arrangement of a "two-line" entry and the significance of the different digits in each of the two lines that make up an entry. From said figure it will be noted that the A digit of the first line is "2," and from Fig. 108 it will further be noted that the B digit of the second line (the Message Unit Index) is either "3" or "4." When the number of message units accumulated against the station is less than 1000, the B digit of the second line is "3," but when the number of such units is 1000, the B digit is "4." In the latter case, however, it is necessary to provide a positive indication that the total number of message units does not exceed 1000, and this indication is provided by the "next" entry that follows the 1000-message unit entry. Said next entry will have the same directory number as the preceding entry, but the number of message units recorded in the next line will be 0000 if the total number of message units does not exceed 1000, or by the excess over the 1000 if the excess is less than 1000. In either case, the B digit of the second line of the message entry will be a "3," as shown. It is understood that there will be as many successive two-line entries for a directory number as there are 1000 message units, plus an additional entry either for the excess over the last 1000 or for the value 0000.

It is the purpose of my invention to produce a card for each 1000 message units accumulated against the directory number plus another card for the excess over the last 1000. The card will contain the actual month, the "round," the calling office code (all obtained from the tape identity entries, as already described), the directory or line number, the message units summary therefor, and an indication when the card is for 1000 message units.

The general appearance of the card is illustrated in Fig. 106. It will be seen from said figure that the card is spaced and arranged for five usages, a punch being made in column 76 of the card for each usage in the particular row which is indicative of that usage. Column 77 on the card is reserved for a "check" in row 9 thereof to indicate a trouble condition.

As in the case of the processing of other tapes previously considered, the set-up switches shown in Figs. 6 and 7 are manually adjusted to agree with the information contained on various lines of the tape identity entries as to tape type, marker tens and marker group units, central office, round and tape section, and month tens and units. In addition, switch SM (Fig. 68) is adjusted to its "0" position. Since the set-up switch **6TT** has been set to terminal **1**, a circuit is completed for relays **68IS** and **69IS**, said circuit extending from battery severally through their windings, switch SM adjusted to terminal **0**, conductor S, brush **3** and terminal **1** of switch **6TT**, conductor TIR, to ground previously traced thereto. Relays **68IS** and **69IS** both operate, the former locking to ground on conductor MON over its No. 19 contacts. A circuit is thereupon closed for relay **33OISA** from battery through the winding of said relay, conductor OIS, No. 11 contacts of relay **68IS**, conductor OL, No. 4 contacts of relay **76ERL**, No. 2 contacts of relay **76EH**, to ground on conductor ON. Relay **33OISA** operates to perform certain functions hereinafter noted. A circuit is also completed for relay **47OC** from ground on the No. 3 contacts of relay **68IS**, conductor OMDC, winding of relay **47OC** to battery. Relay **47OC** operates to extend the EMX and CHX multiples to the C-Digit Register of the Third Storage Register. A circuit is also closed for relay **13–OI**, said circuit extending from battery through the winding of said relay, conductor OI, No. 13 contacts of relay **68IS**, to ground on conductor MON. Relay 13–OI operates and serves to extend the windings of the relays of the Calling Office Index Translator to the conductors connecting with the terminals engaged by brush **2** of the central office set-up switch **6CO**, thereby to cause the operation of one of the ten relays **13–010A . . . 13–019A** from the ground on the No. 4 contacts of relay **1CL5** in accordance with the adjustment of said set-up switch, which adjustment, it will be recalled, is in accordance with the value of the office index in the fifth line of the tape identity entries.

The month and the "round" are registered as before described, while the translation of the office index and marker group into the calling office code takes place in the manner described in section 5.1.

When the tape is advanced to the first line of the first message entry, and noting that the A and B digits thereof are "20," respectively, the operation of reading relays **15A2** and **16B7**, **16B4** in the manner described completes the circuit of relay **55RC1** of the First Storage Register connector, said circuit tracing from battery through the winding of said relay, No. 1 back contacts of relay **55UC1** (which operates as before described), No. 2 contacts of relay **55SR1**, conductor **RC01**, No. 7 contacts of relay **68IS**, conductor **20**, No. 4 contacts of relay **5RLM**, conductor **205**, No. 2 back contacts of relay **5ALS**, conductor **20S1**, No. 3 contacts of relay **16B4**, No. 3 contacts of relay **16B7**, conductor **LL5**, No. 4 contacts of relay **15A2**, No. 4 back contacts of relay **15A1**, No. 5 back contacts of relay **15A0**, conductor **LL4**, and thence as previously traced through the contacts of the reading relays operated in response to the sensing of the C to F digits, inclusive, of the first line of the message entry, to ground on conductor **G1** or **G2**. Relay **55RC1** operates and, in the manner previously described, functions to connect the reading relays to the relays of the First Storage Register, whereby the first line of the message entry (the calling line number) is caused to be registered therein in the manner described.

The tape is then advanced to the second line of the entry (which contains the number of message units) and the latter, including a B digit 3 or 4, is sensed and registered in the relays of the B . . . F digit registers of the Third Storage Unit, all in the manner described for previous entries.

With the two lines of the first message entry thus stored, and after the "up-check" relay **8CUC** has operated through the chain up-check path previously traced, but this time including only two of the Storage Registers instead of all five, and tracing through the back contacts of the chain in the relays not operated for this type of entry (for example, relay **67OD**), and through the front contacts of the chain in the relays which are operated for this type of entry (for example relay **33OISA**), the Gang Punch proceeds to operate in producing an individual summary card for the entry, the apparatus proceeding the meanwhile in the manner subsequently to be described in sensing the two lines of the next succeeding entry and storing said lines in the Zero and Second Storage Registers of the Even Storage Unit. And, as previously described, the card is punched by advancing it successively from row to row, beginning with row 12, and causing all of the punch magnets **89PM1 . . . 89PM15** (for the first usage of the card) to be selectively operated in each row to punch holes in the card as required for the involved rows and columns of the card.

Referring to Fig. 106, it will be noted that the month is punched in column 2 of the card. The punching of the month designation is controlled over conductors SME and SMC (Fig. 21). It will be remembered that for Toll, Message Unit, etc. message entries, these conductors are switched to conductors ME and MC to cause the punching of the month designation in column 2 (see Table VI). For the punching of the month designation on an individual summary card, and due to the fact that relay **69IS** is operated, conductors SME and SMC are extended over the Nos. 14 and 15 contacts of said relay, to conductors terminating on a terminal block shown in Fig. 71, which are further connected to relays **71P2C** and **71PC2** that control the operation of punch magnet **89PM2**, as indicated on Fig. 69. Said relays, operating

in response to the pulse ground on the appropriate E– and C– conductors in the EMX and CHX multiples when the card has been advanced to the corresponding row, cause the operation of said magnet to punch a hole in column 2 for the designation of the month.

The "round," which is punched in the third column of the card, depends upon the setting of the set-up switch 7RO. This switch, it will be recalled, is adjusted in accordance with the "round" designation. It will be noted from Fig. 7 that the EMX and CHX multiples are extended to arcs 3 and 4, respectively, of said switch, the brushes of which are connected, respectively, to conductors RE and RC which, in turn, are connected to the armatures of the Nos. 17 and 18 contacts of relay 69IS. The corresponding stationary contacts extend to a terminal block on Fig. 71, and there connect with those terminals which control the operation of punch magnet 89PM3, as indicated in Fig. 69. Hence, due to the fact that relay 69IS is operated, said magnet will be operated to punch a hole in column 3 when the card is advanced to the row corresponding with the terminal to which brushes 3 and 4 are adjusted, ground being applied to said terminal over the appropriate conductors of the EMX and CHX multiple connected thereto.

The calling office code (in alphabetical characters) is punched in columns 5, 6 and 7 (column 4 being held for reserve). It will be remembered from the description given in Section 5.1 in connection with the production of cards for the different message entries that the punching of the calling office code is controlled by the relays of the overpunch control circuit (Fig. 14) and which, for the punching of cards for said entries, the conductors AC . . . CC are extended to the appropriate punch magnets over the contacts of operated relay 69D. For the production of an individual summary card, however, relay 69D is normal while relay 69IS is operated. The latter relay switches conductors AE and AC for the A digit of the code over its Nos. 20 and 21 contacts to the punch and check relays of punch magnet 89PM5, as indicated; switches conductors BE and BC for the B digit of the code over the Nos. 22 and 23 contacts to the punch and check relays of punch magnet 89PM6, as indicated; and switches conductors CE and CC for the C digit of the code over its Nos. 24 and 25 contacts to the punch and check relays of punch magnet 89PM7, as indicated. Thus, as the card is advanced successively from row to row, said magnets are operated in the manner previously described to punch holes in columns 5, 6, 7 in accordance with the conductors in the EMX and CHX multiples to which the contacts of the relay in the calling office translator representing the calling office are connected.

In connection with relay 69IS, it should be noted that the stationary springs of its Nos. 5 and 6 contacts are indicated as extended to the punch and check relays for punch magnet 89PM77. The armatures of said contacts are extended to the right back contacts 4 and 3 of relay 3PCK9, the armatures of which are connected to conductors CH9 and EM9 of the CHX and EMX multiples. The front contacts are connected to conductors CKC and CKE. From the description previously given in connection with the release of the registers (see Section 6.23) it will be remembered that relay 3PCK9 operates on the punching of row 9 of the card, thereby to indicate, on cards made for individual entries, that one complete card cycle was successfully executed. In the absence of a punch in row 9, column 77, the card would be indicated as incomplete and treated accordingly.

In the production of individual summary cards, the reverse is used to indicate an incomplete card. If relay 3PCK9 "fails" to operate when the card reaches row 9, conductors CH9 and EM9 are extended over the right back contacts of relay 3PCK9, the Nos. 5 and 6 contacts of relay 69IS to the punch and check relays of punch magnet 89PM77, as indicated in Fig. 69. When ground is applied to conductors CH9 and EM9 by the emitter, the circuit of said punch and check relays is completed to cause their operation which, in turn, cause the operation of punch magnet 89PM77 to punch a hole in row 9, column 77 indicating a defective or incomplete card.

The Message Units registered in the C, D, E and F Digit Registers of the Third Storage Register are punched in columns 12 to 15, inclusive, of the card. For this purpose, the conductors E33, C33, E34, C34, E35, C35, E36, and C36, extending in pairs for the C, D, E and F Digit Registers, respectively, of the Third Storage Register, are connected by the operation of relay 33–OISA to the punch and check relays of punch magnets 89PM12 to 89PM15, inclusive. Since relay 47OC was operated to extend the EMX and CHX multiples to the C-Digit Register of the Third Storage Register, and since the D, E and F Digit Registers are connected directly to said multiples, it follows that when the card is successively advanced to the different rows severally indicated by the setting of said registers, and ground is successively applied to those conductors in the EMX and CHX multiples to which the relays of said registers are selectively extended by their setting, said magnets will operate to punch holes in their respective columns to record the total number of message units.

Where the individual summary card is for a 1000-message unit entry, a punch is made in row 11, column 12 of the card for the first usage, and in columns 27, 42, 57 and 72 for the second, third, fourth and fifth usages, respectively. This punch is derived from the setting of the B-Digit Register of the Third Storage Register (or from the B-Digit Register of the Second Storage Register) if said register is set for the digit "4." In this event, conductors 3BE4 and 3BC4 of the Third Storage Register are extended by the operation of relay 33–OISA to conductors EM11 and CH11 of the EMX and CHX multiples. Because the relays of the B-Digit Register are selectively operated to register the digit "4," conductor 3BE4 is, in turn, extended to conductor E43, and conductor 3BC4 to conductor C36. Through contacts of relay 33–OISA, the latter are extended to the Nos. 4 and 5 contacts of relay 14ONP which is operated for rows 11 and 12 of the card. After the latter relay operates and ground is applied to conductors EM11 and CH11 when the card is in row 11, circuits are completed from ground on said latter conductors, through the contacts of the relays of the B-Digit Third Storage Register, conductors E43 and C36, other contacts on relay 33–OISA, Nos. 4 and 5 contacts of relay 14ONP, to the punch and check relays of punch magnet 89PM12, as indicated on Fig. 14. The latter relays operate to complete the circuit of punch magnet 89PM12, which operates to punch a hole in row 11, column 12 to indicate that the card is for an entry having 1000 message units. The same circuit is similarly completed for each usage of the card.

An individual summary card may be used five times for recording five separate summary entries, the card illustrated in Fig. 106 showing punchings for the first usage only, for the subscriber number CHE–7804 and for 592 message units. For this purpose use is made of five "plug boards" two typical ones of which are schematically indicated in Figs. 97B and 97C. Each plug board contains cross-connections by which fifteen punch magnets are extended to their correlated punch and check relays. Thus, the first plug board, illustrated in Fig. 97B, has cross-connections for punch magnets 89PM1 . . . 89PM15. The board also contains five terminals 1 . . . 5 which are connected to the correspondingly numbered emitter conductors. For the first plug board, terminal 1 would be connected to a terminal connecting directly with the winding of punch magnet 89PM76, while for each of the other four plug boards said latter terminal is connected to terminals 2 . . . 5, respectively.

For the first usage of the cards prepared for individual

summary, the first plug board is fitted into position in the space indicated in Fig. 89 between the terminals of the punch magnets **89PM1** . . . **89PM15** and **89PM76**, and the corresponding terminals of punch and check relays **71PC1**, **71P1C** . . . **71PC15**, **71P15C**, **71PC76**, **71P76C** and **71PC77**, **71P77C**. This completes the paths to the involved punch magnets which operate in the manner described to punch the card on first usage, including a punch by magnet **89PM77** which operates only in the event of trouble. During punching operations, and because emitter conductor **1** is connected directly to punch magnet **89PM76** through the board, then when ground is applied to emitter conductor **1** during the card punch cycle, the circuit of said magnet is completed, which operates to punch a hole in row 1, column 76, to indicate the first usage of the card.

When individual summary cards are to be used a second time to punch individual summary entries for the same or different lines, the first plug board is removed and the second (shown in Fig. 97C) is placed in position to connect punch magnets **89PM16** . . . **89PM30** to the involved punch and check relays, and to connect punch magnet **89PM76** to emitter conductor **2**. It should be evident from what has already been said that on the second usage of the card, punch magnets **89PM16** . . . **89PM30** will be caused to function and punch magnet **89PM76** will be operated to punch a hole in row 2, column 76, to indicate the second usage. In the same manner each of the three other plug boards (not shown) is used for the third, fourth and fifth usage of the card.

As has been stated, the second entry is registered in the Zero and Second Registers of the Even Storage Unit (and the following in the First and Third Registers of the Odd Storage Unit, etc.). Consequently, when the second line of the first entry is registered in the Third Register of the Odd Storage Unit, the fact that relays **48RS3** and **68IS** are operated completes the circuit of relay **82SR0** of the Zero Register of the Even Storage Unit Connector, said circuit extending from battery through the winding of relay **82SR0**, conductor **SR0**, No. 8 contacts of relay **68IS**, conductor **SRA3**, No. 2 contacts of relay **48RS3**, conductor SR, and thence as previously traced to ground on reader contacts **H3**. Relay **82SR0** operates and functions in the manner previously described to cause the first line (calling line number) of the second entry to be registered in the Zero Register.

The second line of said entry is then stored in the Second Register (not shown) of the Even Storage Unit in the manner already described for the Third Register. When, however, the tape is advanced to the first line of the third entry, said line will be stored in the First Register of the Odd Storage Unit, since the circuit of relay **55SR1** will then be completed over conductor **SR1**, No. 9, contacts of relay **68IS**, conductor SRA2, through a set of contacts on relay –**RS2** (not shown), conductor SR, to ground on reader contacts **H3**. In this manner, the entries are successively stored in the first two Storage Registers (**1** and **3**) of the Odd Storage Unit and the first two Storage Registers (**0** and **2**) of the Even Storage Unit, each pair of registers then connecting with the Gang Punch and associated circuits to punch an individual Summary Card in the manner described.

15. *Ten summary cards*

15.1. *Registering and comparing summary entries for punching ten summary cards*

My invention is also operative to produce cards which contain the summary of the message units for each of every ten consecutive directory numbers that appear on a Summary tape. For this purpose an additional Calling Line Register is provided (Figs. 62 to 65, inclusive) in which is registered the directory number that appears on the first line of the first Summary entry. The number of message units for the line which are recorded in the second line of the entry is then steered to the particular storage register in the Odd or Even Storage Unit which is indicated by the units digit of the directory number.

Fig. 107 illustrates one form of a typical Ten Summary Card. Each card has four columns reserved for the calling central office code, three for the line number (TH, H and T), and one each for the month, the round, and the check, etc. The thousands, hundreds and tens digit are recorded under line number columns. The latter are followed by ten divisions of five columns each, in which are recorded the summary of the message units for the particular line as they are recorded on the second line of the message entry.

To prepare the apparatus for the production of Ten Summary Cards from the entries on a Summary tape, it is only necessary to adjust switch SM (Fig. 68) to terminal **1**, whereupon the circuit previously completed to relays **68IS** and **69IS** is now completed to relays **68TS**, **69TS**, **70TS0** and **70TSE**.

When relay **5ST4** operates, ground on conductor ON completes a circuit for relay **75GT2** over the No. 2 back contacts of relay **75NRL**, winding of relay **75GT2** to battery, causing said relay to operate and lock to ground on conductor **20**, when ground is applied to said conductor as described below. If the relays of the units digit Calling Line Register are all normal, relay **75UDC** operates over a circuit completed through its upper winding, conductor DC–R, serially through the No. 1 contacts of relays **65U4** . . . **65U00**, conductor ON, to ground. Relay **75UDC** operates. If the remaining digit registers of the Calling Line Register are also normal, then upon the operation of relay **75UDC** a circuit is completed for relay **75NDC** from battery through its upper winding, No. 5 contacts of relay **75** PSC, No. 7 contacts of relay **75PXSC**, No. 1 contacts of relay **75UDC**, conductor TDC, serially through the No. 1 contacts of relays **64T4** . . . **62TH00**, conductor ON, and ground traced thereto. When the first line of the first summary entry is read, and ground is applied to conductor **20** in the manner described for the production of an individual summary card, relays **75UDC** and **75NDC** are locked to said ground over their respective lower windings and No. 2 contacts, back contacts of relay **75GT2**, conductor **20**, No. 19 contacts of relay **68TS**, continuation of conductor **20**, and thence to ground as previously traced to conductor **G1** or **G2**. When relay **75NDC** operates, a circuit is closed for relay **75NH** from battery through the winding of said relay, No. 1 contacts of relay 75NDC, No. 1 back contacts of relay **75NLR**, to ground on conductor ON. Upon the operation of relay **75NH**, relay **75NLK** operates over a circuit from battery through the winding of said relay, No. 2 contacts of relay **75NH**, back contacts of relay **75NRL**, No. 1 contacts of relay **75NRL** to ground on conductor ON. The contacts of relay **75NLK** are continuity contacts, its No. 2 front contacts making before its No. 1 back contacts break, both relays **75NH** and **75NLK** locking over the No. 2 front contacts of the latter relay, to ground on conductor ON.

The locking ground for relay **75UDC** completes an obvious circuit for relay **75URC** which operates. Now if the several registers of the Odd and Even Storage Units are all normal, relays **66DC1** . . . **66DC9** and relays **76DC0** . . . **76DC8** will all operate over the previously described "down check" paths, whereupon a circuit is completed for relays **72NRTH**, **73NRH**, and **74NRT** from locking ground on the No. 2 contacts of relay **75UDC**, No. 2 front contacts of relay **76NDC**, conductor NRL1, No. 4 contacts of relay **5ALS**, conductor NRL, serially through the No. 1 contacts of operated relays **76DC0** . . . **76DC8**, **66DC1** . . . **66DC9**, conductor NR, severally through the windings of relays **74NRT**, **73NRH**, **72NRTH**, to battery. The latter relays operate and connect the windings of the relays of the tens, hundreds and thousands digit registers of the Calling Line Register to the corresponding conductors of the tens, hundreds and thousands digit reading relays (E, D and C digit reading relays) while

relay 75URC connects the conductors from the F digit reading relays to the relays of the units register of the Calling Line Register.

It is not believed necessary to trace the various circuits by which the calling line number in the first line of the entry is registered in the digital registers of the Calling Line Registers. Said circuits are identical to those already traced for registering such number in the First Storage Register of the Odd Storage Unit, except that they involve the relays of the Calling Line Register instead of those of the First Storage Register, the circuits of the relays of said former register being traced through the contacts of relays 72NRTH . . . 75URC. Here it should be noted that when the relays 65U00 . . . 65U4 of the units register are selectively operated in accordance with the units digit of the calling line number, said operated relays are locked over their respective No. 6 contacts, conductor UL, No. 1 back contacts of relay 75URL, No. 1 front contacts of relay 75NLK, to ground on conductor ON. The relays of the three remaining registers, on the other hand, lock over their respective No. 6 contacts, conductor DL, No. 1 front contacts relay 75NLK, to ground on conductor ON.

It should further be noted that with each relay in the thousands, hundreds and tens digit register of the Calling Line Register, a relay is provided in parallel therewith so that the operation of any of the relays of said registers from the contacts of the reading relays will operate the relays severally in parallel with them. Thus, for the relays 62TH00 . . . 62TH4 of the thousands digit register of the Calling Line Register, relays 72TH00 . . . 72TH4 are provided respectively in parallel, so that the selective operation of relays 62TH00 . . . 62TH4 by the reading relays will also cause the selective operation (through the contacts of relay 72NRTH) of the "comparer" relays 72TH00 . . . 72TH4. In the same manner, relays 73H00 . . . 73H4 are connected in parallel with the relays 63H00 . . . 63H4 of the hundreds digit register, and relays 74T00 . . . 74T4 are connected in parallel with relays 64T00 . . . 64T4 of the tens digit register. As in the case of the thousands digit register, the selective operation of the hundreds and tens digit register relays will operate in parallel (through the contacts of relays 73NRH and 74NRT, respectively) the corresponding "comparer" relays.

With the digit registers of the Calling Line Register operated to register the calling line number in the three-out-of-six code by which said number is transferred from the reading relays to the register, a check is made for the operated and normal relays of each register, said check being the closure of a circuit for relay 27RS. Said check path traces from ground on the lead through the No. 1 front contacts of relay 75NKL, No. 1 back contacts of relay 75URL, conductor UL, serially through the three-out-of-six up-check path of the relays 65U00 . . . 65U4, conductor SUC, similarly through the three-out-of-six up-check paths of relays 62TH00 . . . 62TH4, 63H00 . . . 63H4, 64T00 . . . 64T4, conductor SUC1, No. 8 contacts of relay 72NRTH, conductor TUC, No. 8 contacts of relay 73NRH, conductor HUC, No. 8 contacts of relay 74NRT, conductor UUC, No. 1 contacts of relay 75URR, conductor RS, winding of relay 27RS, to battery. Relay 27RS operates and functions in the manner described to advance the tape to the second line of the entry, which contains the summary of the message units.

The second line of the entry, containing the summary of the message units for the line whose directory number has been stored in the Calling Line Registers is, upon sensing, stored in that Storage Register of the Odd or Even Storage Unit whose numerical designation is identical with the units digit of said directory number. Since the directory numbers on a Summary tape are recorded thereon in an ascending numerical order it may be assumed that the first number is "0000," the second is "0001," etc., up to and including "9999." It may also be assumed for the purpose of illustration that the first number on the tape is "0000" (though this number is often reserved for "official" calls) and that, accordingly, relays 65U1, 65U2 and 65U3 are operated to store the units digits of the number in the Calling Line Register, similar relays being operated in the thousands, hundreds and tens registers for the storing of the other digits of the number.

It will be noted from Fig. 103D that the second line of the entry has "0" for its A digit, in consequence of which relay 15A–0 is operated. Since relay 68TS is operated, and the digit "0" is stored in the Units Register of the Calling Line Register, a path is completed for relay 82RC0 of the Zero Storage Register of the Odd Storage Unit, said path tracing from battery through the winding of said relay, No. 1 back contacts of relay 82UC0, conductor E0, No. 10 contacts of relay 65U3, No. 3 contacts of relay 65U2, No. 3 contacts of relay 65U1, conductor E1, No. 28 contacts of relay 68TS, conductor AA0, No. 6 contacts of relay 15A2, No. 5 back contacts of relay 15A1, No. 5 front contacts of relay 15A0, conductor LL4, thence as previously traced through the contacts of the reading relays C . . . F, selectively operated for whatever may be the number of message units—here assumed to be "0000"—the contacts of the B reading relays set for the digit "3," to ground on conductor G1 or G2. Relay 82RC0 operates to connect the reading relays to the Zero Storage Register whereby the reading 0000 is transferred to the C . . . F registers thereof. In parallel with said relay 82RC0, relay 75RSL is also operated, but performs no function at this time, and releases at the end of the reading cycle.

The summary entry line is registered in the Zero Storage Register in the usual manner, and relay 82RS0 then operates in the described manner to advance the tape. The operation of relay 82RS0 also completes a circuit for relay 75URL, extending from battery through the winding of said relay, conductor URL, No. 4 contacts of relay 82RS0, conductor URL1, No. 5 contacts of relay 68TS, to ground. Relay 75URL operates and removes ground from conductor UL, thereby unlocking the relays of units register of the Calling Line Register. Once relay 82RC0 is operated, it locks over conductor RC1, thence to ground previously traced on conductor RC01, holding said relay to prevent its release before the release of the units register.

Relay 75URL, on operating, completes a circuit for relay 75GT2 over the No. 1 front contacts of relay 75URL, No. 1 front contacts of relay 75NLK, to ground on conductor ON. Relay 75GT2, on operating, locks over conductor 20 in the event that the first line of the next entry is being sensed. Relay 75GT2 unlocks relay 75UDC which releases relay 75URC to prevent the registration of the units digit of said next line until the units register has released. Relay 75URL is locked over the No. 3 contacts of relay 75UDC, its own No. 2 contacts and contacts of relay 75NLK, to ground on conductor ON. Relay 75UDC then reoperates over the original chain path through the No. 1 contacts of the relays of the units register when relays 65U1, 65U2 and 65U3 have released therein.

Relay 75GT2 releases at the end of the reading cycle for the first line of the next entry. When relay 75UDC has reoperated and relay 75GT2 has released, action may be taken in the first line of the next entry. However, relay 75NDC is released, since the thousands, hundreds and tens registers of the Calling Line Register are filled (with the digits "000"). Therefore, when ground is reapplied to conductor 20 on the next reading cycle, said ground completes the circuit of relay 75URC over the back contacts of relay 75GT2 and No. 2 contacts of relay 75UDC, operating said relay and reconnecting the relays of the units register to the conductors extending to the relays of the F-Digit Reading Register. Over the No.

2 back contacts of relay 75NDC, and conductor NC, the "compare" connector relays 74NCT, 73NCH and 72NCTH are operated.

The three-out-of-six output translations of the calling line number which are made by the reading relays are fed over conductors –0 . . . –00 of the different registers through the contacts of the compare connector relays 72NCTH, 73NCH and 74NCT and the contacts of the digit comparison relays 72TH00 . . . 72TH4, 73H00 . . . 73H4, and 74T00 . . . 74T4 to operate relays 75C, 75NC1–, 75NC2–, and/or 75NCB– in the Comparison Control Circuit if the thousands, hundreds and tens digit of the calling line in the next entry are identical with those of the first line; that is, of those digits already stored in the Calling Line Register. Thus it has been assumed that the digit "0" has been stored in each of said registers, in consequence of which relays 72TH3, 72TH1 and 72TH2 were operated in the Thousands Digit Comparison Circuit, relays 73H3, 73H1 and 73H2 were operated in the Hundreds Digit Comparison Circuit, and relays 74T3, 74T1 and 74T2 were operated in the Tens Digit Comparison Circuit. Now if the thousands digit of the line number in the first line of the next entry is also "0," ground on conductor CC1, CC2 and CC3 from the C-Digit Reading relays will cause relays 75NCBTH, 75NC1TH, 75NC2TH to operate. The circuit of relay 75NC2TH traces from grounds on conductor CC1, No. 6 contacts of relay 72NRTH, No. 5 contacts of relay 72NCTH, No. 2 front contacts of relay 72TH1, No. 2 back contacts of relay 72TH0, conductor INC2, winding of relay 75NC2TH, to battery; the circuit of relay 75NC1TH traces from ground on conductor CC2, No. 5 contacts of relay 72NRTH, No. 4 contacts of relay 72NCTH, No. 2 front contacts of relay 72TH2, No. 1 front contacts of relay 72TH1, No. 1 back contacts of relay 72TH0, conductor INC1, winding of relay 75NC1TH, to battery; the circuit of relay 75NCBTH traces from ground on conductor CC3, No. 3 contacts of relay 72NRTH, No. 2 contacts of relay 72NCTH, No. 2 front contacts of relay 72TH3, No. 1 contacts of relay 72TH00, conductor 1NCB, winding of relay 75NCBTH, to battery.

In the same manner and if the hundreds and tens digits of the calling line number are "0," relays 75NCBH, 75NC1H, 75NC2H, 75NCBT, 75NC1T and 75NC2T are operated. However, if there is a change in the digit values being compared, one or more of said relays will not operate and relay 75C will operate. Thus if the tens digit of the line number in the second entry is "1" instead of "0" there will be ground on conductors EE0, EE1, E00 from the E-Digit Reading relays, thus causing relays 74T00, 74T1 and 74T0 to operate. This registration is, of course, different from the registration in the Tens Digit Register of the Calling Line Register (which is "0"). Hence relay 75C will operate over a circuit that traces from battery through the winding of said relay, conductor C, No. 2 back contact of relay 74T2 (or No. 2 back contacts of relay 74T3), No. 4 contacts of relay 74NCT (or No. 2 contacts of relay 74NCT), No. 6 contacts of relay 64T2, conductor DL, No. 1 front contacts of relay 75NLK, to ground on conductor ON.

If, now, the thousands, hundreds and tens digits of the "new" calling line number agree with the corresponding digits which were previously registered, in consequence of which relays 75NCBTH . . . 75NC2T will operate and relay 75C remains normal, a path is completed for relay 27RS as follows: ground on conductor ON, No. 1 front contacts of relay 75NLK, No. 1 back contact of relay 75URL, conductor UL, through the up-check chain of the Calling Line Register relays, conductor SUC1, serially through the contacts of relays 75NCBTH . . . 75NC2T No. 1, contacts of relay 75C, No. 1 contacts of relay 75URC, conductor RS, winding of relay 27RS to battery. Relay 27RS operates and functions in the manner described to advance the tape to the second line of this summary and register it in that Storage Register of the Odd or Even Storage Unit which is indicated by the newly registered units digit.

Should relay 75C operate, indicating a change in the calling line thousands, hundreds or tens digit, the tape will not be advanced from the new first line, but the circuit will proceed in the manner to be described to punch a card containing the summary which has been registered. Relay 75C, in operating under the conditions assumed, completes a circuit from ground on its No. 2 contacts, conductor PSC1, No. 2 contacts of any relay –UC– operated (which relay operates on the "up-check" of a storage register containing a summary), conductor PSC, winding of relay 75PSC, to battery, which relay operates and then locks over its No. 1 contacts, No. 2 front contacts of relay 75NLK, to ground on conductor ON. As will be described later, relay 75PSC controls the start of the punching of a Tens Summary Card.

Normally, the operations above described are repeated for each summary entry until relay 75C operates. However, occasionally two or more summaries appear successively on the tape for the same calling line number, including the units digit. In this case, the first line is registered and compared as described, but when the attempt is made to register the second line, relay –UC– of the storage register described for storing the summary is found to be operated. As a result, the associated register connector relay –RC– is not operated. Under this condition, a circuit is completed for relay 75PXSC, extending from battery through the winding of said relay, contacts of relay 75RSL (which operates during the closed period of the reading cycle as previously described), conductor CI, No. 4 contacts of relay 65U2 (assume "0" to be registered for the units digit of the line), No. 4 contacts of relay 65U1, No. 5 contacts of relay 65U3, conductor C0, No. 27 back contacts of relay 82RC0, to up-check ground on conductor UC of the Zero Storage Register. As will later appear, relay 75PXSC controls the punching of an "X" or supplementary Ten Summary Card.

15.2 *Punching ten summary cards*

The operation of relay 75PSC or 75PXSC starts the Gang Punch to make one Ten Summary Card for whatever is registered. From one to ten register sets may contain summaries, one for each of ten consecutive or "repeat" line numbers with common thousands, hundreds and tens digits. The Ten Summary Connector relays 70TS0 and 70TSE were operated from the tape-type index register 6TT at the time that the tape-type index is checked when reading the tape identity entries, as will be recalled. Said connector (or relays) connects the input to the C to F digits of the registers of the Odd and Even Storage Units to the assigned punch and check relays 71PC1, 71P1C . . . 71PC80, 71P80C by permanent connections in accordance with the card layout as indicated in Fig. 107.

Thus the calling central office code, the translation of which is effected by the calling office translator shown in Figs. 13, 24A and 24B, results in the operation of the appropriate one of the translator relays which designates said code. Due to the fact that relay 69TS is operated, the latter relay, in combination with relays 14OUP, 14ONP and 14UP which operate in accordance with the row to which the card is advanced during punching operations, connects the appropriate conductors in the CHX and EMX multiples over the Nos. 32 to 37 contacts of relays 69TS to the punch and check relays of punch magnets 89PM2 . . . 89PM4 as indicated in Fig. 69, to cause the calling central office code to be punched in columns 2, 3, 4 of the card in the manner described.

The common thousands, hundreds and tens digits of the ten consecutive line numbers for which the card is produced, and which digits are punched in columns 5, 6 and 7 of the card are obtained, of course, from the Call-

ing Line Register shown in Figs. 62, 63 and 64. The contacts on the relays of these registers are extended as shown to conductors in the CHX and EMX multiples to cause ground when applied to said conductors in the manner described to be selectively applied over the contacts of said relays in accordance with the digit for which they have been operated in the three-out-of-six code, to the conductors extending to the Nos. 39 . . . 43 contacts of relay 69TS and thence to the punch and check relays of punch magnets 89PM5 . . . 89PM7, as indicated on Fig. 69. When the card is advanced to the rows where holes are to be punched in columns 5 . . . 7 of the card to indicate the common thousands, hundreds and tens digits of the ten line numbers, said magnets are operated in the manner described to punch said holes. At this point it should be noted that the CKE and CKC leads which, in the case of an individual summary card are used for punching a hole in column 77 to indicate an incomplete card, are similarly used for a Ten Summary Card, except that said leads, through the Nos. 17 and 18 contacts of relay 69TS, are switched to the punch and check relays of punch magnet 89PM77, as indicated in Fig. 69, to punch a hole in row 9, column 77 to indicate an incomplete Ten Summary Card.

The summary of each one of the ten lines is punched on the card in the spaces severally reserved for each under the headings 0 . . . 9 shown below the legend "Calling line number-units digit" on the Ten Summary Card illustrated in Fig. 107. For this purpose, the E1 and C1 leads from each of the D . . . F registers of the ten storage registers comprising the Odd and Even Storage Units are extended to the stationary contacts of the Ten Summary Connector relays 70TS0 and 70TSE in accordance with the numerical registration of the registers, the leads E1 and C1 from even-numbered registers being extended to the stationary contacts of relay 70TSE, while the leads E1 and C1 from the odd-numbered registers are extended to the stationary contacts of relay 70TS0. Certain of the armatures of both relays are extended by permanent connections to the involved punch and check relays of the punch magnets 89PM9 . . . 89PM58, as indicated in Fig. 70, so that when the card is advanced to successive rows, the summaries stored in the several registers will be punched in said rows and in the indicated columns to record said summaries.

The month for the Ten Summary is punched in column 60 of the card. For this purpose conductors SME and SMC which control the punching of the month indication are connected to the armatures of the Nos. 26 and 27 contacts of relay 69TS, the companion stationary contacts being extended and permanently connected to the punch and check relay of punch magnet 89PM60, as indicated in Fig. 69. Since relay 69TS is operated for the production of Ten Summary cards, the closure of said contacts completes the circuit of said punch and check relays, thereby operating punch magnet 89PM60 in the appropriate row indicative of the numerical indication of the month.

The "round" is punched in column 61. For this purpose the round punch conductors RE and RC are extended, respectively, to the armatures of the Nos. 29 and 30 contacts of relay 69TS, the stationary contacts of which are extended and permanently wired to the punch and check relays of punch magnet 89PM61, as indicated in Fig. 69. The "round" number is then punched in the manner previously described for other cards.

Mention has been made of the fact that when any summary for any one of the ten lines is 1,000, an indication of the fact is recorded on the card and then another card is produced for the same line either for any value in excess of 1,000 and below 2,000 or for the value 0000. This special indication is recorded in row 11 of column 62, as indicated in Fig. 107.

As already noted, a line having a summary of 1,000 results in the operation of relay 75PXSC. The stationary springs of the Nos. 2 and 1 contacts of said relay are connected to the EM11 and CH11 conductors, respectively, in the EMX and CHX multiples, while the associated armatures are extended and permanently connected to the punch and check relays of punch magnet 89PM62. When the card is advanced to row 11 during a card cycle, ground then applied to conductors EM11 and CH11 will operate said relays, thereby operating punch magnet 89PM62 which punches a hole in row 11, column 62.

15.3. *Release of the registers in ten summary*

It should be noted at this time that during the punching of Ten Summary Cards relays 76EH, 66OH, 76ERL and 66ORL continue to function, although no distinction is made between cards produced through the registers of the Odd Storage Unit and cards produced through the registers of the Even Storage Unit.

As previously stated, relay 75PSC, when operated, locks to relay 75NLK. Relay 81C1A then operates to signal that one card is to be produced, the path of said relay extending from battery through the winding of said relay, thence as traced to conductor C1A, No. 2 contacts of relay 75PSC (or No. 4 contacts of relay 75PXSC), conductor C1A, No. 10 contacts of relay 68TS, conductor NCA, No. 6 back contacts of relay 81C3B, No. 1 back contacts of relay 81C2B, to aforetraced ground on conductor CRL. Relay 8CUC operates in the regular manner except that all unused connectors and subconnectors are included in its "up-check" operating path. Relay 8CUC then operates relay 8PST, as described, to start a card cycle. When relay 9–1P operates during the punching of row 0, relay 8POC is operated over a path extending from battery through the winding of said relay, No. 1 contacts of relay 8CUC, conductor POC, No. 6 contacts of relay 68TS, conductor POC1, No. 2 contacts of relay 9–1P, to ground on conductor ON1. Relay 8POC, in operating, releases relay 8PST to prevent the Gang Punch from making additional cards from the Ten Summaries locked into the registers.

When the punching of row 9 is completed, relays 66RL1–3, 66RL5–7, 66RL9, 76R0–2, 76RL4–6 and 76RL8 operate in the manner described, relay 66RL9 operating over a path extending from battery through the winding of said relay, conductor RL9, No. 18 contacts of relay 68TS, to aforetraced ground on conductor RLE; relay 76RL8 operating over a path extending from battery through the winding of said relay, conductor RL8, No. 17 contacts of relay 68TS, to aforetraced ground on conductor RLE. All of the above relays operate, and release relays 66LK1–3, 66LK5–7, 66LK9, 76LK0–2, 66LK4–6 and 66LK8 which, in turn, release all of the storage registers. Relay 75NLK, in releasing, releases the thousands, hundreds, tens and units register and comparison relays of the Calling Line Register. In addition, relay 75PSC (or 75PXSC) releases, in turn releasing relays 8CUC and 8POC. When relay 75NLK releases, relay 75GT2 is operated over a previously described circuit and locks to ground on conductor 20 if ground is present on said conductor because of the reading of the first line of a succeeding entry. Since the operating circuit of relay 75URC depends upon the back contacts of relay 75GT2, the operated condition of said latter relay prevents the registering of new entries until the Calling Line Registers have been checked down, after which, with ground removed from conductor 20 at the end of the reading cycle and relay 75GT2 released in consequence thereof, the next line of a summary entry may be registered as previously described.

If relay 75PXSC operates to start the punching of a "supplementary" card, said relay locks over its No. 3 contacts, conductor PXSCL, No. 1 front contacts of relay 76LK8, to ground on the No. 1 contacts of relay 76ST3. In all other respects the punching operations

are the same as for a regular Ten Summary Card, relay 75PXSC releasing upon the release of any contact of its circuit.

16. *Alarms*

16.1.—*Alarm timing*

A gas tube timer comprising tube 26VT is shown which is normally prevented from firing by relay 4RC, the No. 30 contacts of which, by joining conductors A and SA, maintain the same potential on cathode and firing anode through the back contacts of relay 26CT. Once the circuit is started, however, the relay 4RC operates as described, capacitor A begins to charge over a circuit traced from positive battery, resistor R10, capacitor A, back contacts of relay 26CT, winding of relay 26T0, to ground. If the capacitor charges sufficiently to make terminal 1 (the control anode) of the tube approximately 70 volts with respect to terminal 2, the tube 26VT will be rendered conducting, operating relay 26T0 through the tube, to battery. Relay 26T0 operates relay 26AL which locks over its No. 6 contacts, conductor ALL, No. 6 contacts of key KMST, No. 1 contacts of key 5 KMARL, to ground on the No. 1 contacts of relay 5MON. Relay 26AL performs functions noted hereinafter.

However, as long as reading and punching operations are proceeding without delay, the alarm should not be brought in. Hence, capacitor A is discharged whenever a reader step relay --RS-- operates to complete the circuit of relay 26CT as before described, or the circuit breaker CB of the Gang Punch is pulsing, the latter operating relay 8CB as before described and grounding conductor CT which connects directly with relay 26CT. The latter relay is operated from these sources to recycle timing. These sources are provided with a separate guard to prevent them from cancelling the timing for too long a period. Each relay --RS--, and relay 8CB, is provided with a circuit for shunting slow relay 26RSR, relay 8CB from ground on its No. 2 contacts applied to conductor RSR connecting directly with relay 26RSR, and each of the relays 82RS0 . . . 27RS9 by ground over their respective No. 6 contacts or the No. 4 contacts of relay 27RS, conductor RSR1, No. 4 back contacts of relay 26SSL, No. 2 contacts of relay 26SWSL, to the winding of relay 26RSR, said relay normally operating upon the operation of relay 5MON over a circuit completed from battery through resistor R1, No. 10 contacts of relay 5MON, conductor RSR, winding of relay 26RSR, to ground, and operating relay 26RSH over an obvious circuit. If relay 26RSR releases, relay 26AL operates over the No. 1 contacts of relay 26RSR, conductor AL6, No. 1 contacts of relay 5ST4, to ground on the No. 1 contacts of relay 5MON. Relay 26AL operates and completes the circuit for lamp LP2. It should be noted that when lamp 26RSH operates, a circuit is completed for relay LP1 through the No. 5 contacts of relay 26AL, No. 2 contacts of relay 26RSH, No. 4 contacts of relay 26RSF, No. 1 contacts of relay 26FA to ground. This lamp indicates a general circuit alarm.

16.2. *Alarms*

When relay 26AL operates it opens conductor UC3, thereby preventing the reading of further lines of tape. In addition, it completes the circuit of relay 8PSP by ground over its No. 3 contacts to conductor PSP, thereby to prevent further card punching cycles from occurring.

Should a fuse blow, relay 26FA operates in consequence, lights lamp LP6 over an obvious circuit, and completes a circuit for relay 5ALS from ground on its No. 1 front contacts, conductor ALS, winding of relay 5ALS, to battery. Relay 5ALS, in operating, prevents the reading of further lines of message or summary entries except when making Ten Summary Cards. On a new Summary Card (for which the AB digits ground conductor 20) a circuit is completed for relay 5RLS over a path extending from battery through its winding, No. 2 front contacts of relay 5ALS, conductor 20S, No. 7 contacts of relay 68TS, conductor 20S1, and thence as previously traced to ground. Relay 5RLS operates, locks over its No. 1 contacts to ground on the No. 8 contacts of relay 5ST3, and at its No. 2 contacts releases relay 5ST3, the latter releasing relay 5ST4. If something is registered and the fuse involved does not affect the registers or other vital parts of the circuit, relay 5ST3 is held to ground on conductor STH.

Should the Gang Punch run out of blank cards, or the card stacker become full, it will fail to start further card cycles. Hence, when reading halts because registers are full awaiting punching, the time alarm will be brought in by the operation of relay 26AL as previously described. If the Gang Punch failure is due to lack of blank cards in the magazine, relay 8PIC will be released and lamp LP3 will be lighted from ground on the No. 1 contacts of relay 8PIC, conductor LP, No. 1 contacts of relay 26RSH, lamp LP3, to battery.

When relay 26AL operates, it locks over its No. 6 contacts, conductor ALL under the control of the motor start key 5KMST, as previously described. The circuit of relay 5MST is opened at the No. 6 contacts of relay 26AL, releasing the former relay and stopping the reader motor. Should the Gang Punch need only blank cards, these are inserted, and the motor start key is operated, whereupon relay 26CT operates in the manner described to cancel alarm timing, relay 26AL is released, relay 5MST is reoperated and new cards are fed into punch and die positions, since relay 8PIC is released.

Should the alarm be due to a trouble, the machine release key 5KMARL is operated after the operator has noted the lighted or normal condition of the alarm lamps. The operation of key 5KMARL releases relays 5ST1, 5ST2, 5ST3, 5ST4 and 26AL. These relays release any information stored in the machine from entries. The machine may now be restarted by operation of motor start key 5KMST and machine start key 5KMAS.

While I have illustrated my invention in its application to the production of cards for use in telephone automatic message accounting; it should be understood that it is not limited to such application or to the specific arrangements herein disclosed, it being apparent to one skilled in the art that various applications, modifications and arrangements other than those disclosed herein are within the scope of the invention.

The terms and expressions which I have employed in reference to the invention are used as terms of description and not of limitation, and I have no intention in the use of such terms and expressions of excluding thereby equivalents of the features shown and described or portions thereof but, on the contrary, intend to include therein any and all equivalents and modifications which may be employed without departing from the spirit of the invention.

What is claimed is:

1. A record-controlled apparatus for producing individual records for each of a plurality of sensable entries on a continuous medium, each of said entries including an index denoting the number of individual records to be produced for the entry, the order in which said individual records are to be produced, and an arbitrary character specific to each of said records to be recorded thereon, comprising in combination, means for sensing each of said entries, means responsive to said sensing means sensing one of said entries for registering said entry, and means responsive to the operation of said registering means for producing in the order indicated by the index of the entry as many individual records for the entry as indicated by said index, and for recording on each of said individual records the arbitrary character specific thereto.

2. A record-controlled apparatus for producing individual records for each of a plurality of sensable entries

contained on a continuous record medium, each of said entries including an index denoting the number of records required for the entry and a specific character for each of said records, comprising in combination, means for sensing each of the entries on said record medium, means responsive to said sensing means sensing an entry for registering said entry, translating means responsive to the operation of said registering means for transforming part of the registered entry, and means jointly responsive to the operation of said registering means and said translating means for producing for the entry partly as registered and partly as transformed as many individual records as is indicated by the index of the entry, and for recording on each of said individual records the arbitrary character specific thereto.

3. A record-controlled apparatus for producing individual punched cards for each of a plurality of sensable entries contained on a continuous record, each of said entries including an index which denotes the number of cards required for the entry and a specific character individual to each card, comprising in combination, means for sensing each of the entries on said record, means responsive to said sensing means sensing one of said entries for registering said entry, translating means responsive to the operation of said registering means for transforming a part of said registered entry, and means jointly responsive to said operated registering means and said operated translating means for producing the number of punched cards denoted by the index of said entry, each of said cards containing thereon punches in predetermined locations for recording a part of said entry as registered, the remainder as transformed by the operation of said translating means, and the specific character individual to the card.

4. A record-controlled apparatus for producing individual punched cards for each of a plurality of sensable entries contained on a continuous record, each of the entries including an index denoting the number of cards required for the entry, the order in which said cards are to be produced, and an arbitrary character specific to each of said records to be recorded thereon comprising in combination, means for sensing each of the entries on said record, means responsive to said sensing means sensing an entry for registering said entry, translating means responsive to the operation of said registering means for transforming a part of said registered entry, and means jointly responsive to the operation of said registering means and said translating means for producing a number of punched cards for the entry, and for producing said cards in the order denoted by the index of the entry, each of said cards containing a part of the entry as registered in said operated register, the remainder of the entry as transformed by said operated translating means and the arbitrary character specific thereto.

5. A record-controlled apparatus comprising in combination, means for sensing each of a plurality of sensable numbers contained in a record, said numbers being arranged in ascending numerical order, each of said numbers being followed by another sensable number, a register responsive to the operation of said sensing means sensing one of said numerically-ordered numbers for registering said number, a plurality of other registers, a mechanism for producing records on cards having a plurality of columns thereon, said card-producing mechanism having means for recording in each column of a card, means for connecting each of said columnar recording means of said mechanism with one of said plurality of registers, means responsive to the units digit of a numerically-ordered number registered in said register for connecting a particular one of said plurality of registers to said sensing means, thereby to operate said particular register in response to said sensing means sensing the number following the numerically-ordered number registered in said register, and means for operating said mechanism under the joint control of said register and said particular register, thereby to operate said columnar recording means of said card-producing mechanism for recording said numerically-ordered number registered in said register in one column of a card and said number registered in said particular register in another column of said card.

6. A record-controlled apparatus comprising in combination, a plurality of settable registers, a recording mechanism including a plurality of recording magnets, and a circuit for controlling the operation of said recording magnets from said registers, said circuit comprising pairs of relays, one pair for each recording magnet, each relay in each one of said pairs of relays being operable over an independent path from one of said registers, means responsive to the operation of one relay in a pair of relays for operating the associated recording magnet, and a circuit including a relay serially completed over the operated contacts of each pair of operated relays and over the normal contacts of each pair of non-operated relays, said circuit being effective to operate said included relay, thereby to indicate that said pairs of relays are either operated in pairs or normal in pairs.

7. In a machine for producing a perforated card under the control of ten sensable entries, each of said entries comprising a number designating a transaction source and a number designating a summary of charges chargeable to the source, said numbers designating the sources having the values of all digital orders identical except the units digital order, means for sensing said entries, and means under the control of said sensing means for perforating a card corresponding to said ten entries, said means including other means for perforating once the common digits of said source designation numbers in certain columns of said card and the summary for each source in separate columns each indicated by the units digit of the designation number.

8. In a machine for producing a perforated card under the control of ten consecutively arranged sensable numbers included in a record, each of said numbers differing in the units digit thereof, each of said numbers designating a transaction source, and each of said numbers being followed by a summary of charges chargeable to the source, means for sensing said numbers and said summaries, one number register under the control of said sensing means for storing the digits of the first number sensed and for successively registering the units digit of each of the other numbers when sensed by said sensing means, ten summary storage registers under the joint control of said sensing means and said number register for succesively storing in each a summary, the selection of said storage register being determined by the value of the units digit stored in said number register, and means under the control of said number register and said ten summary storage registers for perforating a card with perforations designating said numbers in consecutive order, each number being followed with perforations designating the summary therefor.

References Cited in the file of this patent

UNITED STATES PATENTS

2,124,178	Lasker	July 19, 1938
Re. 21,133	Lake	June 27, 1939
2,340,801	Doty et al.	Feb. 1, 1944
2,522,758	Lesigne	Sept. 19, 1950
2,531,873	Daly	Nov. 28, 1950
2,550,600	Rehm	Apr. 24, 1951
2,550,909	Busch et al.	May 1, 1951
2,558,476	Carpenter et al.	June 26, 1951
2,559,390	Blaisdell	July 3, 1951
2,572,132	Giround et al.	Oct. 23 ,1951
2,572,804	Flint et al.	Oct. 23, 1951
2,595,889	Ryffel	May 6, 1952
2,637,399	Doty	May 5, 1953