June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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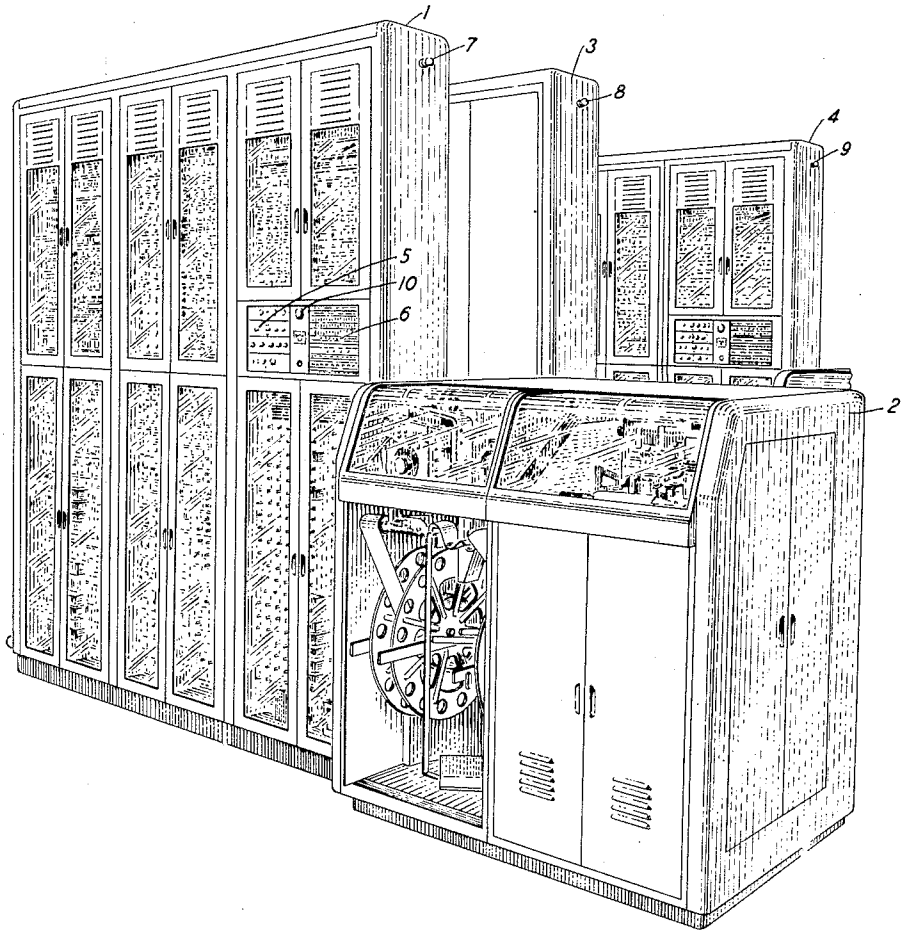
FIG. 0



INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Vale

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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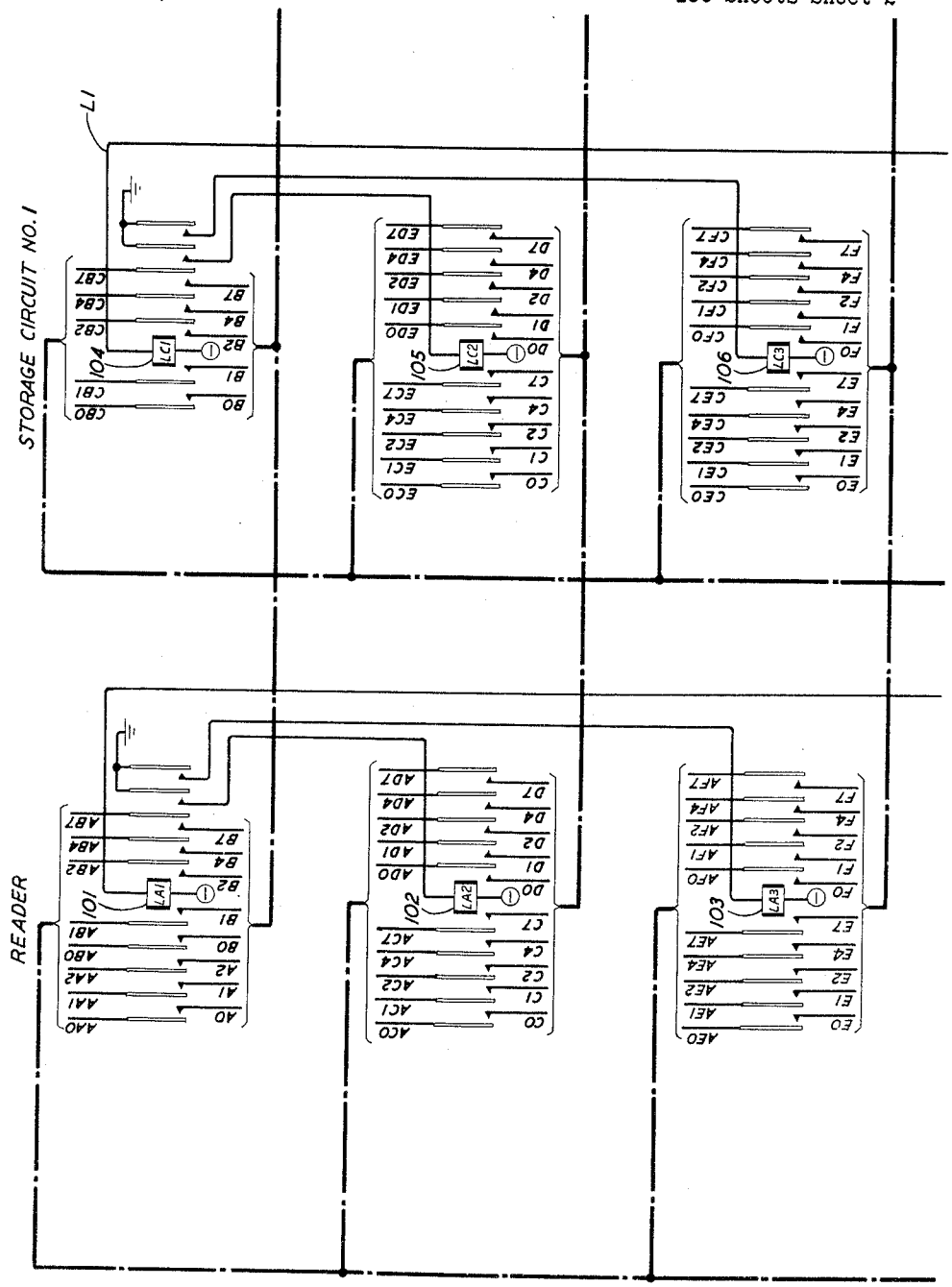

FIG. 1

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

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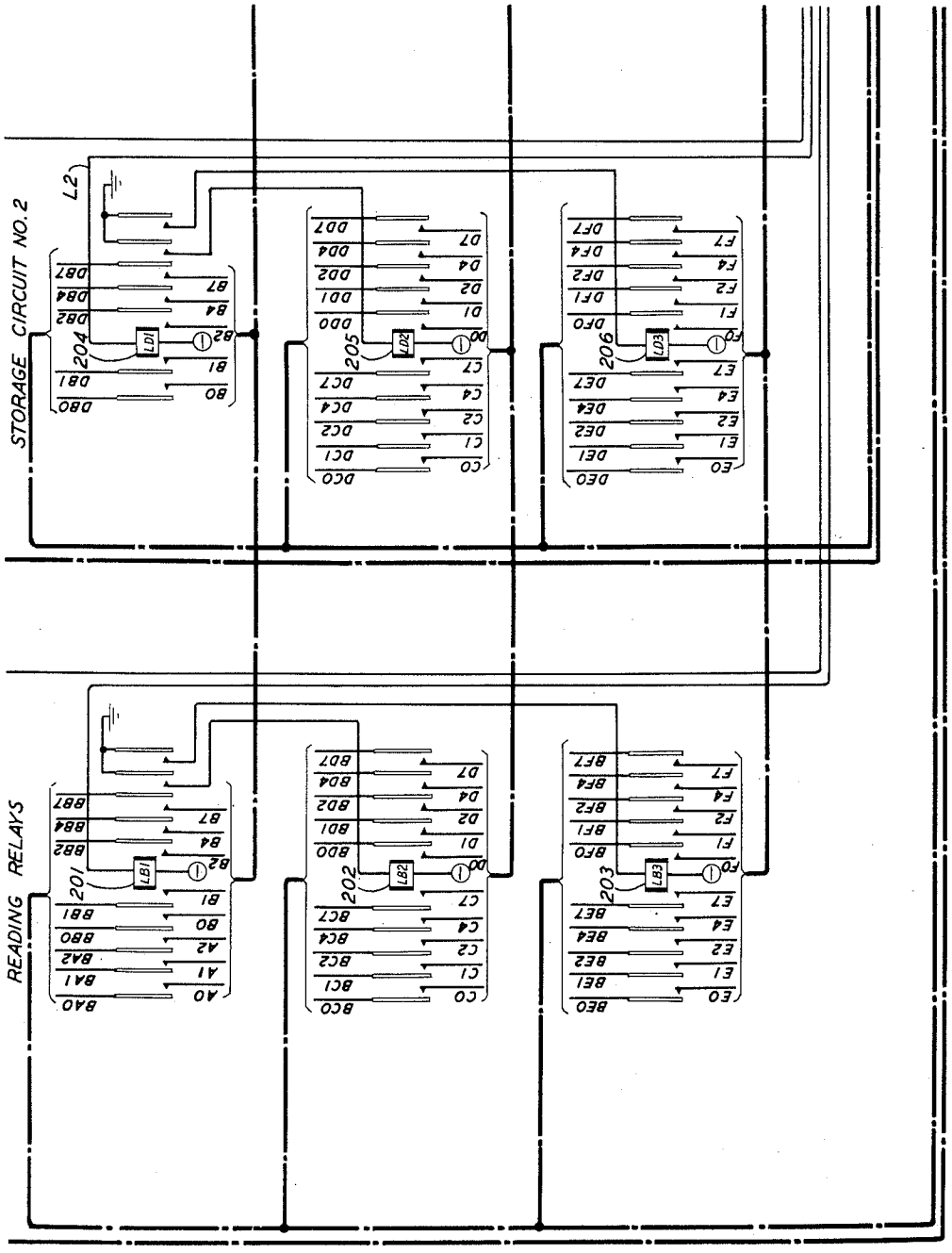

FIG. 2

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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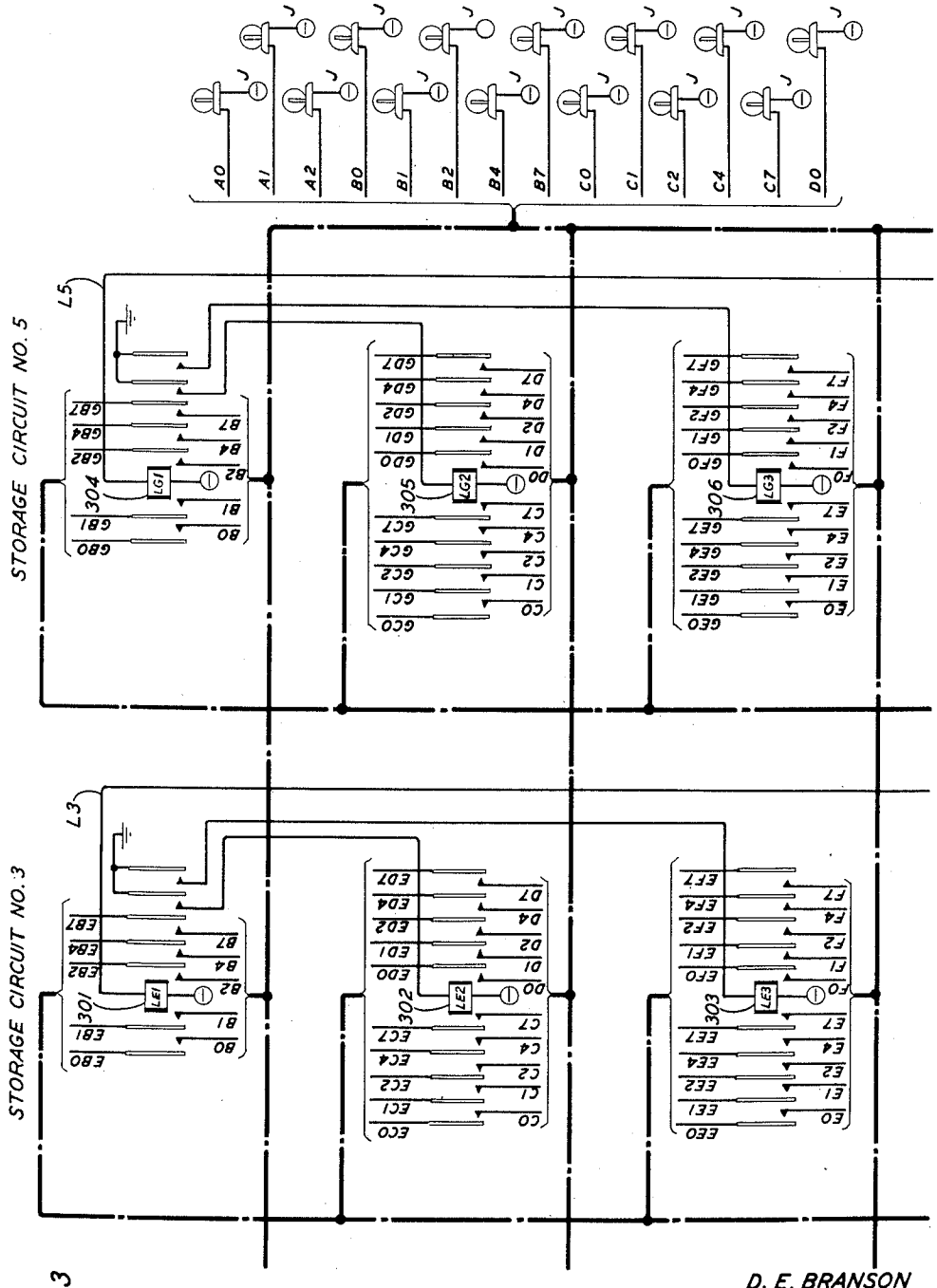

FIG. 3

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

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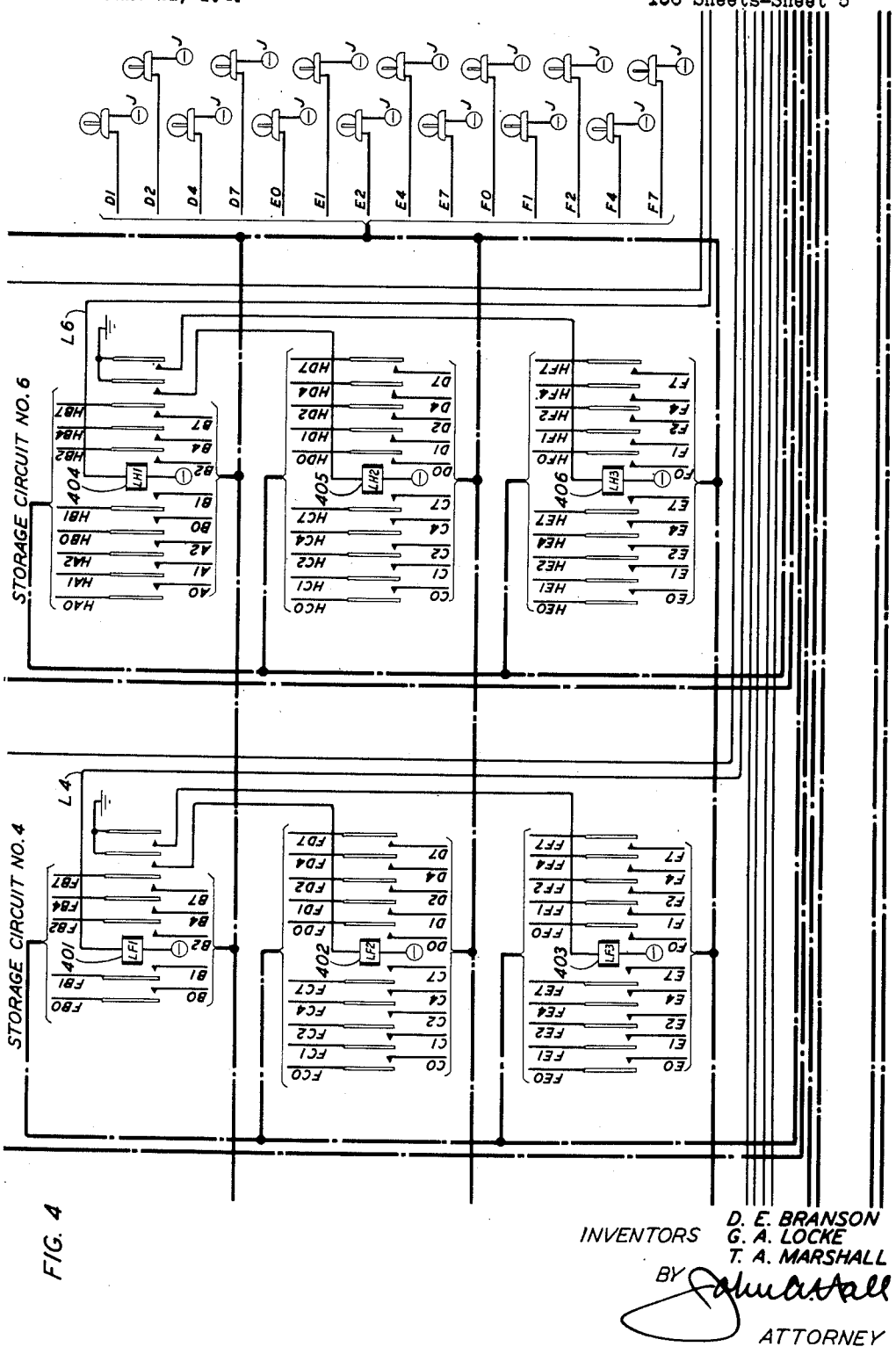

FIG. 4

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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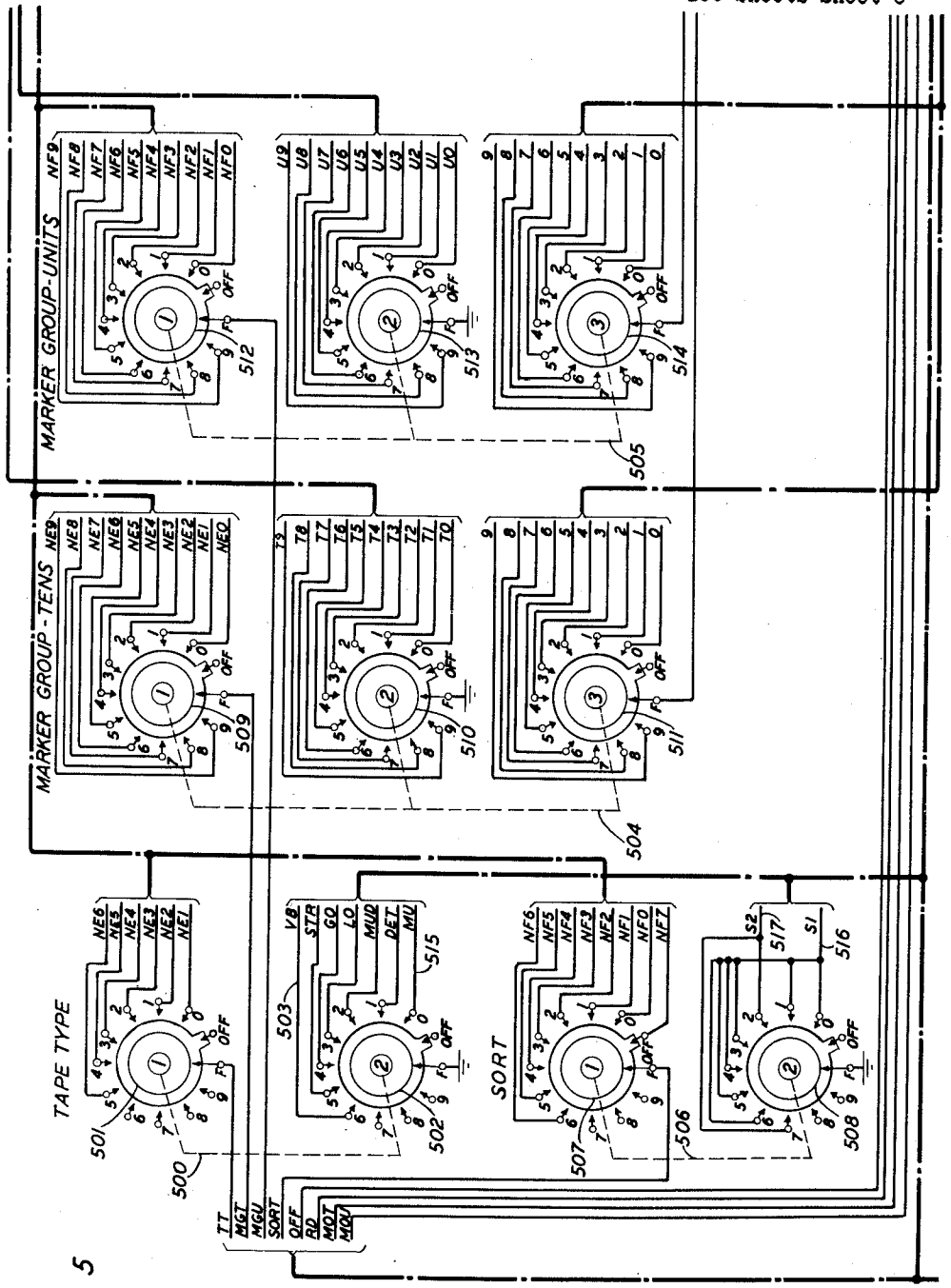

FIG. 5

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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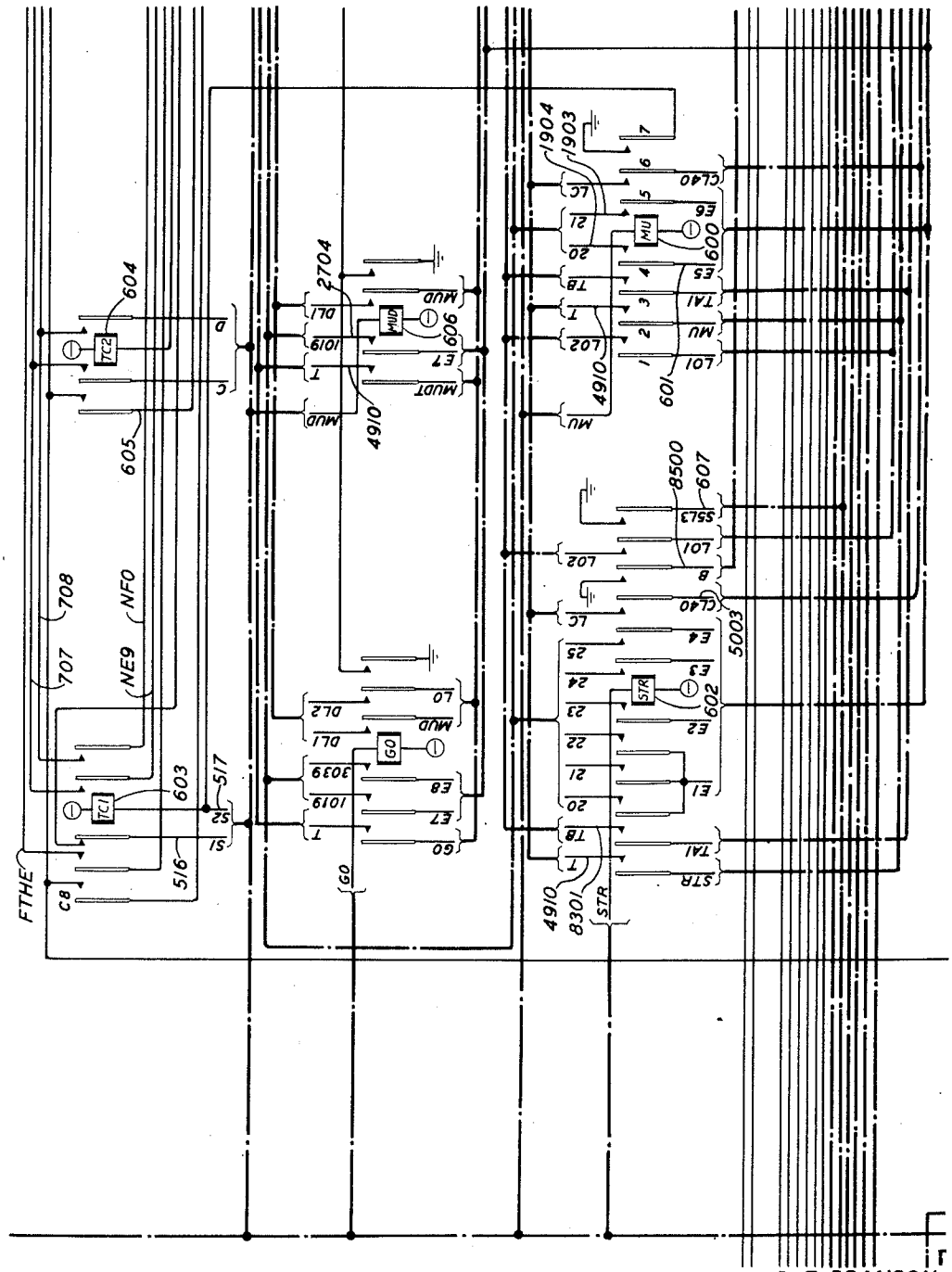

F/G. 6

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

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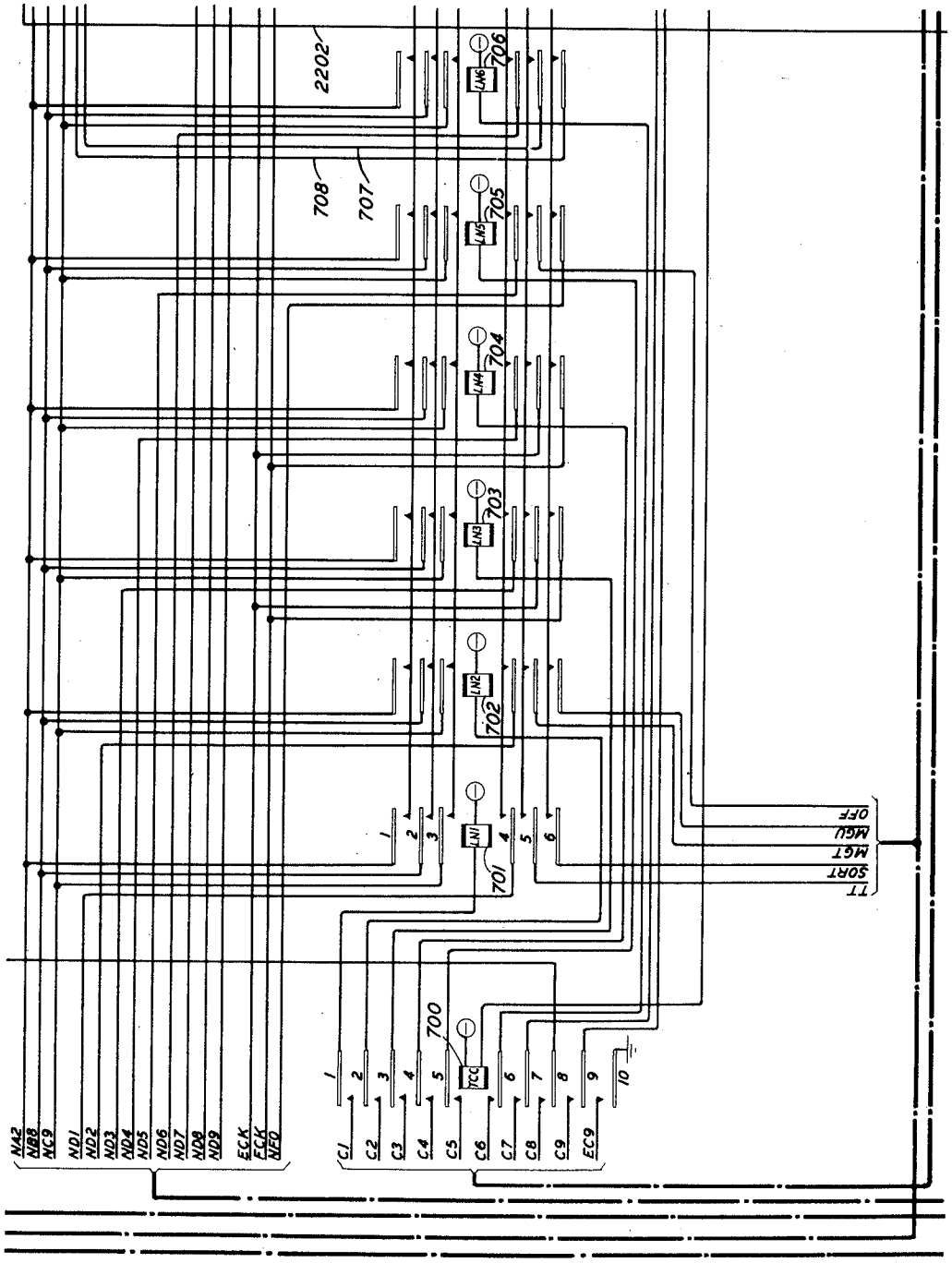

FIG. 7

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

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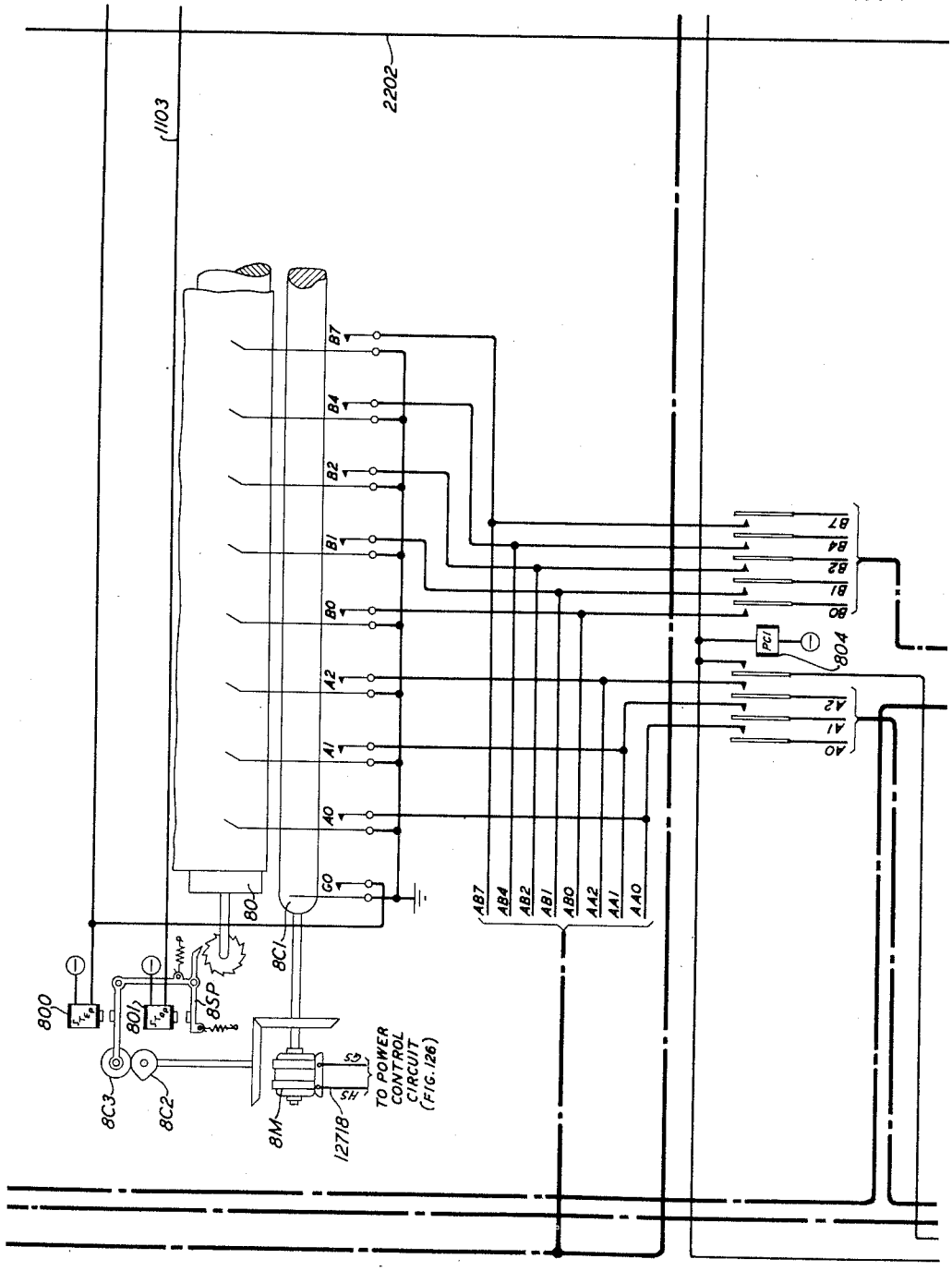

FIG. 8

INVENTORS D. E. BRANSON
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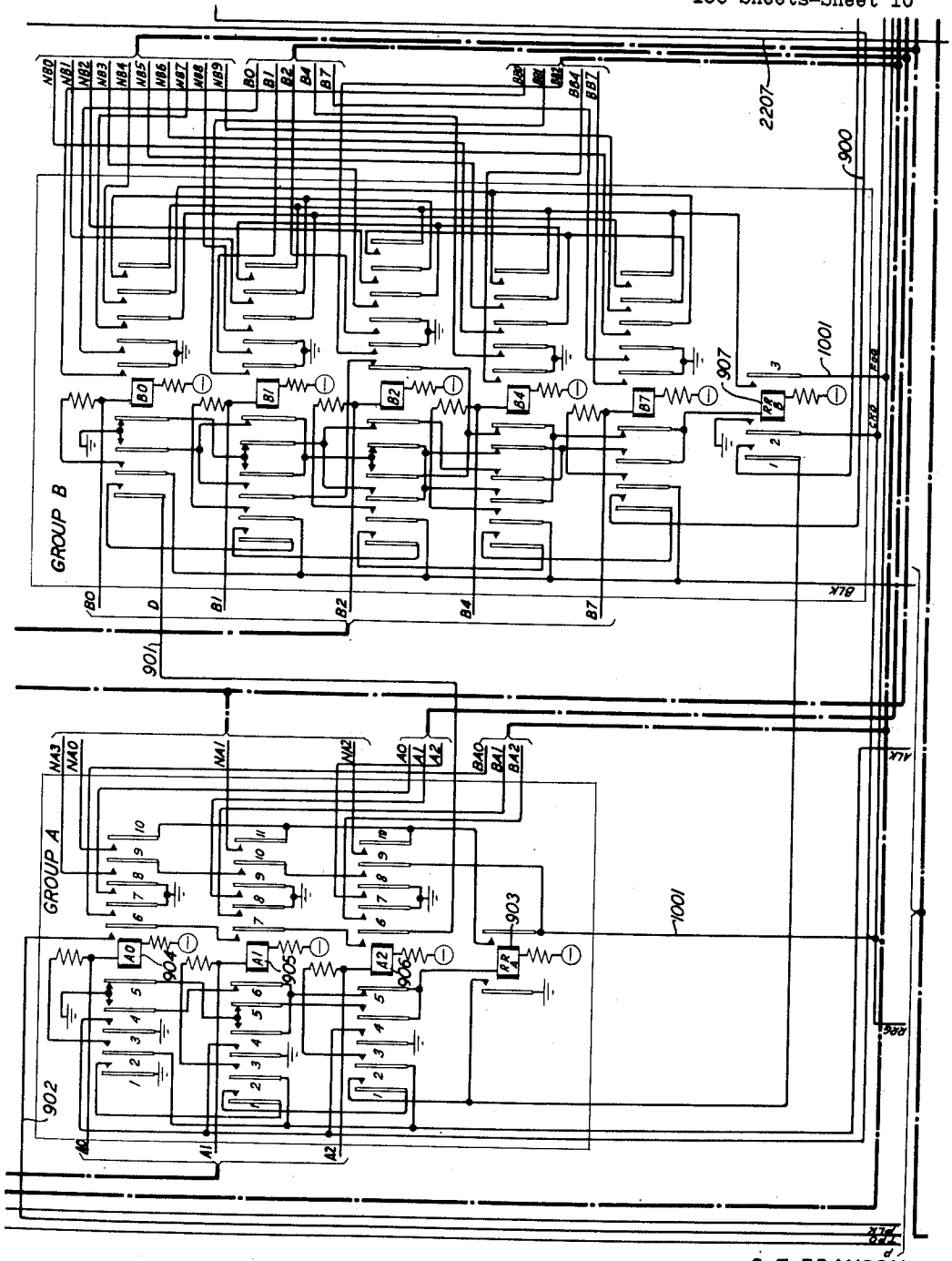

FIG. 9

INVENTORS D. E. BRANSON
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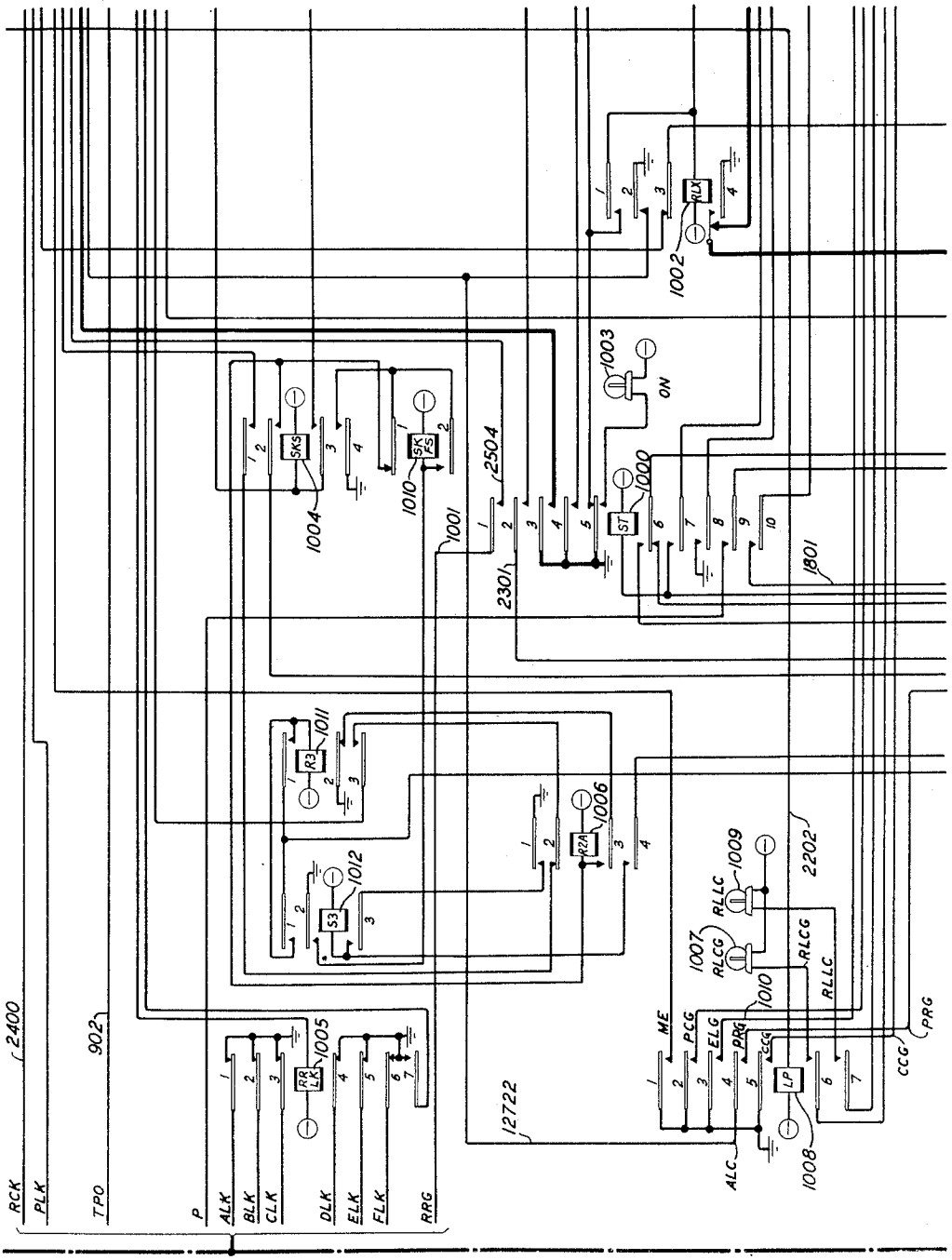

FIG. 10

INVENTORS D. E. BRANSON
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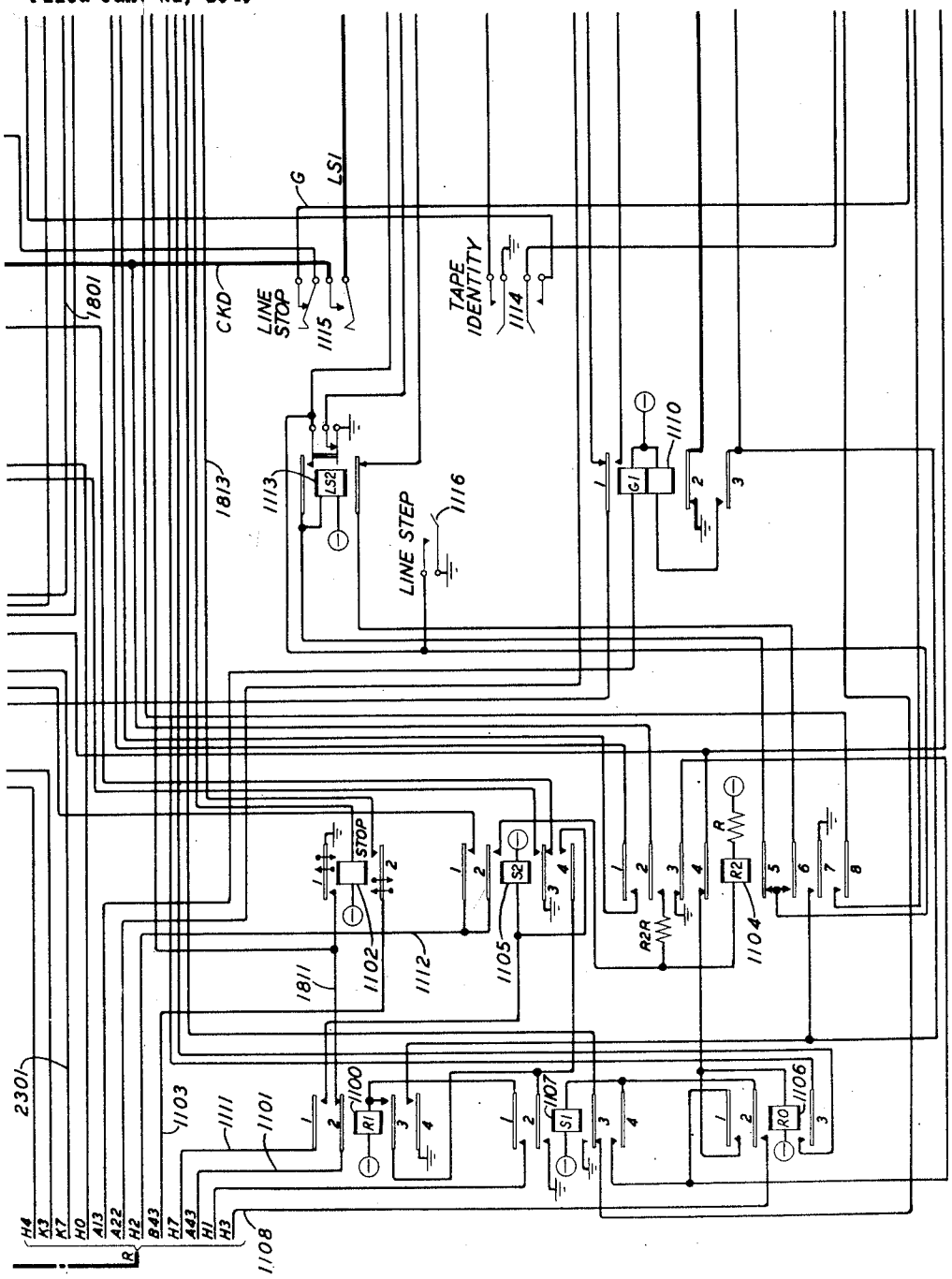

FIG. 11

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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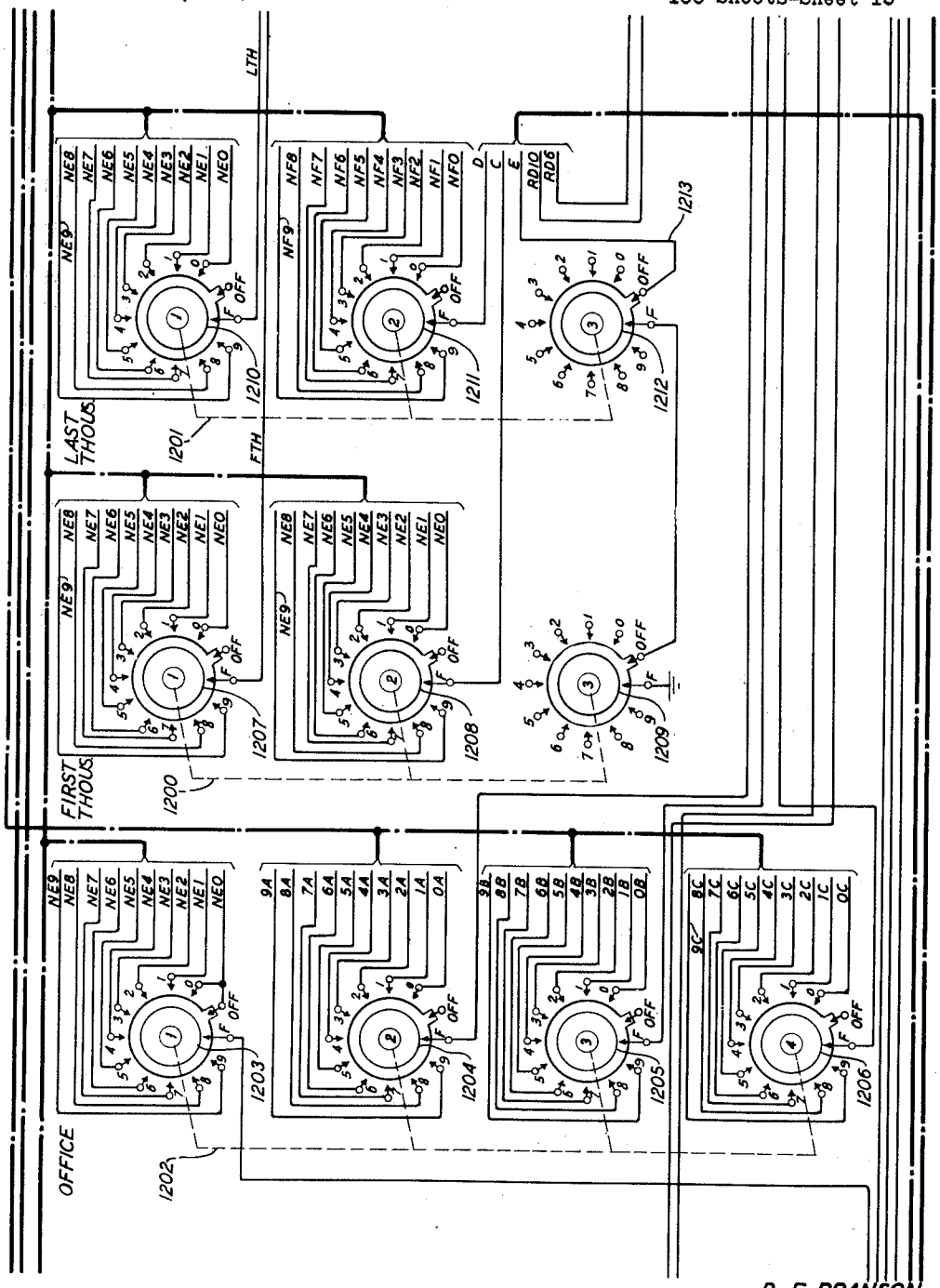

FIG. 12

INVENTORS D. E. BRANSON
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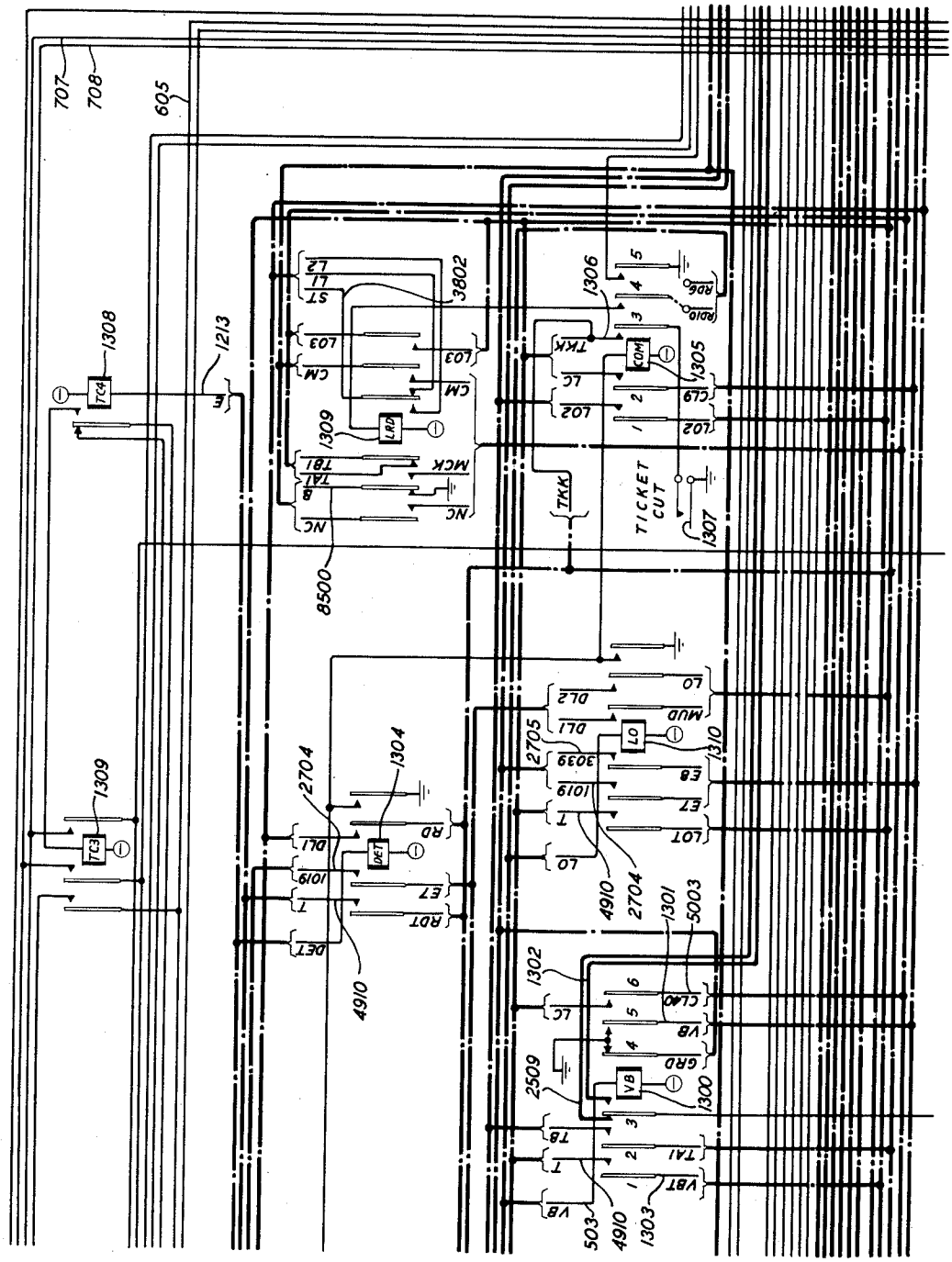

FIG. 13

INVENTORS D. E. BRANSON
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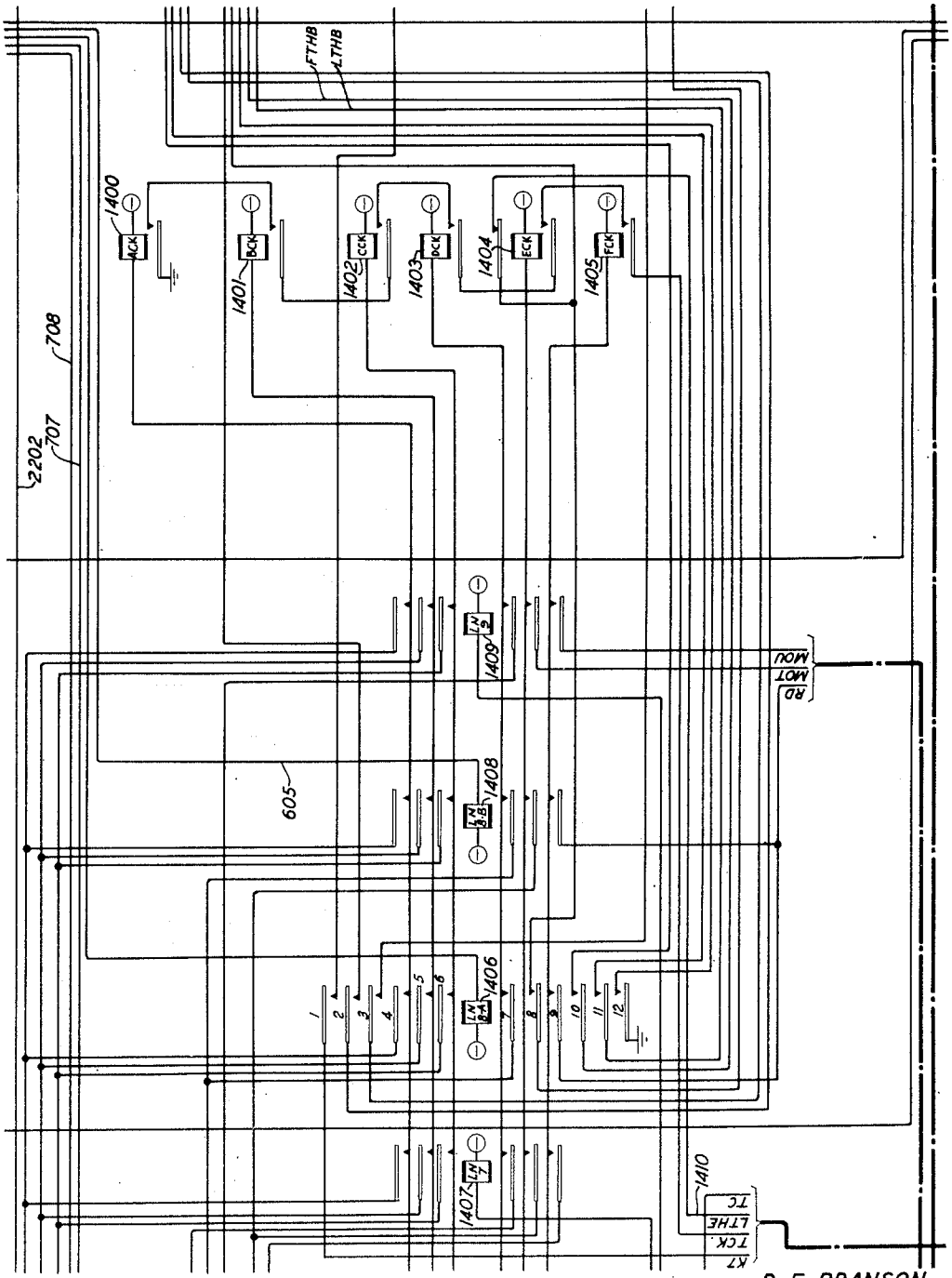

FIG. 14

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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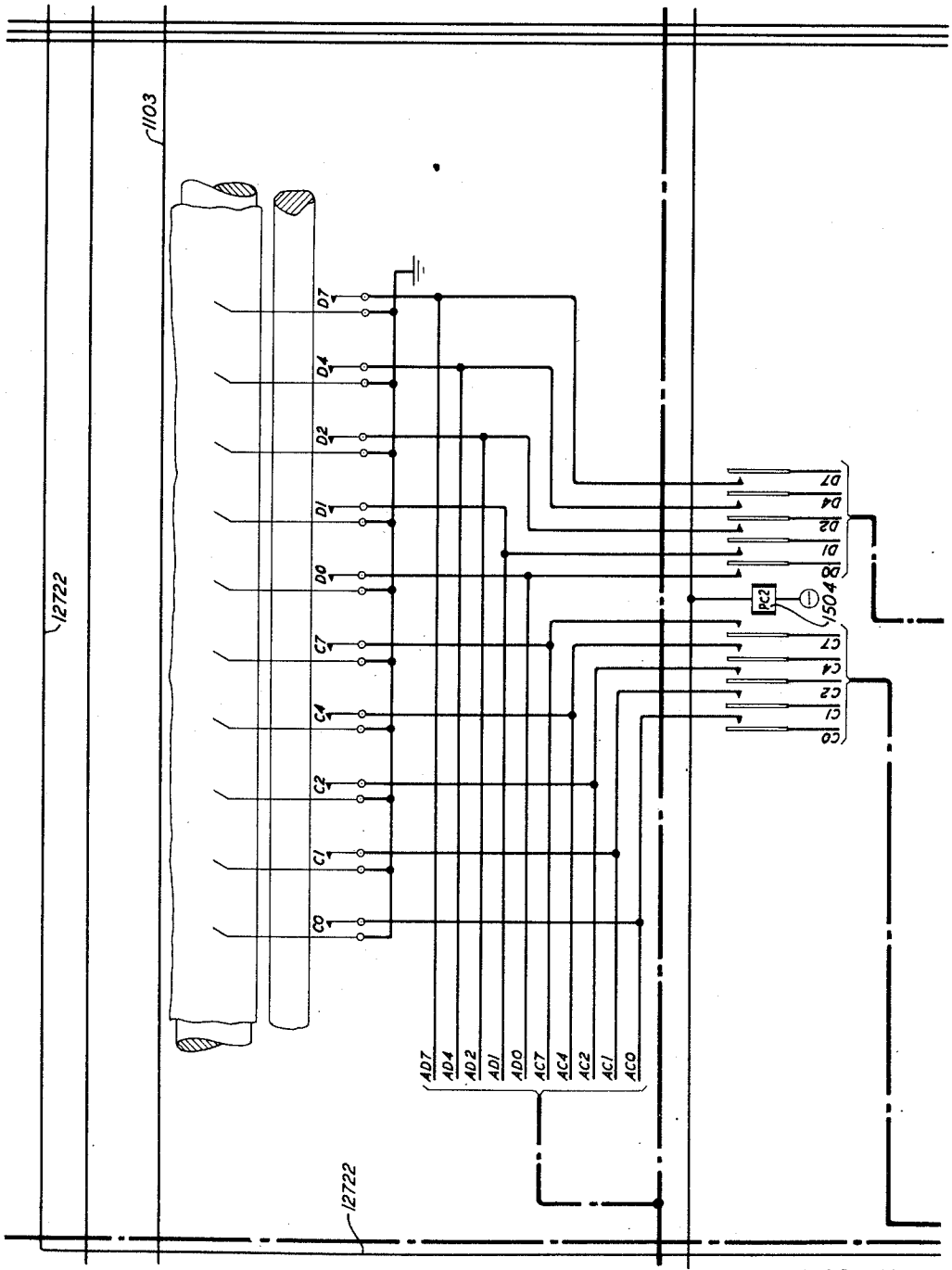

FIG. 15

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John B. Hall

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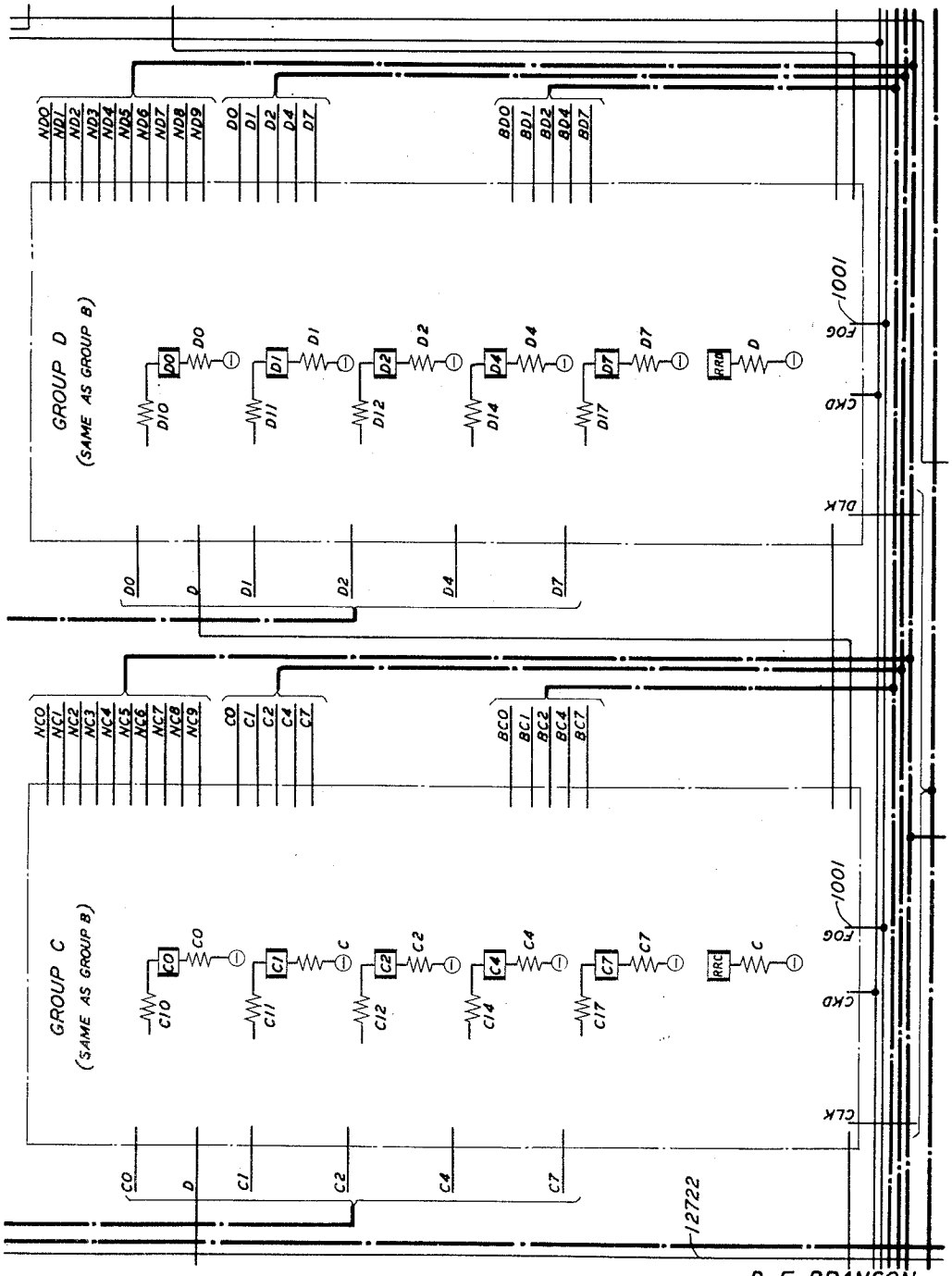

FIG. 16

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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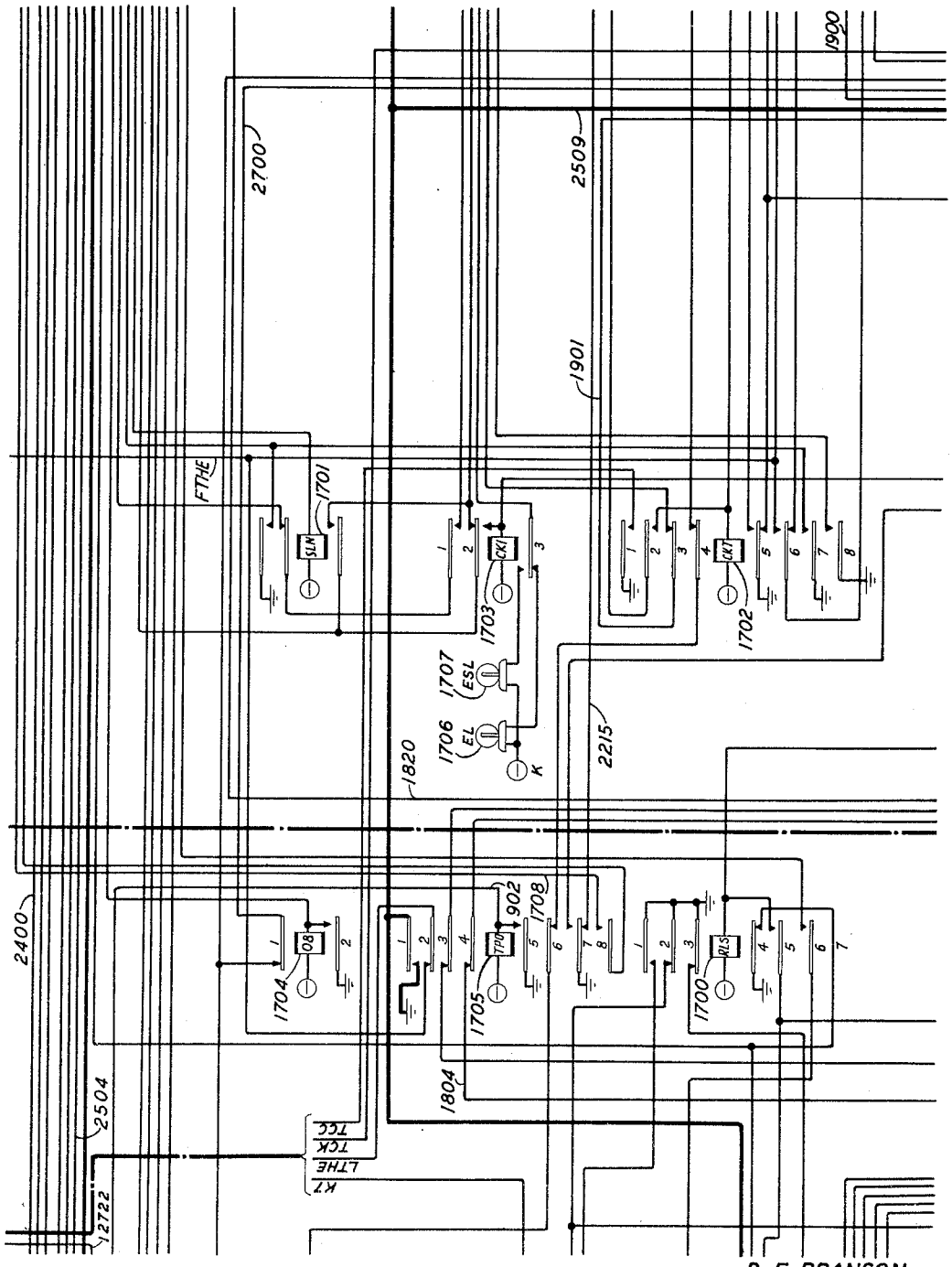

FIG. 17

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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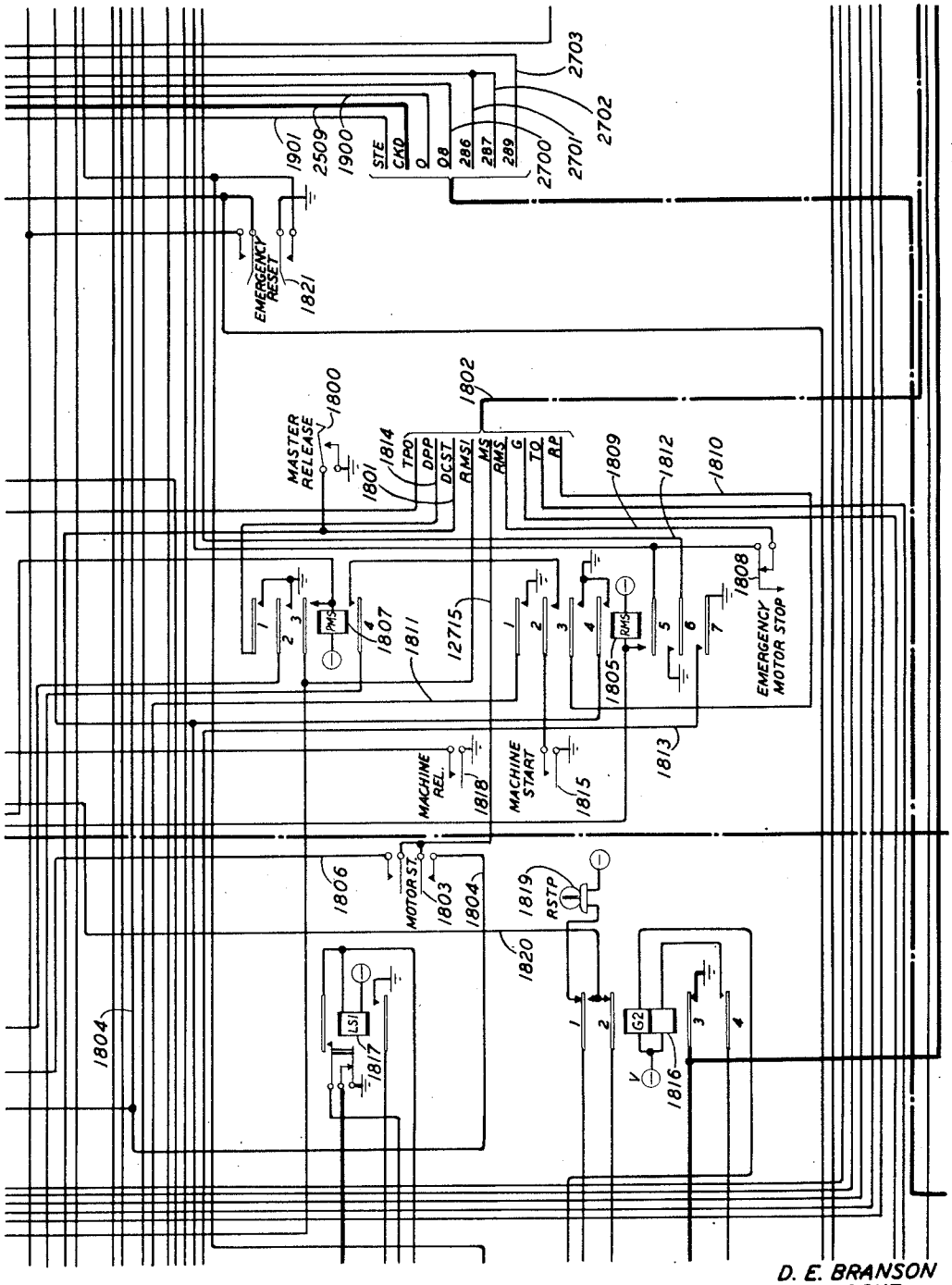

FIG. 18

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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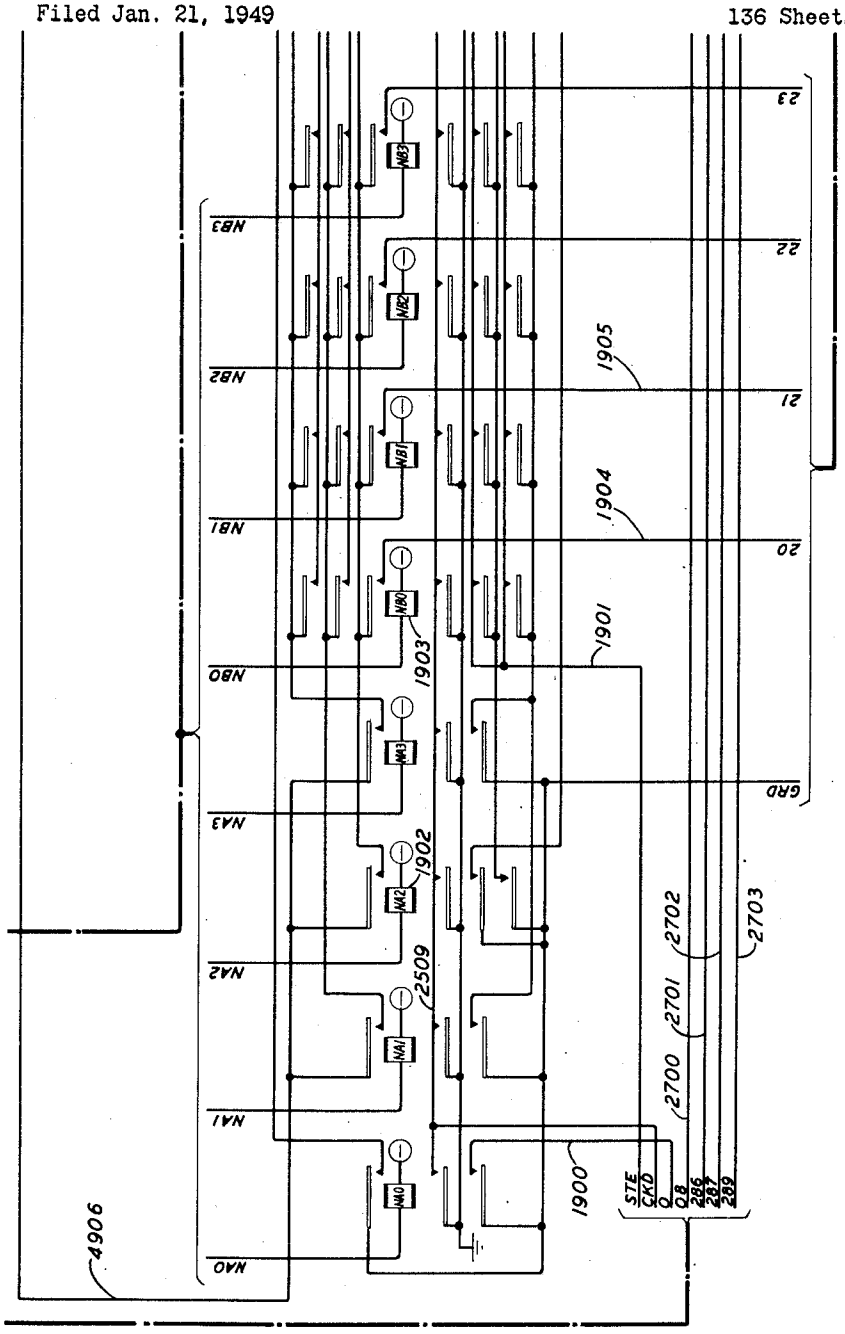

FIG. 19

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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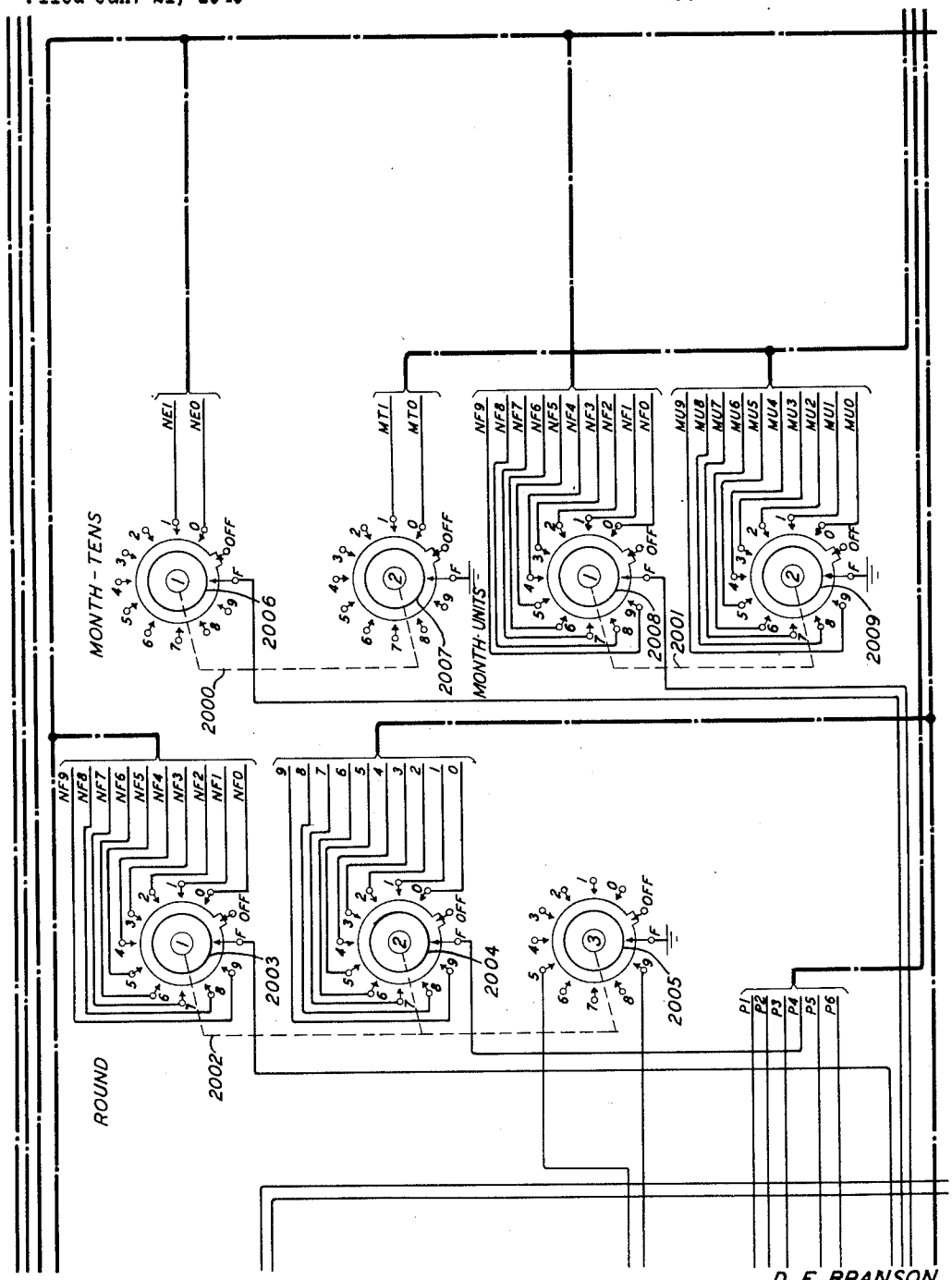

FIG. 20

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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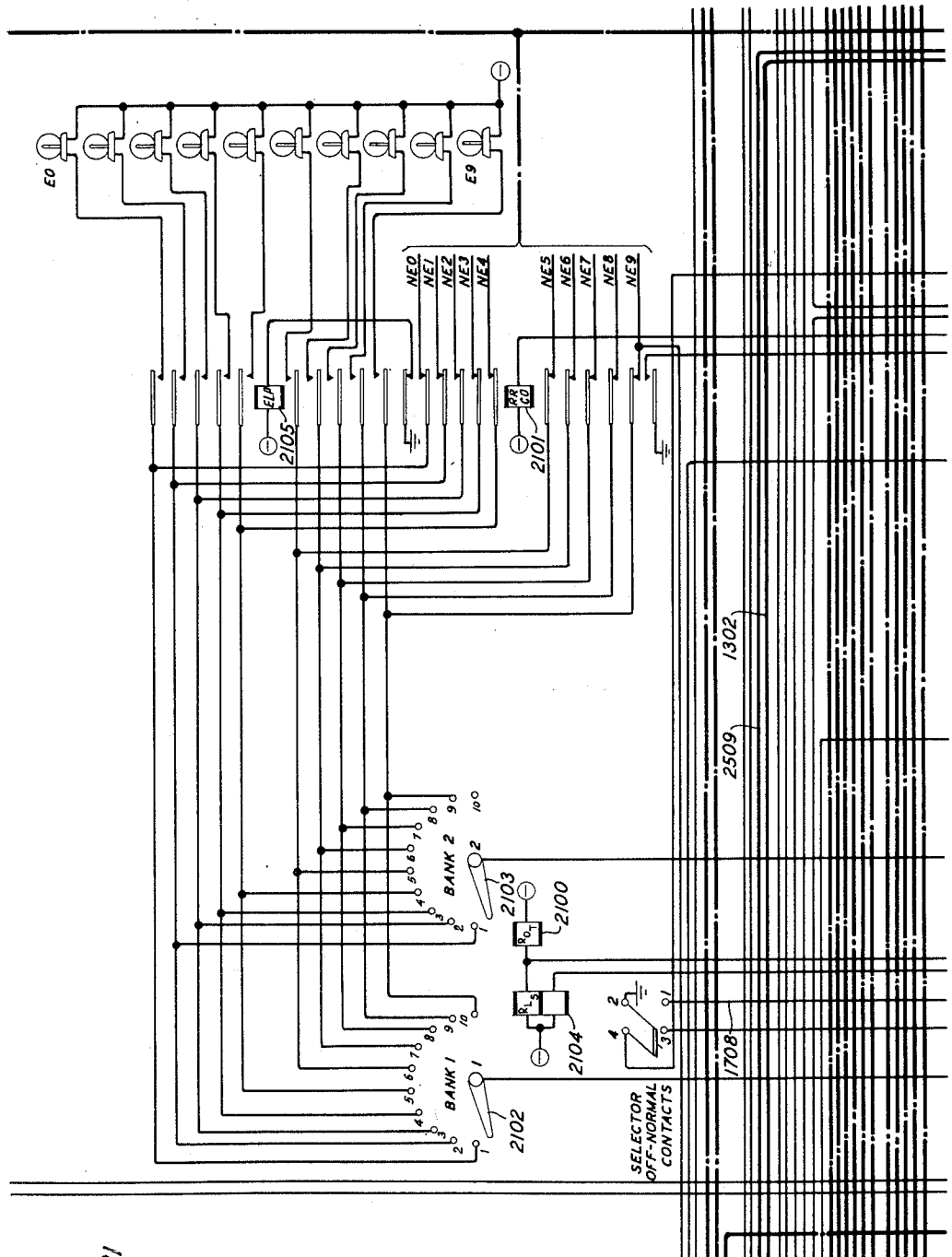

FIG. 21

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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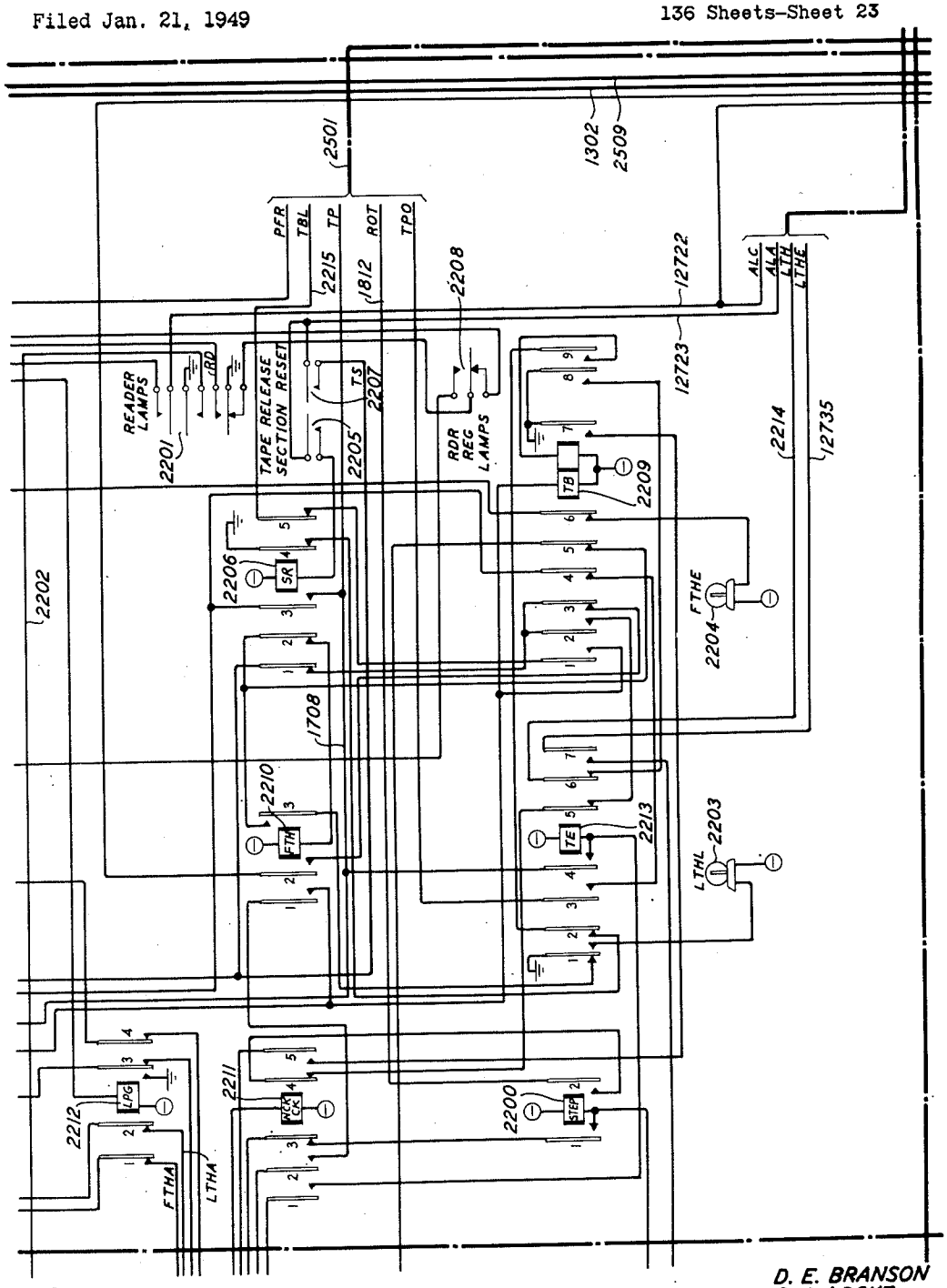

FIG. 22

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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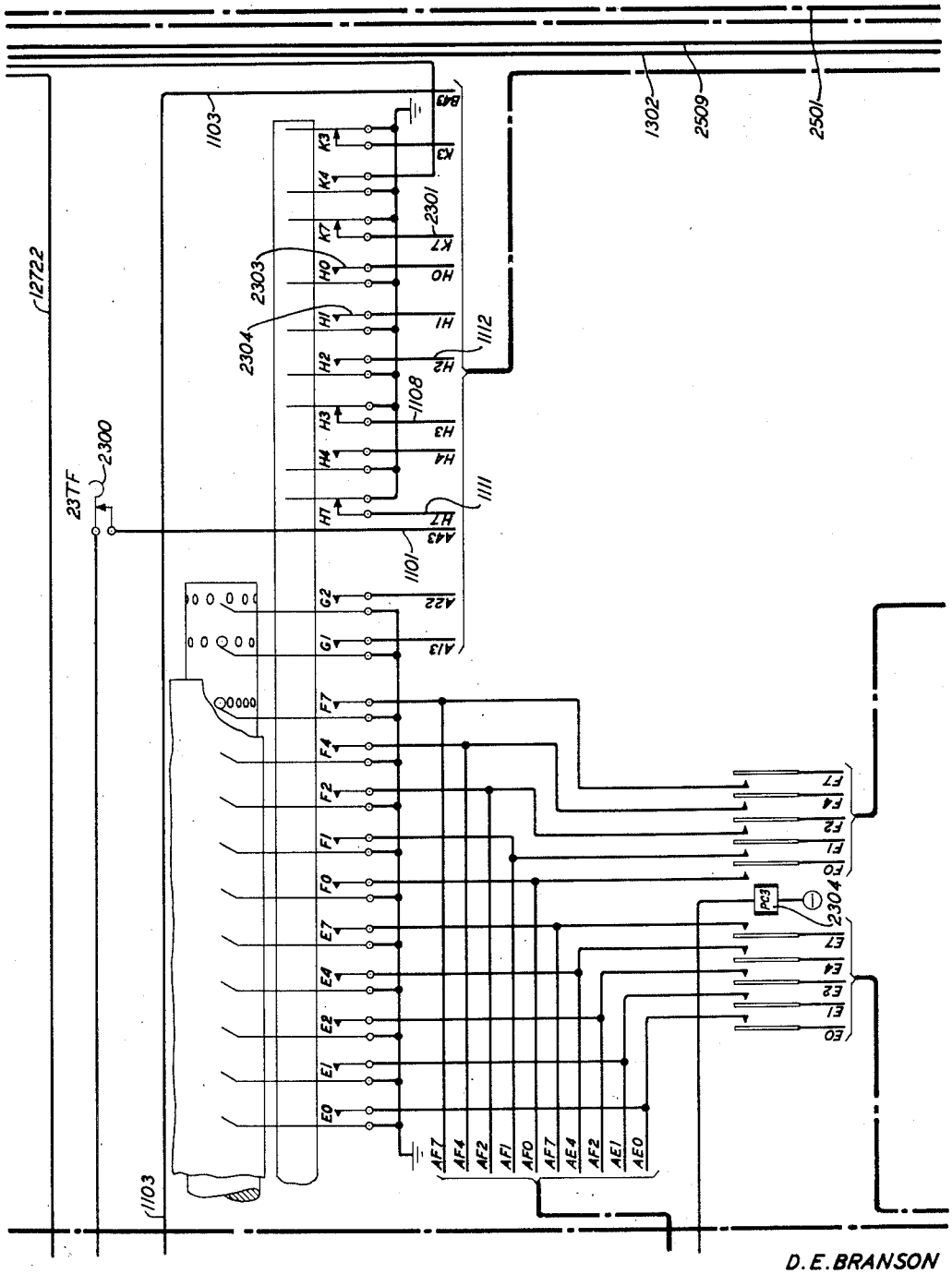

FIG. 23

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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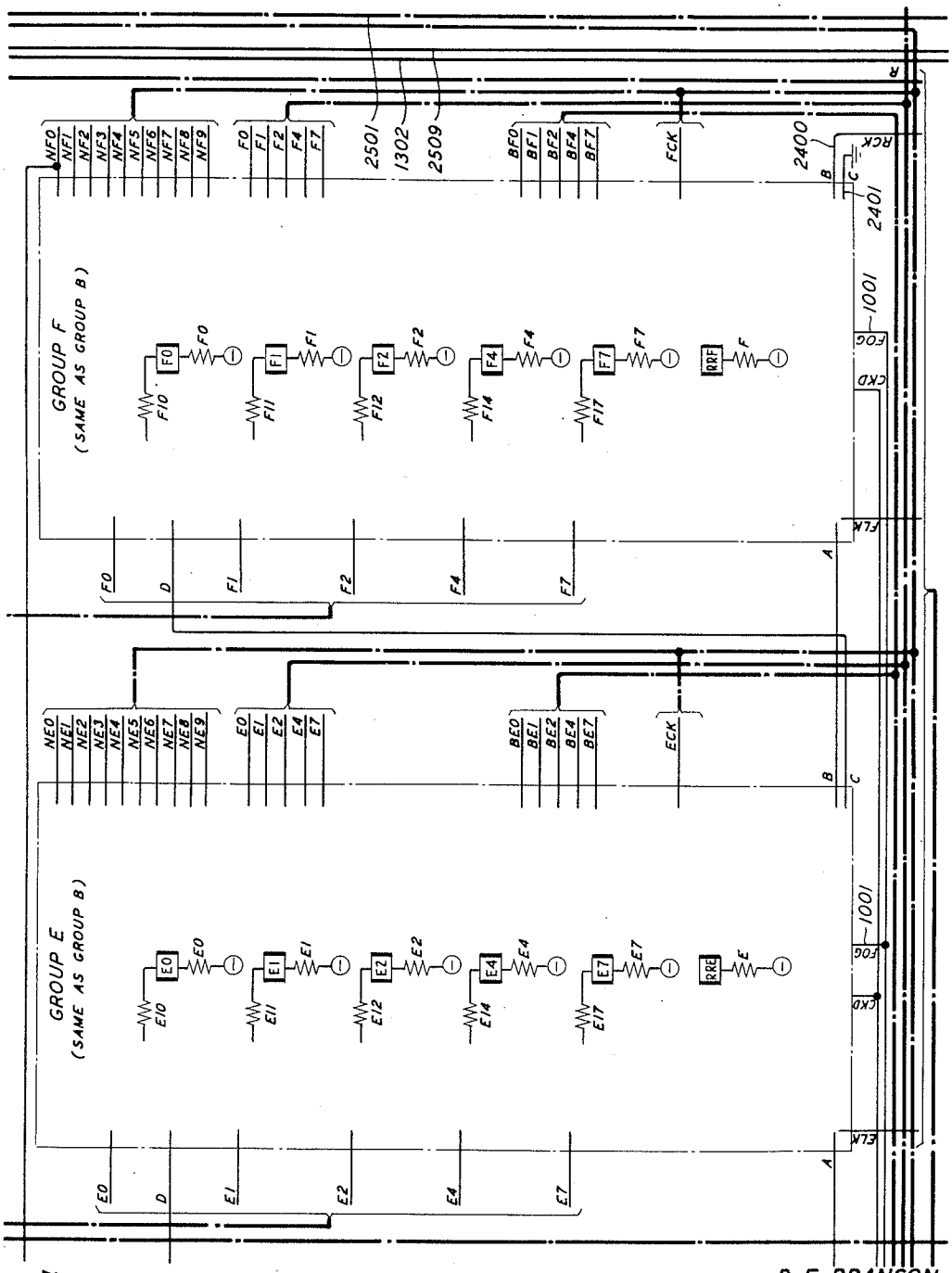

FIG. 24

INVENTORS D. E. BRANSON
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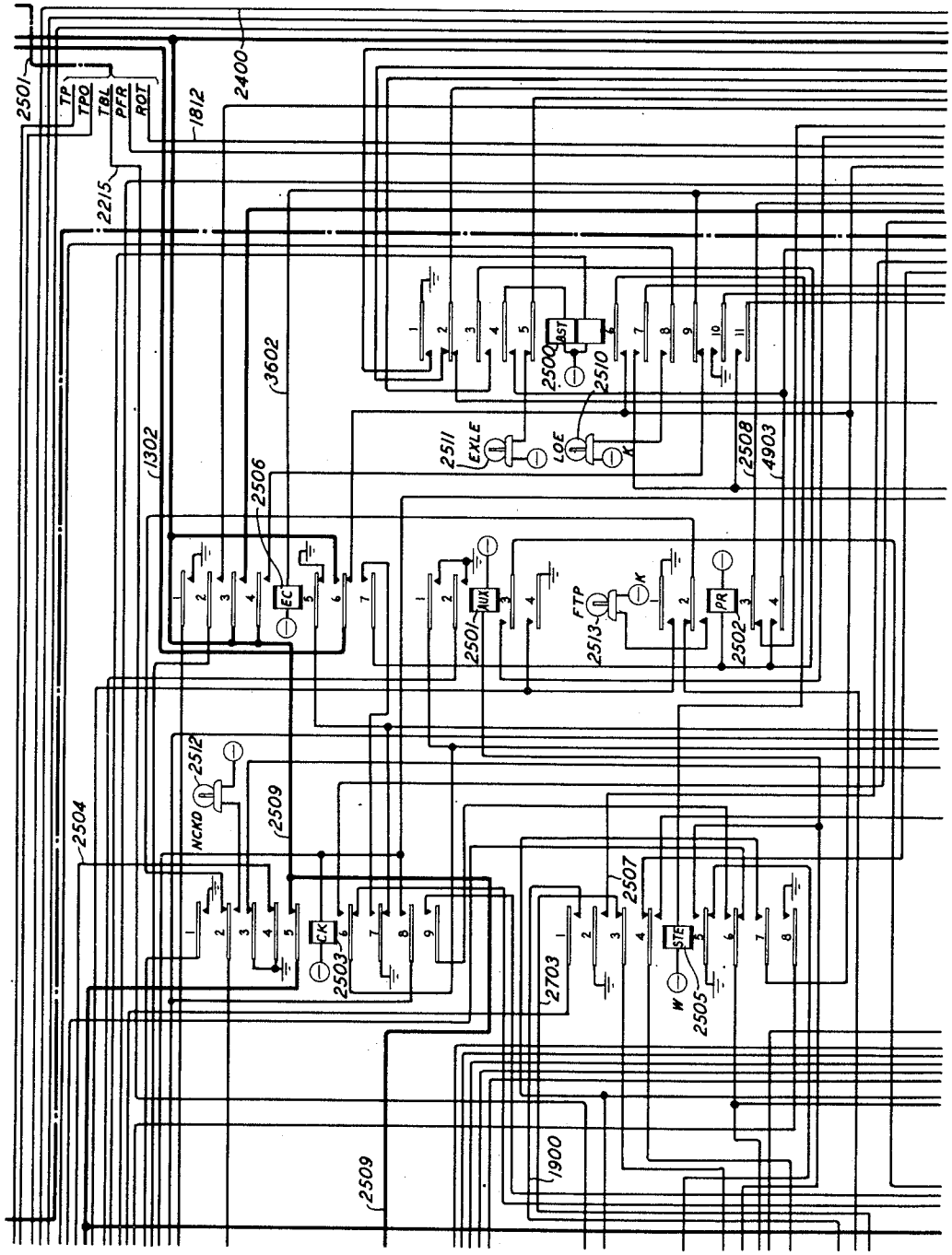

FIG. 25

INVENTORS D. E. BRANSON
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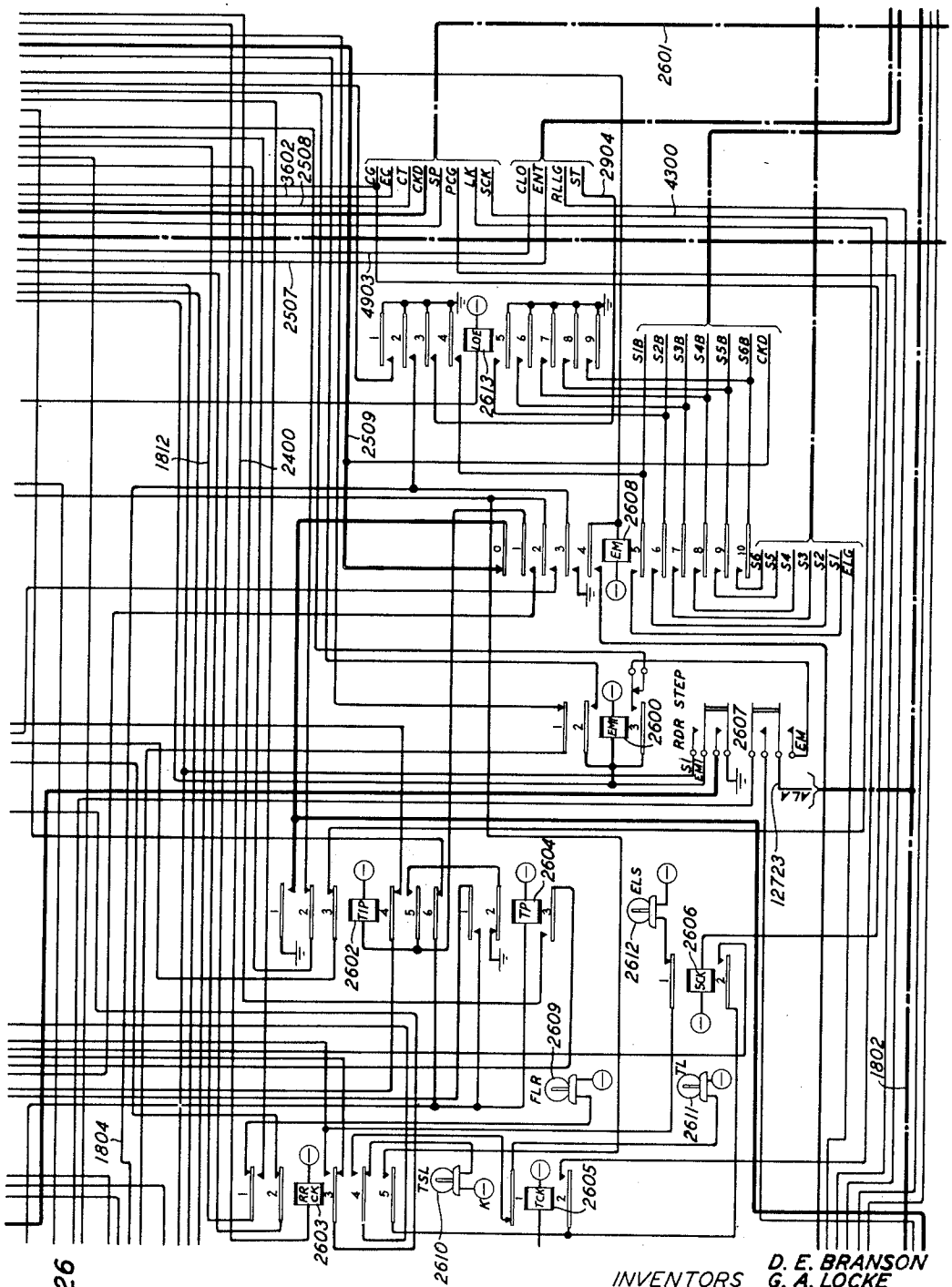

FIG. 26

INVENTORS D. E. BRANSON
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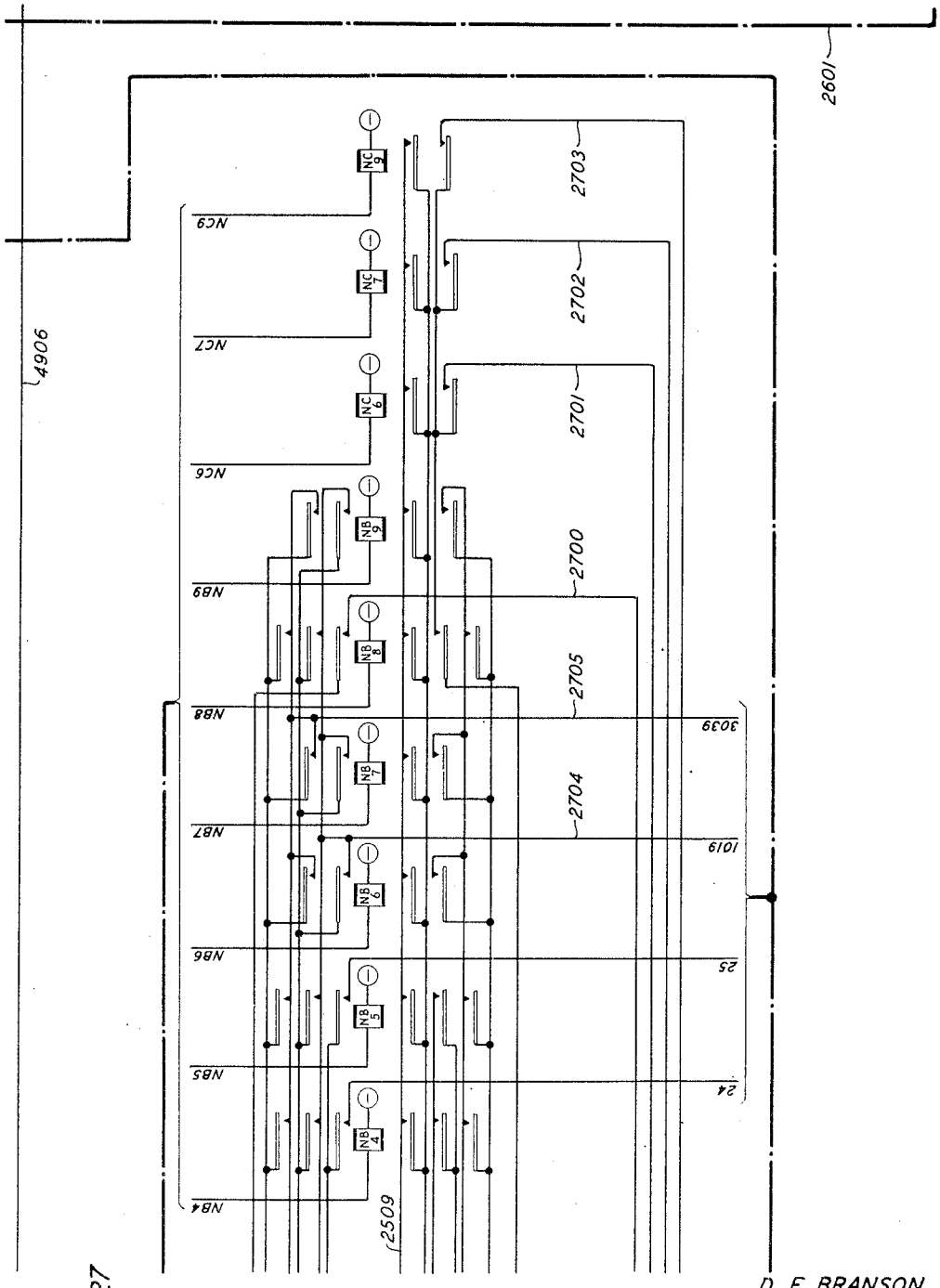

FIG. 27

INVENTORS D. E. BRANSON
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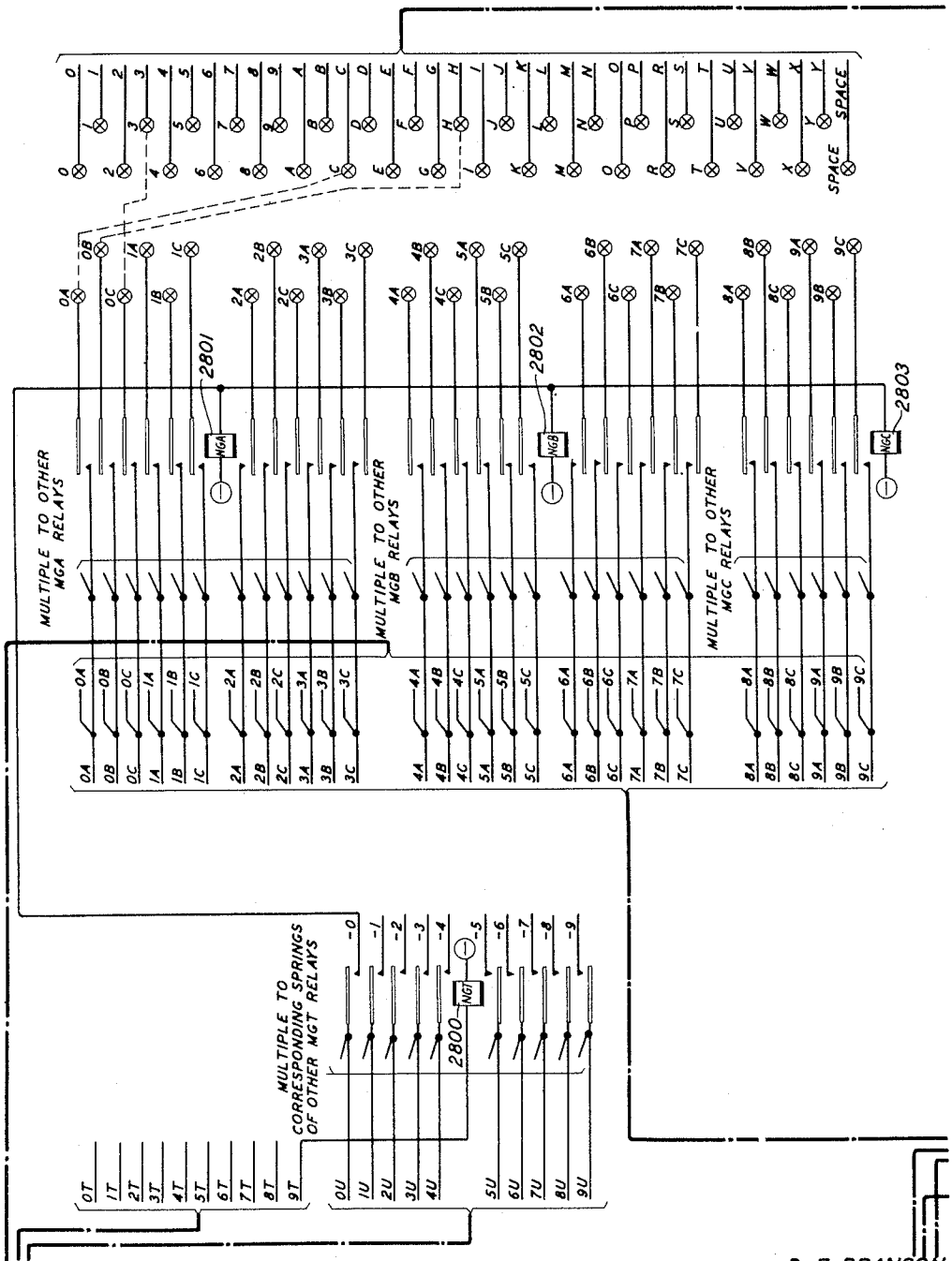

FIG. 28

INVENTORS D. E. BRANSON
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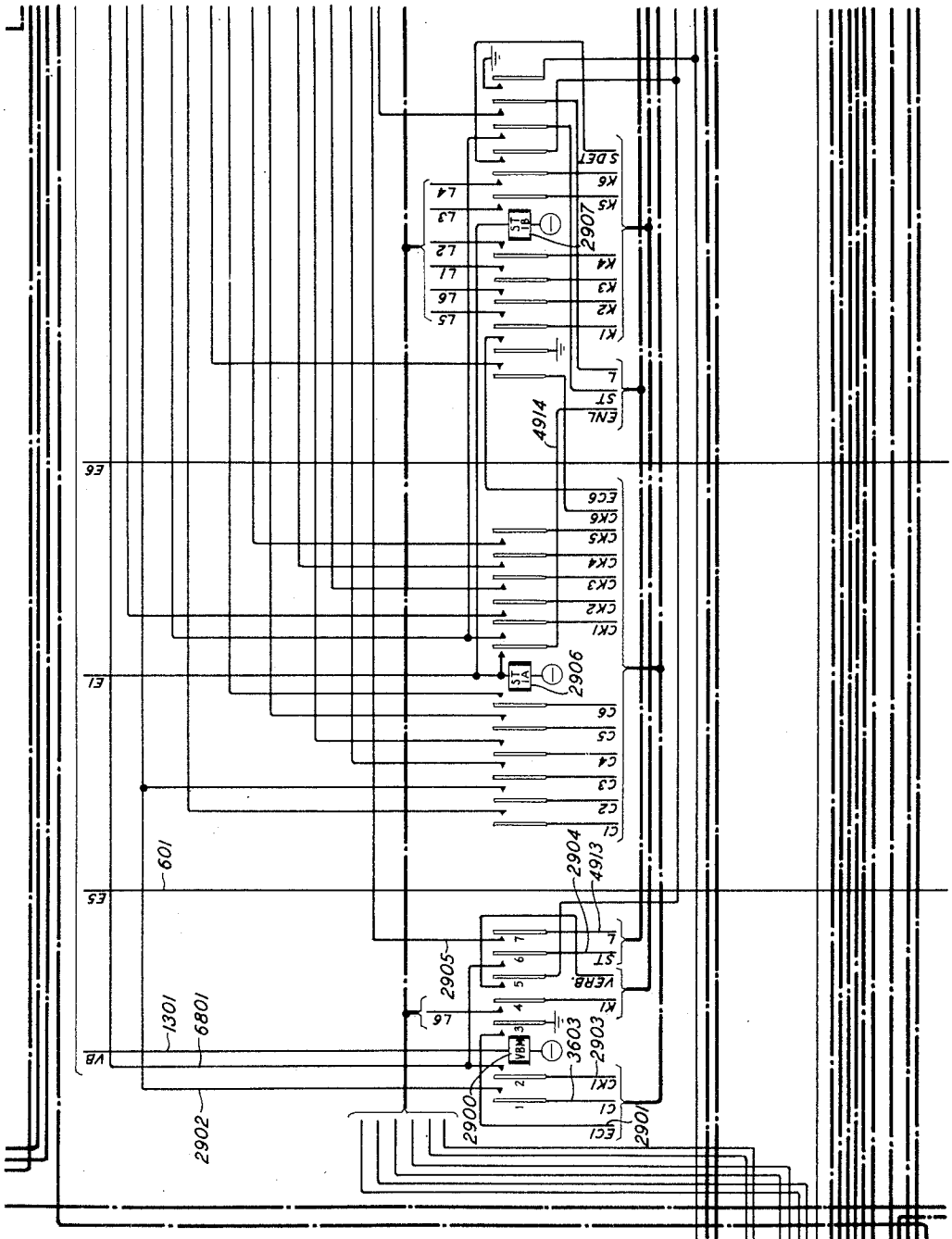

FIG. 29

INVENTORS D. E. BRANSON
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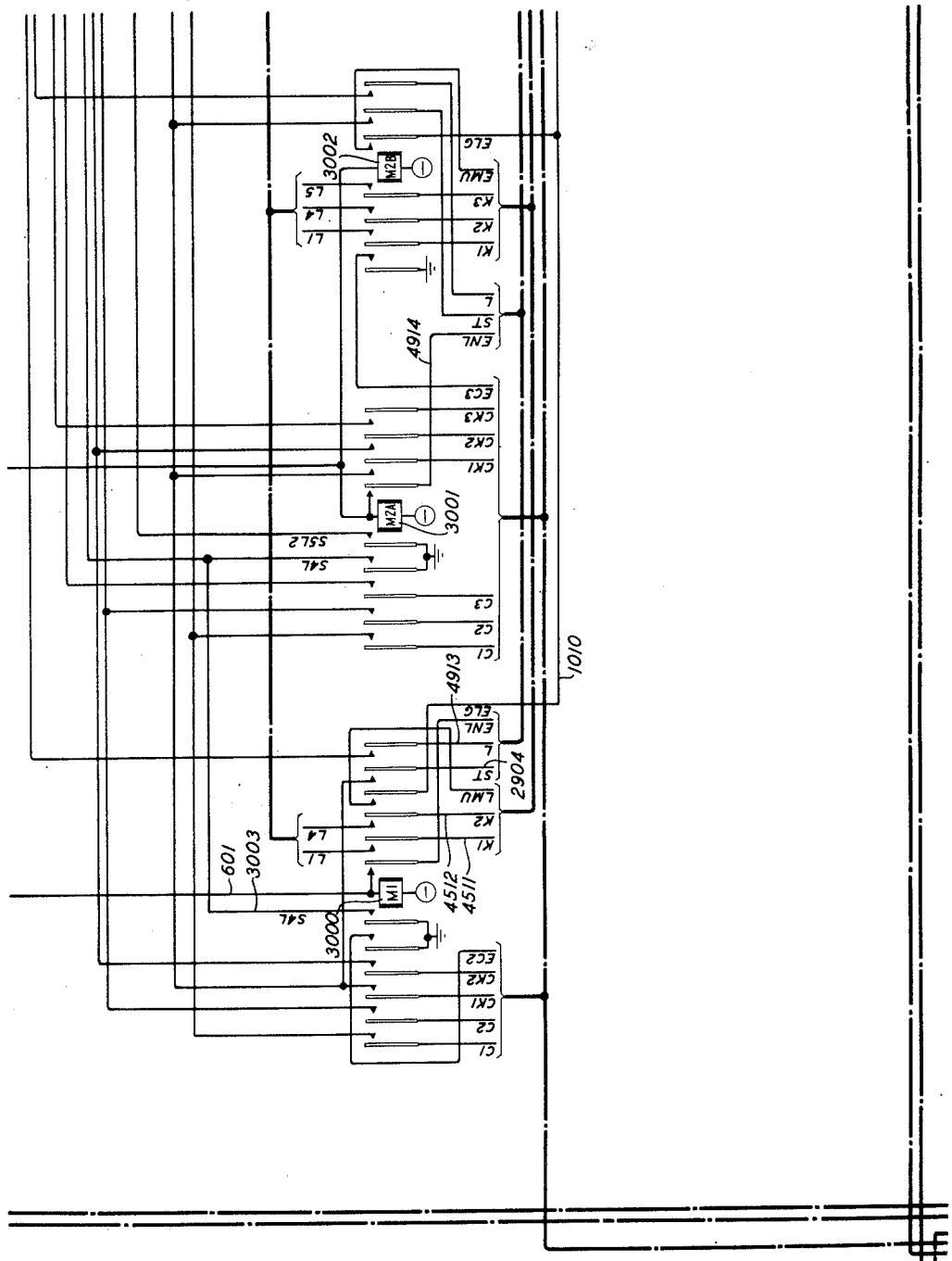

FIG. 30

INVENTORS D. E. BRANSON
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Filed Jan. 21, 1949 136 Sheets-Sheet 32

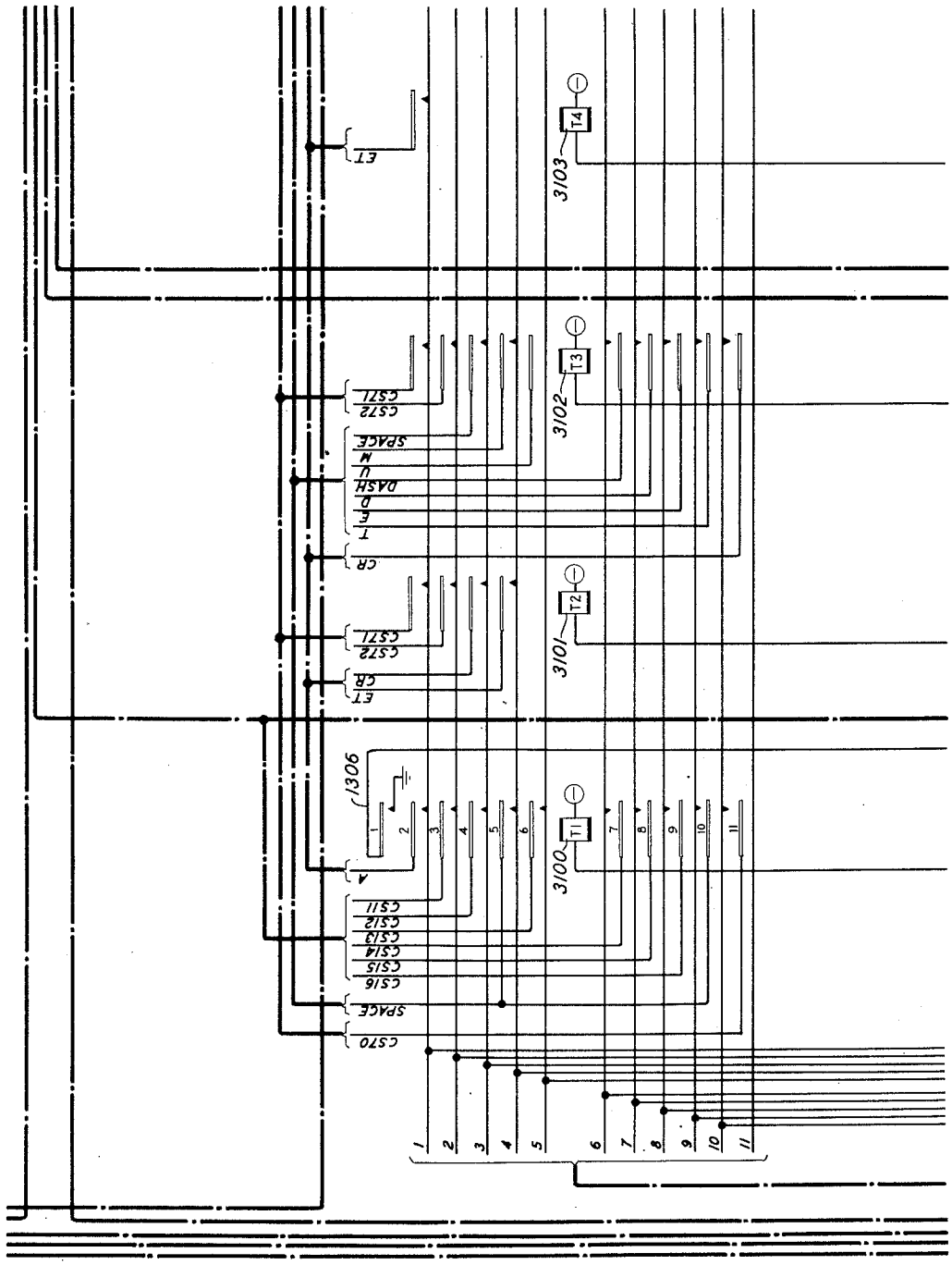

FIG. 31

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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Filed Jan. 21, 1949 136 Sheets-Sheet 33

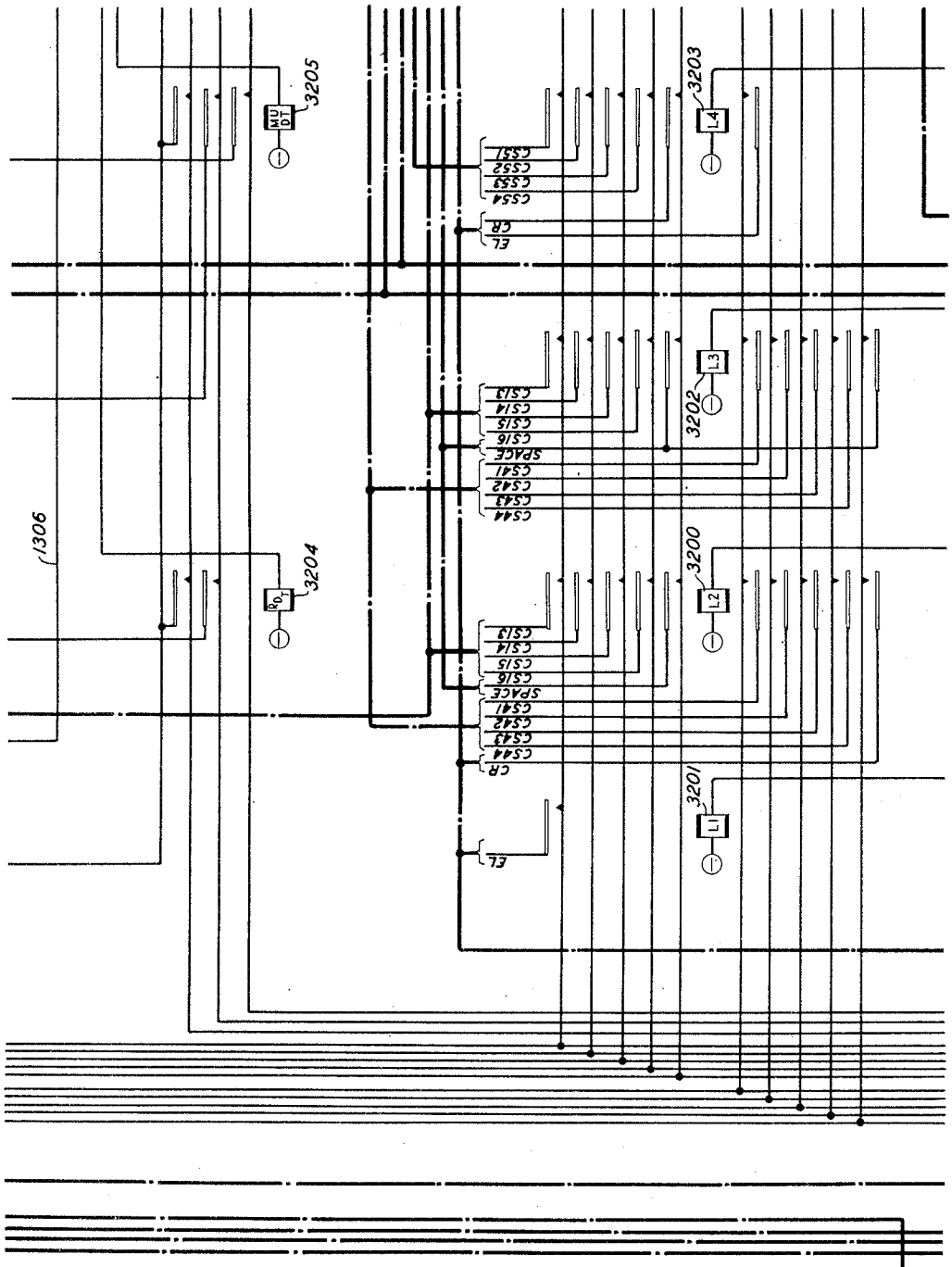

FIG. 32

INVENTORS D. E. BRANSON
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Filed Jan. 21, 1949 136 Sheets-Sheet 34

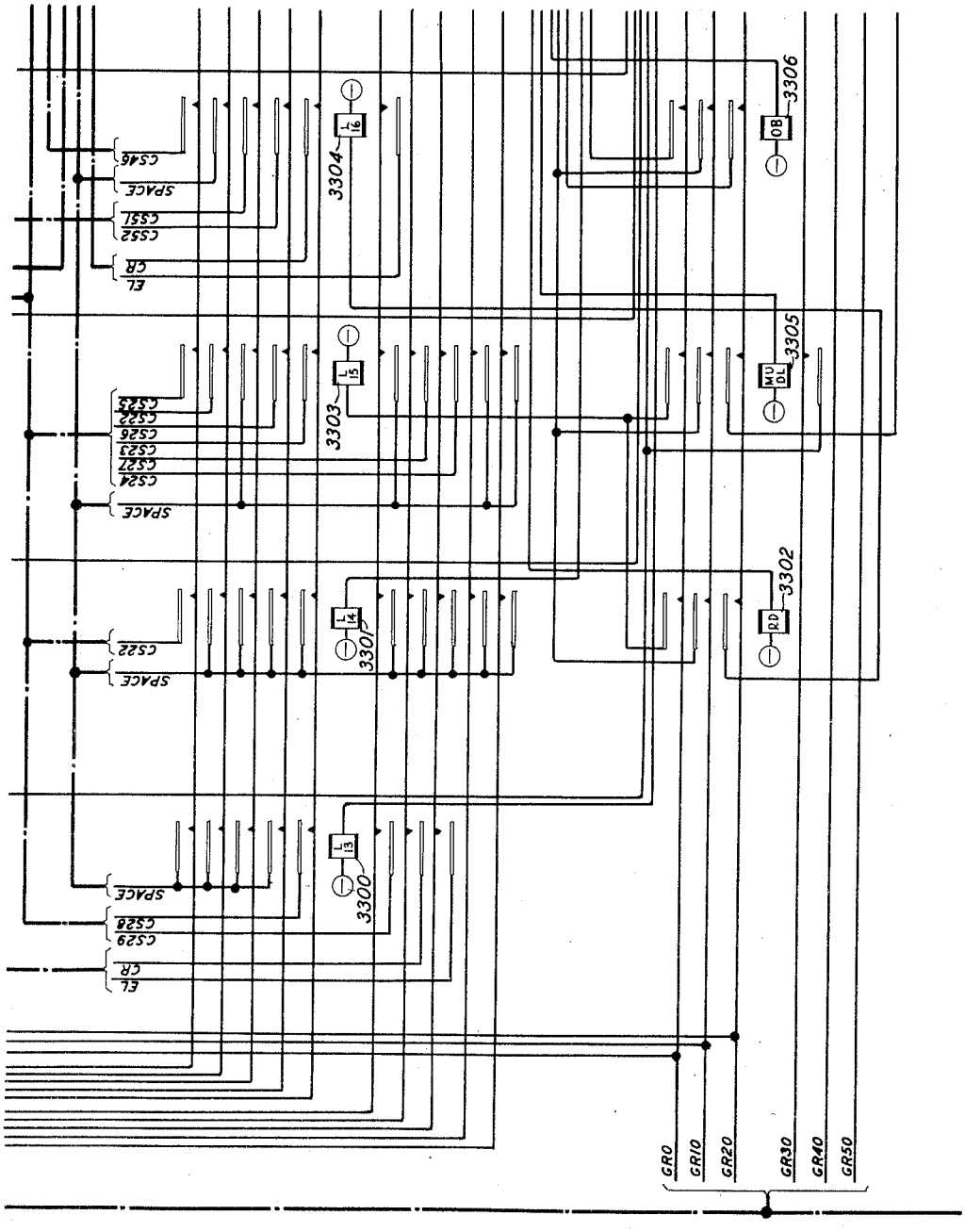

FIG. 33

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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Filed Jan. 21, 1949 136 Sheets-Sheet 35

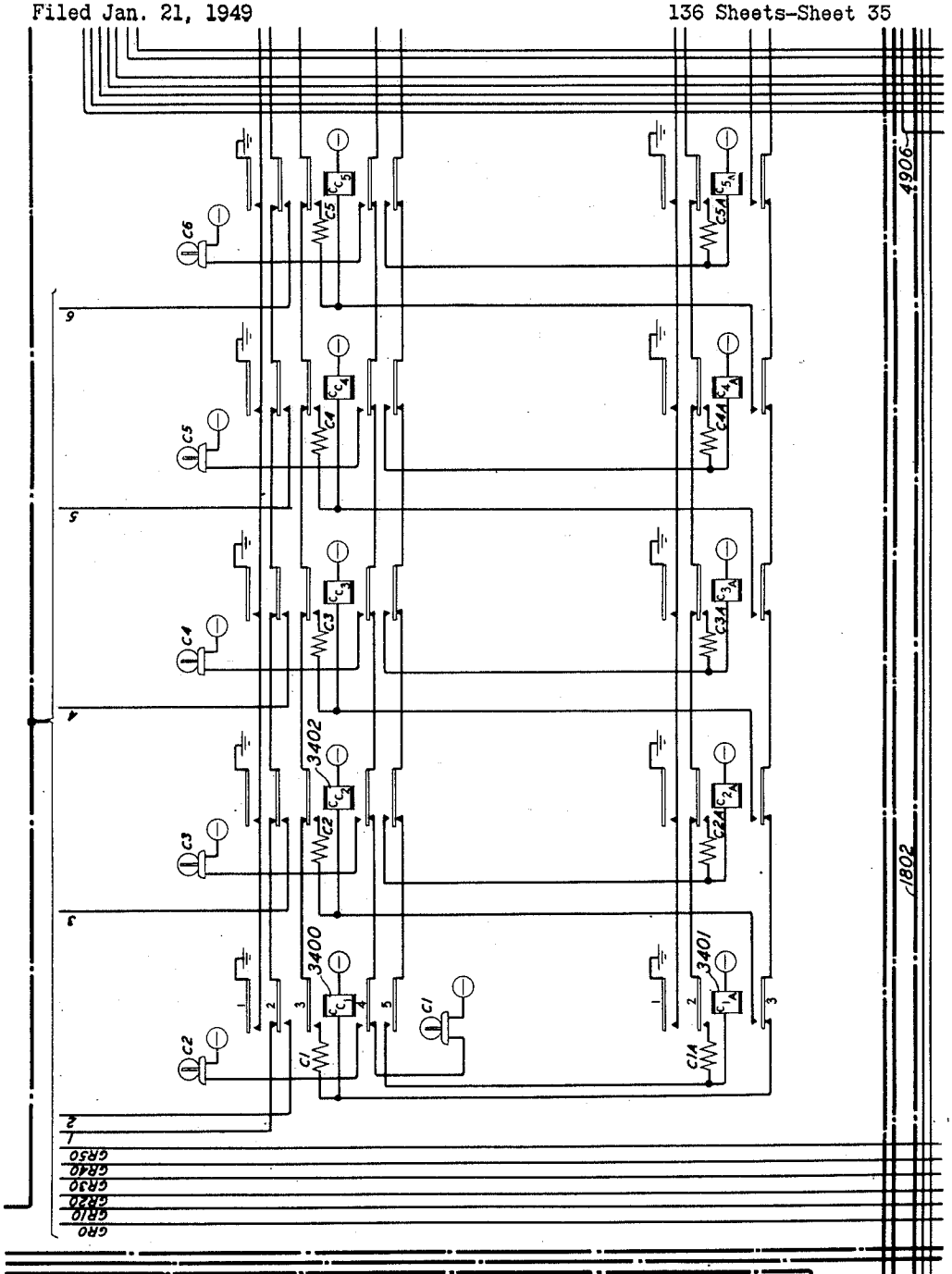

FIG. 34

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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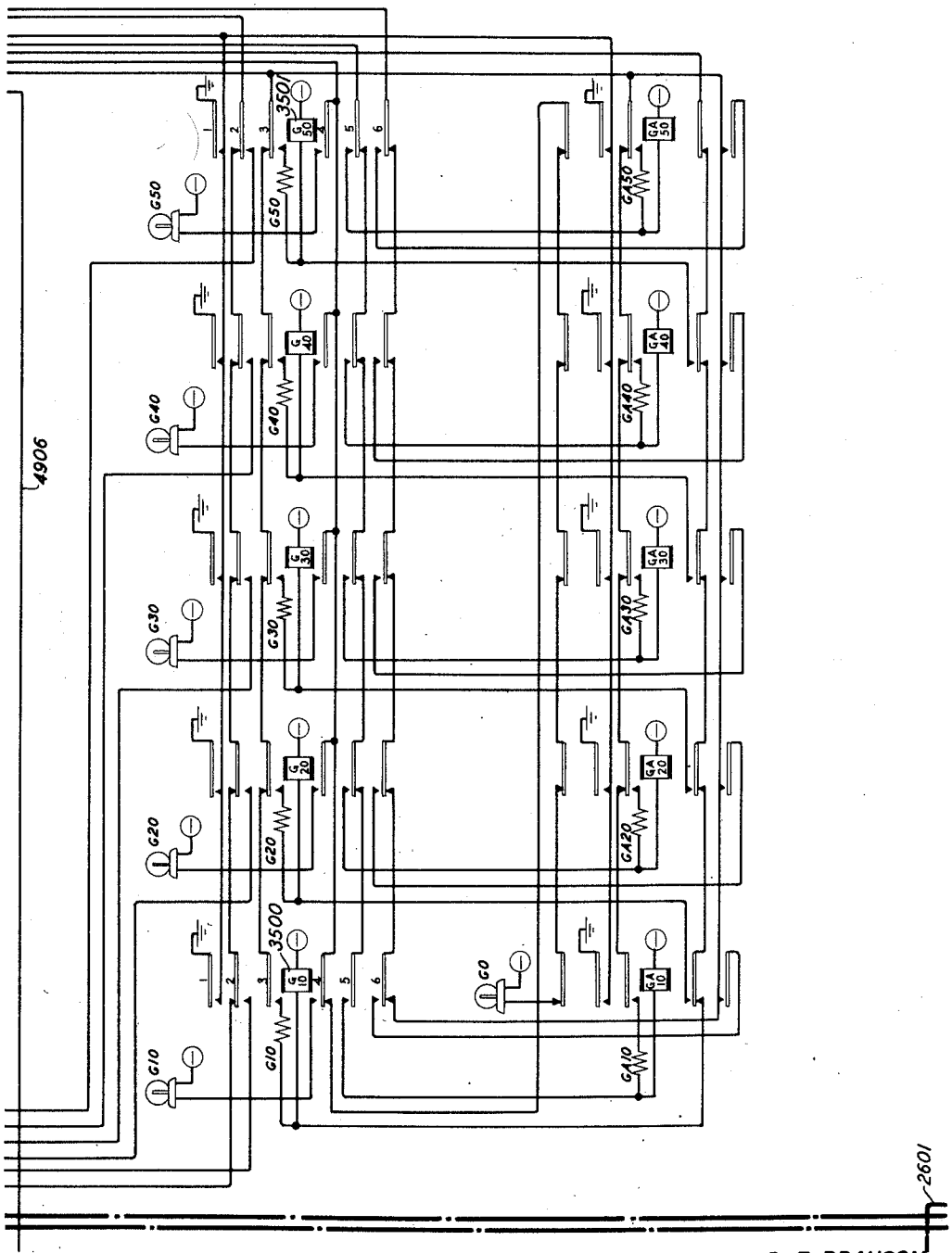

FIG. 35

INVENTORS D. E. BRANSON
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Filed Jan. 21, 1949 136 Sheets-Sheet 37

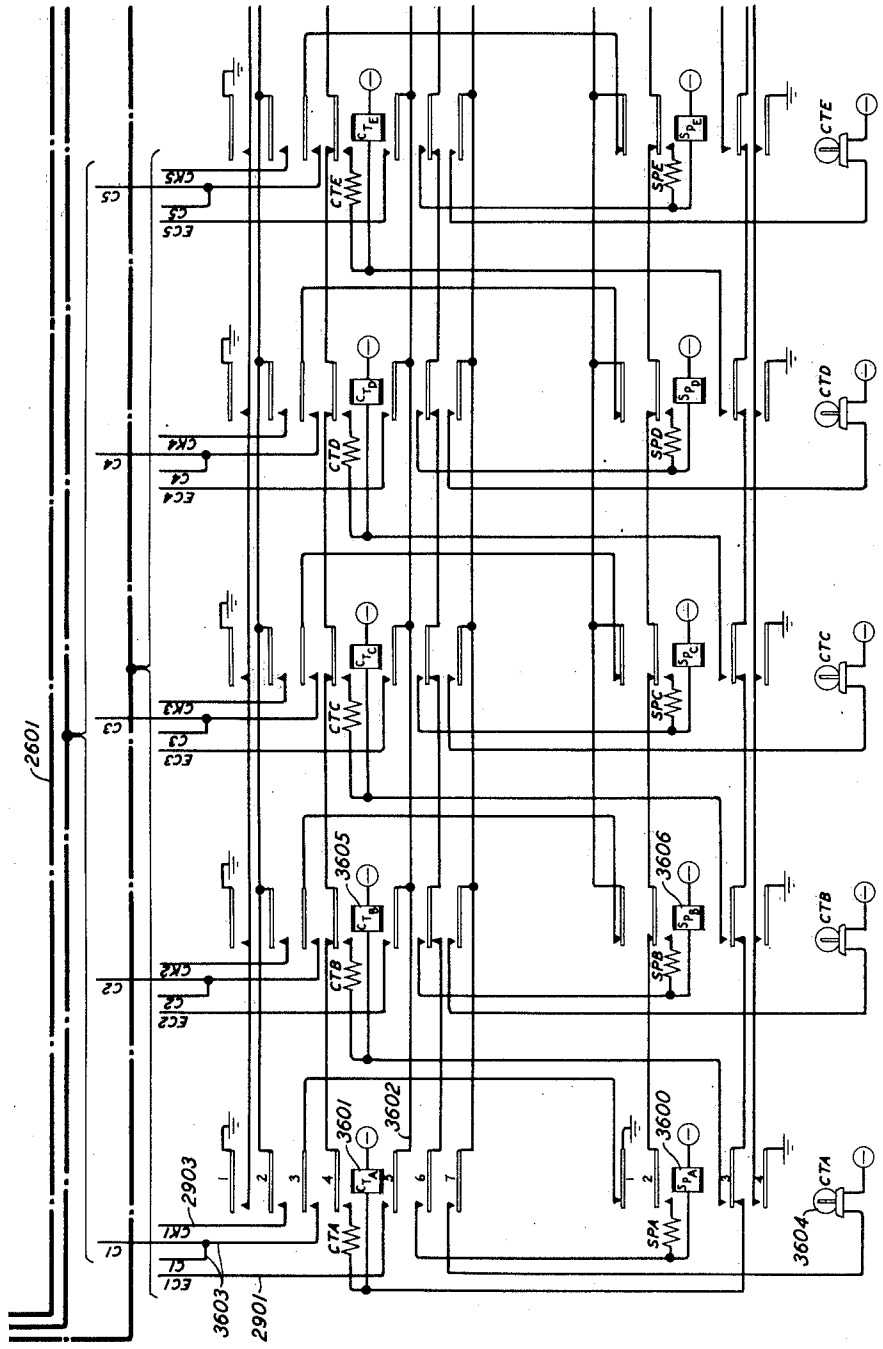

FIG. 36

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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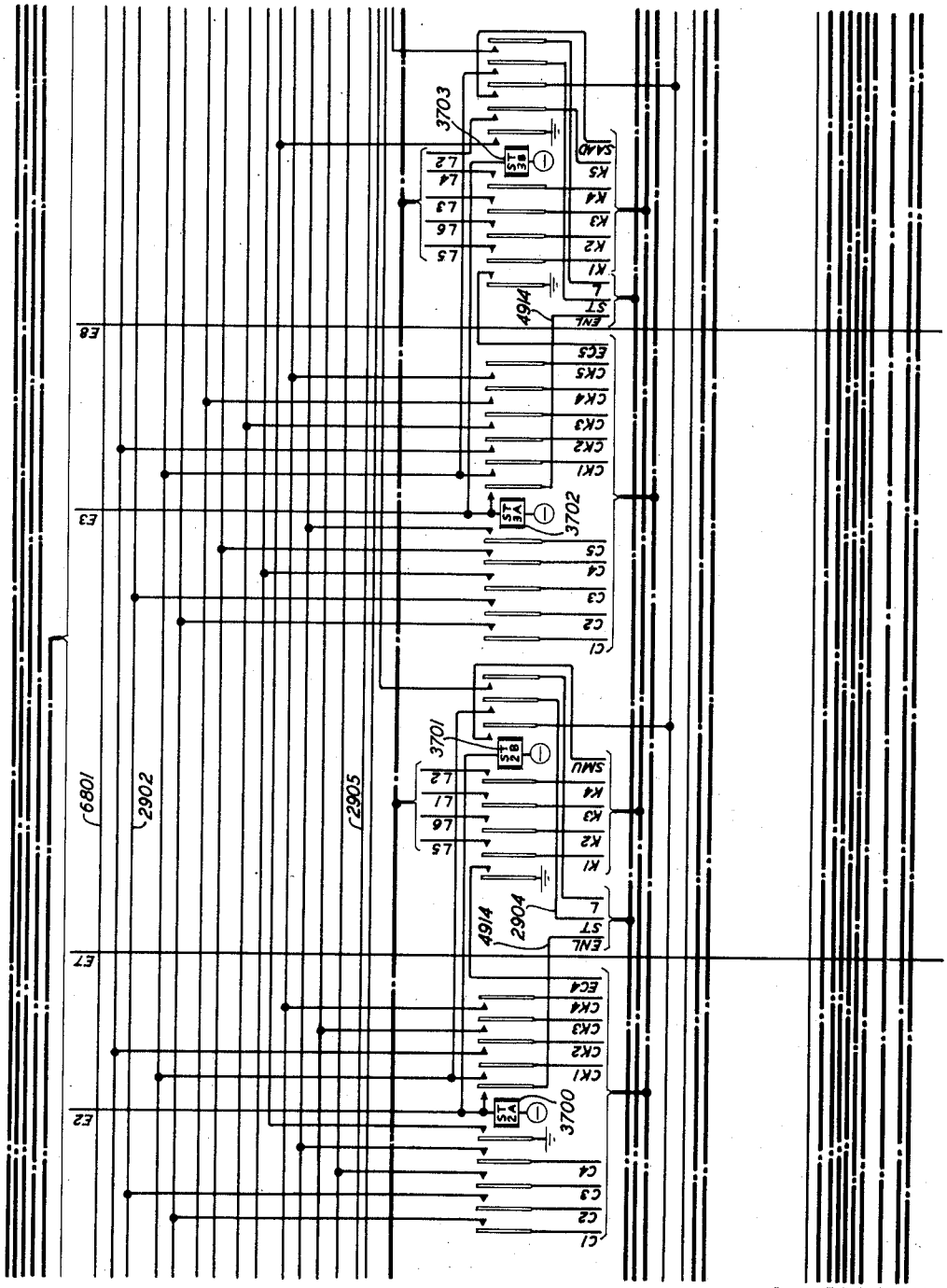

FIG. 37

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 39

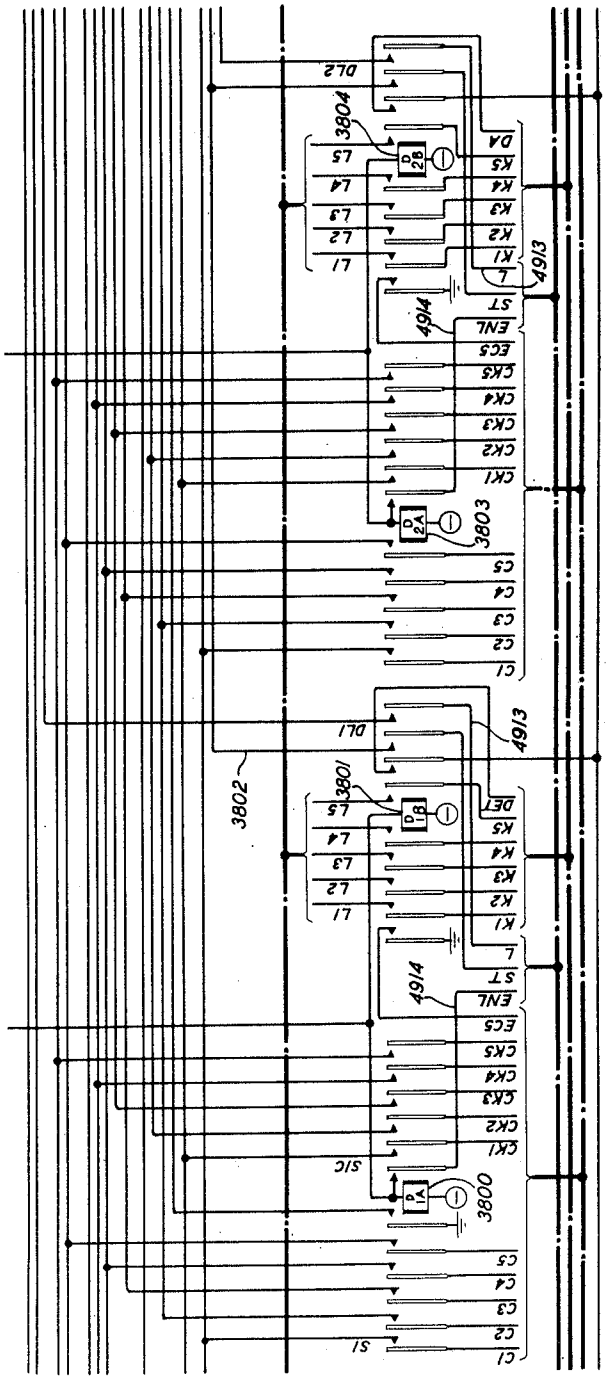

FIG. 38

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

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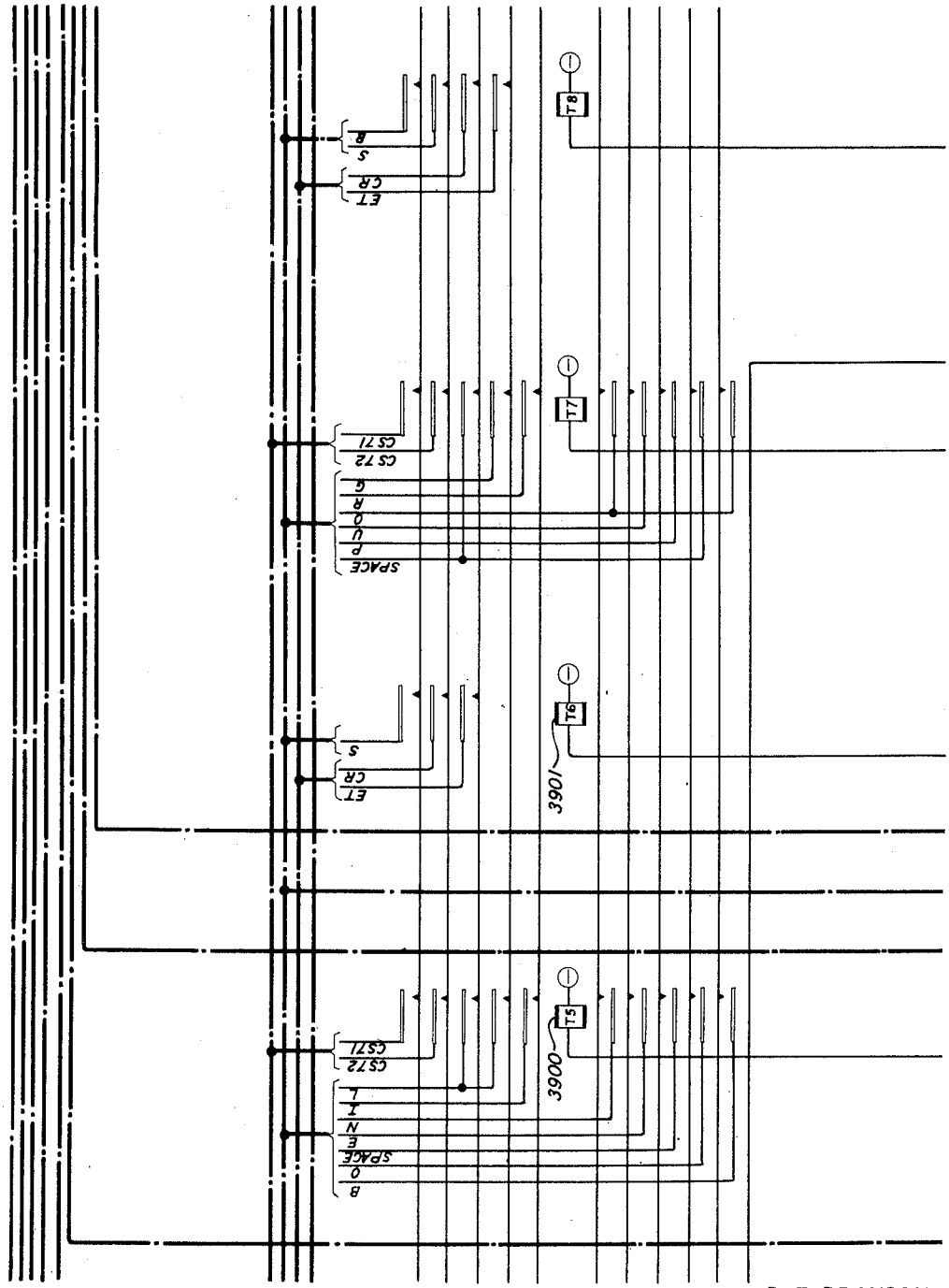

FIG. 39

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 41

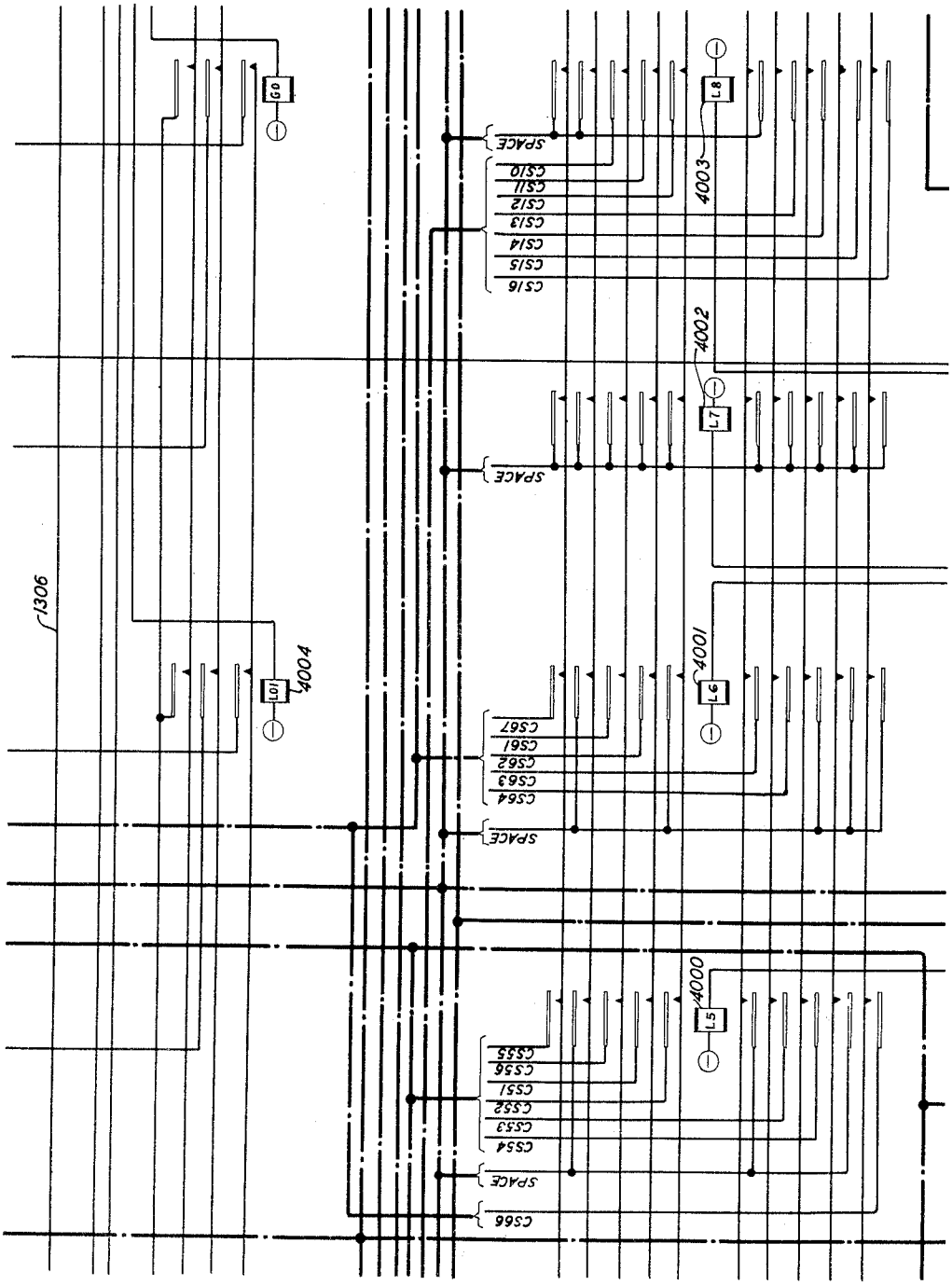

FIG. 40

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

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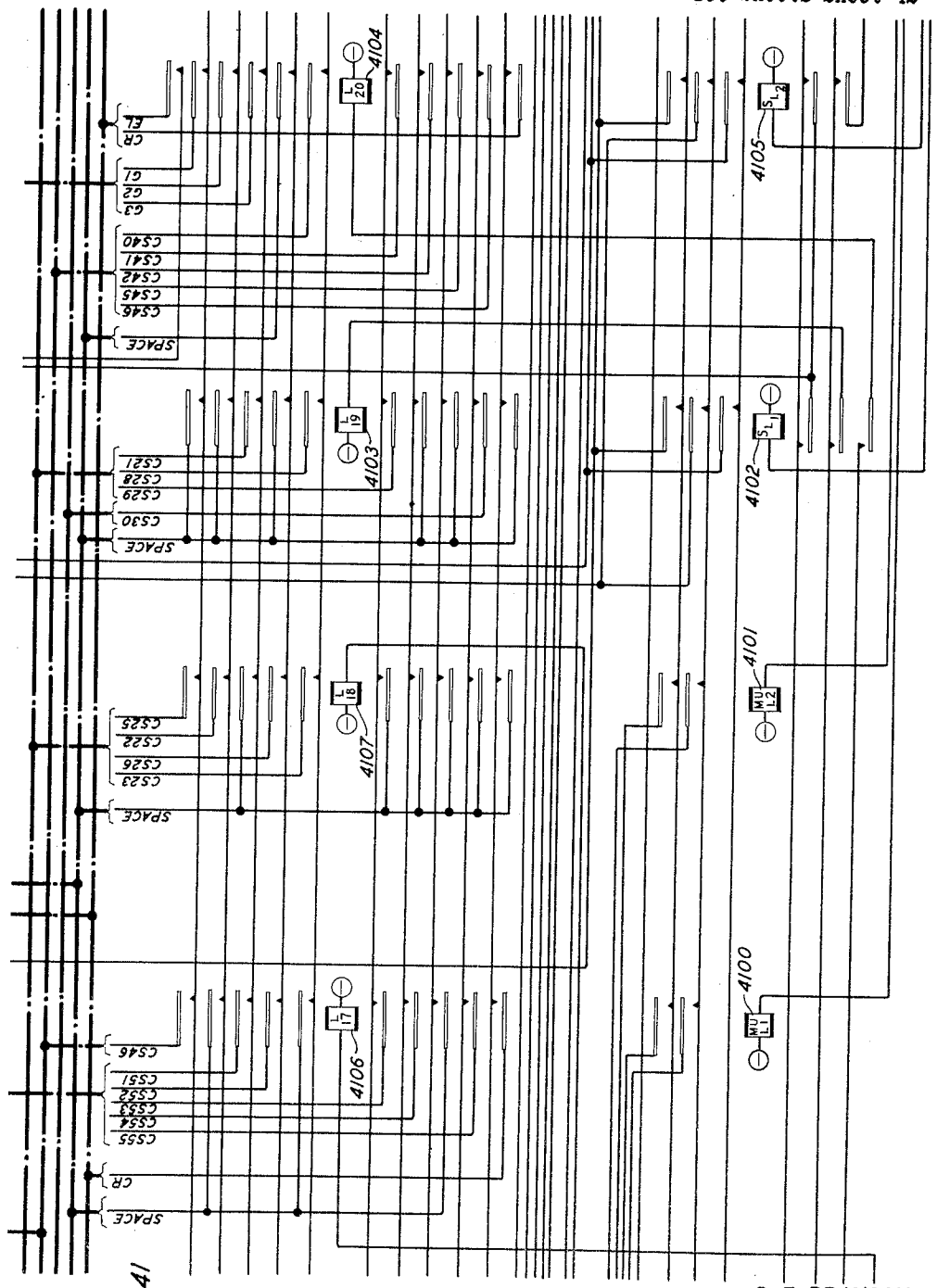

FIG. 41

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 43

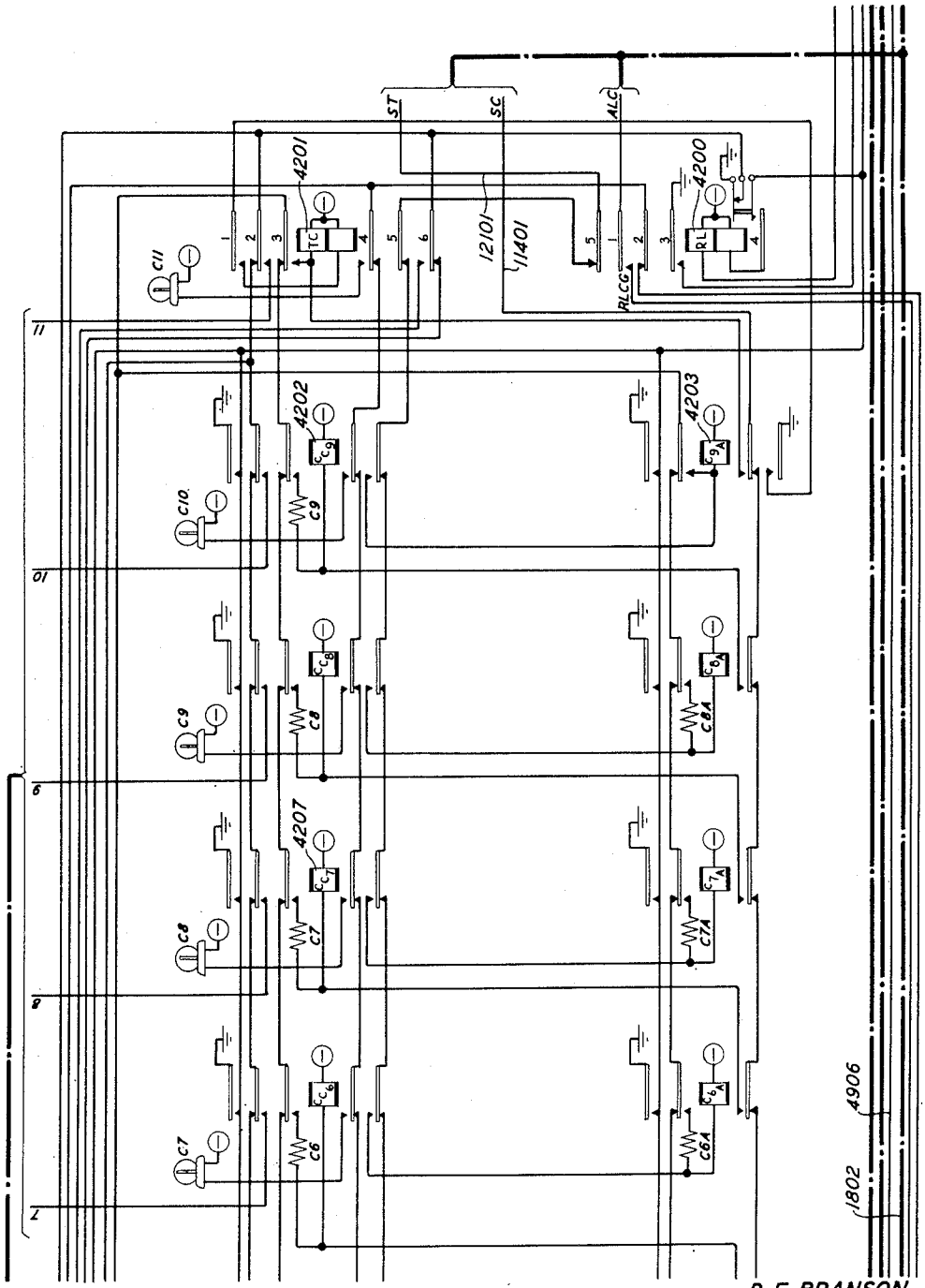

FIG. 42

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 44

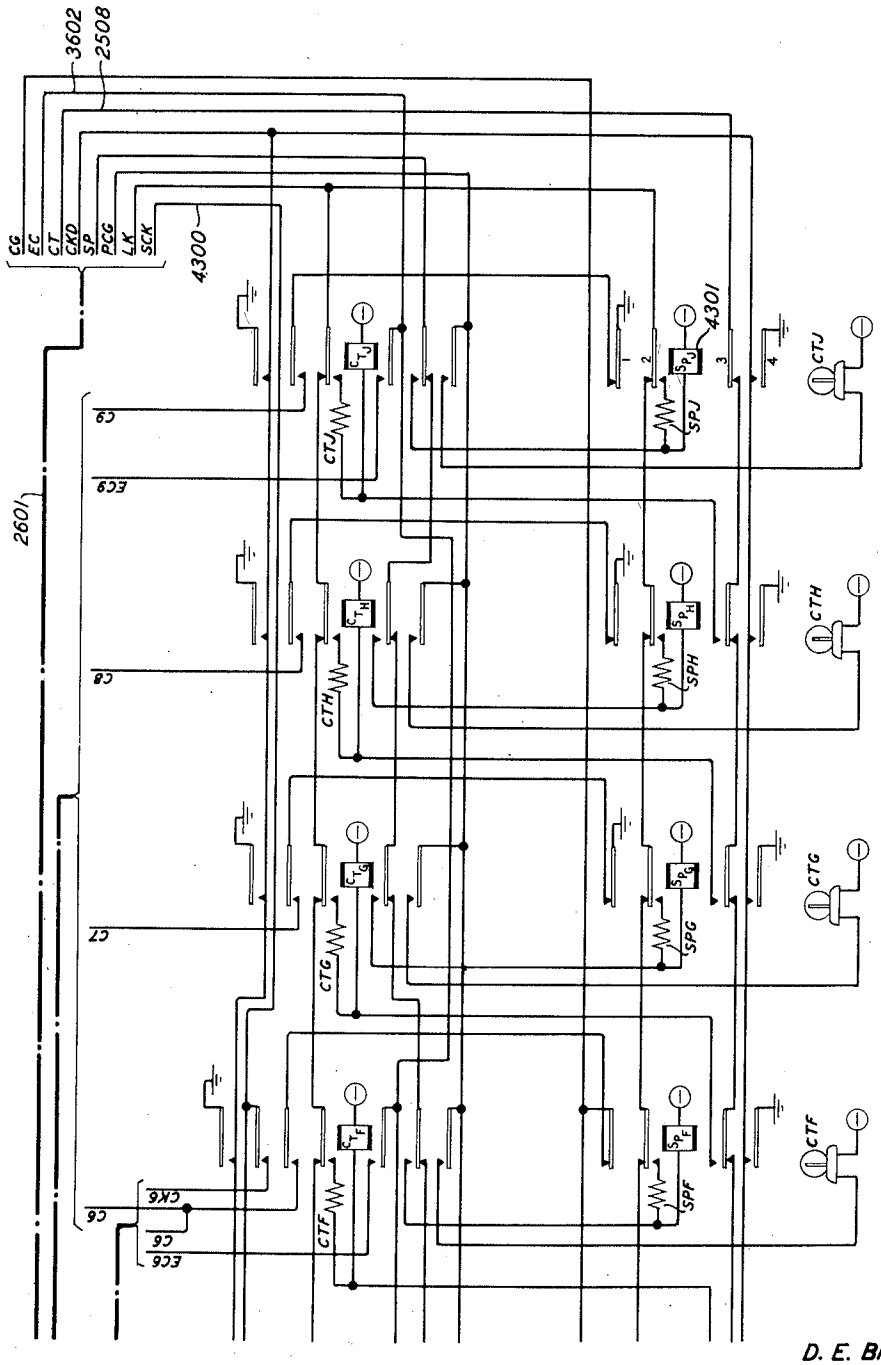

FIG. 43

INVENTORS D. E. BRANSON
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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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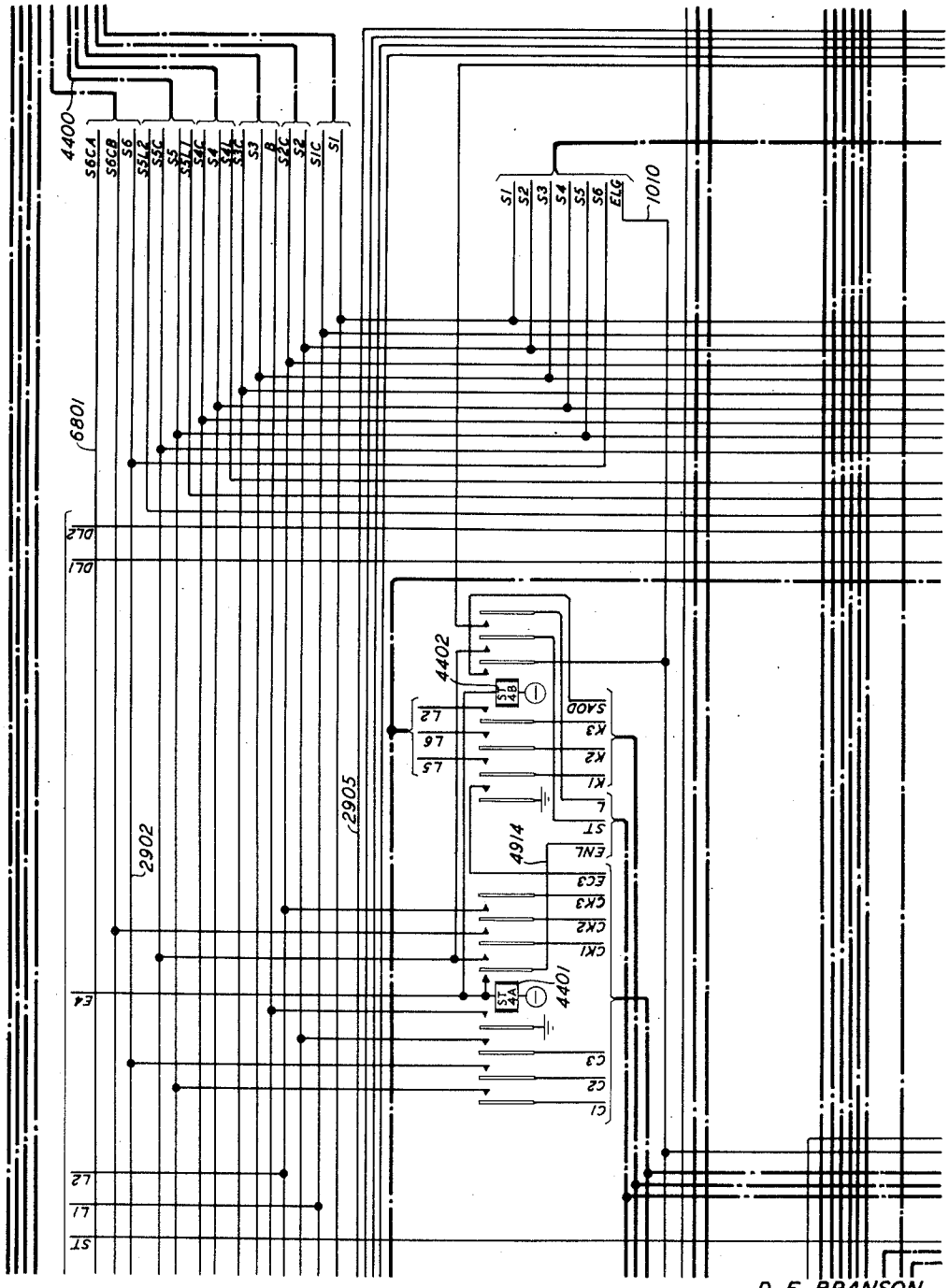

FIG. 44

INVENTORS D. E. BRANSON
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BY John A. Hall

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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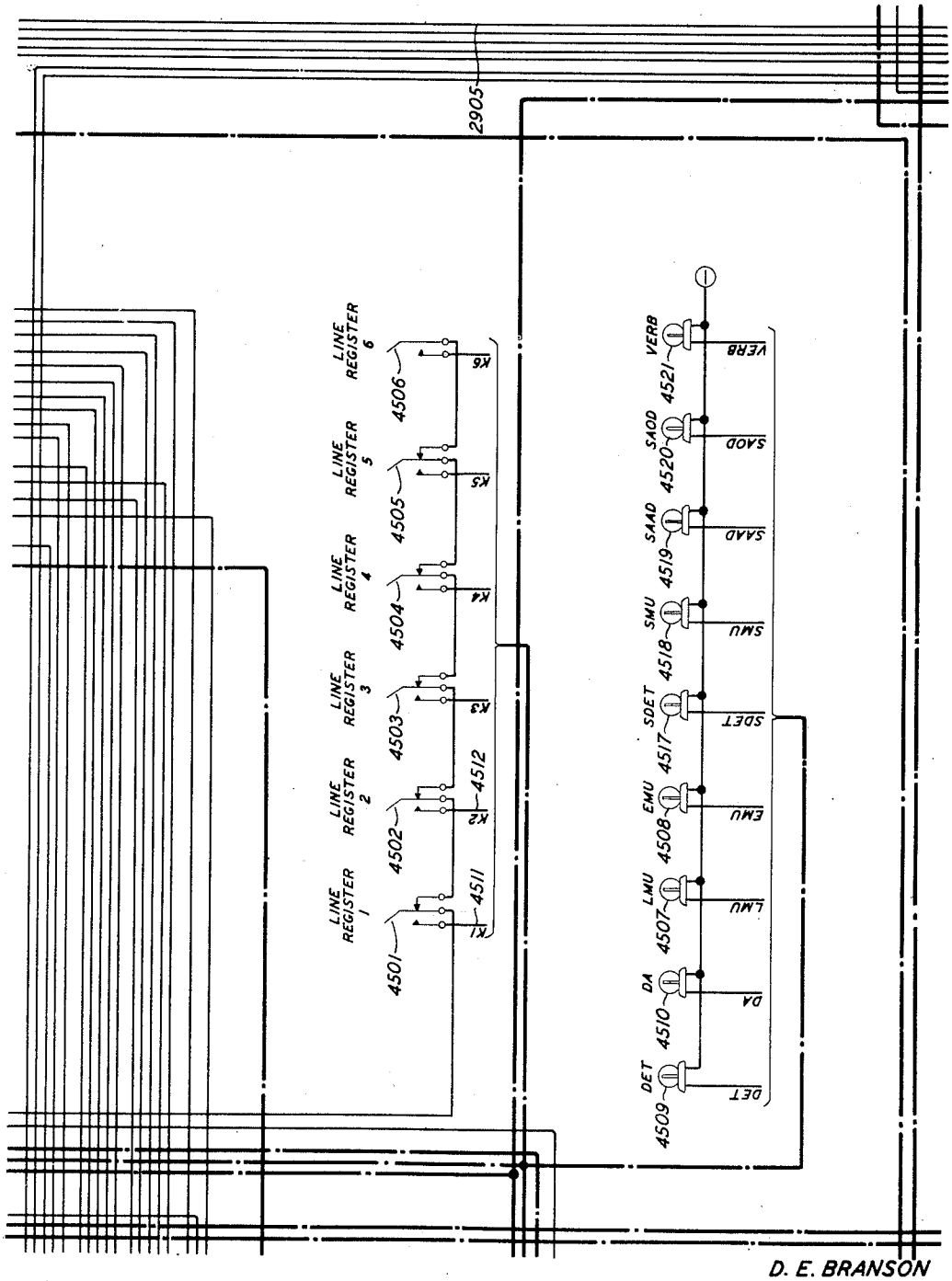

FIG. 45

INVENTORS D. E. BRANSON
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T. A. MARSHALL

BY John A. Hall

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 47

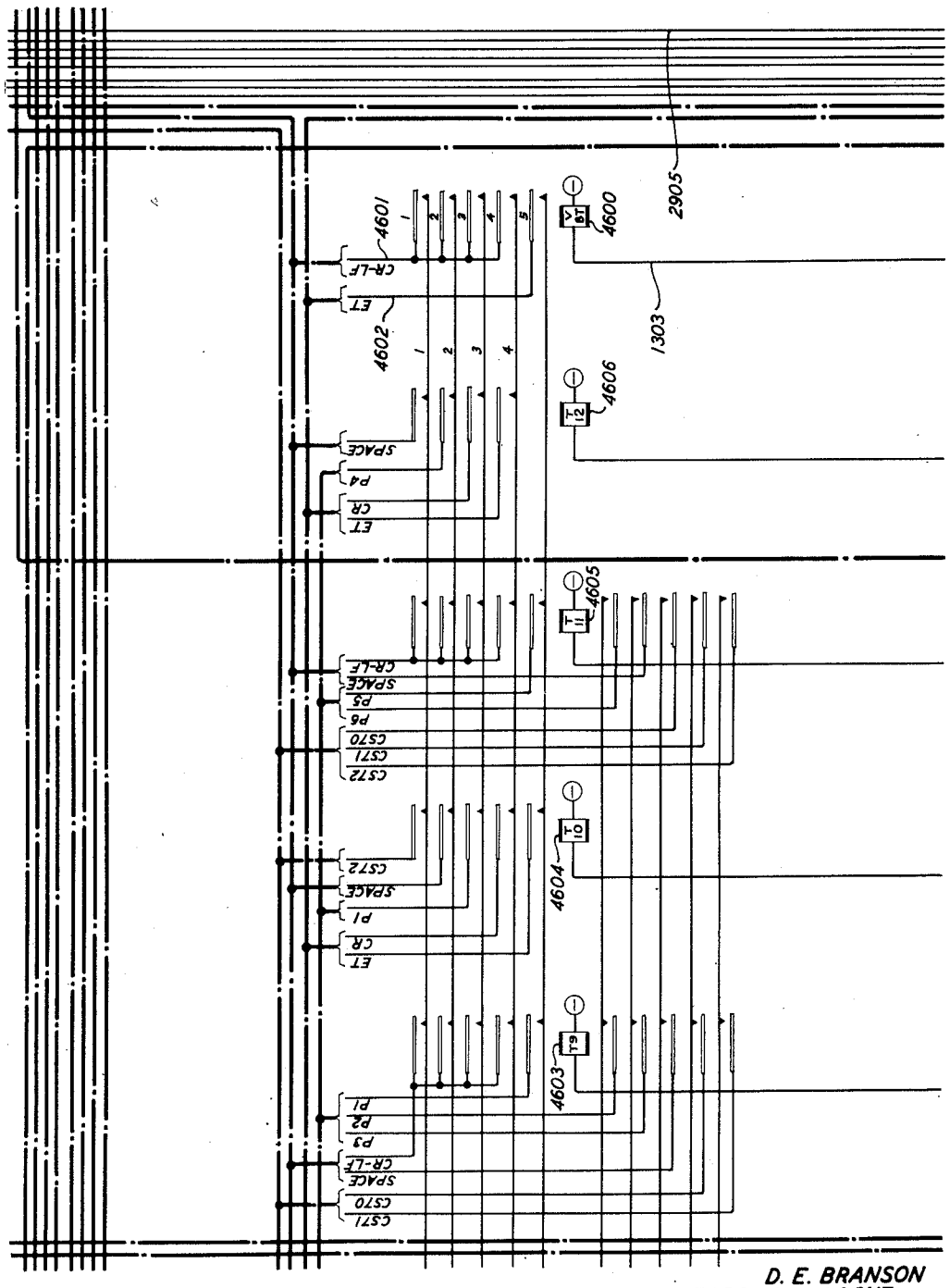

FIG. 46

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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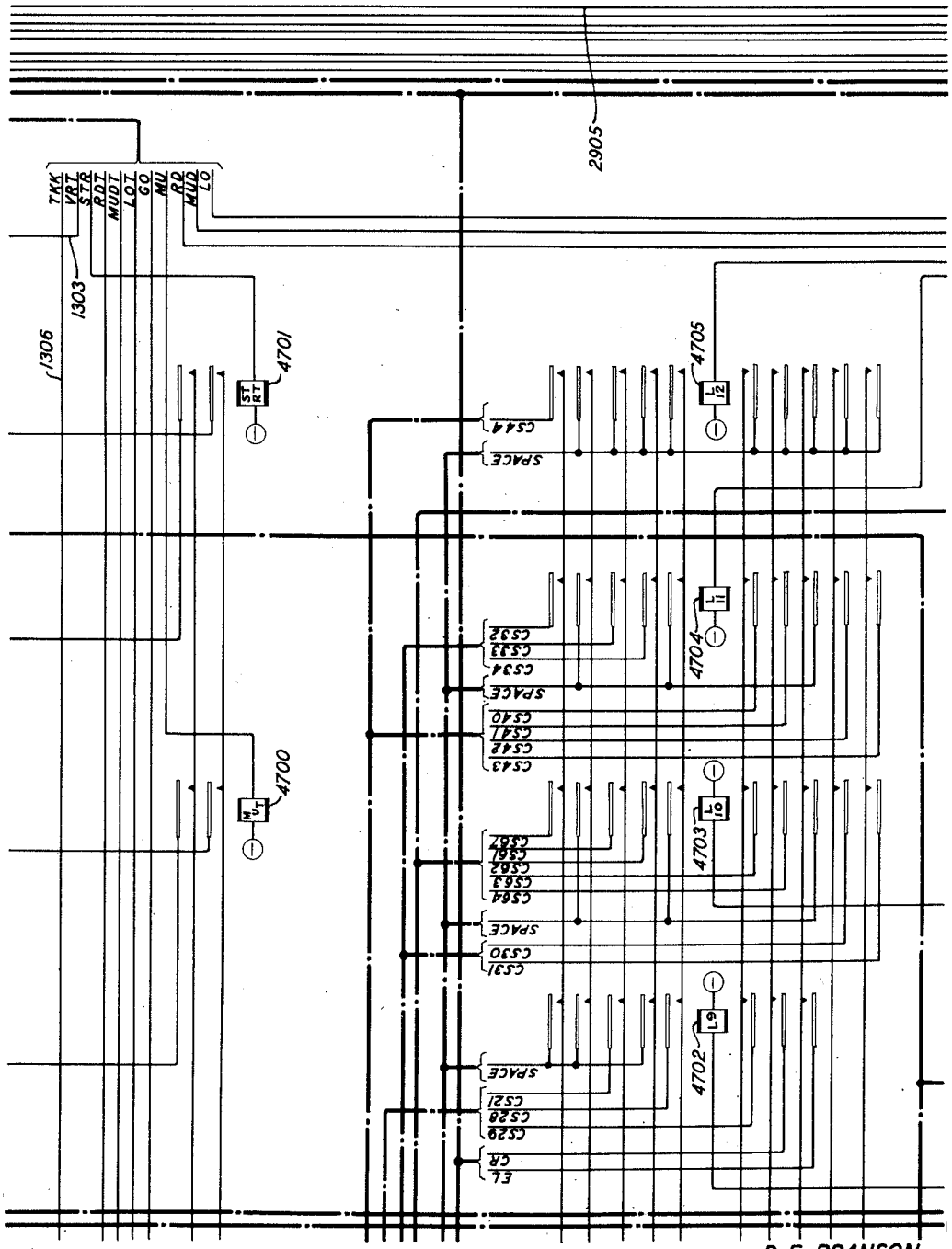

FIG. 47

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 49

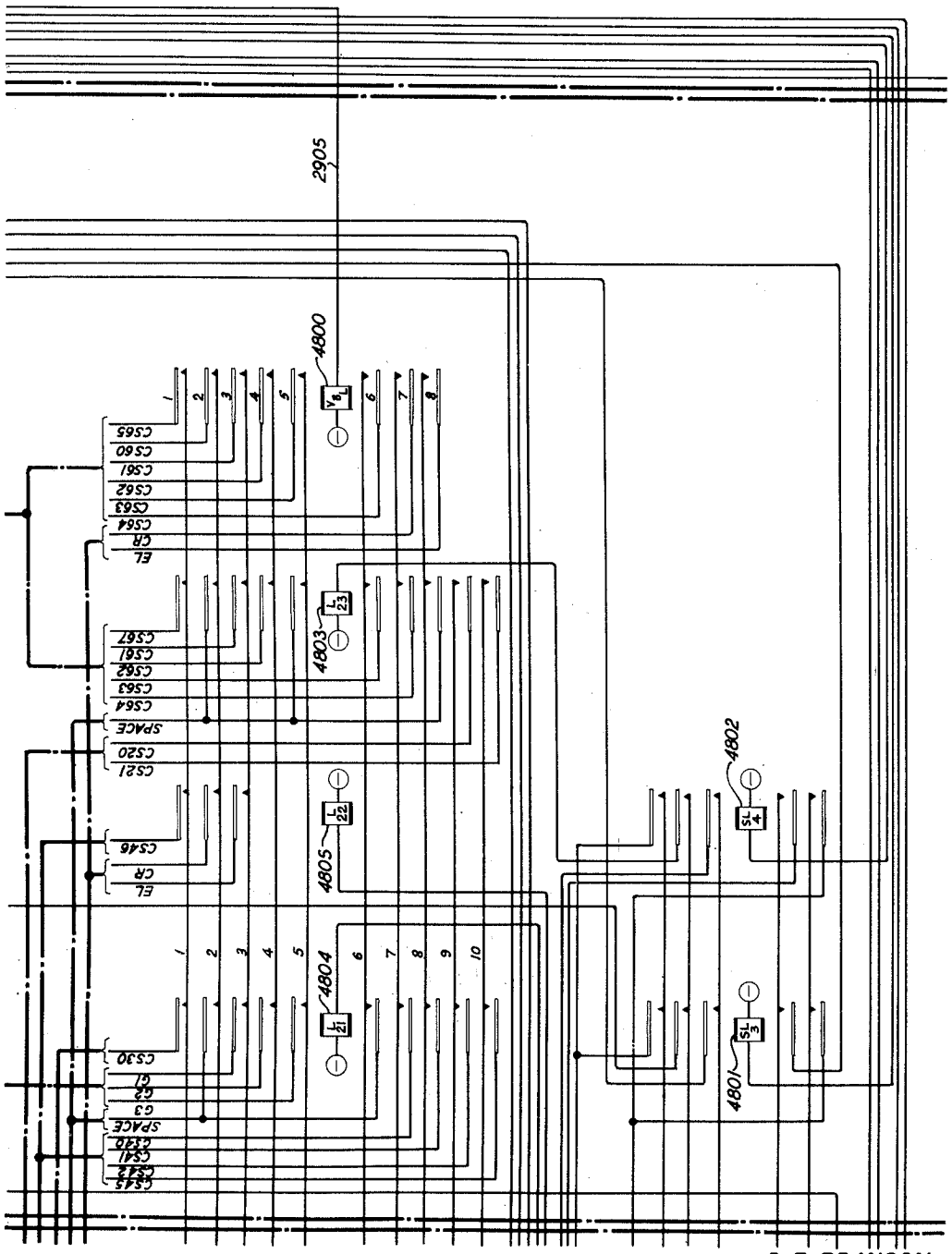

FIG. 48

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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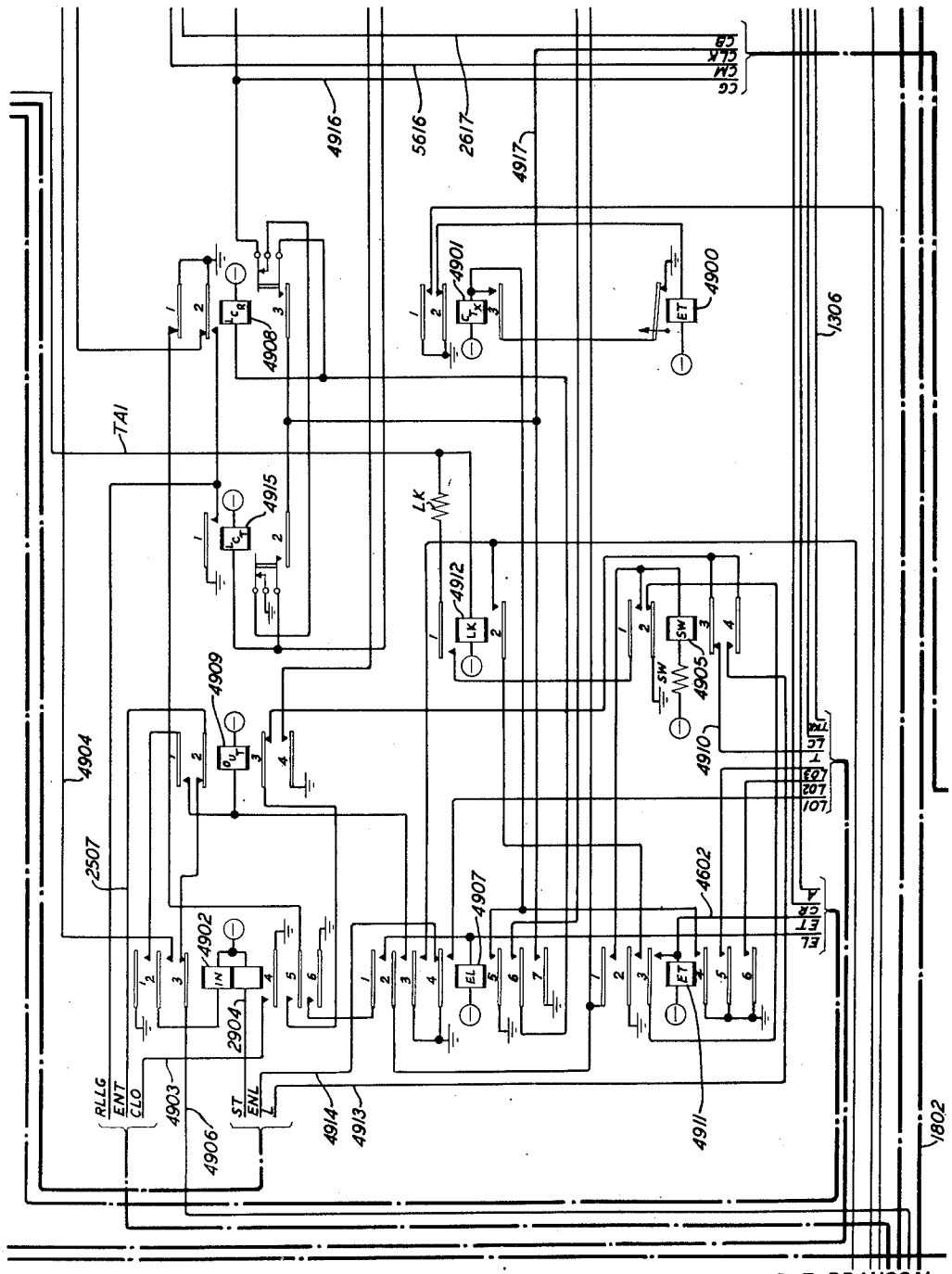

FIG. 49

INVENTORS D. E. BRANSON
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T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 51

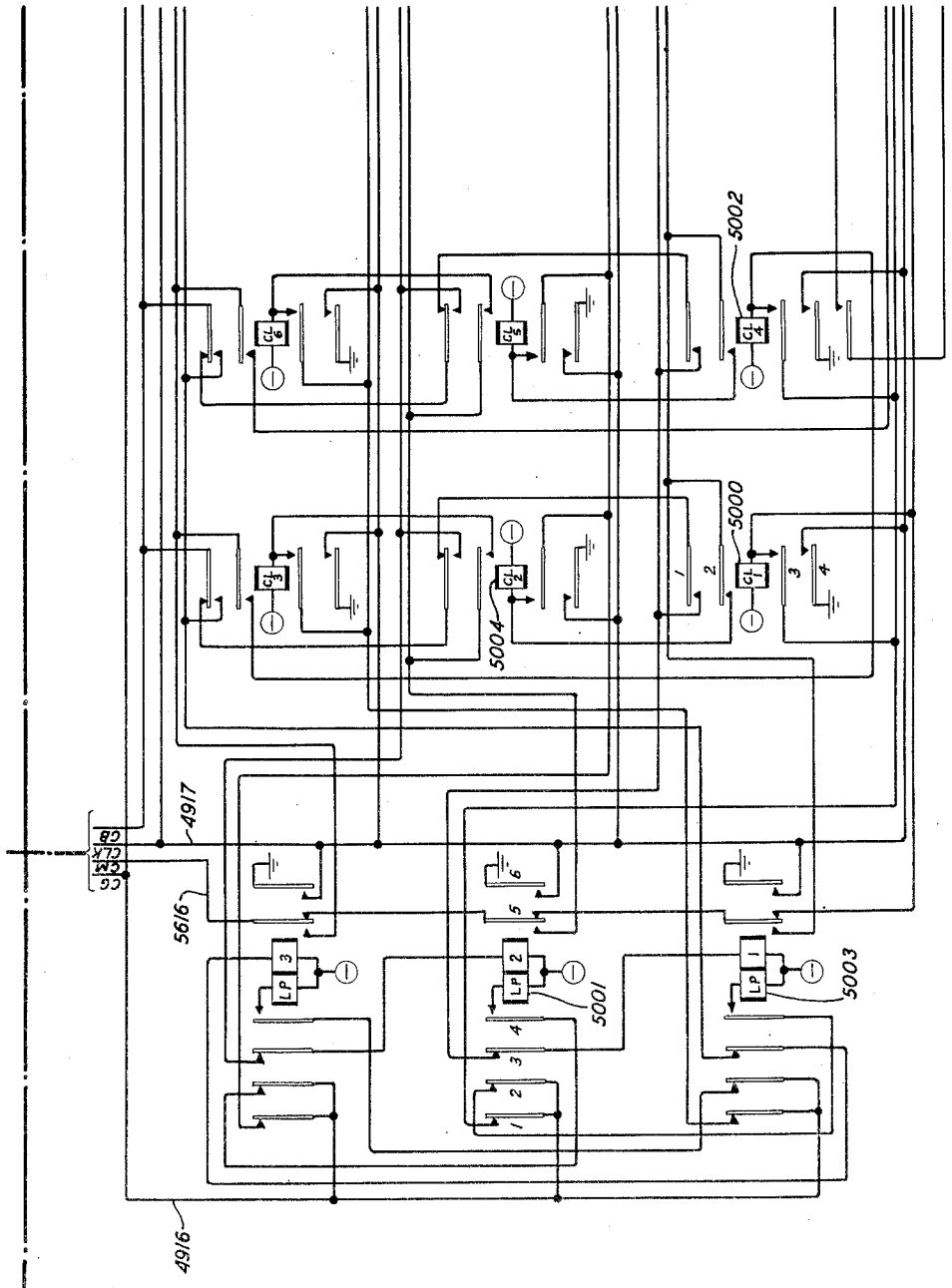

FIG. 50

INVENTORS D. E. BRANSON
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T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 52

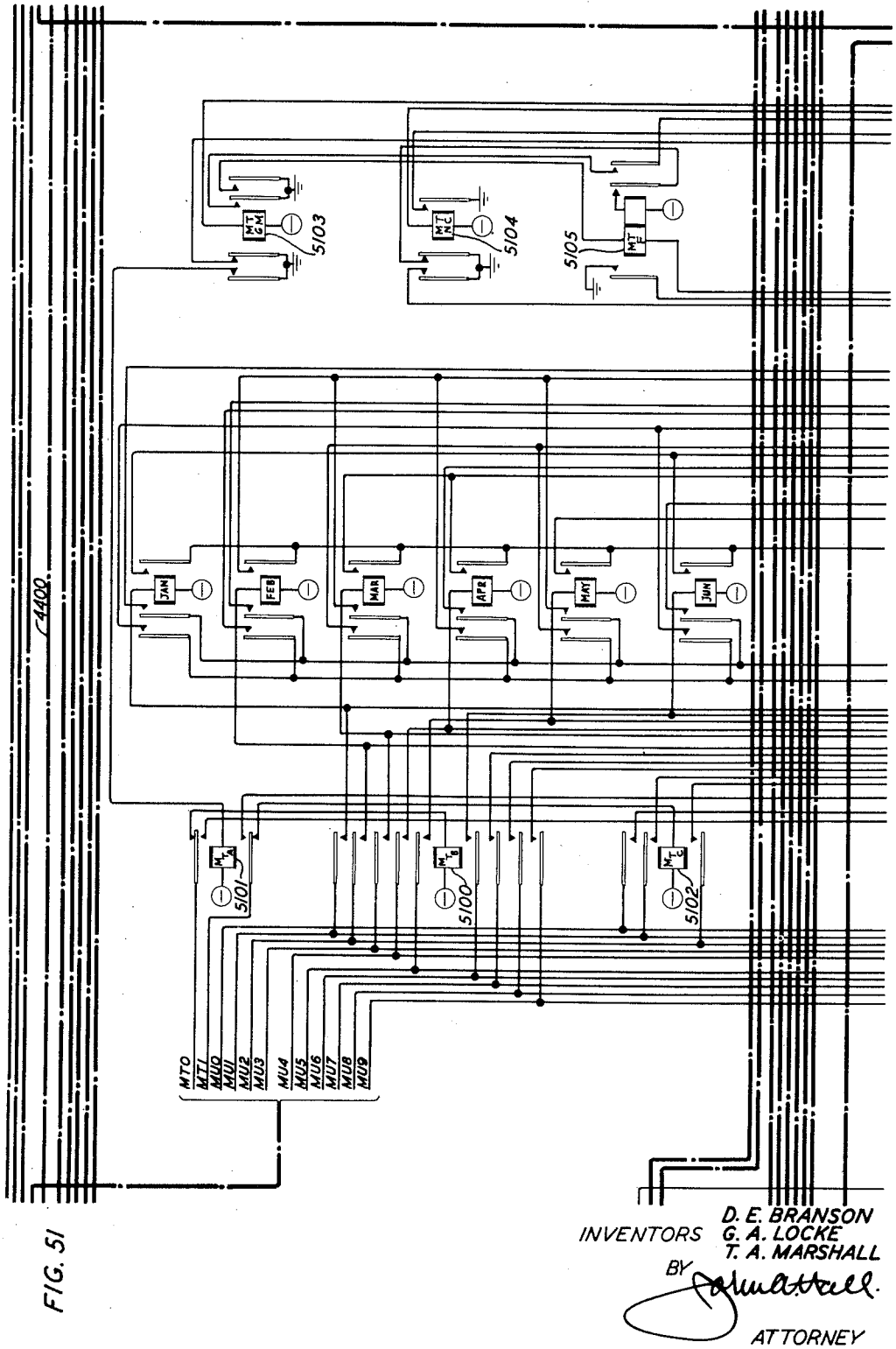

FIG. 51

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 53

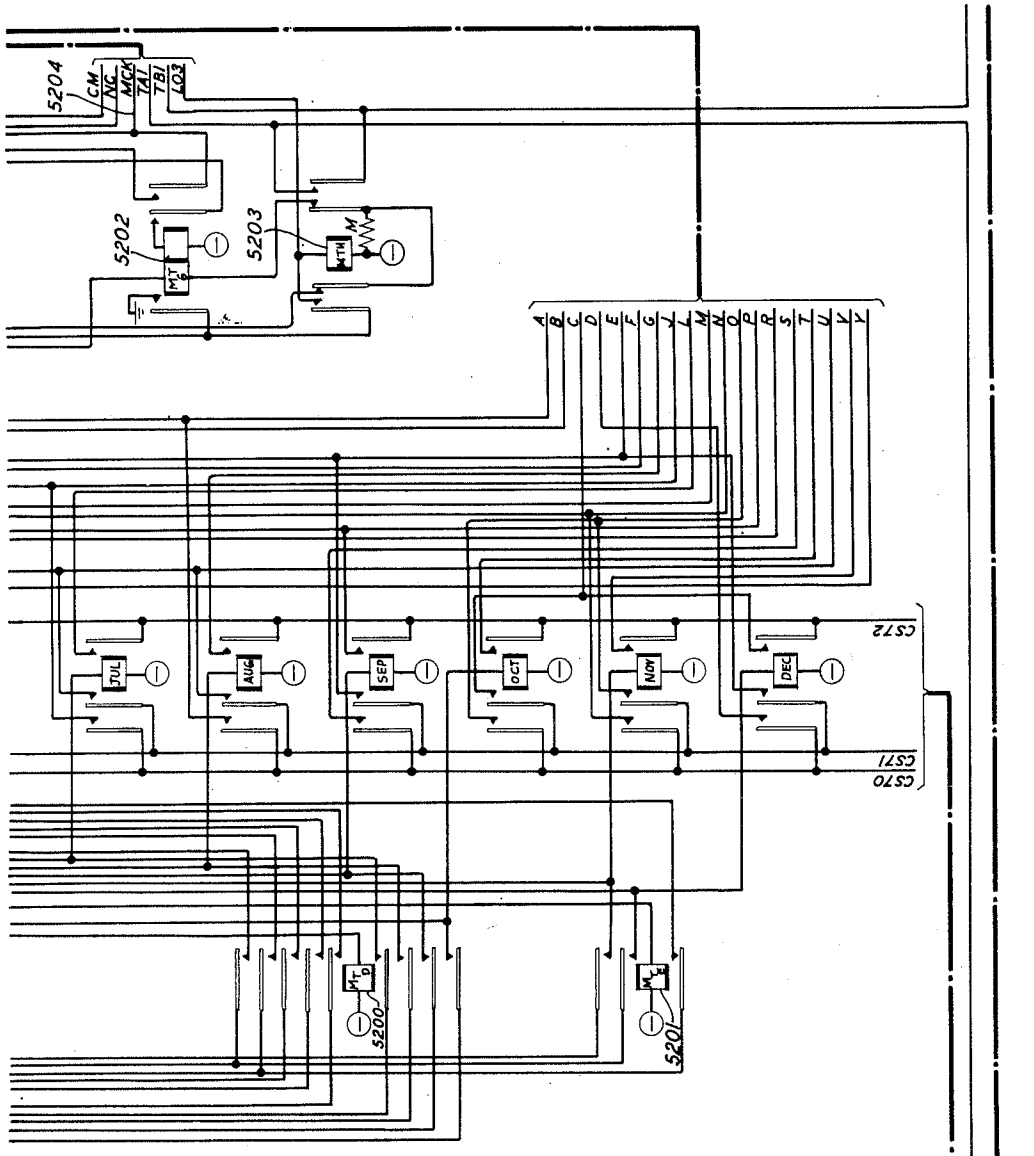

FIG. 52

INVENTORS D. E. BRANSON
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T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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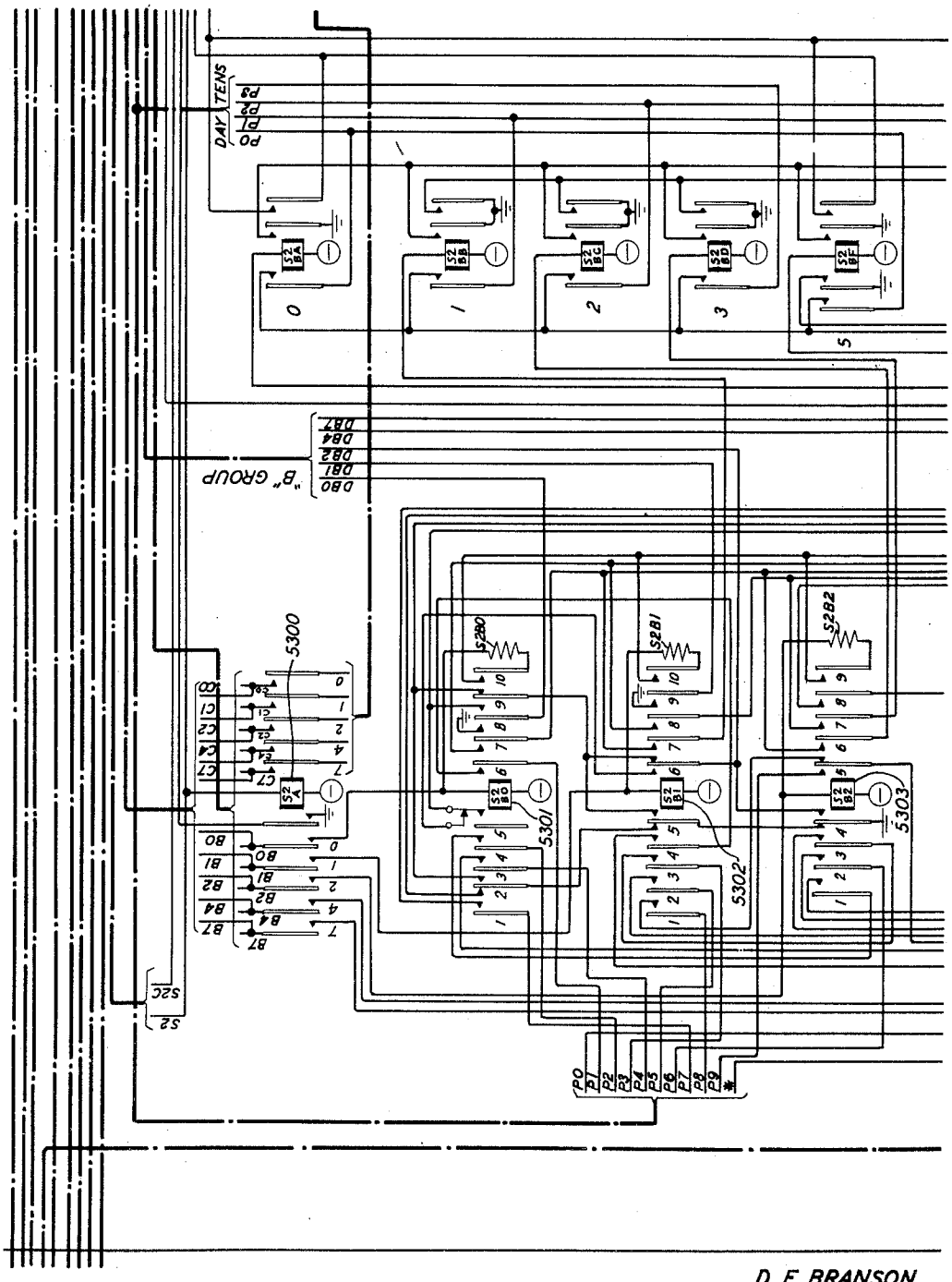

FIG. 53

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 55

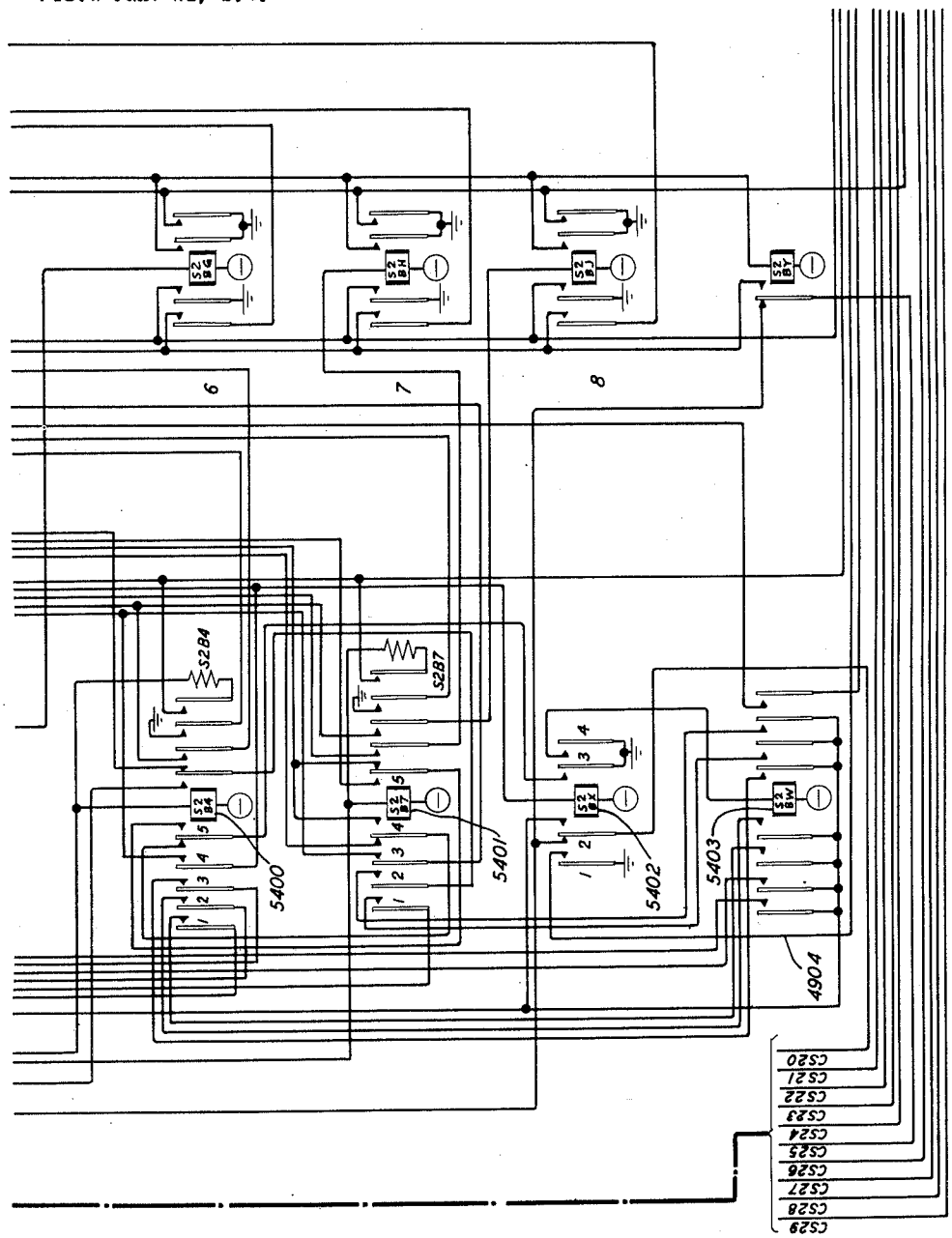

FIG. 54

INVENTORS D. E. BRANSON
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T. A. MARSHALL

BY

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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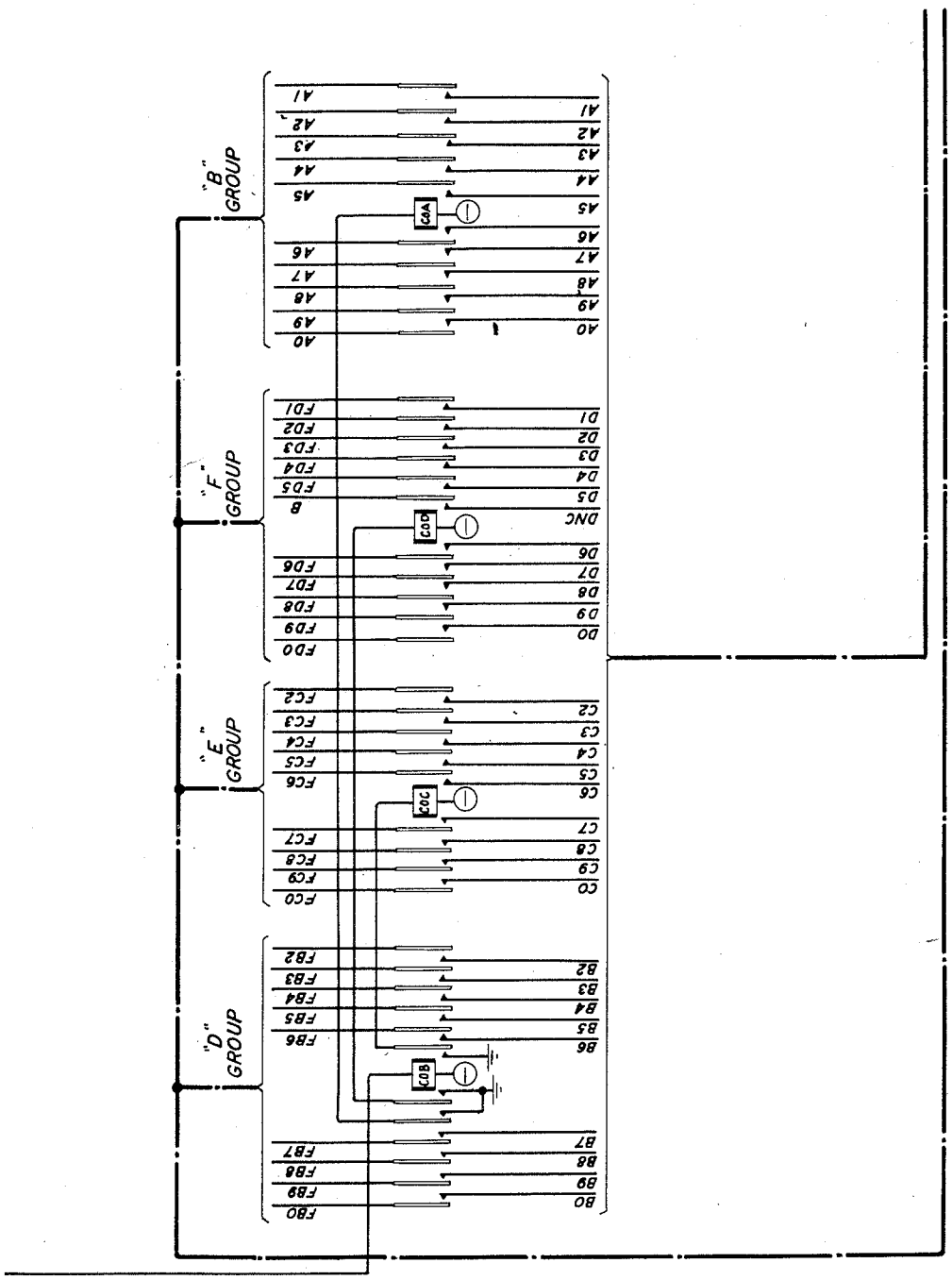

FIG. 55

INVENTORS D. E. BRANSON
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T. A. MARSHALL

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ATTORNEY

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Filed Jan. 21, 1949 136 Sheets-Sheet 57

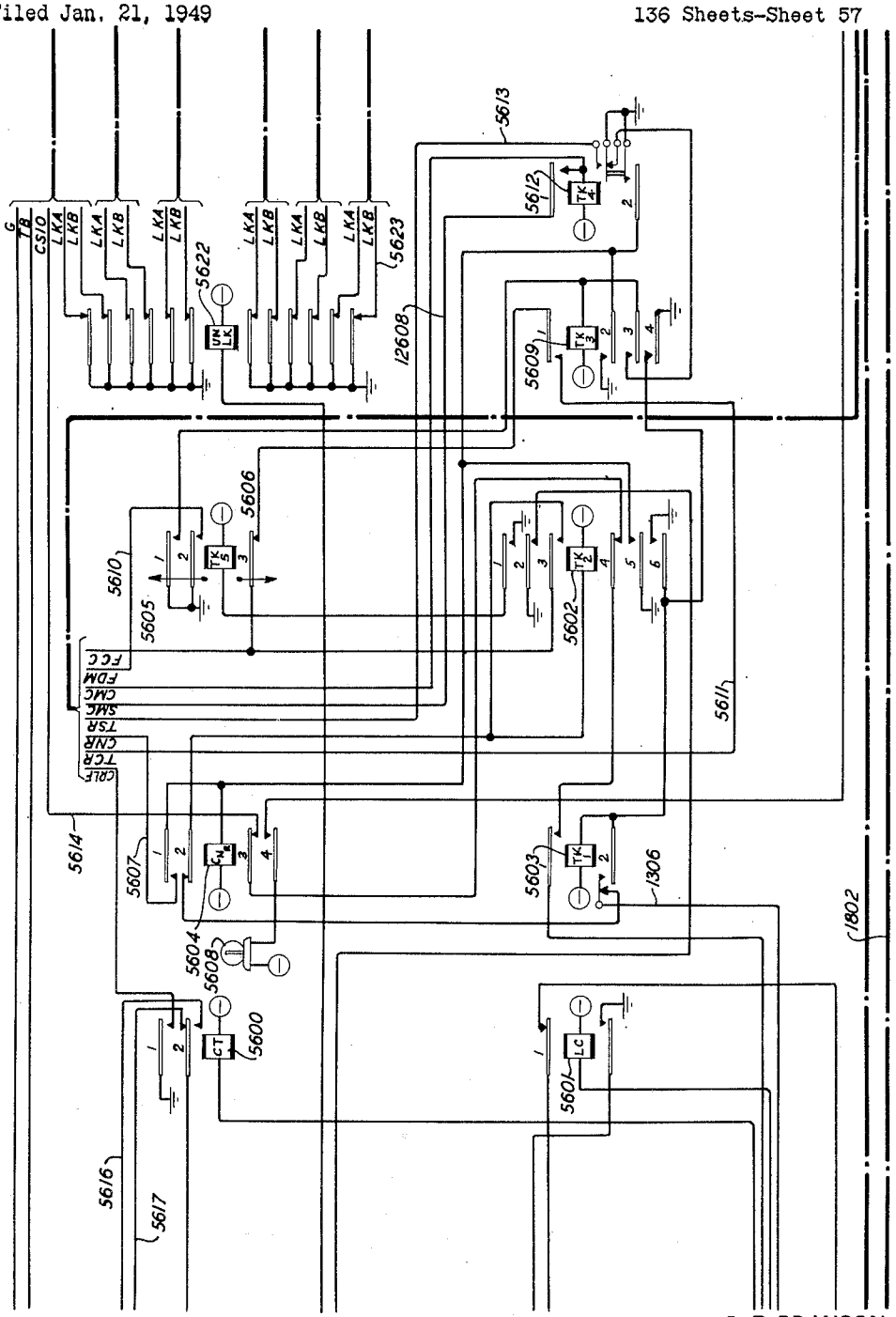

FIG. 56

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 58

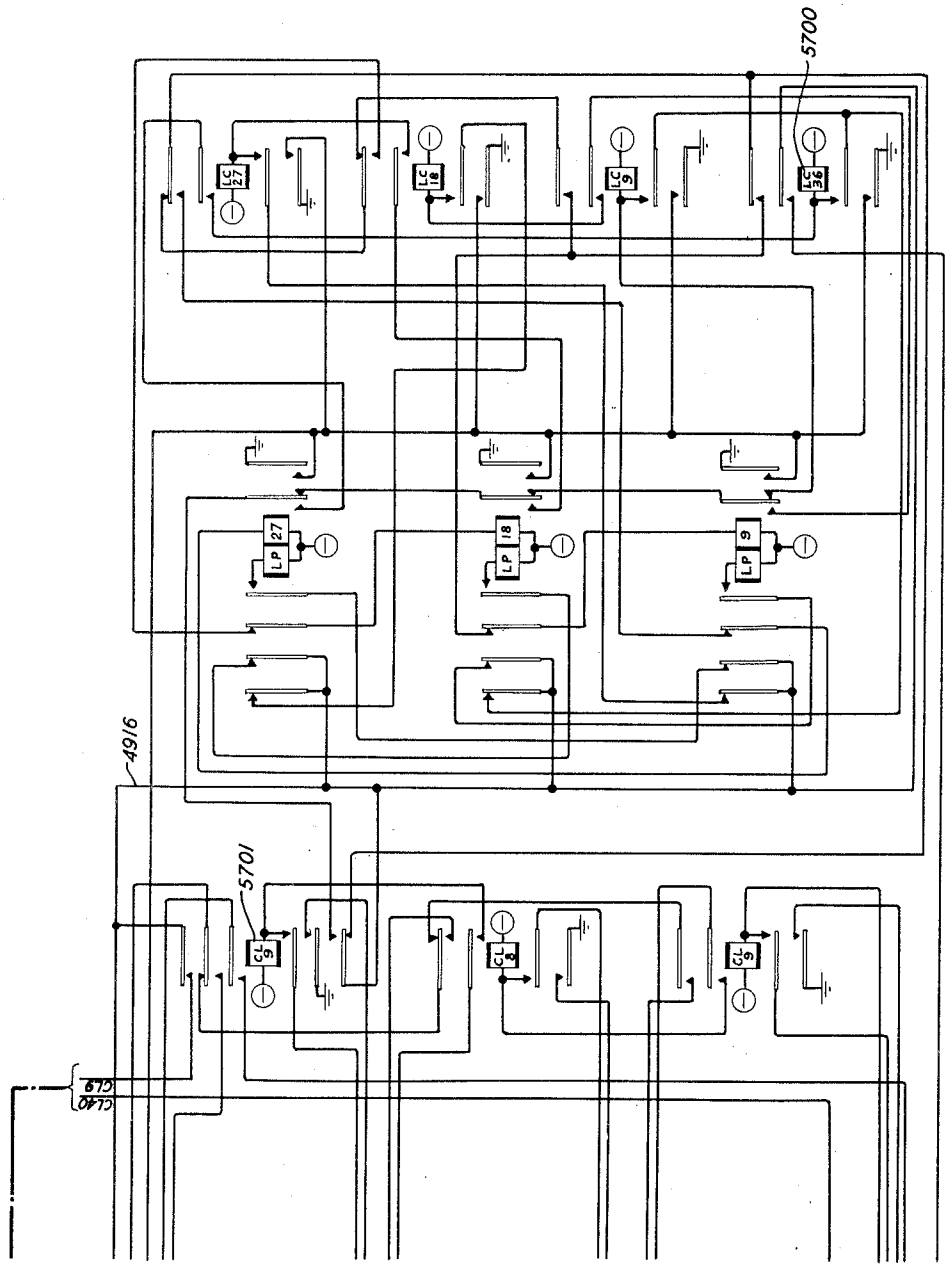

FIG. 57

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 59

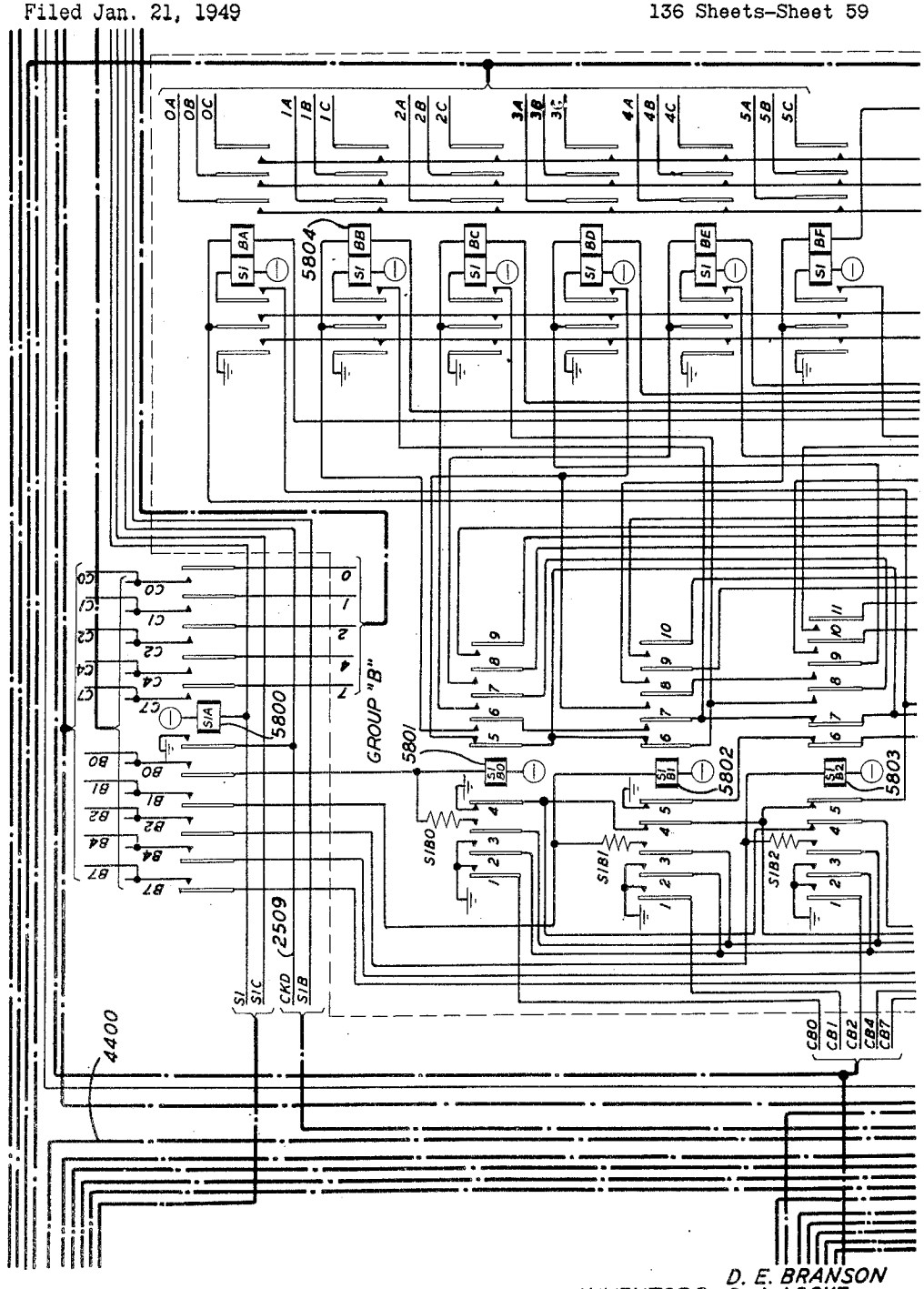

FIG. 58

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 60

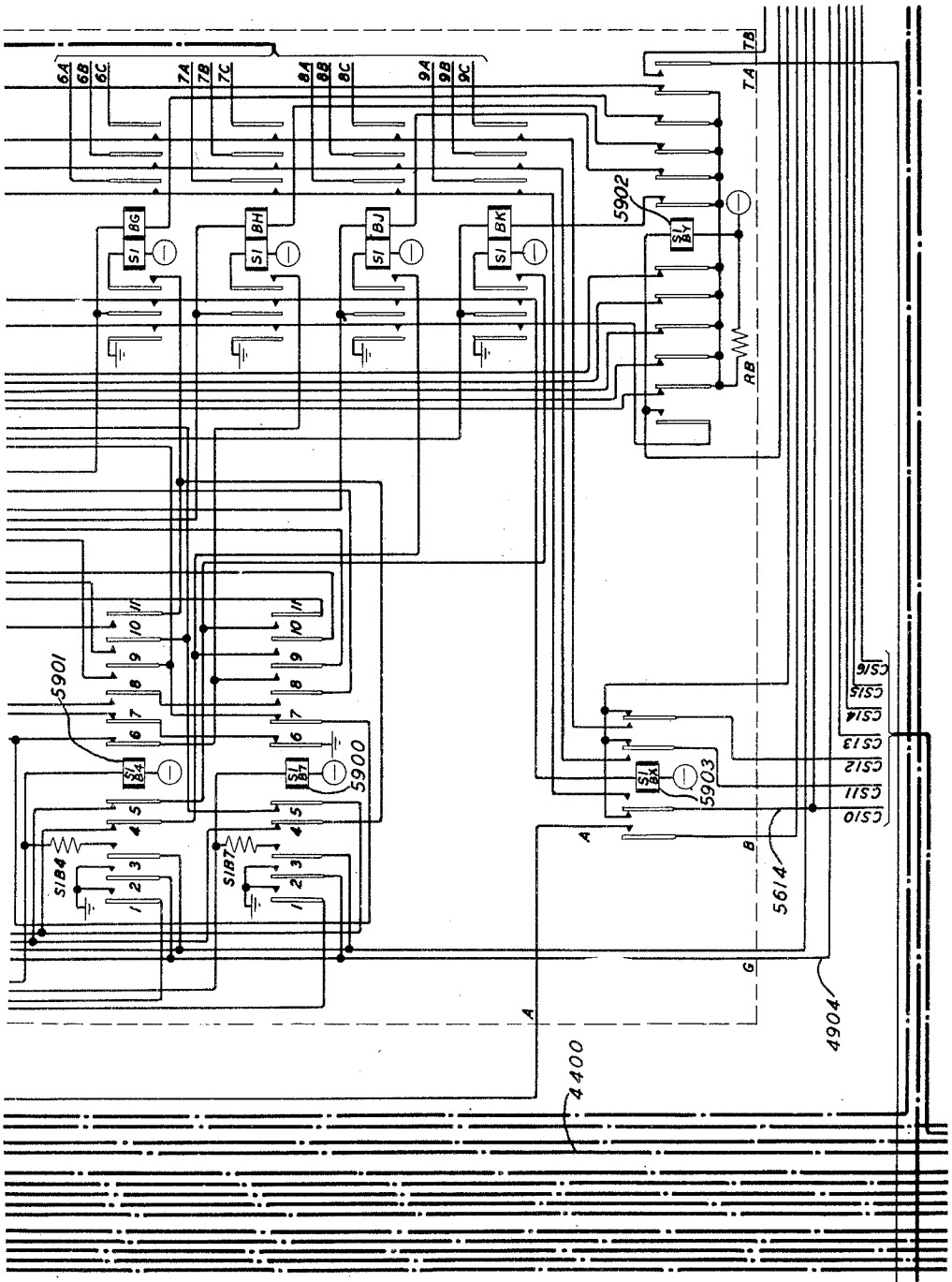

FIG. 59

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 61

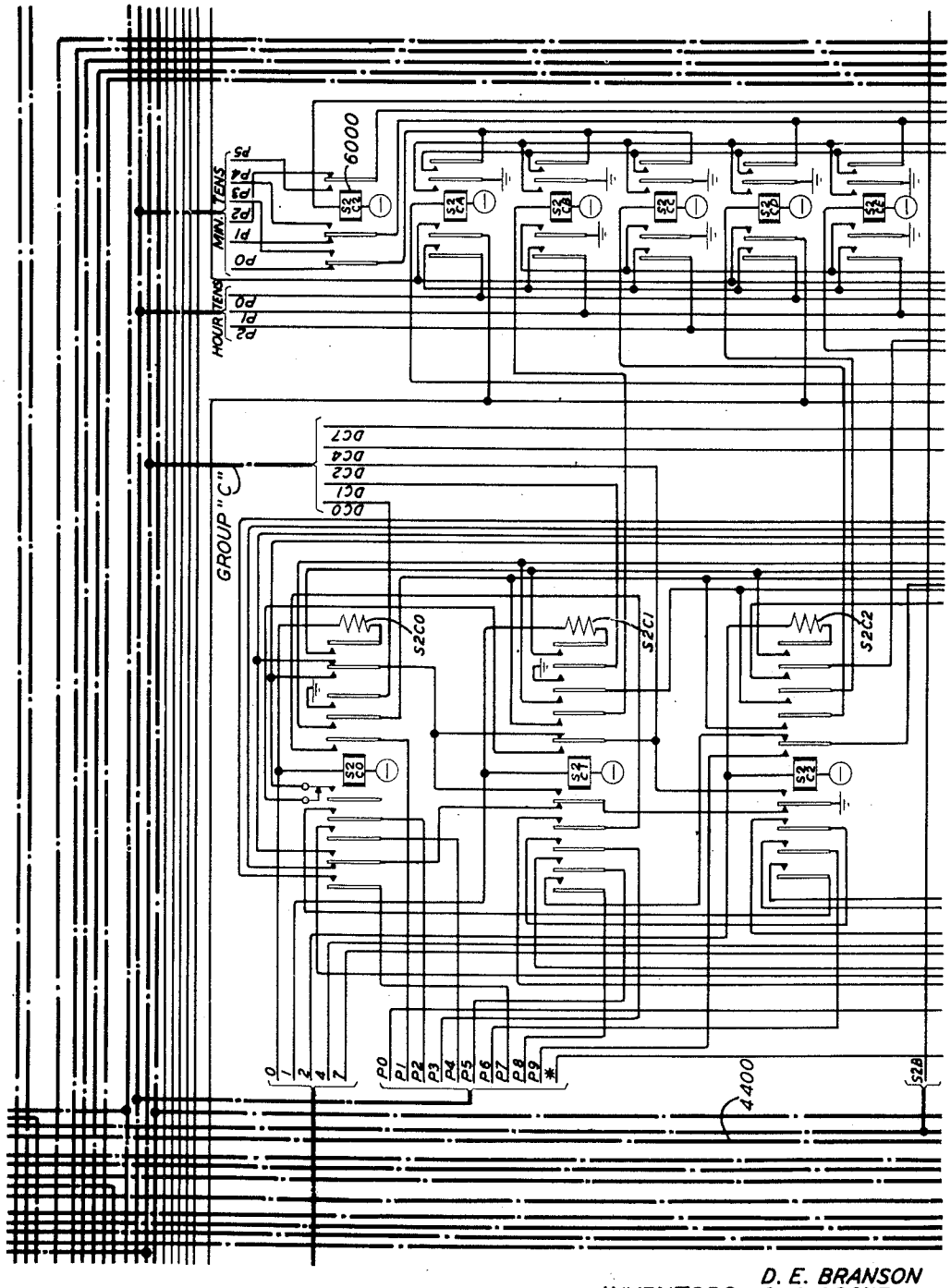

FIG. 60

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 62

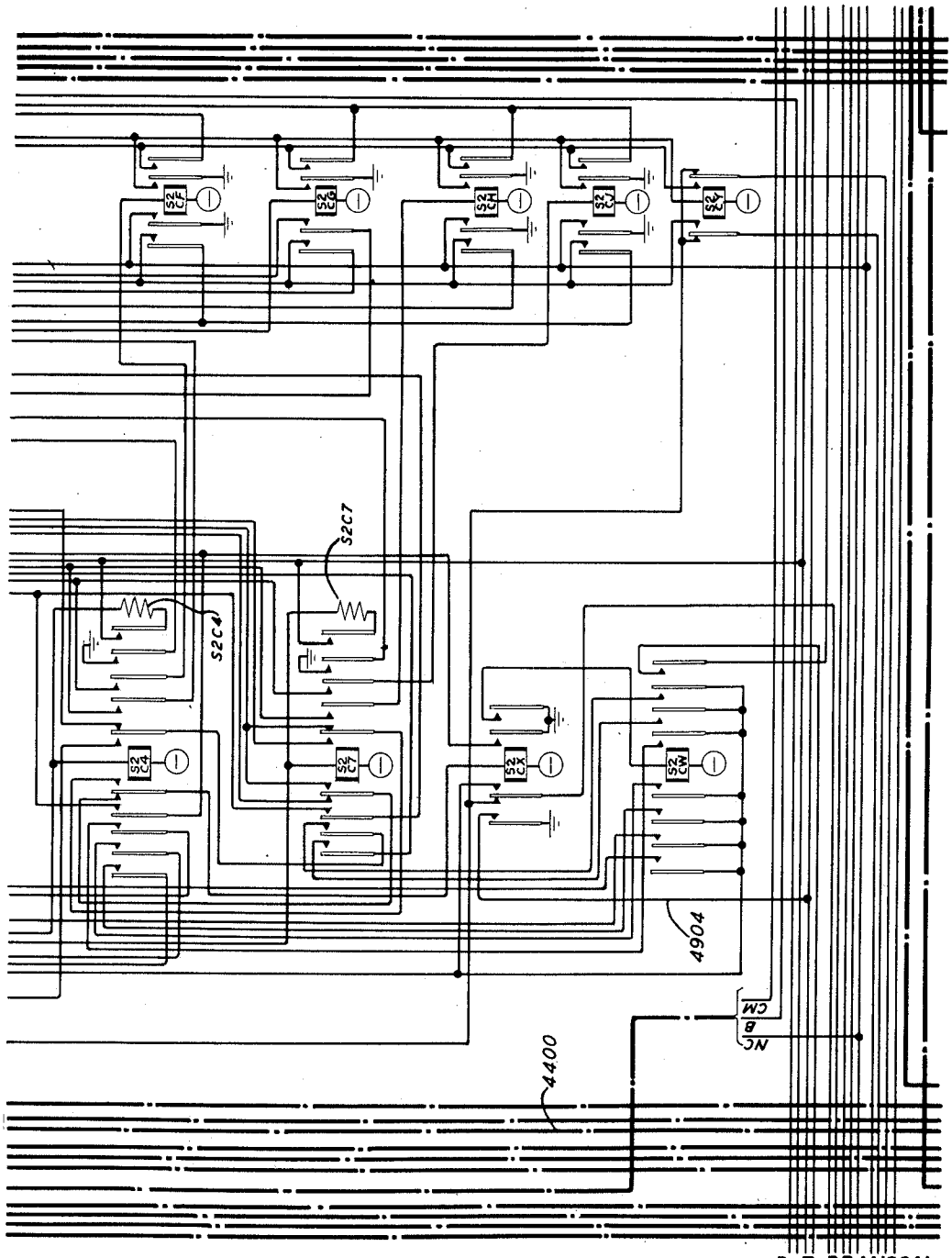

FIG. 61

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 63

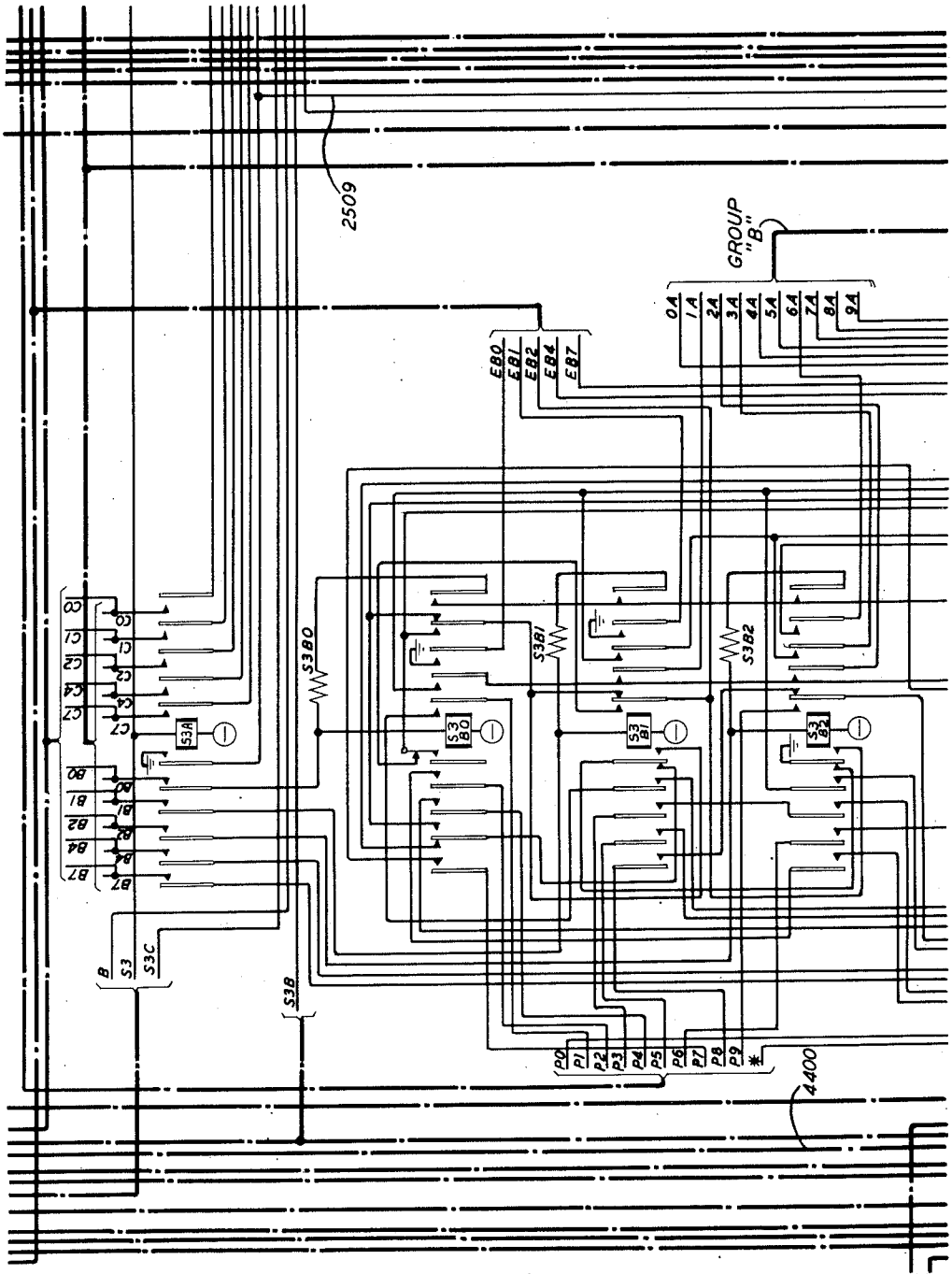

FIG. 62

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 64

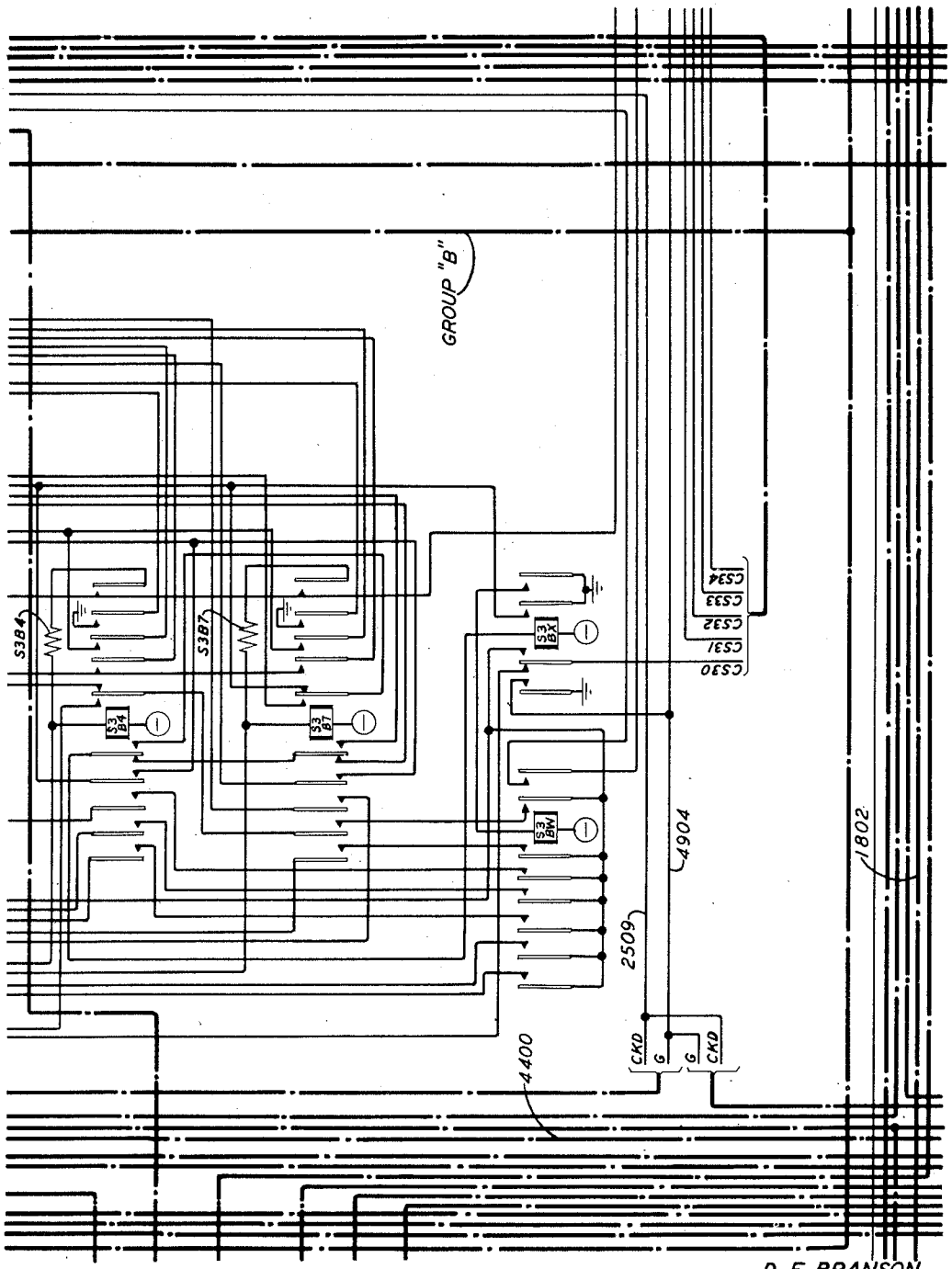

FIG. 63

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Stall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 65

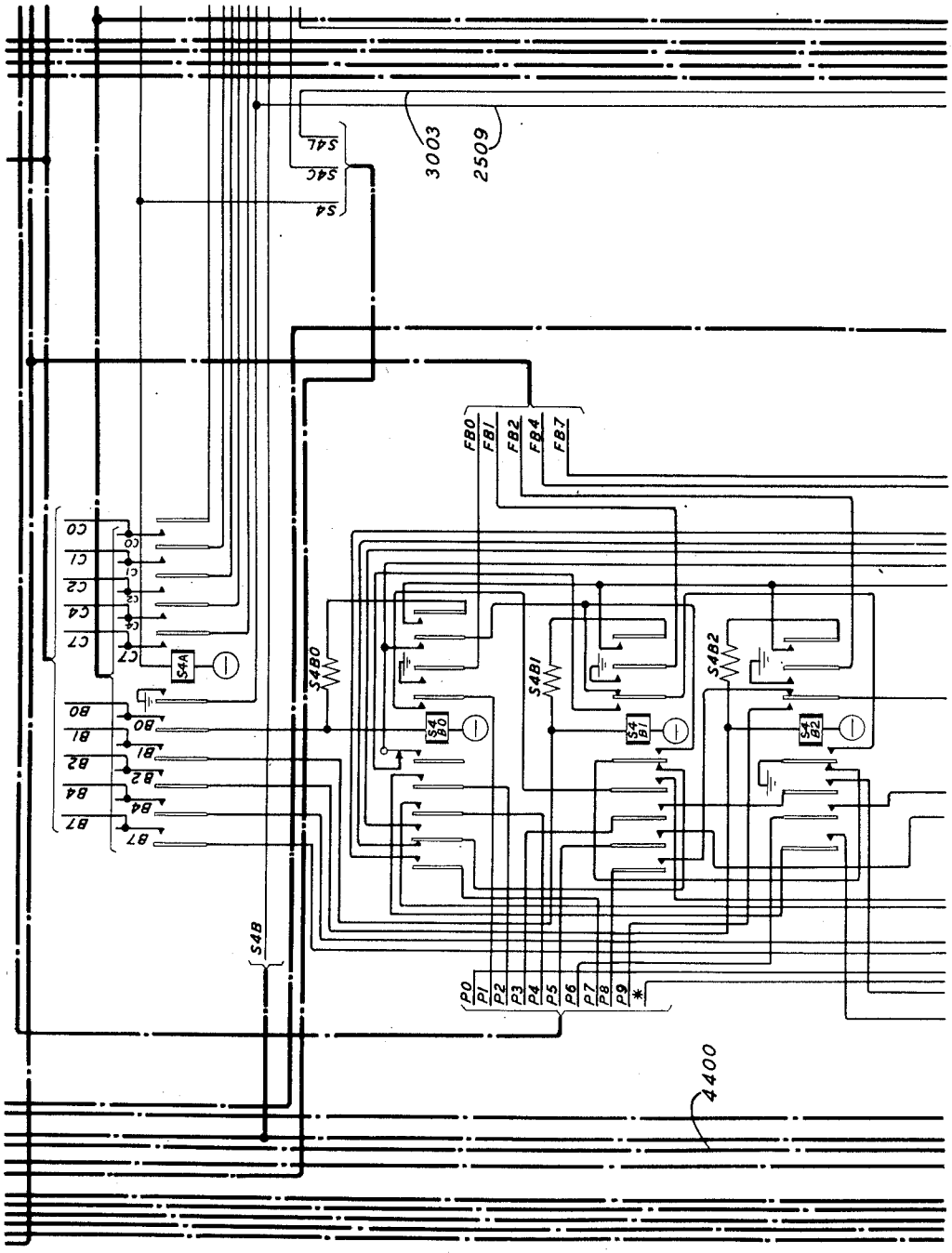

FIG. 64

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 66

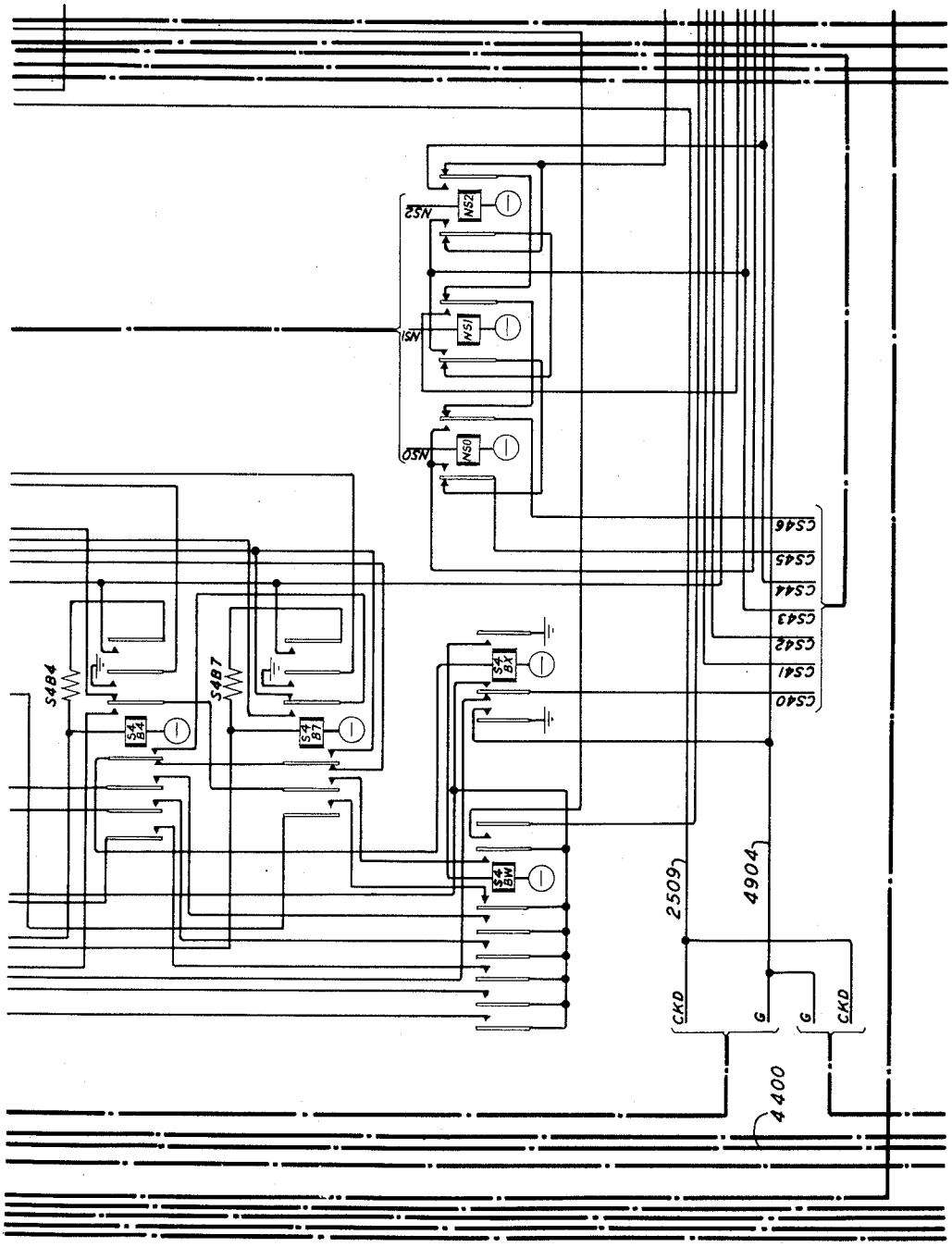

FIG. 65

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 67

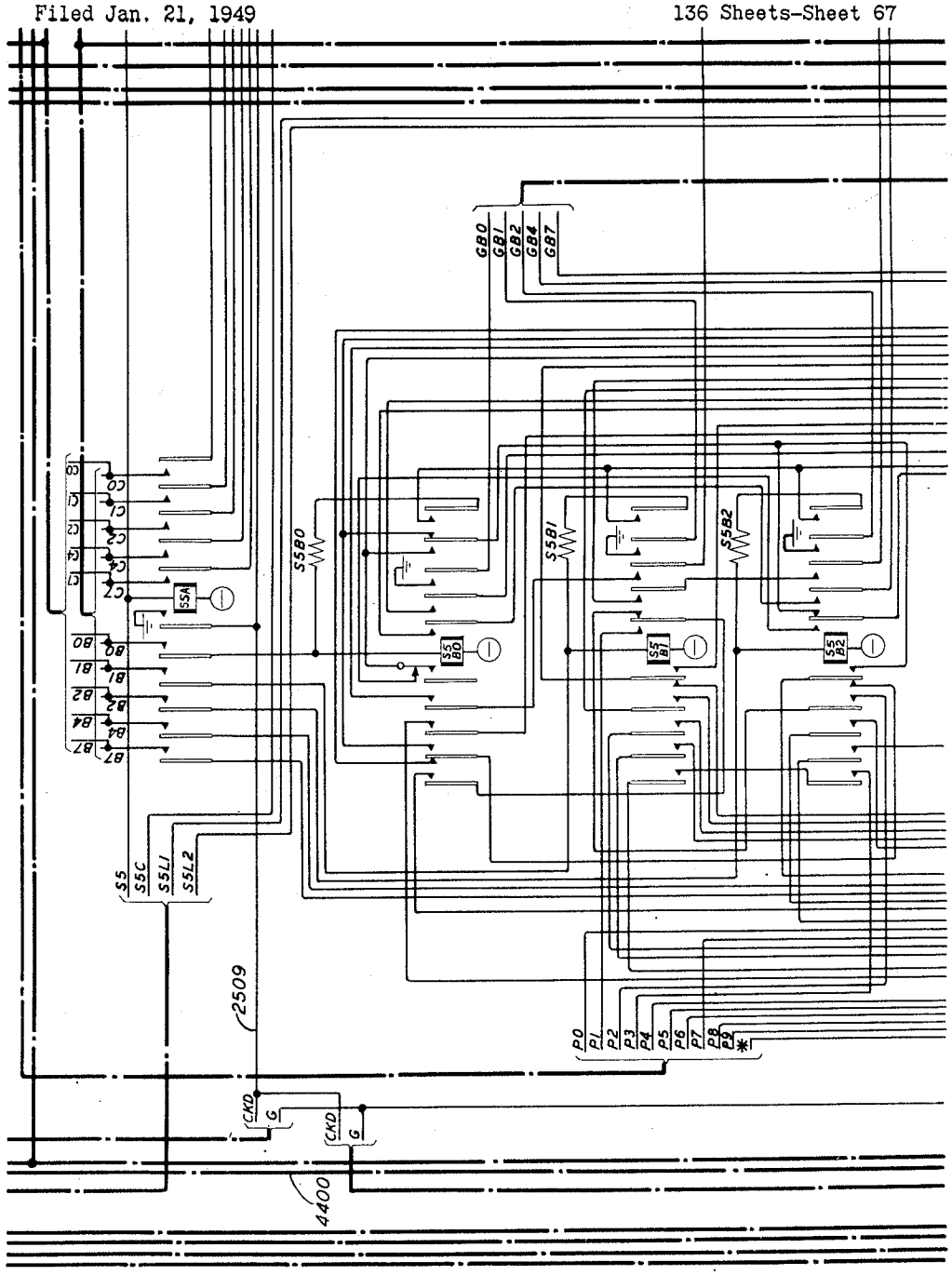

FIG. 66

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 68

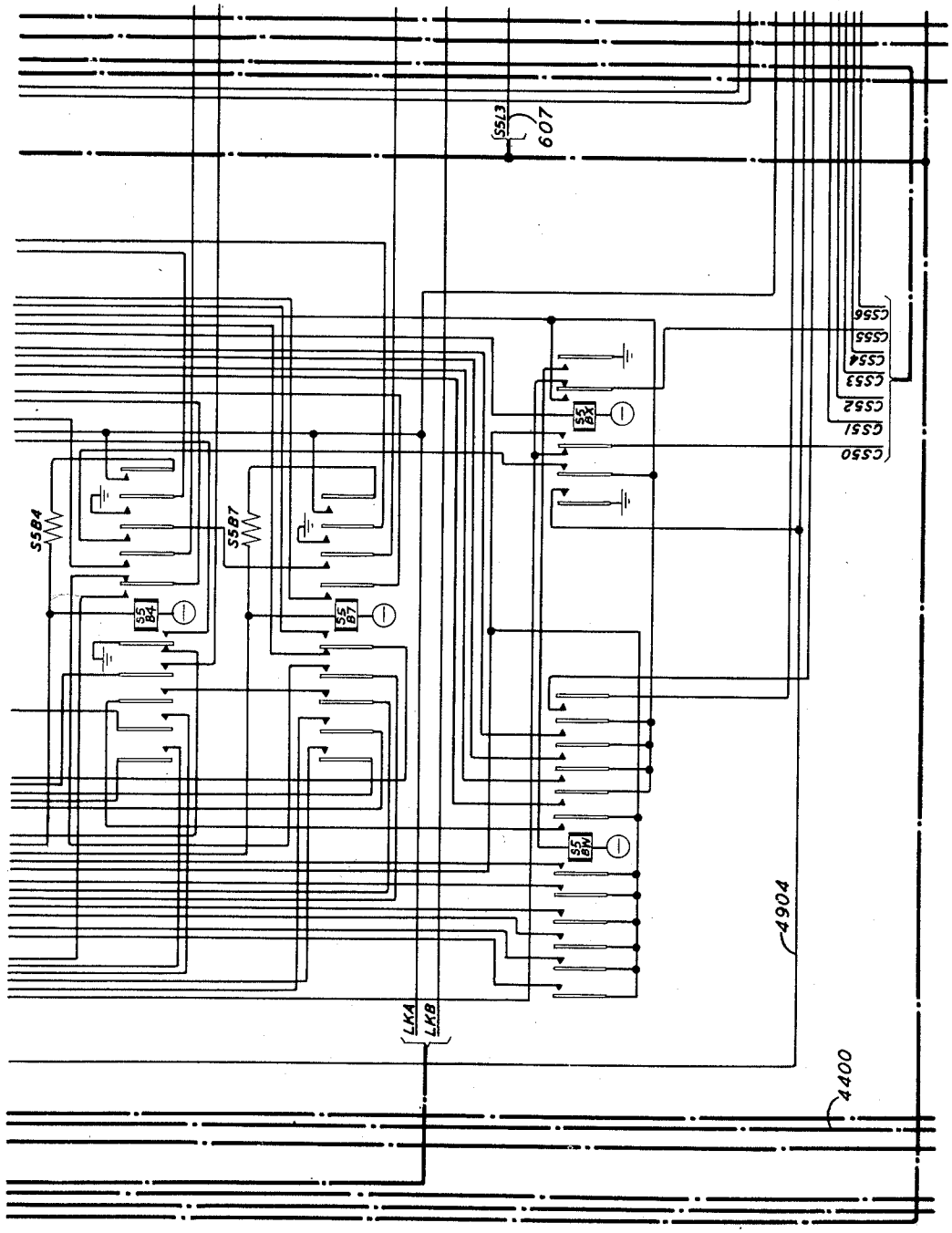

FIG. 67

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 69

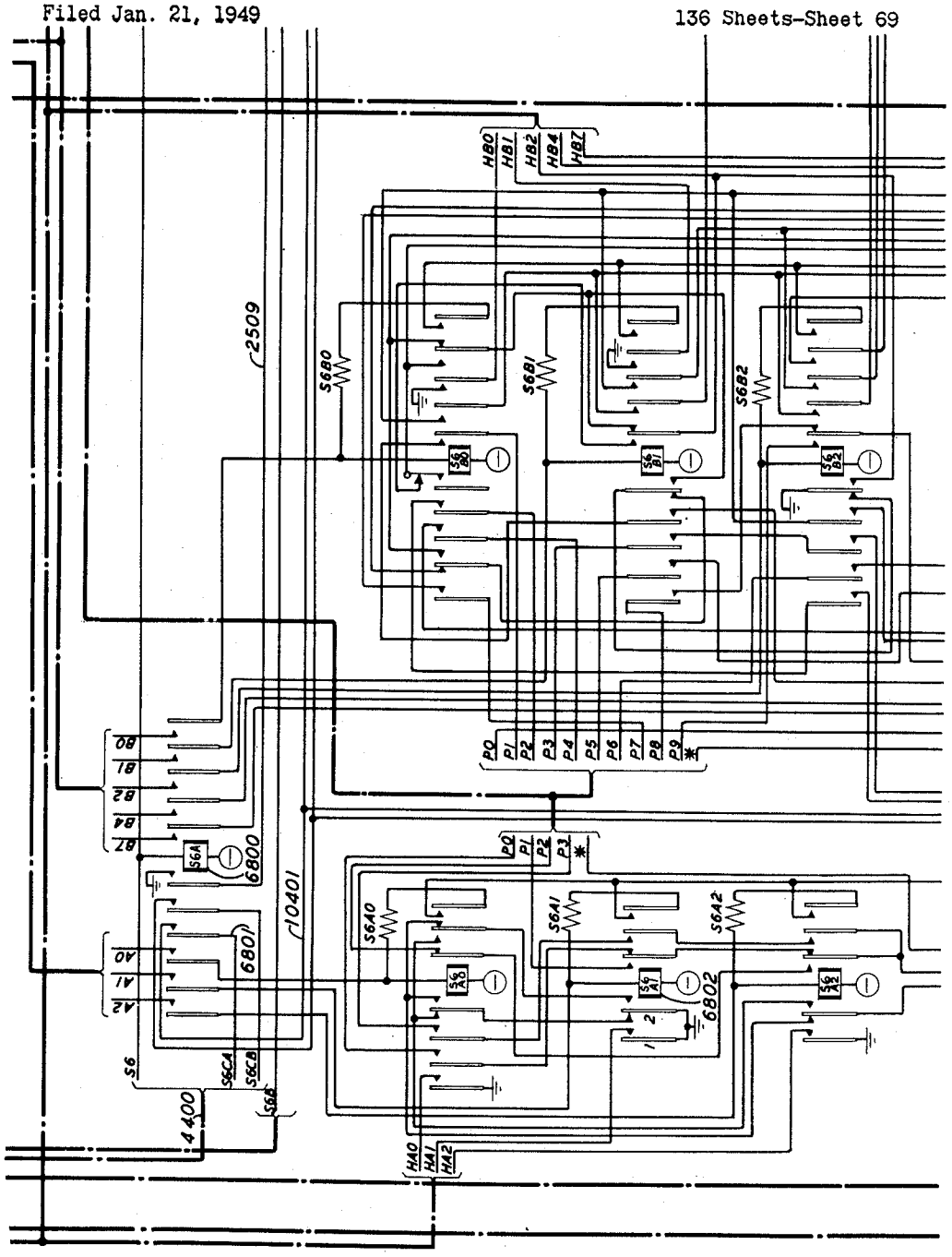

FIG. 68

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 70

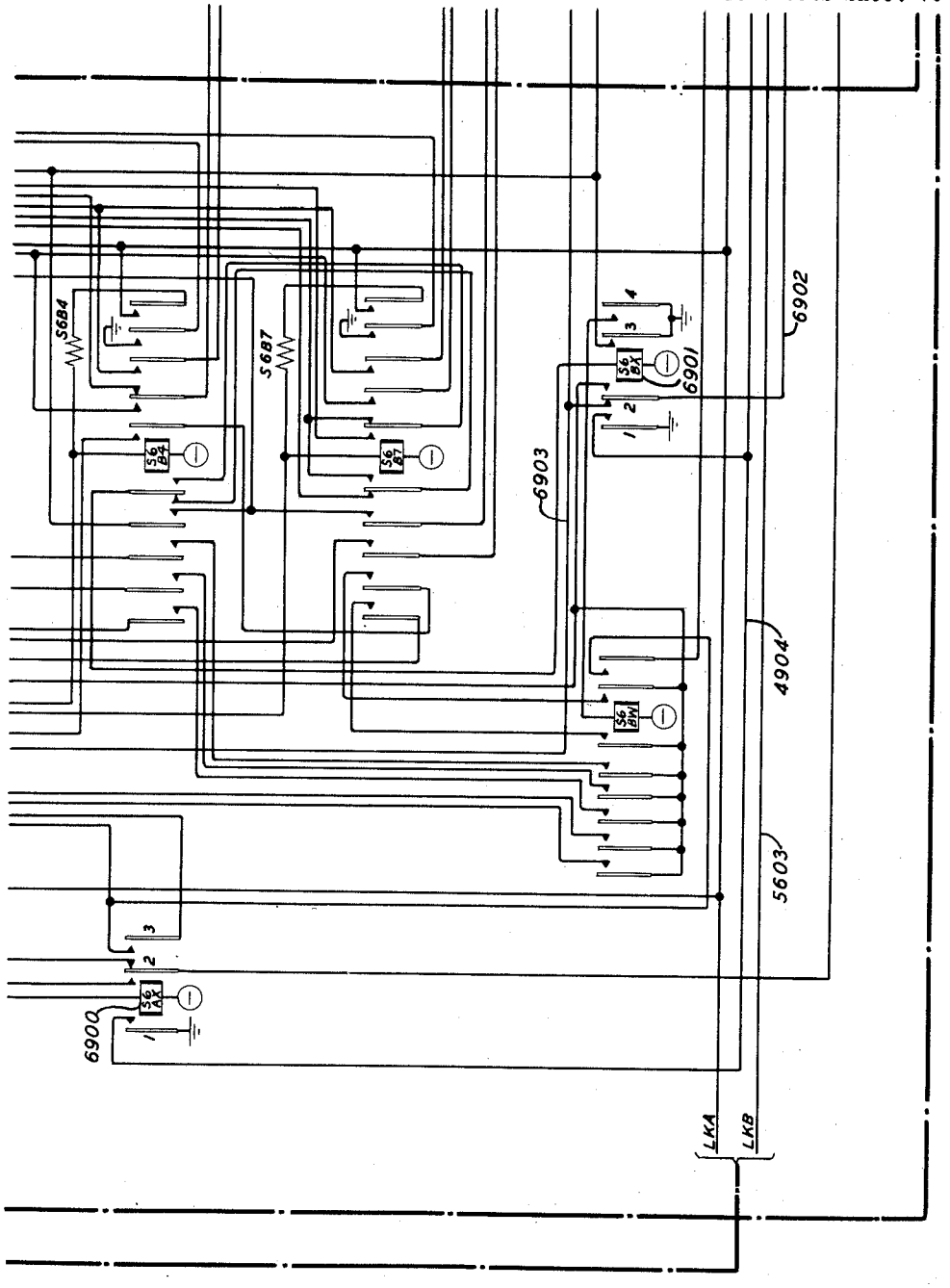

FIG. 69

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 71

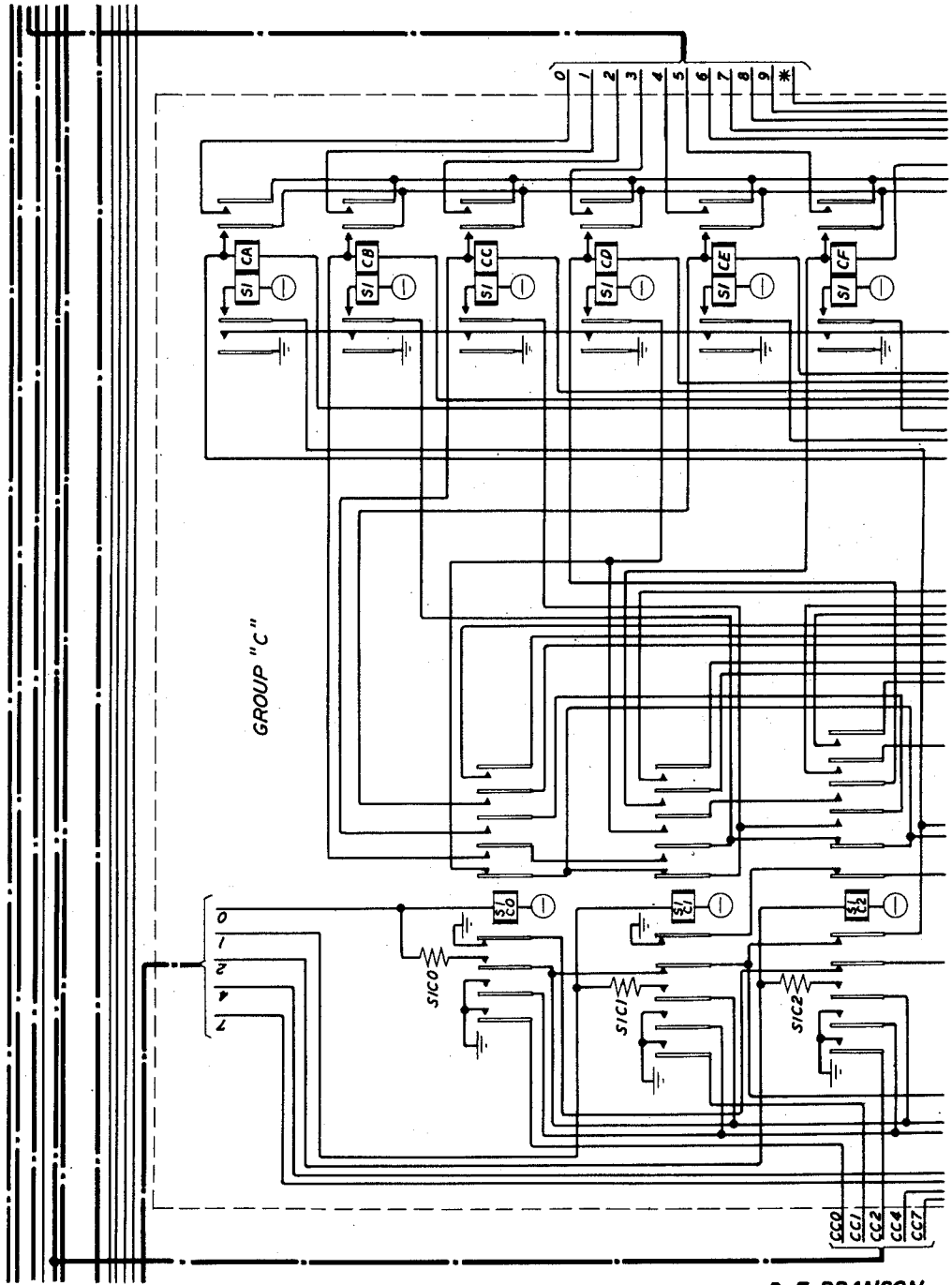

FIG. 70

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 72

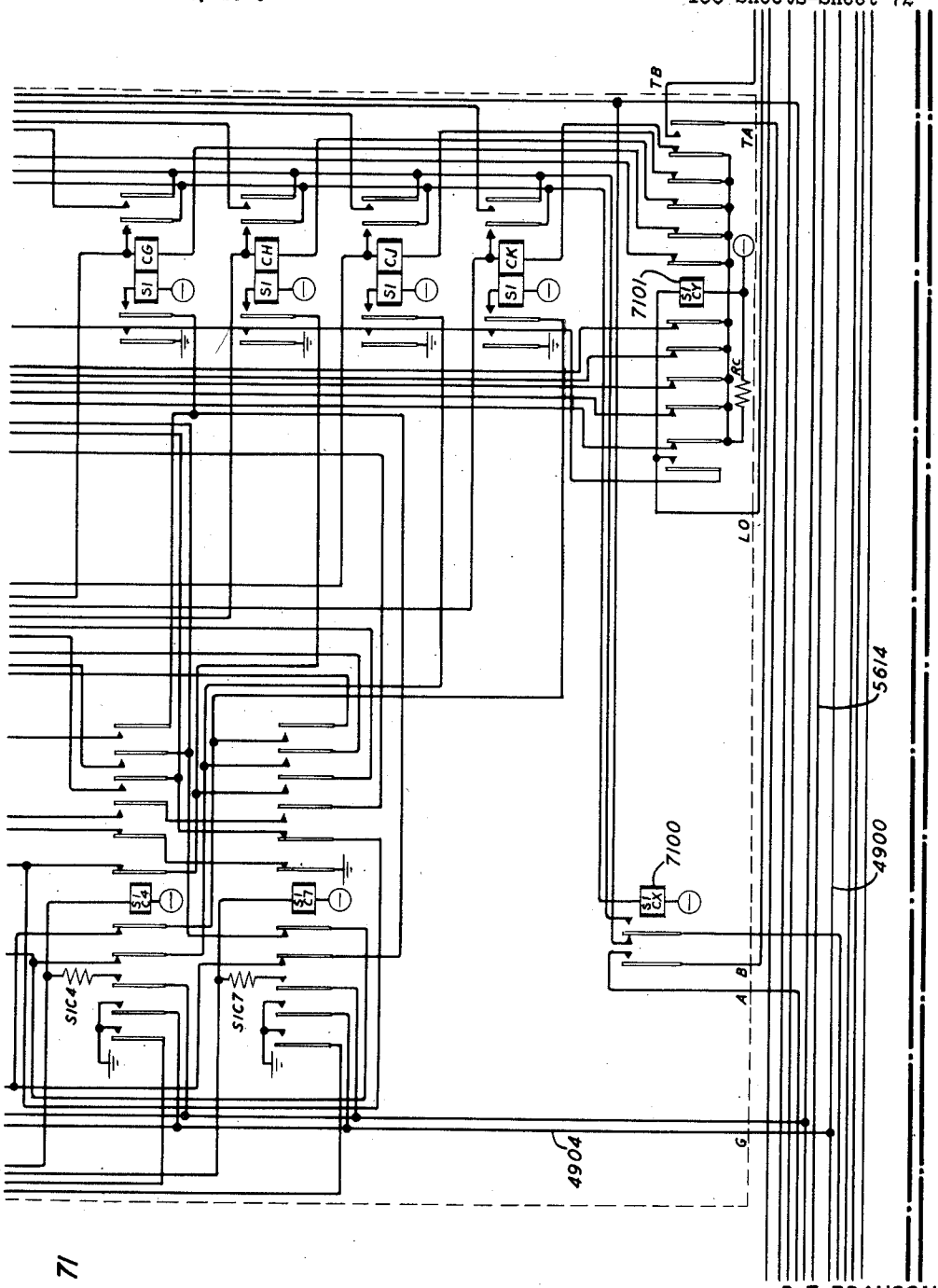

FIG. 71

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 73

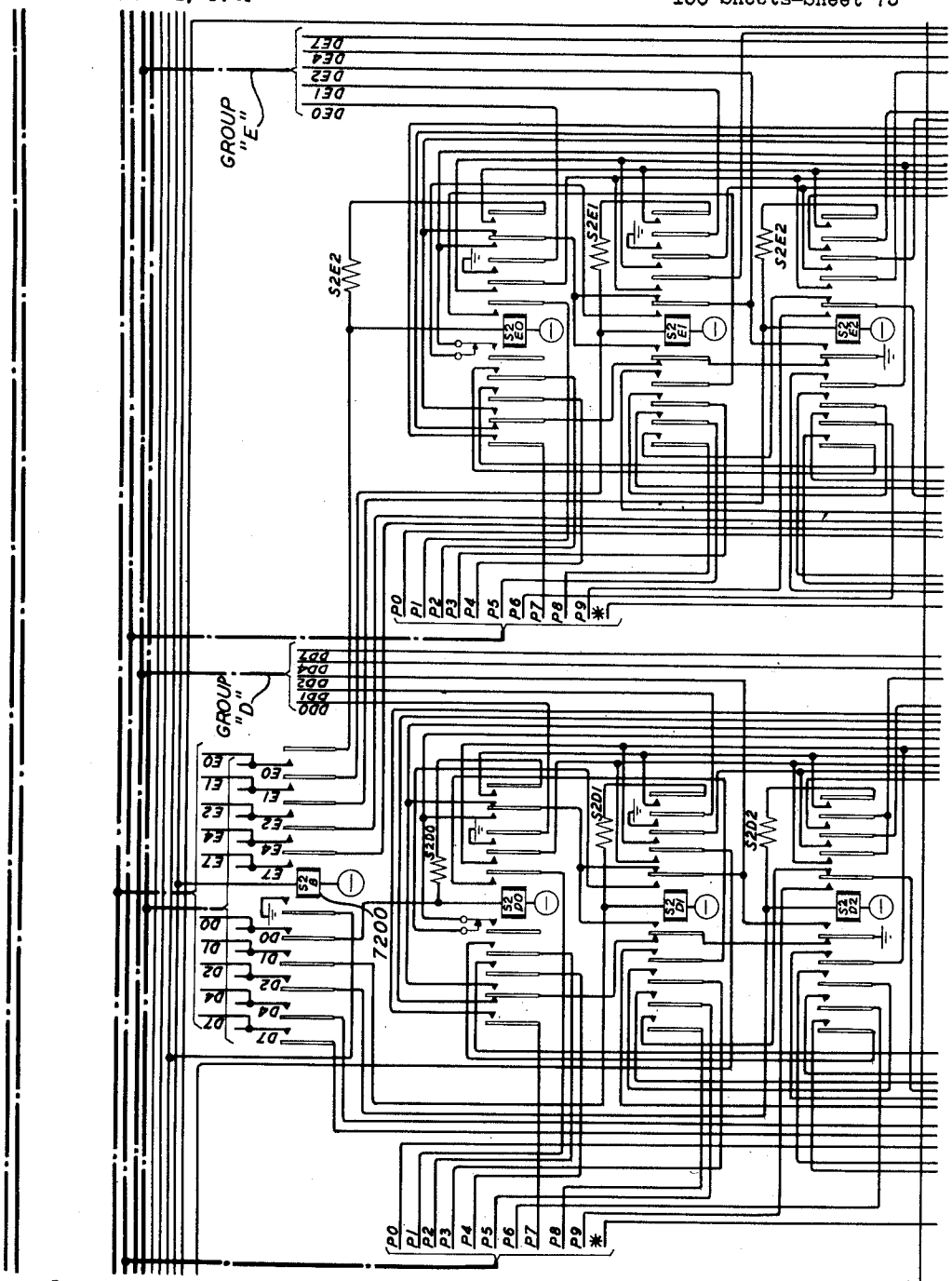

FIG. 72

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 74

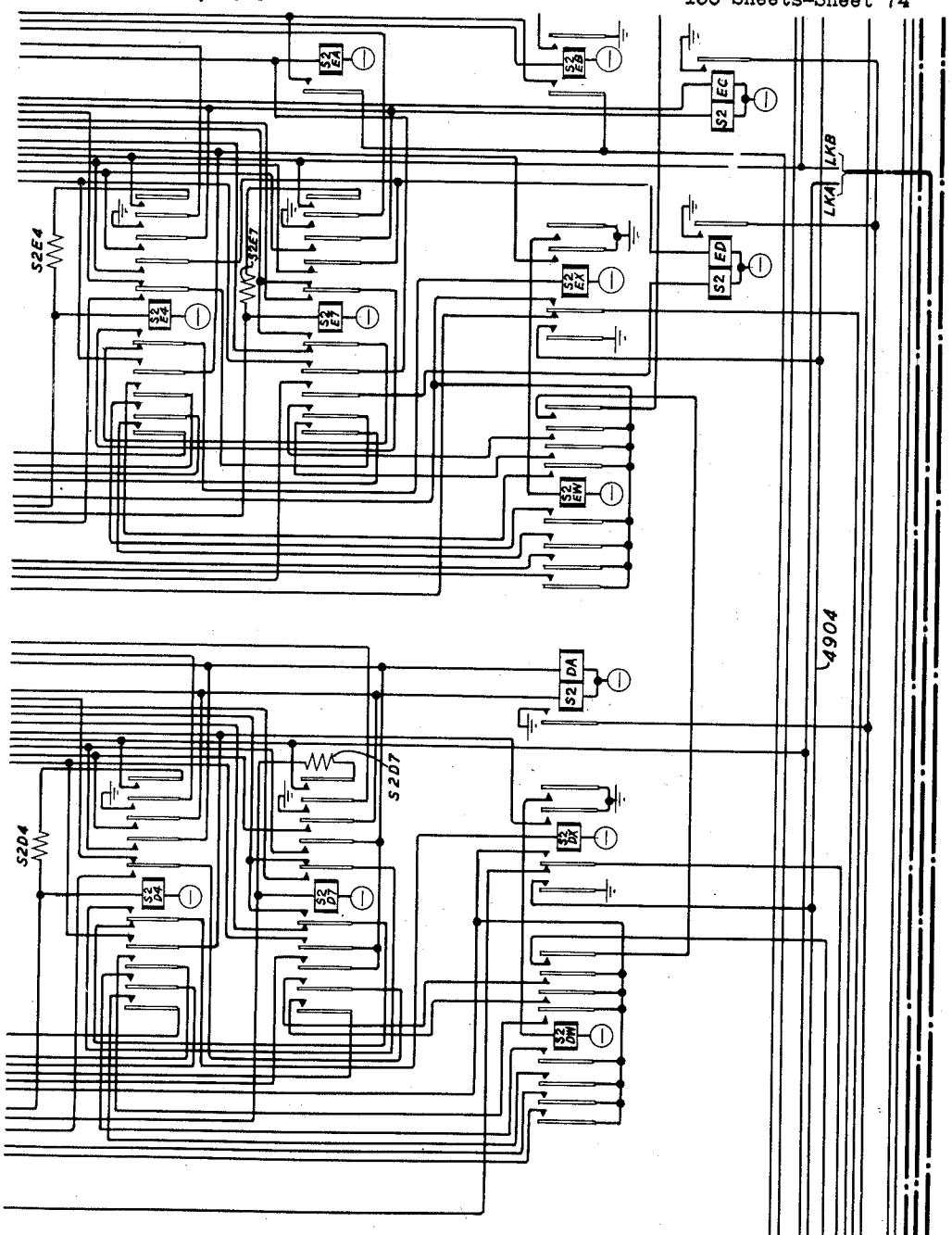

FIG. 73

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 75

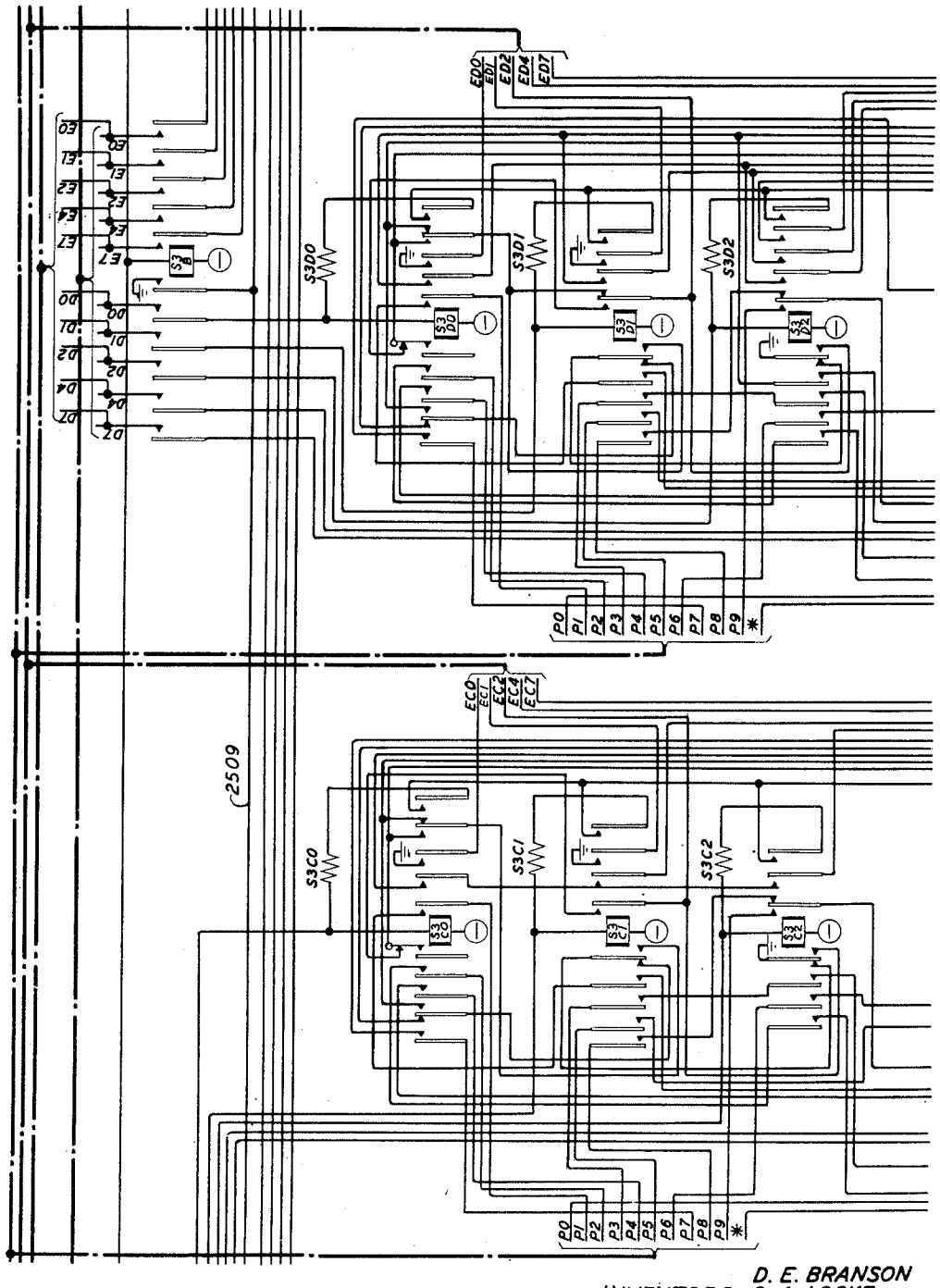

FIG. 74

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 76

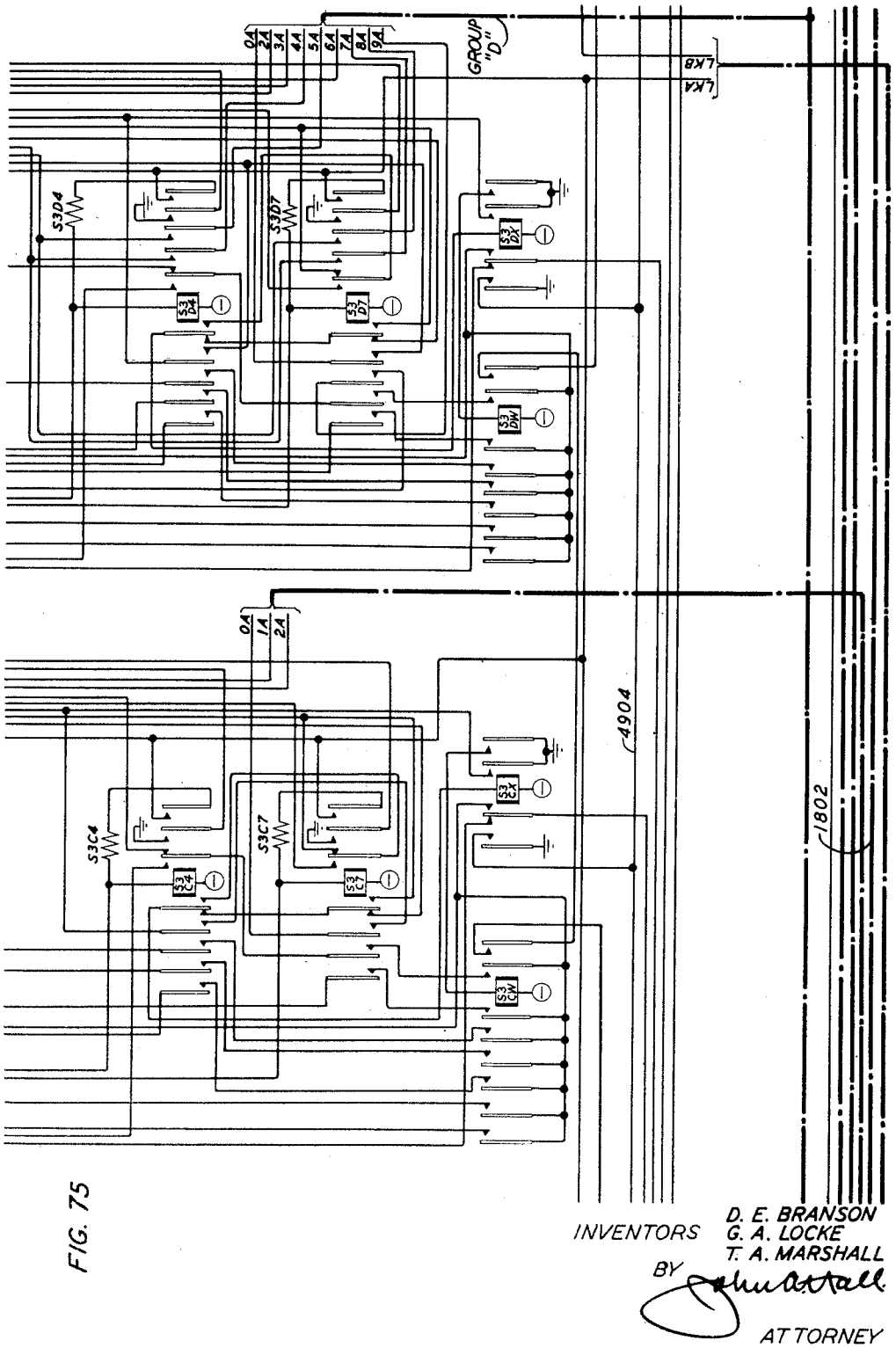

FIG. 75

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 77

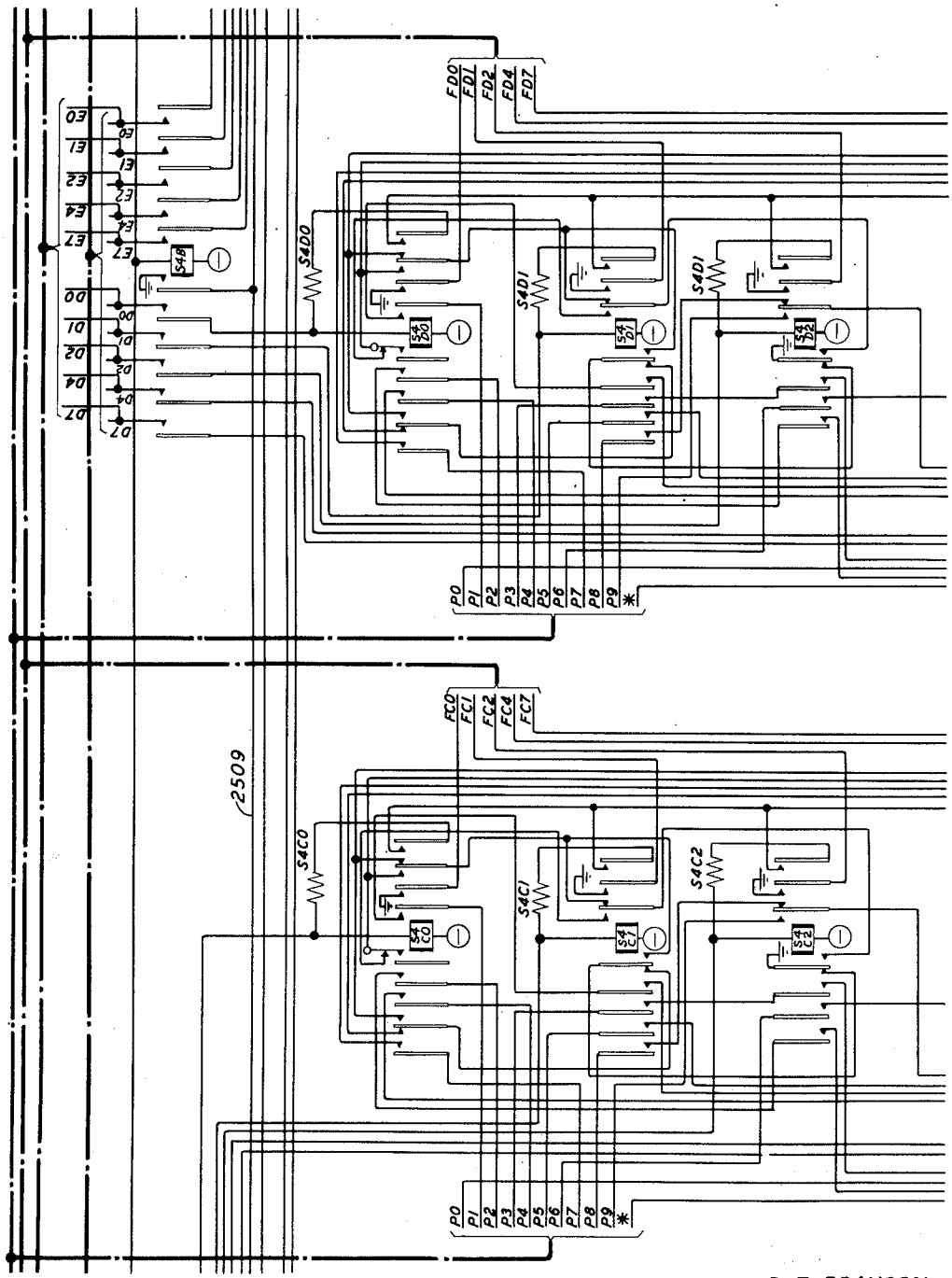

FIG. 76

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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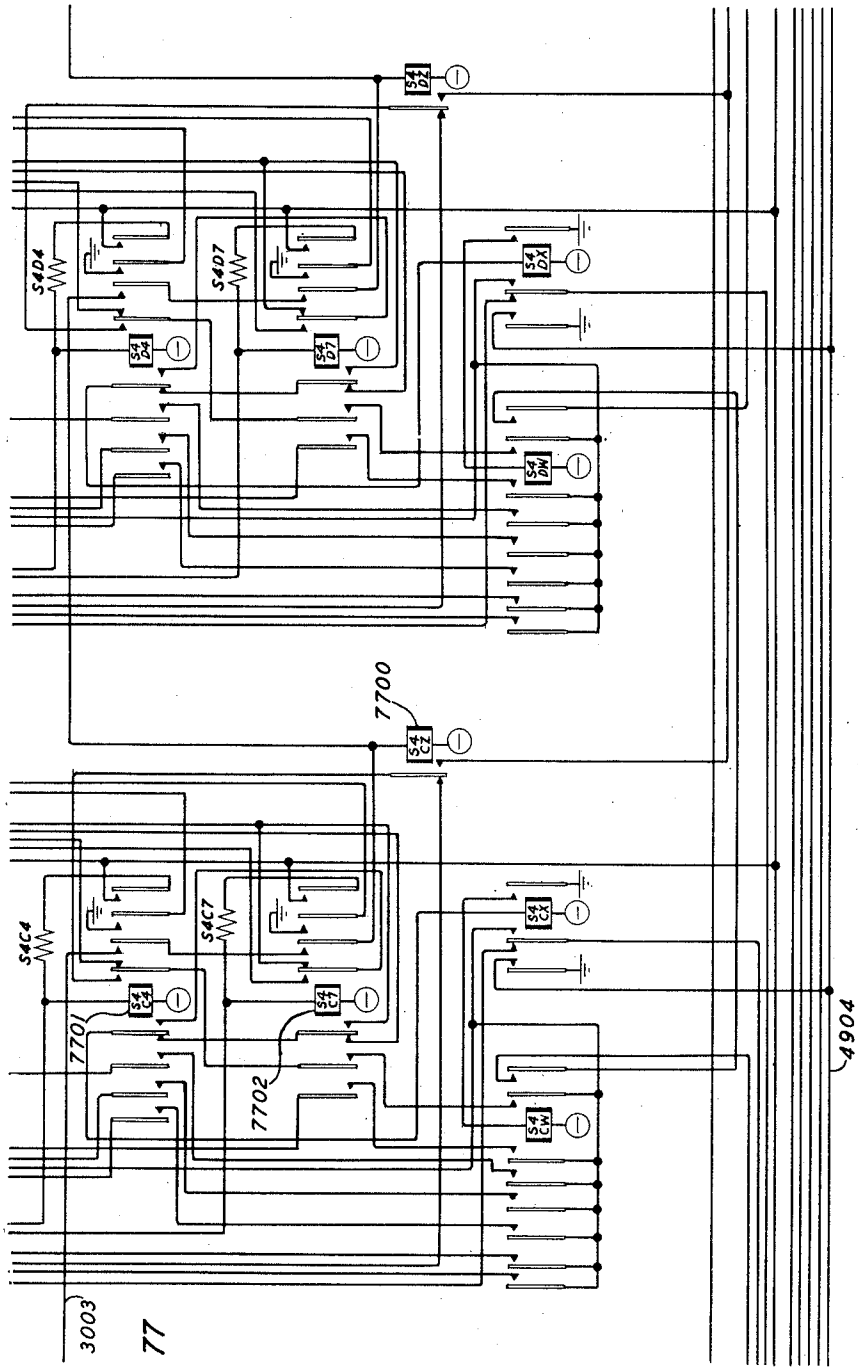

FIG. 77

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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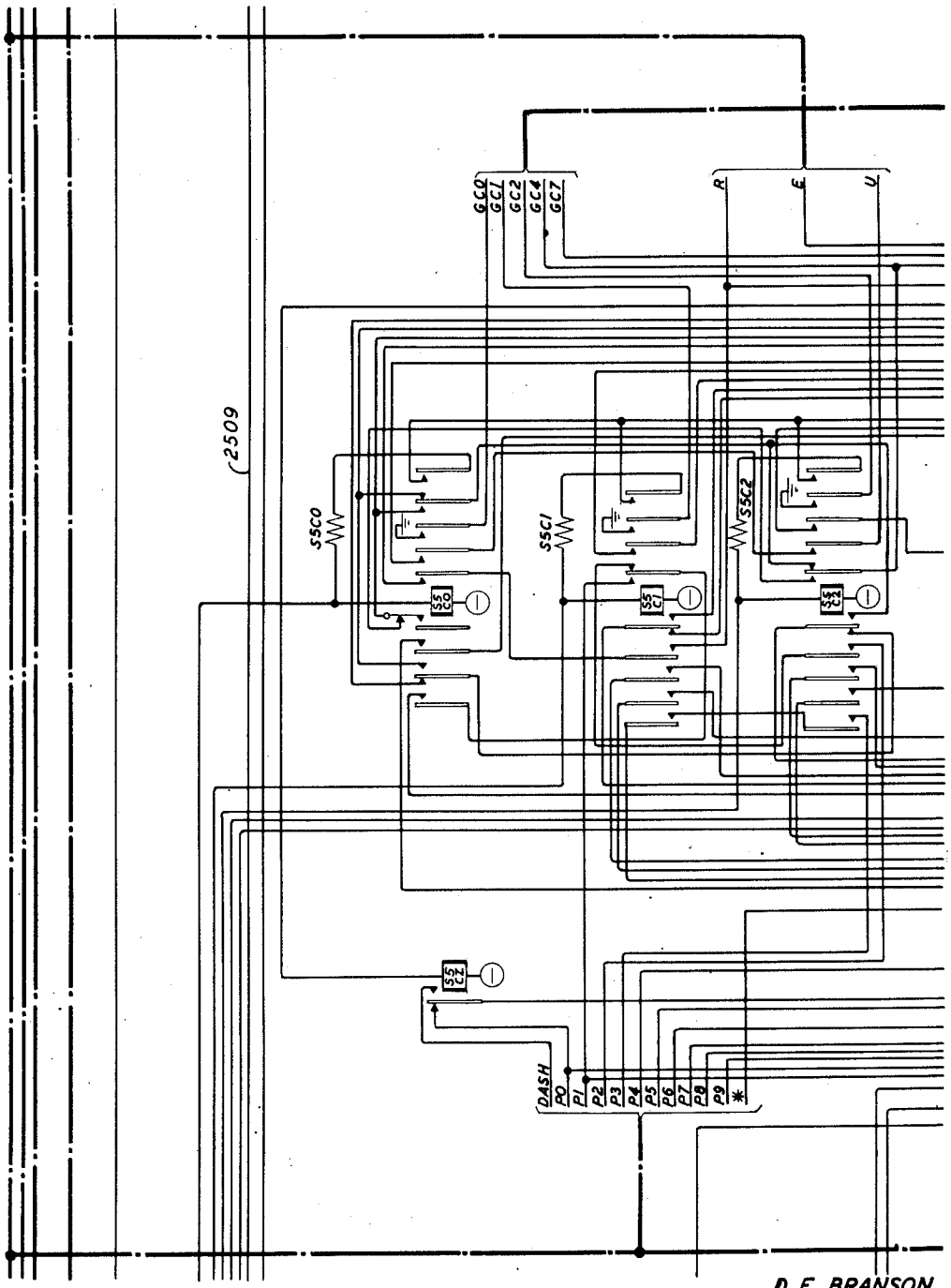

FIG. 78

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

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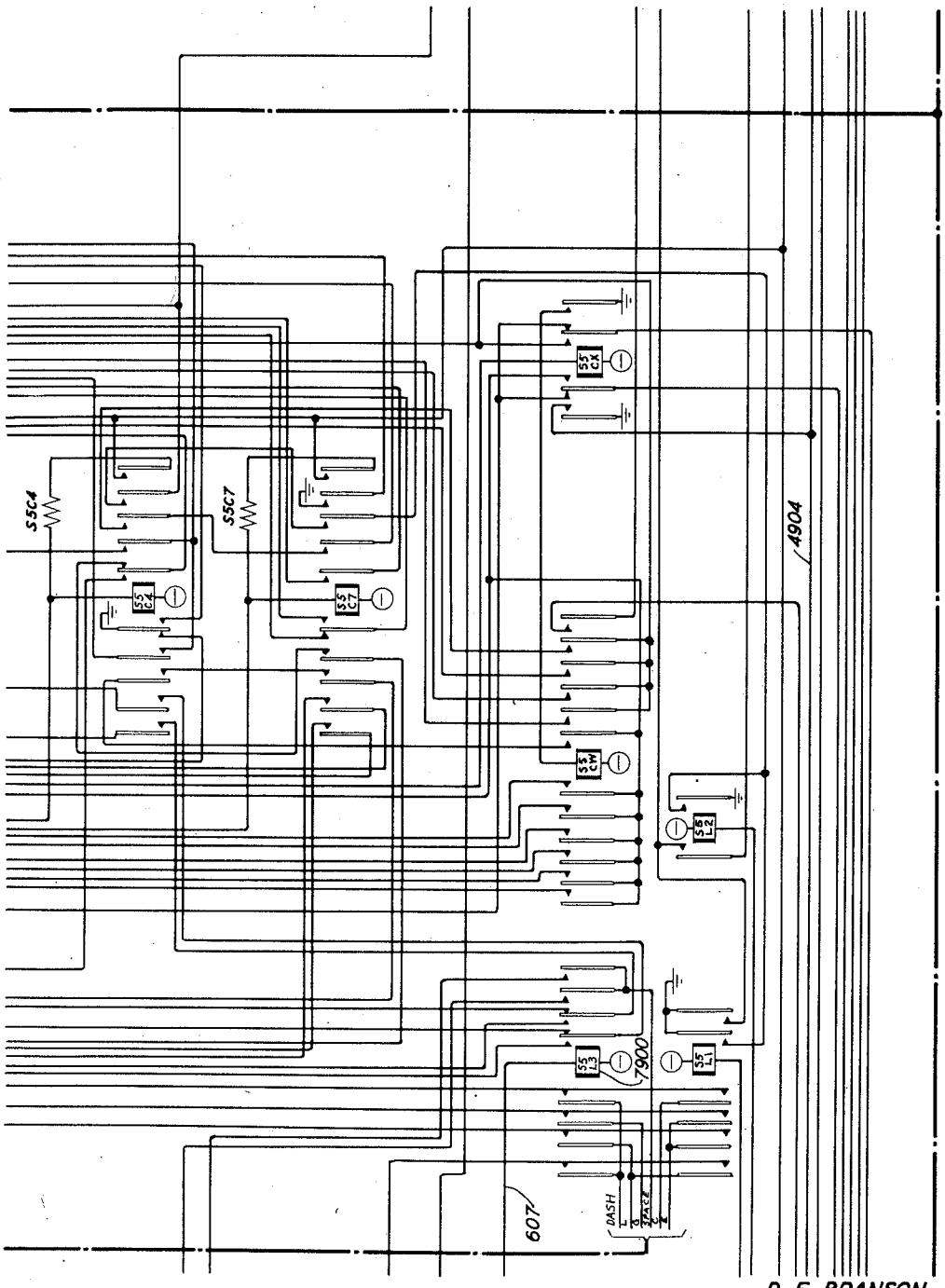

FIG. 79

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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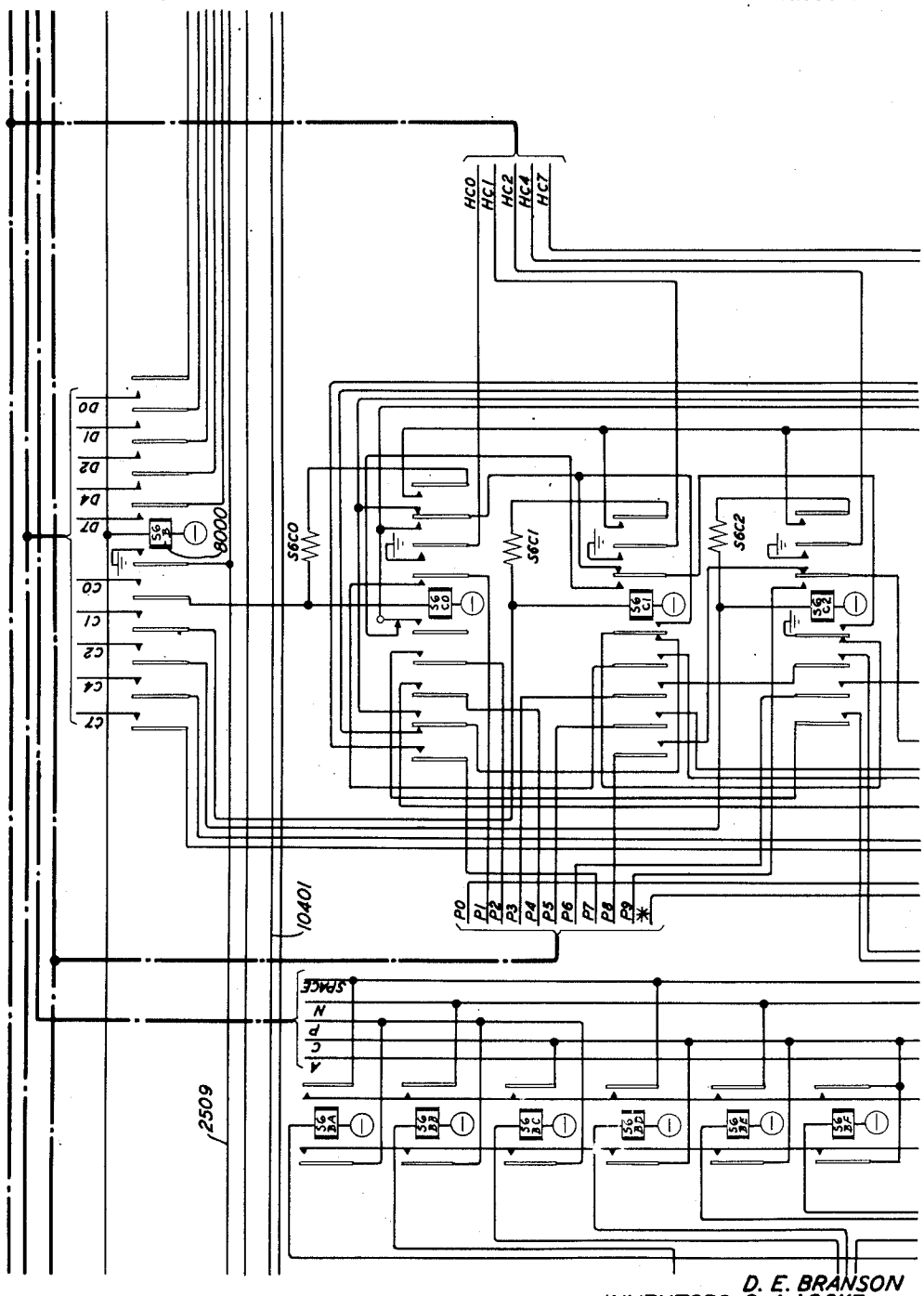

FIG. 80

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY Johnathall.

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

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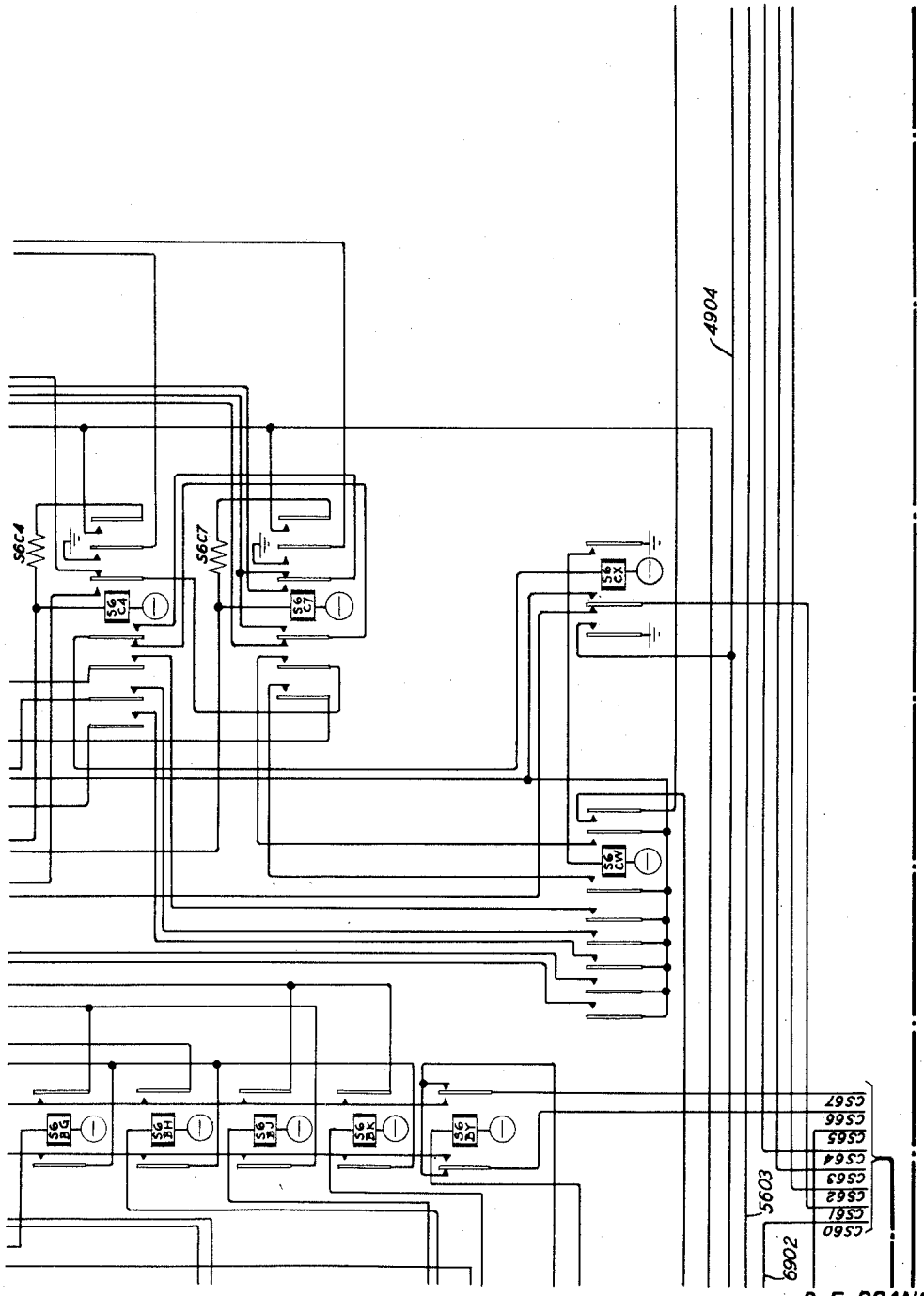

FIG. 81

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

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Filed Jan. 21, 1949 136 Sheets-Sheet 83

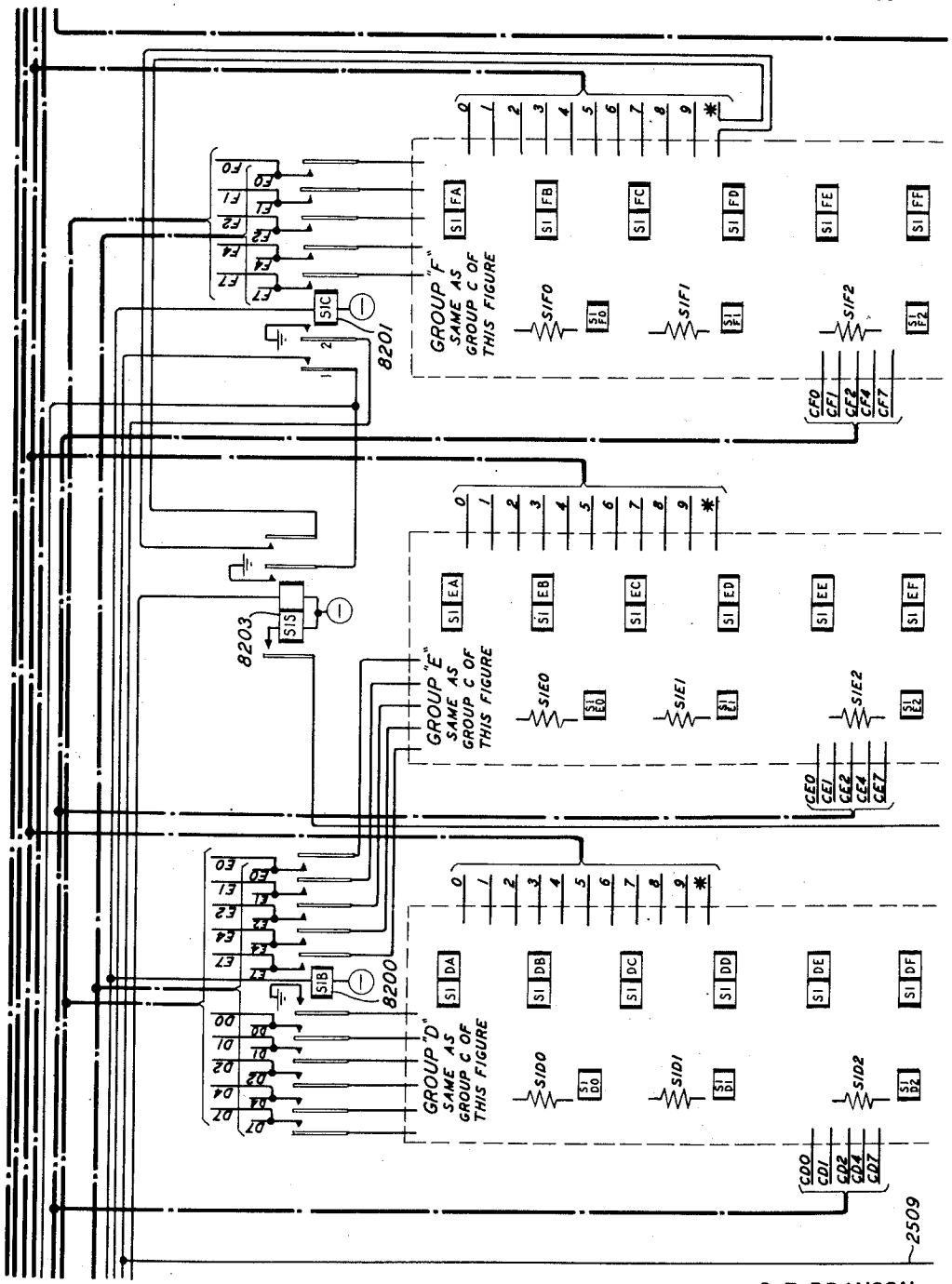

FIG. 82

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 84

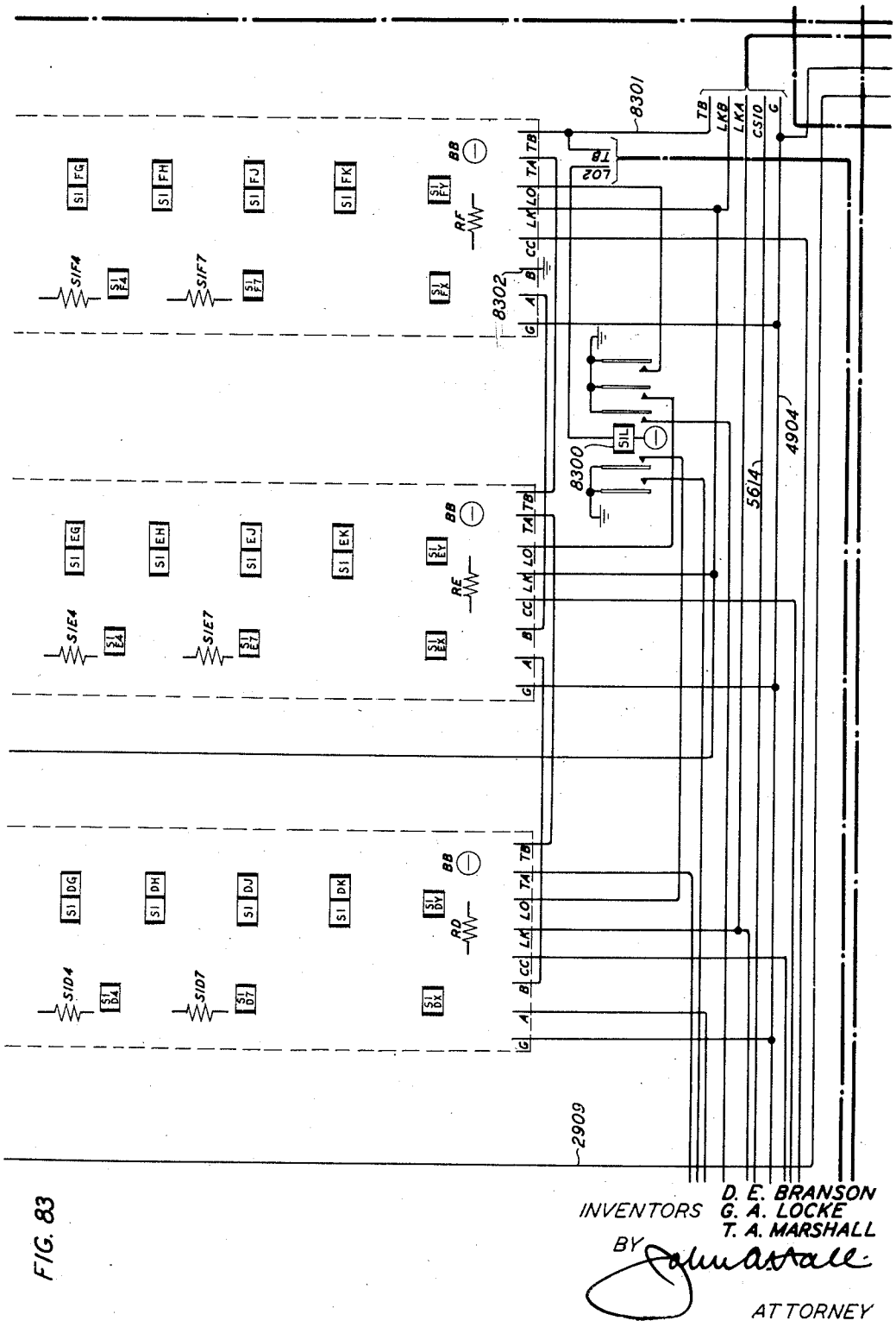

FIG. 83

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

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Filed Jan. 21, 1949 136 Sheets-Sheet 85

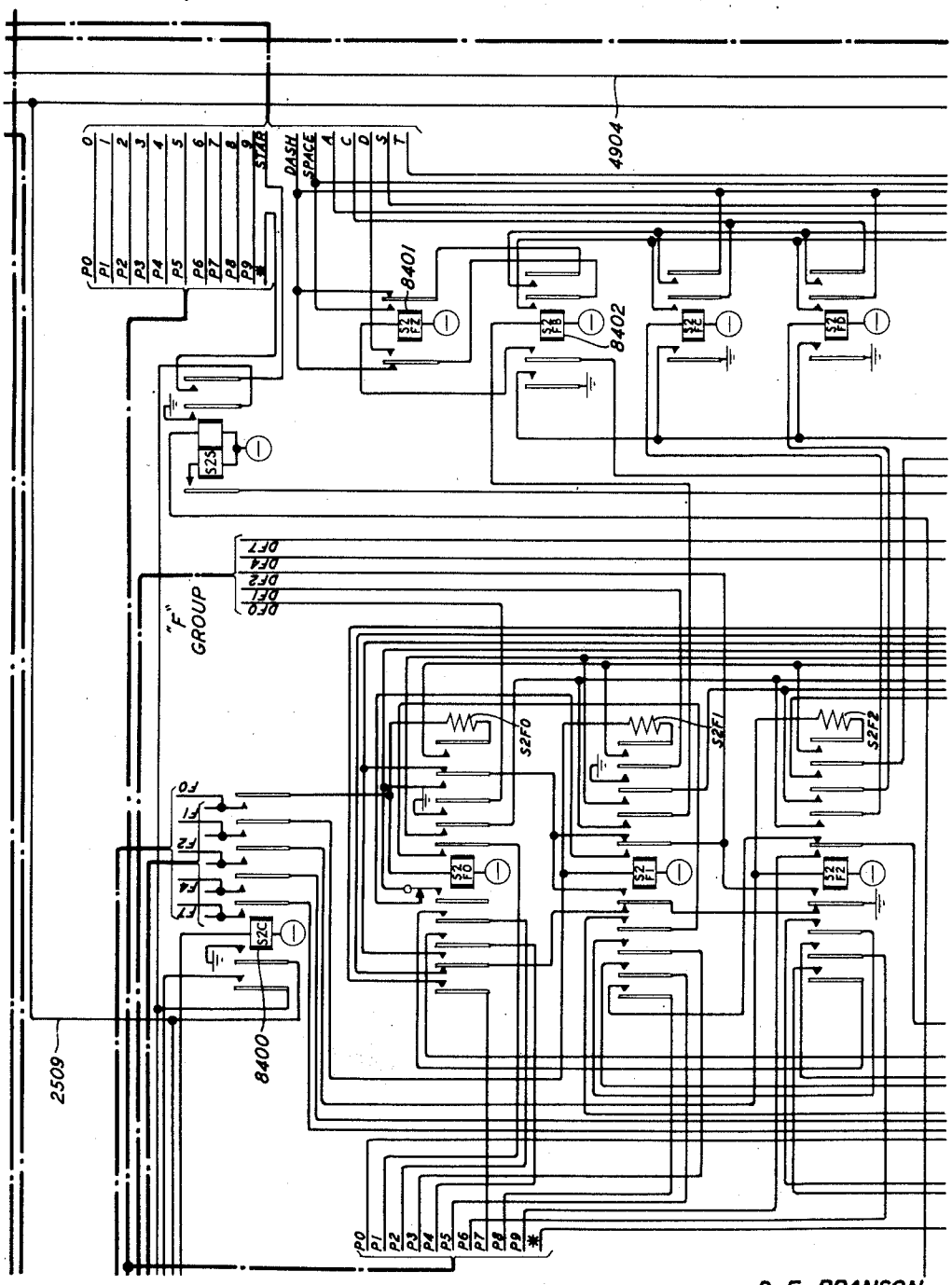

FIG. 84

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 86

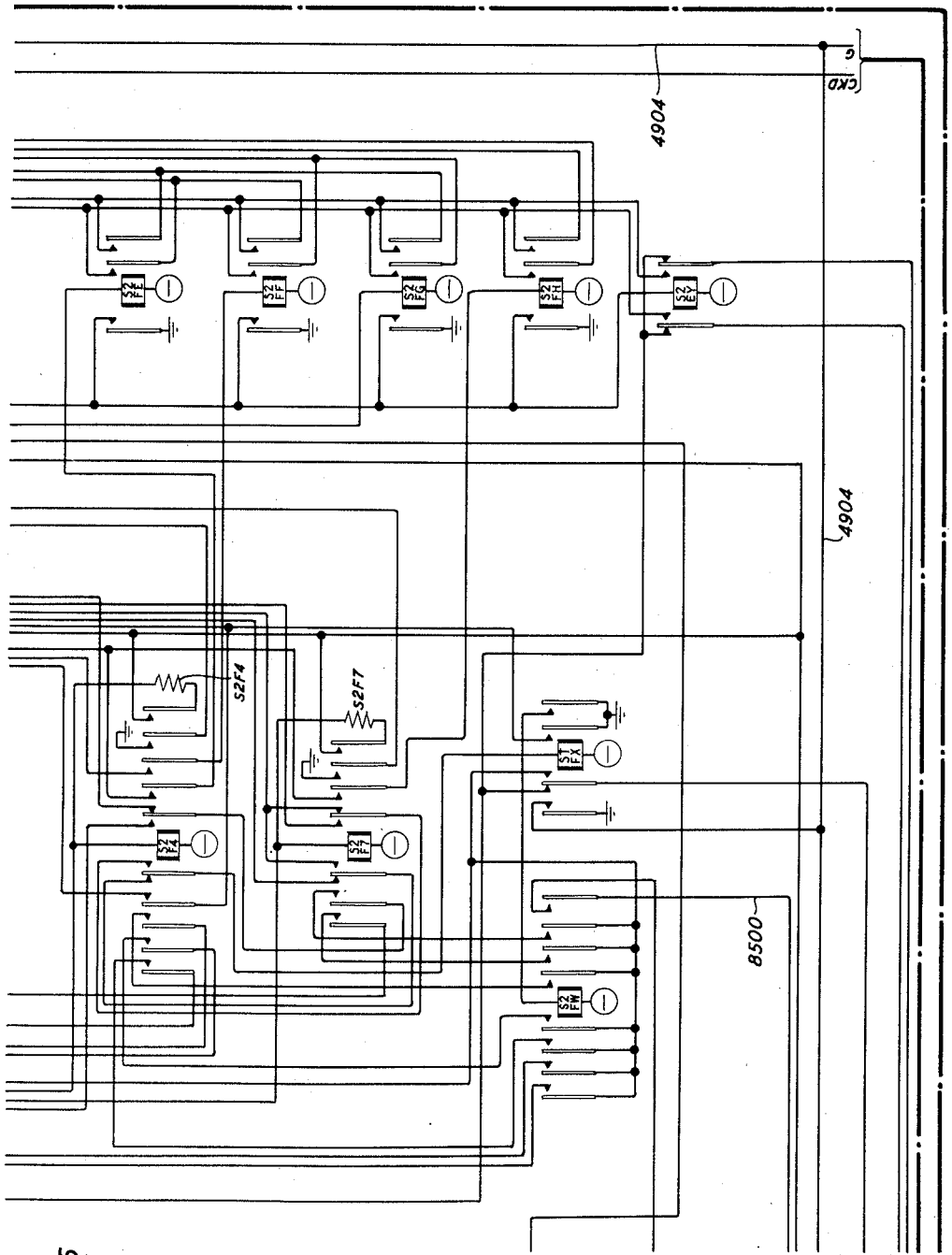

FIG. 85

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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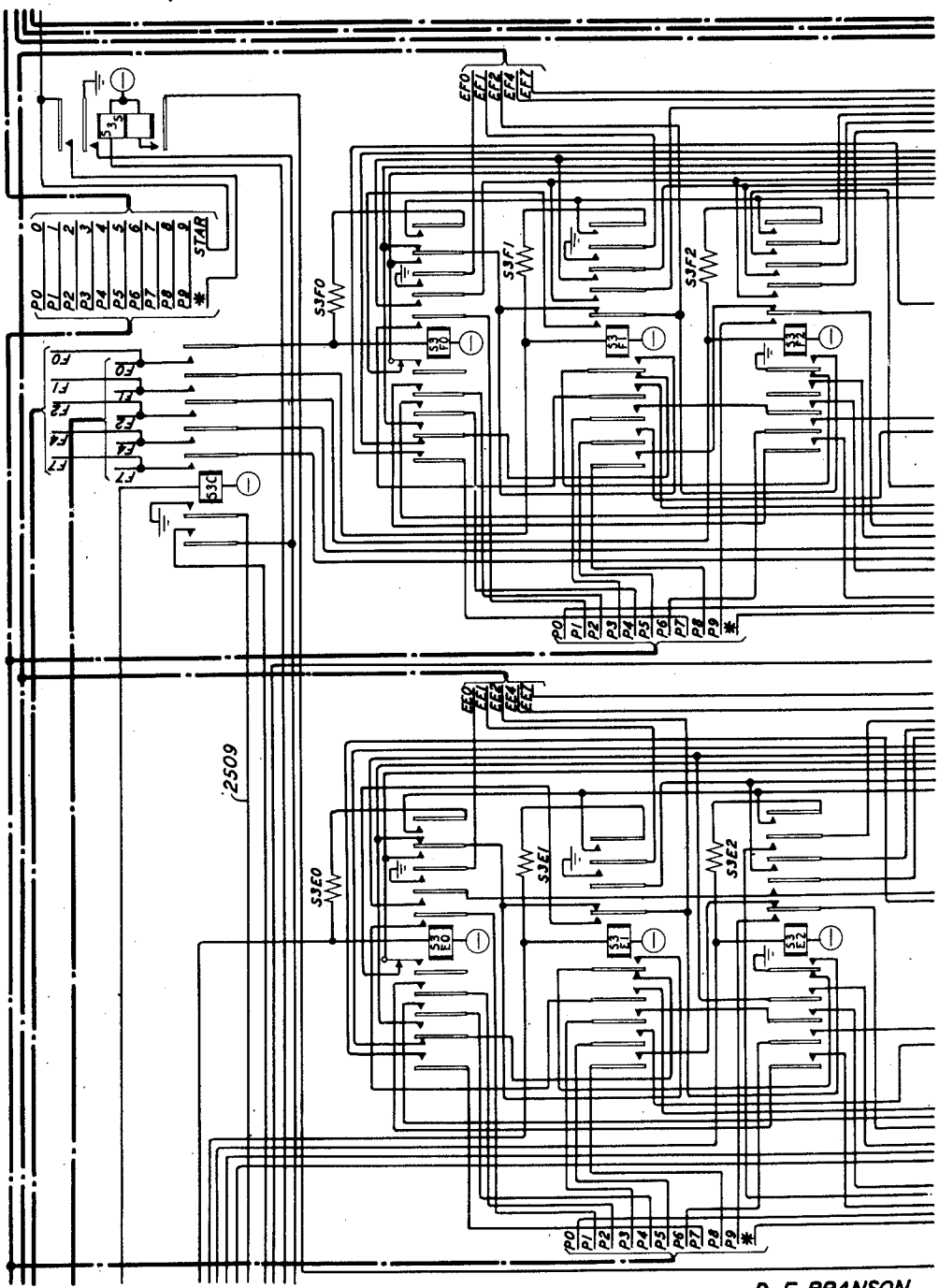

FIG. 86

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

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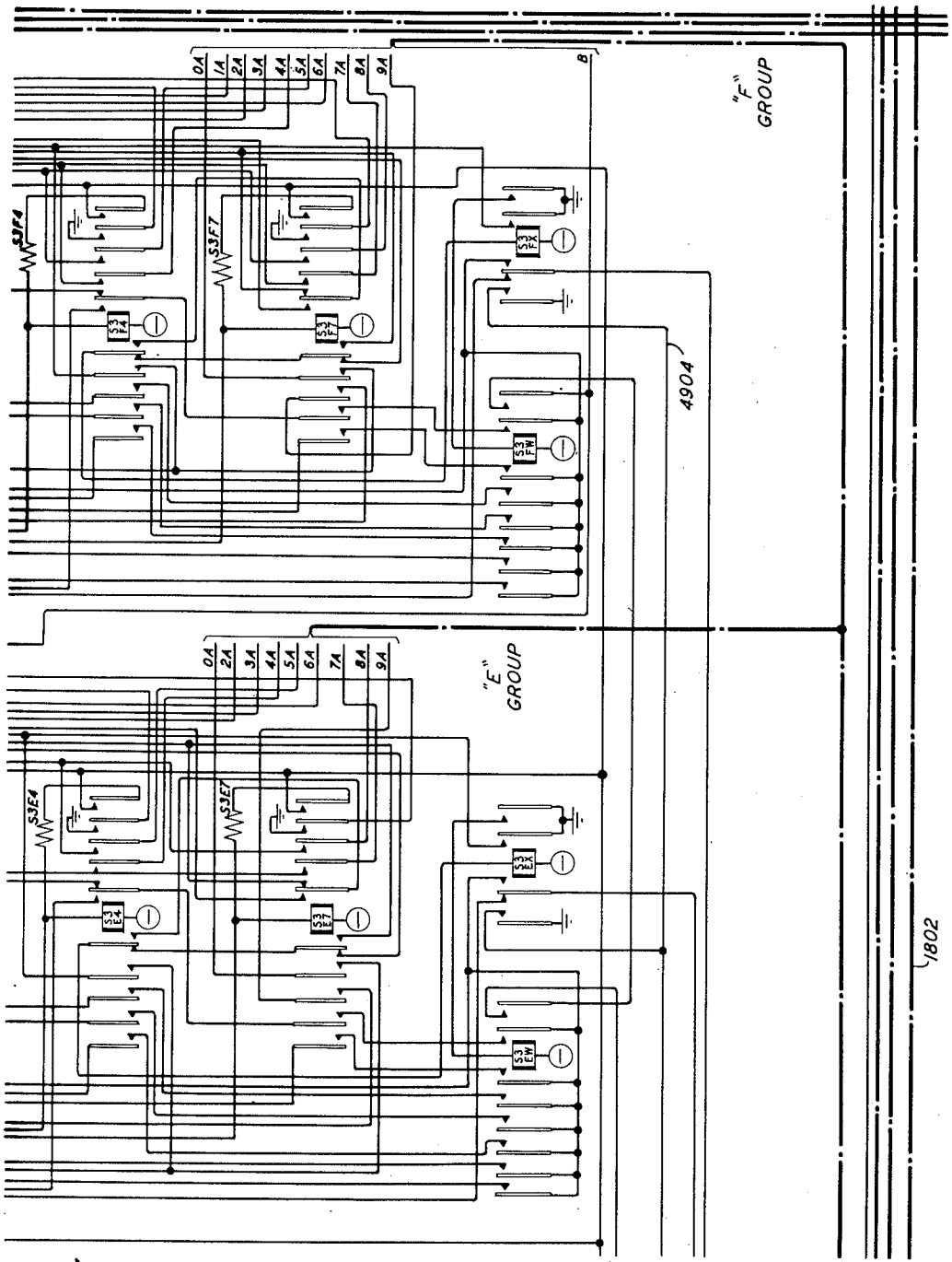

FIG. 87

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

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Filed Jan. 21, 1949 136 Sheets-Sheet 89

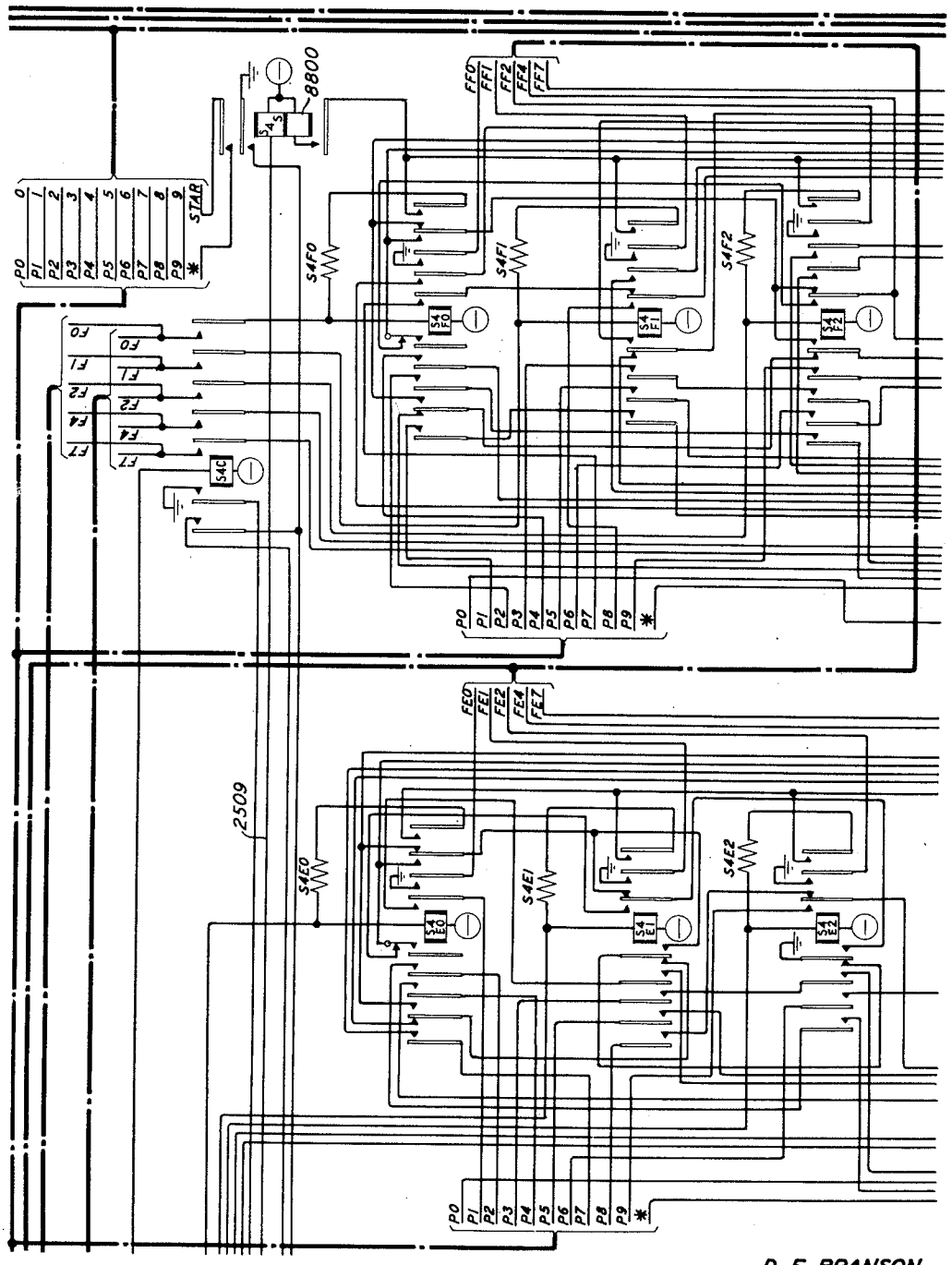

FIG. 88

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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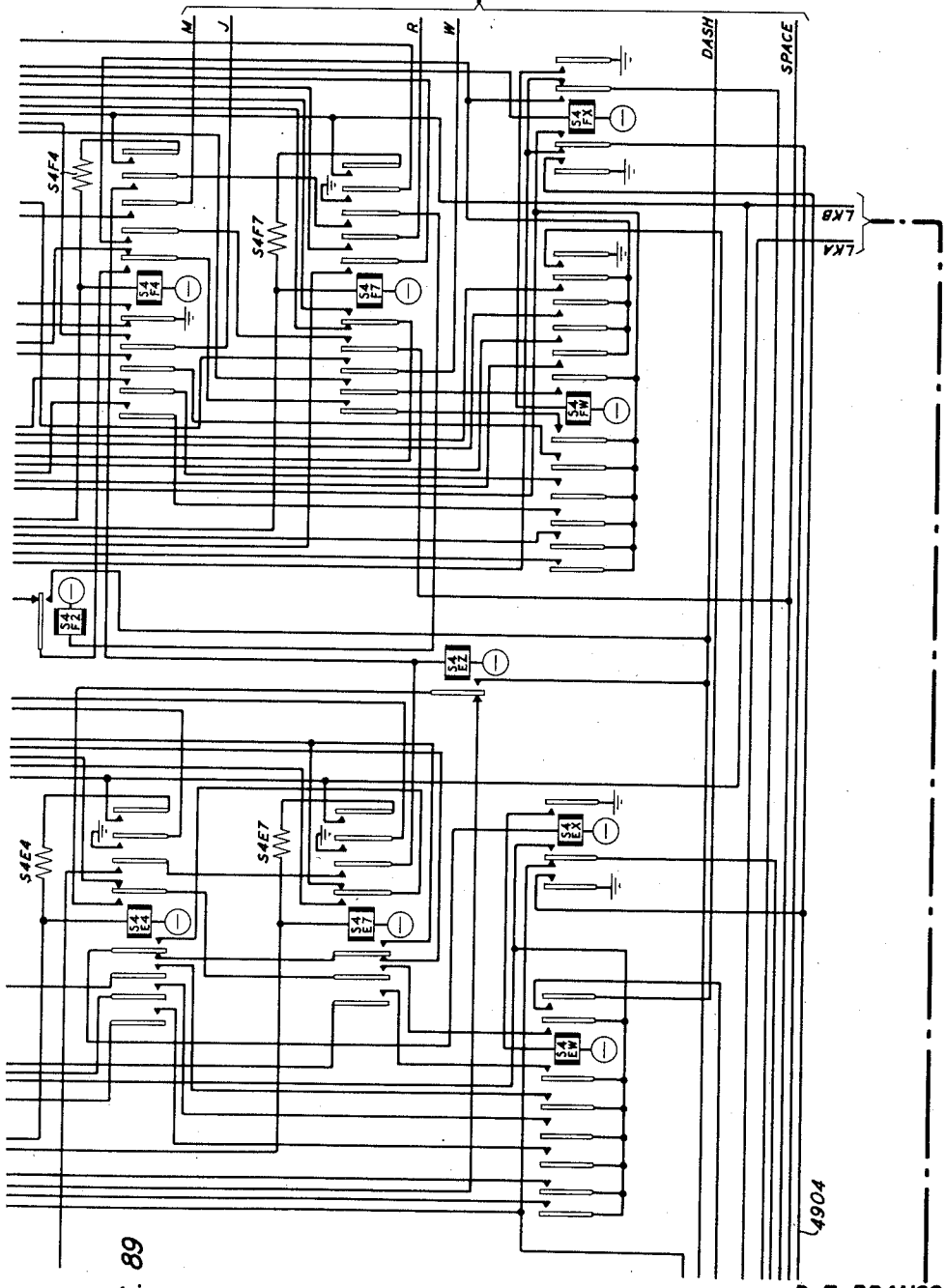

FIG. 89

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

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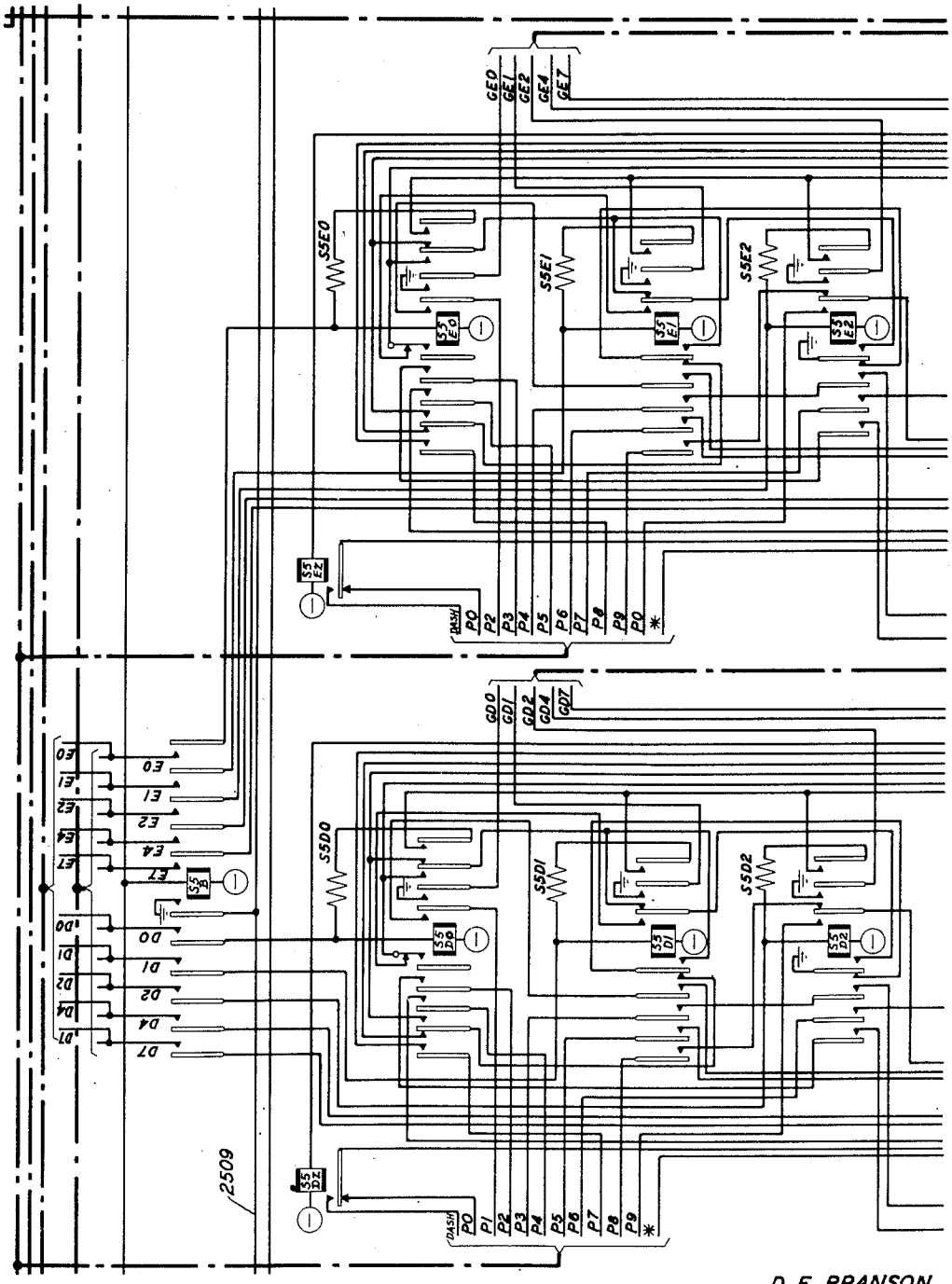

FIG. 90

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 92

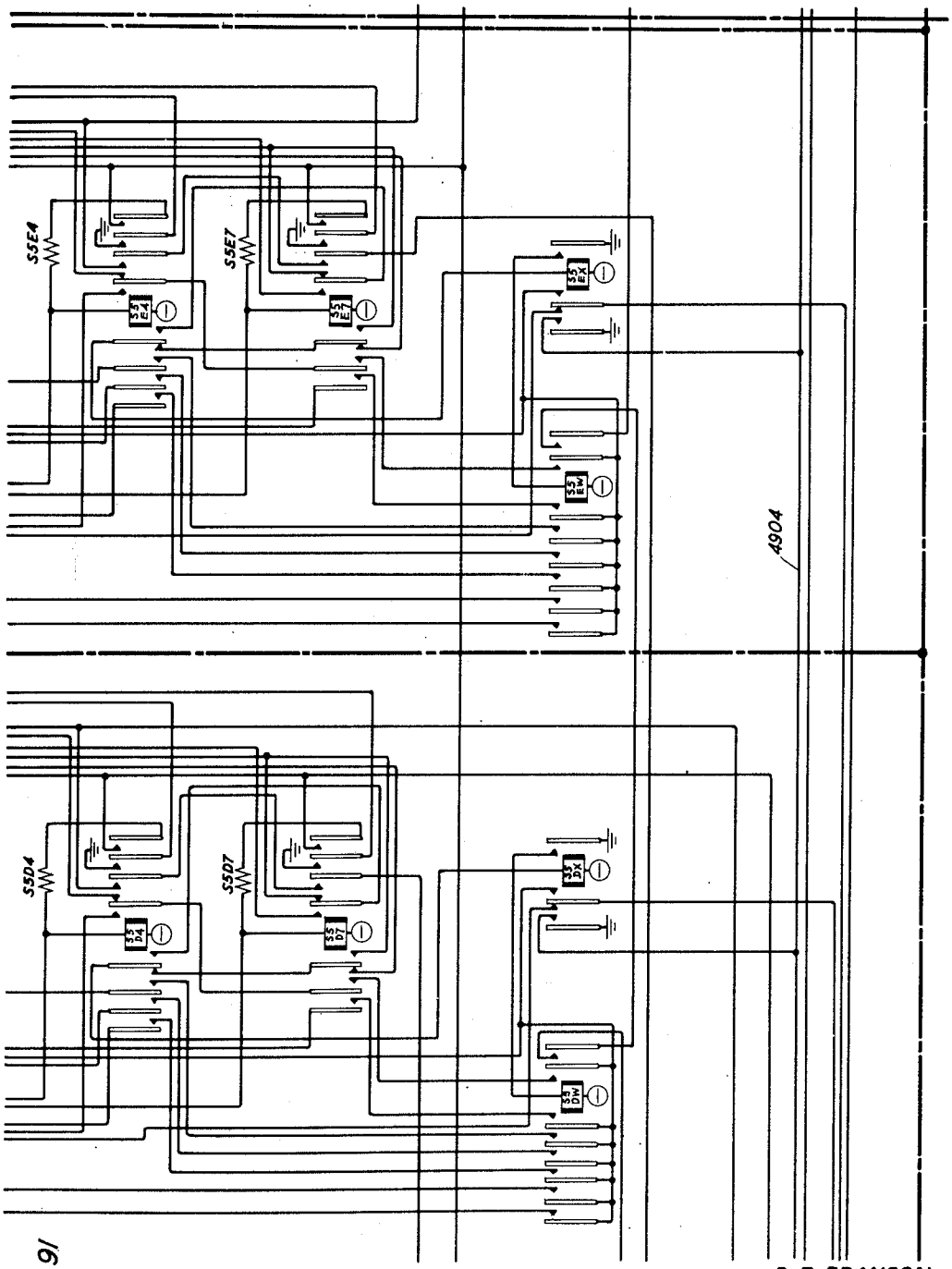

FIG. 91

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John Marshall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 93

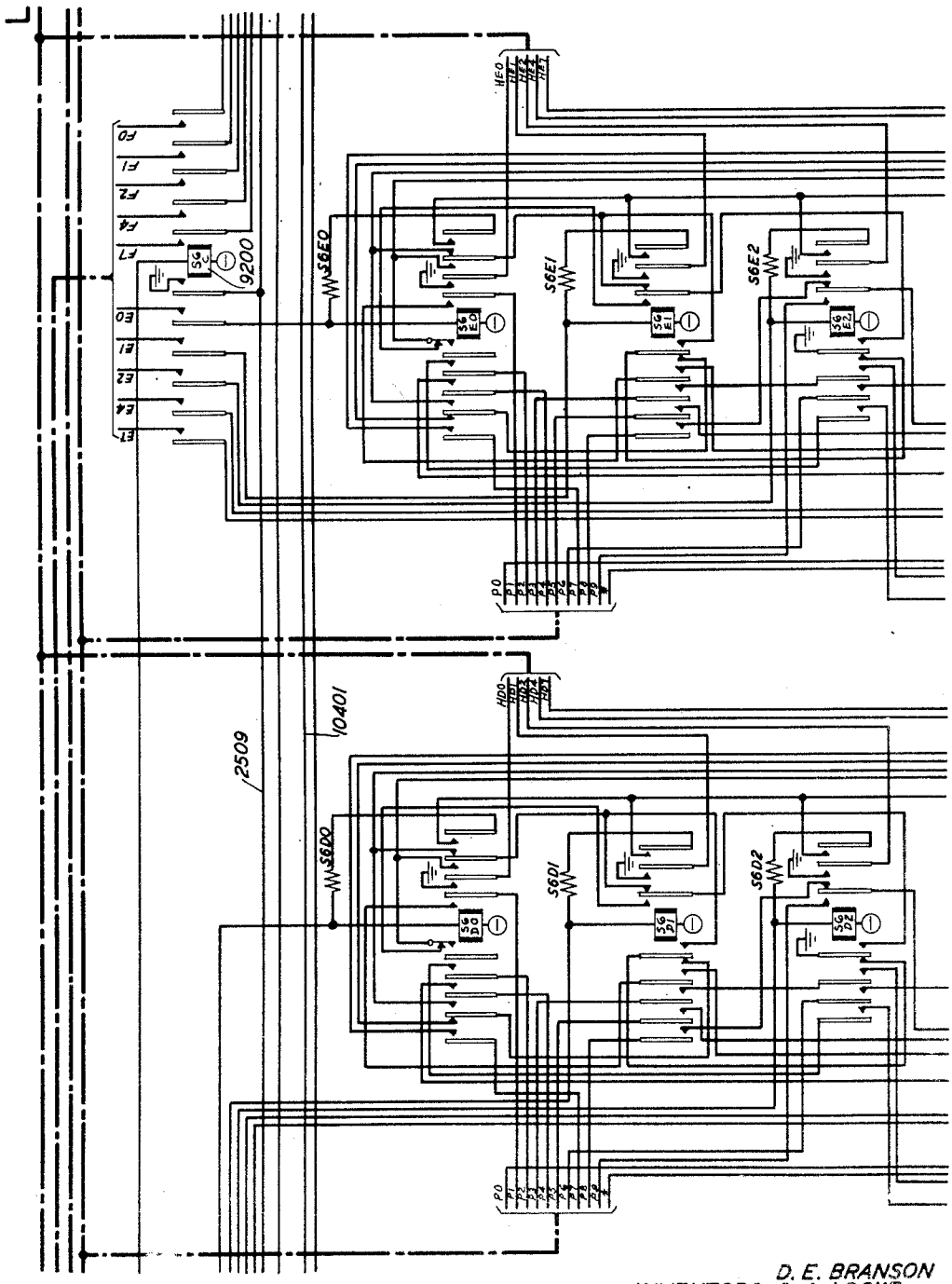

FIG. 92

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 94

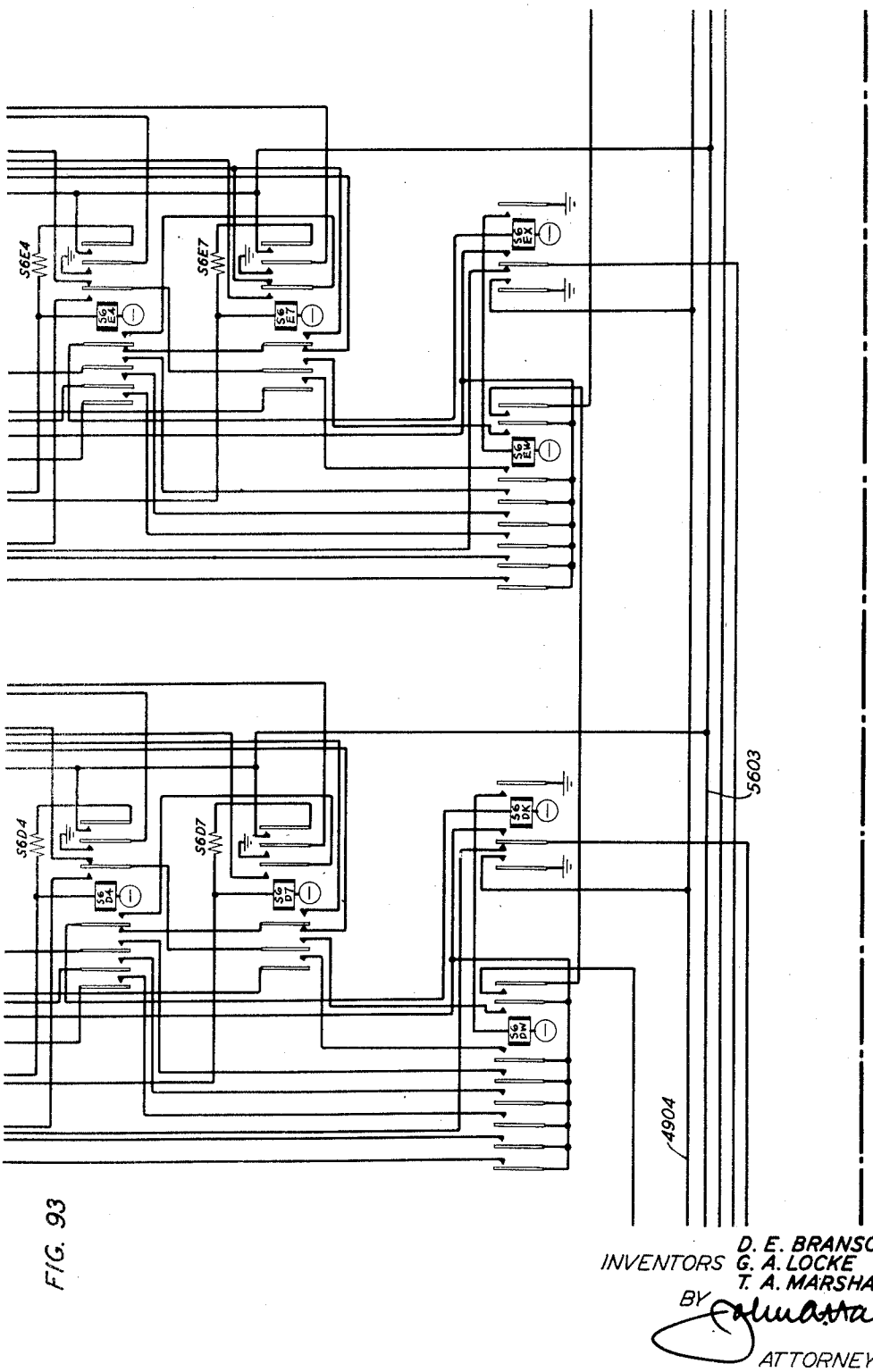

FIG. 93

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 95

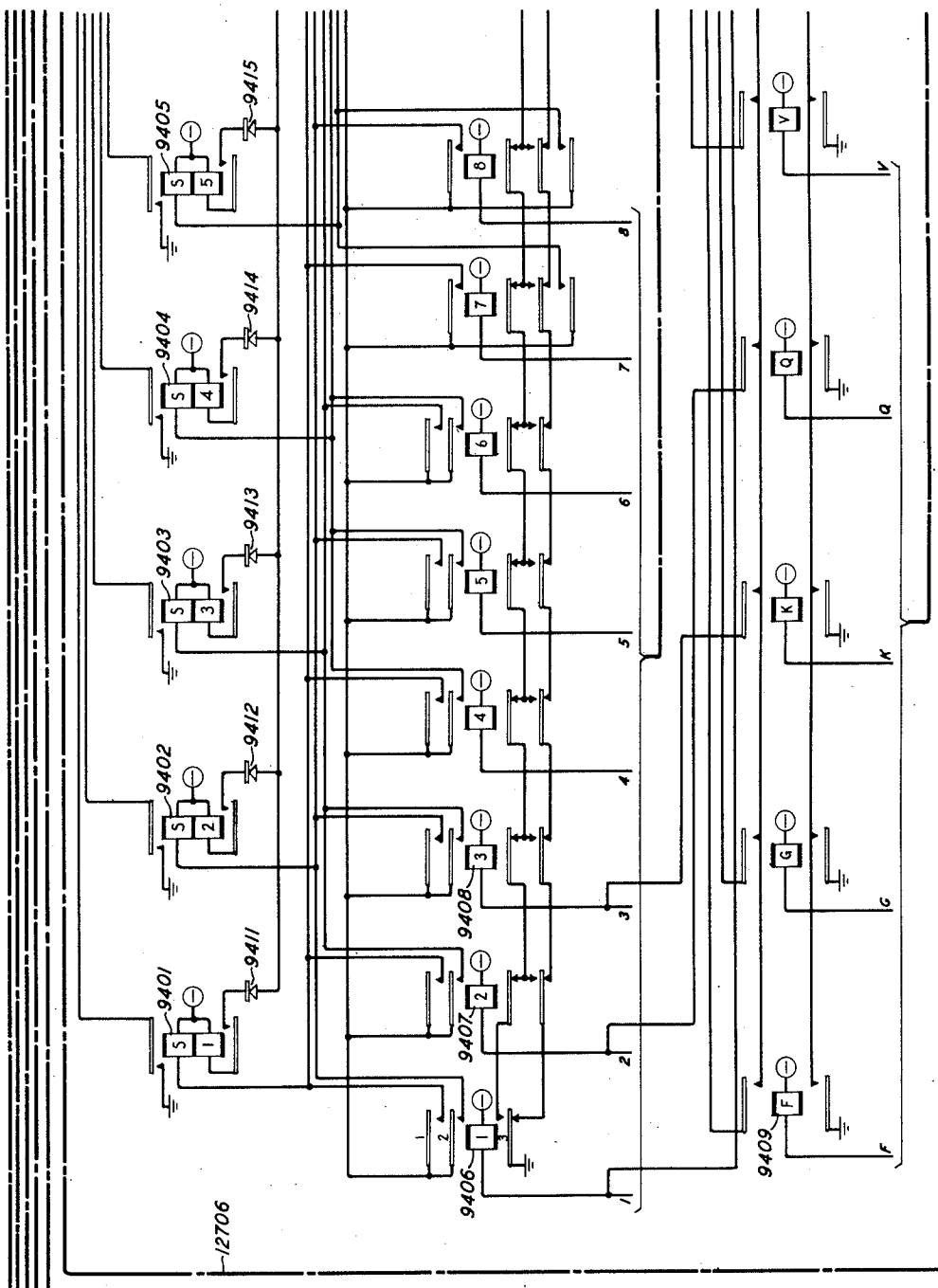

FIG. 94

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 96

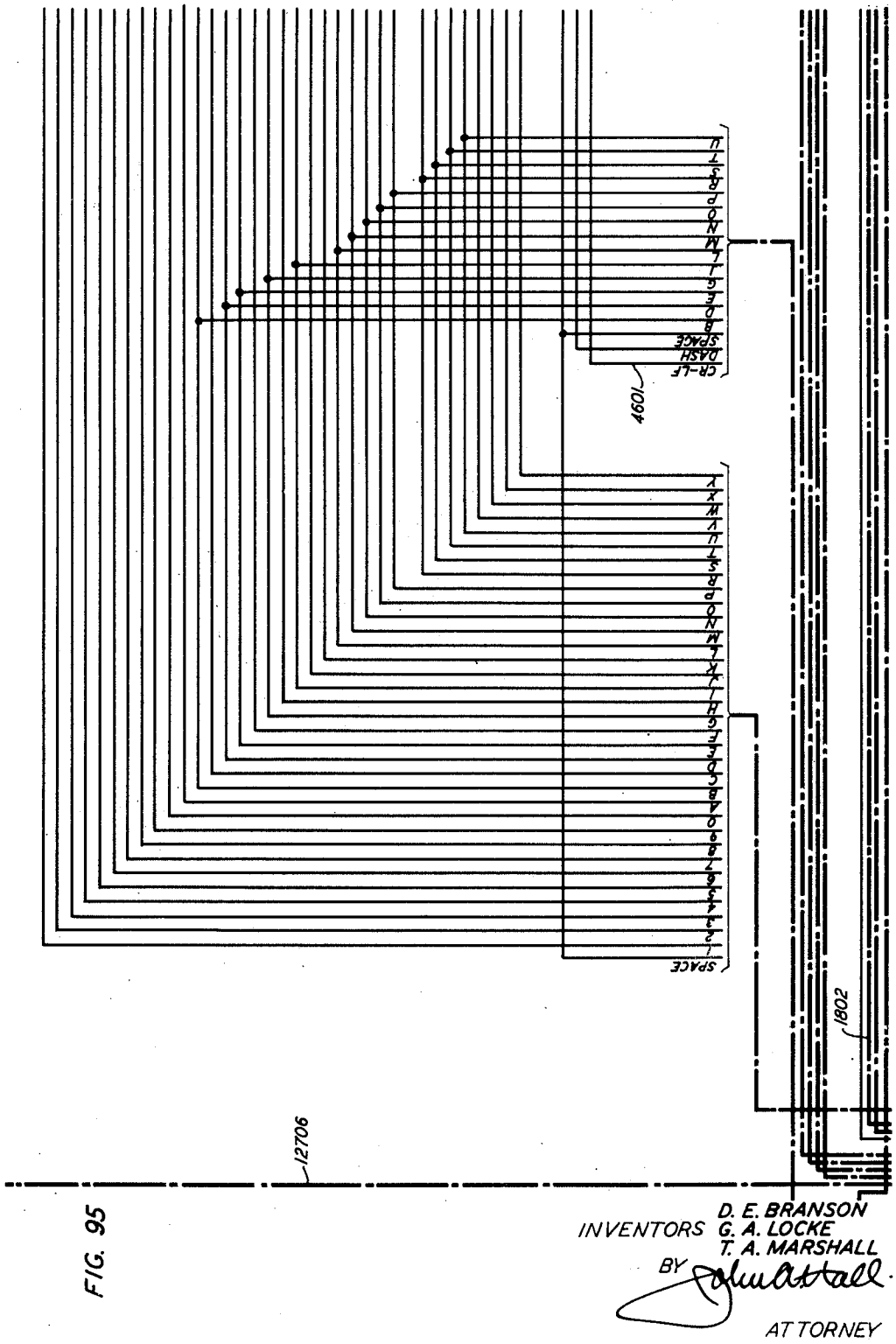

FIG. 95

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Stall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 97

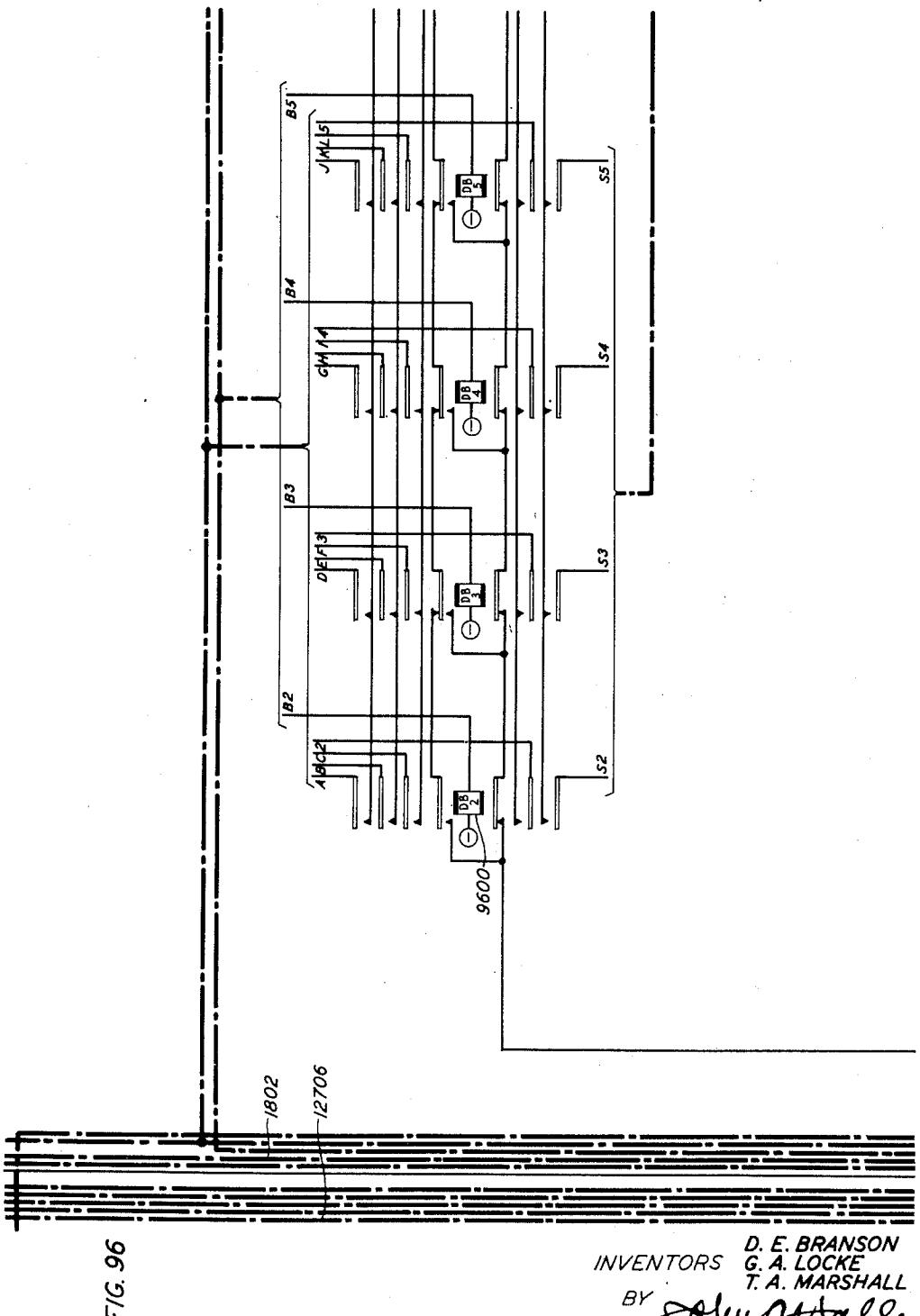

FIG. 96

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 98

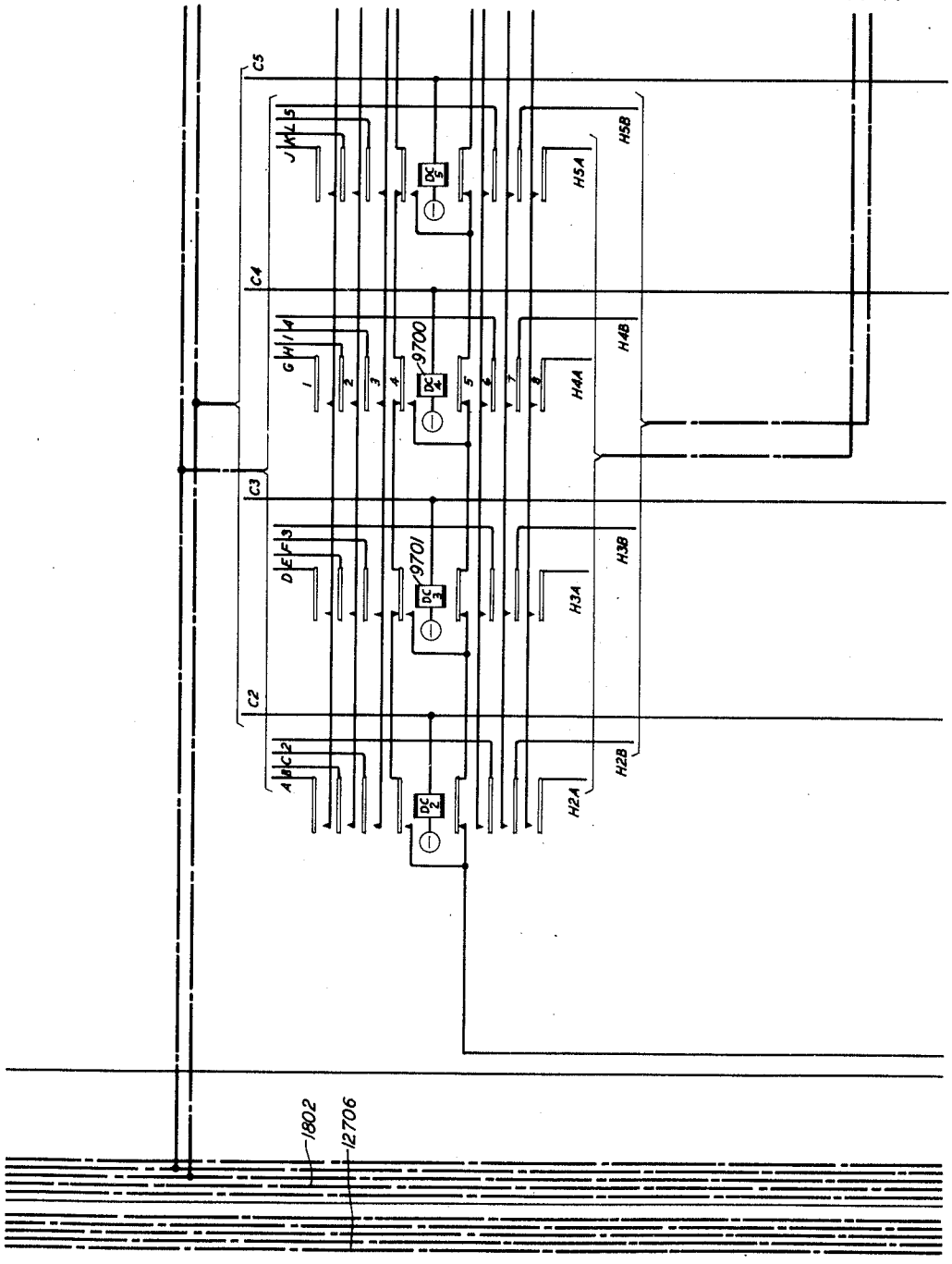

FIG. 97

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall.

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 99

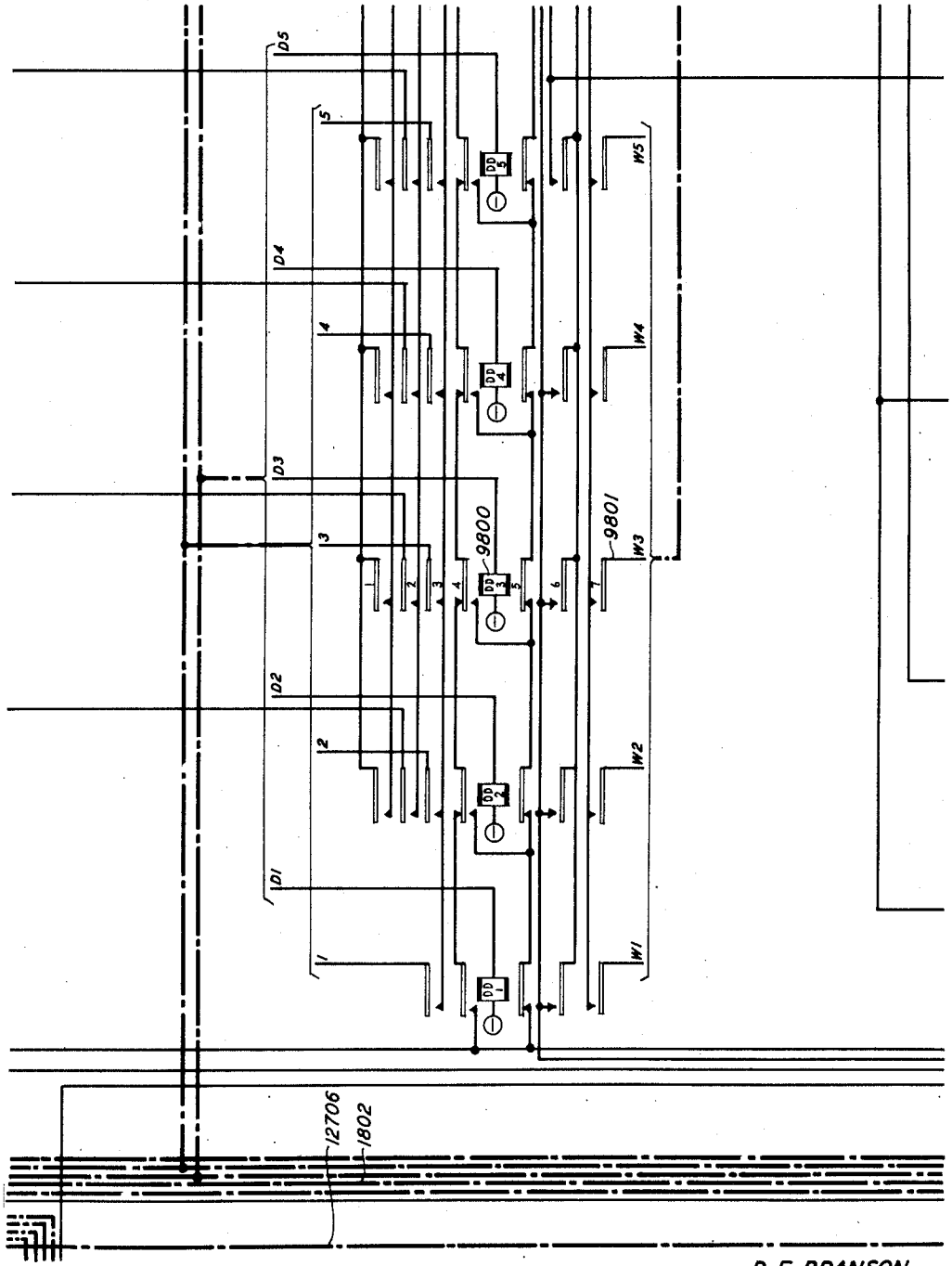

FIG. 98

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 100

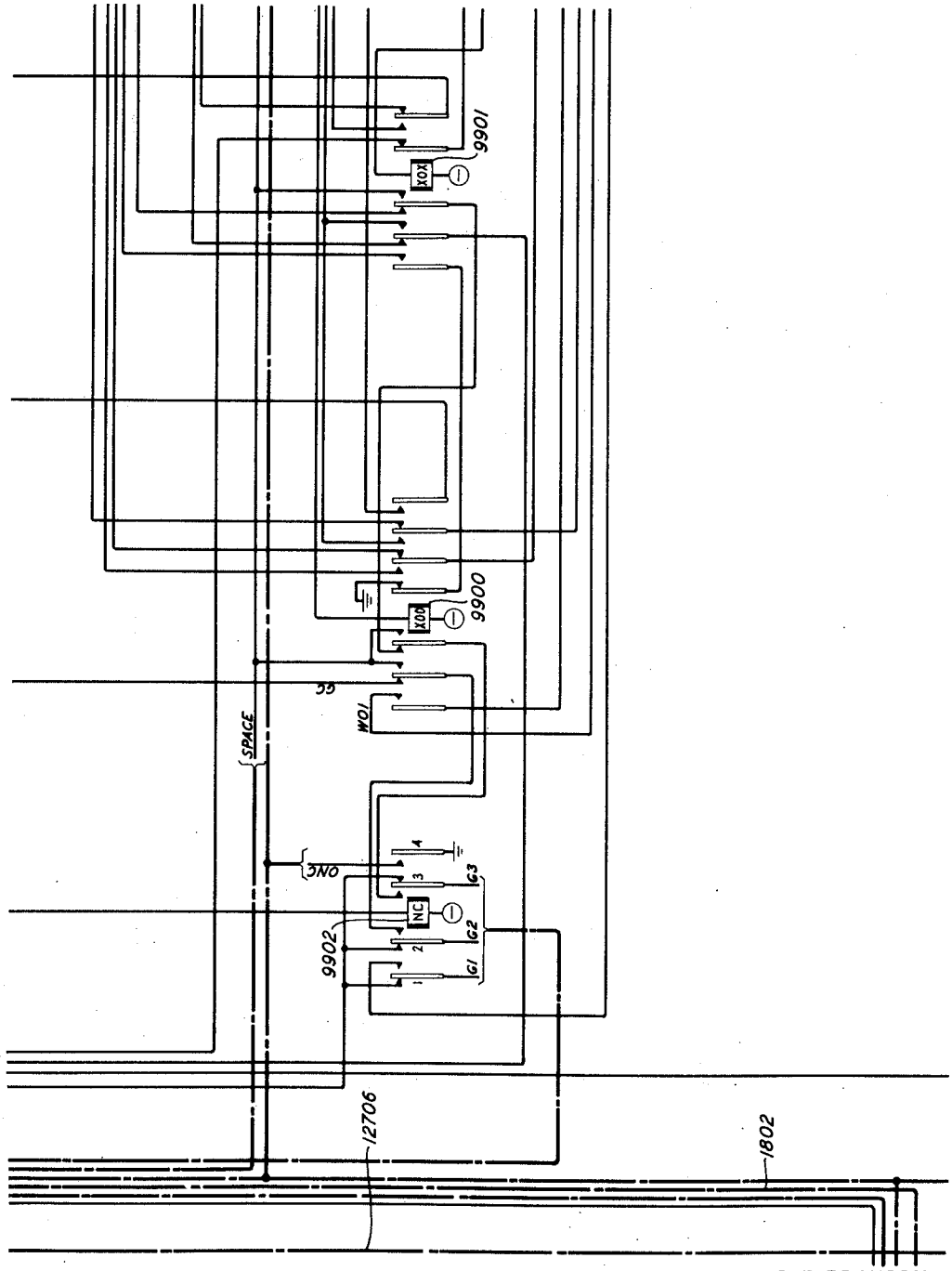

FIG. 99

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Vaccaro

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 101

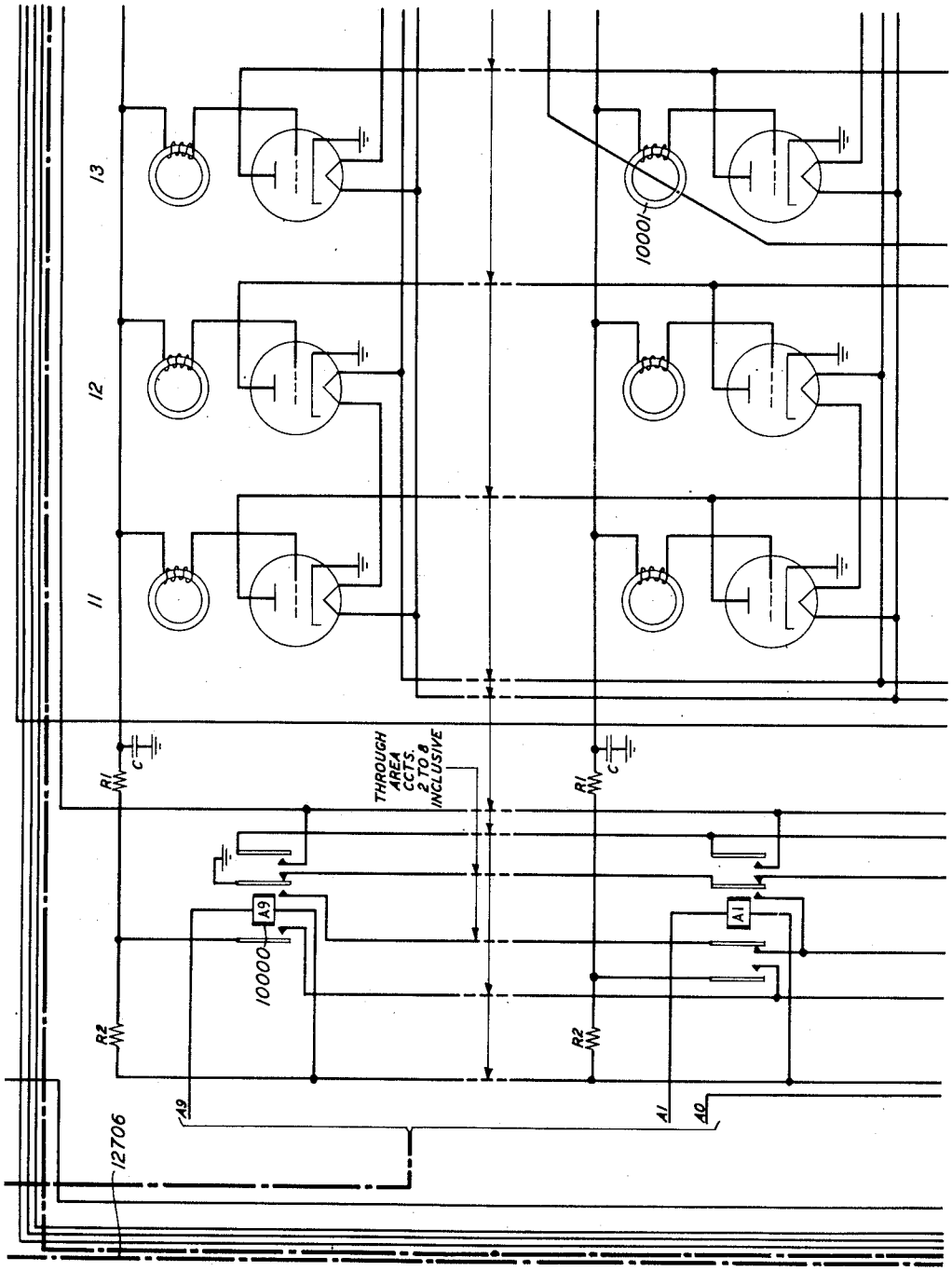

FIG. 100

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 102

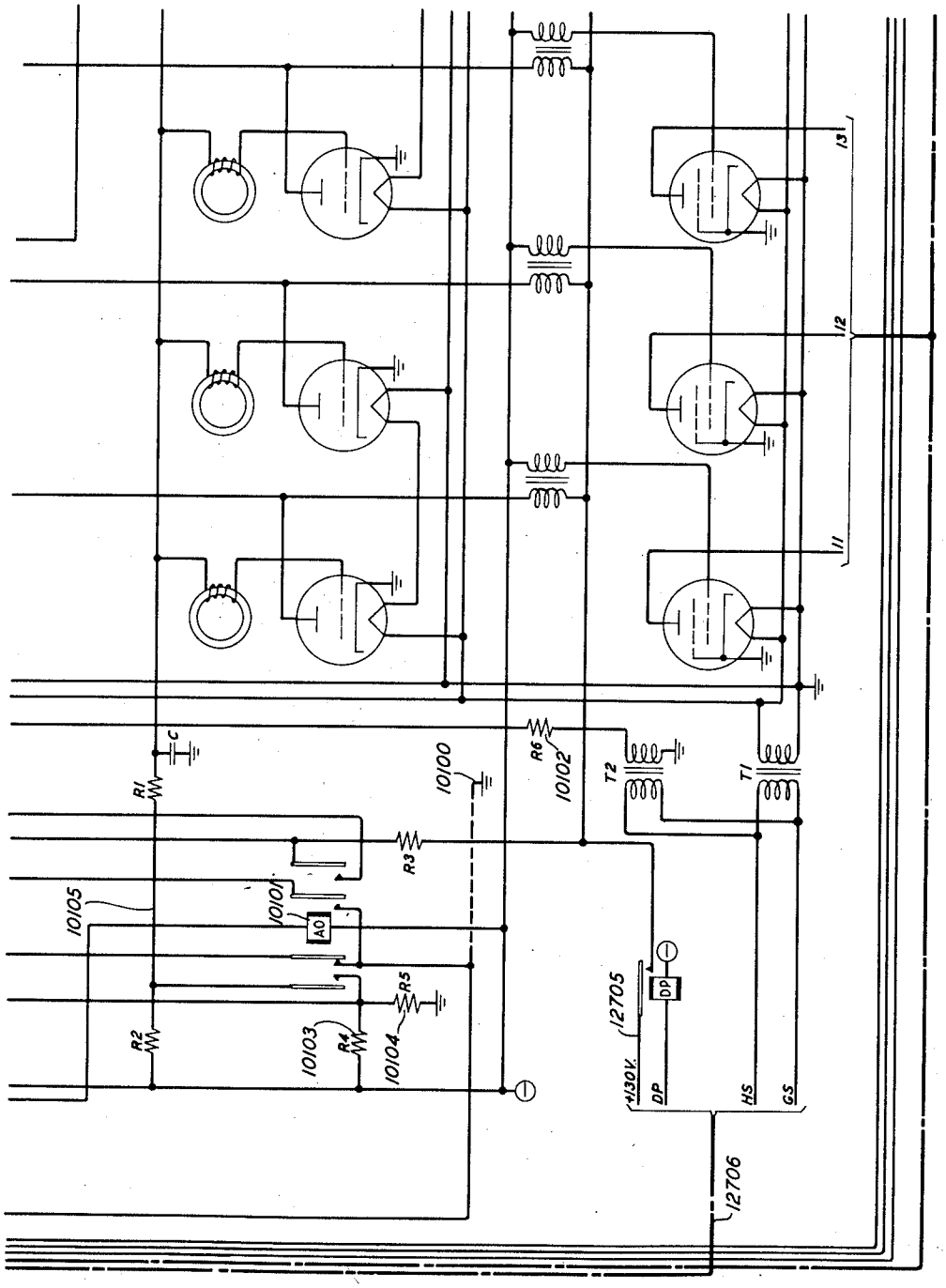

FIG. 101

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 103

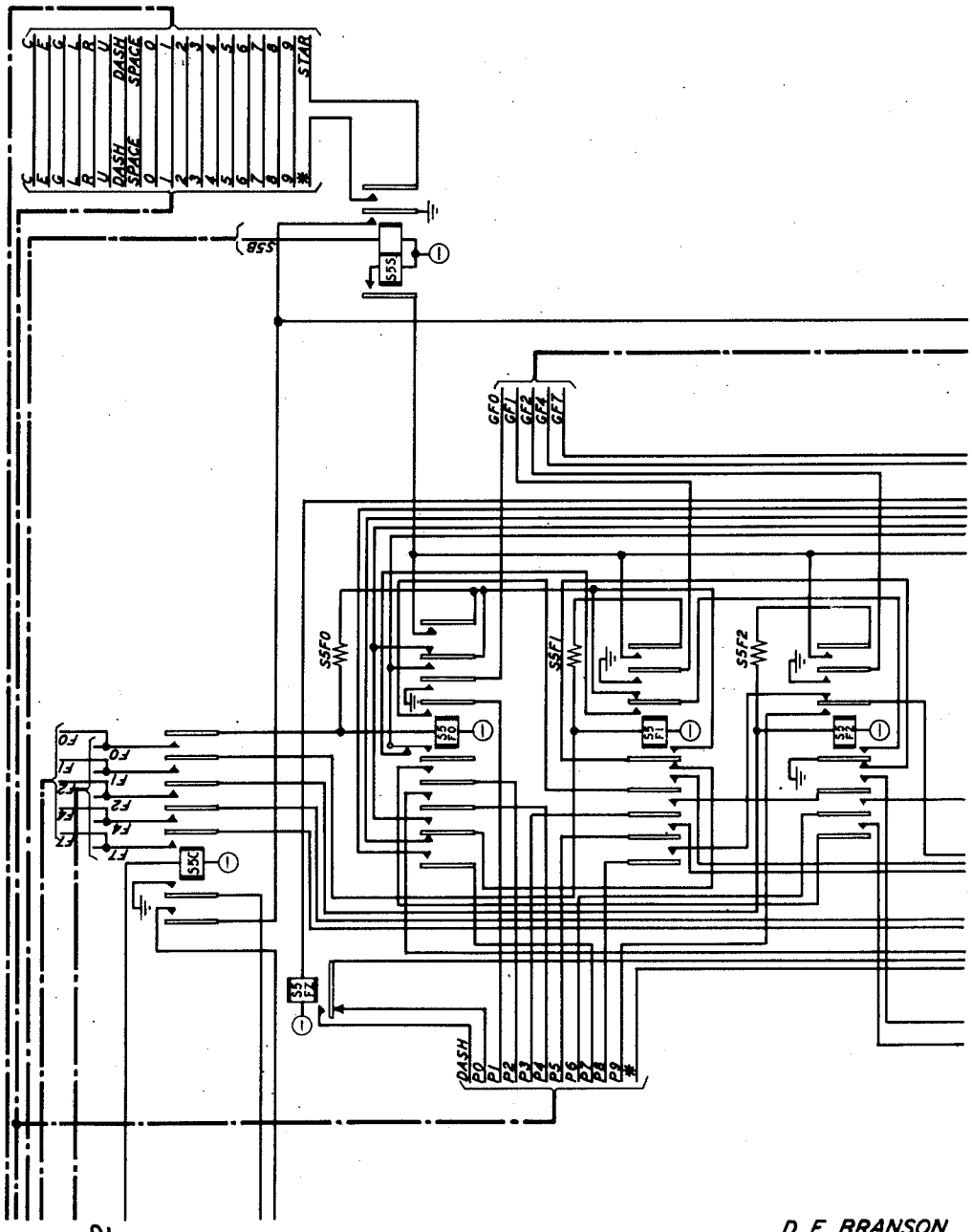

FIG. 102

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 104

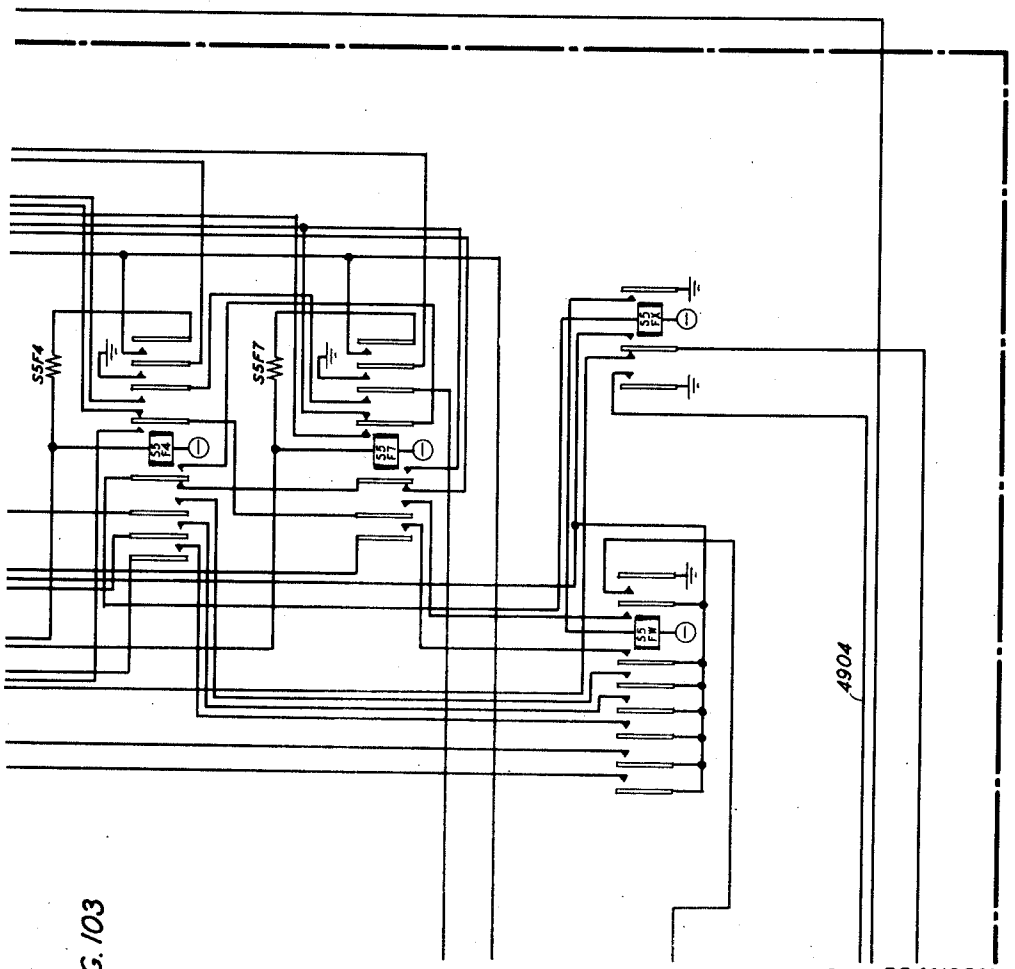

FIG. 103

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 105

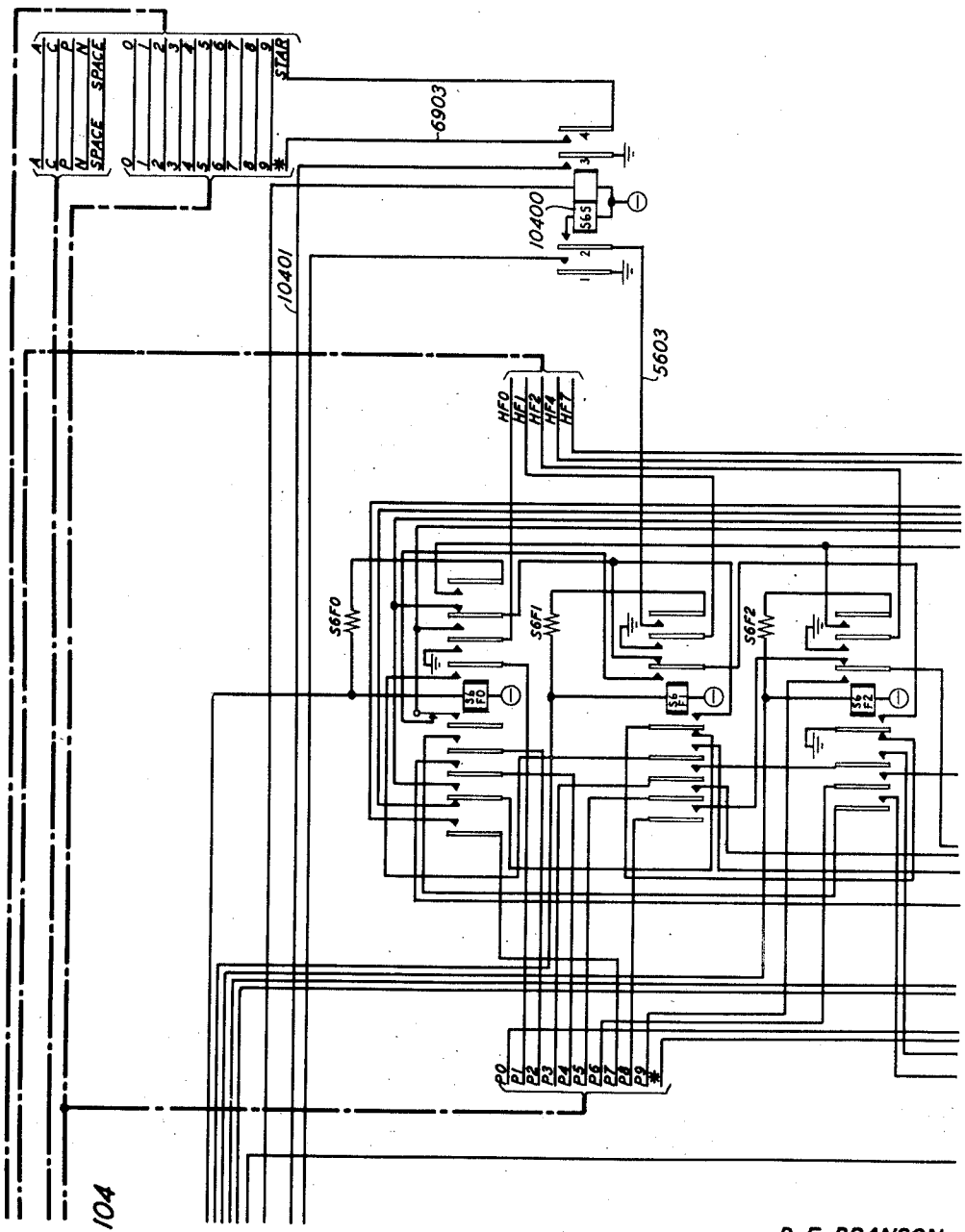

FIG. 104

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY John A. Hall

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 106

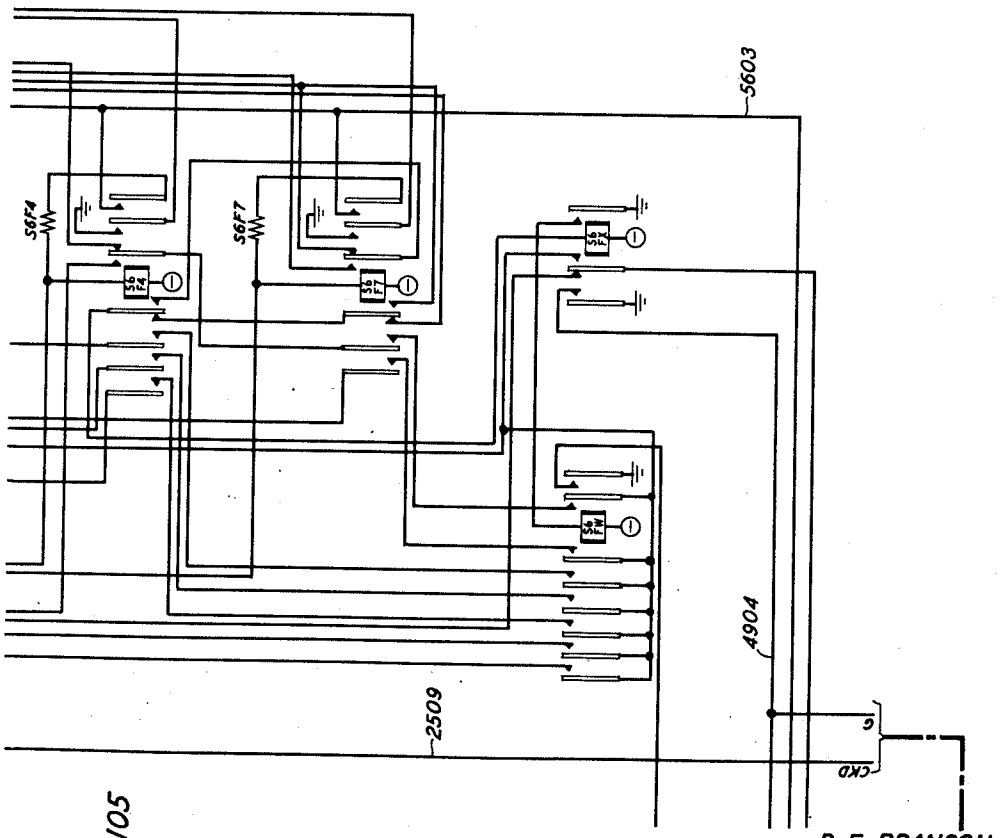

FIG. 105

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 107

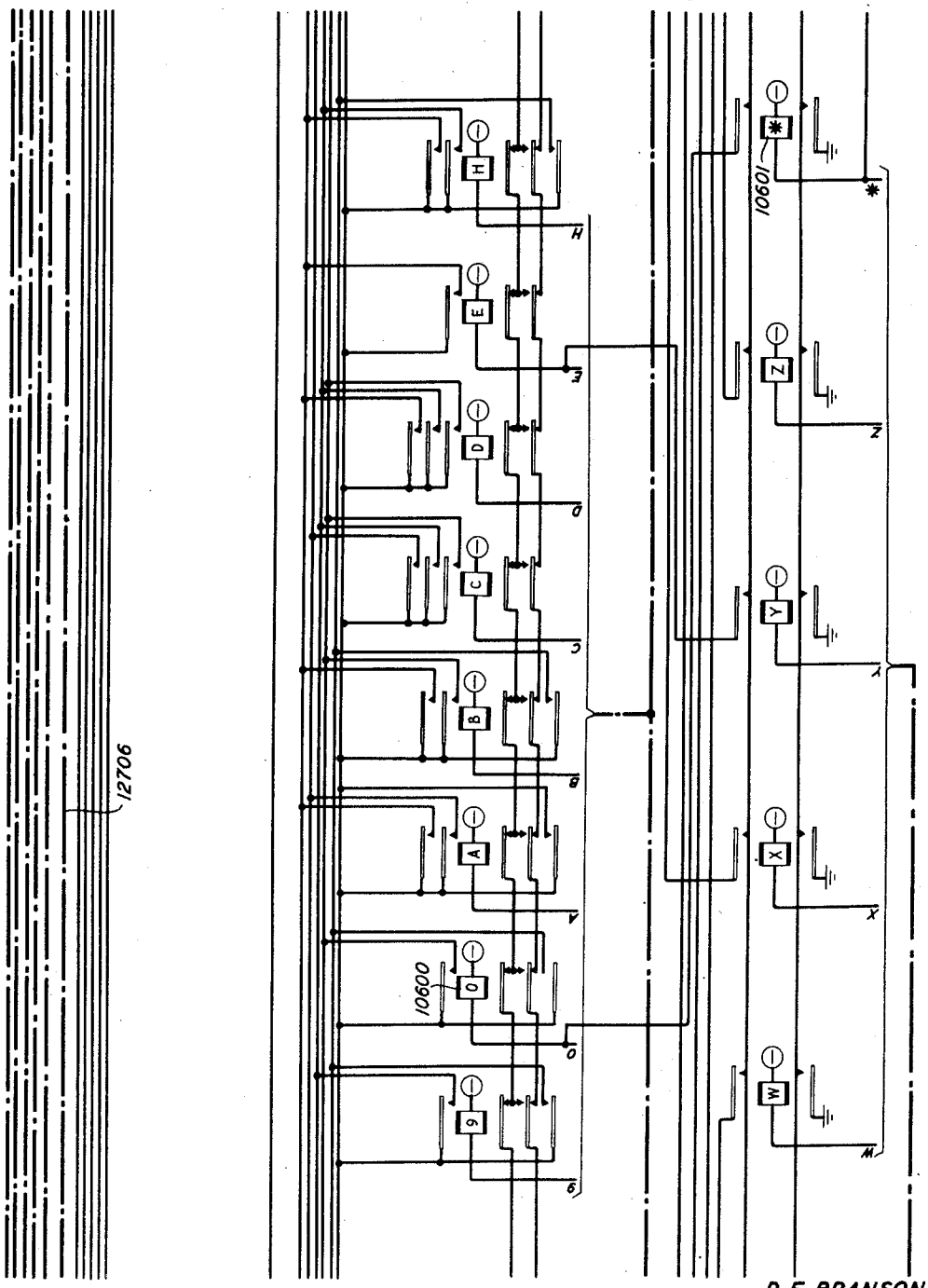

FIG. 106

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 108

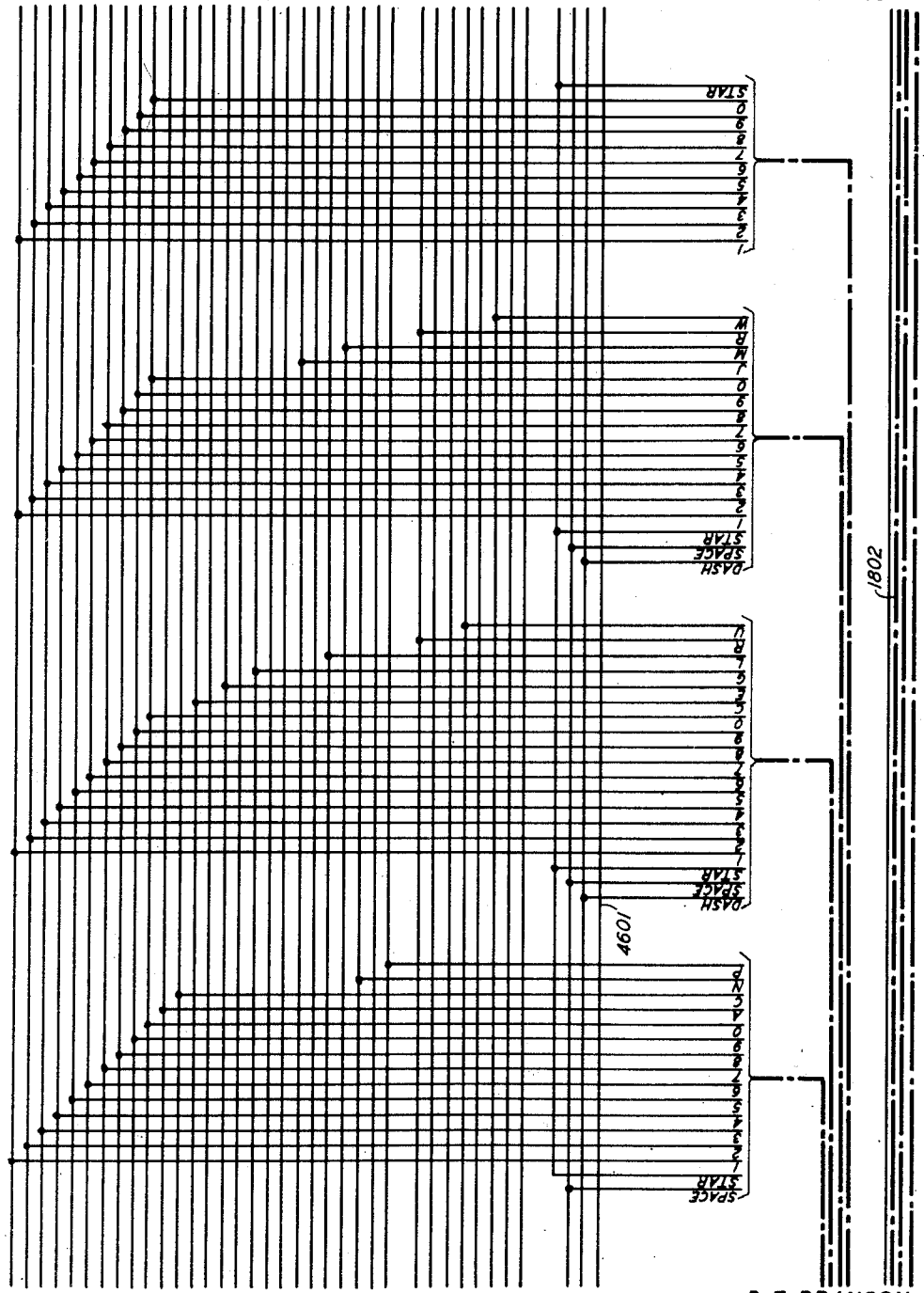

FIG. 107

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 109

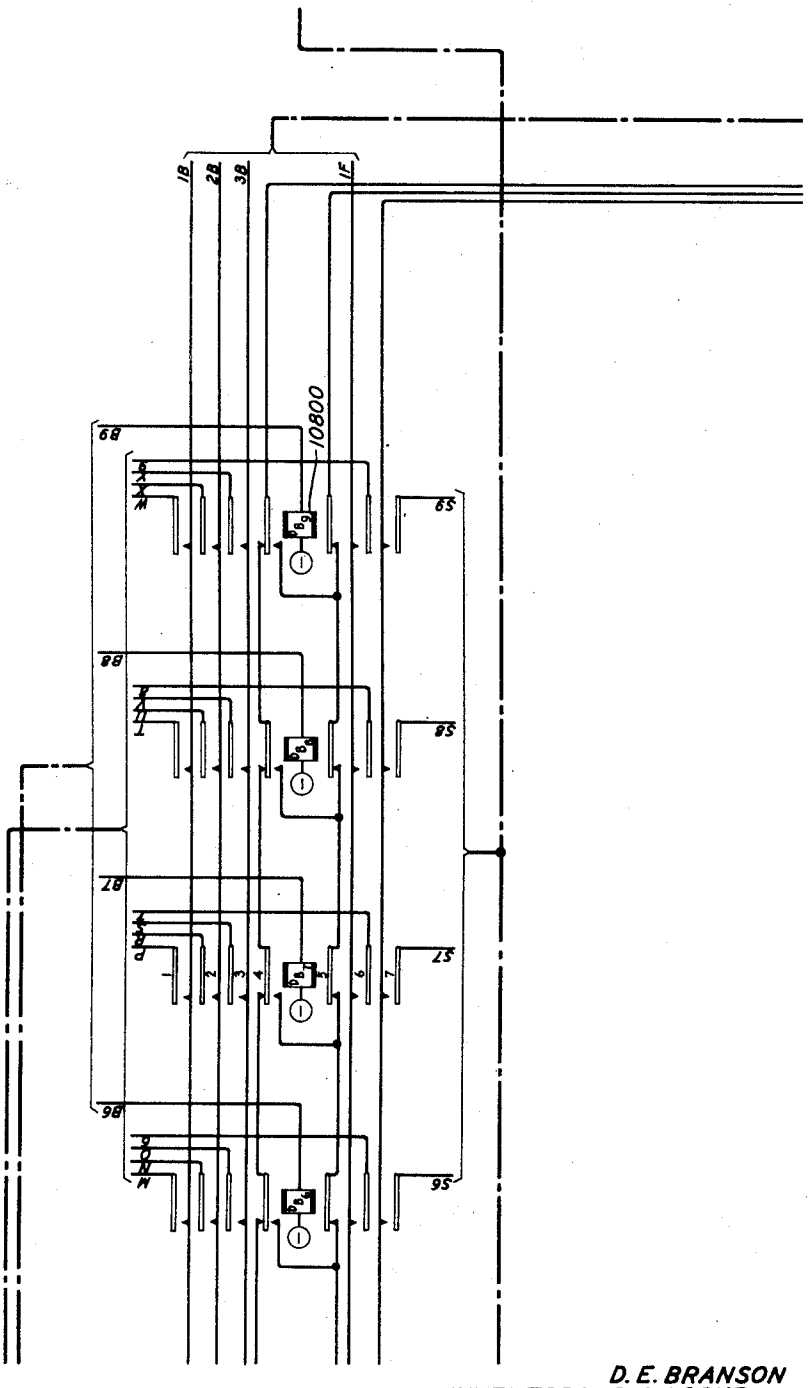

FIG. 108

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 110

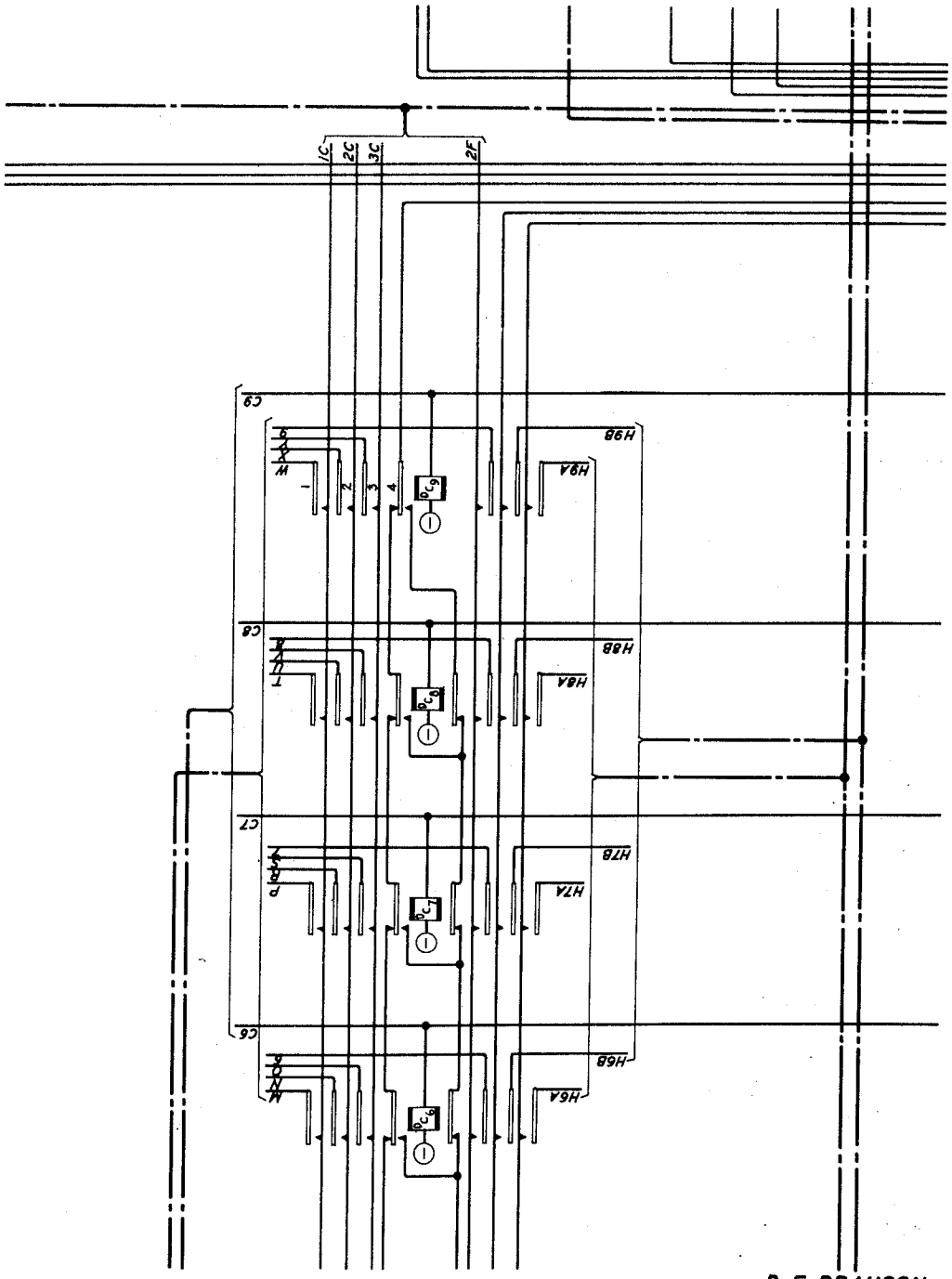

FIG. 109

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 111

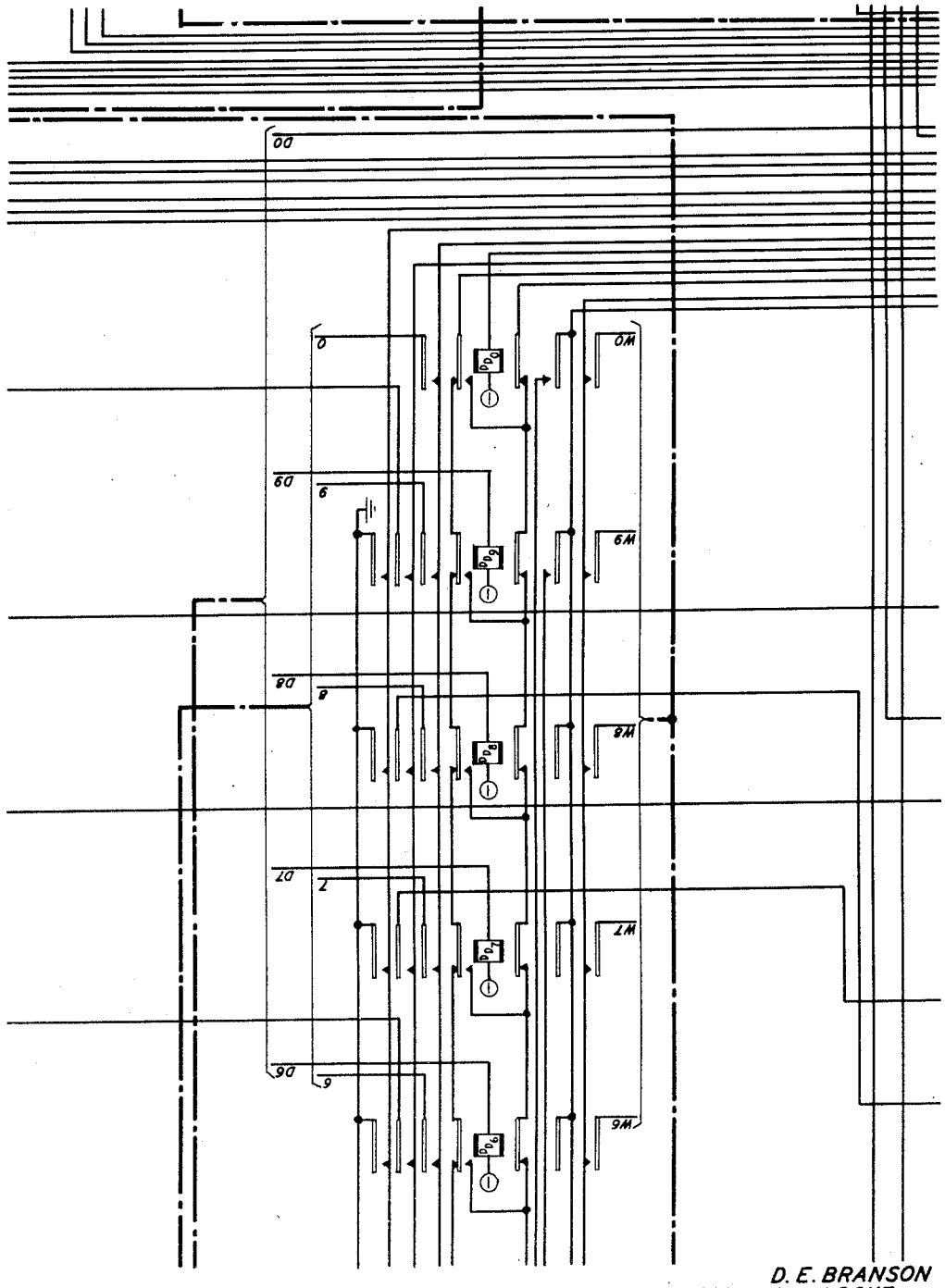

FIG. 110

INVENTORS D. E. BRANSON
G. A. LOCKE
T. A. MARSHALL

BY

ATTORNEY

June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 112

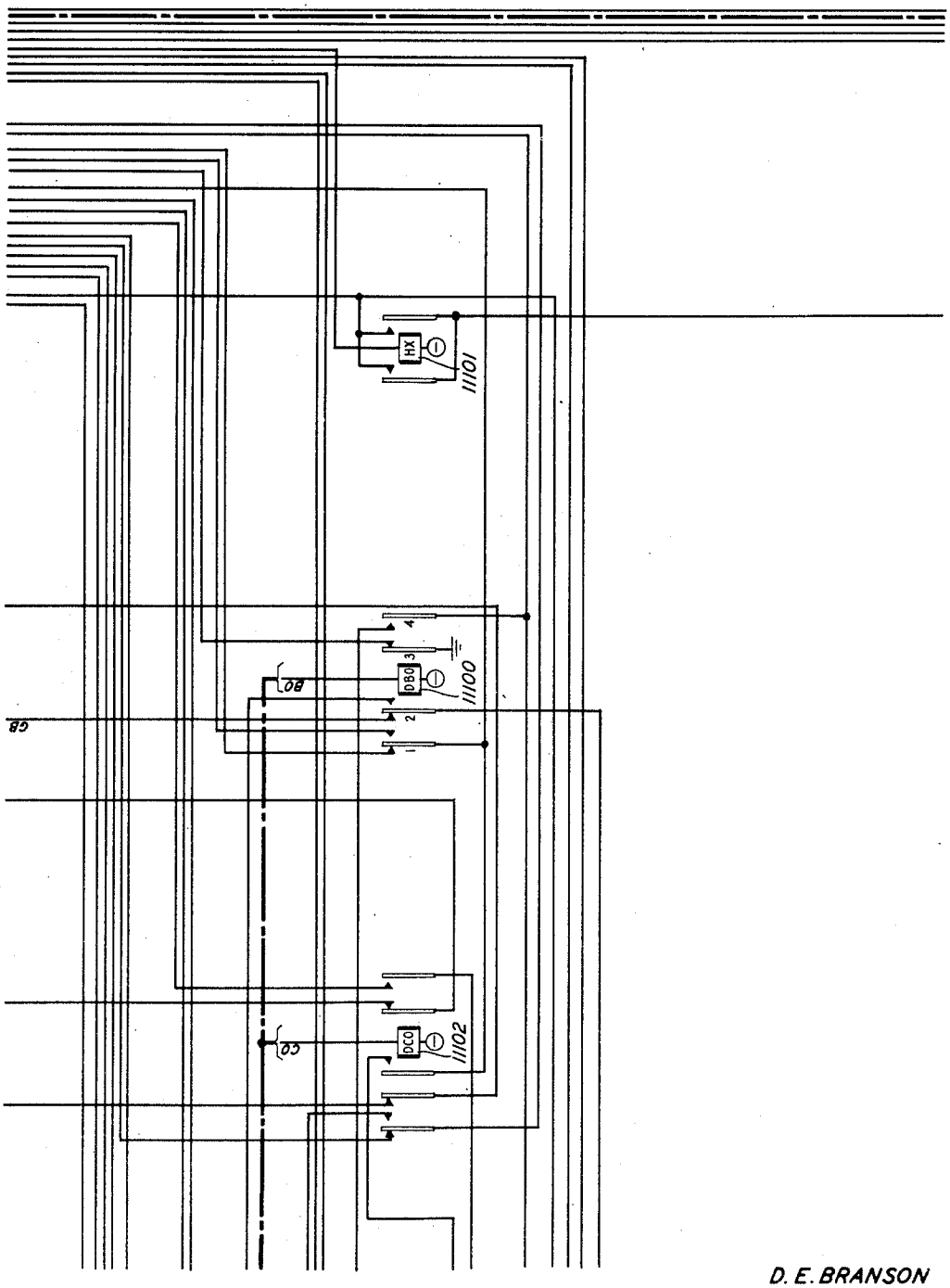

FIG. 111

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 113

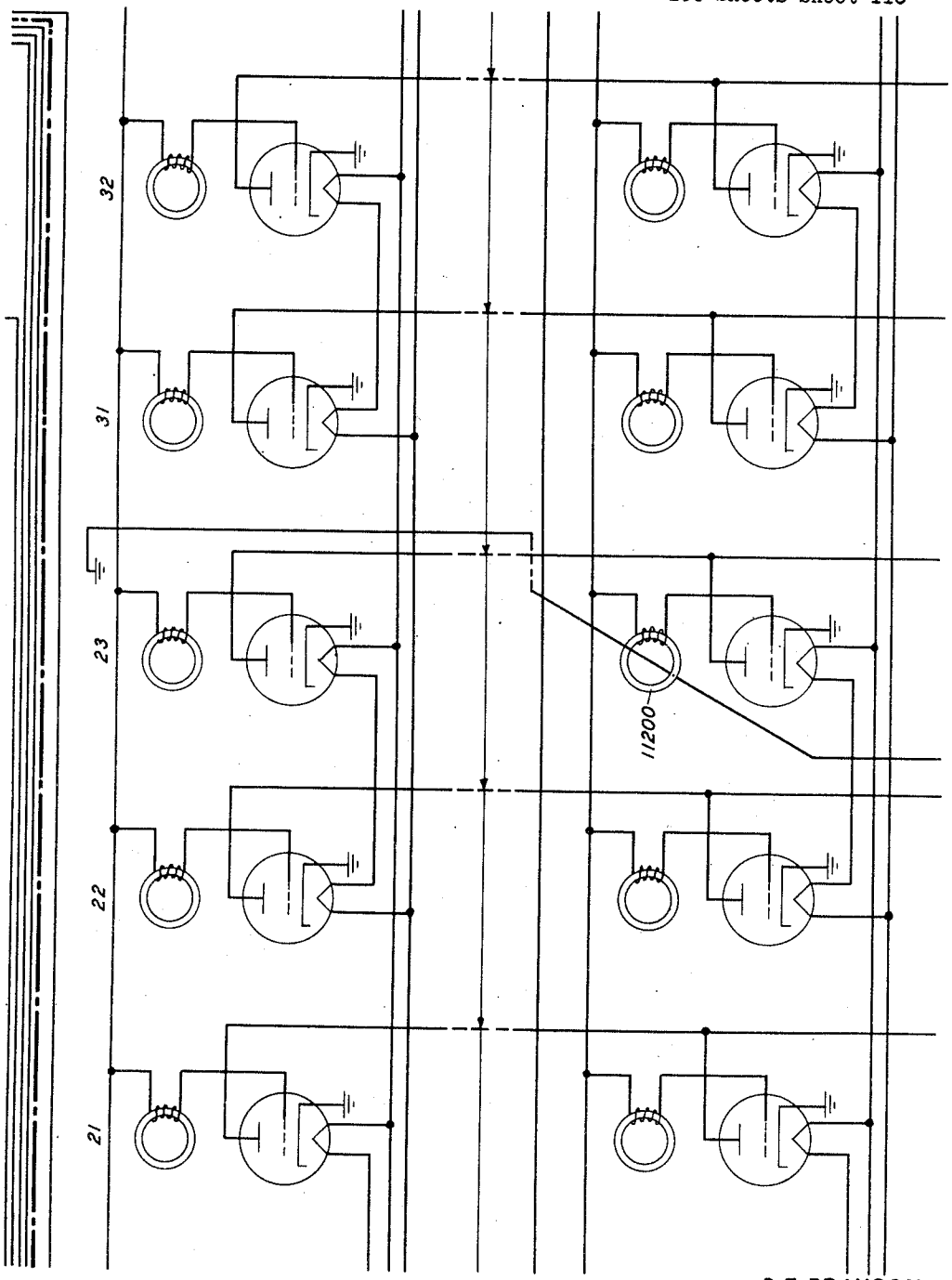

FIG. 112

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 114

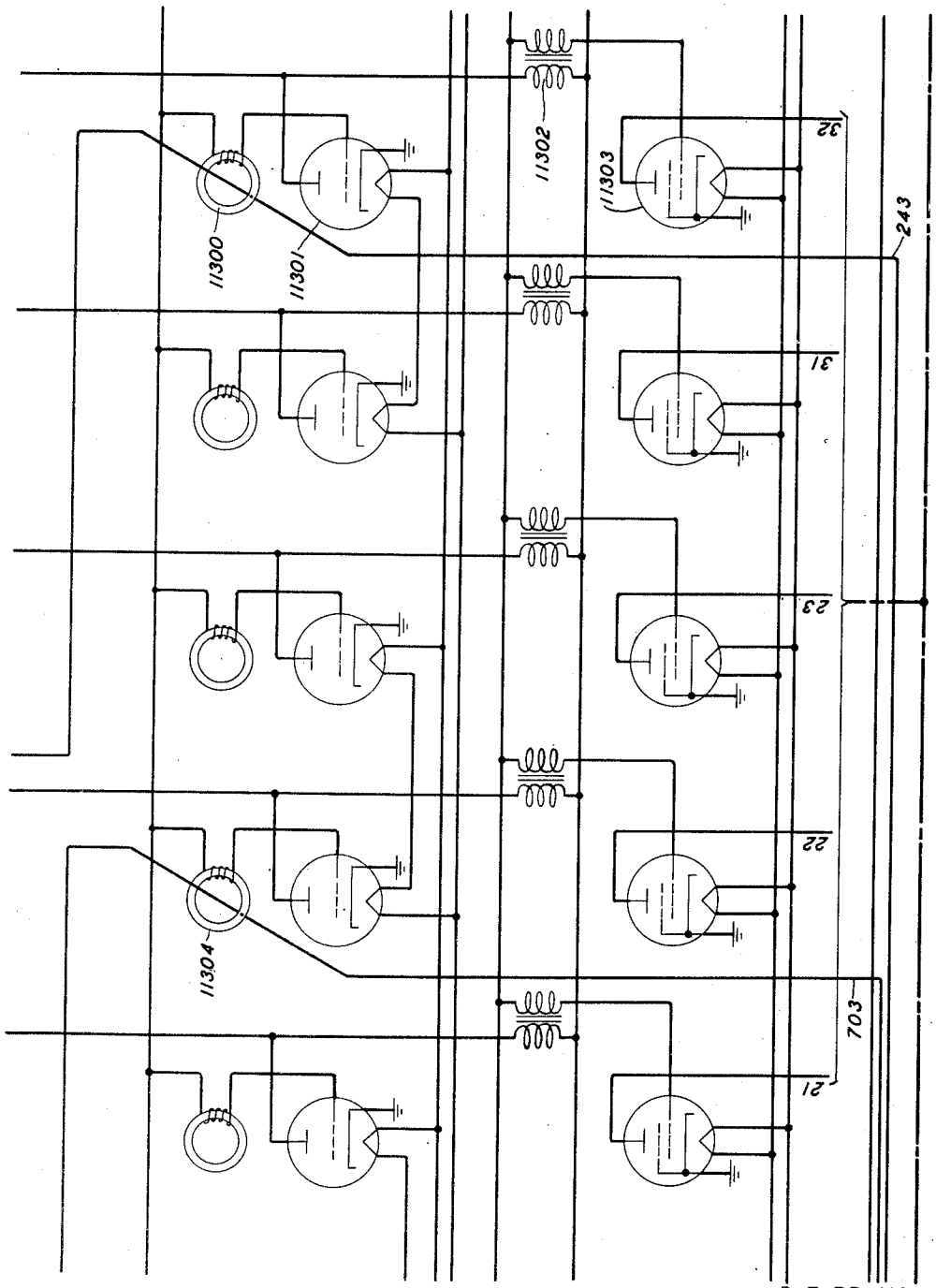

FIG. 113

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 115

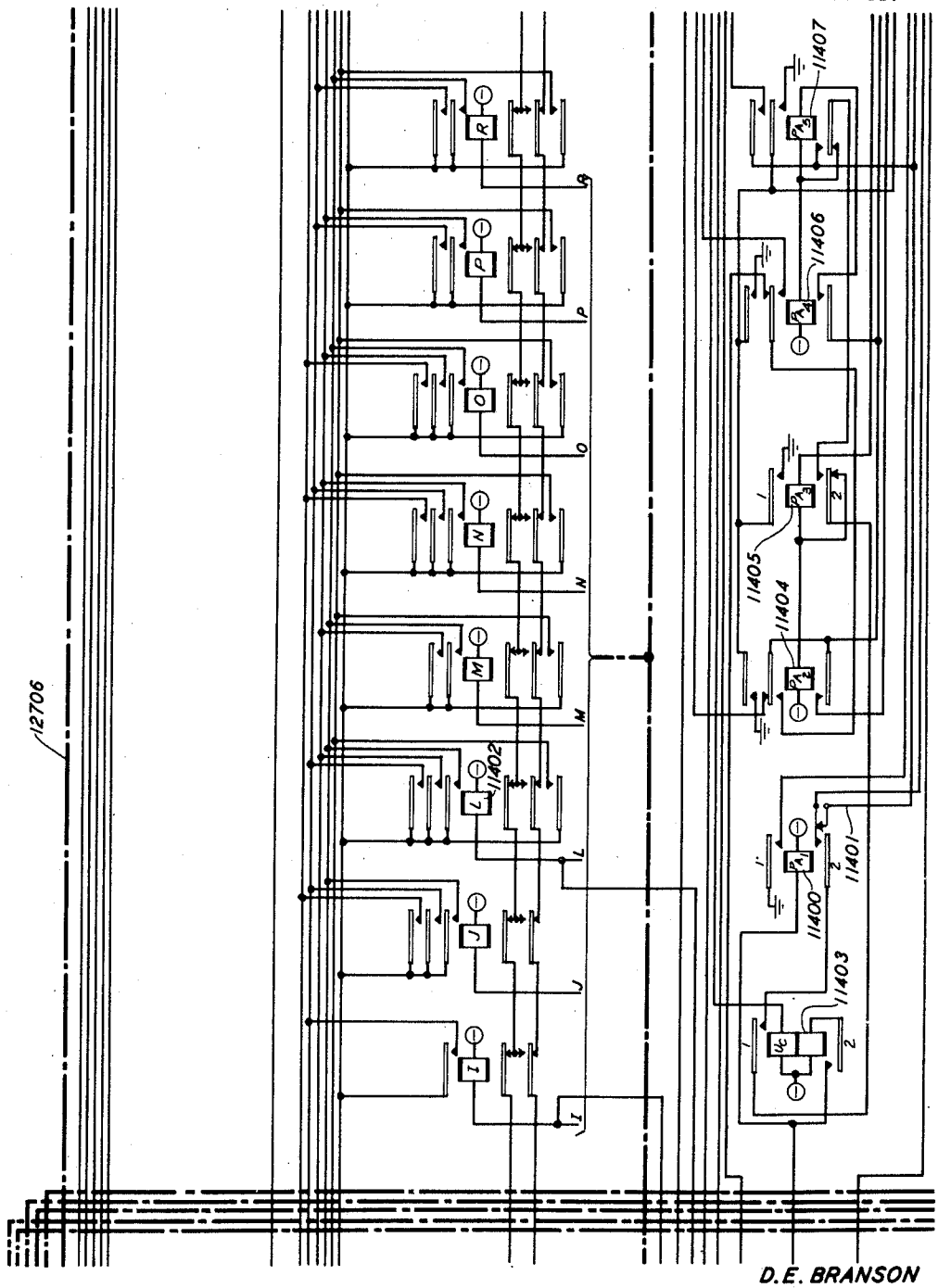

FIG. 114

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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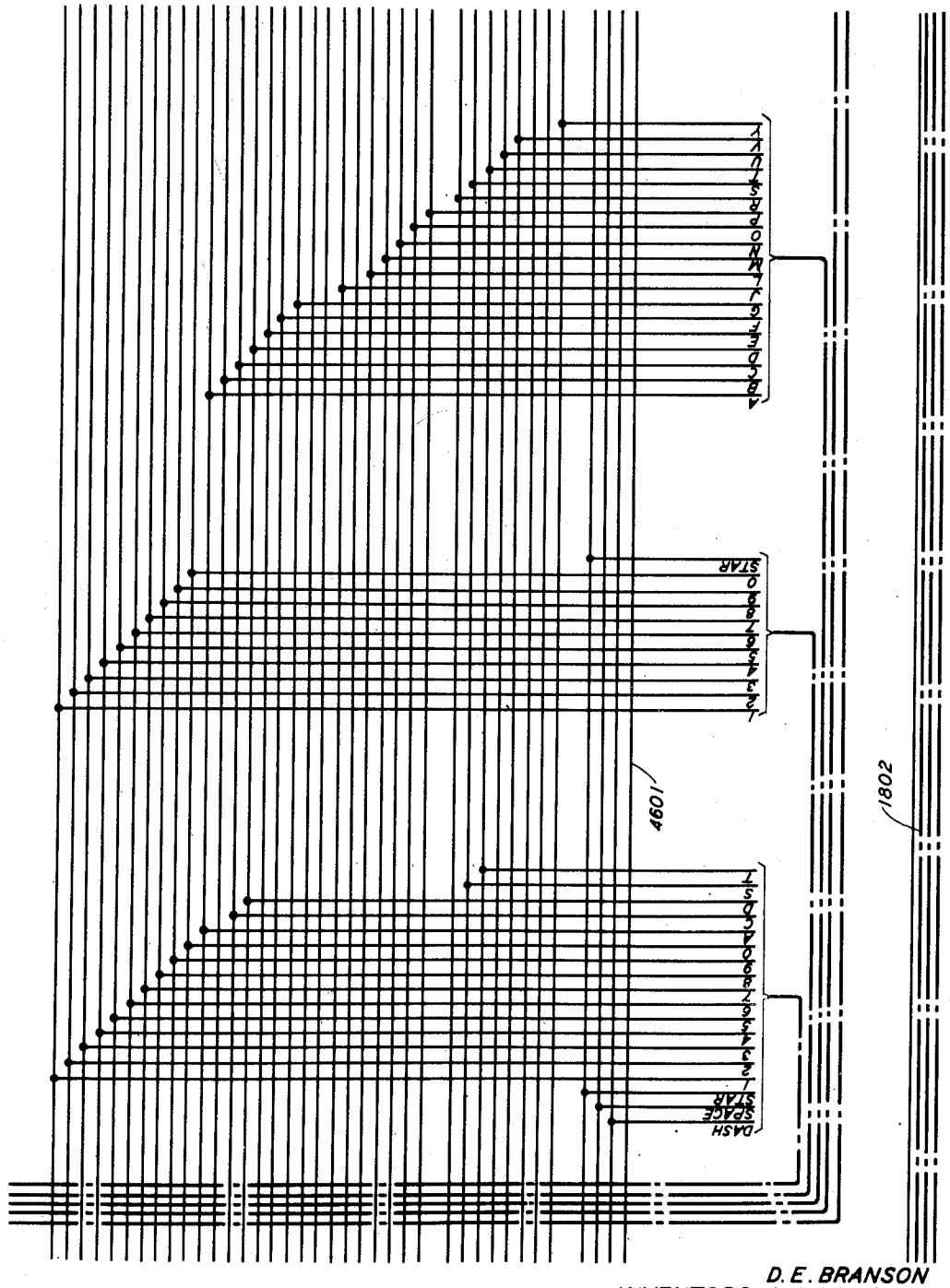

FIG. 115

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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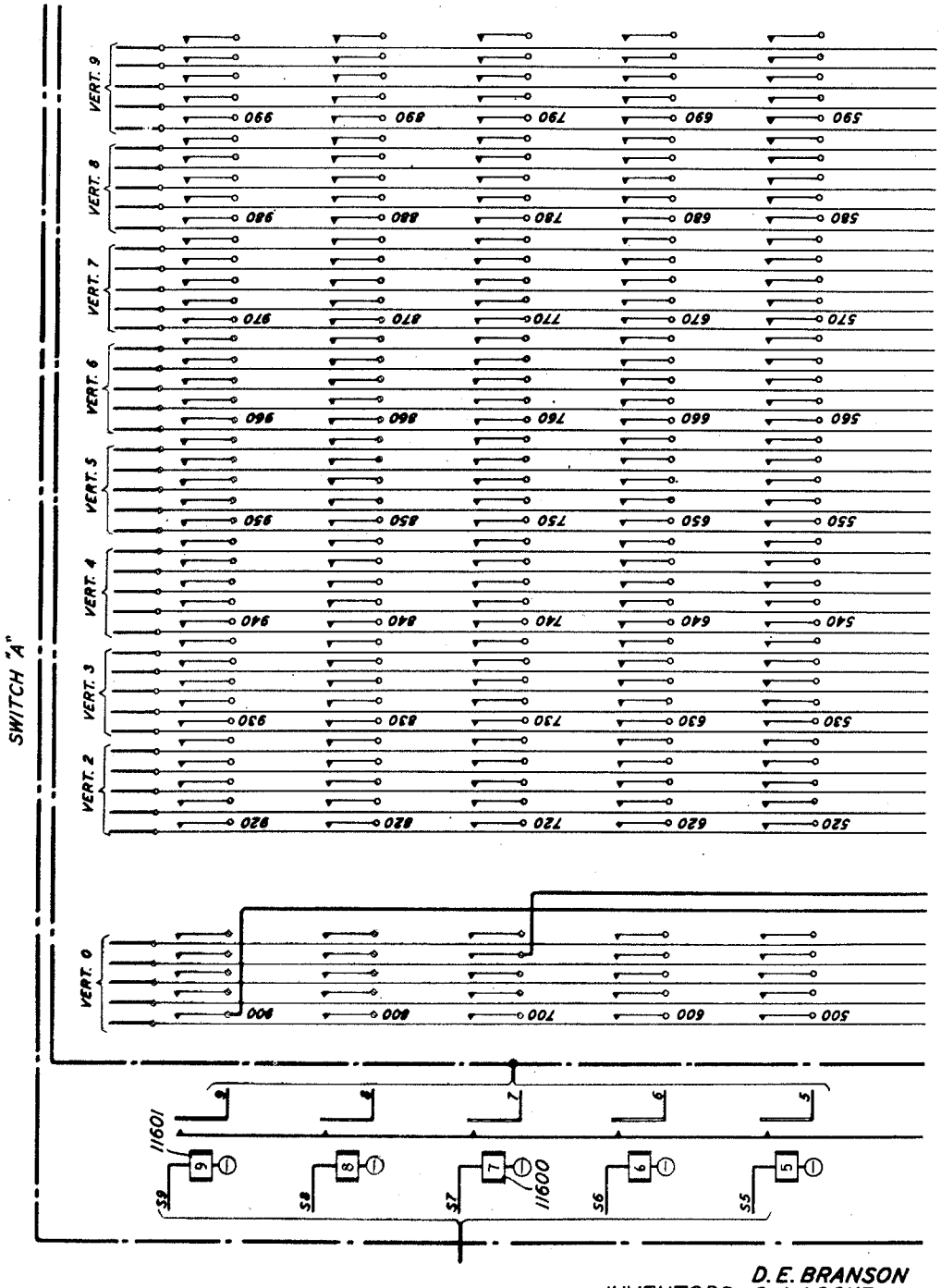

FIG. 116

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 118

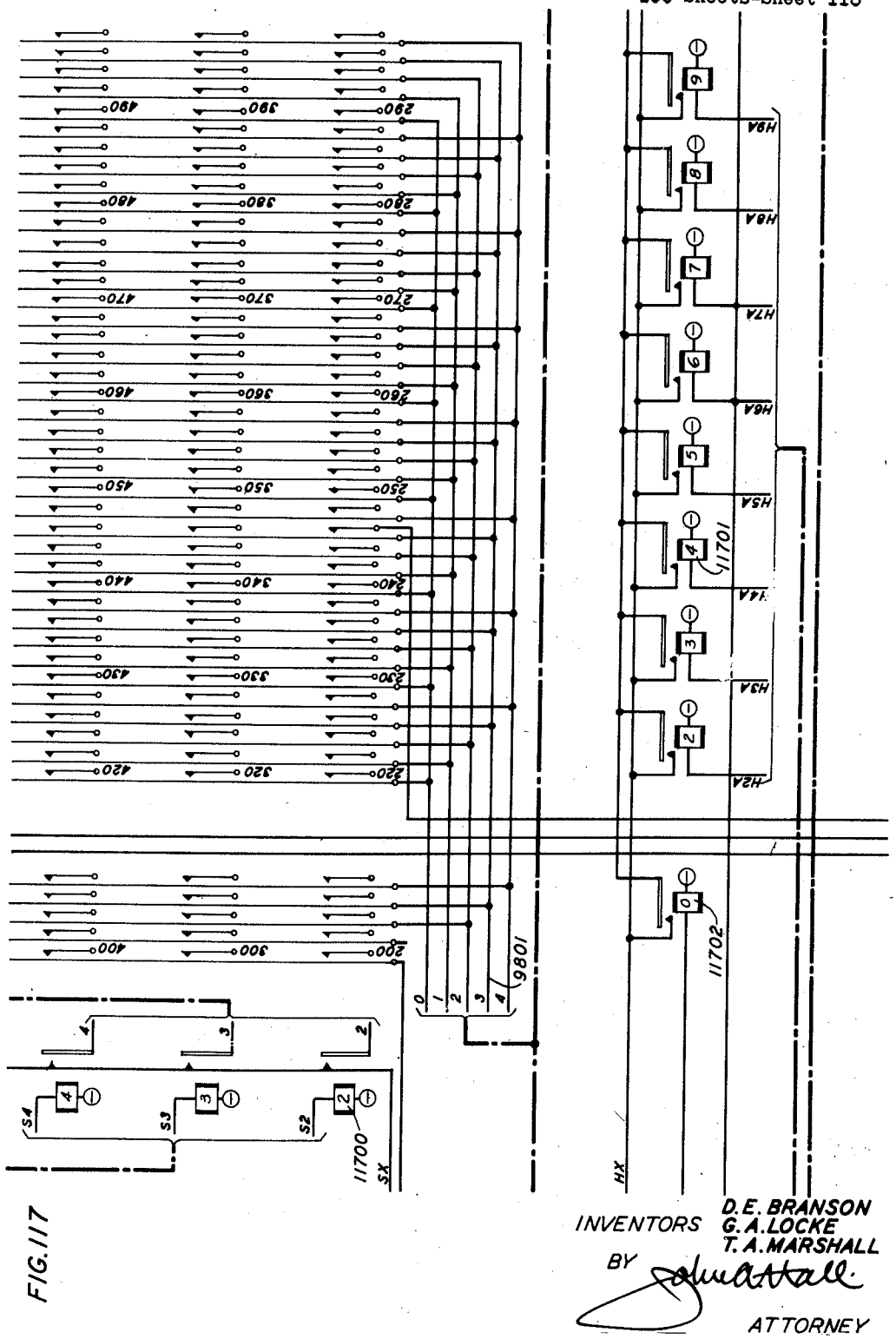

FIG. 117

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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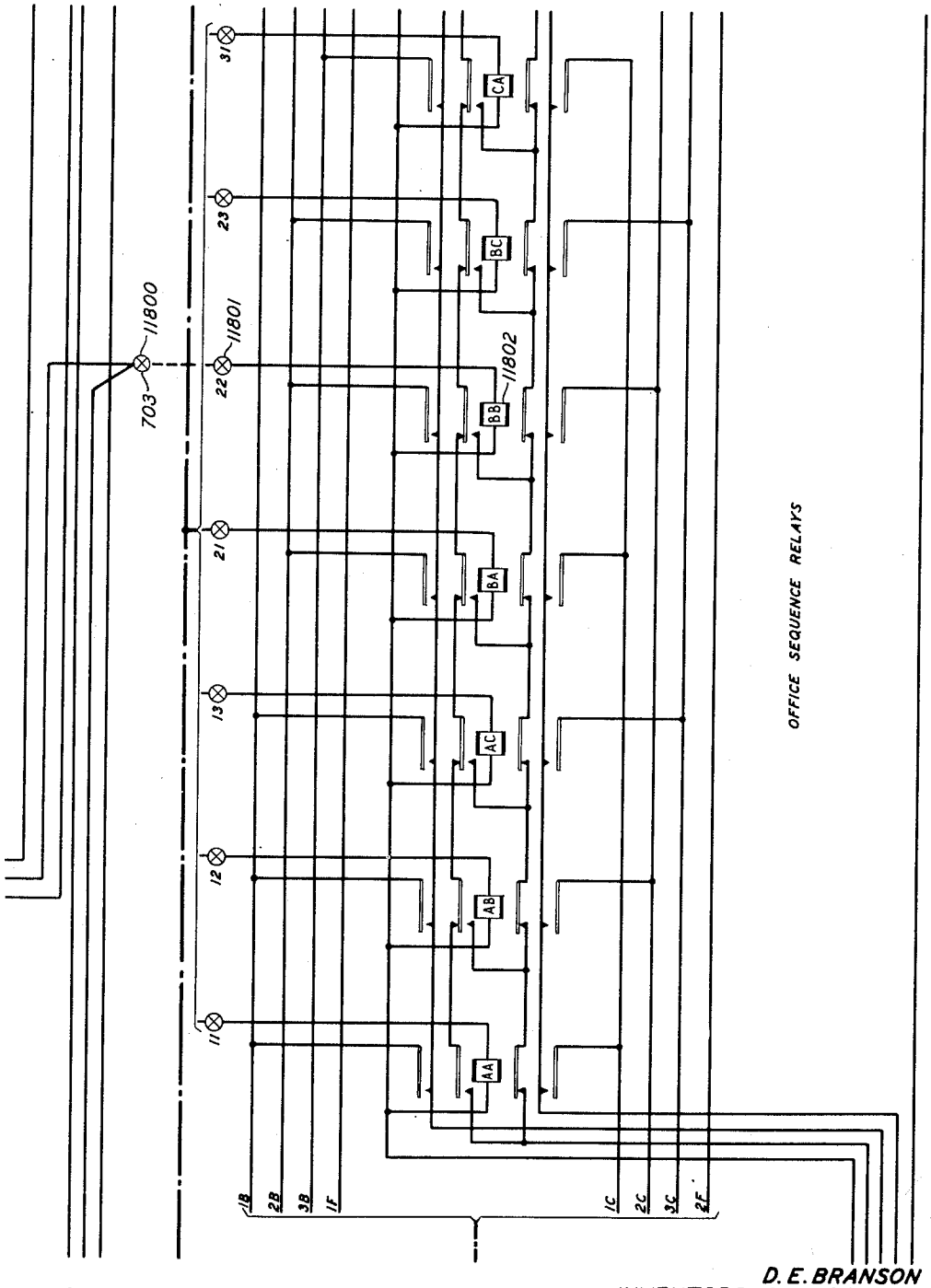

FIG. 118

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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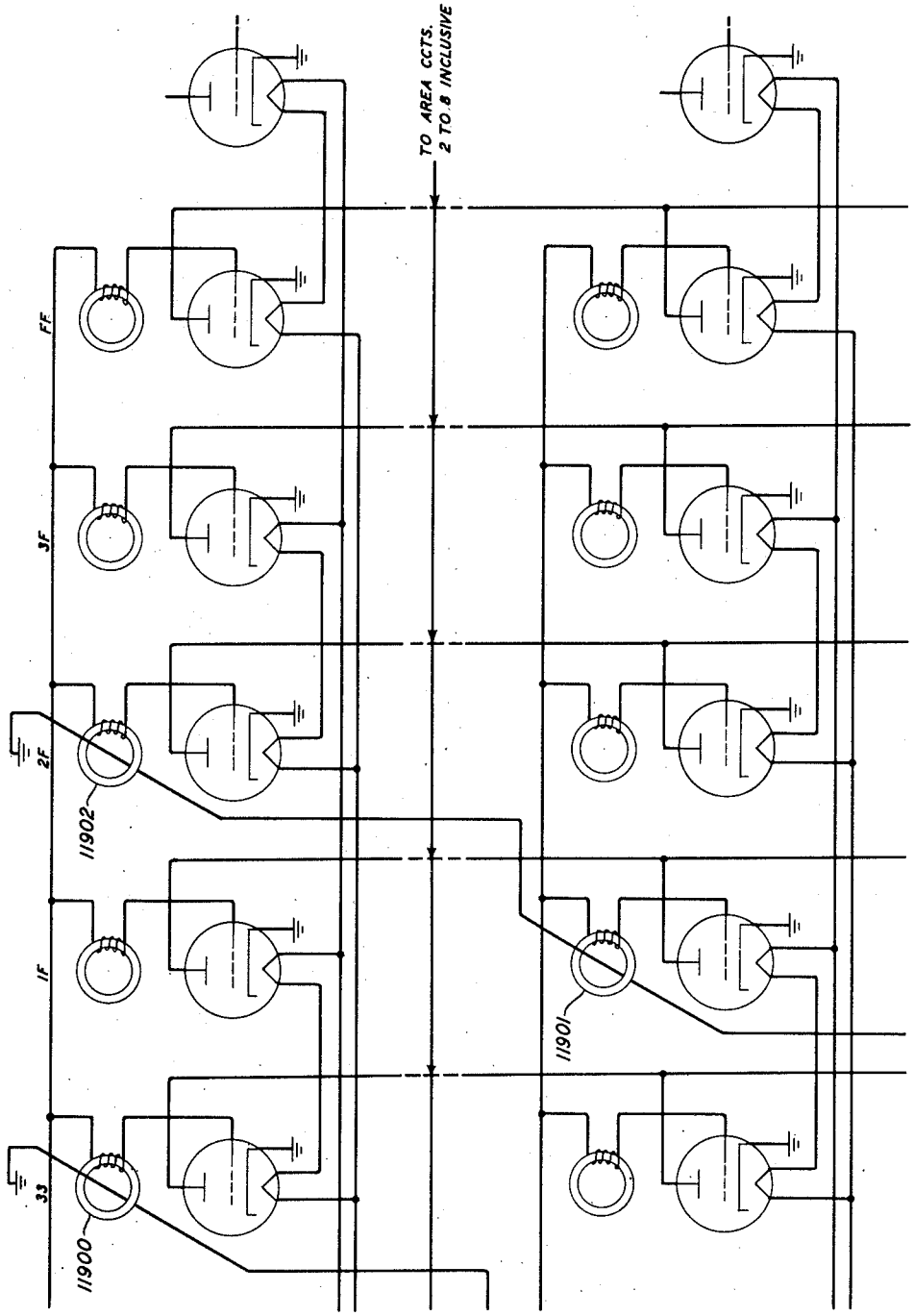

FIG. 119

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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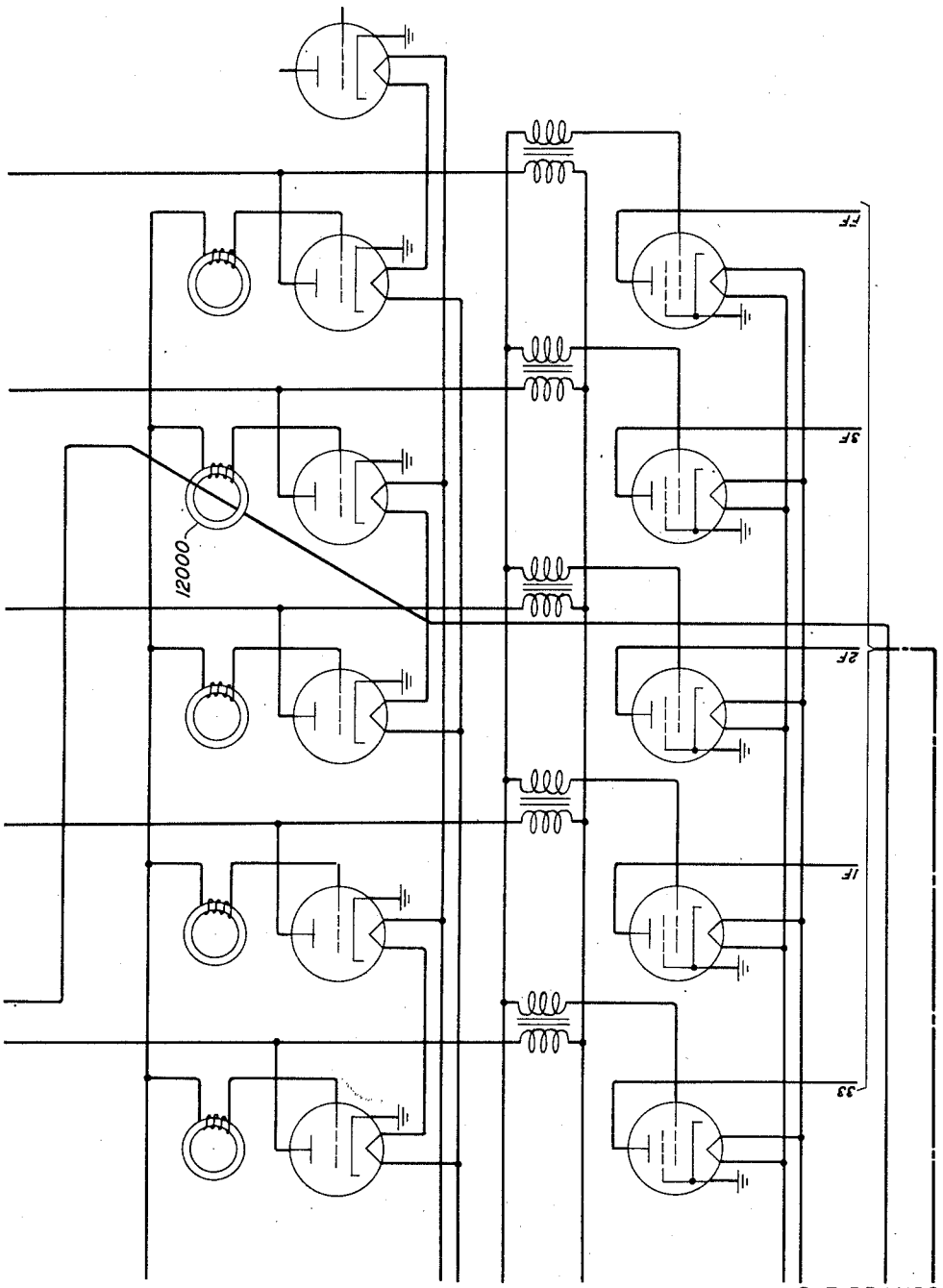

FIG. 120

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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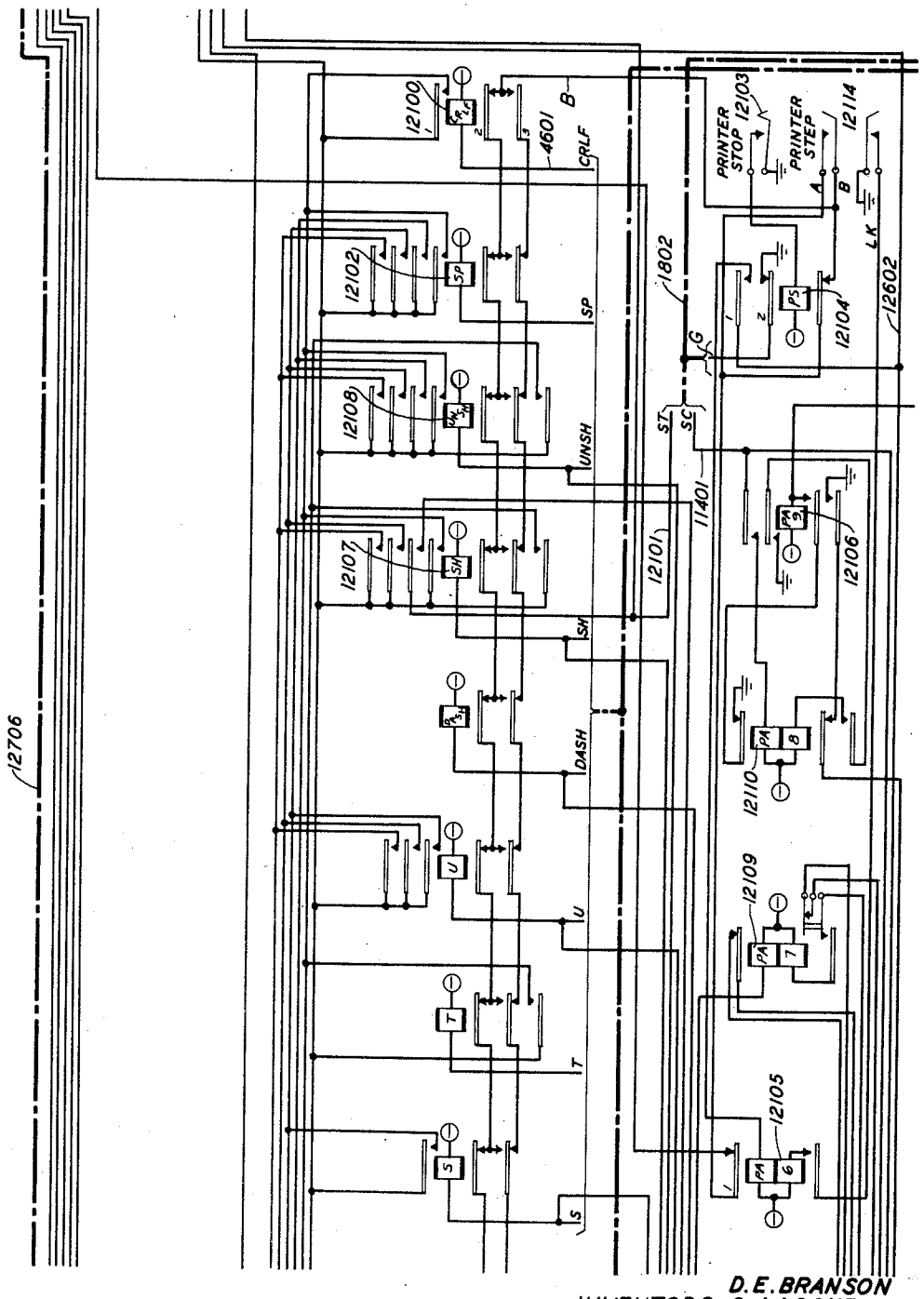

FIG. 121

INVENTORS D. E. BRANSON
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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 123

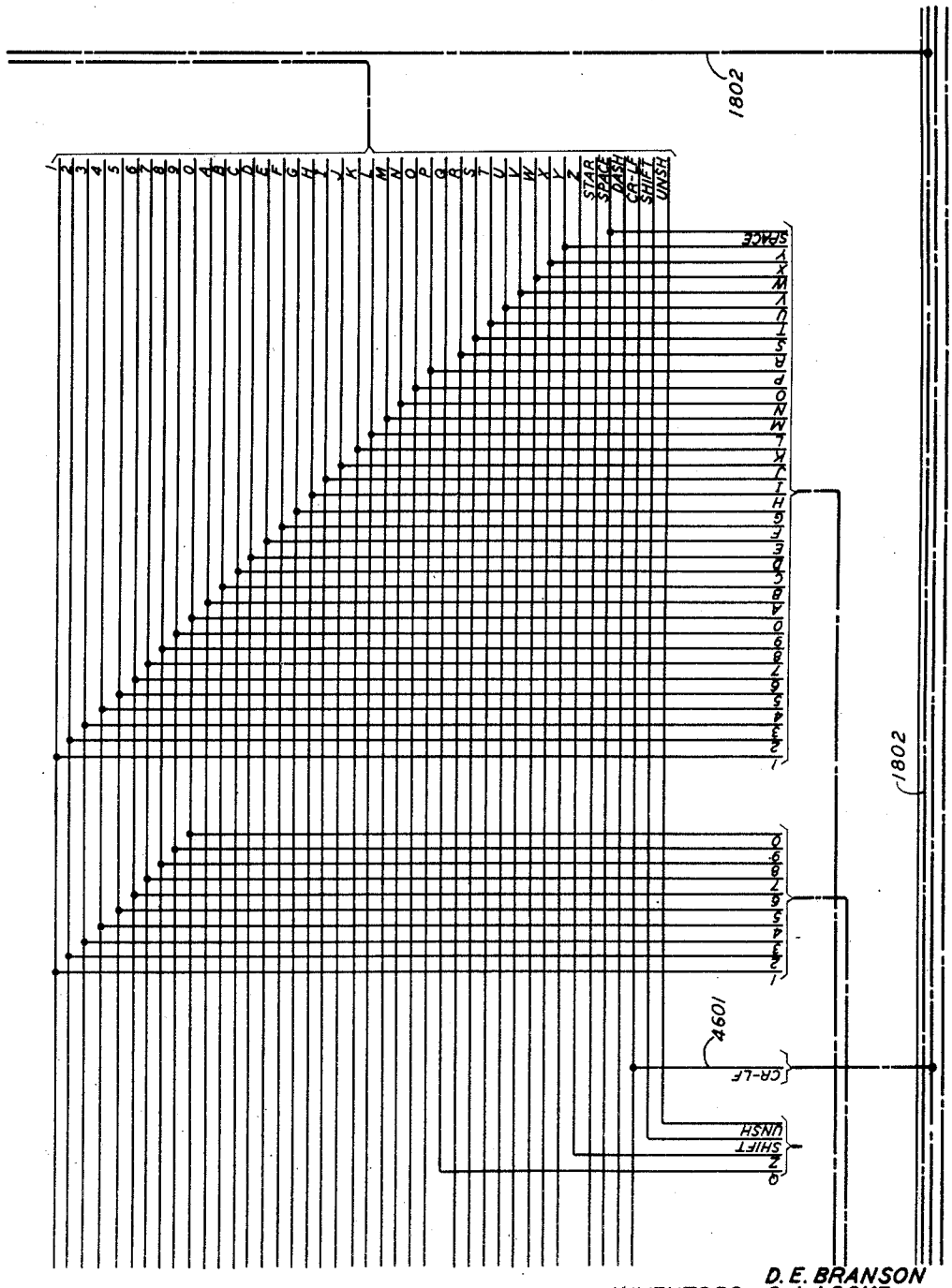

FIG. 122

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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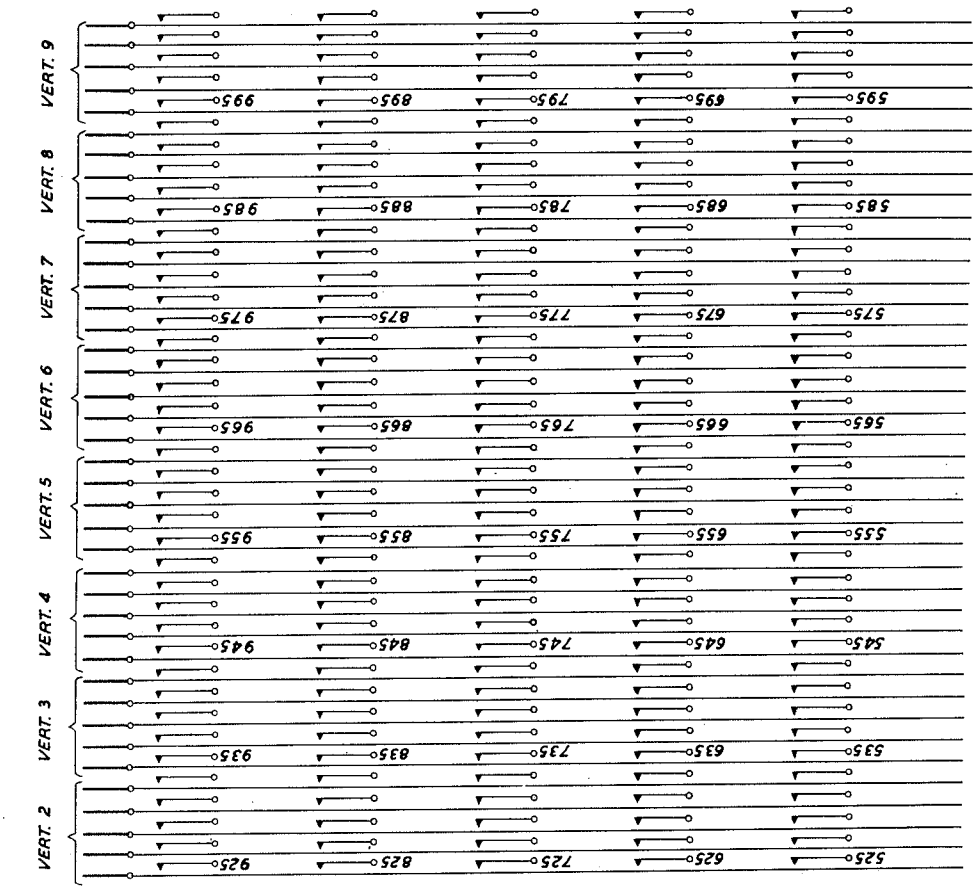

FIG. 123

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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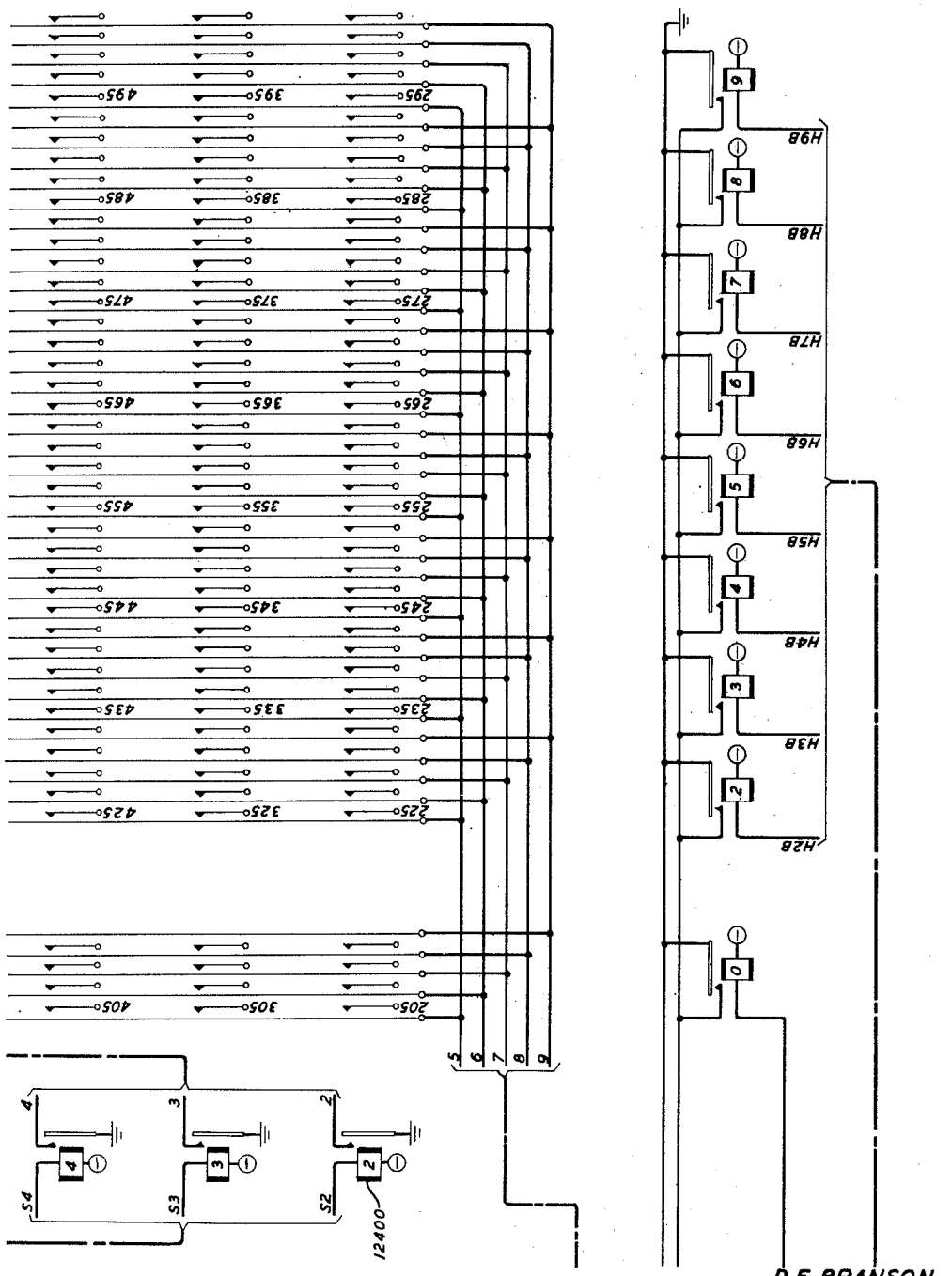

FIG. 124

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 126

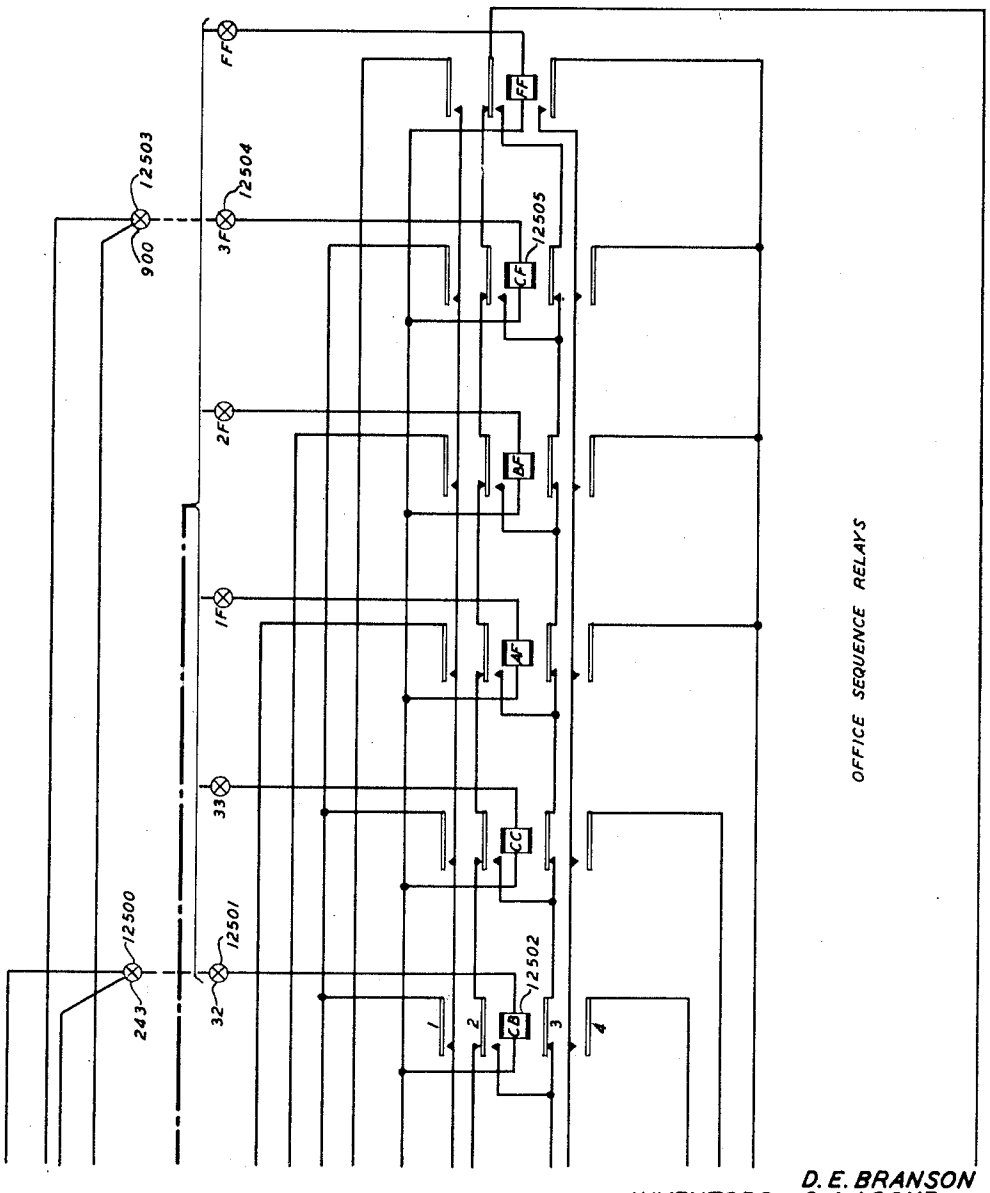

FIG. 125

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Filed Jan. 21, 1949 136 Sheets-Sheet 127

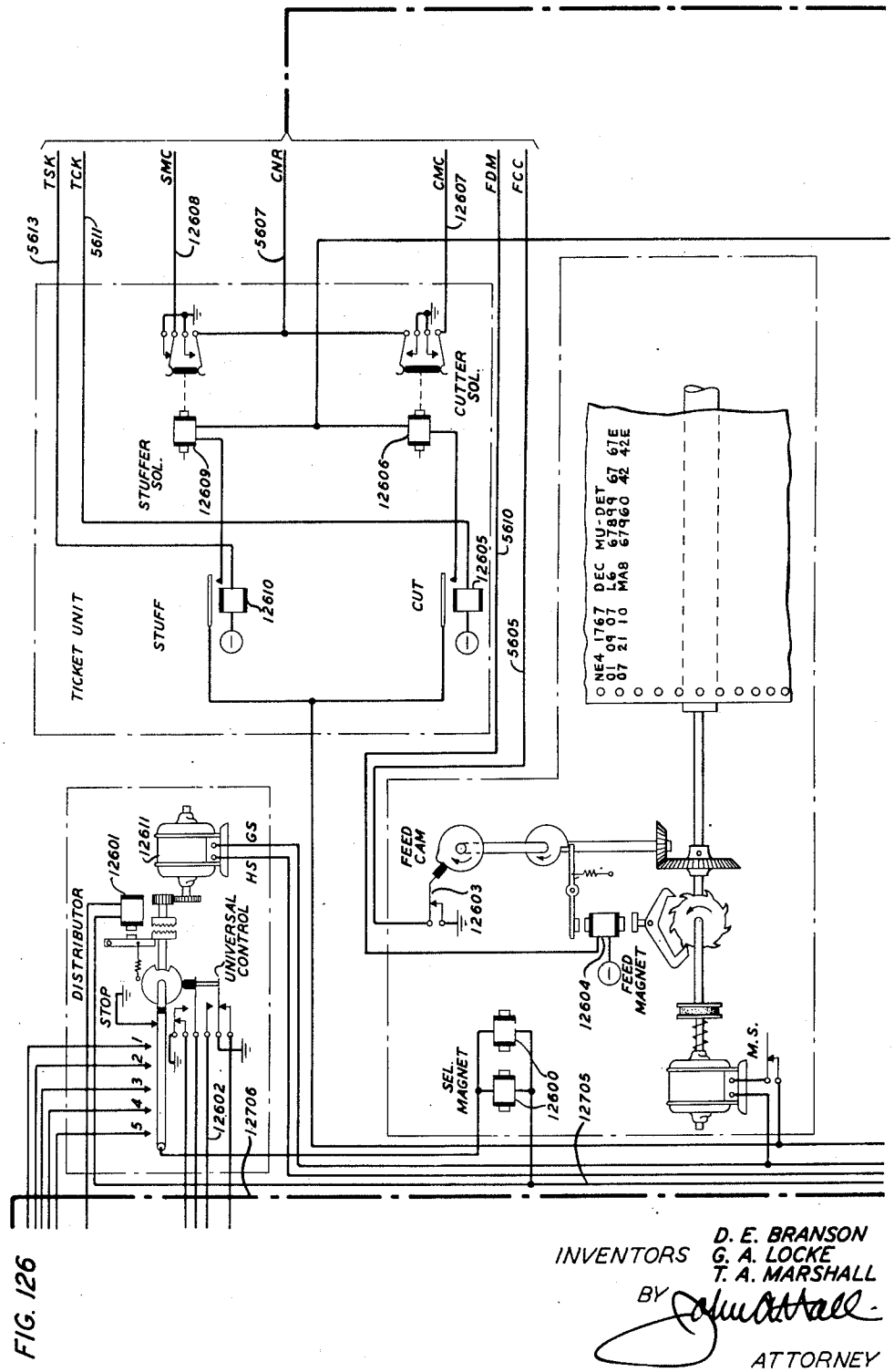

FIG. 126

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 128

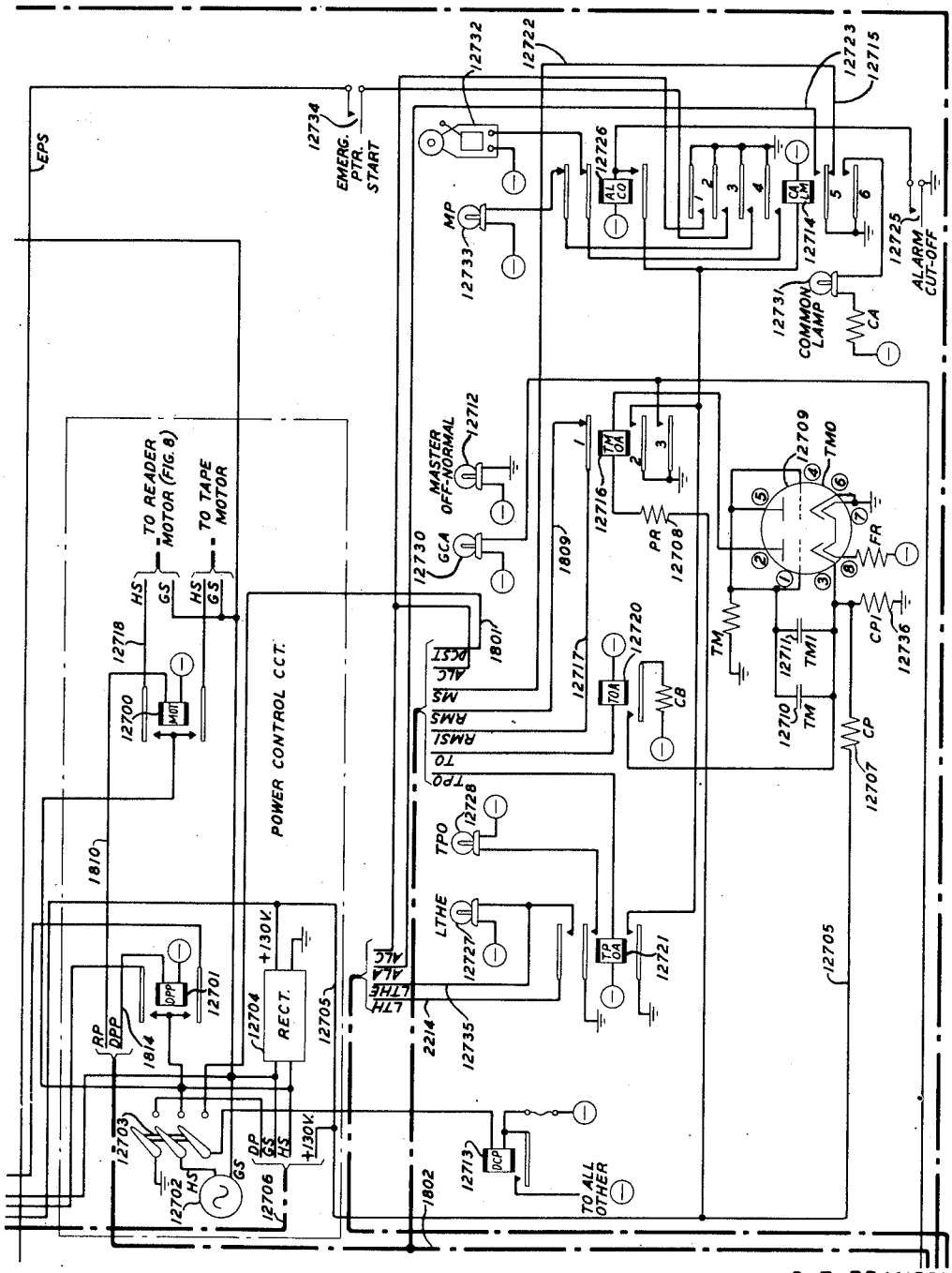

FIG. 127

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 129

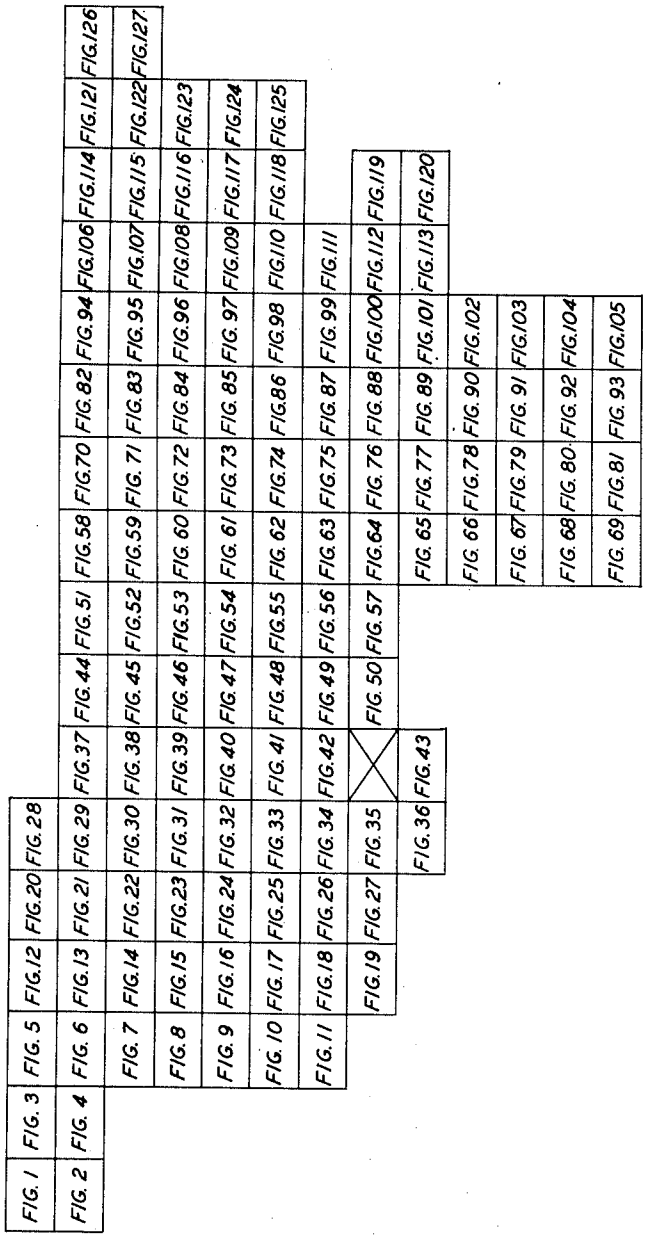

FIG. 128

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June 6, 1950 D. E. BRANSON ET AL 2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 130

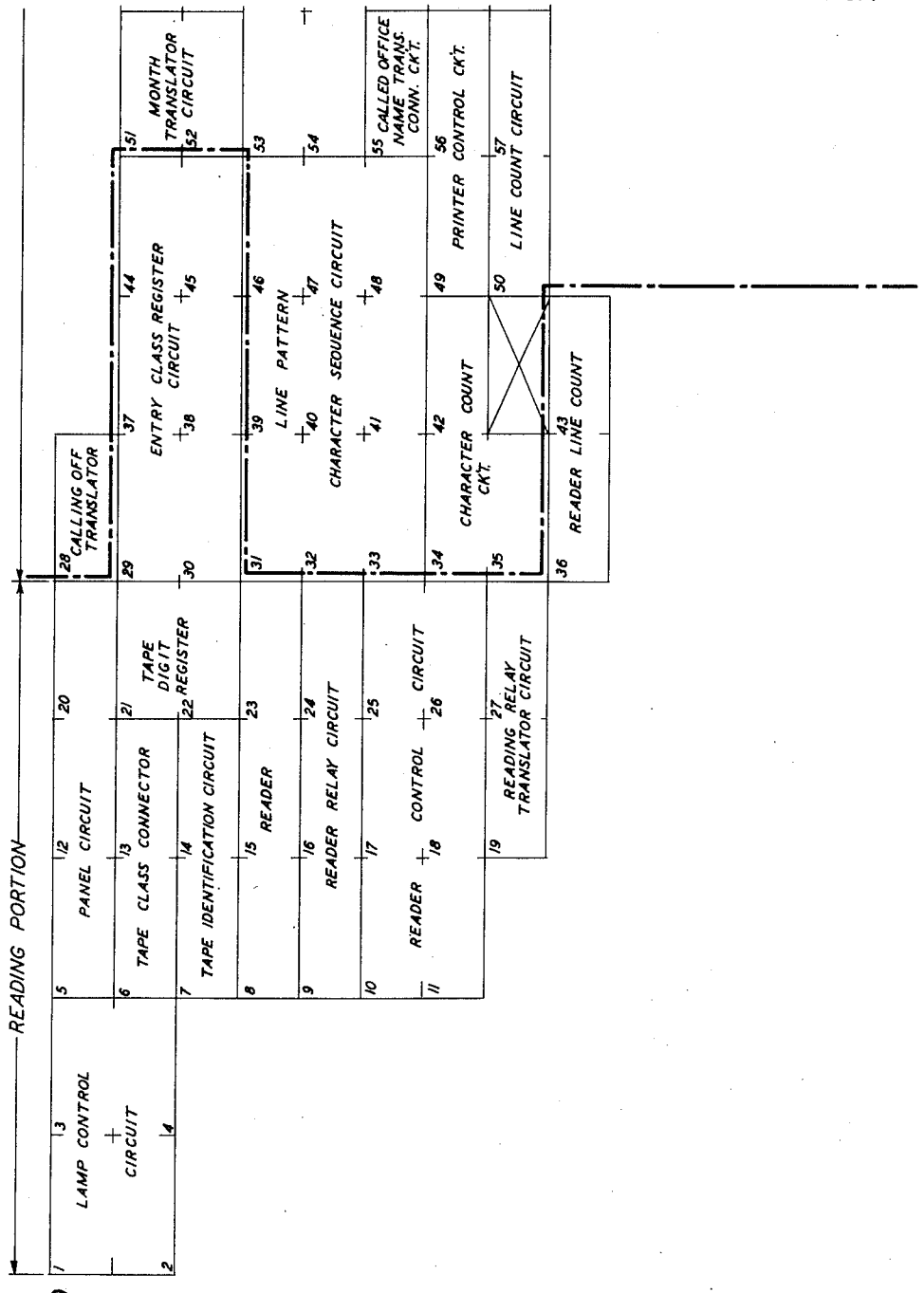

FIG. 129

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

Filed Jan. 21, 1949 136 Sheets-Sheet 131

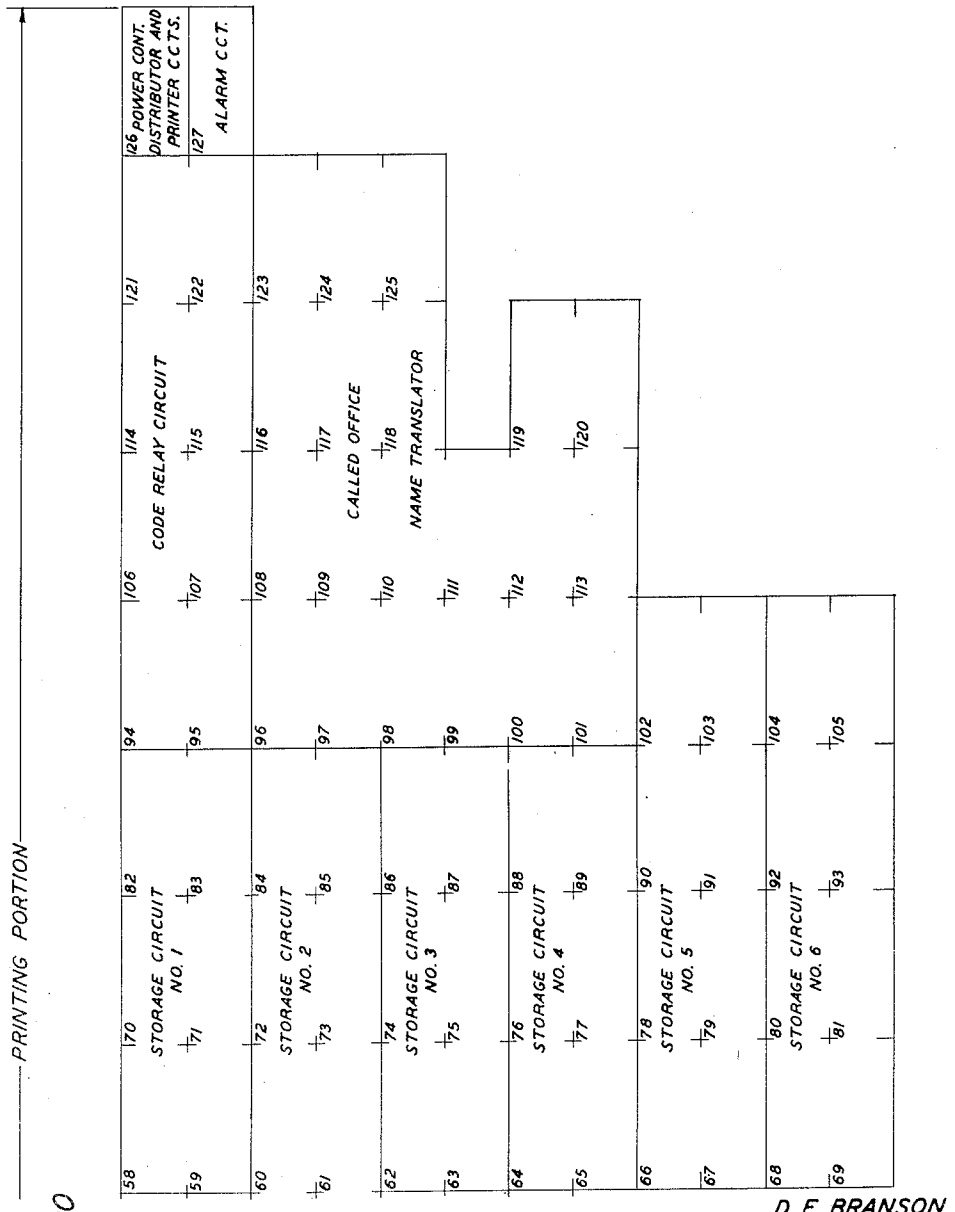

FIG. 130

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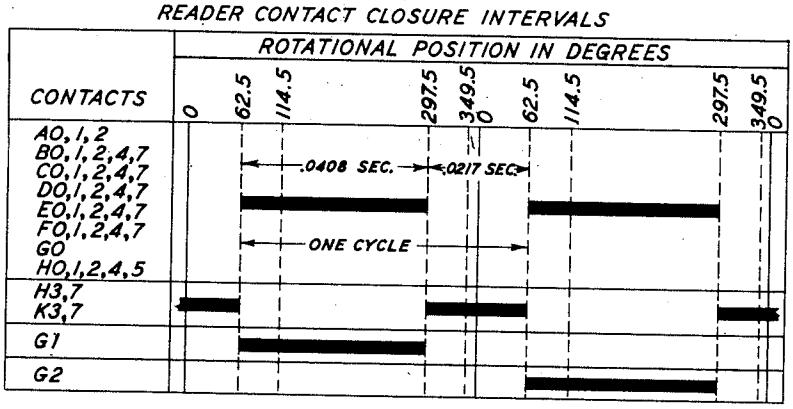
FIG. 131

READER CONTACT CLOSURE INTERVALS



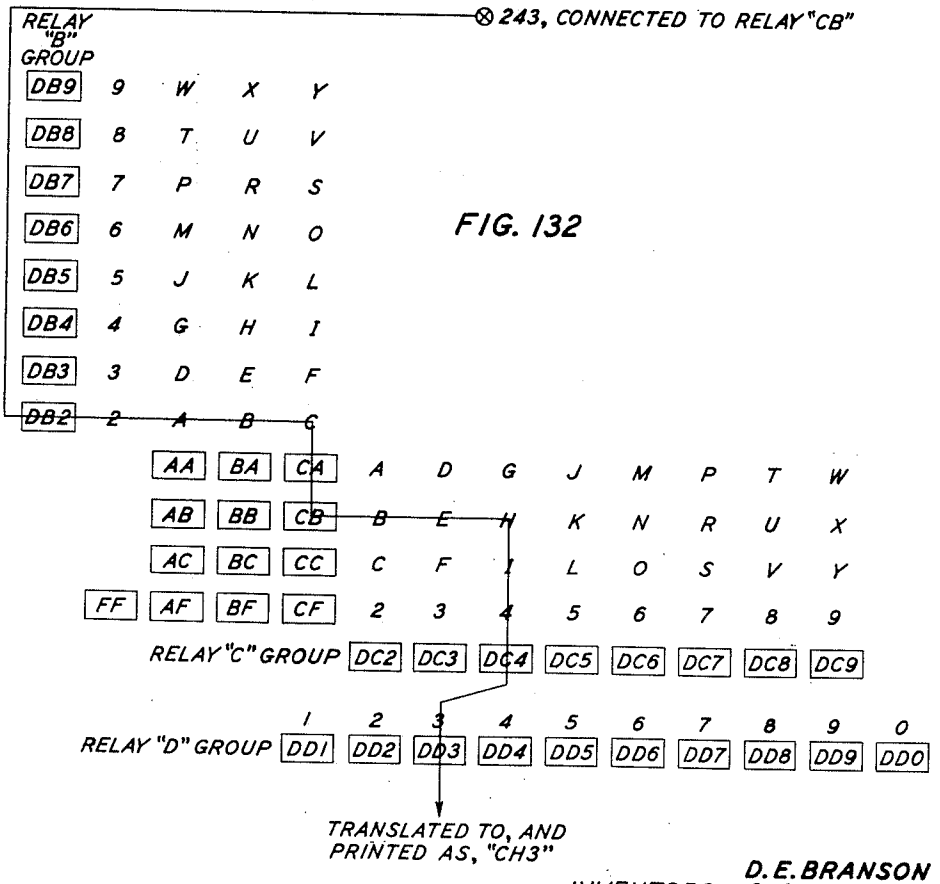


FIG. 132

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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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FIG. 133

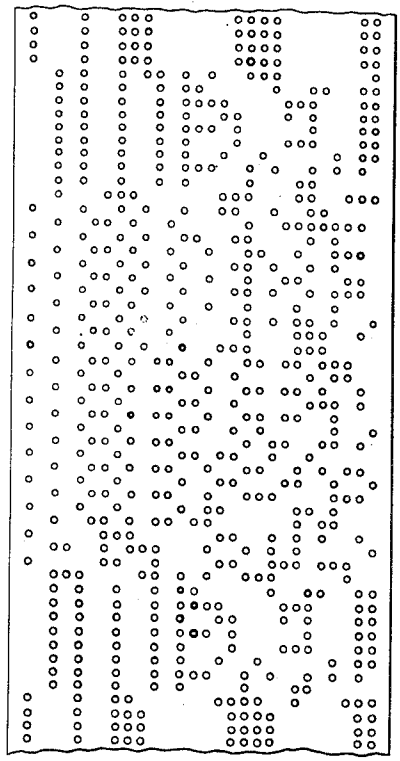

FIG. 135

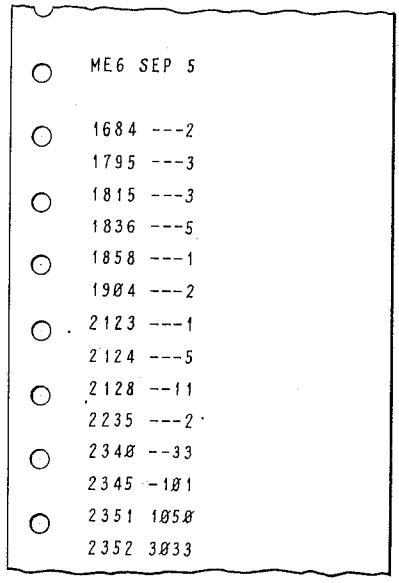

FIG. 134

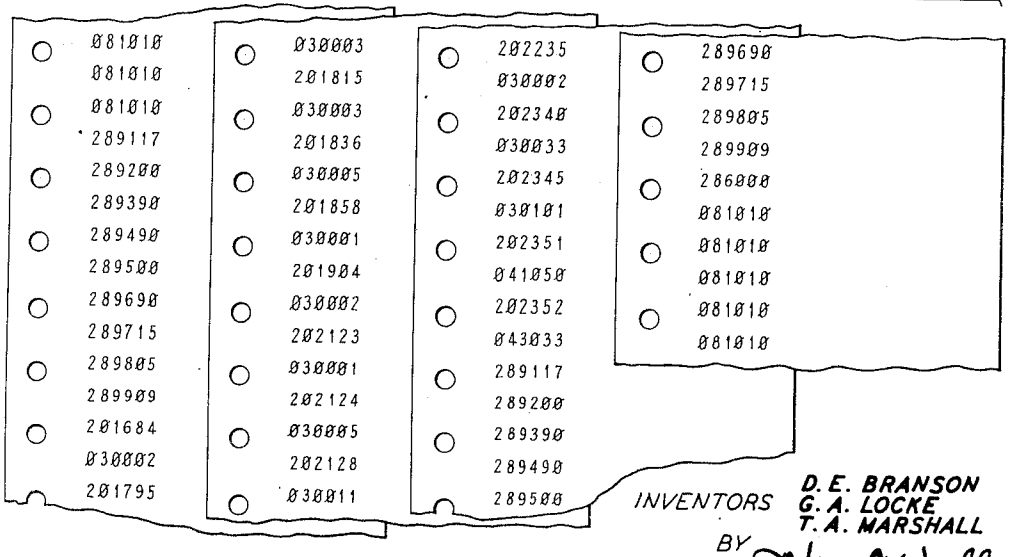

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FIG. 136

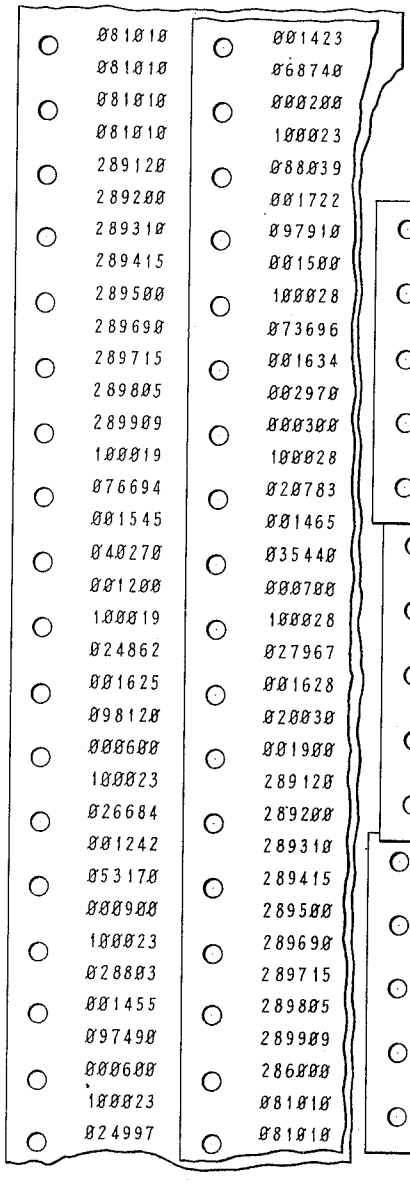
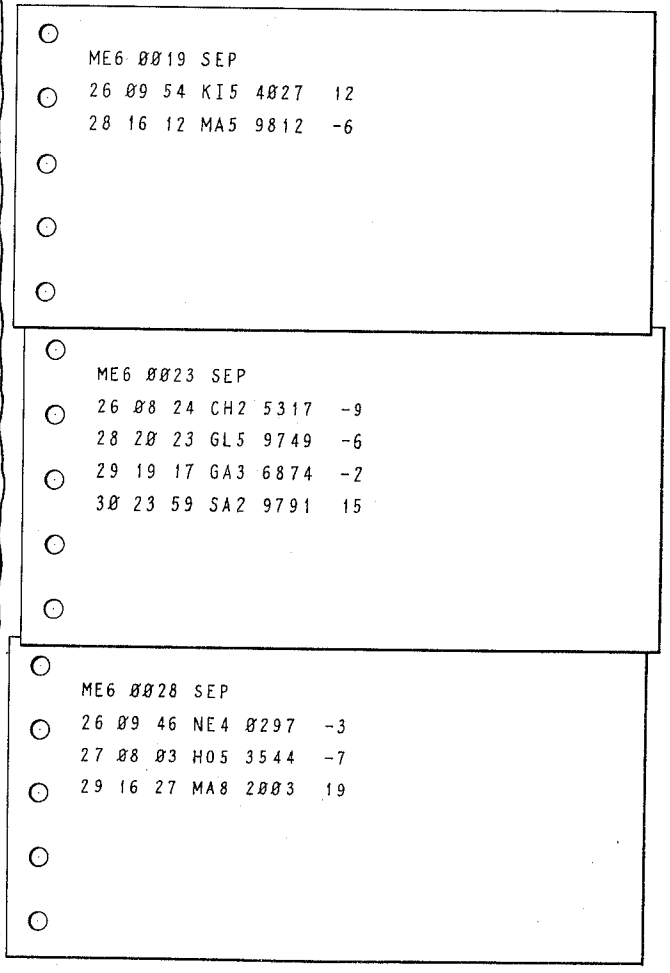


FIG. 137



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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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FIG. 138

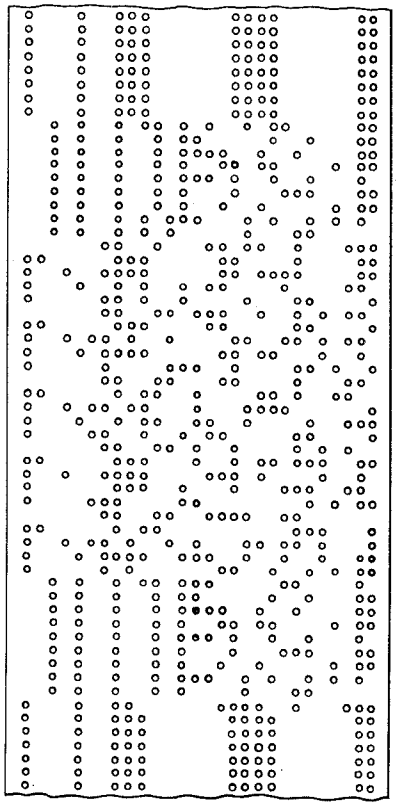


FIG. 140

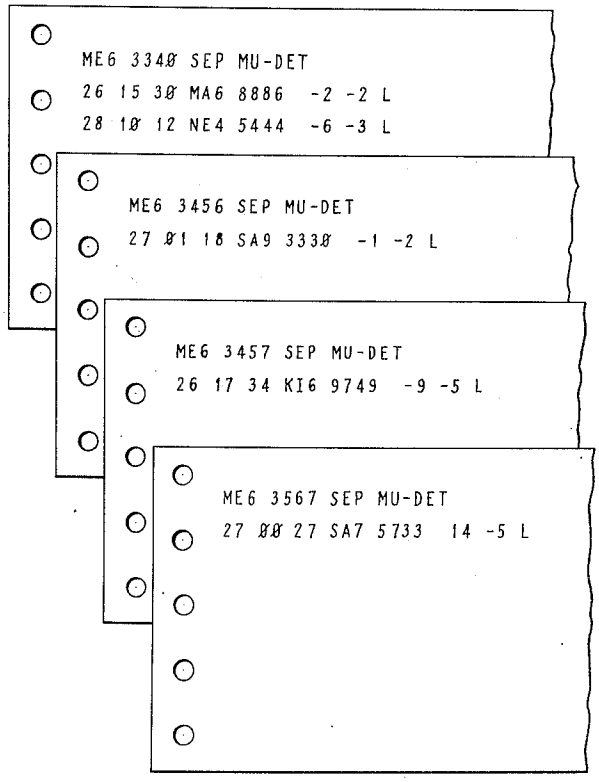
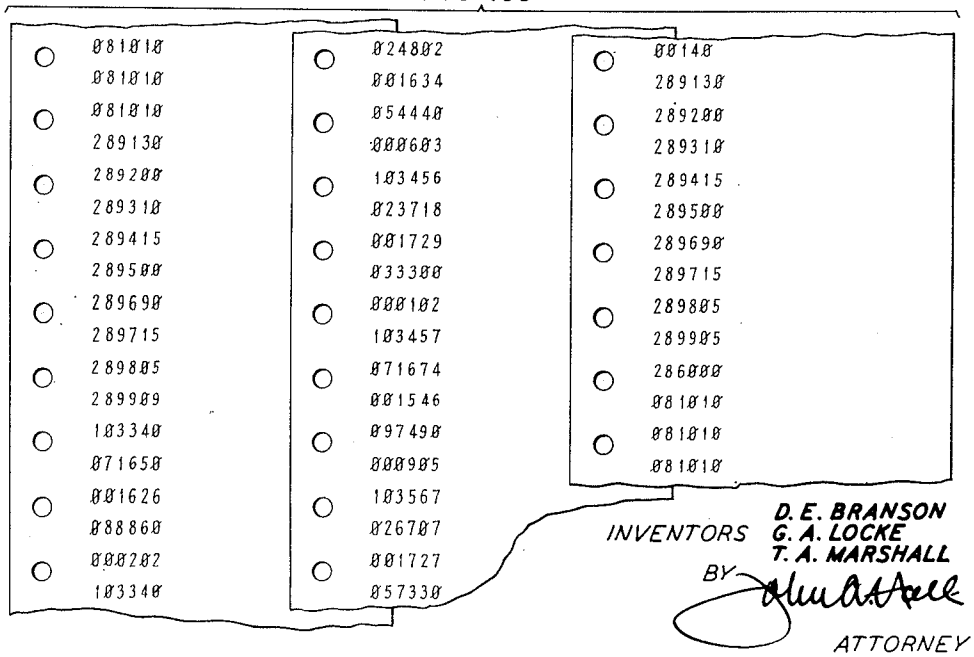


FIG. 139



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CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

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FIG. 141

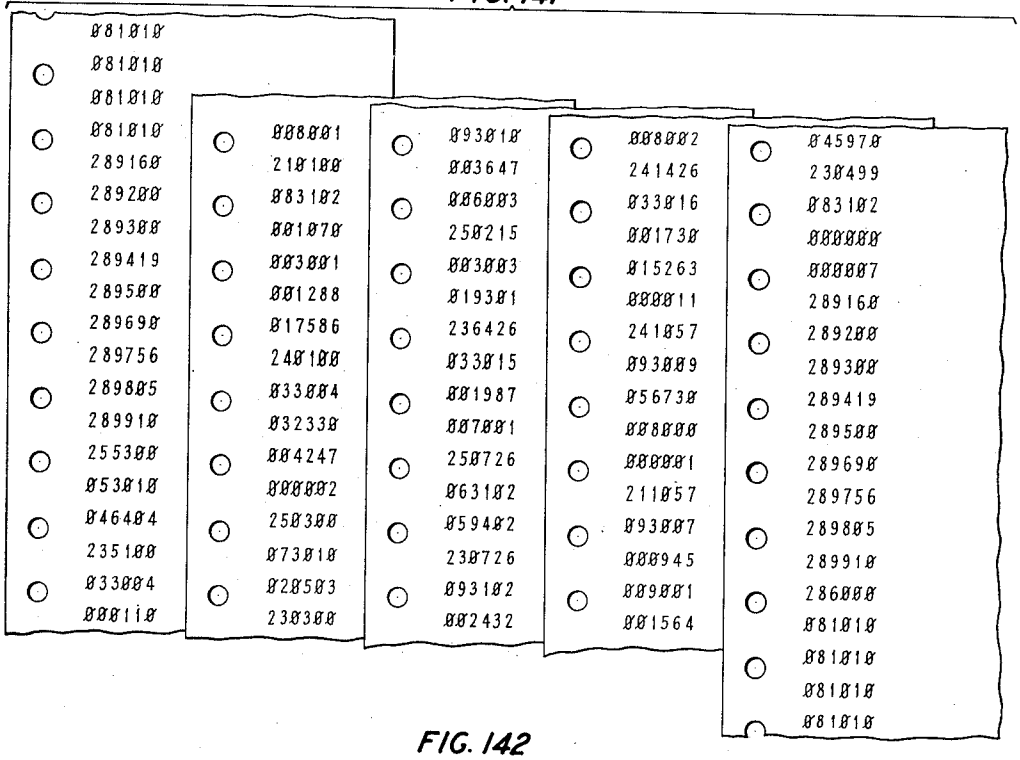
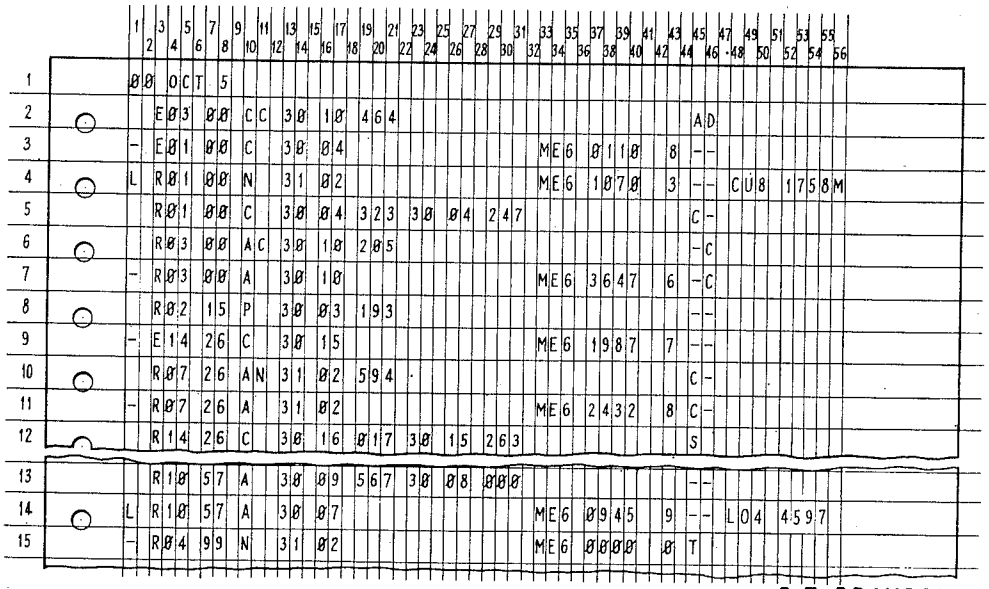


FIG. 142



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Patented June 6, 1950 2,510,061

UNITED STATES PATENT OFFICE

2,510,061

CODE TRANSLATOR AND PRINTER CONTROL CIRCUIT

David E. Branson, River Edge, N. J., and George A. Locke, Glen Head, and Tola A. Marshall Floral Park, N. Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application January 21, 1949, Serial No. 71,882

24 Claims. (Cl. 178—2)

1

This invention relates to automatic accounting systems and particularly to methods of and means for preparing bills to be presented to subscribers to public service systems.

The object of the invention is to promote economy and to improve the public relations between a public service corporation and its subscribers through improved speed and accuracy in the preparation of its bills for services. These objects are attained by rendering the system substantially completely automatic so that the chances for human error are eliminated.

In its general aspects the accounting system which includes the present invention as an essential part thereof is disclosed in the application of Joel-King, Serial No. 793,298, filed December 22, 1947. Means are provided to record items of information regarding the services rendered to each subscriber, to assemble the items pertaining to each individual service performed, to compute the charges incurred, to sort the computed charges, to summarize the charges for each subscriber for a given billing period and to print the results in a form suitable either for direct transmittal to the subscribers or for use by the clerical force handling the preparation of subscriber bills. Every operation in this system is handled on a code basis and it is not until the final operation, performed by the apparatus and the devices of the present invention, that the information recorded, sorted and calculated automatically is converted into printed form suitable for billing purposes and readily understandable by laymen.

The present invention comprises a means for converting a record prepared by some other device of the accounting system into a typed record. Since the output of every other device of the system is in the form of a tape containing a long succession of codes perforated in transverse lines, the device of the present invention is a means, generally spoken of as "the printer," for scanning one of these output tapes, and translating both the form and substance of the information presented thereby into tickets, lists and pages of printed matter. The translation of the form of the information is as important as the translation of the substance thereof since an object of the invention is to produce a final result fitting the uses which will be made of the product.

The device of the present invention consists of a reader for sensing the perforations of the input tape, a plurality of storage registers for temporarily storing the information gained from the input tape, a number of translators for translating from the tape code to other codes suitable for operating a printer, a control circuit for controlling the sequential access of the printer to the various registers and for otherwise controlling the operation of the printer in the production of the format of the output of the device and a printer responsive thereto.

2

The device is provided with a bank of manually operated control switches which must be set in accordance with given information accompanying each tape presented to the device as an input tape. Each such input tape has perforated in it in a section known as the tape identity codes, a series of codes giving information common to all the other information embodied in the tape and this information must be automatically checked against the setting of the said manually controlled switches. This general information contains items common to each specific item of information in the incoming tape as well as information which will determine the form of the product of the printer.

Most of the apparatus employed in the present invention is conventional telecommunication apparatus such as relays, cross bar switches, electronic tubes and ordinary circuit elements such as resistors and condensers. The input device is in the form of a tape transmitter of a type adapted to sense the perforations in a wide tape having a large plurality of code places. Such a reader is disclosed in some detail in the applications of W. W. Carpenter, Serial No. 666,280, filed May 1, 1946, and Serial No. 788,449, filed November 28, 1947, and issued January 31, 1950 as Patent No. 2,496,150. The output device is in the form of a conventional printing telegraph device which has been modified somewhat to perform special functions required in the present system. Such a printer, before the modifications, is disclosed in Patent No. 1,904,164, issued to Morton et al. on April 18, 1933.

In accordance with the present invention a complex control circuit is employed to check the validity of the entries and to supervise the form and substance of the typed billing data produced therefrom. The record used as an input to the device is in the form of a tape having transverse lines of codes perforated therein. These lines are in groups and each group represents an entry or a total amount of information pertaining to a single customer charge which must be typed as an item of billing data. The number of lines in an entry varies in accordance with the circumstances under which the tape was produced in the accounting system and, therefore, means are

provided to count the number of such lines and to sound an alarm if there is deviation from the number which is prescribed under the said circumstances. Each entry tape, therefore, contains in general three sections, first, a group of tape identity lines, second, a long plurality of billing data entries and third, a repetition of the first, a group of tape identity entries.

There is provided as a part of the device a panel on which is mounted a number of manually settable tape identity switches which must be set in accordance with the known circumstances under which an input tape was produced by some other device of the accounting system. The device then also contains a tape identity checking circuit which willl compare each line of the tape identity entries perforated in the input tape with the setting of the said switches and which will sound an alarm if any deviation from an exact correspondence is detected. If the setting of the switches is correct then the device will continue to operate and will proceed to the main business of converting the coded entries into properly arranged slips, lists, or pages of typed billing data characters. One is thus assured not only that the tape presented as an input to the device is of an acceptable type but also that various facts regarding this tape are properly established in the circuits of the device. Thus, the number of lines which must be expected in each entry is set forth and the counting circuit above noted is set to count this number and to give an alarm if either more or less appear in any given entry. As another example of the control exercised by the said manually settable tape identity switches, the device will be conditioned thereby to produce slips, lists, or pages of typed billing data.

A feature of the invention may be stated as a set of manually settable switches which perform the double function of placing the device in condition to accept for use a properly identified input tape and to thereafter control the pattern of operation of the device in its several functions.

Another feature of the invention may be stated as a control circuit, itself controlled by a set of manually settable tape identity switches for in turn controlling the operation of a translator and printer in the disposition of tape entries in combination with an acceptance circuit responsive to tape identity entries, for rendering the said control circuit operative.

Another feature of the invention is the use of a device which will convert variable number multiple line entries into single line type billing data. It has been noted that the device includes six storage registers, since the longest entry is one containing six lines and it takes one register for each line of the entry. However, regardless of the number of lines in an entry there is in the output only a single line, or perhaps more accurately a title and a single line of billing data. In some cases the title will be common to as many as forty lines of billing data and in other cases there will be slips typed each containing a title and a single line of billing data. The full information for billing purposes, of course, must come from a title and a line, but the point is that regardless of the length of the entry the output is always translated into a single line accompanying a title.

Another feature of the invention is the combination of a plurality of counting circuits, for counting the lines of an entry, the lines of typed billing data for each billing charge, the lines of billing charges and the number of characters typed in each line of each billing charge with a

control circuit responsive to said counting circuits for controlling the reader for sensing the coded lines of charge entries and the printer for converting said entries into typed billing charges. In another combination an over-all control over said control circuit is exercised by a tape identity circuit which gleans information from the identity of the various tapes to control the said counting circuits to produce different forms of typed billing data.

Another feature of the invention is a means for controlling the output or form of the typed billing data, comprising a character count circuit, and means for interpolating space signals and special characters at given character counts under control of a set of manually settable tape identity switches. Since the information entered into the device is in code form it has to be translated into billing data characters and these must be separated and properly spaced in accordance with the usual columnar arrangement of such billing data. The character count circuit is then employed not only to count the characters of the data translated from code to be typed but to see that such characters are typed in the proper vertical columns, that is, to see that each character is typed in a predetermined position and that other predetermined positions in a line are spaced. Thus, the make-up of the lines of the various slips, lists and pages of the output of the printer is controlled jointly by the setting of the tape identification switches, particularly the tape type switch, and the character count circuit, which controls through a sequence circuit the automatic insertion of spaces.

Another feature of the invention is a character count circuit by which is predetermined exactly what character shall be typed in each space of every different kind of line of typed billing data which is produced and exactly where such character is to be gleaned, be it a registered character, a character determined by the tape identity switches or a functional operation such as a space, a dash or the inevitable final carriage return and line feed. When, from the tape identity index, it is determined for instance that the title of a toll slip shall contain a count of thirteen characters, three for the office name, a space, four for the line number, a space, three for the month and a carriage return line feed operation, then a particular relay will be operated which will close thirteen leads each extending to the particular point from which this given information is to be gleaned and means is provided to enable each of these leads in sequence.

Another feature is the sequential operation of the device whereby each operation depends on the successful completion of a previous operation. As an instance of such operation it may be noted that the code translator relays control a one and one only circuit, that is, a circuit which becomes effective when one and one only of such relays is operated, to enable the transmitter distributor to transmit the code to the printer set up by the said translator code relay. Only when the transmitter distributor has completed its function does it give the signal to the character count circuit to advance to operate the code relay representing the next character to be printed. Thus, each operation is ordered, then performed and its success then reported as a signal for the next operation.

Another feature of the invention is a means for printing a special character where confusion in a circuit renders a registered character un-

intelligible so that the remainder of the record may be processed. Where a given digit or character which is to be printed has failed of proper registration in one of the storage circuits the printing up to that point is properly completed and then the process is stopped and an alarm is given. Thereupon, an attendant by the use of an array of signal lamps and keys may determine the cause of the stoppage, cause the printer to print a special character (such as a *) in place of the defectively registered character and cause the normal operation of the device to be resumed. As an example of the trouble which may lead to an alarm of this nature, it will be understood that the incoming tape to the reader is perforated with a long series of six-digit codes. Five of these are on what is known as the two-out-of-five code which means that each such code has five places and that each digit may be expressed by perforations formed in the tape at two of the said five places, no more or no less. If through an imperfect perforation only one or no perforations appear in the given five places or through an imperfection in the paper which allows the reader to sense more than two perforations, then the circuit whose duty it is to report that two and two only perforations exist or that two and two only relays have responded will fail with the result that the operation of the device is immediately stopped and an alarm is brought in. The operator or attendant has at her command a bank of signal lamps, one for each code place of a tape line and these may be temporarily associated with the reader pins, the reading relays or any one of the storage registers to which the line being sensed has been transferred and registered. If the trouble then appears to be a defective digit (more or less than the two and two only filled places), then a simple manipulation of a key provided for the purpose will cause the special character to be printed in place of the defective character and the processing restored to normal operation.

Another feature of the invention is a memory device associated with a register by means of which the record established on a first setting of the register is retained as a control. Thereafter, the register may be released and reset repeatedly and so long as there is no deviation from the first setting the said control will be maintained but as soon as there is a deviation then the memory device will interrupt the otherwise normal sequence of operations and will interpolate a special operation.

In the preferred embodiment of the invention a particular storage circuit is employed to register the calling line number in processing those tapes where the billing data is to be produced in the form of tickets or slips, one to each calling line number. If the incoming tape has a single entry for a given calling line number then only a single line of billing data in addition to the title will be typed, after which the device will move the paper a specified amount, cut it off in the proper size for a slip, stuff it into a receptacle for such slips and move the paper forward to the proper position for typing the title of the next. However, if several succeeding entries are all for the same calling line number, then the control is maintained, that is, the cutting and stuffing operation is withheld until there is a change in the calling line number whereupon this memory device interrupts the normal typing of the details of a plurality of billing data lines and seizes control in order that the slip may be cut, a new slip started and a new title typed.

The register consists of a relay device having a group of code relays for each digital code place. Where the line read by the reader contains six digits, five of these are registered in the said register and there are, therefore, five groups of register relays. The memory device consists of five auxiliary sets of relays each of which is set in exact correspondence with its associated set of register relays. The register relays may be released but the memory relays remain operated. Now the next time the register is set, if the setting is the same as on the previous occasion the pattern to which the memory relays had been set will not be disturbed with the result that only the line of billing data, and not a title, will be typed. However, if there is a deviation, then a change in the pattern of operations of the memory relays will take place as a result of which, the otherwise normal sequential typing of billing data is interrupted and a train of operations above set forth is started.

The set of register relays for each digital place consists of five relays, any two of which operated will represent one of the ten digits. The set of memory relays consists of ten relays, one for each of the ten digits and that one which is operated through the joint operation of a selected two of the five register relays will then lock to a circuit jointly controlled by the remaining three register relays which did not operate. Thus, all five of the register relays are involved in the operation of the memory relays so that when on the next setting of the register there is a change in the pattern, not only will some other memory relay be operated but the locking circuit of the memory relay previously operated will be opened. This change results in the starting of the cutting and stuffing operations described.

A somewhat similar or analogous circuit is employed in the month circuit, since each line of billing data contains only the day, hour and minutes of the start of the service, the month being noted in the title. Hence, if there are a plurality of entries all chargeable to the same calling line number, there will have to be a change in title if the time runs out of one month into the next. This may occur because the records embrace the time from 3:00 A. M. of one day to 3:00 A. M. of another day and hence, by way of example, a record for charges incurred on January 31st may also contain a few incurred between midnight on January 31st up to 3:00 A. M. on February 1st. Hence, a memory device is employed in connection with the month circuit which operates in the same manner, that is, the month circuit after its original setting may be released and reset repeatedly and so long as the repeated resettings are the same the memory circuit is not disturbed. However, when it is disturbed, then it interrupts the normal sequence of operations and interpolates a special operation.

The relays of the memory circuit exercise a control over the printer control circuit by maintaining a particular relay therein energized. When this relay becomes released a new cycle of operations is started, consisting of the movement of the paper in the printer to the proper point to be cut to the given sized slip, the cutting of the paper, the stuffing of the severed slip, and the typing of the new title as controlled by a newly energized memory relay. Each of the memory relays of a group controls a group master

relay which in turn not only controls each of the memory relays of the group but jointly with all the other group master relays controls the circuit to the printer control circuit to hold up or to start this new cycle of operations.

The circuits of the memory relays are such that when the pattern of operation of the register relays is changed, the new memory relay to be operated, cannot be operated until the previously operated memory relay has become fully released, whereby a chain circuit to the said particular relay in the printer control circuit is opened to start a new cycle of operations. It is the operation of one of those register relays not previously operated which opens the locking circuit of the previously operated memory relay which starts this operation—for the group master relay is held up by the locked memory relay and through its operation holds open the original operating circuit of every one of the memory relays.

A feature of the invention may, therefore, be said to be a set of register relays for registering a digit in code, a group of memory relays auxiliary thereto, each said memory relay responding to the conjoint operation of a predetermined definite number of said register relays and locking to a circuit conjointly controlled by the remaining unoperated ones of said register relays whereby said memory relays will maintain a given pattern of operation through a repeated release and reoperation of said register relays so long as the pattern of operation thereof is not changed.

Another feature of the invention may be stated as an extension of the above stated feature as one including means responsive to a change in pattern of operation of the said register relays for preventing the operation of another memory relay until a previously energized memory relay in response to the energization of a previously non-energized register relay has become completely released.

Another feature of the invention is a translator, in the present preferred embodiment known as the called office name translator. Every code of every line of the input tape is in the form of a six-digit number and embodied in some one line of an entry the called office name appears as a three-digit number. One will at once recognize from the familiar sight of the telephone dial that practically each finger hole of the dial has a number as well as three alphabetic characters, so that if one dials 263, he may be calling any one of nine different offices, AMerica 3, ANaconda 3, BOwling Green 3 or COcoanut 3 and others, by way of example, where the three characters may be combined to provide realistic office names. Where a single area as in a small city is concerned it is probable that only a single translation will have to be made so that the present device is provided to translate the 263 into BOwling Green 3 only.

In accordance with this arrangement a bank of selector relays is provided so that a single conductor representing a particular three-digit office code may be alternatively connected to that one of the said relays which will represent the wanted translation. Then by the use of a register for each digit of the office code the combination of the particular selector relay operated and the particular components of the said registers operated, a particular typed result may be achieved.

The called office name translator then consists of a register for each digit of the called office name, a means responsive thereto for electrically characterizing a single point, a bank of selector relays and a cross-connection device for associating each of said points with a particular one of said selector relays.

Where a great district is concerned, another register for the various areas is provided, for this same number may represent a different office name in each area. In this case a variable cross-connecting device is employed, one which in one area will effectively associate a given point with a particular selector relay and in another area will effectively associate the same point with another area. In this case the area register will be provided with a plurality of sets of coils each wound on a core and constructed as in the Potts Patent 2,339,803, so that a conductor or a plurality of conductors may be threaded through the core so as to be in mutually inductive relation with the coil. The coils are coordinately arranged, one coil for each selector relay for each area, so that when the area register is operated to designate a particular area, only those coils for that area will be rendered effective. Therefore, when a conductor, threaded through one coil for each area is electrically characterized, only a single selector relay is energized.

Another feature of the invention is a circuit for insuring that the reading relays shall have a full and complete reader interval in which to operate so that some mischance cannot cut the reading interval short and cause faulty operation. The reader operates at the rate of sixteen cycles per second and the reading interval is only slightly greater than four-hundredths of a second long. The reader is provided with a plurality of auxiliary control contacts some of which are closed in the reading interval and others are closed in the intervals between the reading intervals, or the remainder of a cycle. Therefore, a series of relays is provided, the first of which closes a circuit for the second, the second for the third and so on and each succeeding relay is operated by a contact closed in the next reading or in-between interval. In this sequential operation of a series of relays, the connector relays for closing the connections between the reader pins and the reading relays are operated in an in-between interval so that the reading relay circuits are fully closed at the beginning of the next reading interval. This series of relays is then controlled by the last relay in the series so that the sequential action cannot be restarted until the last relay has been released and since this relay cannot be released until a complete validity check of the reading relay has been made, insurance for the proper operation of the reading relays is provided.

A feature of the invention may, therefore, be stated as a synchronizing means for operating a connector relay to prepare for a given operation of a transitory nature consisting of a plurality of relays connected in cascade, each preparing the circuit for the next and each in turn responding to a circuit closed in the following interval.

Another feature of the invention may be stated as a continuously operating reader and means to sense the code presented to the said reader periodically preparing for its registration through a number of cycles and accomplishing the registration during one cycle following said preparatory cycles. In other words, advantage is taken of the fact that the reader is inherently a faster operating device than the printer to provide surety means free of (time) marginal means,

Since the printer can be operated at top speed and still allow the reader to sense each code several times, this circumstance is used to advantage and a particularly reliable circuit operation is gained.

Other features will appear hereinafter.

The drawings consist of one hundred and thirty-six sheets having one hundred and forty-three figures as follows:

Fig. 0 is a perspective view of an exemplary embodiment of the invention;

Figs. 1 to 127, inclusive, are detailed circuit drawings of the said exemplary embodiment;

Fig. 128 is a block diagram showing how Figs. 1 to 127, inclusive, may be placed to form a complete circuit diagram;

Figs. 129 and 130 placed with Fig. 130 to the right of Fig. 129 are block diagrams showing how the various Figs. 1 to 127, inclusive, are grouped in the various component circuits of the device;

Fig. 131 is a time chart of the auxiliary contacts of the reader;

Fig. 132 is a chart used in explaining the cross-connecting scheme for the called office name translator;

Figs. 133, 134 and 135 represent respectively an incoming summary tape, a verbatim printing of the same and the printed result thereof;

Figs. 136 and 137 show the verbatim printing of a tape for producing toll slips and Fig. 137 shows three toll slips printed therefrom;

Figs. 138, 139 and 140 show respectively an incoming perforated tape carrying data for producing message unit detail slips, a verbatim printing of the same and four of such message unit detail slips;

Fig. 141 shows a verbatim printing of an incoming straddle tape; and

Fig. 142 shows a straddle page produced by the device of the present invention from such straddle tape.

In detail, Fig. 1 shows two groups of relays, one for connecting the reader pins to the reading lamps shown at the right-hand ends of Figs. 3 and 4 and the other group for connecting these lamps to storage circuit No. 1.

Fig. 2 shows similar groups of relays for connecting the lamps to the reading relays, one group for connecting the lamps to the reading relays and another group for connecting these lamps to storage circuit No. 2.

Fig. 3 shows a similar two groups of relays, one for connecting the lamps to storage circuit No. 3 and the other for connecting the lamps to storage circuit No. 5.

Fig. 4 shows a similar two groups of relays, one for connecting the lamps to storage circuit No. 4 and the other for connecting the lamps to storage circuit No. 6.

Figs. 5, 12 and 20, designated on Fig. 129 as the panel circuit, show in Fig. 5 the manual switches for setting up the tape identity (1) with regard to the tape type, (2) with regard to the previous sort, (3) with regard to the marker group tens and (4) with regard to the marker group units. Fig. 12 shows three switches, one for the office, another for the first thousands and the third for the last thousands and Fig. 20 shows three switches, one for the round, a second for the month tens and the last for the month units.

Figs. 6 and 13, designated on Fig. 129 as the tape class connector circuit, show a group of relays controlled from the panel switches of the panel circuit to control the operation of the device with regard to the class of tape which is being processed.

Figs. 7 and 14, designated on Fig. 129 as the tape identification circuit, show a group of relays in general designated LN1 to LN9, inclusive, for setting up the proper circuits whereby the identity information perforated in the tape may be checked against the identity information set up on the switches of Figs. 5, 12 and 20, together with a group of check relays which must be completely energized in order to prove correspondence between such identity information in the two places aforesaid.

Figs. 21 and 22, designated in Fig. 129 as the tape digit register circuit, show a step-by-step switch and its controlling circuit used for the purpose of checking the nine lines of the tape identity information perforated in the incoming tape.

Figs. 8, 15 and 23, designated in Fig. 129 as the reader, show in schematic form the reader employed in the present invention for sensing the perforations of the incoming tape, Fig. 8 showing the various magnets, cams and ratchets for moving the drum of the reader together with the contacts of the A and B groups. Fig. 15 shows the drum and the contacts of the C and D groups and Fig. 23 shows the E and F groups together with the auxiliary contacts used for circuit control.

Figs. 9, 16 and 24 show the six groups of reading relays, Fig. 9 showing the A and B groups, Fig. 16 indicating the C and D groups and Fig. 24 indicating the E and F groups.

Figs. 10, 11, 17, 18, 25 and 26, designated in Fig. 129 as the reader control circuit, show a large group of relays for the control of the reader in its various functions.

Figs. 19 and 27, designated in Fig. 129 as the reading relay translator circuit, show a group of relays responsive to the reading relays for setting up particular circuits frequently used, such as the 289 circuit (meaning some one of the tape identity lines whose first three digits are 2, 8 and 9).

Fig. 28, designated in Fig. 129 as the called office translator, shows a group of relays responsive to the three digits designating a calling office and translating such numerals to the corresponding characters used in the name of such office.

Figs. 29 and 30, 37 and 38, 44 and 45, designated in Fig. 129 as the entry class register circuit, show a group of relays for controlling the circuits of the device in accordance with the class of each entry as it is read from an incoming tape. Fig. 29 shows a single relay (VBM) which must be operated in order to control the printing of a verbatim line and a pair of relays (ST1A) and (ST1B) which must be operated in order that an initial detail entry be printed. Fig. 30 shows a single relay (M1) which must be operated in order that a message unit local entry be printed and a pair of relays (M2A) and (M2B) which must be operated when a message unit local and extended entry is printed. Fig. 37 shows a pair of relays (S2A) and (S2B) which must be operated when an initial message unit entry is printed and a pair of relays (ST3A) and (ST3B) which must be operated when an answer or disconnect entry is printed. Fig. 38 shows a pair of relays (D1A) and (D1B) which must be operated when a detail entry is to be printed and a pair of relays (D2A) and (D2B) which must be operated when a non-answered entry is to be printed. Fig. 44 shows a pair of relays (ST4A) and (ST4B) which must be operated when a straddle timing entry is to be

printed and Fig. 45 shows a group of line register keys by which a line registered in any one of the six storage circuits may be visualized in the lamps of Figs. 3 and 4 together with a series of lamps below the said keys which indicate the nature of the entry.

Figs. 31, 32, 33, 39, 40, 41, 46, 47 and 48, indicated in Fig. 129 as the line pattern character sequence circuit, show the various relays which have to be operated in sequence in order to operate the printer code relays in proper sequence to perform the printing operation. Figs. 31, 39 and 46 show the title relays and Figs. 32, 40 and 47 in the upper portions thereof show the general title control relays. Figs. 32, 40 and 47, 33, 41 and 48 show the line relays and at the bottom of Figs. 33, 41 and 47 are the line control relays.

Figs. 49 and 56, designated in Fig. 129 as the printer control circuit, show a group of relays for controlling the printing portion of the device.

Figs. 50 and 57, designated in Fig. 129 as the line count circuit, are a chain of counting relays for counting the number of lines printed and for controlling certain paper handling functions of the printer.

Figs. 51 and 52, designated in Fig. 129 as the month translator circuit, show a group of relays for translating the numerical designation of the month into the proper abbreviated spelling thereof.

Fig. 55 shows the called office name translator connector circuit which consists essentially of a multicontact relay for connecting the called office name translator to the printing device when it is necessary to translate the three numerical digits of the called office name translator to the proper alphabetical designation thereof.

Figs. 58, 59, 70, 71, 82 and 83, designated on Fig. 130 as the storage circuit No. 1, show the five groups of code relays for the B, C, D, E and F digits of a line which may be registered therein together with the controlling relays therefor.

Figs. 53, 54, 60, 61, 72, 73, 84 and 85, designated on Figs. 129 and 130 as storage circuit No. 2, show the same arrangement of five-digit groups of relays and in addition the groups of relays for translating the five-digit start time line into the six digits representing the day, hour and minutes on which a call was started.

Figs. 62, 63, 74, 75, 86 and 87, designated on Fig. 130 as the storage circuit No. 3, show the five groups of digit registering relays similar to those of the storage circuit No. 1.

Figs. 64, 65, 76, 77, 88 and 89, designated on Fig. 130 as the storage circuit No. 4, show the five groups of digit registering relays similar to the storage circuit No. 1.

Figs. 66, 67, 78, 79, 90, 91, 102 and 103, designated on Fig. 130 as the storage circuit No. 5, show the five groups of digit register relays similar to the storage circuit No. 1.

Figs. 68, 69, 80, 81, 92, 93, 104 and 105, designated on Fig. 130 as the storage circuit No. 6, show the six groups of digit storing relays similar in arrangement to the storage circuit No. 2.

Figs. 94, 95, 106, 107, 114, 115, 121 and 122, designated on Fig. 130 as the code relay circuit, show in the top row of these figures the character and numeral relays for controlling the printing telegraph distributor whereby any character such, for instance, as the letter H may be translated into a series of time-spaced impulses in order to operate the printer in the conventional manner.

Figs. 95, 107, 115 and 122 show merely a multiple arrangement whereby these various relays may be reached from various circuits.

Figs. 96 and 108 show part of the circuit designated on Fig. 130 as a called office name translator and contain the relays operated in response to the first digit of the called office name.

Figs. 97 and 109 of this group contain the relays responsive to the second digit of the registered called office name.

Figs. 98 and 110 contain the relays responsive to the third digit of the called office name.

Figs. 99 and 111 contain certain common relays used for the control of the printing and for translation between one, two and three-digit office names.

Figs. 116, 117, 123 and 124 embody a showing of a conventional cross bar switch whereby these three digits of the called office name may be translated into the activation of a particular cross-connecting point.

Figs. 118 and 125 show a group of thirteen coordinately arranged relays for cross-connection to these points which are selectively designated for printing certain ones of the three characters conventionally found in each finger-hole of a telephone dial.

Figs. 100, 101, 112, 113, 119 and 120 show an arrangement of electronic circuits whereby a cross-connecting point activated by the cross bar switches of Figs. 116, etc. may be translated to different alphabetical designations in different areas.

Fig. 126 shows in schematic form the conventional distributor for transmitting code to the printing telegraph device and a conventional printing telegraph device operated thereby.

Fig. 127 shows the power control and alarm circuit used in connection with the present device.

In the following description the various relays are designated by both letters and numerals which have come to have certain significance to persons familiar with the technical details of the disclosed arrangements. By way of example, the reading relays are known as the A0, A1 and A2 relays for the first group thereof used to register the A digit of the six-digit line used in the automatic accounting system tapes. In the present case, there are three relays in the first or A set and five relays such as the B0, B1, B2, B4 and B7 relays in each of the remaining five sets. In the various storage circuits such, for instance, as the storage circuit No. 1, the B set of relays is known as S1B0, S1B1, etc. and in the No. 6 storage circuit these relays will be S6B0, S6B1, etc. In a great many cases a relay will have only such an alphabetic designation but in other cases it will have in addition a numerical designation which always consists of the figure number plus two other digits, by way of example, the LA1 relay in Fig. 1 is also designated 101 and the DCP relay in Fig. 127 is designated 12713. Where conductors are designated by numerals in addition to the usual alphabetic designation thereof the number used will be a combination of the figure number wherein the conductor is first picked up in the tracing of a circuit and this number will be retained even though the conductors extend through another large number of circuits. Thus, by way of example, the CT conductor connected to armature 3 of the PR relay 2505 and thus originating in Fig. 25 may be found extended to Fig. 43 where it is connected to armature 3 of the SPJ relay 4300.

For obvious purposes, in certain cases, conductors will bear the same alphabetic designation

as other apparatus. This is not to be taken as a duplication of the designation but will be readily understood that such a conductor bears an intimate relation to the other piece of apparatus. The use of the same designation is a help rather than a source of confusion.

Similar logical means for designating various elements of the circuits will be found in the drawings and are used as an aid to the clear understanding of the present arrangement.

The apparatus used in constructing the device of the present invention is mostly standard communication apparatus, details of which may be found in the following references:

The relays are of types shown in patents:

1,156,671, E. B. Craft, Oct. 12, 1915
1,633,576, C. H. Franks, June 28, 1927
1,652,489, E. D. Mead, Dec. 13, 1927
1,652,490, D. D. Miller, Dec. 13, 1927
1,652,491, D. D. Miller, Dec. 13, 1927
2,169,551, C. I. Baker, Aug. 15, 1939
2,178,656, P. W. Swenson, Nov. 7, 1939
2,323,961, F. A. Zupa, July 13, 1943

The printing telegraph receiver employed is of a type disclosed in patent: 1,904,164, Morton et al., April 18, 1933.

The transmitter-distributor is shown in patent: 1,595,472, H. L. Krum, Aug. 10, 1926.

The cross bar switches are shown in patents:

2,021,329, J. N. Reynolds, Nov. 19, 1935
2,039,630, J. A. Burwell, May 5, 1936
2,039,644, D. A. Gleason and F. J. Redmond, May May 5, 1936
2,086,136, J. N. Reynolds, July 6, 1937
2,117,702, J. A. Burwell, May 17, 1938
2,118,935, A. C. Magrath, May 31, 1938

The reader is disclosed in: application Serial No. 666,280, May 1, 1946, W. W. Carpenter.

The type of coil used in the called office name translator circuit is indicated in patent: 2,339,803, L. M. Potts, Jan. 25, 1944.

Other apparatus is of conventional design.

Reference is made to previously filed applications having some relation to the present disclosure in that such applications show details of the complete development of which the present is but a part.

Serial No.	Filing Date	Inventor
724,992	Jan. 29, 1947	Carpenter-Gooderham
759,402	July 7, 1947	Carpenter-Collis
788,449	Nov. 28, 1947	W. W. Carpenter
793,298	Dec. 22, 1947	Joel-King
38,927	July 15, 1948	J. W. Gooderham

Other applications covering parts of the same development having disclosures overlapping the present disclosure in certain respects but covering independent inventions as claimed therein, are as follows:

Serial No.	Filing Date	Inventor
101,086	June 24, 1949	R. O. Rippere
101,081	June 24, 1949	S. L. Eppel
101,087	June 24, 1949	A. E. Joel, Jr.
101,082	June 24, 1949	Eppel-Joel
101,084	June 24, 1949	Flint-Hague-Joel-Rippere
101,085	June 24, 1949	Flint-Joel
101,090	June 24, 1949	Hague-Joel
101,088	June 24, 1949	Joel-Rippere
101,089	June 24, 1949	A. E. Hague
101,083	June 24, 1949	E. W. Flint

GENERAL APPEARANCE

The general appearance of the device of the present invention is shown in Fig. 0. In this figure the cabinet 1 together with the cabinet 2 include all the apparatus of the present invention. Cabinets 3 and 4 are used to house the apparatus of other processing units of the automatic accounting system.

The cabinet 2 consists of two portions, that to the right with the doors to the lower part thereof closed houses the printer or output unit and that to the left with the lower front part of the cabinet open houses the reader or input unit. No attempt has been made to show the details of the printer or the reader but it will be noted that each is installed under a transparent plastic window so that the operation thereof may be observed. In the lower part of the reader cabinet a reel will be noted from which the input tape is taken to be fed through the reader and a very small portion of the take-up reel is also visible.

In the left-hand portion of this perspective drawing three cabinets may be seen each of which consists of a lower and an upper part and each part having glass-fronted doors. Each of these cabinets contains a relay rack on which relays, cross bar switches and other apparatus involved are mounted.

Particular attention is directed to the lower part of the upper portion of the right-hand cabinet where the tape identity switches are mounted in a panel designated 5 and where the lamps and various control keys are mounted in a panel designated 6.

It will be noted that lamps 7, 8 and 9 mounted on the various processing unit cabinets are general alarm lamps which will operate to notify an attendant which particular processing unit has brought in an alarm. In the printer unit forming the subject-matter of the present invention, a general alarm lamp 10 on the control panel may also be noted.

With this short general description of the appearance of the apparatus, a detailed description of the operation of the circuits will now be given. In order to avoid confusion in such a large and complicated circuit the various elements and their functions have been separately described and as an aid to a person reading the following description an index is provided as follows:

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1. Purpose of circuit

1.1 The purpose of this circuit is to provide a means whereby the information contained in certain automatic accounting system tapes received from other circuits in an accounting center may be converted into printed form.

2. Working limits

2.1 This circuit operates at a maximum printer speed of 100 words or 600 characters a minute, while the associated reader operates at a maximum speed of 16 steps a second.

3. Functions

3.001 Tape identification

This circuit is arranged to check the tape identity group of a tape, by means of setting the same information on set-up switches in the circuit, against which the tape identity group is checked. An alarm is given if these do not match.

3.002 Tapes accepted by this circuit

This circuit will accept twenty-one different kinds of tapes. These twenty-one types of tapes and their tape index numbers are listed below (section 7.03).

(*a*) Summary tapes from the summarizer, Tape index No. 17.

(*b*) Unsorted tapes from the computer.
1. Toll tapes, Tape index No. 20.
2. Message unit detail tapes, Tape index No. 30.
3. Observing tapes, Tape index No. 40.
4. Straddle tapes, Tape index No. 60.

(*c*) Sorted by office, from either the computer or the sorter.
1. Toll tapes, Tape index No. 21.
2. Message unit detail tapes, Tape index No. 31.
3. Observing tapes, Tape index No. 41.

(*d*) Preliminary sort by thousands from either the computer or the sorter.
1. Toll tapes, Tape index No. 22.
2. Message unit detail tapes, Tape index No. 32.

(*e*) Sorted by units, from either the computer or the sorter.
1. Toll tapes, Tape index No. 23.
2. Message unit detail tapes, Tape index No. 33.

(*f*) Sorted by tens, from the sorter.
1. Toll tapes, Tape index No. 24.
2. Message unit detail tapes, Tape index No. 34.

(*g*) Sorted by hundreds, from the sorter.
1. Toll tapes, Tape index No. 25.
2. Message unit detail tapes, Tape index No. 35.
3. Observing tapes, Tape index No. 45.

(h) Final sort by thousands, from the sorter.
1. Toll tapes, Tape index No. 26.
2. Message unit detail tapes, Tape index No. 36.
3. Observing tapes, Tape index No. 46.

(i) Any tape from any part of the accounting office, or the central office, to be read on a verbatim basis.

3.003 Printed records

This circuit is arranged to translate the information contained in the entries on the various tapes listed above and print them in various forms. The forms of these printed records are shown in detail in section 38 of this circuit description.

3.004 Printed paper sizes

This circuit is arranged to print the information received from the various automatic accounting system tapes, on three different sizes of paper depending on the type of information being printed. These various sizes and their uses are as follows:

1. Message unit lists and verbatim lists are printed on pages 3 inches wide and 11 inches long, which come from a folded pack. These lists will contain forty lines to the page, the first line of which in the message unit lists will be taken up by the title. The verbatim lists, there being no title, will have forty entry lines.
2. The straddle page is printed on pages 7 inches wide and 11 inches long, which come from a folded pack. These pages contain forty lines the first line of which is taken up by the title.
3. Toll, message unit detail and observing tapes are printed on a slip 5 inches wide and 2½ inches long, the paper for which comes from rolls, and the slips are cut off to the 2½ inch length by a cutter on the printing unit.

3.005 Acceptance of serially numbered sections of tape

This circuit is arranged to accept under certain conditions, a tape containing a number of sections that have been spliced together, all having the same tape index number, and check them for the numerical sequence of the sections. The tapes that can be so treated are as follows:

1. Summary tapes, Index No. 17.
2. Toll tapes and message unit detail tapes having a preliminary or first thousands sort. Tape index No. 22 or 32, respectively.
3. Toll tapes, message unit detail tapes or observing tapes having a final or second thousands sort. Tape index Nos. 26, 36 or 46, respectively.

3.006 Skipping of leading end of tape pattern

This circuit is arranged to begin skipping on the splice entry, 081010 in the leading end of the tape directly, and to stop skipping on the first line of a tape identity group. Skipping cannot again start on a splice entry without previous preparation.

3.007 Skipping of trailing end of tape pattern

This circuit is arranged to prepare for skipping on the skip splice entry, and to actually start skipping on the following splice entry. This skipping is terminated by the mutilated splice entry at the end of the tape.

3.008 Skipping of window pattern

This circuit is arranged to prepare for skipping on the first skip window entry, and to actually start skipping on the following splice entry. This skipping is terminated by the second skip window entry.

3.009 Emergency termination of skipping

This circuit is arranged to terminate skipping on other elements of an automatic accounting system line, if a tape identity group entry or the second skip window entry fails to stop it.

3.010 Tape identity group check before processing

This circuit is arranged so that all nine entries of a tape identity group must be checked before processing of the following call entries can begin.

3.011 Main power switch

This circuit is arranged so that all power may be removed from the circuit by the operation of a single switch.

3.012 Reader

This circuit uses a reader to sense the codes of an incoming tape.

3.013 Starting of motors

This circuit is arranged to cause the starting of all motors used, the reader, distributor and printer, by the momentary operation of the (Motor start) key.

3.014 Emergency stopping of reader motor

This circuit is arranged so that the reader motor may be stopped at any time by the momentary operation of the (Emerg. motor stop) key.

3.015 48-volt potential control

This circuit is arranged so that all 48-volt potential can be removed from the circuit, releasing all relays, by the following means:

1. When processing, by operating both the (Machine release) and (Master release) keys.
2. When not processing, by operating only the (Master release) key. The (Master release) key is a locking key.

3.016 Release of circuit

This circuit is arranged so that the momentary operation of the (Machine release) key will complete printing of any entry in process at the moment, and will then cause the circuit to stop in a condition to be restarted at any time from the point of stoppage.

3.017 Time out alarm

This circuit is arranged so that if processing stops for a period of approximately 8 seconds, both a visual and audible alarm will be given.

3.018 130-volt potential supply

This circuit uses approximately 180 ma. of 130-volt direct current potential, supplied by a rectifier, which is a part of this circuit.

3.019 Start processing

This circuit is arranged to start processing by the momentary operation of the (Machine start) key after and only after the motors have been started.

3.020 Arrangement of circuit for types of under the figure printing.

The over-all circuit is arranged for the various printing arrangements by the setting of the (Tape type) and (Previous sort) switches.

3.021 Fast feeding of tape

This circuit is arranged so that the tape may be fed quickly into the reader for starting purposes by the operation of a key (TF) on the reader.

3.022 Reader relays

The reader relays will take up the same com-

bination as represented by the closed contacts of the reader, and will indicate a check only when proper registration of digits has been attained.

3.023 Tape out indication

If all reader relays are operated, a tape out condition will be indicated by the lighting of the (End of tape) lamp accompanied by a general alarm, without timing.

3.024 Reading first line under reader pins

This circuit is arranged to read and print the first line presented to the pins, before stepping of the reader drum takes place.

3.025 Verbatim entry

Every line in a verbatim tape except a blank is an entry, and regardless of whether the digits check will be transferred to the verbatim storage circuit. If the digits in the line do not check in storage, a stoppage will take place, and an alarm will be given.

3.026 Printing of a mutilated entry line

A mutilated entry may be printed with stars in place of numerals or other characters in the mutilated positions, by operating the (Reader step) key momentarily.

3.027 Counting of entry lines

A count circuit is provided to count the lines of an entry, both of the tape identity group and call entries, and to steer the information in each line into the proper storage circuits.

3.028 Verbatim line count

A verbatim entry is a one-line entry and uses a single count in the count circuit.

3.029 Verbatim storage

The storage circuit used for verbatim translates the automatic accounting system code as received from the reader into the decimal system for printing.

3.030 Over-all check

A new line can only be brought under the reader pins automatically when the previous line has been checked in both the reader relays and the storage circuit.

3.031 Verbatim title

The verbatim title consists of line feed operations of the printer to properly place the first printed line on the folded page.

3.032 Character relay check

The character relays are equipped with a one and one only check circuit to prevent the starting of the distributor if more than one relay be operated.

3.033 Character pulse distribution

Character pulses, five-unit code, are distributed on a time basis to the printer.

3.034 Upper case characters

Some characters used in this printer are in the upper case. For each upper case character to be printed this circuit is arranged to first send a shift signal, then the lower case signal for the character on the pallet of which the upper case character is located, and then an unshift signal.

3.035 Counting of printed characters

The form of the printed line is determined by the action of the printer character sequence circuit in directing the ground circuit for operating each character relay through the line pattern connector circuit.

3.036 Counting of printed lines

The printed lines are counted by a line count circuit, for the purpose of entering a new title after a nine-line count for slips or a forty-line count for pages.

3.037 Skipping between sections of tape

This circuit is arranged to prepare for skipping between sections of a tape by the recognition of a skip splice entry, and to actually start skipping on the following splice entry. This skipping is terminated by the recognition of a tape identity group entry, in the next section of the tape.

3.038 Summary entry line count

A summary entry may consist of two or three lines, and, therefore, uses a two or three count as the case requires.

3.039 Calling office name translation

This circuit is arranged to translate the two-digit number of the marker group set up on the set-up switches, in combination with a single office digit, this office digit being set up on the set-up switches or being obtained from a line in an entry, into a one, two or three-digit office name.

3.040 Month translation

This circuit is arranged to translate a two-digit number representing the month set up on the set-up switches into a three-letter abbreviation, and to change to the abbreviation for the succeeding month in the last round, when the day register indicates that the call was made in the following month.

3.041 Round number

This circuit provides a means for printing the round number when required, from the position of the round switch in the set-up switches.

3.042 Non-significant zeros

This circuit is arranged so that in all printing of message units or chargeable time, non-significant zeros are replaced by dashes.

3.043 Use of service zero

The zero used on the printer associated with this circuit is printed "Ø," a zero with a line drawn through it slanting to the left downward, to differentiate between a zero and the letter "O."

3.044 Straddle entry line count

A straddle entry may consist of three, four, five or six lines, and, therefore, uses a 3, 4, 5 or 6-line count as the case requires.

3.045 Type of entry in straddle entries

This circuit is arranged to interpret the B digit of the first line of a straddle entry, as an indication of the type of entry and to print an appropriate character to indicate the type of entry.

3.046 Printing of the recorder number

This circuit is arranged to print the recorder number from straddle entries, the C and D digits of the first line, and to indicate whether the recorder is the regular or emergency machine, or whether this information is unknown.

3.047 Printing of call identity index

This circuit is arranged to print the call identity index from straddle entries, the information for which is obtained from the E and F digits of the first line.

3.048 Printing of straddle index

This circuit is arranged to translate the straddle index, obtained from the B digit of the second

line into symbols which serve as a guide to related entries of the call, as to their location.

3.049 Printing of time from straddle entries

This circuit is arranged to print the day and the hour from straddle initial entries or detail straddle initial entries, the day, hour and minute for both answer and disconnect from straddle answer-disconnect entries and the day, hour and minute for straddle timing entries.

3.050 Printing of directory number

This circuit is arranged to print the directory number when the printing of this number is required.

3.051 Printing of message billing index

This circuit is arranged to print the index number from the C digit of the fourth line of straddle entries.

3.052 Printing of straddle charge index

This circuit is arranged to interpret the straddle charge index from the (F) digit of the fourth line of initial straddle entries, the fifth line of answer-disconnect entries and the third line of timing entries into symbols indicating what special charging action should be taken.

3.053 Printing of area index

This circuit is arranged to print the area index of the called office, if calls can be made to more than one area. This feature for single or multiple area printing is on an optional basis in this circuit.

3.054 Called number index

This circuit is arranged to read the called number index, and to use this number to print the called number in the proper form.

3.055 Called office

This circuit is arranged to register the digits of the called office, transfer them to the associated printer translator circuit, and print the characters indicated by that circuit.

3.056 Called number

This circuit is arranged to print the called number in the form dictated by the called number index.

3.057 Straddle entries, timed release index

This number is registered from the E digit of line 5 of the answer-disconnect entries, and line 3 of the timing entries and only affects the printing, when 1 is present in this E digit, and 1 also is present in the F digit, in which case an S is printed in the straddle charge index.

3.058 Cutting of slips

This circuit is arranged when printing slips to automatically cut the slips from a roll of paper and stuff them in a ticket box.

3.059 Time translation

This circuit is arranged to convert a five-digit start time line into a six-digit printed record.

3.060 Chargeable time

This circuit is arranged to print the chargeable time when required, with a dash for non-significant zeros.

3.061 Message units

This circuit is arranged to print message units when required, with a dash for non-significant zeros.

3.062 Type of message units

This circuit is arranged to print the type of message units when required.

3.063 Non-answered entries

This circuit is arranged to print non-answered entries when printing observing tapes.

3.064 Line-a-time stepping of reader

This circuit is arranged so that the reader may be manually stepped a line at a time either before processing or during processing.

3.065 Character-a-time stepping

This circuit is arranged so that processing can take place a character at a time when desired.

3.066 Indication of entry under process—(Entries) lamps

This circuit is arranged to display an indication of the entry being processed with the number of lines in that entry.

3.067 Indication of line of entry being processed—(Line of entry) lamps

This circuit is arranged to display an indication of the line of entry being processed.

3.068 (Reader or register) lamps

This circuit is arranged to display the combination in the reader contacts, reader relays, or the storage circuits associated with an entry being processed by operating appropriate keys.

3.069 Section of tape in process—(Tape section) lamps

This circuit is arranged to display an indication of the section of tape that is in process.

3.070 First tape section in error—(First thou. in error) lamp

This circuit is arranged to display an indication when the first section in a tape does not agree with the first tape section expected by the set-up switches.

3.071 Last tape section in error—(Last thou. in error) lamp

This circuit is arranged to display an indication when the last section of a tape does not agree with the last tape section expected by the set-up switches.

3.072 Last tape section in process—(Last thou.) lamp

This circuit is arranged to display an indication when the last tape section is in process.

3.074 (Character in printer line) lamps

This circuit is arranged to display an indication of the number of the character in the printed line that is being processed.

3.075 Line does not check in reader relays—(Line NO CK IN RDR) Lamp

This circuit is arranged to display an indication that an unidentified line in the reader relays does not check.

3.076 Tape identity group entry does not check in reader relays—(TI NO CK IN RDR) lamp

This circuit is arranged to display an indication that a tape identity group entry does not check in the reader relays.

3.077 Tape identity group entry does not check in tape identity group check (Tape ident.) lamp

This circuit is arranged to display an indication that a tape identity group entry does not check in the tape identity group check circuit.

3.078 (Fails to print) lamp

This circuit is arranged to light a lamp, when an entry line is fully checked in the circuit, but the actual printing fails.

3.079 Cutter or stuffer fails to release—(Cutter NO RLS) lamp

This circuit is arranged to light a lamp when the cutter or the stuffer of the printing unit does not release.

3.080 Line count does not release—(Line CT NO RLS) lamp

This circuit is arranged to light a lamp when the printer line count relays do not release in the proper time.

3.081 Character count does not release—(CHAR CT NO RLS) lamp

This circuit is arranged to light a lamp when the character count relays do not release in the proper time.

3.083 (Alarm cut-off) key

This circuit is arranged with means for cutting off the external alarm when desired.

3.084 Emergency printer start—(Emerg. PTR start) key

This circuit is arranged to star out an individual character in a printer line when printing does not take place in a normal manner.

3.085 Manual cutting of slips—(Toll slip cutter) key

This circuit is arranged so that when it is not in the processing condition, slips may be cut in the printing unit by the operation of a key.

3.086 Manual operation of selector

This circuit is arranged so that when the circuit is not in a processing condition the selector used for counting tape sections may be manually released by the (Tape section release) key or stepped forward by the (Tape section reset) key.

3.087 Entries for slip printing

All entries for which slips are printed consist of five lines and, therefore, use a five-line count.

3.088 Tape identity group skip (Tape ident.) and (Emerg. reset) keys

This circuit is arranged so that when necessary the circuit may be put in condition for processing entries without checking the tape identity group. This is done by keys that are made less accessible than other keys.

3.089 Lamp display—(Reader lamps) key

This circuit is arranged with a key, which when operated will enable all lamps to light that are equipped to indicate a trouble.

3.090 Storage circuits

This circuit is arranged to utilize one storage circuit for each line of an entry being processed. There are six such circuits therefor as the largest entry is the straddle initial detail entry which contains six lines.

5. Description of operation—General

5.01 Method of description

The method of description will be to take the six distinctive tapes that this circuit is designed to process and follow in detail the circuit method of processing. These six distinctive tapes are as follows, in their order of complexity in the operation of the circuit:

1. Verbatim
2. Summary
3. Straddle
4. Toll
5. Message unit detail
6. Observing

The result of this method of description will be that the control circuits will permeate the whole description, as they contain the controlling elements of the whole circuit. The primary or reader control circuit is shown in Figs. 10, 11, 17, 18, 25 and 26 and the secondary or printer control circuit is shown in Figs. 49 and 56. Most of the other figures will have sections entirely devoted to themselves, and will be referred to in the running description of the method of processing. Also, certain operations of the control circuits which have once been described will thereafter only be referred to. It is felt that by this means considerable repetition will be avoided.

5.02 Division of the circuit

The circuit as a whole is divided into two portions, the reading portion, and the printing portion. The reading portion reads the entry lines of the automatic accounting system tape and determines what disposal shall be made of them. The printing portion translates and prints in proper form any information that the reading portion places at its disposal.

The type of the tape to be processed, the extent of the sort to which the tape has been subjected previously, and certain other information pertaining to the tape, is set up on switches in the panel circuit and this information acting on the tape class connector circuit conditions the entire circuit for printing the proper format for this type of tape, and also sets up circuit conditions for accepting only the particular tape indicated. The proper type of paper must also be inserted in the printer, namely, the slip roll, or the 3- or 7-inch folded page as may be required.

5.03 Machine units used in this circuit

Three mechanical units are used in this circuit, the reader, the distributor and the printer. It is not within the scope of this circuit description to describe in minute detail the mechanical operation of these machines. Disclosures of these units will be found in the prior art hereinbefore set forth.

5.04 Basic parts of the automatic accounting system tapes

All automatic accounting system tapes received by the printer circuit contain a number of distinct elements which are listed below.

1. Leading end of tape pattern
2. Tape identity group
3. (Call) entries
4. Splice pattern
5. Window pattern
6. Trailing end of tape pattern

The tapes may consist of one section, or there may be a number of sections spliced together.

For all printing, except verbatim, the above types of elements are essential to the complete processing of a tape. For verbatim, which is merely the printing of the digital information in each line, all kinds of entries are treated alike.

5.05 Treatment of leading end pattern

The pattern at the leading end of a tape is a series of splice entries. The entry under the pins of the reader at the time of starting the circuit will be read and the information will be passed to the reading relay circuit. The reader relays decode the two-unit code as received from the reader into grounded leads representing the numerals of the decimal system. Certain of this information is passed to the reading relay trans-

lator circuit and this circuit ascertains the type of line that is being read.

In this case the splice entry is recognized and this information is passed to the reader control circuit. This information sets up a condition so that all the splice entries are automatically skipped until the reading relay translator circuit identifies the first line of a tape identity group.

5.06 Treatment of tape identity group

When a tape identity entry is read, the 289 is recognized by the reading relay translator circuit. This information is passed to the reader control circuit which brings into action the reader line count circuit and connects it to the tape identity circuit by means of the reader line count connector circuit. The tape identity circuit contains relays which in conjunction with the switch settings will check each entry of the nine entries of the tape identity group, and if the tape class connector circuit so dictates will also bring into action the tape digit register circuit to check the progression of the numbers of the tape sections. The tape cannot progress beyond the tape identity group unless the nine lines have been properly checked.

5.07 Treatment of call entries

The call entries now follow. These are to be printed. When a call entry is recognized by the reading relay translator circuit, the reader control circuit releases the reader line count connector circuit removing the connection of the reader line count circuit to the tape identity circuit and causing an entry relay in the entry class relay circuit to be operated. This operated relay represents the particular type of entry to be printed. This entry relay causes certain of the storage circuits to be connected to the reader line count circuit.

The reader line count circuit is advised by the entry relay in the entry class relay circuit as to how many lines are contained in the entry. The circuit then proceeds to store the information contained in each line of the call entry in the proper predetermined storage circuit for translation into the characters to be printed. The number of storage circuits used will correspond to the number of lines in the entry.

The information in an entry line is placed in its storage circuit exactly as read by the reader, on a two-out-of-five basis, and when it is checked into the storage circuit, the next line is read and stored. This operation takes place as fast as registering and checking can be done, until all the lines of the entry are stored. When the predetermined number of lines has been stored, the reader line count circuit indicates that fact to the reader control circuit. The reader control circuit permits the reader to step immediately to the first line of the next entry, and then forces it to wait until the previous entry has been printed.

Printing starts, however, as soon as sufficient information is present in the storage circuits to determine the title. Usually the title is determined by the first line, and, therefore, printing starts as soon as the first line is registered. In the last round, however, in making slips, it is necessary to observe the day in the second line to determine if a change in month is to be made, before printing can be started.

The tape class connector circuit indicates to the line pattern connector circuit what the title sequence is to be and where the information is to be obtained, while the entry class register circuit indicates to the line pattern connector circuit what the printed line character sequence is to be.

The method of printing is to cause a grounded lead from the printer character sequence circuit which corresponds to the number of the character in the printed line, to be routed via the circuit which contains the formation for that character, to operate a relay in the printer code translator circuit.

The operation of the character relay in the printer code translator circuit will cause the distributor to rotate and transmit the character to the printer. The distributor in rotating steps forward the printer character sequence circuit to cause the next character lead, which is routed by the line pattern connector circuit, to operate a character relay corresponding to the next character to be printed. When the printing of a line starts the entire line is printed at the rate of 100 words a minute with very slight hesitations every ten characters.

When the line has been printed, the storage circuits are cleared and the storage and printing of the next line proceeds.

The completion of a line, the returning of the type basket in the printer, and the beginning of storage of the next entry is governed by the printer control circuit.

The printer line count circuit is actuated by the printer control circuit to count the number of lines on the printed page, so that the paper may be advanced for new slips or pages when the previous one is completely full.

The calling office name must be obtained from the marker group number, which is stored in the marker group switches and a single digit number which is present in the call entry or in the (Cent. office) switch and which must then be translated, usually into two letters and a numeral, for printing. The marker group translator circuit makes this translation.

The called office name must be translated directly from three numerals that are present in the entry. The printer translator, shown in Fig. 130 as the called office name translator, to which the printer circuit is connected by the printer translator connector circuit is used to make this translation. This printer translator is acted upon by both the called office entry and the area index.

All the other translations are made in the storage circuits with the exception of the month translation which is made in the month translator circuits and which translates a two-digit numeral of the month, as set up on the (Month) switches into a three-letter abbreviation of the month.

In printing slips, it is necessary to compare the directory number with the previous directory number to see if a change has taken place, to determine whether a new slip is required. Storage circuit No. 1 is the storage memory circuit for this operation. In some cases, the office must also be compared This is also done by storage circuit No. 1. In the last round, it is necessary to remember whether a change in month has taken place or not. This operation is performed by the month translator circuit.

5.08 Treatment of the splice pattern

The splice pattern is that portion of the tape, between two sections of the tape, where they have been spliced together. A skip splice entry is first encountered which indicates to the reader control circuit that a splice entry should follow.

When the following splice entry is encountered the reader control circuit sets up the skipping condition, which skips all lines including the actual splice, until the first tape identity entry of the following section is met, at which time skipping stops, and the regular processing continues.

5.09 Treatment of the window pattern

A window pattern is a group of entries applied to a tape as a result of a perforator recognizing a tape window at a splice in unperforated tape. The first indication of such a pattern to the printer circuit is the encountering of a skip window entry 287020 which indicates to the reader control circuit that a splice entry should follow. When the following spice entry is encountered the reader control circuit sets up the skipping condition which skips all lines including the actual window until another skip window entry is met, at which time skipping stops, and the regular processing continues. A full description of such an operation may be found in the copending application of J. W. Gooderham, Serial No. 38,927, filed July 15, 1948.

5.10 Treatment of trailing end pattern

A skip splice entry is first encountered which sets up the skipping condition, and the circuit continues to skip all lines until the actual end of the tape is encountered. This circuit is arranged so that other elements of a line will stop the skipping, so the circuit will usually stop, before the tape passes out from under the reader pins. When this occurs an alarm will be given, and observing that this is the end of the tape, the tape is stepped out manually until the (End of tape) lamp lights. The circuit is then released by operating the (Machine release) and (Master release) keys.

5.11 Alarms

An alarm circuit is provided which brings in both a visual and audible alarm when trouble is encountered in the circuit. Associated with the alarm functions are a number of keys and lamps which are used for diagnosing trouble. If processing stops it is possible to check the digits of the line in process and determine the extent to which it has been processed.

6. Processing of verbatim tapes

6.01 General

Any tape from any machine in the accounting office or any tape from a central office, may be printed on a verbatim basis. Verbatim printing means to print one line of six numerals for each perforated line in the automatic accounting system tape. The six printed numerals represent in the same order, the six numerals perforated in the automatic accounting system tape, digits, A, B, C, D, E and F from left to right. The entry and the method of printing are shown in sections 37 and 38.

6.02 Automatic accounting system code

The method of representing the numerals in the six groups across the tape is described in section 12.

6.03 Motor-driven apparatus

The printer circuit contains three motor-driven pieces of apparatus.

1. The reader
2. The distributor
3. The printer

The reader motor will start when (MOT) relay 12700 in Fig. 127 is operated, and the distributor and printer motors will start when (DPP) relay 12701 is operated.

6.04 Turning on power

It is assumed that the circuit has been completely shut down, that is, the (A. C.) switch 12703 is in the (off) position and the (Master release) key 1800 in Fig. 18 is operated as shown. Through another blade the switch 12703 closes a break in the "DCST" lead 1801 to the (DCP) relay 12713 which when operated will apply 48-volt power to all of the various points in the drawings symbolized by a circle with a minus sign within it.

To turn on the power, therefore, the (A. C.) switch 12703 is operated to the (on) position. This switch when operated:

1. Applies 110-volt (A.C.) potential to the motor circuits.
2. Connects the winding of a direct current power supply relay 12713 (not shown) to the (Master release) key, but this key being operated, relay (DCP) is not effected. This connection is indicated by the "DCST" wire 1801 which may be traced from the (Master release) key 1800 through the cable 1802 to Fig. 127. This contact of the switch insures that relay (DCP) cannot be operated unless the (A. C.) switch is in the (on) position.
3. Applies ground to the printer translator circuit the purpose of which is explained in that circuit.

6.05 130-volt supply

Certain portions of this circuit are operated at a potential of 130 volts direct current. The source of this 130-volt supply is a rectifier 12704, Fig. 127.

This means that as soon as the (A. C.) switch 12703 in Fig. 127 is operated to its (on) position, the rectifier is immediately energized, and 130-volt potential is applied to conductor 12705 and to (CP) resistance 12707 and (PR) resistance 12708.

This application of 130 volts to conductor 12705 completes a circuit through the printer selector magnets 12600 in parallel in Fig. 126, through the (Stop) contact of the distributor to ground.

A circuit is, therefore, immediately available to energize the printer selector magnet and hold it energized with a current of approximately 60 ma.

The application of 130 volts to resistances (CP) and (PR) in Fig. 127 applies a positive cathode bias of approximately 100 volts to (TM0) tube 12709, supplies the plate voltage for the tube, and also charging potential for (TM) condenser 12710 and (TM1) condenser 12711. A complete description of the operation of this tube timing circuit is given in section 19.

6.06 Restoration of the (Master release) key

The (Master release) key 1800 in Fig. 18 is then restored to normal. The restoration of this key, completes a circuit for operating relay (DCP) in Fig. 127.

The operation of this relay applies negative 48-volt potential to the (Bus bars) of the fuse panels in all cabinets thus applying potential to the circuit generally.

Under this unoperated conditions of the circuit, certain apparatus is energized when the 48 volts is applied. These are as follows:

1. The heater of (TM0) tube 12709 in Fig. 127.

2. (ETA) relay 4900 in Fig. 49 which is operated from ground on (CTX) relay 4901.
3. The (Master off normal) lamp 12712 in Fig. 127 is lit.

6.07 Switch set up for verbatim printing

To set the circuit up for verbatim printing the (Tape type) switch 500 in Fig. 5 is placed on its sixth point. The position of the other switches is of no importance.

Ground on the common of the second section 502 of this switch operates (VB) relay 1300 over conductor 503. The effect of the operation of relay (VB) on the circuit is given in section 20.

The (VB) relay of Fig. 13 operates (VBM) relay 2900 in Fig. 29 over the "VB" conductor 1301, the action of which relay is described in section 22.

With these two relays operated the circuit is conditioned for verbatim printing.

6.08 Starting of motors

The motors are started by momentarily operating the (Motor start) key 1803. This key receiving ground from the unoperated (CALM) relay 12714 over conductor 12715 connects it to the "RMS" lead 1804 an the "PMS" lead 1806. Ground on the "RMS" lead 1804 operates (RMS) relay 1805 while the ground on the "PMS" lead 1806 operates the (PMS) relay 1807.

Relay (RMS) operated:

1. Locks at its armature 7 and front contact through a break contact on the (Emerg. motor stop) key 1808, conductor 1809 over armature 1 and back contact of (TMOA) relay 12716, conductor 12717 over the back contact and armature 2 of the (RLS) relay 1700.
2. Over its front contact and armature 3 the (RMS) relay 1805 applies ground to conductor 1810 leading to the (MOT) relay 12700 in Fig. 127 whereby this relay operates to start the reader motor by applying alternating current to the (HS) conductor 12718.
3. Through its front contact and armature 1 the (RMS) relay extends ground over conductor 1811, the back contact and armature 2 of the (RI) relay 1100, conductor 1101, the contacts of the (TF) key 2300, conductor 2301 to the winding of the step magnet 800 to hold this magnet energized to prevent the reader drum from stepping even though the reader is running.
4. The (RMS) relay 1805 at its armature 2 and front contact partially closes the circuit for operating the (ST) relay 1000.
5. The (RMS) relay applies ground through its front contact and armature 4 to operate the stop relay 1102. This same ground is also used under an operated condition of the (BST) relay 2500 to operate the (EMI) relay 2600.
6. The (RMS) relay 1805 closes a circuit from ground through its front contact and armature 6 over conductor 1802 through the cable 2501 to the armature 2 of the step magnet 2200 in Fig. 22 for the use of this rotary magnet of the selector.
7. The (RMS) relay 1805 closes a circuit from ground through its armature 7 and front contact, conductor 1813, the front contact and armature 2 of the stop relay 1102, conductor 1103 to the stop magnet 801 of the reader in Fig. 8.

Stop relay 1102, operated:

1. Through armature 1 and front contact it closes additional ground connection on conductor 1101 to the step magnet 800 of the reader to supplement that supplied by armature 1 and front contact of the (RMS) relay.
2. Through its armature 2 and front contact it crosses a circuit to the stop magnet 801 as above described. The energization of the stop magnet permits the later stepping of the reader drum. For a full description of the use of the step relay see section 6.29.

(PMS) relay 1807, operated:

1. Locks directly to ground at armature 2 and back contact of the (RLS) relay 1700.
2. Applies ground at its armature 1 and front contact over conductor 1814 to the (DPP) relay 12701 which energizes the motors of both the distributor and printer. These mechanisms, however, are equipped with clutches so that only the motors run at this time.
3. At its armature 2 and front contact it supplies a locking ground for the (RLS) relay 1700.
4. At its armature 4 and front contact it closes another point in the circuit of the (ST) relay 1000. Thus all motors in the circuit are in operation and these mechanisms, the reader, distributor and printer are ready to operate.

6.09 Inserting tape in the reader

The tape that is to be processed on a verbatim basis is inserted in the lower reader chute, with the embossed side towards the drum. When the tape is pushed in as far as it will go, sufficient engagement is made with the drum to pull the tape, if the drum is rotated. Operating the (TF) key 2300 on the reader will disconnect the (Step) magnet 800 from the external ground circuit and the drum will rotate pulling the tape forward until the desired line of the tape is under the reader pins (see section 12). The circuit opened by the (TF) key is the ground circuit previously described as originating at the (RMS) and (Stop) relays and connecting via (RI) relay 1100.

While the (TF) key is operated the reader (Step) magnet circuit will be closed only during the intervals that the reader pins are presented to the tape. This closure takes place at the (G0) contact 803 and insures that the drum will not be rotating while pins are engaged with holes. Opening of the (Step) magnet circuit at the (G0) contact 803 permits the reader drum to rotate one step while the pins are disengaged.

6.10 Starting of processing

The circuit is started processing by operating the (Machine start) key 1815 in Fig. 18 momentarily. The operation of this key applies ground via contacts on the (RMS) and and (PMS) relays previously described to operate relay (ST) in Fig. 10. Relay (ST) cannot be operated unless relays (RMS) and (PMS) have been previously operated.

(ST) relay 1000, operated:

1. Locks under the control of the (RLS) relay 1700 on its armature 4 and front contact. Supplementary locking paths for this relay are also supplied by the (AUX) relay 2501 on its armature 2 and back contact and the (PR) relay 2502 on its armature 1 and front contact when these relays are operated.
2. At its armature 1 and front contact it closes an operating ground supplied over conductor 2504 from armature 9 and back contact of (CK) relay 2503 to conductor 1001 for the decimal decoding leads. See section 13.
3. At its armature 2 and front contact it closes the "K7" lead 2301 from a break contact in

the reader which opens during the stepping interval of the reader cycle, through to Fig. 14 for the ultimate use of Fig. 22.

4. At its armature 3 and front contact provides a ground for locking (R2) relay 1104 under control of (CK) relay 2503.
5. At its armature 4 and front contact provides a supplementary locking ground for relays (RMS) and (PMS).
6. At its armature 5 and front contact removes a locking ground for (RLX) relay 1002 and applies this ground to light the (off normal) lamp 1003 to show that the circuit is in the processing condition.
7. At its armature 9 and front contact it prepares a circuit to operate the connector relays, (PC1) relay 804, (PC2) relay 1504 and (PC3) relay 2304. (See section 13.)
8. At its armature 8 and front contact it applies a locking ground for (RLS) relay 1706.
9. At its armature 10 and front contact it supplies a ground derived from the armature 3 and back contact of the (RLS) relay to hold relay (DCP), Fig. 127, operated independent of the (Master release) key in Fig. 18.

6.11 Reading of automatic accounting system line, operation of reader relays

The operation of the (PC1) relay 804, (PC2) relay 1504 and (PC3) relay 2304 will cause the register relays in Figs. 9, 16 and 24 to take up the same combination that is on the reader pin contacts. A complete description of the operation of the reading relays is given in section 13. If the digits check the (RRCK) relay 2603 will be operated over (RCK) lead 2400 from the reading relays and the (STE) relay 2505 will be operated over "VB" lead 1302. We will disregard relay (RRCK) for a moment and confine our attention to relay (STE).

6.12 First line read is transferred to storage

The (STE) relay 2505, operated:

1. Locks at its armature 7 and front contact via the armature 4 and back contact of the (TIP) relay 2602 to the armature 5 and back contact of the (EC) relay 2506.
2. At its armature 1 and front contact, connects the (0) lead 1900 to the winding of the (SLN) relay 1701. This is not used in verbatim printing.
3. At its armature 2 and front contact it grounds the "ENT" lead 2507. This lead is not used in verbatim printing.
4. At its armature 3 and back contact is opens the operating circuit of (CKT) relay 1702.
5. At its armature 4 it rearranges the trouble lamp circuit, a function to be explained later (see section 39).
6. At its armature 5 it removes ground from the locking circuit of the (SKS) relay 1004 and operates (AUX) relay 2501.
7. At its armature 6 it removes a ground derived at the armature 5 of (CKT) relay 1702, from a check circuit for skipping, which is explained in section 7, and applies a ground to the armature 9 of (CK) relay 2503 for later use in operating (CK1) relay 1703.
8. At its armature 8 it applies a locking ground for relay (CK1)

The (AUX) relay 2501, operated:

1. Completes the circuit from ground, front contact and armature 1 of (AUX) relay 2501, armature 6 and back contact of (CK) relay 2503, front contact and armature 1 of (R2) relay 1104, armature 3 and front contact of (AUX) relay 2501, armature 1 and back contact of (TIP) relay 2602, back contact and armature 3 of (PR) relay 2502, "CT" conductor 2508 over cable 2601, armature 3 and back contact of (SPJ) relay 3400 and thence in a changing circuit including similar contacts to armature 3 and back contact of (SPA) relay 3600, thence through the winding of the (STA) relay 3601 to operate this last-named relay.
2. It operates (08) relay 1704 at its armature 2 and front contact.
3. At its armature 4 and front contact provides a supplementary locking ground for locking (ST) relay 1000.

The (RRCK) relay which informs the reader control circuit that a complete check has taken place, when operated:

1. At its armature 1 rearranges the lamp circuit as will be explained later (see section 39).
2. At its armature 2 opens the locking circuit of the connector relays of Figs. 8, 15 and 23.
9. At its armature 3 also rearranges the trouble lamp circuit (see section 39).
4. At its armature 4 contacts also rearranges the trouble lamp circuit (see section 39).
5. At its armature 5 contacts closes part of the check circuit to ultimately operate (CK) relay 2503.

6.13 Entry is transferred to the storage circuit

As before explained (CTA) relay 3601 in Fig. 36 has been operated. A complete description of the reader line count circuit is given in section 18.

The operated (VBM) relay 2900 supplies a ground from its armature 1 over the "EC1" lead 2901 via armature 5 of the (CTA) relay 3601 to the "EC" lead 3602 to operate the (EC) relay 2506 to end the line count which in the case of verbatim is one. The operated (CTA) relay 3601 also closes a circuit from ground on armature 1 of (SPA) relay 3600 over the "C1" lead 3603, armature 2 of (VMB) relay 2900, conductor 2902, cable 4400, to operate the connector relays, (S6A) relay 6800, (S6B) relay 8000 and (S6C) relay 9200.

(EC) relay 2506 operated:

1. At its armature 1 and front contact provides a circuit which may later be used for operating (RLX) relay 1002.
2. At its armature 2 and front contact partially closes an operating path for (TP) relay 2604.
3. At its armature 3 and front contact provides a locking path for relay (R2) from any operated relay in Figs. 35 and 43.
4. At its armature 4 and front contact provides a locking path for itself to the ground at armature 3 and front contact of (ST) relay 1000, to any ground supplied on "CKD" leads from Figs. 36, 43, 9, 16, 24 and storage figures and to any other ground that will also lock (R2) relay 1104.
5. At its armature 5 and back contact removes a locking ground from relay (STE).
6. At its armature 6 and front contact it locks relay (R2) and itself to the operated relays in the reading relay circuit.
7. At its armature 7 and front contact provides an operating path for (PR) relay 2502.

Thus the greater control circuit is conditioned waiting action on the part of the No. 6 storage circuit.

6.14 Storage circuit checks

The operation of relays (S6A), (S6B) and (S6C) in the No. 6 storage circuit connects the twenty-eight register relays of this circuit to contacts of corresponding relays in the reading relay circuit and those relays that are operated, will place ground on similar relays in the storage circuit and operate them. A description of the use of the No. 6 storage circuit for verbatim printing is given in section 35.

The digit check "S6CA" lead 6801 is routed via (VBM) relay 2900 and (CTA) relay 3601 to operate (SCK) relay 2606.

We now have (RRCK) relay 2603 operated because of a proper check in the reader relays, and the (SCK) relay 2606 because of a proper check in Fig. 29. A circuit is now complete from ground, front contact and armature 8 of (STE) relay 2505, armature 2 and back contact of (CK1) relay 1703, front contact and armature 2 of (SCK) relay 2606, armature 5 and front contact of (RRCK) relay 2603 to the winding of the (CK) relay 2503 to operate this latter relay. Thus is indicated a complete satisfactory reception of an automatic accounting system line.

(CK) relay 2503, operated:

1. Locks at its front contact and armature 8 to the contact of (S2) relay 1105, released.
2. At its armature 1 and front contact operates (RRLK) relay 1005.
3. At its armature 2 contacts it rearranges the trouble lamp circuit which functions will be explained later (see section 39).
4. At its armature 3 and back contact it removes the locking ground for the connector relays (PC1), (PC2), (PC3), whereupon these connector relays release.
5. At its armature 4 it removes the ground from "RRG" lead 1001.
6. At its armature 5 it removes the (ST) relay lock of relay (R2).
7. At its armature 6 contacts it removes the operating ground for (CTA) relay 3601 and applies ground which through the armature 6 and front contact of operated (CTA) relay 3601 causes (SPA) relay 3600 to operate.
8. At its armature 7 and front contact it operates (PR) relay 2502 via the armature 7 and front contact of (EC) relay 2506.
9. At its armature 9 contacts partially prepares a path for operating (CK1) relay 1703, a function not used in verbatim printing.

(RRLK) relay 1005 operated by (CK) relay 2503:

1. Releases all registry relays that are operated in Figs. 9, 16 and 24.
2. At its armature 7 and front contact operates (TP) relay 2604 via relay (EC), an operation of no effect in verbatim printing.

It will have been noted that at a certain stage in this process, relays (R2) and (EC) are locked on check-down leads "CKD" to a number of places.

These places are:

1. (ST) relay 1000, the armature 3 and front contact.
2. To any relay that might be operated in Figs. 19 and 27 (conductor 2509). Even though these relays are not used in verbatim, they are allowed to operate.
3. To any registry relay operated in Figs. 9, 16 and 24.
4. To any relay operated in the reader line count circuit, Figs. 36 and 43.
5. To any connector relay in any one of the six registers (register No. 6 only used in verbatim).

When the registry relays in the reader relay circuit release as a result of the operation of (RRLK) relay 1005, (1) ground will be removed from the "RCK" lead 2408 releasing (RRCK) relay 2603 and (2) the relays in Figs. 19 and 27 will release removing the locking ground on the "CKD" lead 2509 to the reader control circuit.

When (SPA) relay 3600 released as a result of the operation of (CK) relay 2503 the connector relays in the No. 6 register release, (1) removing ground from the "S6CA" lead 6801 through the entry class register circuit, Fig. 29, to "CK1" lead 2903, front contact and armature 2 of (CTA) relay 3601 to the "SCK" lead 4300 for the release of (SCK) relay 2606 and (2) removing the locking ground on the "CKD" lead 2509 which reaches the control circuit via the other register circuits.

The operation of (PR) relay 2502 following the operation of (CK) relay 2503 released (AUX) relay 2501 which releases (STE) relay 2505 and all operated relays in the reader line count circuit. The release of all relays in the reader line count circuit removes the locking ground from the "CKD" lead 2509.

Thus, relays (R2) and (EC) release simultaneously when the "CKD" lead has been cleared of ground. The release of (R2) relay 1104 initiates the first step of the reader.

6.15 First step is taken by reader

The removal of all grounds that were holding the (R2) relay operated permits it to release, and the (RRLK) relay 1005 being operated the circuit from the make contact 2303 of the reader to the (R0) relay 1106 is completed. When the (H0) contact 2303 closes on the reading interval of the reader, relay (R0) will operate.

Reading is now going to take place with a step of the drum. It is, therefore, necessary that the reading relays be synchronized with the reader cycle. Synchronization is accomplished by relays (R0), (R1), (R2), (S1) and (S2) in Fig. 11.

(R0) relay 1106, operated:

1. Locks at its armature 1 and front contact under the control of (R2) relay 1104.
2. At its armature 3 and front contact, it closes an operating circuit for (CK1) relay 1703, which is not used in verbatim printing.
3. At its armature 2 and front contact, it connects (S1) relay 1107 to a break contact in the reader on lead 1108.

The contact on lead 1108 of the reader closes during the stepping interval of the reader cycle, therefore, its closure follows that of the contact 2303 and its closure now operates (S1) relay 1107.

Relay (S1) operated:

1. Locks at its armature 4 and front contact to armature 3 of relay (R2).
2. At its armature 2 and front contact it provides a locking ground for (R1) relay 1100 and (S2) relay 1105.
3. At its armature 3 it supplies ground to the (Reader step) key 2607 to operate (EM1) relay 2600 at the proper place, when necessary to use that key to step the reader.

4. It connects at its armature 1 and front contact the winding of (R1) relay 1106 to make contact 2304 in the reader.

In the next reading interval of the reader cycle the (H1) contact 2304 of the reader will operate (R1) relay 1106.

Relay (R1) operated:

1. Locks at its armature 3 and front contact to (S1) relay 1107.
2. At its armature 4 and front contact supplies a locking ground for (G1) relay 1110 and (G2) relay 1816.
3. At its armature 2 and back contact opens the holding ground for the reader (STEP) magnet 2200 so that on the next stepping interval of the reader cycle, the drum will step.
4. Closes at its armature 1 and front contact the winding of relay (S2) to a break contact (H1) in the reader on lead 1111.

On the next stepping interval the drum steps and advances the tape to the next row of holes, and the (H2) reader contact closes operating (S2) relay 1105.

Relay (S2) operated:

1. Locks on its armature 4 and front contact to relay (S1).
2. At its armature 3 and back contact removes locking ground from (CK) relay 2503 and operates (PC1) relay 804, (PC2) relay 1504 and (PC3) relay 2304, the connector relays in Figs. 8, 15 and 23, respectively. The connector relays lock on lead "PLK" to the armature 3 and back contact of relay (CK) via the armature 2 and back contact of relay (RRCK).
3. At its armature 2 and front contact it connects the winding of (R2) relay 1104 to a make contact (H2) in the reader on lead 1112.
4. At its armature 1 and front contact it connects the same reader contact to armature 2 of (SKS) relay 1004, for use under the skip conditions to operate (R2A) relay 1006 which does not apply to verbatim tape.

The contact on lead 1112 of the reader closes during the reading interval of the reader cycle. This is the interval in which we have prepared to take information by the operation of the connector relays in Figs. 8, 15 and 22. The reader relays will take up the condition of the closed pin contacts of the reader.

The contact on lead 1112 of the reader operates (R2) relay 1104 at the same time as the closed reader pin contacts operate the reader relays.

Relay (R2) operated:

1. Locks at its armature 2 and front contact to the armature 3 and front contact of the (ST) relay 1000, via the contacts of armature 3 of (RLX) relay 1002, and the armature 5 and back contact of the (CK) relay 2503 immediately with further locking to "CKD" leads 2509 later.
2. At its armature 1 and front contact it prepares a circuit for operating the reader line count circuit. This circuit may be traced from the front contact and armature 1 of the (AUX) relay 2501 which will presently be operated, the armature 6 and back contact of (CK) relay 2503, front contact and armature 1 of relay (R2), armature 3 and front contact of (AUX) relay 2501, the armature 2 and back contact of the (TIP) relay 2002, the armature 3 and back contact of the (PR) relay 2502, if relay (PR) were released, to the reader line count circuit over "CT" lead 2508.
3. At its armature 3 and back contact releases relays (R3) and (S1), which in turn release relays (R1) and (S2).
4. At its armature 4 and back contact opens the operating lead for relay (R3).
5. At its armatures 5 and 6 rearranges the operating circuits of (LS1) relay 1817 and (LS2) relay 1113, the function of which relays will be explained later (see section 39.21).
6. At its armature 7 and front contact provides a locking circuit for relays (G1) and (G2).
7. At its armature 8 and front contact closes the alarm circuit to (TOA) relay 12720.

Relay (STE) will operate from the registry relays and be followed by relay (AUX) as described in paragraphs 6.11 and 6.12.

Thus, a new line is brought under the reader pins and registered in the reader relays, but the information cannot be transferred to a storage circuit because relay (PR) is operated preventing the operation of the reader line count circuit.

6.16 Preparation for printing

At the time that (SCK) relay 2006 operated as a check that the first line to be processed was properly registered in the storage circuit, (IN) relay 4002 was also operated from the same source. The circuit for operating the (IN) relay 4002 can be traced from the "S6CA" lead 6001, through the front contacts and armature 6 of (VBM) relay 2000 in Fig. 29 to the "ST" lead 2004.

When (PR) relay 2502 was operated by the operation of relay (CK), it locked at its armature 4 and front contact on "CL3" lead 4003 to the (IN) relay. It, therefore, will remain operated as long as the (IN) relay is operated.

6.17 Verbatim title, preparation for printing

As before stated the (IN) relay 4002 was operated when the complete line had been registered in the No. 6 register.

Relay (IN) operated:

1. Locks at its armature 2 and front contact on "G" lead 4004 to the storage circuits.
2. Partially prepares a circuit to operate relay (SW), at its armature 1 and front contact.
3. Opens the "E" lead 4006 to the reading relay translator circuit at its armature 3 and back contact, a function that is not used in verbatim printing.
4. Locks the (PR) relay on "CL3" lead 4003 at its armature 4 and front contact.
5. Prepares a locking path for (EL) relay 4006 at its armature 6 and front contact.
6. Closes a circuit on armature 5 and front contact which initiates the form or pattern of the line about to be printed, in this case the title, and the first line of printing. The path of the circuit is: From ground on armature 1 and front contact of the (LCR) relay 4006, armature 5 and front contact of the (IN) relay 4002, back contact and armature 3 of the (OUT) relay 4009, armature 3 and front contact of the (SW) relay 4005, over the "T" conductor 4010, the front contact and armature 1 of the (VB) relay 1300, thence over the "VBT" conductor 1303, to the winding of the (VBT) relay 4600, thus causing the operation of the (VBT) relay.

A complete description of the line pattern connector circuit is given in section 28 and of the printer character sequence circuit in section 23.

Briefly, (VBT) relay **4600** closes the first four sequence leads "1" to "4" through to the carriage return line feed character (CRLF) relay **12100** and the "5" lead through to lead "ET" to the (ET) relay **4911**. Ground from the contacts of (RL) relay **4200** via contacts of (TC) relay **4201** and (CC9) relay **4202** to (CC1) relay **3400** is present on lead "1" and is connected through relay (VBT) to "CRLF" lead **4601** to operate (CRLF) relay **12100**.

6.18 Verbatim title, make-up of title

The order of printer operations for verbatim title is listed in section 28.

In verbatim printing there is no printed title as such. The title operations are solely for the purpose of properly placing the paper. When the 3-inch folded paper is placed in the printer unit, a fold is placed opposite an arrow which is located in the printer unit. The title operations are, therefore, for the purpose of placing the paper in the proper position for printing the first line on the page, and these operations consist of four line feeds of the printer.

6.19 Verbatim title, printing operations

The operation of the (CRLF) relay **12100** following the operation of relay (VBT) initiates the first line feed in the printer. The (CRLF) relay is one of thirty-two character relays. When one of these relays and only one is operated the clutch magnet of the distributor is energized and starts the main shaft of the distributor rotating. A complete description of the code relay circuit is given in section 25.

When the (CRLF) relay **12100** is operated, ground is present on its armature **1** from the inner contact of the make-before-break contact on the distributor, Fig. 126. The operation of relay (CRLF) will operate (P4) relay **9404**. The operation of relay (P4) places ground on the No. 4 contact of the distributor.

As soon as the distributor starts, three actions take place, (1) the continuity contacts securing the character code, (2) the transfer contacts advancing the character sequence in the line pattern circuit, and (3) the transmitting contacts transmitting the character code to the printer. The detail operation is as follows:

1. Continuity contact of the distributor

The ground that was applied to the contact of the (CRLF) relay, is applied on a continuity basis, via the (P4) varistor **9414** to lock (P4) relay **9404**. Thus, the operating winding of relay (P4) is opened and its lock winding energized.

2. Transfer contact of the distributor

Ground is applied over conductor **12602**, the contacts of (PA1) relay **11400**, the "SC" lead **11401** and via the contacts of (C1A) relay **3401** to (C9A) relay **4203** to operate (CC1) relay **3400**.

Relay (CC1) operated locks via its armature **3** and front contact and the similar contacts of relays (CC1) to (CC9) and (TC) relay **4201**, and via the armature **6** contacts of (G10) relay **3500** to (G50) relay **3501** to the ground on contacts of (RL) relay **4200**.

Relay (CC1) removes ground from lead "1" and applies ground to lead "2," which via the armature **2** and front contact of relay (VBT) again energizes (CRLF) relay **12100**.

3. Distribution of signals to the printer

The distributor, Fig. 126, is described in section 26. When the distributor first starts moving, it opens the selector magnet of the printer for the time of one interval which starts the printer. It then sends the five selecting intervals, only the fourth of which is closed in this case. The reception of these five intervals with the closed fourth pulse, by the printer, causes the printer to return the carriage to the left and feed the paper up one line.

When the distributor reaches the end of its revolution, it closes the select magnet circuit of the printer and returns the two contact pile-ups to normal.

The continuity pile-up in returning to normal removes the locking circuit of relay (P4) and applies operating ground again to the contacts of relay (CRLF). As this relay is still up due to the operation of relay (CC1) in Fig. 34 which via relay (VBT) still calls for this relay, therefore, relay (P4) remains operated.

The restoration of the transfer contact of the distributor to normal applies ground to "ST" lead **12101**, the armature **5** and back contacts of (CC2) relay **3402** to (CC9) relay **4202** and (TC) relay **4201**, and contacts of operated (CC1) relay **4202** and causes (C1A) relay **3401** to operate.

Relay (C1A) operated:

1. Locks via its armature **2** and front contact to the normal contacts of armature **4** of (RL) relay **4200**.
2. Removes the operating path for (CC1) relay **3400** and prepares an operating path for (CC2) relay **3402**.

As the (CRLF) relay is still operated, the clutch magnet is again energized, so that the distributor will not stop but continue to its next revolution.

The same process that has been described will again take place, but this time relay (CC2) will operate, energizing lead "3" via relay (VBT) which again operates relay (CRLF) in Fig. 121.

Thus, transmission continues until relay (CC4) is operated. Now, relay (CRLF) will not be operated, and when the distributor comes to the end of the revolution transmitting the fourth carriage return line feed signal the distributor will stop.

(ET) relay **4911**, however, will be operated via the armature **5** and front contact of relay (VBT) and "ET" conductor **4602**.

Relay (ET) operated:

1. Locks at its armature **3** and front contact to armature **2** and back contact of (SW) relay **4905**.
2. At its armature **1** and front contact prepares a circuit for the operation of relay (SW).
3. At its armature **2** and front contact closes a circuit to operate (RL) relay **4200** through armature **2** of (LK) relay **4912** operated at this time.
4. At its armature **4** and front contact operates (CTX) relay **4901**.
5. At its armatures **5** and **6**, grounds two leads "L02" and "L03" which have no function in verbatim printing and are not connected.

Relay (CTX) operated:

1. Provides a lock at its armature **1** and front contact for relay (RL). This relay (RL) was operated by relay (ET) and when operated locks to this relay (CTX), therefore, relay (RL) cannot be released until this (CTX) relay releases.

2. (CTX) relay 4901 locks at its armature 3 and front contact to (ETA) relay 4900.
3. Opens the circuit of (ETA) relay 4900.

Relay (ETA) is of the slow release type requiring such time to release as to allow the type carriage basket of the printer to return to the left. In this particular verbatim title all the signals to the printer being carriage return line feed signals, this time is not necessary, but in all other lines and titles this time is necessary.

When (ETA) relay 4900 releases, it will release relay (CTX), as relay (ET) will already be released, and as a result of the release of relay (CTX) relay (ETA) will reoperate.

(RL) relay 4200 operated:

1. At its armature 1 and front contact partially prepares a circuit for lighting the (RLCC) lamp 1007 (character count no release).
2. At its armature 2 and back contact it opens the lamp lighting lead from armature 5 of (LP) relay 1000.
3. At its armature 3 and front contact it operates (SW) relay 4905.
4. At its armature 4 and front contact it locks to relay (CTX) and all the operated counting relays in Figs. 34 and 42.
5. At its normal contacts of armature 4 it removes all locking grounds and other operating grounds, from the counting relays in Figs. 34, 35 and 42.

The releasing of all the counting relays removes the operating circuit for (ET) relay 4911, which releases because (SW) relay 4905 is operated. When all the counting relays have been released and the (CTX) relay 4901 is released, which occurs after (CTA) relay 3601 is released, insuring that the printer carriage has returned, then (RL) relay 4200 releases restoring the locking and operating grounds.

6.20 Verbatim line, printing operations

The order of printer operations for a verbatim line is listed in section 28.

The verbatim line consists of six numerals. When (SW) relay 4905 in Fig. 49 operated, it removed ground from the "T" lead 4910 which via the armature 1 and front contact of (VB) relay 1300 had held operated (VBT) relay 4600 and applies ground to "L" lead 4913, which via the armature 7 and front contact of (VBM) relay 2900 operates (VBL) relay 4800 over conductor 2905. The restoration of the counting relays reapplies ground to lead "1," and this ground routed through the armature 1 and front contact of relay (VBL) applies ground to lead "CS65" of Fig. 48, which appears in Fig. 69 on the armature 2 and back contact of (S6AX) relay 6900, which relay has been operated because a numeral has been properly registered in the (A) group of relays. This ground is, therefore, routed via the (A) group of relays to any one of four possible leads "P0," "P1," "P2" or "P3" which are connected to the correspondingly numbered relays 10600, 9406, 9407 and 9408, respectively, in Figs. 106 and 94. Which one of these leads is grounded depends upon the combination set up in the (A) group of relays.

A numeral relay is, therefore, operated in the code relay circuit and the numeral represented by this relay is printed, (CC1) relay 3400 operating as described before. Ground is, therefore, removed from lead "1" and applied to lead "2," this lead via armature 2 and front contact of (VBL) relay 4600 grounds the "CS60" lead which appears on armature 2 of (S6BX) relay 6901. The numeral relay operated through group (A) is released, and another numeral relay is energized via the "P0" to "P9" leads of the (B) group of relays, depending upon the combination set up in the (B) group. (S6BX) relay 6901 is operated because a proper check has been assumed in the (B) group. The second numeral is, therefore, printed.

The same operation takes place in the (C), (D), (E) and (F) groups by the operation of the (CC2), (CC3) and (CC4) and (CC5) relays of Fig. 34, the character relays in the code relay cuit being operated via leads "CS61," "CS62," "CS63" and "CS64."

While printing the numeral in the (F) group, relay (CC6) in Fig. 42 is operated, applying ground via lead "7" and via the armature 7 and front contact of (VBL) relay 4800 to operate (CT) relay 5600 in Fig. 56.

The (CT) relay 5600 has two functions:

1. To initiate the carriage return line feed which it does at its armature 1 and front contact, by operating the (CRLF) relay 12100 in Fig. 121.
2. To count the line or make a record that a line has been printed. This it does at its armature 2 by removing a ground which it receives via the contacts of (LCT) relay 4914 and the contacts of (LCR) relay 4908 from the "CB" lead and applies it to the "CM" lead to Fig. 50. This action via the contacts of relays (LP3), (LP2) and (LP1) of Fig. 50 operates (CL1) relay 5000. The (CL1) relay locks via the contacts of (LP2) relay 5001 to the same ground by which it was operated at the contacts of (LCT) relay 4914. Thus, a record is made that a line has been printed. A full description of the printer line count circuit is given in section 24.

When the distributor moves off the "start" position to transmit the carriage return line feed signal to the printer, ground from the distributor on "SC" lead 11401 will operate (CC7) relay 4207 which will release (CT) relay 5600 and operate (EL) relay 4907.

6.21 Printing another line

(EL) relay 4907 operated:

1. Locks at its armature 1 and front contact under the control of the operated (IN) relay 4902.
2. Prepares a circuit at its armature 2 and front contact to operate (OUT) relay 4909.
3. At its armature 3 and front contact it operates (RL) relay 4200.
4. At its armature 4 it removes a ground from lead "ENL" which has no function in verbatim printing, and applies it to lead "L01" which also is not used in verbatim printing.
5. At its armature 5 and front contact it operates (CTX) relay 4901 for the function previously explained in section 6.19.
6. At its armature 6 and front contact it partially prepares an operating circuit for (LCR) relay 4908.
7. At its armature 7 and front contact it provides a locking circuit for (LCR) relay 4908 and (LCT) relay 4914.

Relay (RL) in Fig. 42 will act in the manner previously described in section 6.19 and will operate (OUT) relay 4909, via the armature 1 and front contact of (LC) relay 5601 and the armature 2 and front contact of (EL) relay 4907.

Relay (OUT) operated:

1. At its armature 1 and front contact locks to (IN) relay 4902.
2. At its armature 2 opens the lead 4906 which has no function in verbatim printing.
3. At its armature 3 and back contact it opens the "L" lead 4913 releasing the (VBL) relay 4800 in that circuit.
4. At its armature 4 and front contact it operates (UNLK) relay 5622.

The (UNLK) relay operated releases all the register relays that may be operated in any storage circuit. As storage circuit No. 6 is the only storage circuit used in verbatim printing, all register relays in that circuit will release, consequently releasing all the (S—X) relays in this circuit. The release of the (S—X) relays will remove the locking ground of (IN) relay 4902.

This relay (IN) released:

1. Releases (OUT) relay 4909.
2. Releases (PR) relay 2502.
3. Releases (EL) relay 4907.

With both relays (IN) and (OUT) released, (VBL) relay 4800 is reoperated, as (SW) relay 4905 remains operated due to (LK) relay 4912 remaining operated.

The (CTX) relay 4901 releases following relays (EL) and (ETA), in turn releasing relay (RL) which restores ground to lead "1." The printing portion of the circuit is now normal waiting for the storage of another line in the No. 6 storage circuit.

The new line is waiting in the reader relays, and the release of (PR) relay 2502 closes the "CT" circuit 2808 to the reader line count circuit, causing the line registered in the reader relays to be transferred to the No. 6 storage circuit.

The whole process will repeat itself line by line of the automatic accounting system tape.

6.22 Placement of verbatim lines on 3-inch page and counting

When either the 3-inch or 7-inch folded paper is placed in the printer unit a fold is placed opposite the white arrow-head just in front of the platen. As explained above, when the verbatim title is given, four line feed carriage return signals are given which places the paper in the proper position for the first printed line.

The operation of the (VB) relay 1300 connected the "CL40" lead to the winding of (LC) relay 5601. When forty lines have been counted by the printer line count circuit, ground will be applied to the "CL40" lead 5003 by (LC36) relay 5700 and (CL4) relay 5002.

6.23 New title due to a completed page

When ground is applied to "CL40" lead 5003, (LC) relay 5601 operates. It will be noted that this action takes place immediately after the operation of (CT) relay 5600 and during the time the carriage return line feed signal is being given and before (EL) relay 4907 is operated.

Relay (LC) operated:

1. At its armature 1 and back contact opens the operating lead for relay (OUT).
2. Prepares a circuit at its armature 2 and front contact for operating (LCR) relay 4908.

When (EL) relay 4907 operates, it will cause (LCR) relay 4908 to operate but will not cause (OUT) relay 4909 to operate.

Relay (LCR) operated:

1. Will lock at its armature 3 and front contact to any operated relay in Figs. 50 and 57 and to (EL) relay 4907.
2. Will open the "L" lead at its armature 1 and back contact releasing (VBL) relay 4800.
3. At its armature 2 and back contact will open lead "TB," the operating circuit of relay (LK), causing it to release and in turn release relay (SW).
4. At its armature 2 and front contact will prepare a circuit to light the (RLLC) lamp 1009 (Line count NO RLS) lamp in Fig. 10.
5. At its armature 3 will remove ground from the printer line count circuit, Figs. 50 and 57, causing the relays in that circuit to release. When all the relays have released, their lock for this (LCR) relay 4908 will be removed from conductor (CLK), and (LC) relay 5601 will release.

Relay (LC) released will cause relay (OUT) to operate, and the regular process of releasing will take place. Relay (EL) released will release relay (LCR), causing relay (LK) to reoperate. Relay (SW), however, will remain released and when relay (IN) again operates the (VBT) relay will operate and a title will be inserted, after which relay (SW) will again operate and lock.

This process will continue page by page as has been described.

6.24 Completion of verbatim tape

We will assume for the purpose of this description that the tape being processed has no irregularities of any kind. The type of irregularities referred to are as listed below.

1. Mutilated digits
2. Regular splices
3. Window splices
4. End of tape unevenly cut

Under this assumption then, all lines on the tape will be printed regardless of what they are, until the last line is reached when the tape partially steps out from under the pins. The reader will stop, after which it should be stepped one step at a time by the (Reader step) key 2607, until all the pins are out from under the tape. When this occurs no check can take place in the reader relays and the line cannot be transferred to the storage circuit. There is a circuit, however, extending from ground, conductor 2401 in series through all reading relays, conductors 900, 901 and "TPO," conductor 902 to (TPO) relay 1705. When the tape passes out from under the pins of the reader this circuit will close and operate (TPO) relay 1705.

The (TPO) relay operated:

1. Locks at its armature 5 and front contact under control of the functions of the (Master release) key 1800.
2. Provides at its armature 1 and front contact a ground to lock (R2) relay 1104 thus preventing any further stepping of the reader.
3. Opens at its armature 2 and back contact the "LTHE" lead to the tape identification circuit, a function to be described (see section 16).
4. Opens at its armature 3 and armature 4 the operating circuits of the (PMS) and (RMS) relays, respectively, so that when the motors stop they cannot again be restarted until after a master release has taken place.
5. At its armature 6 and back contact releases the (SKS) relay 1004 if it has been operated.

6. At its armature 7 and back contact removes ground from the "TBL" lead to the tape digit register circuit, a function described in section 16, and applies ground to operate the (TPOA) relay 12721 to bring in the alarm.
7. At its armature 8 and front contact connects together the "TP" and "TPO" leads to Fig. 22, a function described in section 16.

(TPOA) relay 12721 in Fig. 127 operated, brings in the general alarm. A complete description of the alarm circuit is given in section 19.

6.25 Complete release of circuit after verbatim printing

When the (TMOA) relay 12716 operates, it lights the general alarm lamp, and the common alarm pilot. It also lights the machine alarm lamp, a yellow lamp on the end of the row of cabinets, and energizes the common audible alarm.

On observing the general alarm it will be noted that the (End of tape) lamp is lighted. The circuit is then released by operating both the (Machine release) key 1818 and (Master release) key 1800.

The operation of the (Machine release) key 1818 in this case operates (RLS) relay 1700 which locks under the control of (ST) relay 1000. The real function of the operation of relay (RLS) at this time is to remove a ground at its armature 3 and back contact which was disabled by the (Master release) key. As soon as this ground is removed, the (Master release) key being operated, (DCP) relay 12713 is released, and all 48-volt potential is removed from the circuit and all relays are released.

The circuit is now ready for another verbatim tape, on which the usual starting procedure must be used.

6.26 Use of the (Machine release) key 1818

The (Machine release) key is for the purpose of stopping the machine while a tape is in process, so that the machine may be left for an indefinite length of time, and again be restarted at any time by operating the (Motor start) key 1803 and the (Machine start) key 1815.

When the (Machine release) key 1818 is operated the circuit completes the printing of any material that has been taken into the circuit, and then shuts the circuit down.

The operation of the (Machine release) key 1818 applies ground to operate the (RLS) relay 1700.

Relay (RLS) operated:

1. Locks at its armature 5 and front contact to the (ST) relay at its armature 8 and front contact and to the armature 2 and front contact of the (PMS) relay 1807.
2. Provides at its armature 1 and front contact a locking ground for (RLX) relay 1002.
3. Opens at its armature 2 and back contact part of the locking circuit for (PMS) relay 1807 and (RMS) relay 1805.
4. At its armature 3 and back contact removes the disabling ground from the (Master release) key 1800.
5. At its armature 4 and back contact removes one of the locking grounds from (ST) relay 1000.
6. At its armature 6 and front contact prepares an operating path for (RLX) relay 1002.

When the (EC) relay 2506 operates at the end of the storage of the entry in process at the time the (Machine release) key 1818 and (RLS) relay 1700 are operated, it will close a circuit on its armature 1 and front contact via the armature 6 and front contact of relay (RLS) to operate (RLX) relay 1002.

Relay (RLX) operated:

1. Locks at its armature 1 and front contact to relay (RLS) operated and to relay (ST) when it is released.
2. At its armature 2 and front contact it connects ground to the (Reader lamps) key 2201 over conductor 12722 to permit the lighting of the "progress" lamps after the processing of the tape has ceased as no alarm is brought in.
3. At its armature 3 and back contact opens the circuit to the (TOA) relay 12720 to prevent the bridging in of an alarm.
4. At its armature 4 opens the "check-down" circuit and applies ground to hold (R2) relay 1104 operated.

This status will be maintained until printing ceases. No more lines of tape can be read because relay (R2) is held operated. When the printing is complete (PR) relay 2502 will release, releasing (ST) relay 1000. The release of relay (ST) applies ground to lock relay (RLX) and releases relays (RLS), (PMS) and (RMS) stopping all motors. Relay (RLS) releases after relay (PMS) releases, which is necessary as relay (RLS) released restores the locking circuit of relays (PMS) and (RMS).

The circuit will remain thus. To start again, the (Motor start) key 1803 is operated followed by the (Machine start) key 1815, which releases (RLX) relay 1002 and sets the circuit up for continuing the processing.

6.27 Handling irregularities in verbatim tape

1. Mutilation of one or more digits in an automatic accounting system tape

If one or more digits in an automatic accounting system line are mutilated, when this line is registered in the reader relays, one or more of the (RR–) relays such as (RRA) relay 903, will not be operated, therefore, (RRCK) relay 2603 will not operate. Whatever combination is in the reader relays will be passed to the No. 6 storage circuit, however, and again in that circuit one or more of the (S6—X) relays such as (S6AX) relay 6900 will not operate, therefore, (SCK) relay 2606 in the reader control circuit will not operate.

Because relays (RRCK) and (SCK) are not operated (CK) relay 2503 cannot operate, therefore, the relays in the reading relay circuit cannot release and in consequence relay (R2) cannot release. Because relay (R2) has not released within certain time limits, the timing circuit will time out and both a visual and audible alarm will be given, and the reader motor will stop.

As the circuit has stopped and an alarm been given it is desired to find out the cause of the stoppage. When the (CALM) relay 12714 operated, ground was placed on "ALC" lead 12722 to armature 4 of (LP) relay 1008. The (Reader lamps) key 2201 is now operated which operates (LP) relay 1008, therefore, this "ALC" ground 12722 is extended through armature 4 and front contact of the (LP) relay to the (G1) and (G2) relays 1110 and 1118, respectively. We are assuming that the reader has not failed to step and, therefore, only one of the (G1) or (G2) relays will be operated and, therefore, this "ALC" ground will be extended to conductor 1819 and

thence to armature 2 of the (CK) relay 2503. Relay (CK) is not operated so this circuit is, therefore, further extended through the back contact of armature 2 to armature 2 of the (PR) relay 2502 which is not operated, thence to armature 6 of the (CKT) relay 1702 over its back contact to armature 4 of the (STE) relay 2505. Since the (STE) relay is operated this circuit will be extended over the front contact to armature 1 and back contact of the (RRCK) relay 2603 to light the (FLR) lamp 2607. The lighting of this lamp indicates that no check has been established in the reader relays. The fact that the (STE) relay 2505 is operated indicates that what has been received is an entry.

The type of error in the tape can then be determined by observing the (Reader or Register) lamps which for convenience are scattered over the drawings instead of being pictured in a lamp panel. A complete description of the lamp connector circuit is given in section 14.

6.28 Starring out a mutilated line

This circuit is so arranged that when a line in the tape is mutilated a star can be printed, for the mutilated digit or digits in the line. The circuit is stopped as has been explained and the line has been examined.

Certain actions are required on the part of the operator to print the stars when it has been decided that the mutilations are in the tape, and that stars should be printed.

To print the stars the operator operates the (Reader step) key 2607 momentarily. When the general alarm was given, the (CALM) relay 12714 placed ground on the "ALA" lead 12723 which supplies this ground to the (Reader step) key.

The (Reader step) key operated:

1. Connects the "S1" and "EM1" leads together. This action supplies ground from the armature 3 and front contact of relay (S1), to the "EM1" lead, which has no effect until the (S1) relay 1107 operates.
2. Operates the (EM) relay 2608 via the normal contacts of armature 3 of relay (EM1), by applying ground received from the alarm circuit over "ALA" lead 12723.

(EM) relay 2608 operated:

1. At its armature 2 and front contact operates (CK) relay 2503, from ground on the armature 3 and back contacts of (S2) relay 1105.
2. At its armature 3 and front contact it operates (RMS) relay 1805.
3. At its armature 1 and front contact it partially closes the operating circuit for the (TIP) relay 2602 without effect in verbatim printing.
4. At its armature 1 and back contact it removes the circuit to the possible ground at the armature 1 and back contact of (TIP) relay 2602.
5. The six lower make contacts of this relay on which are the operating leads of the connector relays of the six storage circuits, connect these operating leads individually to an (S—S) relay such as (S6S) relay 10400 in the same storage circuit as the connector relays.

In this case we are only concerned with the No. 6 storage circuit. The operating lead to the connector relays of this circuit is the only lead grounded, therefore, when relay (EM) operated closes its armature 10 and front contact, (S6S) relay 10400 will operate.

Relay (S6S) operated:

1. Locks at its armature 2 and front contact over the "LKB" conductor 5623 to ground supplied by (UNLK) relay 5622.
2. At its armature 3 and front contact it provides an artificial check as though the storage relays in this storage circuit had been satisfied. This artificial check consists of a grounding of conductor 10401 which is extended by the (S6A) relay 6800 to the "S6CA" conductor 6801, through the armature 6 of the (VMB) relay 2900 to the "ST" conductor 2904 and thence to the (IN) relay 4902. Therefore, relay (IN) will operate, and the printing process will begin. When ground is applied by the printer character sequence circuit, it will print good numerals where they have been properly registered and stars for the mutilated digits.

Assuming for explanation purposes that the B digit had not been satisfied, then (S6BX) relay 6901 will not be operated and the ground applied to "CS60" lead 6902 will be routed via the armature 3 and back contact of (S6BX) relay 6901 over the * conductor 6903 via the armature 4 and front contact of (S6S) relay 10400 to operate the (Star) relay 10601. Thus, the proper numerals will be printed for those digits that are good while a star will be printed for those that are mutilated. The (Star) is an upper case character on the printer, and is printed in the upper case in the manner described in section 25. If the next line is good the circuit will proceed in the regular manner. If more than one line is bad, which may be encountered in the double thickness of a tape in a regular splice, and in the window of a window splice, and also on the end of a tape where the end of the tape is jagged, the (Reader step) key 2602 must be operated for each line so treated. The alarm or its equivalent must be present to step, under these conditions. To speed up stepping (Alarm cut-off) key 12725 may be held operated which simulates an alarm condition as explained in section 19.

6.29 Stopping and starting reader

In stopping and starting the reader, care must be taken to prevent the stepping of the reader drum, so that the same line of tape will be under the reader pins when the reader is again started after having been stopped. Section 12 gives the sequence of operations that must be observed in starting and stopping the reader.

(Stop) relay 1102, in conjunction with (RMS) relay 1805 performs these functions in the following manner. When the (RMS) relay is operated by the (Motor start) key 1815, the (Step) magnet 800 is immediately energized by the armature 1 and front contact of (RMS) relay 1805. (Stop) relay 1102 is also energized by the armature 4 and front contact of relay (RMS). Relay (Stop) being of the slow-acting type is slightly slow to operate, slow enough to allow the (Step) magnet to operate, before closing its contacts.

Relay (Stop) operated, applies an auxiliary holding path for the (Step) magnet at its armature 1 and front contact and energizes the (Stop) magnet at its armature 2 and front contact from ground at the armature 7 and front contact of the (RMS) relay 1805.

Thus, the step magnet is fully energized to prevent the drum from moving before the (Stop) magnet moves its latch.

When the motor is stopped by releasing the (RMS) relay, the (Stop) magnet circuit is opened by relay (RMS) and relay (Stop) is deenergized. But relay (Stop) is also slow to release, so the (Step) magnet is held until the (Stop) magnet

has released. Then relay (Stop) releases releasing the (Step) magnet

The reader is in this manner stopped or started without stepping the drum.

7. Processing of summary tapes

7.01 General

The summary tapes are obtained from the summarizer and may contain two types of call entries, two line local message unit entries, or three line local and extended message unit entries. In the present design of the summarizer only two line entries will be produced. The form of these entries and the form of the printing on 3-inch folded pages is shown in sections 37 and 38.

7.02 Switch set-up for summary printing

In processing all tapes except verbatim tapes, the nine entries of the tape identity group that are placed in the leading end of the tape, just before the call entries, and in the trailing end of the tape, just after the call entries, must be checked by the circuit in order to be sure that the tape placed in the machine is the tape that it is desired to process. To do this the information that is contained in the tape identification group is set up on switches in Figs. 5, 12 and 26. A description of these switches is given in section 15, and a full description of the information contained in the tape identity group including the switch set-up for the various tapes is given in the following section 7.03.

7.03 Tape identification and switch set-up

The nine tape identification entries that make up the tape identification group, at each end of the tape contain the following information in the six digits of the automatic accounting system tape line:

A	B	C	D	E F
2	8	9	1	Tape Type
2	8	9	2	Marker Group
2	8	9	3	First Recorder
2	8	9	4	Last Recorder
2	8	9	5	Office 0
2	8	9	6	Thousands First Last
2	8	9	7	Day of Round First Last
2	8	9	8	Section Round
2	8	9	9	Month

These entries are listed in the order in which they are read by the reader.

(a) *Tape type*

The tape type is the tape index which identifies a tape as to its type and the processing stage from which it has been derived, and is given in the E and F digits of the 2891 entry.

(b) *Marker group*

The marker group number is an arbitrary number given to the central office equipment of one or more central offices served by a common group of markers. This number is for automatic accounting system purchases only, and may be from 00 to 99. This number appears in the E and F digits of the 2892 line.

(c) *First recorder*

The first recorder number identifies the first, or lowest recorder number represented in the tape. This number may be from 00 to 19 and appears in the E and F digits of the 2893 entry.

(d) *Last recorder*

The last recorder number identifies the last, or highest recorder number represented in the tape. This number may be from 00 to 19 and appears in the E and F digits of the 2894 entry.

(e) *Office*

The office is an arbitrary digit assigned to identify the central office code within a marker group. This number appears in the E digit of the 2895 entry the F digit of which entry is always zero. This number may be from 0 to 9 and is taken in conjunction with the marker group number to determine the actual office name.

(f) *Thousands first and last*

The thousands first and last digits which appear in the E and F digits of the 2896 entry, represent the thousands range, indicating the first, lowest thousands digit and the last, highest thousands digit of the calling numbers represented in the tape.

(g) *Day of round, first and last*

These digits, which appear in the E and F digits of the 2897 entry indicate the first, lowest and the last highest day of the round represented in the tape.

(h) *Section and round*

This information appears respectively in the E and F digits of the 2898 entry. The section indicates the number of the section of the tape where a number of sections are spliced together. The round is the number of the accounting round to which the tape applies. There may be six or ten rounds in a month.

(i) *Month*

The month is a two-digit number appearing in the E and F digits of the 2899 entry. This two-digit number may be from 01 to 12, and indicates the month in which the calls shown on the tape were made, except on summary tapes the month indicated is that of the last round included.

The information contained in the tape identification entries for the different kinds of tapes is shown below.

(j) *Information in tape identity entries*

1. Summary tape from the summarizer.

2891	1	7	
2892	Marker group		
2893	0	0	
2894	0	0	
2895	Office	0	
2896	0	0	
2897	0	0	
2898	Section round		
2899	Month		

2. Unsorted tapes from the computer.

2891	2	0	For toll
	3	0	For message unit detail
	4	0	For observing
	6	0	For straddle
2892	Marker group		
2893	First recorder		
2894	Last recorder		
2895	0	0	
2896	0	0	
2897	Day of round, first and last		
2898	0	Round	
2899	Month		

3. Sorted by office from the computer.

2891	2	1	For toll
	3	1	For message unit detail
	4	1	For observing
2892	Marker group		
2893	First recorder		
2894	Last recorder		
2895	Office	0	
2896	9	0	
2897	Day of round, first and last		
2898	0	Round	
2899	Month		

4. Sorted by office from the sorter.

2891	3	1	For toll
	3	1	For message unit detail
2892	Marker group		
2893	First recorder		
2894	Last recorder		
2895	Office	0	
2896	9	0	
2897	0	0	
2898	Office round		
2899	Month		

5. Preliminary or first sort by thousands from either the computer or the sorter.

2891	2	2	For toll
	3	2	For message unit detail
2892	Marker group		
2893	First recorder		
2894	Last recorder		
2895	Office	0	
2896	9	0	
2897	0	0	
2898	Thousands round		
2899	Month		

6. Sort by units from the sorter.

2891	2	3	For toll
	3	3	For message unit detail
2892	Marker group		
2893	9	0	
2894	9	0	
2895	Office	0	
2896	Thousands, first and last		
2897	0	0	
2898	Units round		
2899	Month		

7. Sort by tens from the sorter.

2891	2	4	For toll
	3	4	For message unit detail
2892	Marker group		
2893	9	0	
2894	9	0	
2895	Office	0	
2896	Thousands, first and last		
2897	0	0	
2898	Tens round		
2899	Month		

8. Sort by hundreds from the sorter.

2891	2	5	For toll
	3	5	For message unit detail
	4	5	For observing
2892	Marker group		
2893	9	0	
2894	9	0	
2895	Office	0	
2896	Thousands, first and last		
2897	0	0	
2898	Hundreds round		
2899	Month		

9. Second or final sort by thousands.

2891	2	6	For toll
	3	6	For message unit detail
	4	6	For observing
2892	Marker group		
2893	9	0	
2894	9	0	
2895	Office	0	
2896	9	0	
2897	0	0	
2898	Thousands round		
2899	Month		

(k) Switch set-up

The circuit is equipped with a group of ten switches on which the operator will set up the information which is contained in the tape identity group, including only that part which it is necessary to check in order that the operator may be sure that the right tape has been inserted in the reader.

The switches that are provided are as follows:

1. Month tens, **2000**
2. Month units, **2001**
3. Round, **2002**
4. First thousands, **1200**
5. Last thousands, **1201**
6. Central office, **1202**
7. Marker group tens, **504**
8. Marker group units, **505**
9. Tape type, **500**
10. Previous sort, **506**

The setting of the switches for the various tapes which corresponds to the information on the tape identity entries is given below:

1. Summary tapes:

Tape type	Mess unit
Previous sort	Normal
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Sections F and L
Round	Round
Month T and U	Month

2. Unsorted tapes:

Tape type	Toll, MU-DET, Observ. or Straddle
Previous sort	Unsort
Marker group T and U	Marker group
Central office	Normal
Thousands F and L	Normal
Round	Round
Month T and U	Month

3. Sorted by office from the computer:

Tape type	Toll, MU-DET or Observ.
Previous sort	Office
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Normal
Round	Round
Month T and U	Month

4. Sorted by office from the sorter:

Tape type	Toll or MU-DET
Previous sort	Office
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Normal
Round	Round
Month T and U	Month

5. Preliminary sort by thousands:

Tape type	Toll or MU-DET
Previous sort	1st thousand
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Sections F and L
Round	Round
Month T and U	Month

6. Sort by units:

Tape type	Toll or MU-DET
Previous sort	Units
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Thousands F and L
Round	Round
Month T and U	Month

7. Sort by tens:

Tape type	Toll or MU-DET
Previous sort	Tens
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Thousands F and L
Round	Round
Month T and U	Month

8. Sort by hundreds:

Tape type	Toll, MU-DET or Observ.
Previous sort	Hundreds
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Thousands F and L
Round	Round
Month T and U	Month

9. Second sort by thousands:

Tape type	Toll, MU-DET or Observ.
Previous sort	2nd thousand
Marker group T and U	Marker group
Central office	Office
Thousands F and L	Sections F and L
Round	Round
Month T and U	Month

The circuit always checks for (1) the tape index number given in the E and F digits of entry 2891, (2) for the marker group number given in the E and F digits of entry 2892, (3) the office which is given in the E digit of entry 2895, except in the case of unsorted tapes, (4) the round given in the F digits of entry 2898, and (5) the month given in the E and F digits of entry 2899.

The circuit also checks in some cases as indicated for the first and last thousands, which when used are given in the E and F digits of the 2896 entry. In the case of tapes 23, 24, 25, 33, 34, 35 and 45 a check is made simply for a good numeral rather than for a specific numeral.

In the case of tapes 17, 22, 26, 32, 36 and 46 the thousands switches indicate that a number of sections of tape have been spliced together to form a single tape, and indicate with what numbered section it ends. Each section must be checked for its number as the tape is processed.

In the entry 2896 if no first and last thousands are indicated the circuit will check for 90. Likewise in entry 2895 if no office is indicated the circuit will check for 0.

A complete description of the tape identity circuit and the tape digit register circuit is given in sections 16 and 17. These are the circuits involved in the tape identity check.

7.04 Skipping of leading end splice pattern

The first line that the reader will read, when the tape is first placed in the reader, is a splice entry which has the digits 081010 in the six digits of the entry. When the reader relays receive this combination in the manner described in section 6, the combination will not be transferred to a storage circuit because relay (STE) will not operate. The relays of the reading relay translator circuit described in section 21, will receive certain parts of this combination and will place a ground on the "88" lead 2700. Ground on the "88" lead will operate (SKS) relay 1004 via the armature 1 and back contact of (08) relay 1704.

Relay (SKS) operated:

1. Locks at its armature 3 and front contact via the armature 6 and back contact of (TPO) relay 1705, the armature 4 and back contact of (CKT) relay 1702 to ground on the armature 5 and back contact of (STE) relay 2505.
2. At its armature 1 and front contact it partially closes a circuit for operating (CK) relay 2503.
3. At its armature 2 and front contact extends the (H2) make contact of the reader on lead 1112 via contacts on relay (S2) to the winding of (R2A) relay 1006.
4. At its armature 4 and front contact it operates relay (R2A) via the armature 1 and back contact of (SKFS) relay 1010. This is to insure the operation of relay (R2A) the first time in case there is no closure time left on the "H2" lead 1112 to operate it, and also provides a lock for (SKFS) relay 1010 when it operates.

(R2A) relay 1006 operated:

1. At its armature 3 and front contact locks to (R3) relay 1011 at its armature 2 and back contact.
2. Opens at its armature 2 and back contact the operating circuit for the (CK) relay partially closed by the (SKS) relay 1004.
3. At its armature 1 and front contact provides a lock for (S3) relay 1012.
4. At its armature 4 and front contact connects the winding of (S3) relay 1012 to the (K3) break contact in the reader.

When the circuit was started, in accordance with the description given in section 6.10, relay (R2) will be operated and relays (R0), (S1), (R1) and (S2) will not operate on the first automatic accounting system line that is read. However, with (R2A) relay 1006 operated the reader will ground the "K3" lead in the next stepping interval of the reader cycle and relay (S3) will operate.

Relay (S3) operated:

1. Locks at its armature 3 and front contact to relay (R2A).
2. At its armature 2 and front contact operates (SKFS) relay 1010 which locks to relay (SKS) and removes the operating circuit for relay (R2A) from relay (SKS).
3. Connects at its armature 1 and front contact the winding of relay (R3) to the (H4) contact in the reader.

Now on the next reading interval of the reader cycle, relay (R3) operates to ground supplied by the (H4) contact.

Relay (R3) operated:

1. Locks at its armature 1 and front contact to the ground on the (H4) reader contact so that it remains operated for the duration of the reading interval of the reader cycle.
2. At its armature 2 and back contact removes the lock from relay (R2A).
3. At its armature 3 and front contact completes the circuit for operating relay (CK).

The operating circuit for relay (CK) may be traced from ground on the armature 5 and back contact of (CKT) relay 1702, through the armature 6 and back contact of (STE) relay 2505, the armature 1 and front contact of (SKS) relay 1004, the armature 2 and back contact of (R2A) relay 1006, the armature 3 and front contact of (R3) relay 1011 to operate (CK) relay 2503.

Relay (CK) removes the locking circuits for relay (R2) as described in section 6, and the next step will be taken. This time, with (SKS) relay 1004 operated, relay (R2A) operates on the reading interval that operates relay (R2). Relay (S3) will operate on the next stepping interval and be followed by the operation of relay (R3) on the following reading interval. During this last interval the (CK) relay will be operated again to conclude the skipping cycle.

This skipping process then continues until the first line of a tape identity group is read. When such an entry is read, the relays of the reading relay translator circuit ground lead "289" and operate the (CKT) relay via the armature 3 and back contact of (STE) relay 2505. The operation of relay (CKT) releases relays (SKS) and (SKFS) so that a check cannot again take place from that source, and relays (R2A), (S3) and (R3) become inactive.

The operation of (CKT) relay 1702 also operates (AUX) relay 2501, which in turn operates (08) relay 1704. Relay (08) operated, removes the "08" lead 2700 from the (SKS) relay 1004 winding. The (08) relay 1704 locks under control of the (Master release) key 1805.

7.06 Skipping of splice between sections of tape

Any splice pattern following a group of call entries is preceded by a skip splice entry which is made up of digits 2860XX where the X's shown in digits E and F represent the machine number that made the tape.

The first indication to the circuit of a splice, is the reading of this entry. The reading relay translator circuit will recognize the 286 of this entry and will ground "286" lead 2701, operating (SKS) relay 1004 whereupon skipping will take place as above described.

7.07 Failure of 286 to be recognized

If the 286 is not recognized, relay (SKS) will not operate, and as relay (CK) is not operated the circuit will stop. To proceed with the tape the whole splice pattern will have to be stepped through manually by the (Reader step) key until a tape identity entry is reached.

7.08 Skipping a window splice

A window splice is preceded by a skip window splice entry 287020. The recognition of the 287 entry by the reading relay translator circuit grounds "287" lead 2702 which operates (SKS) relay 1004 and skipping is started in the same manner as for the 286 entry described in section 7.06.

7.09 Failure of first 287 to be recognised

A failure to recognize the first 287 entry will act in the same manner as described for 286 in section 7.07, it being necessary to step through the window splice manually.

7.11 Trailing end of tape skipping

Skipping for the trailing end will be initiated by a 286 entry. When the very end of the tape is reached the skipping will be stopped and an alarm sounded as hereinbefore described. The tape is then manually stepped out until the (End of tape) lamp lights.

7.12 Over-all set-up for summary printing

As before stated the tape type switch is set on point (Mess unit). Ground on this point from the second section 502 of the switch operates (MU) relay 600. A complete description of the set-up of the circuit by relay (MU) is given in section 20.

The operation of this (MU) relay 600 makes possible the operation of two groups of relays in the entry class register circuit. These are the (M1) relay 3000 and the (M2A) relay 3001 and (M2B) relay 3002, these last two relays forming one group. The (M1) relay conditions the circuit for a message unit local entry, while the (M2A) and (M2B) relays condition the circuit for a local and extended message unit entry. A complete description of the set-up of the circuit by these relays is given in section 22.

7.13 Processing of tape identity entries

In section 7.03 a description of the tape identity entries was given. When the first 289 entry is read (CKT) relay 1702 will operate from ground on the "289" lead 2703.

Relay (CKT) operated:

1. Locks at its armature 2 and back contact via the armature 1 and back contact of the (TIP) relay 2602, to ground at the armature 5 of (EC) relay 2506.
2. At its armature 1 and front contact operates the (TCC) relay 700. The entire function of this relay (TCC) is to connect the reader line count circuit, Figs. 36 and 43, to the tape identity circuit, Figs. 7 and 14, and at the armature 10 and front contact of (TCC) relay 700, to indicate that there are nine entries in the tape identity group.
3. Opens at its armature 3 and back contact the winding circuit of (STE) relay 2505 which may be traced from the "STE" conductor 1901, armature 3 and back contact of the (CKT) relay 1702, armature 3 and front contact of the (TP) relay 2604, back contact and armature 6 of the (BST) relay 2500 to the winding of the (STE) relay 2505.
4. Opens at its armature 4 and back contact the locking circuit of the (SKS) relay.
5. Opens at its armature 5 and back contact the ground for the skipping check lead which is applied to the (CK) relay by relay (SKS). This ground is also the locking ground for relay (TP), and the ground for operating the (TP) relay by means of the (Tape ident.) key 1114. At these contacts it closes this ground to operate the (AUX) relay 2501.
6. At its armature 6 contacts it rearranges the lamp circuit in a manner to be described later, see section 39.
7. At its armature 7 and front contact it supplies ground for operating relay (CK) via (TCK) relay 2605.

8. At its armature 8 and front contact partially closes the operating circuit for relay (TIP).

The tape identification circuit, a description of which is given in section 16, now comes into action to check the 2891 entry and the result is to operate (TCK) relay **2605** if all the digits check with the switch set-up.

Relay (TCK) operated:

1. At its armature 2 and front contact closes the operating circuit for (CK) relay **2503**, the (RRCK) relay **2603** already being operated.
2. At its armature 1 and back contact opens the lamp circuit.

The (CK) relay operated causes the tape to advance, and the second entry is checked by the tape identity circuit. All entries are checked in this way except the eighth entry which in summary tape processing uses the tape digit register circuit, Figs. 21 and 22, the description of which is given in section 17.

When the line count circuit, Figs. 50 and 57, reaches the ninth count, (EC) relay **2506** is operated, and when the (CK) relay **2503** operates, (PR) relay **2502** operates but as (IN) relay **4902** is not operated, (PR) relay **2502** cannot remain operated as no printing is to take place.

When (EC) relay **2506** operates there is completed a circuit from the armature 7 and front contact of relay (RRLK) to operate relay (TP). Relay (EC) operated, also, in combination with the operated (CK) relay releases (CKT) relay **1702**.

Relay (TP) operated:

Locks at its armature 1 and front contact to (CKT) relay **1702** released, opens the lock circuit of relay (TIP) at its armature 2 and back contact, and closes its part of the operating circuit of the (STE) relay. This relay (TP), is operated only after all entries of the tape identity group have been checked, thereby a complete check of this tape identity is made, before call entries can be processed.

When another tape identity group is checked, relay (CKT) is again operated causing the release of relay (TP). Therefore, every time that a tape identity group is checked all the entries of the group must be checked before call entries can be processed.

The next entry in the tape is the first line of a call entry.

7.14 Processing a local message unit entry

The information contained in the two lines which form a local message unit entry is described in section 37.

The **20** in the A and B digits of the first line of the entry is recognized by the reading relay translator circuit, Figs. 19 and 27, as the distinguishing element of the entry. This circuit then grounds the "STE" lead **1901** to operate (STE) relay **2505**, a description of which has been given.

The point of interest at this time is that the (STE) relay **2505** operates the (M1) relay **3000** over a circuit from ground, armature 2 and front contact of the (STE) relay **2505**, the "ENT" conductor **2507**, armature 2 and back contact of the (OUT) relay **4909**, back contact and armature 3 of the (IN) relay **4902**, conductor **4906**, armature 1 and front contact of the (NA2) relay **1902**, armature 3 and front contact of the (NB0) relay **1903** to the "20" conductor **1904**, front contact and armature 4 of the (MU) relay **600** over the "E5" conductor **601** to the winding of the (M1) relay **3000**.

Now as the reader line count circuit is set to line 1 the connector relays of storage circuit No. 1 are operated to cause the register relays of this circuit to receive the information from the reader relays and printing is caused to start. The method of storage in this circuit is described in section 30. The method of starting printing is the same as was described before the verbatim processing.

The title must first be printed and in consequence the (MUT) relay **4700** is operated from the "T" lead **4910**. The (MUT) relay **4710** permits the use of (T9) relay **4603** and (T10) relay **4604** which form the title, to be operated by the printer character count circuit, described in section 23. The operation of the character sequence circuit is described in section 28.

The printed title which is shown in section 38, consists of:

1. The office name of the calling subscriber's office, which is obtained from decoding the position of the marker group switches in Fig. 5 and the position of the (Cent. Office) switch in Fig. 12 by the called office name translator which is described in section 36.
2. The month, which is obtained from decoding the position of the month switches in Fig. 20 is described in section 29.
3. The round, which is obtained directly from the position of the round switch in Fig. 20.

The order of printer operations for the message unit summary title is listed in section 28. The titling operation for message unit summary, like verbatim described in sections 6.18 and 6.19, requires four carriage return line feed operations to position the paper for printing.

In this case, the title is counted as a line by the printer line count circuit, which is described in section 24. After the (ET) relay **4911** operates, the condition is set up for printing a line. The order of printer operations for message unit lines is listed in section 28.

Now as (M1) relay **3000** indicates to the reader line count circuit that the number of lines in this entry is two, when the first line checks into the No. 1 storage circuit, the reader is immediately stepped forward to read the second line, which is stored in storage circuit No. 4, described in section 33. The reader then proceeds to read the first line of the next entry and holds it until printing of the previous entry is complete.

When the "L" lead **4913** is energized, (MUL1) relay **4100** is operated, bringing into action (L2) relay **3200** and (L1) relay **3201** in that order. By grounding the leads to the No. 1 and No. 4 storage circuits in the order shown in section 28, the subscriber's number, the first four numerals in the line and the number of message units the second four digits in the line are printed. The spaces in the title and line are obtained by energizing the (SP) relay **12102** directly from the character sequence circuit.

When the printing of an entry is complete the next entry is treated in exactly the same manner.

7.15 Processing of local and extended entry

The contents of the local and extended entry are shown in section 37. The method of printing this entry is shown in section 38.

The title is the same for this entry as for the local entry. This entry, however, contains three lines which are stored in the No. 1, No. 4 and No. 5 storage circuits. The (MUL2) relay **4101** is

operated which brings into action the (L3) relay 3202 and the (L4) relay 3203 in that order.

This entry is identified by 21 in the A and B digits of the first line of the entry.

7.16 Trailing end tape identity

When the tap identity at the end of a tape is read it will be checked in the same manner as the leading end tape identity group.

8. Processing straddle tapes

8.01 General

The straddle tape is obtained from the computer and may contain four types of entries, a six-line initial detail entry, a four-line initial message unit entry, a five-line answer-disconnect entry and a three-line straddle timing entry. The method of printing these entries and an explanation of the meaning of the various portions of the printed line are given in section 38. The information contained in the various lines of the entries in the automatic accounting system tape is given in section 37.

8.02 Switch set-up for straddle printing

The switch set-up for the straddle tapes is given in section 7.03.

8.03 Skipping in straddle tapes

The straddle tapes bring into play all methods of skipping which were described in section 7 except that between sections of tape, as the straddle tape always is made up of only one section.

8.04 Over-all set-up of circuit for straddle printing

As before stated the tape type switch 500 is set on point (straddle). Ground on this point on the second section 502 of the switch operates (STR) relay 602, a description of which is given in section 20. The operation of the (STR) relay makes possible the operation of four groups of relays in the entry class register circuit. These are the (ST1A) relay 2906 and (ST1B) relay 2907, the (ST2A) relay 3700 and (ST2B) relay 3701, the (ST3A) relay 3702 and (ST3B) relay 3703, and the (ST4A) relay 4401 and (ST4B) relay 4402, representing respectively the straddle initial detail entry, the straddle initial message unit entry, the straddle answer-disconnect entry and the straddle timing entry.

8.05 Processing the tape identity entries

The tape identity entries are processed in the same manner as described for the summary tape in section 7.

8.06 Straddle title

The "T" lead 4910 is connected to the (STRT) relay 4701 which brings into action the (T11) relay 4605 and (T12) relay 4606 in that circuit to print the title. The straddle title consists of the marker group number, which is obtained directly from the marker group switches, the month, which is obtained from the month translator circuit, and the round number which is obtained from the round switch. See description of the character sequence circuit in section 28.

8.07 Straddle initial detail entry

This entry is identified by 20, 21 or 22 in the A and B digits of the first line, and may be printed either with or without the called number area by using the character sequence circuit. In either case the "L" lead 4913 operates the (SL1) relay 4102 which brings into action the (L5) relay 4000, (L6) relay 4001, (L7) relay 4002, (L8) relay 4003, (L10) relay 4103 and (L20) relay 4104 in this order to print the line.

The first line of the entry is stored in the No. 5 storage circuit described in section 34.
The second line of the entry is stored in the No. 6 storage circuit described in section 35.
The third line of the entry is stored in the No. 1 storage circuit described in section 30.
The fourth line of the entry is stored in the No. 2 storage circuit described in section 31.
The fifth line of the entry is stored in the No. 3 storage circuit described in section 32.
The sixth line of the entry is stored in the No. 4 storage circuit described in section 33.

8.08 Straddle initial message unit entry

This entry is identified by 23 in the A and B digits of the first line of the entry, which causes the operation of the (SL2) relay 4105, bringing into action the (L5) relay 4000, (L6) relay 4001, (L7) relay 4002, (L8) relay 4003 and (L9) relay 4702 in this order.

The first line is stored in the No. 5 storage circuit.
The second line is stored in the No. 6 storage circuit.
The third line is stored in the No. 1 storage circuit.
The fourth line is stored in the No. 2 storage circuit.

8.09 Straddle answer-disconnect entry

This entry is identified by 24 in the A and B digits of the first line which causes the operation of the (SL3) relay 4801 which brings into action the (L5) relay 4000, (L10) relay 4703, (L11) relay 4704, (L12) relay 4705 and (L13) relay 3300.

The first line is stored in the No. 5 storage circuit.
The second line is stored in the No. 6 storage circuit.
The third line is stored in the No. 3 storage circuit.
The fourth line is stored in the No. 4 storage circuit.
The fifth line is stored in the No. 2 storage circuit.

8.10 Straddle timing entry

This entry is identified by 25 in the A and B digits of the first line, which causes the operation of the (SL4) relay 4802 which brings into action the (L5) relay 4000, (L23) relay 4803, (L14) relay 3301, (L7) relay 4002 and (L13) relay 3300 in this order.

The first line is stored in the No. 5 storage circuit.
The second line is stored in the No. 6 storage circuit.
The third line is stored in the No. 2 storage circuit.

The general method of printing all these entries has been previously described, and only differs from the printing of verbatim in the detail of the units printed.

9. Processing of toll tapes

9.01 General

The entries of toll tapes which are obtained from either the computer or the sorter, are printed on toll slips, 2½ inches long, and 5 inches wide, which come from a roll and are automatically cut every 2½ inches by the printer mechanism associated with this circuit. This tape

contains one type of entry, the detail entry, a five-line entry which is described in section 37 and which is printed in the manner described in section 38.

9.02 Switch set-up for toll slip printing

The switch set-up for toll tapes is given in section 7.03.

9.03 Skipping in toll tapes

The toll tapes bring into action all the methods of skipping which were described in section 7.

9.04 Over-all set-up for toll slip printing

As before stated the tape type switch 500 is set on point (Toll). Ground on this point in the second section 502 of the switch operates (DET) relay 1304 which in turn operates (COM) relay 1305 in that circuit. The description of the circuit set-up by these relays is given in section 20.

The operation of (DET) relay 1304 makes possible the operation of (D1A) relay 3800 and (D1B) relay 3801, a description of which is given in section 22.

9.05 Manual cutting of slips

Manual cutting of slips can take place when the circuit is not in the processing condition, that is when the (ST) relay 1000 is released. In this condition ground is present on the (Toll slip cutter) key 1307.

Slip cutting in the printer unit means to feed the paper up automatically so that there is exactly 2½ inches between the top edge of the paper, if it has been previously cut, and the edge of the knife.

To cut a slip, therefore, the (Toll slip cutter) key 1307 is operated. There will be one slip cut for each operation of the key, provided sufficient time elapses between the operation of the key to permit the completion of the cutting. More frequent operations of the key will have no effect. The cutting operation is also only effective when the (COM) relay 1305 is operated.

The operation of the (Toll slip cutter) key 1307 operates (TK2) relay 5602 via the normal contacts of armature 2 of (TK1) relay 5603 and the armature 2 and back contact of (CNR) relay 5604.

(TK2) relay 5602 operated:

1. Locks at its armature 3 and front contact to the feed cam contact 12603 in the printer unit over the "FCC" conductor 5605. This feed cam contact is closed when feeding can be initiated.
2. At its armature 1 and front contact it operates (TK5) relay 5606.
3. At its armature 2 and front contact it operates (LCT) relay 4914.
4. At its armature 4 and back contact it opens the printing "CS10" lead to prevent printing from taking place while cutting is in process. This lead is already also open at (TK1) relay 5603.
5. At its armature 5 and front contact it operates (CNR) relay 5604.
6. At its armature 6 and front contact it operates (TK1) relay 5603.

Relay (LCT) operated, releases the printer line count circuit in the same manner as has been described for relay (LCR), it does not rearrange the circuit for a new title as relay (LCR) does.

Relay (CNR) operated:

1. Prepares a lock circuit for itself to the off-normal contacts of the cutter and stuffer solenoids of the printer unit, Fig. 126, over the "CNR" lead 5607.
2. At its armature 2 and back contact it opens the operating circuit of (TK2) relay 5602.
3. At its armature 3 and back contact it opens the "CS10" lead which is already open at relay (TK2).
4. At its armature 4 and front contact prepares a circuit to light the (Cutter NO RLS) lamp 5608.

(TK1) relay 5603 operated:

1. Locks via its armature 2 to the ticket cut key, and opens the operating circuit for (TK2) relay 5602.
2. At its armature 1 and front contact partially closes the "CS10" lead.

(TK5) relay 5606 operated:

1. At its armature 1 and front contact operates (TK3) relay 5609.
2. At its armature 2 contacts operates the feed magnet 12604 in the printer over the "FDM" conductor 5610.
3. At its armature 3 and back contact opens the operating circuit of the (CUT) relay 12605 over the "TCR" lead 5611.

(TK3) relay 5609 operated:

1. Locks at its armature 3 and front contact to the (TK4) relay 5612.
2. Partially closes at its armature 1 and front contact the operating circuit of the (CUT) relay 12605.
3. At its armature 4 and front contact provides a supplementary operating path for (TK1) relay 5603.
4. At its armature 2 and front contact provides a supplementary operating path for (CNR) relay 5604.

The net result of the operation at this stage, is to operate the feed magnet in Fig. 126. The operation of this magnet releases a latch which permits the platen to rotate, through a friction clutch, carrying with it the feed cam. When it reaches the point where the feed cam contact opens on the hump of the cam, the platen will also stop against a projection which has been brought into play by the operation of the feed magnet. This point is within one-half a line feed of the full 2½ inches of the slip. The feed may have been started anywhere along the slip.

The result of opening the cam contact is to release (TK2) relay 5602.

Relay (TK2) released:

1. Releases (LCT) relay 4914.
2. Closes its part of the "CS10" lead.
3. Removes its operating ground for (CNR) relay 5604.
4. Removes its ground from relay (TK1). Both relays (CNR) and (TK1) remain operated, however, from relay (TK3).
5. Deenergizes (TK5) relay 5606.

Relay (TK5) is of the slow release type, requiring sufficient time to release as to insure that the platen has truly stopped with the feed cam contact open.

When relay (TK5) does release:

1. It removes the operating ground for (TK3) relay 5609.

2. Closes its part of the path for operating the (CUT) relay **12605**.
3. Releases the feed magnet **12604**.

Releasing the feed magnet allows the platen to complete its throw, to its final resting place, and closes the feed cam contact.

When the feed cam contact closes, the circuit is finally closed to operate the (CUT) relay. When the (CUT) relay operates it applies 110-volt alternating current potential to operate the (Cutter) solenoid **12606**. This action actually causes the knife to cut the toll slip, and close two make contacts (1) to close a locking circuit for (CNR) relay **5604** over the conductor **5607** and (2) to operate (TK4) relay **5612** over "CMC" conductor **12607**.

Relay (TK4) operated:

1. Locks at its armature 1 and front contact to the break contact of the (Stuffer) solenoid **12609**, over "SMC" conductor **12608**.
2. At its armature 2 and front contact provides a supplementary operating ground for relay (CNR).
3. At its armature 2 supplementary contacts removes the locking circuit for relay (TK3), and operates the (STUFF) relay **12610** over the "TSR" conductor **5613**.

Releasing (CUT) relay **12605** deenergizes the cutter solenoid causing the knife to return, and the knife returned removes its lock for (CNR) relay **5604**.

The operation of the (STUFF) relay energizes the (Stuffer) solenoid which pushes the slip that has just been cut into the ticket box, and locks relay (CNR).

When the stuffer reaches its extreme forward throw, it releases (TK4) relay **5612**, deenergizing the (STUFF) relay, which in turn deenergizes the stuffer solenoid. When the stuffer solenoid releases, (CNR) relay **5604** will be released.

With all relays released, (TK1) relay **5603** will release and the circuit is ready for cutting another slip.

This is the manual method of cutting slips, which description applies equally well for the automatic method which will follow.

9.06 Processing of the tape identity group entries

The tape identity entries are checked in the same manner as described for the summary tape in section 7.

9.07 The toll slip title

The automatic cutting of the toll slips is a part of an operation in the toll slip title. The (RDT) relay **3204** is operated to initiate the toll slip title. The operation of relay (RDT) brings into action the (T1) relay **3100** and the (T2) relay **3101**, in that order, to print the title.

This title consists of the calling office, the calling number and the month, and all three pieces of information may determine the title.

The make-up of the toll entry is shown and described in section 37, and the five lines of the entry are stored in the following storage circuits:

Line 1 in No. 1 storage circuit.
Line 2 in No. 2 storage circuit.
Line 3 in No. 3 storage circuit.
Line 4 in No. 4 storage circuit.
Line 5 in No. 5 storage circuit.

Line 1 contains the office and the directory number of the calling subscriber and is stored in No. 1 storage circuit, but this information is printed in the toll slip title. Section 30 describes how this information is stored, and the registration kept from one call to the next in order to determine by a change in the information whether a new title is required.

The operation of (RDT) relay **3204** enables the (T1) and (T2) relays to be operated by the tens relays of Fig. 35. When relay (T1) is operated, ground is applied by its armature 1 and front contact to the "TKK" conductor **1306** to operate relay (TK2). This initiates the feeding and cutting cycle in the same manner as described in section 9.05. When this cycle is complete the circuit via the armature 2 and front contact of relay (T1) will be complete to print whatever character has been set up by the No. 1 storage circuit and the marker group translator circuit, as the first character of the calling office, over "CS10" lead **5614**.

The title determined by (T1) relay **3100** and (T2) relay **3101** is, therefore, printed and upon its completion the entry line is printed.

The relay in the character sequence circuit that determines the printing of the line is the (RD) relay **3302** which brings into action the (L15) relay **3303**, (L21) relay **4804** and (L16) relay **3304** in that order.

The toll entry line contains the time obtained from the second line of the entry. This time is converted from five digits given in the automatic accounting system tape to six digits in the printed record. This method of translation is described in section 31. The rest of the line contains the called office, the called number and the chargeable time. The circuit is arranged to provide for optional printing of the area when desired as shown in section 38.

10. Processing of message unit detail tapes

Message unit detail printing is described in section 38. The entry used is the same entry as that used for toll printing. The method of printing these slips differs from the toll slips, only in that the title contains the additional characters (MU-DET), and the line contains in addition the message units and the type of message units.

The title forming relay that is operated is the (MUDT) relay **3205** which brings into action the (T1) relay **3100**, (T3) relay **3102** and (T4) relay **3103** in that order. The line forming relay is the (MUDL) relay **3305** which brings into action the (L15) relay **3303**, (L21) relay **4804** and (L17) relay **4106** in that order, for single area printing, and the (L15) relay **3303**, (L21) relay **4804**, (L17) relay **4106** and (L1) relay **3201** in that order for multiple area printing.

11. Processing of observing tapes

Observing printing is described in section 38. The observing tapes contain two entries, the detail entry, and the non-answered entry, both of which are described in section 37.

The title is the same as for the toll slips except that it contains the additional characters, (Line obs.).

The title forming relay is the (LOT) relay **4004**, which brings into action the (T1) relay **3100**, (T5) relay **3900** and (T6) relay **3901** in that order. The relays used for the detailed entry are the same as for message unit detail tapes. The line forming relay for the non-answered entry is the (OB) relay **3306**, which brings into action the (L18) relay **4107** and (L22) relay **4805** for single area printing and the (L18) relay **4107**, (L21)

relay 4804 and (L22) relay 4805 for the multiple area printing.

12. Reader circuits

12.01 General

Figs. 8, 15 and 23 show the circuit of the reader.

The reader requires that the step magnet circuit be opened in order to permit the drum to rotate. Further, a stop magnet is provided for insuring the stopping and starting of the reader without falsely rotating the drum.

12.02 The automatic accounting system tape

The tape made in the perforators of the central office, or the accounting office, is a paper tape about 3 inches in width into which have been punched certain combinations of twenty-eight holes laterally across the tape. The holes made in this tape by the perforators, are not cleanly punched holes, but are embossed holes with the paper pushed out to the back. Further than this while it is possible to punch twenty-eight holes in line across the tape, it is not practicable to arrange the punch magnets physically in the perforator, twenty-eight in line. In consequence, they have been arranged in two groups of fourteen. Because of this arrangement the holes representing one line of an entry appear not in one line, but in two lines.

The paper is fed into the bottom tape chute of the recorder with the embossed portions of the holes upward. The tape is then fed around the reader drum, with the embossed portions of the holes in the paper fitting into the holes in the drum, with the forward end continuing into the upper tape chute.

The fitting of the embossed portion of the holes of the tape, into the holes in the drum, provides a means for stepping the paper through the reader. In other words, it provides traction whereby the paper may be pulled forward.

12.03 Reader pin contacts

The reader is equipped with a set of twenty-eight contacts to which are attached feeler pins, which pass through any holes in the tape and into corresponding holes in the periphery of the drum. The drum is arranged with a mechanical device for stepping the drum one line at a time. A system of cams for operating reader and control contacts and the stepping mechanism are mounted on a motor-driven shaft. The speed at which either reader in the printer circuit will be operated is sixteen cam revolutions per second.

The sequence of action of the reader pins and drum motion as determined by the cams on the axle is as follows:

1. Move the pins back from the drum. With the pins fully back the contacts that are attached to the pins are open.
2. The drum is stepped forward, one step.
3. The pins are brought forward to the drum, those pins which when presented to the drum, find a hole in the tape, will enter that hole, and close the contact associated with that pin. If there is no hole in the paper, the pin will not enter, and its associated contact will not close. Thus, when the pins are presented the combination that is represented by the holes in the paper, will also be represented by the contacts that are made.

While the motor is running, the pins are presented to the drum once in each revolution of the cams and this presentation of the pins cannot be stopped without stopping the motor.

12.04 Reader step magnet control of drum advance

The drum will step freely with each revolution of the cams unless the step magnet is energized. Once in each revolution of the cam a ratchet device is placed in position to rotate the drum one step under compulsion of a spring. If the step magnet be energized, the spring will be restrained and the step will not take place. Rapid advance of the tape can be obtained by operating the tape feed (TF) key 2300 which opens the step magnet circuit in the reader. Single step advance of the tape may be obtained by opening the step magnet circuit external to the reader as desired.

12.05 Auxiliary control contacts

Other cams on the axle actuate other contacts, which have certain time relations to the reading contacts, and are used for various operations in the printer circuit. This printer circuit uses a total of nine of these contacts which are related to the reading contacts as follows:

The (H0), (H1), (H2), (H4) and (K4) contacts which open and close in phase with the reading contacts, and (H3), (H7), (K3) and (K7) which open and close 180 degrees out of phase with the reading contacts.

When the reader is operated at a speed of sixteen revolutions a second, the over-all time of the operating cycle is approximately 60 milliseconds. The reader contacts are closed for about 40 milliseconds of this time, leaving 20 milliseconds for stepping the drum.

The timing of these contacts is charted in Fig. 131.

12.06 Reader advance check contacts

Associated with the drum are two auxiliary pins and contacts (G1) and (G2) which are arranged so as to enter holes in the end of the drum alternately line by line as the drum advances. A circuit arrangement in the reader control circuit is associated with these contacts for showing if the drum fails to advance or if it oversteps. If either of these happen the circuit will time out and bring in the general alarm.

12.07 Stop magnet

The reader is also equipped with a magnet 881, that when operated in the proper sequence with the (Step) magnet 880, will prevent the drum from feeding the tape during the starting and stopping of the reader motor. The sequence of deenergization of the (Step) and (Stop) magnets when stopping the reader is as follows:

1st. Stop the reader motor with the (Step) magnet energized.
2nd. Disconnect the current from the (Stop) magnet.
3rd. Disconnect the current from the (Step) magnet.

When starting the motor the following sequence takes place:

1st. Energize the (Step) magnet.
2nd. Energize the (Stop) magnet.

12.08 Reader circuit used in the printer circuit

The contacts of the reader are the contacts associated with the reader pins of the six groups:

(A0), (A1) and (A2) (B0), (B1), (B2), (B4) and (B7)	shown in Fig. 8
(C0), (C1), (C2), (C4) and (C7) (D0), (D1), (D2), (D4) and (D7)	shown in Fig. 15
(E0), (E1), (E2), (E4) and (E7) (F0), (F1), (F2), (F4) and (F7)	shown in Fig. 20

Contacts (G1) and (G2), Fig. 20, are the reader advance pin contacts which are associated with a circuit in the reader control circuit which examines the position of these pins to give an alarm if the drum does not step, or if it oversteps.

(TF) key **2300** can be used to advance the drum at a rapid rate.

The (G0) contact **803** energizes the (Step) magnet during each revolution of the cams. Thus, the magnet is energized so that it may be held externally if it is so desired, and if it is not held externally it will be held internally during the reading cycle, and released so that it can step during the stepping cycle. When it is released the drum can step.

The contacts (H0), (H1), (H2), (H3), (H4), (H7), (K3), (K4) and (K7) are the auxiliary contacts which are used for other functions of the circuit, as has been previously pointed out.

12.09 Combination of the pins representing the numerals

Certain combinations of the contacts in the six different groups of pin contacts represent certain numerals in the following manner:

Contact Closed	Numeral Represented
A GROUP	
0	0
1	1
2	2
0, 1 and 2	3
B, C, D, E AND F GROUPS	
0 and 1	1
0 and 2	2
1 and 2	3
0 and 4	4
1 and 4	5
2 and 4	6
0 and 7	7
1 and 7	8
2 and 7	9
4 and 7	0

It will be noted that in all cases the numeral designation of the pins added together, whether one or more pin contacts are closed, show the numeral represented by the combinations, except in the case of **4** and **7** which represents 0 in the B, C, D, E and F digits.

13. Reading relay circuit, Figs. 8, 9, 15, 16, 23 and 24

13.01 General

This circuit consists of six groups of relays (A) to (F), and three connector relays. Three relays in Group A and five relays each in groups B to F are associated with the twenty-eight contacts of the reader when the three connector relays, (PC1) relay **804**, (PC2) relay **1504** and (PC3) relay **2304** are operated.

A description of groups A and B will be given, and the description of group B will serve for groups C to F.

These relays have a number of functions.

1. To decode the combinations of the relays to the numerals of the decimal system, represented by the various combinations of the relays which are the same as the combinations of the pins described in section **12**, for the use of the reading relay translator circuit, Figs. 19 and 27, the tape identity circuit, Figs. 7 and 14, the reader control circuit, Figs. 10, 11, 15, 16, 23 and 24, and the tape digit register circuit, Figs. 21 and 22.
2. To provide grounds corresponding to the exact setting of the relays, for the use of the No. 1 to No. 6, inclusive, storing circuits.
3. To provide grounds corresponding to the exact setting of the relays, for the use of the lamps in Figs. 1, 2, 3 and 4 to which they are connected by the relays of these same figures.
4. To provide an over-all circuit to show when the tape steps out from under the pins of the reader to indicate to the control circuit that the end of the tape has been reached.

13.02 The A group

A check circuit is provided beginning at ground on the front contact of armature **4** and back contact of armature **5** of (A0) relay **904** which is so arranged that if one and one only of these relays, (A0) relay **904**, (A1) relay **905** or (A2) relay **906** is operated, (RRA) relay **903** will operate.

Relay (RRA) operated, applies ground to the armature **1** of (RRB) relay **907** which forms a part of an over-all circuit, which will be fully closed when all the groups of reading relays have been satisfied, and which when closed will place a ground on "RCK" conductor **2400** to operate the (RRCK) relay **2603**.

Examining each contact of these relays (A0), (A1) and (A2), they function as follows:

1. Contact and armature **1** of each form a part of a check circuit for the case where all three relays are operated to indicate the numeral **3** in this group, and where relay (RRA) does not operate.
2. Contact and armature **2** of each are the locking contacts which lock the relays to a contact of the (RRLK) relay **1005**.
3. The armature **3** contacts close the check-down lead "CKD" which indicates to the control circuit when any of these relays are operated, so that, that circuit will know when these relays are released. In the case of verbatim printing this lead is used to indicate that some information is in the reading relays.
4. The armatures **4** and **5** of the (A0) and (A3) relays and armatures **4**, **5** and **6** of the (A1) relay form a part of the one and one only check circuit for operating (RRA) relay **903** when only one relay of the group is operated.
5. The armature **6** and front contact of the (A0) relay forms a part of a series circuit through a large part of all the relays in this circuit, that will be closed if the tape steps out from under the pins of the reader. When this series circuit is closed, the (TPO) relay **1705** will operate.
6. The armature **7** and front contacts of relays (A0) and (A2) and armature **8** and front contact of relay (A1) close ground for lighting a lamp via Fig. 2.
7. The armature **8** and front contacts of relays (A0) and (A2) and armature **9** and front contact of relay (A1) close ground for operating the corresponding relay in the storage circuits.
8. The armature **9** of relays (A0) and (A2) and armature **10** of relay (A1) close part of the numeral **3** lead to the reading relay translator circuit, Figs. 19 and 27 if all three relays are operated.
9. The armature **10** and front contacts of relays (A0) and (A2) and armature **11** of relay (A1) close the numeral leads represented by these relays, for the use of the tape identity circuit and the reading relay translator circuit, Figs.

19 and 27. These leads only become active when (RRA) relay 903 is operated.

If all three relays are operated relay (RRA) will not operate. The ground for operating the relays in the translator circuit is derived from the control circuit over the "RRG" lead 1001.

13.03 The B group

The relays in the B group operate in the same manner as group A except that the check circuit provides for the operation of two and only two relays at all times. When two and only two relays in the group are operated the (RRB) relay 907 will operate.

The ground for the "CKD" check-down lead is supplied from relay (RRB) only. All the other functions of these relays, the operation of the relays in the storage circuits, the lamp lighting leads, and the portion of this group involved in the lead for operating the (TPO) relay 1705 are apparent without further description.

The C, D, E and F groups operate in the same manner and the "ECK" and "FCK" leads grounded individually by the (RRE) and (RRF) relays, respectively, are used by the tape identity circuit where it is only necessary to check that some numeral, and not a specific one, is registered in the E and F digits.

13.04 Over-all operation of the circuit

When the (S2) relay 1105 of the control circuit operates in the stepping interval of the reader cycle, (PC1) relay 804, (PC2) relay 1504 and (PC3) relay 2304 operate and connect the six groups of relays to the reader pins. The relays will take up the condition represented by the reader contacts, the closed contacts operating corresponding relays in this circuit.

The relays being operated, will decode the combinations of the relays and connect the ground on the "RRG" lead 1001 to the proper points in the translator circuit. They will close the lamp contacts, and the contacts for operating the relays in the storage circuits. When valid numerals are registered in each group the check "RCK" lead 2400 is closed.

At the end of the tape when the tape moves out from under the reader pins, all the relays will be operated and ground will be applied to the "TPO" lead 902 to indicate that condition.

Another group of leads is provided in this circuit by means of which the lamps of Figs. 1, 2, 3 and 4 can be directly connected to the reader pins by operating a relay in this lamp control circuit.

To sum up, the function of this circuit is to take the information from the reader contacts, and store it until it has been properly digested in the other parts of the circuit, after which the relays in this circuit are released.

14. Lamp connector circuit

14.01 General

The lamp connector circuit is for the purpose of connecting certain elements of the circuit to a group of twenty-eight lamps located in the panel circuit and shown in Figs. 3 and 4 and to apply ground to or close the circuits of other lamps when it is desired to observe the condition of the over-all circuit under trouble conditions.

The twenty-eight lamps (Reader or register) on the panel may be connected to eight different points in the circuit, these eight points being, the reader pin contacts, the reading relays and the six storage circuits.

There are eight sets of three relays each in this circuit, one set of relays for each of these points. (LA1) relay 101, (LA2) relay 102 and (LA3) relay 103 are operated by the (Reader lamps) key 2201, relays (LA2) and (LA3) being operated by relay (LA1), to connect the twenty-eight lamps to the reader pin contacts. (LB1) relay 201, (LB2) relay 202 and (LB3) relay 203 are operated by the (RDR REG lamps) key 2206, relays (LB2) and (LB3) being operated by relay (LB1), to connect the twenty-eight lamps to the reading relays. These two sets of relays are always operated by the same keys. The other six sets of relays may be operated by different keys, depending upon the order in which the storage circuits are used for the entry.

(LC1) relay 104, (LC2) relay 105 and (LC3) relay 106 connect the lamps to storage circuit No. 1.

(LD1) relay 204, (LD2) relay 205 and (LD3) relay 206 connect the lamps to storage circuit No. 2.

(LE1) relay 301, (LE2) relay 302 and (LE3) relay 303 connect the lamps to storage circuit No. 3.

(LF1) relay 401, (LF2) relay 402 and (LF3) relay 403 connect the lamps to storage circuit No. 4.

(LG1) relay 304, (LG2) relay 305 and (LG3) relay 306 connect the lamps to storage circuit No. 5.

(LH1) relay 404, (LH2) relay 405 and (LH3) relay 406 connect the lamps to storage circuit No. 6.

There are only twenty-five relays in each of the Nos. 1 to 5 storage circuits to which the lamps are connected, but the No. 6 storage circuit contains twenty-eight relays requiring twenty-eight lamps.

14.02 Connection to line register keys on panel

On the panel circuit there are six keys which are used to operate these six groups of relays over leads "L1," "L2," "L3," "L4," "L5" and "L6." These keys are known as line register 1 key 4501, line register 2 key 4502, line register 3 key 4503, line register 4 key 4504, line register 5 key 4505 and line register 6 key 4506, but they do not always operate the same group of relays. The leads from these keys are routed via the relays of Figs. 29, 30, 37, 38 and 44, to the group of relays that represent the storage circuit used for the particular line. In other words, line register 1 key connects the lamps to the storage circuit that is storing line 1 of the particular call entry being processed, and likewise for the other keys. If there are less than six lines in the entry, only those keys are activated that are for the lines involved, the others being inactive.

14.03 Operation of the (LP) relay 1008

The (Reader lamps) key 2201 on the panel circuit when operated, will apply ground to "LP" lead 2202 causing relay (LP) to operate.

Relay (LP) operated:

1. Applies ground at its armature 2 and front contact to the "PCG" lead to Figs. 36 and 43 which will light a lamp in the panel circuit indicating which line in the entry or in the tape identity group is being processed.
2. Applies ground at its armature 3 and front contact to the "ELG" lead of the entry class register circuit, to light a lamp on the panel indicating what type of entry is being processed, and the lamp cap on that lamp indicates how many lines are in the entry.

3. Connects together the "ALC" and "PRG" leads to apply a ground supplied by the alarm circuit to the reader control circuit to cause certain lamps to light on the panel circuit which indicate the condition of the control circuit under an alarm condition for the purpose of locating trouble.
4. At its armature 5 and front contact applies ground to the "CCG" lead of the printer character sequence circuit which will light two (Character in PTR line) lamps on the panel to indicate which character in the printed line is under process.
5. Connects at its armature 6 and front contact the "RLCG" lead to show by lighting the (CHAR CT NO RLS) lamp that the printer character sequence circuit is attempting to release, but has not done so.
6. Connects at its armature 7 and front contact lead "RLLG" to show by the lighting of the (Line count NO RLS) lamp that the printer line count circuit is attempting to release, but has not done so.
7. Connects at its armature 1 and front contact a ground to the "ME" lead to light the (Missing line) lamp 2510 if the (BST) relay 2500 is operated.

The over-all function of this relay is to keep the lamps on the panel circuit, that are not required to light in the normal operation of the circuit, dark, until such time as their illumination becomes necessary.

15. Panel circuit

15.01 General

This panel circuit shows all the rotary switches, lamps and keys, with the exception of the main power switch, that are required for the operation of the printer circuit.

15.02 Rotary switches

1. Tape type switch 500

This is a two-section switch. Section 1, 501, is used by the tape identity circuit to check the tens digit of the tape index. Section 2, 502, is used to operate certain relays in the tape class connector circuit, Figs. 6 and 13, to indicate the basic type of tape being processed.

These basic types are as follows:

1. Summary	Tens digit 1
2. Toll	Tens digit 2
3. Message unit detail	Tens digit 3
4. Observing	Tens digit 4
5. Straddle	Tens digit 6
6. Verbatim	No tape index

2. Previous sort switch 506

This is a two-section switch. Section 1, 507, is used by the tape identity circuit to check the units digit of the tape index. Section 2, 508, is used to operate certain relays in the tape class connector circuit to determine what type of thousands check is to be made by the tape identity circuit.

The types of sorts are as follows:

1. Unsorted	Units digit 0
2. Sorted by office	Units digit 1
3. First sort by thousands	Units digit 2
4. Sorted by units	Units digit 3
5. Sorted by tens	Units digit 4
6. Sorted by hundreds	Units digit 5
7. Last sort by thousands	Units digit 6
8. Message unit summary	Units digit 7

The summary is on the off position of the switch, so that in setting up for summary tapes the sort switch must be in its off position.

3. Marker group tens switch 504

This is a three-section switch. Section 1, 509, is used by the tape identity circuit to check the marker group tens digit. Section 2, 510, operates an appropriate relay in the calling office translator circuit, Fig. 28. Ssection 3, 511, provides paths for printing the marker group tens numeral.

4. Marker group units switch 505

This is a three-section switch. Section 1, 512, is used by the tape identity circuit to check the marker group units digit. Section 2, 513, operates appropriate relays in the calling office translator circuit. Section 3, 514, provides paths for printing the marker group units numeral.

5. Central office switch 1202

This is a four-section switch. Section 1, 1203, is used by the tape identity circuit to check the office numeral. Sectiton 2, 1204, section 3, 1205, and section 4, 1206, provide paths for printing the calling office name via the relays of the calling office translator circuit leads "1," "2" and "3" being grounded in sequence by the printer character sequence circuit, Figs. 34 and 42. This switch is used for printing the calling office name only in the case of summary tapes.

6. First thousands switch 1200

This is a three-section switch. Section 1, 1207, is used in conjunction with section 1 of the last thousands switch, by the tape digit register circuit, to check the sequence of the sections of the tape, where a number of sections are spliced together to form one tape. Section 2, 1208, provides a means for checking the first thousand, where only a first and last thousands check is made. Section 3, 1209, provides a circuit when normal, in conjunction with the last thousands switch to operate a relay in the tape class connector circuit which determines whether the tape identity circuit shall check the first and last thousands, or check 90 in the E and F digits of the 2896 entry of the tape identity group.

7. Last thousands switch 1201

This is a three-section switch. Section 1, 1210, is used in conjunction with section 1, 1207, of the first thousands switch, by the tape digit register circuit, to check the sequence of sections of the tape, where a series of sections have been spliced together to form one tape. Section 2, 1211, provides a means for checking the last thousand, where only a first and last thousands check is made. Section 3, 1212, provides a circuit when normal, in conjunction with the first thousands switch, to operate a relay in the tape class connector circuit which determines whether the tape identity circuit shall check the first and last thousands, or check 90 in the E and F digits of the 2896 entry of the tape identity group.

8. Round switch 2002

This is a three-section switch. Section 1, 2003, provides a means for the tape identity circuit to check the round number. Section 2, 2004, provides a means for printing the numeral representing the round. Section 3, 2005, provides on an optional basis for the sixth or tenth rounds to arrange the month translator circuit, Figs. 51 and 52, to change the month when 0 is present in the tens digit of the day in the time entry. This applies only to toll, message unit detail and observing slip printing.

9. Month tens switch 2000

This is a two-section switch. Section 1, 2006, provides a means for the tape identity circuit to check the tens digit of the month. Section 2, 2007, provides a means for operating the month tens relay in the month translator circuit.

10. Month units switch 2001

This is a two-section switch. Section 1, 2008, provides a means for the tape identity circuit to check the units digit of the month. Section 2, 2009, provides a means for operating the month units relays in the month translator circuit.

15.03 Lamps

1. Reader or register lamps

The twenty-eight lamps A(0 to 2), B(0, 1, 2, 4, 7), C(0, 1, 2, 4, 7), D(0, 1, 2, 4, 7), E(0, 1, 2, 4, 7) and F(0, 1, 2, 4, 7) are connected to relays in Figs. 1, 2, 3 and 4 and via these relays may be connected to eight different places in the circuit to show the information stored therein. These eight places are:

1. Reader pin contacts
2. Reading relays
3. Storage circuit No. 1
4. Storage circuit No. 2
5. Storage circuit No. 3
6. Storage circuit No. 4
7. Storage circuit No. 5
8. Storage circuit No. 6

The A group of lamps is used only in cases 1, 2 and 8.

2. Line of entry lamps, Figs. 36 and 43

The line of entry lamps show the position of the reader line count circuit and in consequence show what line, of either a call entry or a tape identity group is being processed. There is a maximum of six lines in the largest call entry, and nine in the tape identity group.

3. Tape section lamps, Fig. 21

These lamps are connected to the tape digit register circuit to show what section of tape is being processed, when a series of sections is involved.

4. Last thousand lamp 2202

The (Last thou.) lamp 2202 shows when the last section of a tape in a series is being processed and lights directly without the operation of the (Reader lamps) key.

5. First thousand in error lamp 2204

The (First thou. in error) lamp 2204 indicates that the first thousand switch setting does not correspond with the number of the first section in a series of sections of a tape.

6. Last thousand in error lamp 12727

The (Last thou. in error) lamp 12727 indicates that the last thousand switch setting does not agree with the number of the last section in a series of sections of a tape.

7. End of tape lamp 12728

This lamp indicates that the tape has run out from under the pins of the reader. This lamp lights directly from the alarm circuit without the operation of the (Reader lamps) key.

8. Character in printer line lamps

These seventeen lamps in Figs. 34, 35 and 42 show the progress of the printer character sequence circuit and at all times when the (Reader lamps) key is operated, indicates the number of the element in the line or title that it is desired to print. The total elements in a line is two more than the actual characters printed in the line. The maximum number of elements is sixty-one which is attained in a straddle initial detail call when printing multiple area.

The number indicated by these lamps is read by adding the lighted digit lamps, (C1) to (C10) to the lighted tens lamps (G0) to (G50), there always being two lamps lit. In any line count that exceeds ten the (C11) lamp will flash momentarily when a transition from one group of ten to the next group of ten takes place. In the case of count sixty-one, however, it will light steady to be added to the (G50) lamp.

The number of elements in a printed line depends on the entry and the type of tape being processed. The number of elements in the title and lines of the various tapes and entries is given below.

Summary:	
Title	15
Local entry	11
Local and extended	16
Toll:	
Title	14
Entry, single area	23
Entry, multiple area	26
Message unit detail:	
Title	21
Entry, single area	28
Entry, multiple area	31
Observing:	
Title	23
Entry, single area	28
Entry, multiple area	31
Non-answered, single	20
Non-answered, multiple	23
Straddle:	
Title	14
Initial detail, single	58
Initial detail, multiple	61
Initial message unit	48
Answer and disconnect	48
Timing entry	48
Verbatim:	
Title	5
Entry	8

10. Entries lamps, Fig. 45

The nine (Entries) lamps show which type of entry is being processed, and the numeral on the lamp cap shows the number of lines in the entry.

11. Line no check in reader lamp 2607

The (Line NO CK IN RDR) lamp 2607 indicates that a line has failed to check in the reader relays, but indicates no knowledge of the particular type of line that it is.

12. Tape identity no check in reader lamp 2610

The (TI NO CK IN RDR) lamp 2610 indicates that an entry of the (Tape identity) group is being processed but that it has failed to check in the reader relays. No knowledge as to whether it is a first line or subsequent line is given.

13. Tape identity check lamp 2611

The (Tape ident.) lamp 2611 indicates that a tape identity line is being processed, but that it has failed to check in the tape identity circuit. No knowledge as to whether it is a first line or a subsequent line is given by this lamp.

14. Entry first line no check in reader lamp 1706

The (ENT 1ST line NO CK IN RDR) (EL) lamp

1706 indicates that the first line of an entry has failed to check in the reader relays.

15. Entry supplementary line no check in reader lamp 1707

The (ENT SUPP line NO CK IN RDR) (ESL) lamp 1707 indicates that a supplementary line of an entry does not check in the reader relays.

16. Storage no check lamp 2612

The (Storage NO CK) (ELS) lamp 2612 indicates that the line being processed has failed to check into the storage circuit.

17. Missing line lamp 2510

This lamp indicates that there is a line or more missing from an entry.

18. Extra line lamp 2511

This lamp indicates that there are more lines in the entry than required.

19. Reader step failed lamp 1819

The (RDR step failed) (RSTP) lamp 1819 indicates that the drum of the reader has failed to advance.

20. No check-down lamp 2512

This lamp indicates that the (R2) relay 1104 in the reader control circuit has failed to release because some operated relay in the system which should have released has not done so.

21. Fails to print lamp 2513

This lamp indicates that a circuit fault has prevented printing, although all units have properly checked.

22. Master off-normal lamp 12712

This lamp is connected directly between battery and ground for the purpose of indicating when 48-volt potential is applied to the circuit. If the (Master release) key 1800 is operated (as indicated) this lamp will not be lighted.

23. Off-normal lamp 1003

The (Off-normal) lamp 1003 lights from ground on the contacts of the (ST) relay 1000 to indicate that that relay is operated, and that the circuit is in the processing condition.

24. General alarm lamp 12730

The (General alarm) lamp 12730 lights whenever the time-out alarm functions due to circuit operation stopping because of wrong information in the tape, a failure of the circuit, paper out, or tape out alarm. In general, when the (General alarm) lamp lights, the attendant operates the (Reader step) key to determine the location of the difficulty.

25. Common alarm lamp 12731

This is a large bull's eye lamp that lights from the alarm circuit as an auxiliary signal whenever an alarm condition exists.

26. Character count no release lamp 1007

The (CHAR CT NO RLS) lamp 1007 indicates that the printer character sequence circuit is attempting to release but has not done so.

27. Line count no release lamp 1009

The (Line CT NO RLS) lamp 1009 indicates that the printer line count circuit is attempting to release but has failed to do so.

28. Cutter no release lamp 5609

The (Cutter NO RLS) lamp 5608 indicates that either the cutter knife or the stuffer of the printer has failed to return to normal. This lamp is lit directly without the operation of the progress lamps key.

15.04 Keys

1. Line stop key 1115

This is a locking twist key, which is first operated if it is desired to step the reader forward line by line by means of the (Line step) key 1116. This key when operated connects together the "CKD" and "LS1" leads to ground the "CKD" lead and put the release of the (R2) relay 1104 under the control of the (Line step) key 1116 and disables the alarm lead.

2. Printer stop key 12103

This is a locking twist key, which operates the (PS) relay 12104 in the printer code translator circuit to stop the printing and to disable the alarm circuit, so that the printer may be stepped character by character by means of the (Printer step) key 12103.

3. Line step key 1116

This in a non-locking push-button key which operates the (LS2) relay 1113 in the reader control circuit, to permit the reader to be stepped along one line at a time. One step of the reader takes place for each operation of the key.

4. Printer step key 12103

This is a non-locking push-button key which connects together the "A" and "B" leads to energize the distributor magnet and grounds the "LK" lead to provide a lock for (PA6) relay 12105 so that only one character at a time can be printed.

5. Line register 1 key 4501

This is a non-locking push-button key the lead from which, when guided by a relay in the entry class register circuit, operates relays in the lamp connector circuit to connect the (Reader or register) lamps to the storage circuit associated with line 1 of the entry involved.

6. Line register 2 key 4502

This is a non-locking push-button key the lead from which, when guided by a relay in the entry class register circuit, operates relays in the lamp connector circuit to connect the (Reader or register) lamps to the storage circuit associated with line 2 of the entry involved.

7. Line register 3 key 4503

This is a non-locking push-button key the lead from which, when guided by a relay in the entry class register circuit, operates relays in the lamp connector circuit to connect the (Reader or register) lamps to the storage circuit associated with line 3 of the entry involved.

8. Line register 4 key 4504

This is a non-locking push-button key the lead from which, when guided by a relay in the entry class register circuit, operates relays in the lamp connector circuit to connect the (Reader or register) lamps to the storage circuit associated with line 4 of the entry involved.

9. Line register 5 key 4506

This is a non-locking push-button key the lead from which, when guided by a relay in the entry class register circuit, operates relays in the lamp connector circuit to connect the (Reader or register) lamps to the storage circuit associated with line 5 of the entry involved.

10. Line register 6 key 4507

This is a non-locking push-button key the lead from which, when guided by a relay in the entry class register circuit, operates relays in the lamp connector circuit to connect the (Reader or reg-

ister) lamps to the storage circuit associated with line 6 of the entry involved.

These six keys, and the (Reader lamps) key 2201 and the (Reader reg. lamps) key 2208 are connected in series so that only one is effective at a time.

11. Tape identity skip key

The (Tape ident.) key 1114 is a non-locking push-button key which operates the (TP) relay 2604 to release the (TIP) relay 2602 and (CKT) relay 1702 and also to operate the (RMS) relay 1805 to start the reader motor if it is stopped. This key is operated if there has been trouble in the tape identity check, which caused the operation of the (TIP) relay 2602, and thus prevented the progress of the tape into the call entries. This key is made less accessible than the other keys and must not be operated unless it has been determined that the tape identity is correct even though it has not been checked in the regular manner.

12. Alarm cut-off key

The non-locking (Alarm cut-off) key 12725 operates the (ALCO) relay 12726 which locks operated and cuts off the external audible alarm 12732 and machine pilot lamp 12733. This key may also be used to simulate an alarm condition when desired.

13. Motor start key 1803

This non-locking key grounds the "RMS" and "PMS" leads to start the reader, printer and distributor motors. It is not effective during an alarm condition as it receives ground on lead "MS" from the alarm circuit.

14. Emergency printer start key

The non-locking (Emerg. PTR start) key 12734 grounds lead "EPS" to the printer code translator circuit which will operate (PA9) relay 12106 in that circuit to cause the printer to print a (Star) and step it forward to continue with the rest of the printing of the line. It is effective only during an alarm condition at which time ground is received from armature 2 and front contact of (CALM) relay 12714 of the alarm circuit.

15. Emergency motor stop key

The non-locking (Emerg. motor stop) key 1808 opens the locking circuit of the (RMS) relay 1805 to cause the reader motor to stop.

16. Reader step key

The non-locking (Reader step) key 2607 has two functions; one to step the reader a line at a time when desired in feeding the tape into the reader before processing starts, and the other, to restart the processing of the tape after the reader has stopped due to a failure of the circuit for some cause.

The operation of the key will close leads "S1" and "EM1" and will connect ground received on lead "ALA" from the alarm circuit to the "EM" lead to operate the (EM) relay 2608. Due to the operation of the (EM) relay the reader control circuit will cause the reader to take another step. At a certain stage in this next stepping cycle the circuit closed through the "S1" and "EM1" leads will operate the (EM1) relay 2600 for the purpose of releasing relay (EM) to permit the processing to continue without interruption.

17. Machine release key 1818

This non-locking key will operate the (RLS) relay 1700 over the "RLS" lead. This key and its accompanying relay stops all the motors of the circuit and releases the (ST) relay 1800, when the entry that is being processed at the moment is complete. The circuit in all other respects remains unchanged, so that processing may be resumed at any later time beginning with the next entry. Processing is resumed by operating the (Motor start) key 1803 and (Machine start) key 1815.

18. Machine start key 1815

This non-locking key operates the (ST) relay 1800 over lead "ST" to start the processing of the tape. This key is only effective if the (Motor start) key 1803 has been previously operated.

19. Toll slip cutter key 1307

This non-locking key provides a means for feeding out and cutting slips in the printer unit. This key is only effective when the type of tape calls for slips, and when the circuit is not in the processing condition. This key when operated, grounds lead "TKK" which operates (TK2) relay 5602. One slip will be cut for each depression of the key.

20. Tape section release key 2205

This non-locking key connects ground received on the "ALA" lead 12723 to the "RM" lead to operate (SR) relay 2606 in the tape digit register circuit to release the selector. This key is used when it is desired to restore the selector of the tape digit register circuit under trouble conditions. This key is effective under alarm conditions or when processing is not taking place.

21. Tape section reset key 2207

This non-locking key when operated applies ground received from the "ALA" lead to the "TS" lead which operates the rotary magnet 2100 of the selector. Ground is available on the "ALA" lead under alarm conditions or when the circuit is not processing. This key is used to step the selector to a new position after it has been released by operation of the (Tape release) key 2205 or before the operation of that key.

22. Master release key 1808

The (Master release) key 1808 is a locking key, which when normal operates the (DCP) relay 12713 if the main power switch 12703 is in the (on) position, to keep 48-volt power on the circuit. When the (Master release) key is operated the (DCP) relay will release removing all 48-volt potential from the circuit which will cause all relays to release. This key must be operated after each tape is processed and should remain operated when the circuit is idle.

23. Reader register lamps key 2208

The non-locking (RDR reg. lamps) key 2208 grounds lead "RDR" to connect the reader relays to the (Reader or register) lamps.

24. Reader lamps key 2201.

This non-locking key, when operated during an alarm condition, grounds lead "RRCO" operating the (RRCO) relay 2101 which cuts off the decoding leads of the E digit of the reading relays and connects the (Tape section) lamps to the selector so that the position of the selector can be noted. The operation of this key will also ground "LP" lead 2202 to the lamp connector circuit which will operate the (LP) relay in that circuit to display any trouble lamps for which circuits have been prepared by the progress conditions of the circuit at the moment of trouble.

This key also grounds lead "RD" to Fig. 1 to connect the twenty-eight reader pin contacts to the code indicator lamps.

25. Emergency reset key 1021

This is a non-locking key that will operate the (TP) relay 2004 and the (TB) relay 2209 over lead "PFR" in the event that the selector is off-normal. These relays are normally locked operated during the processing of the tape. If their fuses should be blown it is necessary to operate this key to proceed. It is also necesary to operate this key in case a master release has taken place when processing a series of sections of tape.

16. Tape identity circuit

16.01 General

As has been previously stated there is a tape identity group of nine entries at the beginning and the ending of a tape or of a section of a tape. This tape identity group may appear in other places in the tape but not usually. Certain of the information that is contained in these tape identity entries is variable from tape to tape, while other information is constant. The variable information is set up on switches of the panel circuit and the tape must agree exactly with the information set up on these switches.

In order to make this check this tape identity circuit is provided, there being one relay for each entry of the tape identity group with the exception of the eighth line, which has two relays.

When the reading relay translator circuit recognizes the 289 of the first line of the tape identity group, the reader control circuit will cause the reader line count connector circuit to connect the reader line count circuit to this tape identity circuit. The (TCC) relay 700 is operated by the (CKT) relay 1702 and is operated by the recognition of the 289 by the reading relay translator circuit.

The No. 1 count of the reader line count circuit operates (LN1) relay 701 of this circuit over "C1" lead 3603 and the count cannot progress until a full check of the first entry of the tape identity group has been made, which will operate the (TCK) relay 2605. The registering of the check in the reader control circuit has been described in section 7.

At the same time that (LN1) relay 701 is operated, the 2891 entry of the tape identity group will be present in the reader. Line 1 contains 2891 in the A, B, C and D digits, and the tape index in the E and F digits. The tape index expected is set up by the tape type and previous sort switches. These A, B, C, D, E and F digits are checked in the following manner:

16.02 Entry 2891

A. The armature 1 and front contact of relay (LN1) are connected to lead "NA2" of the reading relay circuit. If the "NA2" lead is grounded, (ACK) relay 1400 will operate.

B. The armature 2 and front contact are connected to lead "NB8" of the reading relay circuit. If the "NB8" lead is grounded, (BCK) relay 1401 will operate.

C. The armature 3 and front contact are connected to lead "NC9" of the reading relay circuit. If this "NC9" lead is grounded, (CCK) relay 1402 will operate.

D. The armature 4 and front contact are connected to lead "ND1" of the reading relay circuit. If this "ND1" lead is grounded, (DCK) relay 1403 will operate.

E. The armature 5 and front contact are connected to the common of the No. 1 section 501 of the tape type switch and through this switch to the "NE" leads of the reading relay circuit.

This tape type switch determines the tens unit of the tape index, and if the lead of the reader relay circuit that is grounded agrees with the position of the switch, (ECK) relay 1404 will operate.

F. The armature 6 and front contact are connected to the common of the No. 1 section 601 of the previous sort switch. The previous sort switch determines the unit digit of the tape index. Through this switch these contacts are connected to the "NF" leads of the reading relay circuit. If the lead of the "NF" group that is grounded agrees with the position of the previous sort switch 606, the (FCK) relay 1405 will operate.

When all the relays (ACK) to (FCK) are operated, ground is applied to the "TCK" lead to the reader control circuit, to operate the (TCK) relay, which causes the reader control circuit to advance the reader, and the reader line count circuit releases relay (LN1), and operates relay (LN2) in this circuit.

16.03 Entry 2892

The 2892 entry of the tape identity group contains the digits 2892 and the marker group number.

The six sets of contacts of the (LN2) relay 702 are connected to leads as follows:

1. (NA2) of the reading relays.
2. (NB8) of the reading relays.
3. (NC9) of the reading relays.
4. (ND2) of the reading relays.
5. The number one section of the marker group tens switch, on the common, the contacts of which are connected to the "NE" leads of the reading relay circuit.
6. The number one section of the marker group units switch, on the common, the contacts of which are connected to the "NF" leads of the reading relay circuit.

If these six digits check, the (ACK) to (FCK) relays will again be operated and the (TCK) relay again energized, stepping to the third entry.

16.04 Entry 2893

Relay (L2N) is released and the (LN3) relay 703 operated.

Entry three contains the digits 2893, and the first recorder number. The printer circuit is not concerned with checking the first recorder number precisely, it is only concerned with seeing that a proper numeral is present in the E and F digits.

Each of the B to F groups of the reading relay circuit is equipped with a lead which is grounded when two and only two relays are operated in the group, and these leads "ECK" and "FCK" are used in the case of the (LN3) relay.

The six contacts of the (LN3) relay 703 are connected to leads as follows:

1. (NA2) of the reading relays.
2. (NB8) of the reading relays.
3. (NC9) of the reading relays.
4. (ND3) of the reading relays.
5. "ECK" lead of the E group of the reading relays.
6. "FCK" lead of the F group of the reading relays.

16.05 Entry 2894

Entry four contains the digits 2894 and the last recorder number. Again the circuit is not interested in checking the last recorder number precisely. The (LN3) relay is released and the (LN4) relay 704 operated.

The six contacts of the (LN4) relay 704 are connected to leads as follows:

1. (NA2) of the reading relays.
2. (NB8) of the reading relays.
3. (NC9) of the reading relays.
4. (ND4) of the reading relays.
5. "ECK" lead of the E group of the reading relays.
6. "FCK" lead of the F group of the reading relays.

16.06 Entry 2895

Relay (LN4) is released and the (LN5) relay 705 operated.

Entry five contains the digits 2895, the office numeral and 0.

The six sets of contacts are connected to leads as follows:

1. (NA2) of the reading relays.
2. (NB8) of the reading relays.
3. (NC9) of the reading relays.
4. (ND5) of the reading relays.
5. To the common of the No. 1 section 1203 of the central office switch the contacts of which are connected to the "NE" leads of the E group of the reader relays.
6. (NF0) of the reading relays.

16.07 Entry 2896

Relay (LN5) is released and (LN6) relay 706 operated.

Entry six of the tape identity group contains the digits 2896, and either the first and last thousands or the digits 90 in the E and F groups. Whether this circuit checks the first and last thousands or checks for 90 in these groups is governed by the setting of the switches as shown in section 7.03, as they affect the relays of the tape class connector circuit.

The six contacts of the (LN6) relay are connected to leads as follows:

1. (NA2) of the reader relays.
2. (NB8) of the reader relays.
3. (NC9) of the reader relays.
4. (ND6) of the reader relays.
5. Either connected to the common of the second section 1208 of the first thousands switch and thence to the "NE" leads of the E group of the reader relays, or to the "NE9" lead of the reading relays.
6. Either connected to the common of the second section 1211 of the last thousands switch and thence to the "NE" leads of the reading relays, or to the "NF0" lead of the reading relays.

16.08 Entry 2897

Relay (LN6) is released and (LN7) relay 1407 operated.

Entry seven contains the digits 2897 and the first and last day of the round or 00. The printer circuit does not require that these E and F digits be checked precisely, therefore, the overall check leads "ECK" and "FCK" of the reading relays are used.

The six contacts of the (LN7) relay are connected to leads as follows:

1. (NA2) of the reading relays.
2. (NB8) of the reading relays.
3. (NC9) of the reading relays.
4. (ND7) of the reading relays.
5. The "ECK" lead of the reading relays.
6. The "FCK" lead of the reading relays.

16.09 Entry 2898

Relay (LN7) is released and either (LN8A) relay 1406 or (LN8B) relay 1408 operated, depending upon the condition of the relays in the tape class connector circuit. The eighth entry contains the digits 2898, the section index and the round number.

If the tape being processed is a summary tape, or a first or second sort, of other types of tapes, there usually is a number of sections spliced together, and these sections must be checked for the sequence of their section indexes which are given in the E digit of the eighth entry. For this purpose the (LN8A) relay is operated in the manner described in section 20.

The six contacts of the (LN8A) relay are connected as follows:

1. The armature 4 and front contact to the "NA2" lead of the reading relays.
2. The armature 5 and front contact to the "NB8" lead of the reading relays.
3. The armature 6 and front contact to the "NC9" lead of the reading relays.
4. The armature 7 and front contact to the "ND8" lead of the reading relays.
5. The armature 10 and front contact connect together the "FTHA" and "FTHB" leads and the armature 11 and front contact connect together the "LTHA" and "LTHB" leads for the use of the tape digit register circuit, which is described in section 17. The (ECK) relay 1404 is operated after a proper check has been made of the section index number.
6. The armature 9 and front contact are connected to the common of section 1, 2003, of the round switch and thence to the "NF" leads of the reading relay circuit.

This (LN8A) relay 1406 also closes other leads to the tape digit register circuit, which are necessary for the operation of that circuit.

No other tapes use the progressive check of sections of tape end, therefore, the (LN8B) relay 1408 is used in the case of all other tapes.

The six contacts of the (LN8B) relay are connected to leads as follows:

1. (NA2) of the reading relays.
2. (NB8) of the reading relays.
3. (NC9) of the reading relays.
4. (ND8) of the reading relays.
5. The "ECK" lead of the E group of reading relays.
6. The common of section 1, 2003, of the round switch through which connection is made to the "NF" leads of the reading relays.

16.10 Entry 2899

The (LN8A) or (LN8B) relay is released and the (LN9) relay 1409 is operated. The ninth entry contains the digits 2899 and the month.

The six contacts of the (LN9) relay are connected to leads as follows:

1. (NA2) of the reading relays.
2. (NB8) of the reading relays.
3. (NC9) of the reading relays.
4. (ND8) of the reading relays.
5. Section No. 1, 2006, of the months tens switch and thence to the "NE" leads of the reading relays.
6. Section No. 1, 2008, of the months units switch and thence to the "NF" lead of the reading relays.

17. Tape digit register circuit, Figs. 21 and 22

17.01 Operation of the circuit

This circuit provides the means for checking

the sequence of the sections of a tape, when a number of sections are spliced together to form one tape. In other words, it checks the sequence of the numerals in the E digit of the eighth entry, in the tape identity groups.

The tape class connector circuit, Figs. 6 and 13, from the setting of the switches in Figs. 5, 12 and 20, arranges the circuit so that (LN8A) relay 1406 is operated in the tape identity circuit.

The first and last thousand switches on the panel circuit are set to indicate the first and last digits that are to be expected in the E digit of the 2898 entry, in the series of sections that are being processed.

When this entry is read by the reader, and we will now assume that this is the first tape identity group that is encountered, there is set up in the reader relays in the E group, the numeral corresponding to the number of the first section of the tape.

(LN8A) relay 1406 operated:

1. Connects the (K7) break contact of the reader, at its armature 1 and front contact to the (FTH) relay 2210 via the armature 5 and back contact of the (TB) relay 2209, and the armature 2 and back contact of the (SR) relay 2206. This reader contact is out of phase with the reader contacts.
2. Connects at its armature 4 and front contact the "NA2" lead of the reading relays to the (ACK) relay 1400.
3. Connects at its armature 5 and front contact the "NB8" lead of the reading relays to the (BCK) relay 1401.
4. Connects at its armature 6 and front contact the "NC9" lead of the reading relays to the (CCK) relay 1402.
5. Connects at its armature 7 and front contact the "ND8" lead of the reading relays to the (DCK) relay 1403.
6. Connects at its armature 9 and front contact the common of section 1 of the round switch to (FCK) relay 1405.
7. Connects at its armature 2 and front contact the (NCK) relay 2211 to the switch arm 2102.
8. Connects at its armature 3 and front contact the step magnet 2200 to the switch arm 2103.
9. Connects at its armature 8 and front contact the "LTHE" lead 12735 to the "LTHE" lead 1410 via the armature 1 and back contact of the (ECK) relay 1404.
10. Connects at its armature 10 and front contact the "FTHA" lead to the "FTHB" lead.
11. Connects at its armature 11 and front contact the "LTHA" lead to the "LTHB" lead.
12. Grounds at its armature 12 and front contact the "STLK" lead to provide a lock for the stepping relay.

The common point of section 1, 1207, of the first thousand switch is connected via the armature 1 and back contact of the (LPG) relay 2212 and via the armature 10 and front contact of relay (LN8A) to the armature 2 on the (NCK) relay 2211.

The common point of section 1, 1210, of the last thousand switch is connected via the armature 2 and back contact of the (LPG) relay and via the armature 11 and front contact of relay (LN8A) to armature 1 of the (NCK) relay.

When the stepping interval of the reader cycle is reached, ground will be applied by the (K7) reader contact which will operate (FTH) relay 2210.

Relay (FTH) operated:

1. Locks at its armature 3 and front contact under the control of (SR) relay 2206 and (TE) relay 2213.
2. Connects the (K4) contact of the reader, at its armature 2 and front contact via the armature 3 and back contact of (TB) relay 2209 and the armature 1 and back contact of (SR) relay 2206 to the rotary magnet 2100 of the selector.
3. Partially closes a circuit at its armature 1 and front contact to operate relay (TB).

When the contact (K4) of the reader closes the selector will begin to step. Because ground is applied by the (E) group relays of the reading relays to the first thousand switch 1207 and the switch setting corresponds to the digit present in the reader relays, ground will be standing on the armature 2 of (NCK) relay 2211.

The (E) digit relays of the reader relay circuit are also connected to the two banks of the selector via the contacts of (RRCO) relay 2101, being wired 0 to 9 on bank 1 for arm 2102, while bank 2 for arm 2103 is wired one ahead eliminating the 0.

As the selector progresses over its points, bank 2 will first encounter the lead that is grounded at the reader relays. This ground via the arm 2103, the armature 4 and back contact of (LPG) relay 2212, the armature 3 and front contact of (LN8A) relay 1406 will operate (Step) relay 2200.

Relay (Step) operated:

1. Will lock at its armature 1 and front contact via the armature 3 and back contact of (NCK) relay 2211 to the armature 12 and front contact of (LN8A) relay 1406.
2. Extends the "ROT" lead 1812 for future operation of the rotary magnet 2100.

On the next step of the selector, arm 2102 will encounter the ground, which via the armature 3 and back contact of (LPG) relay 2212 and the armature 2 and front contact of the (LN8A) relay 1406 will operate (NCK) relay 2211.

Relay (NCK) operated:

1. Closes at its armature 2 and front contact the lead from the first thousand switch through to operate (TB) relay 2209.
2. Unlocks and releases (Step) relay 2200.
3. Opens the "ROT" lead 1812.
4. Partially closes the lead to the (ECK) relay 1404.
5. Connects the last thousand switch to (TE) relay 2213, but relay (TE) cannot operate at this time unless the tape has only one section. In this case, both the first and last thousand switches would be set on the same numeral.

(TB) relay 2209 operated:

1. Open the rotary magnet at its armature 3 and and back contact to stop stepping from the contact (K4) and connects it by its armature 2 and front contact to the "ROT" lead 1812 which is now open at relays (Step) and (NCK).
2. Opens the lead from contact (K7) to (FTH) relay 2210.
3. Operates (ECK) relay 1404, thus completing the check of the 2898 entry.
4. Grounds "LTH" lead 2214 at its armature 8 and front contact.
5. Opens the lead to "FTHE" lamp 2204.
6. Opens the circuit of the (RLS) release magnet

2104 so that when the tape eventually runs out and the (TB) relay 2209 releases, the selector will be restored to normal.

7. Locks itself operated by its secondary winding under the control of the (TE) relay 2213 and (SR) relay 2206.
8. Locks itself operated by its primary winding to ground on the (TPO) relay 1705 over the "TBL" lead 2215.

Relay (TB) is locked to two different places to insure that it will be released only after a tape has been completed and all the section indexes checked.

The operation of the (ECK) relay 1404 completes the check of the first section number, and if the other digits of the eighth entry also check, the reader control circuit will progress and release (LN8A) relay 1406 and the (NCK) relay 2211.

Thus, when the first tape identity group is passed this circuit is left with selector bank 1 on the point representing the digit that has just been checked, and bank 2 on the next higher digit. The (TB) and (FTH) relays are operated. The condition of the circuit is now such that the selector can only be advanced by the operation of the (Step) relay 2200 as leads to the (K4) and (K7) contacts are now open.

Identical tape identity groups appear on the leading and trailing ends of a tape section. Similar groups may occur between the ends of a section although not usually. When a tape identity group similar to the previous one is encountered, this circuit merely checks the digit by operating the (NCK) relay 2211 via bank 1 of the selector. When a tape identity group is encountered having the next higher digit, the (step) relay 2200 operates via bank 2 connecting the ground to the rotor magnet causing the selector to step and operate (NCK) relay 2211 via bank 1 from the new digit, thus completing the check of the entry.

In this manner the series of sections of the tape are checked.

When the section containing the digit represented by the setting of the last thousand switch is reached, ground will be placed on the "LTH" lead and when the (NCK) relay 2211 operates, this ground will be applied over leads "LTHA" and "LTHB" to operate (TE) relay 2213.

Relay (TE) operated:

1. Locks to the off-normal contacts of the selector which are now closed.
2. Removes ground from the locking circuit of (FTH) relay 2210, which releases. At its armature 1 and front contact it lights the (Last thou.) (LTHL) lamp 2203.
3. Connects the "TPO" lead to the release magnet of the selector via contacts on (TB) relay 2209 which are open.
4. Opens the "LTH" lead 2214 to prevent lighting the (Last thou. in error) lamp 12727 when the alarm circuit times out due to the tape running out of the reader.
5. Prepares a circuit for the "LTHE" lead 12735 for the (Last thou. in error) lamp 12727.
6. Opens the circuit of the selector rotary magnet.

When the tape finally runs out of the reader, the (TPO) relay 1705 in the reader control circuit will operate removing ground from the "TBL" lead 2215 and applying ground to the "TPO" lead. The ground for the "TPO" lead is obtained from the off-normal contacts of the selector over "TP" lead 1708. (TB) relay 2209 losing its locking circuit releases and the circuit for the release magnet of the selector is completed causing the selector to restore to normal. (TE) relay 2213 releases when the selector restores to normal extinguishing the (Last thou.) lamp 2203.

17.02 Trouble conditions

1. Progress lamps

The tape section lamps, Fig. 21, are useful during difficulties for displaying the numerical position of the selector or the section index in the eighth entry of the tape identity group.

The position of the selector may be observed after a time-out alarm, by operating the (Reader lamps) key 2201 on the panel which will operate (RRCO) relay 2101 from ground derived at the alarm circuit over "ALC" lead 12722.

The (RRCO) relay operated:

1. Disconnects the selector bank from the reading relays.
2. Operates the (LPG) relay 2212.
3. Operates the (ELP) relay 2105.

Relay (ELP) connects the (Tape section) lamps to the banks of the selectors.

Relay (LPG) disconnects the selector bank from the circuit and applies ground to the arm 2102 of bank 1. The lamps then indicate the position of the selector.

Another function of the (Reader lamps) key 2201 when a time-out occurs is to activate the circuit that will light the (TI NO CK IN RDR) (TLS) lamp 2610 of the (Tape ident.) (TL) lamp 2611 by the operation of the (LP) relay 1008.

The section index is displayed on the (Tape section) lamps.

2. Non-check due to mutilation

If the numeral is mutilated in the tape, then naturally no check can be made and the circuit will time out. The manual check is made as described in the next paragraph and the next appearance of the tape identity group will pick up the count. However, if this mutilated numeral is the last appearance of this particular numeral, the next tape identity group will fail to check because the selector did not step. It will be necessary to step the selector one step by operating the (Tape section reset) key 2207 which grounds lead "TS." The position of the selector may be verified by operating the (Reader lamps) key 2201, and the tape numeral may be verified by observing the numeral in the E digit on the (Reader or register) lamps.

3. First thousand in error

The assumption is being made here that the position of the first thousand switch does not correspond with the E digit in the first tape identity group.

When the selector bank 2 steps up to the position indicated by the numeral in the E digit, (Step) relay 2200 will operate, and when bank 1 steps to the same point (NCK) relay 2211 will operate. However, as the switch does not agree with the number in the tape, there will be no ground on the "FTH" lead and (TB) relay 2213 cannot operate. Because this relay is not operated, ground will not be connected to the "ECK" lead. Therefore, the line will not check, and the time-out alarm will be given because the reader has not been permitted to step to the next line of perforations. Also the reader contact (K4)

will not be cut off from the selector at armature 3 and back contact of (TB) relay 2209 and the selector will, therefore, during the time-out interval, step up to the top of the selector bank and continue to pulse there until the time-out is complete. At the completion of the time-out, the reader motor will stop and the pulsing will cease.

When the (Reader lamps) key 2201 is operated, ground will be supplied from the control circuit to this circuit on lead "FTHE," and because relay (TB) is released, will light the (First thou. in error) lamp 2204 on the panel.

The procedure to take care of this situation is as follows: The (RDR REG lamps) key 2208 is operated to display the combination in the reader relays, and thus determine the reason for the lack of check. After determining what the numeral should be, the rest of the tape identity group is passed through manually by operating the (Reader step) key 2607. The operation of the (Reader step) key operates (EM) relay 2608 which when operated causes the operation of the (TIP) relay 2602 in that circuit, and releases the reader line count circuit. In addition to the manual stepping of the tape identity the first thousand switch should be set to the proper numeral, and the (Tape section release) key 2205 operated. This key when operated operates (SR) relay 2206.

Relay (SR) operated:

1. Opens the circuit of the rotary magnet 2100.
2. Releases (FTH) relay 2210.
3. Applies ground from the selector off-normal contacts to the selector release magnet 2104, releasing the selector.

Processing of the tape is again started by operating the (Tape ident.) key 1114 and the tape digit register circuit awaits another appearance of the tape identity group to cause the proper setting of the selector.

4. Last thousand in error—More tapes than indicated

When the numeral representing the last thousand is reached, (TE) relay 2213 will operate and lock. The selector cannot progress beyond this point, because relay (TE) opens the rotary magnet of the selector.

If there is another section of tape with a higher number than the indicated last number, the selector cannot progress, therefore, no check will be made, and a time-out will take place. When the (Reader lamps) key is operated the (Last thou. in error) lamp 12727 will light via the "LTHE" lead.

The correction for this trouble is as follows:

1. Manually verify the information in the tape to be certain of the number of the new section coming up.
2. Reset the last thousand switch 1201 to the number of the new section if only one additional section is expected or set to whatever the last number is that is expected in the tape.
3. Release the selector to its normal position by operating the (Tape section release) key 2205, this is to release the (TE) relay 2213.
4. Operate the (Reader lamp) key 2201 and step the selector by the (Tape section reset) key 2207, to the position of the new section of tape.

5. Last thousand in error—less tapes than indicated

In this case, the tape will run from under the reader pins before the numeral indicated by the last thousand switch is reached. Because the tape has run out the alarm circuit will be actuated, and because the (TE) relay 2213 has not been operated the (Last thou. in error) lamp 12727 will be lighted, when the (Reader lamp) key 2201 is operated. The lighting of this lamp in addition to the (End of tape) lamp 12728 indicates that fewer sections are present than were anticipated in the setting of the last thousand switch.

Such a condition should be noted and checked, and if there are additional sections that should have been spliced to the other sections, they may now be processed in a new run by operating first the (Machine release) key 1818 and (Master release) key 1800 and proceeding as for a new tape, with the first and last thousand switches set for the new sections.

6. Missing section in middle of tape

In this case, the eighth entry of the tape identity group will fail to check. The circuit will time out and the operation of the (Reader lamp) key 2201 will cause the lighting of the (Tape ident.) lamp 2611 and the lighting of the (Tape section) lamp of Fig. 21 indicating the position of the selector. The new number will be indicated in the E digit of the (Reader or register) lamps by operating the (RDR REG lamps) key 2208.

The selector may be stepped to the position of the new section number by operating the (Tape section reset) key 2207.

In all cases when the tape identity fails to check for any reason, the balance of the tape identity group should be stepped through manually, and the act of stepping it forward manually causes the operation of the (TIP) relay 2602. The (Tape ident.) key 1114 must be operated before call entries can be processed. When the next tape identity appears the circuit will check, and the selector will be advanced by the normal operation of the circuit.

7. Blown fuse

Whenever a fuse is blown in the printer circuit, it should be routine practice to operate the (Emerg. reset) key 1821 which will operate certain relays as an assurance that if these relays were operated previously they will again be in the operated condition. One of these relays is the (TB) relay 2209 of this circuit. Ground applied by the (Emerg. reset) key 1821 to the "PFR" lead will operate the (TB) relay 2209 via the off-normal contacts of the selector.

18. Reader line count circuit

18.01 Operation of the circuit

This is the count circuit that operates the various connector relays for the tape identity check or in the storage circuits for the call entries. For the tape identity check it operates the relays of Figs. 7 and 14 in the proper sequence, and for the call entries it operates the connecting relays of the various storage circuits as required for the particular entry.

Leads "C1" to "C9" are the leads over which either the relays of Figs. 7 and 14 are operated to which they are connected by (TCC) relay 700 or the connector relays of the storage circuits to which they are connected by the relays of the entry relay circuit, Figs. 29, 30, 37, 38 and 44. Lead "C1" always obtains its ground from (SPA) relay 3600, but leads "C2" to "C6" must obtain their grounds over lead "CG" from the reader control circuit. When processing the tape iden-

tity this ground is obtained from (CKT) relay 1702, but when processing call entries this ground is obtained from the (SLN) relay 1701 which is operated from the 0 in the A digit of the reader relays. This means that when processing call entries, only supplementary lines can be transferred to the storage circuits associated with relays (CTB) and (CTF) of Figs. 36 and 43 because they contain a 0 in the A digit, and no first lines can be placed in these storage circuits because they do not operate the (SLN) relay 1701.

Leads "EC1" to "EC8" and "EC9" are the end of count leads which, if grounded by either the (TCC) relay 700 or the various relays of the entry relay circuit will cause the operation of (EC) relay 2506 to indicate the end of the count required for the particular entry that is being processed.

Leads "CK1" to "CK6" are the check leads from the storage circuits which indicate that the storage circuit has been satisfied, when they are grounded, and are routed to the "SCK" lead 4300 to operate the (SCK) relay 2606 in the control circuit.

Leads "CTA" to "CTJ" are the lamp leads for lighting the line of entry lamps in Figs. 36 and 43 if ground is applied to the "PCG" lead by armature 2 of (LP) relay 1008.

To operate this circuit, ground is applied to "CT" lead 2508 from armature 1 of (AUX) relay 2501.

This action operates (CTA) relay 3601.

Relay (CTA) operated:

1. Locks via all the other relays (CTB) to (CTJ) released, to ground from armature 1 of (AUX) relay 2501 over lead "LK."
2. Applies ground to the "CKD" lead which indicates to the control circuit that a relay is operated in the reader line count circuit.
3. Connects the "CK1" lead 2903 to the "SCK" lead 4300.
4. Connects the "C1" lead 3603 to ground on (SPA) relay 3600.
5. Connects the "EC1" lead 2901 to the "EC" lead 3602.
6. Connects the winding of (SPA) relay 3600 to the "SP" lead via relays (CTB) to (CTJ).
7. Connects the (CTA) lamp 3604 to lead "PCG" to the (LP) relay 1008.

(TCC) relay 700 or a storage circuit relay will operate depending on where lead "C1" is routed. If it is connected to a storage circuit, ground will be returned via lead "CK1" to operate (SCK) relay 2606 which indicates that the storage circuit is satisfied and will cause the control circuit to apply ground to lead "SP." If the circuit is connected to (TCC) relay 700, leads "CK1" and "SCK" are not used and a direct check circuit to the control circuit will ground the "SP" lead.

Ground placed on lead "SP" will operate (SPA) relay 3600 via the (CTB) to (CTJ) relays.

Relay (SPA) operated:

1. Locks to the control circuit over lead "LK" and the (SPB) to (SPJ) relays.
2. Removes ground from "C1" lead 3603 releasing any relay that may be connected to lead "C1."
3. Connects the winding of (CTB) relay 3605 to lead "CT."
4. Further grounds lead "CKD" to the control circuit.

Ground again applied to lead "CT" now operates relay (CTB), which governs the same types of leads as relay (CTA), but also releases relay (CTA) and establishes a circuit for (SPB) relay 3606 from lead "SP."

Ground now placed on lead "SP" operates relay (SPB) which acts in the same manner as relay (SPA) but releases relay (SPA). So the count will progress with only two relays locked up at any time.

Nine counts are used for the tape identity in Figs. 7 and 14 while entries which use the storage circuits may have counts of from one to six.

When an "EC" lead is encountered, that is grounded, the (EC) relay 2506 operates, preparing the control circuit for the end of the entry being processed.

The (AUX) relay 2501 is released when the entry is complete which removes the locking ground from this circuit, and when all the relays in this circuit are released ground is removed from the "CKD" lead thus removing its hold on relay (R2). This "CKD" lead is only effective during the time that the (EC) relay is operated, and the (EC) relay will stay operated until all parts of the "CKD" lead in the control circuit are clear including this circuit.

Operating the (Reader lamps) key 2201 on the panel will cause the grounding of lead "PCG" and a lamp in the (Line of entry) lamps will light indicating which line of the entry is being processed.

19. Alarm circuit

19.01 General

This circuit contains the relays and the timing circuit for actuating an external alarm and lighting appropriate lamps for indicating certain troubles, and the time-out condition when the circuit fails to progress.

19.02 Tape out of reader

When the tape runs out from under the reader pins, ground is applied to the "TPO" lead 900 to operate (TPOA) relay 12721 in this circuit.

Relay (TPOA) operated:

1. Provides a circuit for lighting the (Last thou. in error) lamp 12727 over lead "LTHE" if the condition of the tape identification circuit calls for the lighting of this lamp.
2. Lights the (End of tape) (TPO) lamp 12728.
3. Operates the (CALM) relay 12714.

19.03 Time out

Whenever (R2) relay 1104 is operated (TOA) relay 12720 of this circuit also operates.

Relay (TOA) operated applies 48-volt minus potential to the cathode of the (TMO) tube 12709.

This tube (TMO) with its accompanying resistances and condensers form a timing element which begins to time as soon as relay (TOA) is operated.

This timing circuit consists of a condenser-resistance network connected to a triode, in which the plate draws sufficient current to operate a relay after a time interval of approximately the product of the capacity in microfarads and the resistance in megohms. The other triode is used as a diode to permit a fast recovery after the timing interval, without using another contact on the starting relay.

In the circuit the cathode is connected to a potentiometer consisting of (CP) resistance 12707 and (CP1) resistance 12736, producing a potential of approximately 100 volts, which is applied to (TM) condenser 12710 and (TM1) condenser 12711.

When relay (TOA) operates the potential of

the cathodes goes to minus 48 volts and the grid momentarily changes from ground potential to minus 148 volts. Resistance (TM) tends to reverse the charge on the condensers from plus 100 volts to minus 48 volts. When the potential of the grid approaches that of the cathode very closely, sufficient plate current will flow to operate (TMOA) relay 12716. If relay (TOA) remains operated the current in the plate will be limited by the resistance in the plate circuit and by the characteristic of the grid.

Assuming relay (TOA) released as shown, the potential of the cathode returns to plus 100 volts instantly and the potential of the grid reaches approximately this voltage.

When the potential of grid 4 and plate 5 is positive with respect to cathode 6 these elements will act as a diode and will charge the condensers very rapidly since its effective resistance is low and resistance (TM) will have very little effect on this time.

The net effect of this circuit is that after a time governed by the product of resistance (TM) and the capacity of the (TM) condenser 12710 and (TM1) condenser 12711, which in this case is about 8 seconds, (TMOA) relay 12716 will operate.

Relay (TMOA) operated:

1. Opens the locking circuit of the (RMS) relay 1805 which causes that relay to release and stop the reader motor.
2. Operates (CALM) relay 12714.
3. Provides a ground which can be used to light the (Cutter NO RLS) lamp 5608 on the panel and also light the (General alarm) (GCA) lamp 12730.

19.04 Common alarm

It will be noted that all relays in this circuit operate (CALM) relay 12714.

Relay (CALM) operated:

1. At its armature 2 and front contact provides ground on the "ALB" lead to the emergency printer start key 12734.
2. At its armature 1 and front contact provides ground on the "ALC" lead to the panel circuit and the printer character sequence circuit.
3. At its armature 3 and front contact provides ground via contacts on the (ALCO) relay to light the machine pilot lamp 12733.
4. At its armature 4 and back contact provides ground via contacts on the (ALCO) relay to sound the audible external alarm 12732.
5. At its armature 5 and back contact removes ground from the "MS" lead and applies ground to the "ALA" lead 12723.
6. At its armature 6 contacts it lights the alarm lamp 12731, a red bull's eye lamp located on the panel.

The operator upon observing an alarm will operate the (Alarm cut-off) key 12725 which operates (ALCO) relay 12726.

Relay (ALCO) operated:

1. Cuts off the external audible alarm and the machine pilot lamp.
2. Locks to the relay that has operated relay (CALM), or in other words locks to the alarm. Clearing the source of the alarm will release this relay.

By operating the (Alarm cut-off) key a simulated alarm condition can be produced, as both relays (ALCO) and (CALM) will operate. This function is useful in some cases for handling the circuit.

20. Tape class connector circuit, Figs. 6 and 13

20.01 General

This circuit is used to set up the various portions of the circuit to process particular types of tapes.

Each type of tape will be discussed in detail as to the set-up.

Two switches must be set to fully determine the type of tape to be processed, the tape type switch 500 and the previous sort switch 506.

20.02 Summary tape, index 17

The tape type switch will be set on point Mess unit.

The previous sort switch will be in the off position.

(MU) relay 600 in this circuit will be operated from ground on the "MU" lead 515.

Relay (MU) operated:

1. Connects the "T" lead 4910 to the "MU" lead to prepare a circuit for operating the (MUT) relay 4700 for the summary title.
2. Connects the "TA1" lead to the "TB" lead. This amounts to connecting together the armature 2 and back contact of (LCR) relay 4908 and the winding of (LK) relay 4912, thus holding relay (LK) always operated unless a new page is needed, which requires a new title.
3. Connects "20" lead 1904 and "21" lead 1905 of the reading relay translator circuit respectively to the M1 and M2 groups of relays in Fig. 30 to operate, when required, the entry relay corresponding to the entry being processed.
4. Connects the "CL40" lead of the printer line count circuit to the "LC" lead to prepare a circuit for indicating when forty lines have been printed on a page.
5. Operates (TC1) relay 603.
6. Connects the "L01" lead from armature 4 of (EL) relay 4907 to the "L02" lead to operate the (S1L) relay 8300 at the end of each line. The reason for this operation is explained in section 30.

A summary tape usually consists of more than one section, and it is necessary to set up the tape identity circuit and the tape digit register circuit to check the series of sections. The numeral representing the tape section is in the E digit of the eighth entry of the tape identity group, and 90 appears in the E and F digits of the sixth entry. (TC1) relay 603 operated prepares circuits for these checks as follows:

1. Connects the "C8" lead on armature 8 of (TCC) relay 700 to bring into action the (LN8A) relay 1406 which is associated with the tape digit register circuit.
2. Closes the "FTHE" leads, for the (First thou. in error) lamp 2204.
3. Opens the "S1" lead 516 from the previous sort switch to (TC4) relay 1308.
4. Connects the "ECK" lead 707 to the "NE9" lead of the reading relays and the "FCK" lead 708 to the "NF0" lead of the reading relays, so that the (LN6) relay 706 can check 90 in the E and F digits of the sixth entry of the tape identity group.

20.03 Toll tapes, indexes 20, 21, 22, 23, 24, 25 and 26

Toll tapes may have a number of sections spliced together requiring a progress check of the section numbers, they may have only one tape requiring a check of the first and last thousands in the sixth entry of the tape identity group, with-

out a series of sections check, or they may require a check of 90 in the sixth entry, without a series of sections check.

The tape type switch is set on the point Toll which sets up to check 2, as the tens digit of the tape index, and operates (DET) relay 1304 in this circuit.

The previous sort switch may be set in regard to this circuit in one of two places, to ground of either lead "S1" or "S2." Obviously, it must be set in the correct radial position to check the tape index units. This circuit, however, is only concerned with the grounding of either of the leads "S1" or "S2."

The (DET) relay 1304 operated:

1. Connects the "T" lead 4910 to the (RDT) relay 3204 to prepare a circuit for operating the proper title sequence for toll slips.
2. Connects the "1019" lead 2704 of the reading relay translator circuit to the D1 group of relays in Fig. 38 over lead "ET" as only one entry is used in this type of tape.
3. Connects the "L1" lead from (D1B) relay 3301 to (RD) relay 3302 to set up the proper line sequence for toll slips, as this entry may print different information depending on the type of tape being processed.
4. Operates (COM) relay 1305.

Relay (COM) operated:

1. Connects the "L02" lead from armature 6 of (ET) relay 4911 to the "L02" lead to operate the (S1L) relay 3300 at the end of each title. The reason for this operation is explained in section 30.
2. Connects ticket cut key 1307 to the "TKK" lead 1306 to activate the cutting mechanism.
3. Connects the "CL9" lead from (CL9) relay 5701 of the printer line count circuit to the "LC" lead to prepare a circuit to operate (LC) relay 5601 for indicating when nine lines have been printed on a slip.
4. Partially closes the operating lead of the (LRD) relay 1309 which would be operated if the round switch on the panel were on the last round, either the sixth or tenth depending upon whether the accounting office is arranged for six or ten rounds in the month.
5. Operates the relays of the called office name translator connector circuit, Fig. 55, over lead "A" to connect in the printer translator circuit.

If ground is present on "S2" lead 517 the (TC1) relay 603 is operated and the circuit is set up to check a series of sections of tapes in the manner previously described.

If ground is present on "S1" lead 516 the (TC1) relay 603 is released and ground is extended by the armature and back contact of (TC4) relay 1308. As shown in section 7.03, when a check of a series of sections of tape is not required, a check of either the first and last thousands which are set up on the first and last thousand switches, or a check of 90 in the E and F digits of the sixth tape identity entry is required. In the second case the first and last thousand switches are in the (off) position. If the first and last thousand switches are set to show the first and last thousand numbers, that is, they are away from the (off) position, no ground will be present on the "E" lead and in consequence (TC4) relay 1308 will be released. In this case, ground on lead "S1" will operate (TC2) relay 604.

Relay (TC2) operated:

1. Connects lead "C8" from armature 8 and front contact of (TCC) relay 700 to the "L8B" lead 605 which brings into action the (LN8B) relay 1408 of that figure.
2. Connects the commons of the second sections of the first 1208 and last 1211 thousand switches on leads "C" and "D" to the "ECK" lead 707 and the "FCK" lead 708 to check the proper digits in these switches against the digits in the sixth entry of the tape identity group by the (LN6) relay 706.

If the first and last thousand switches are in the (off) position, ground will be present on the "E" lead and the (TC4) relay 1308 will operate, and in consequence with ground present on lead "S1," (TC3) relay 1309 will be operated.

Relay (TC3) operated:

1. Connects the "C8" lead from armature 8 and front contact of (TCC) relay 700 to the "L8B" lead 605 to bring into action the (LN8B) relay 1408.
2. Connects the "ECK" lead 707 to the "NE9" lead of the reading relays and the "FCK" lead 708 to the "NF0" lead of the reading relays, so that the digit 90 can be checked.

20.04 Last round

For all rounds of the month, the title of the slips varies with the directory number and the office, the month staying constant. In the last round, however, the round will overlap into the following month, so that in this round the title must also vary with the month.

The third section 2005 of the round switch is arranged to ground lead "RD6" on point 5 of (RD10) on point 9, on an optional basis, depending upon whether the accounting office is set up for a six or ten round month. In the last round, therefore, when relay (COM) operates, relay (LRD) also operates. The armature 4 of (COM) relay 1305 may be permanently connected to either (RD10) or "RD6."

(LRD) relay 1309 operated:

1. Connects the "NC" and "CM" leads from the month translator circuit to the storage circuit No. 2 to permit storage circuit No. 2 to indicate to the month translator circuit when a change in month is required.
2. Removes ground from the "B" lead 8500, the check ground, and connects lead "B" to the "MCK" lead to receive the check ground from the month translator circuit.
3. Opens the connection between the "TA1" and "TB1" leads to the month translator circuit to make that circuit active in the title change.
4. Switches the "ST" lead 3802 from the first line check lead "L1", to the second line check lead "L2" in order that the title information, now also contained in line 2, will be fully registered before printing begins. That is, the printing of an entry will begin when the second line has been stored rather than the first line.
5. Connects the "L03" lead from armature 5 of (ET) relay 4911 to the "L03" lead of the month translator circuit to lock in the title information in the month translator circuit.

20.05 Message unit detail tapes Nos. 30, 31, 32, 33, 34, 35 and 36

The tape type switch is set on point MU DET, which sets up three as the tens digit of the tape index.

The previous sort switch has the same function as previously described and the (MUD) relay 606 of this circuit is operated.

Relay (MUD) operated:

1. Connects the "T" lead 4910 to the (MUDT) relay 3205 to prepare a circuit for operating the proper title sequence relays for the message unit detail title.
2. Connects the "1019" lead 2704 to the "E7" lead to enable the operation of the D1 group of relays in Fig. 38.
3. Connects the "L1" lead to the (MUDL) relay 3305 to set up the proper line sequence for the message unit detail printed line.
4. Operates (COM) relay 1305.

The operation of the (COM), (LRD), (TC1), (TC2), (TC3) and (TC4) relays is the same as has been described above.

20.06 Observing tapes Nos. 40, 41, 45 and 46

The tape type switch is set on point Observ. which sets up to check 4 as the tens digit of the tape index.

The previous sort switch has the same function as previously described.

(L0) relay 1310 in this circuit is operated.

Relay (L0) operated:

1. Connects the "T" lead 4910 to the (L0T) relay 4004 to prepare a circuit for operating the proper title sequence for the observing slips.
2. Connects the "1019" lead 2704 and the "3039" lead 2705 to the "E7" and "E8" leads to enable the operation of the D1 and D2 groups of relays in Fig. 38 as two different entries are present in this tape.
3. Connects the "L1" and "L2" leads to the (MUDL) relay 3305 and the (OB) relay 3306, respectively, to set up the proper line sequence for the observing entry and the non-answered entry.
4. Operates the (COM) relay.

All other operations are the same as have been described above.

20.07 Straddle tape No. 60

The tape type switch is set on the Straddle point, which sets up 6 as the tens digit of the tape index.

The previous sort switch for straddle tapes is always set on the Unsorted position and checks 0 as the units digit of the tape index.

The (STR) relay 602 of this circuit is operated.

The (STR) relay operated:

1. Connects the "T"lead 4910 to the ((STRT) relay 4701 for operating the proper title sequence relays for straddle tapes.
2. Short-circuits the "TA1" lead from winding of (LK) relay 4912 to the "TB" lead 8301 which is grounded at the back contact and armature 2 of (LCR) relay 4908, thus operating the (LK) relay 4912 as the title is only changed by completing a page of printing.
3. Connects the "20," "21" and "22" leads of the reading relay translator circuit to the "E1" lead to enable the operation of the (ST1) group of relays in Fig. 29.
4. Connects the "23," "24" and "25" leads, respectively, to the "E2," "E3" and "E4" leads to enable the operation of the (ST2), (ST3) and (ST4) groups of relays in Figs. 37 and 34.

There are four different entries in a straddle tape.

5. Connects the "CL40" lead 5003 of the printer line count circuit to the "LC" lead to the winding of (LC) relay 5601 to prepare a circuit for indicating when a full page of forty lines has been printed.
6. Grounds the "B" lead 8500 for the check lead of that figure.
7. Grounds the "S5L3" lead 607 to the winding of (S5L3) relay 7900 of the No. 5 storage circuit to arrange that circuit to show the type of entry.
8. Connects the "L01" lead from the front contact of armature 4 of (EL) relay 4907 to the "L02" lead to operate the (S1L) relay 8300 in the No. 1 storage circuit.

20.08 Verbatim tapes, no specific tape index

The tape switch is set on point Verbatim.

The previous sort switch is in the off position.

The (VB) relay 1300 in this circuit is operated.

The (VB) relay operated:

1. Connects the "T" lead 4910 to the (VBT) relay 4600 to prepare that circuit for the proper title sequence for verbatim tapes, which is only for the purpose of feeding the paper into the correct position.
2. Connects the "TA1" lead from winding of (LK) relay 4912 to the "TB" lead grounded at the back contact and armature 2 of (LCR) relay 4908, thus operating the (LK) relay 4912.
3. Grounds the "VB" lead to operate the (VBM) relay 2900 in that circuit.
4. Removes ground from the "GRD" lead to prevent the operation of any of the entry relays.
5. Connects the "CL40" lead 5003 of the printer line count circuit to the "LC" lead to the winding of (LC) relay 5601 to prepare a circuit for indicating when a full page of forty lines has been printed.

21. Reading relay translator circuit, Fig. 13

21.01 General

The purpose of this circuit is to read certain combinations of relays that may be set up in the reading relays for the purpose of providing a circuit for these particular combinations in the other parts of the over-all circuit.

This circuit contains seventeen relays which are connected to the decoded output of the reading relays as follows:

Relay	Lead of Reading Relays
NA0	NA0
NA1	NA1
NA2	NA2
NA3	NA3
NB0	NB0
NB1	NB1
NB2	NB2
NB3	NB3
NB4	NB4
NB5	NB5
NB6	NB6
NB7	NB7
NB8	NB8
NB9	NB9
NC6	NC6
NC7	NC7
NC9	NC9

The particular combinations that must be recognized are as follows:

1. A0 which indicates a supplementary line of an entry.
2. A0, B8 which indicate the first two digits of a splice entry.
3. A2, B8 and C7 which indicate a skip window entry.

4. A2, B8 and C8 which indicate a tape identity entry.
5. A2, B0 which indicate a message unit local entry or a straddle initial detail entry.
6. A2, B1 which indicate a message unit local and extended entry or a straddle initial detail entry.
7. A1 and B0 to B9 which indicate a toll, message unit detail or observing entry.
8. A3 and B0 to B9 which indicate a non-answered entry.
9. A2 and B2 which indicate a stradlle initial detail entry.
10. A2 and B2 which indicate a straddle message unit initial entry.
11. A2 and B4 which indicate a straddle answer-disconnect entry.
12. A2 and B5 which indicate a straddle timing entry.
13. A2, B8 and C6 which indicate a skip splice entry.

21.02 Function of relays to indicate an entry

All operations of the (NA0) relay ground lead "0" to the reader control circuit to indicate a supplementary line in an entry.

When relays (NA0) and (NB8) operate, ground is applied to lead "08" of the reader control circuit. This lead indicates the presence of a splice pattern. If 08 appears in a supplementary line of an entry, this lead is open in the reader control circuit.

When relays (NA2), (NB8) and (NC6) operate, ground is applied to lead "286" to the reader control circuit which prepares the circuit for the presence of the splice entry, so that it may be skipped.

When relays (NA2), (NB8) and (NC7) operate, ground is applied to lead "287" to the reader control circuit, which prepares that circuit for skipping a window splice.

When relays (NA2), (NB8) and (NC9) are operated, ground is applied to lead "289" to the reader control circuit, which will operate relay (CKT) in that circuit.

Relays (NA2) and (NB0) operated, connect lead "E" of the printer control circuit to lead "20" of the tape class connector circuit.

Relays (NA2) and (NB1) operated, connect lead "E" of the printer control circuit to the "21" lead of the tape class connector circuit.

Relays (NA2) and (NB2) operated, connect lead "E" of the printer control circuit to the "22" lead of the tape class connector circuit.

Relays (NA2) and (NB3) operated, connect lead "E" of the printer control circuit to the "23" lead of the tape class connector circuit.

Relays (NA2) and (NB4) operated, connect lead "E" of the printer control circuit to the "24" lead of the tape class connector circuit.

Relays (NA2) and (NB5) operated, connect lead "E" of the printer control circuit to the "25" lead of the tape class connector circuit.

Relay (NA1) and any one of the (NB0) to (NB9) relays operated, connect lead "E" of the printer control circuit to the "1019" lead of the tape class connector circuit.

Relay (NA3) and any one of the (NB0) to (NB9) relays operated, connect lead "E" of the printer control circuit to the "3039" lead of the tape class connector circuit.

These combinations 20 to 25, 10 to 19 and 30 to 39 also ground lead "STE" to the reader control circuit which indicates to that circuit that the first line of an entry is present and the (STE) relay 2505 should operate.

22. Entry class register circuit, Figs. 29, 30, 37, 38, 44 and 45

22.01 General

A relay, or a pair of relays, in this circuit must be operated in order for an entry to be printed. The operated relays determine the order in which storage circuits will be connected to the reading relays to receive the information for a line of an entry.

The particular relay, or pair of relays, that can be operated is determined by the reading relay translator circuit, Figs. 19 and 27, and by the tape class connector circuit, Figs. 6 and 13. The ground for operating the relays in this circuit begins at the armature 2 and front contact of the (STE) relay 2505 and may be traced via "ENT" lead 2507 through the (OUT) and (IN) relays of the printer control circuit, and via the "E" lead 4906, through the relays of Figs. 19 and 27, via the "20," "21," "22," "23," "24," "25," "1019" or "3039" leads, thence through the relay contact of the tape class connector circuit, the leads "E1," "E2," "E3," "E4," "E5," "E6," "E7" or "E8" to this entry class register circuit, all depending on the setting of the tape type switch and the type of entry.

The particular operated relay, or pair of relays lock operated throughout the printing of an entry to ground on the "ENL" lead 4914 of the printer control circuit.

The entries will be described in relation to the tapes with which they are associated.

22.02 Summary tapes

The tape class connector circuit arranges the circuit so that (M1) relay 3000 of this circuit is operated over "20" lead 1904 and via lead "E5" and the pair of relays, (M2A) relay 3001 and (M2B) relay 3002 over "21" lead 1905 and via lead "E6."

22.03 Relay (M1), message unit local entry

The first function of all these groups of relays is to select the proper storage circuits into which the various lines of the entry are to be placed. This means that grounds on the operating leads "C1," etc. of the reader line count circuit are connected to the proper storage circuit to cause that storage circuit to be connected to the reading relays, and the check leads from the storage circuits are connected through the proper checking leads "CK1," etc., in the reader line count circuit to the reader control circuit. Also in addition to the proper storage circuit, the operating leads "C1," etc. are connected directly to the reader control circuit, so that in the event of an emergency printer start, ground will be connected via the reader control circuit to bring in a start printing condition in that particular storage circuit.

This message unit local entry uses storage circuit No. 1 for line 1, and storage circuit No. 4 for line 2. Lead "C1" of the reader line count circuit is connected to the "S1" lead of the No. 1 storage circuit and the reader control circuit and the "S1C" lead of the No. 1 storage circuit is connected to the "CK1" lead of the reader line count circuit. Lead "C2" of the reader line count circuit is connected to lead "S4" of the No. 4 storage circuit and lead "S4C" of the No. 4 storage circuit is connected to lead "CK2" of the reader line count circuit.

This relay also determines when sufficient in-

formation is stored to begin printing, by connecting the check lead of the proper storage circuit to the "ST" lead 2904 of the printer control circuit. In this case lead "S1C" of the No. 1 storage circuit is connected to the "ST" lead 2904.

These entry relays determine the proper count of the reader line count circuit, in this case grounding lead "EC2" for a count limit of two.

Ground is applied to "S4L" lead 3003 to set the No. 4 storage circuit for the proper printing of message units.

The (M1) relay 3000 locks under the control of the (E1) relay 4911 in the printer control circuit.

These entry relays also arrange the circuits of the (Line register) keys in Fig. 45 so that they will connect the (Reader or register) lamps to the correct storage circuit in the same order as they are used on the entry lines. This relay, therefore, connects "K1" lead 4511 from the (Line register) key 4501 to lead "L1" of the lamp connector circuit and connects "K2" lead 4512 to lead "L4."

This relay also connects ground when applied by the (LP) relay 1008 to the "ELG" lead 1010 to the "LMU" lead to light the (LMU lamp) 4507 to show that a local message unit entry is in process.

This relay connects the "L" lead 4913 to the (MUL1) relay 4100 to set up the proper sequence for printing a local message unit line.

22.04 (M2A) relay 3001 and (M2B) relay 3002, message unit local and extended entry

The message unit local and extended entry uses storage circuits Nos. 1, 4 and 5 in this order for lines 1, 2 and 3, and relays (M2A) and (M2B) connect the leads as follows:

"C1" of Fig. 36 to "S1" of Figs. 58 and 26.
"S1C" of Fig. 58 to "CK1" of Fig. 36 and "ST" of Fig. 49.
"C2" of Fig. 36 to "S4" of Figs. 64 and 26.
"S4C" of Fig. 64 to "CK2" of Fig. 36.
"C3" of Fig. 36 to "S5" of Figs. 66 and 26.
"S5C" of Fig. 66 to "CK3" of Fig. 36.
"K1" of Fig. 45 to "L1" of Fig. 1.
"K2" of Fig. 45 to "L4" of Fig. 4.
"K3" of Fig. 45 to "L5" of Fig. 3.

Grounds lead "S4L" of Fig. 64 to arrange it to print message units.

Grounds lead "S5L2" of Fig. 66 to arrange it to print message units.

Grounds lead "EC3" of Fig. 36 to set up a count limit of three.

Connects lead "ELG" of Fig. 10 to the "EMU" lead of Fig. 45 to light the extended message unit entry (EMU) lamp 4508.

(M2A) relay 3001 and (M2B) relay 3002 lock in parallel to "ENL" lead 4914.

Connects the "L" lead 4913 to the (MUL2) relay 4101 to set up the sequence for a local and extended message unit line.

22.05 Toll tape

The tape class connector circuit arranges the circuit so that (D1A) relay 3800 and (D1B) relay 3801 are operated over "1019" lead 2704 via lead "E7." This tape uses only one entry, which is represented by these relays.

22.06 Relays (D1A) and (D1B), detail entry

The detail entry uses the Nos. 1, 2, 3, 4 and 5 storage circuits in this order for lines 1, 2, 3, 4 and 5 and relays (D1A and D1B) connect leads as follows:

"C1" of Fig. 36 to "S1" of Figs. 58 and 26.
"S1C" of Fig. 58 to "CK1" of Fig. 36.
"C2" of Fig. 36 to "S2" of Figs. 53 and 26.
"S2C" of Fig. 53 to "CK2" of Fig. 36.
"C3" of Fig. 36 to "S3" of Figs. 62 and 26.
"S3C" of Fig. 62 to "CK3" of Fig. 36.
"C4" of Fig. 36 to "S4" of Figs. 64 and 26.
"S4C" of Fig. 64 to "CK4" of Fig. 26.
"C5" of Fig. 26 to "S5" of Figs. 66 and 26.
"S5C" of Fig. 66 to "CK5" of Fig. 36.
"K1" of Fig. 45 to "L1" of Fig. 1.
"K2" of Fig. 45 to "L2" of Fig. 2.
"K3" of Fig. 45 to "L3" of Fig. 3.
"K4" of Fig. 45 to "L4" of Fig. 4.
"K5" of Fig. 45 to "L5" of Fig. 3.

Connects the "ST" lead 2904 to the "ST" lead 3802 where it is returned by the (LRD) relay 1309 in that circuit over lead "L1" or "L2" to the "S1C" lead to Fig. 58 or the "S2C" lead to Fig. 53. Thus, the (LRD) relay 1309 governs whether one or two lines are required to determine the title information.

Grounds lead "S5L1" to Fig. 66 to set that circuit up for printing message units.

Grounds lead "EC5" of Fig. 36 to set up a count limit of five.

Connects the "L" lead 4913 to the "DL1" lead to the tape class connector circuit where it is guided to operate the proper sequence in the line pattern character sequence circuit to print the line.

Connects the "ELG" lead of Fig. 10 to the "DET" lead to light the detail entry (DET) lamp 4509.

Relays (D1A) and (D1B) lock in parallel to "ENL" lead 4914.

22.07 Message unit detail tapes

The tape class connector circuit arranges the circuit so that relays (D1A) and (D1B) are operated over lead "1019" via lead "E7" of the tape class connector circuit.

The tape class connector circuit also guides the "DL1" lead to the (MUDL) relay 3305 for the proper printer sequence. This tape uses only one entry, the same entry as used in the toll tape, and the same relays (D1A) and (D1B). The operation of the relays has been described above.

22.08 Observing tapes

The tape class connector circuit arranges the circuit so that relays (D1A) and (D1B) are operated over "1019" lead 2704 via lead "E7" and (D2A) relay 3803 and (D2B) relay 3804 over "3039" lead 2705 via lead "E8." Thus, this tape uses two entries, the detail entry and the non-answered entry. The tape class connector circuit guides the "DL1" lead to operate the (MUDL) relay 3305 for the printing of the observing entry.

22.09 (D2A) relay 3803 and (D2B) relay 3804, non-answered entry

The non-answered entry uses the Nos. 1, 2, 3, 4 and 5 storage circuits in this order for lines 1, 2, 3, 4 and 5 and relays (D2A) and (D2B) connect leads as follows:

"C1" of Fig. 36 to "S1" of Figs. 58 and 26.
"S1C" of Fig. 58 to "CK1" of Fig. 36.
"C2" of Fig. 36 to "S2" of Figs. 53 and 26.
"S2C" of Fig. 53 to "CK2" of Fig. 36.
"C3" of Fig. 36 to "S3" of Figs. 62 and 26.
"S3C" of Fig. 62 to "CK3" of Fig. 36.

"C4" of Fig. 36 to "S4" of Figs. 64 and 26.
"S4C" of Fig. 64 to "CK4" of Fig. 36.
"C5" of Fig. 36 to "S5" of Figs. 66 and 26.
"S5C" of Fig. 66 to "CK5" of Fig. 36.
"K1" of Fig. 45 to "L1" of Fig. 1.
"K2" of Fig. 45 to "L2" of Fig. 2.
"K3" of Fig. 45 to "L3" of Fig. 3.
"K4" of Fig. 45 to "L4" of Fig. 4.
"K5" of Fig. 45 to "L5" of Fig. 3.

Connects the "ST" lead 2004 to the "ST" lead 3002 where it is returned over lead "L1" or "L2" to the "S1C" lead of Fig. 58 or the "S2C" lead of Fig. 53. Thus, the (LRD) relay 1309 governs whether one or two lines are required to determine the title.

Grounds lead "EC5" of Fig. 36 to set up a count limit of five.

Connects the "L" lead 4913 to the "DL2" lead where it is guided over the "L8" lead to operate the (OB) relay 3306 to print the line.

Connects the "ELG" lead of Fig. 10 to the "DA" lead to light the non-answered (DA) lamp 4518.

Relays (D2A) and (D2B) lock in parallel on "ENL" lead 4914.

22.10 Straddle tapes

Four types of entries occur in straddle tapes. The tape class connector circuit arranges the circuit so that the entry relays for the four entries may be operated over circuits as follows:

Entry	Relays	Leads of Figs.—	
		19 and 27	6 and 13
Initial Detail	(ST1A) & (ST1B)	"20", "21," "22."	"E1."
Initial Message Unit	(ST2A) & (ST2B)	"23"	"E2."
Answer-Disconnect	(ST3A) & (ST3B)	"24"	"E3."
Timing	(ST4A) & (ST4B)	"25"	"E4."

22.11 (ST1A) relay 2006 and (ST1B) relay 2007, initial detail entry

This entry uses Nos. 5, 6, 1, 2, 3 and 4 storage circuits in this order for lines 1, 2, 3, 4, 5 and 6, and these relays connect the leads as follows:

"C1" of Fig. 36 to "S5" of Figs. 66 and 26.
"S5C" of Fig. 66 to "CK1" of Fig. 36.
"C2" of Fig. 36 to "S6" of Figs. 68 and 26.
"S6CB" of Fig. 68 to "CK2" of Fig. 36.
"C3" of Fig. 36 to "S1" of Figs. 58 and 26.
"S1C" of Fig. 58 to "CK3" of Fig. 36.
"C4" of Fig. 36 to "S2" of Figs. 53 and 26.
"S2C" of Fig. 53 to "CK4" of Fig. 36.
"C5" of Fig. 36 to "S2" of Figs. 62 and 26.
"S3C" of Fig. 62 to "CK5" of Fig. 36.
"C6" of Fig. 36 to "S4" of Figs. 64 and 26.
"S4C" of Fig. 64 to "CK6" of Fig. 36.
"K1" of Fig. 45 to "L5" of Fig. 3.
"K2" of Fig. 45 to "L6" of Fig. 4.
"K3" of Fig. 45 to "L1" of Fig. 1.
"K4" of Fig. 45 to "L2" of Fig. 2.
"K5" of Fig. 45 to "L3" of Fig. 3.
"K6" of Fig. 45 to "L4" of Fig. 4.

Connects the "S5C" lead of Fig. 66 to the "ST" lead 2004 as only one line is required to start printing.

Connects ground to the "EC6" lead of Fig. 43 to set up a count limit of six.

Connects lead "ELG" to the "SDET" lead to light the straddle initial detail entry (S—DET) lamp 4517.

Connects the "L" lead 4913 to the (SL1) relay 4102 to set up the proper line printing sequence.

Relays (ST1A) and (ST1B) lock in parallel to "ENL" lead 4914.

Grounds lead "A" to the called office name translator circuit, Fig. 55, to cause that circuit to connect the called office name translator circuit to the storage circuit No. 3.

22.12 (ST2A) relay 3700 and (ST2B) relay 3702, initial message unit entry

This entry uses storage circuits Nos. 5, 6, 1 and 2 in this order for lines 1, 2, 3 and 4 and these relays connect leads as follows:

"C1" of Fig. 36 to "S5" of Figs. 66 and 26.
"S5C" of Fig. 66 to "CK1" of Fig. 36.
"C2" of Fig. 36 to "S6" of Figs. 68 and 26.
"S6CB" of Fig. 68 to "CK2" of Fig. 36.
"C3" of Fig. 36 to "S1" of Figs. 58 and 26.
"S1C" of Fig. 58 to "CK3" of Fig. 36.
"C4" of Fig. 36 to "S2" of Figs. 53 and 26.
"S2C" of Fig. 53 to "CK4" of Fig. 36.
"K1" of Fig. 45 to "L5" of Fig. 3.
"K2" of Fig. 45 to "L6" of Fig. 4.
"K3" of Fig. 45 to "L1" of Fig. 1.
"K4" of Fig. 45 to "L2" of Fig. 2.
Grounds lead "B" of Fig. 62.

Grounds lead "EC4" of Fig. 36 to provide a count limit of four.

Connects the "S5C" lead of Fig. 66 to the "ST" lead 2004.

Connects the "ELG" lead 1010 to the "SMU" lead to light the initial message unit entry (SMU) lamps 4516.

Connects the "L" lead 4913 to the (SL2) relay 4105 to set up the proper line sequence.

22.13 (ST3A) relay 3702 and (ST3B) relay 3703, answer-disconnect entry

This entry uses storage circuits Nos. 5, 6, 3, 4 and 2 in this order for lines 1, 2, 3, 4 and 5 and these relays connect leads as follows:

"C1" of Fig. 36 to "S5" of Figs. 66 and 26.
"S5C" of Fig. 66 to "CK1" of Fig. 36.
"C2" of Fig. 36 to "S6" of Figs. 68 and 26.
"S6CB" of Fig. 68 to "CK2" of Fig. 36.
"C3" of Fig. 36 to "S3" of Figs. 62 and 26.
"S3C" of Fig. 62 to "CK3" of Fig. 36.
"C4" of Fig. 36 to "S4" of Figs. 64 and 26.
"S4C" of Fig. 64 to "CK4" of Fig. 36.
"C5" of Fig. 36 to "S2" of Figs. 53 and 26.
"S2C" of Fig. 53 to "CK5" of Fig. 36.
"K1" of Fig. 45 to "L5" of Fig. 3.
"K2" of Fig. 45 to "L6" of Fig. 4.
"K3" of Fig. 45 to "L3" of Fig. 3.
"K4" of Fig. 45 to "L4" of Fig. 4.
"K5" of Fig. 45 to "L2" of Fig. 2.

Connects ground to lead "B" of Fig. 62.

Connects ground to lead "EC5" of Fig. 36 to provide a count limit of five.

Connects "ELG" lead 1010 to the "SAAD" lead to light the straddle answer-disconnect (SAAD) lamp 4519.

Connects the "S5C lead, Fig. 66, to the "ST" lead 2004.

Connects the "L" lead 4913 to the (SL3) relay 4001 to set up the proper printing sequence.

These relays lock in parallel to lead "ENL" 4914.

22.14 (ST4A) relay 4401 and (ST4B) relay 4402, straddle timing entry

This entry uses storage circuits Nos. 5, 6 and 2 in this order for lines 1, 2 and 3, and these relays connect leads as follows:

"C1" of Fig. 36 to "S5" of Figs. 66 and 26.

"S5C" of Fig. 66 to "CKL" of Fig. 36.
"C2" of Fig. 36 to "S6" of Figs. 68 and 26.
"S6CB" of Fig. 68 to "CK2" of Fig. 36.
"C3" of Fig. 36 to "S2" of Figs. 53 and 26.
"S2C" of Fig. 53 to "CK3" of Fig. 36.
"K1" of Fig. 45 to "L5" of Fig. 3.
"K2" of Fig. 45 to "L6" of Fig. 4.
"K3" of Fig. 45 to "L2" of Fig. 2.

Connects ground to lead "B" of Fig. 62.

Connects ground to lead "EC3" of Fig. 36 to provide a count limit of three.

Connects "ELG" lead 1010 to lead "SOAD" to light the straddle timing entry (SOAD) lamp 4520.

Connects lead "S5C" of Fig. 66 to the "ST" lead 2904.

Connects the "L" lead 4913 to the (SL4) relay 4802 to set up the proper sequence for printing the line.

These relays are locked in parallel to "ENL" lead 4914.

22.15 Verbatim tapes

The storage circuit No. 6 is used for storing the lines of a verbatim tape, which is any automatic accounting system tape. The (VBM) relay 2900 is operated directly by the (VB) relay 1300 of the tape class connector circuit.

The "C1" lead of Fig. 36 is connected to lead "S6" of Fig. 68.

The "S6CA" lead of Fig. 68 is connected to "CK1" of Fig. 36.

Ground is connected to lead "EC1," Fig. 36, to provide a count limit of one.

Lead "K1" of Fig. 45 is connected to (L6) of Fig. 4.

The "ELG" lead 1010 is connected to the "Verb." lead to light the (Verb.) lamp 4521. Lead "S6CA" of Fig. 68 is connected to "ST" lead 2904.

22.16 Storage circuits used for various entries

Local message unit entry.—Summary tape

Line 1 stored in storage circuit No. 1.
Line 2 stored in storage circuit No. 4.

Local and extended message unit entry.—Summary tape

Line 1 stored in storage circuit No. 1.
Line 2 stored in storage circuit No. 4.
Line 3 stored in storage circuit No. 5.

Detail entry.—Toll, message unit detail and observing tapes

Line 1 stored in storage circuit No. 1.
Line 2 stored in storage circuit No. 2.
Line 3 stored in storage circuit No. 3.
Line 4 stored in storage circuit No. 4.
Line 5 stored in storage circuit No. 5.

Non-answered observing entry.—Observing tapes

Line 1 stored in storage circuit No. 1.
Line 2 stored in storage circuit No. 2.
Line 3 stored in storage circuit No. 3.
Line 4 stored in storage circuit No. 4.
Line 5 stored in storage circuit No. 5.

Detail straddle initial entry.—Straddle tapes

Line 1 stored in storage circuit No. 5.
Line 2 stored in storage circuit No. 6.
Line 3 stored in storage circuit No. 1.
Line 4 stored in storage circuit No. 2.
Line 5 stored in storage circuit No. 3.
Line 6 stored in storage circuit No. 4.

Message unit straddle initial entry.—Straddle tapes

Line 1 stored in storage circuit No. 5.
Line 2 stored in storage circuit No. 6.
Line 3 stored in storage circuit No. 1.
Line 4 stored in storage circuit No. 2.

Straddle answer-disconnect entry.—Straddle tapes

Line 1 stored in storage circuit No. 5.
Line 2 stored in storage circuit No. 6.
Line 3 stored in storage circuit No. 3.
Line 4 stored in storage circuit No. 4.
Line 5 stored in storage circuit No. 2.

Straddle timing entry.—Straddle tapes

Line 1 stored in storage circuit No. 5.
Line 2 stored in storage circuit No. 6.
Line 3 stored in storage circuit No. 2.

Verbatim

Line 1 stored in storage circuit No. 6.

23. Printer character sequence circuit, Figs. 34, 35 and 42

23.01 Operation of the circuit

This circuit provides the means for controlling the sequence of the printed characters across the printed page or slip.

Leads "GR0" to "GR50" control a number of relays in the line pattern character sequence circuit which relays in turn control the "1" to "11" leads from relays (CC1) to (CC9) and (TC) relay 4201, inclusive.

When this circuit is normal, ground from (RL) relay 4200 at its normal contacts of its armature 4 via armature 2 and back contact of (TC) relay 4201 is connected via relays (G10) to (G50) to lead "GR0," and via relays (CC1) to (CC9) to lead "1."

Thus, when an entry is to be printed and other units of the circuit have been made ready, the ground on the "GR0" lead of this character count circuit will operate a relay in the line pattern character sequence circuit which will guide the "1" lead of this figure via the proper storage circuit to a character relay of the code relay circuit to print the character required.

When the distributor in Fig. 126 steps off normal to send the first character, ground is applied to "SC" lead 11401 of this circuit which via relays (C1A) and (C9A) operates (CC1) relay 3400. Relay (CC1) operated locks via relays (CC1) to (CC9) and (TC) and via relays (G10) to (G50) to ground on (RL) relay 4200.

In addition relay (CC1) operated:

1. Removes ground from lead "1" and applies it to lead "2" to select another character to be printed.
2. Transfers the "CCG" lead from the front contact of armature 5 of (LP) relay 1008 from lamp lighting lead "C1" to "C2" to provide a path for lighting the proper (Character in printer line) lamp when the (Reader lamps) key is operated.
3. Prepares a circuit for operating (C1A) relay 3401.
4. Provides a locking path for (RL) relay 4200.

When the distributor comes to the end of its rotation, ground will be applied to "ST" lead 12101, which, via relays (CC2) to (CC9) and (TC) released and (CC1) operated, operates (C1A) relay 3401.

Relay (C1A) operated locks to relay (RL) via the (C2A) to (C9A) relays, and also:

1. Provides a locking path for (RL) relay 4206.
2. Prepares an operating circuit for (CC2) relay 3402.

The next character is now transmitted and ground is again applied to "SC" lead 11401 and relay (CC2) operates.

Relay (CC2) operated:

1. Locks over a path previously described.
2. Provides a locking path for relay (RL).
3. Removes ground from lead "2" and grounds lead "3."
4. Releases relay (CC1).
5. Transfers the "CCG" lead from lead "C2" to lead "C3."
6. Prepares a path to operate relay (C2A).

Ground again on "ST" lead 12101 now operates relay (C2A).

Relay (C2A) operated:

1. Locks in the manner explained above.
2. Provides a locking path for relay (RL).
3. Releases relay (C1A).
4. Prepares a path for relay (CC3).

So the count proceeds down the group of relays with no more than two relays in the upper group operated at a time.

If the line exceeds ten characters this circuit is arranged to release the relay operated over lead "GR9" and operate another relay over lead "GR10" to set up a second series of ten characters. When relay (C9A) operates after the ninth character is transmitted, a circuit is provided from "SC" lead 11401 to (TC) relay 4201. Then when the distributor steps off to transmit the tenth character, relay (TC) will operate.

Relay (TC) operated:

1. Locks on its secondary winding under the control of relay (C9A).
2. Locks on its own primary winding and the winding of relay (C9A) to the "SC" lead 11401.
3. Transfers the character operating circuit for lead "10" to lead "11," but lead "11" is used only in the special case where a line has sixty-one characters.
4. Transfers the lamp lighting lead "CCG" from lead "C10" to lead "C11."
5. Unlocks and releases relay (CC9).
6. Connects ground derived at relay (RL) via relays (GA10) to (GA50) to operate relay (G10).

Relay (G10) operated:

1. Locks to relay (RL).
2. Provides a locking circuit for relay (RL).
3. Removes ground from lead "GR9" and applies it to lead "GR10."
4. Removes ground from lamp lead "G9" and applies it to "G10."
5. Prepares a circuit for operating relay (G10A).
6. Removes one locking circuit for relay (TC).

It will be noted that as long as ground is present on lead "SC" with relay (C9A) operated, both relays (TC) and (C9A) remain locked, and because relay (TC) is operated there is no ground present on the "GR" or the "1" to "11" leads.

When ground is removed from lead "SC," relay (C9A) will release, and when it is released relay (TC) will release. The release of relay (TC) will (1) restore the locking circuit for relays (CC1) to (CC9), (2) operate relay (GA10), (3) apply ground to lead "GR10" to operate the second required (L–) or (T–) relay and (4) apply ground to the "1" lead via the relay just operated on lead "GR10," to operate the eleventh character relay.

By this process the count can go to any number up to 61. The sixty-first count will be explained later.

When a line is complete, the ground over one of the character leads will operate either (EL) relay 4907 or (ET) relay 4911 which will eventually operate (RL) relay 4200 in this circuit.

Relay (RL) operated locks to any of the relays in this circuit that are operated, which removes all grounds from this circuit releasing all relays. When all these relays are released, relay (RL) can release.

Relay (RL) also applies ground to lead "RLCG" to indicate that relay (RL) is operated and opens the "ST" lead 12101 to prevent possible holding of count relays at end of title or line.

In one case sixty-one elements are required in the line, and when (TC) relay 4201 operates, lead "11" is used to indicate the end of the line. As there are no further relays in the lower group, no further action takes place there.

Relays (TC) and (C9A) remain locked up via relays (G50) and (GA50) to relay (RL), and the circuit remains in this condition until relay (RL) is operated to clear the circuit.

24. Printer line count circuit, Figs. 50 and 57

24.01 Operation of the circuit

This circuit is provided to count the number of lines on the slip or page that is being printed, in order to know when the proper number of lines has been printed, so that a new slip or page may be started.

The count for slips is 9, while the count for pages is 40.

Ground for this circuit is provided from the printer control circuit over "CG" lead 4916.

When a line is completed the printer control circuit applies ground to "CM" lead 5616 upon the operation of (CT) relay 5600.

This ground, when making the first count, is routed via back contacts of relays (LP1), (LP2) and (LP3) to operate (CL1) relay 5000.

Relay (CL1) operated:

1. Locks via a back contact of armature 1 of (LP2) relay 5001 to ground on the "CG" lead 4916.
2. Closes "CB" lead 5617 via relay (LP2) to the primary winding of (LP1) relay 5003.
3. Partially closes a circuit for operating relay (CL2).
4. Grounds "CLK" lead 4917 to provide a check-down ground.

When (CT) relay 5600 releases, it applies ground to "CB" lead 5617 for operating (LP1) relay 5003 via relays (CL3) and (CL2), the operated relay (CL1) and relay (LP2) released.

Relay (LP1) operated:

1. Removes locking ground from relay (CL3).
2. Removes locking ground from relay (LP3).
3. Opens the operating circuit of relay (LP3).
4. Locks via relay (LP2) to "CG" conductor 4916.
5. Disconnects "CM" lead 5616 from relay (CL1) and connects it to relay (CL2) via operated relay (CL1).
6. Grounds the check-down lead 4917.

This completes the first count, (CL1) relay

5000 and (LP1) relay 5003 being operated and locked.

When (CT) relay 5600 operates the second time, ground is now applied to operate (CL2) relay 5004.

Relay (CL2) operated:

1. Connects lead "CB" to relay (LP2) via relay (LP3).
2. Partially closes the operating circuit for relay (CL3).
3. Locks to "CG" conductor 4916 under the control of relay (LP3).
4. Grounds the check-down "CLK" lead 4917.

The application of ground to lead "CB" for the second time, now operates (LP2) relay 5001.

Relay (LP2) operated:

1. Releases (CL1) relay 5000.
2. Releases (LP1) relay 5003.
3. Opens the operating circuit of relay (LP1).
4. Locks to "CG" lead 4916 via relay (LP3).
5. Connects "CM" lead 5616 to relay (CL3) via operated relay (CL2).
6. Grounds the check-down lead 4917.

This completes the second count, (CL2) relay 5004 and (LP2) relay 5001 being operated and locked.

Thus, the count progresses. The following tabulation will show the relays operated for each of the forty counts:

Count 1	Relays (CL1) and (LP1)
Count 2	Relays (CL2) and (LP2)
Count 3	Relays (CL3) and (LP3)
Count 4	Relays (CL4) and (LP1)
Count 5	Relays (CL5) and (LP2)
Count 6	Relays (CL6) and (LP3)
Count 7	Relays (CL7) and (LP1)
Count 8	Relays (CL8) and (LP2)
Count 9	Relays (CL9) and (LP3) and (LC9) and (LP9)

Relay (CL9) operated, grounds lead "CL9" which if in use indicates that nine lines have been printed and that a new slip is to be started. Relay (LC9) also operates, via relays (LP27), (LP18) and (LP9). Relay (LC9) acts in its own group in the same manner as the (CL) relays of the first group

Count 10	Relays (CL1), (LP1), (LC9) and (LP9)
Count 11	Relays (CL2), (LP2), (LC9) and (LP9)
Count 12	Relays (CL3), (LP3), (LC9) and (LP9)
Count 13	Relays (CL4), (LP1), (LC9) and (LP9)
Count 14	Relays (CL5), (LP2), (LC9) and (LP9)
Count 15	Relays (CL6), (LP3), (LC9) and (LP9)
Count 16	Relays (CL7), (LP1), (LC9) and (LP9)
Count 17	Relays (CL8), (LP2), (LC9) and (LP9)
Count 18	Relays (CL9), (LP3), (LC18) and (LP18)
Count 19	Relays (CL1), (LP1), (LC18) and (LP18)
Count 20	Relays (CL2), (LP2), (LC18) and (LP18)
Count 21	Relays (CL3), (LP3), (LC18) and (LP18)

Count 22	Relays (CL4), (LP1), (LC18) and (LP18)
Count 23	Relays (CL5), (LP2), (LC18) and (LP18)
Count 24	Relays (CL6), (LP3), (LC18) and (LP18)
Count 25	Relays (CL7), (LP1), (LC18), and (LP18)
Count 26	Relays (CL8), (LP2), (LC18) and (LP18)
Count 27	Relays (CL9), (LP3), (LC27) and (LP27)
Count 28	Relays (CL1), (LP1), (LC27) and (LP27)
Count 29	Relays (CL2), (LP2), (LC27) and (LP27)
Count 30	Relays (CL3), (LP3), (LC27) and (LP27)
Count 31	Relays (CL4), (LP1), (LC27) and (LP27)
Count 32	Relays (CL5), (LP2), (LC27) and (LP27)
Count 33	Relays (CL6), (LP3), (LC27) and (LP27)
Count 34	Relays (CL7), (LP1), (LC27) and (LP27)
Count 35	Relays (CL8), (LP2), (LC27) and (LP27)
Count 36	Relays (CL9), (LP3), (LC36) and (LP9)
Count 37	Relays (CL1), (LP1), (LC36) and (LP9)
Count 38	Relays (CL2), (LP2), (LC36) and (LP9)
Count 39	Relays (CL3), (LP3), (LC36) and (LP9)
Count 40	Relays (CL4), (LP1), (LC36) and (LP9)

With relays (LC36) and (CL4) operated a circuit is completed to apply ground to lead "CL40" to indicate that forty lines have been printed, that is, if the "CL40" lead is in use.

In either the case of the "CL9" or the "CL40" lead, whichever has been extended by some one of the relays of the tape class connector circuit, Figs. 6 and 13, a relay is operated in the printer control circuit which removes ground from "CG" lead 4916 causing all relays in this circuit to release. When they have all been released, ground is removed from "CLK" lead 4917 which indicates to the printer control circuit that this circuit is clear.

25. Printer code translator circuit, Figs. 94, 95, 106, 107, 114, 115, 121 and 122

25.01 Code translation

Basically this circuit contains one relay for each character, or printer operation that is required to be printed or performed by the printer, forty-two in all. These relays operate in conjunction with the distributor circuit, Fig. 126, and the printer character sequence circuit, Figs. 34, 35 and 42.

These relays are designated in accordance with their affect on the printer and are as follows: their effect on the printer and are as follows:

10 relays 1 to 0
26 relays A to Z
Dash
Shift
Unshift
Space
Carriage return—Line feed
Star

The primary function of these relays is to set up the code on the distributor that is required by the printer to print or perform that particular character or function.

The printer is a five-unit code device, and performs different functions on different combinations of five time units. The distributor feeds five time units to the printer magnet and during the time of a unit the circuit of the printer magnet is either opened or closed. The following table shows the combinations for the different characters. "X" means the circuit to the magnet is closed, and "—" means the circuit is open. There are thirty-two combinations of five units, any one of which may be open or closed taken five at a time.

Printer code

Character	Time Elements				
	1	2	3	4	5
A	X	X	—	—	X
B	X	—	—	X	X
C	—	X	X	X	—
D	X	—	X	X	—
E	X	—	—	—	—
H	X	—	X	—	X
I	—	X	—	—	—
J	X	X	—	X	—
L	—	X	X	X	X
M	—	—	X	X	X
N	X	X	X	—	X
O	X	—	X	X	X
P	—	X	X	—	X
R	—	X	—	X	X
S	—	—	X	—	—
T	—	—	—	—	X
U	X	X	X	—	—
1	X	X	—	—	—
2	X	—	X	—	—
3	—	X	X	—	—
4	X	—	—	X	—
5	—	X	—	X	—
6	—	—	X	X	—
7	X	—	—	—	X
8	—	X	—	—	X
9	—	—	X	—	X
0	—	—	—	X	X
Dash	—	—	—	—	—
Shift	X	X	—	X	X
Unshift	X	X	X	X	X
Space	X	X	X	X	—
CR-LF	—	—	—	X	—

The above combinations take up the entire thirty-two combinations of the printer. The maximum number of type bars available in the printer is twenty-eight, and these twenty-eight have been assigned to the characters shown above. They consist of ten numerals, the codes for which correspond to the two-out-of-five basis in the same manner as the automatic accounting system code, seventeen letters and the dash "—."

This printer has both lower and upper case characters, however, and the above characters have been assigned to the lower case, as they are the most often used.

There still remain nine characters and a star "*," which have been assigned to the upper case of the following characters:

Upper Case	Lower Case
F	L
G	U
K	3
Q	2
V	S
W	1
X	I
Y	E
Z	— Dash
* "Star"	O

We will assume that this circuit is in a static condition and that we wish to print the numeral 1. (1) relay **9406** will operate from a circuit the ground for which is derived from the printer character sequence circuit.

Relay (1) when operated, operates (P1) relay **9401** and (P2) relay **9402** which are the code relays, and closes a one and one only check circuit through its associated group of thirty-two relays.

This check circuit, when one and only one of the thirty-two relays is operated closes a circuit from armature 1 and front contact of (1) relay **9406**, thence through a back contact and armature of each of the other character relays, through the armature **3** and back contact of the (PS) relay **12104**, and the armature 1 and back contact of the (PA6) relay **12105** to energize the clutch magnet **12601** of the distributor in Fig. **126**. The energization of this magnet starts the distributor.

The stop contact of the distributor is normally closed, holding ground on the circuit to the printer selector magnet. The first operation of the distributor is to open this stop contact, and thus release the printer magnet causing the printer to start. This is the start interval. Then the No. 1 contact is closed, and if there is ground present at its corresponding (P1) relay, which there is in the case assumed, numeral 1, the selector magnet will close. Then the No. 2 contact and so on through the five contacts. Thus, any combination can be sent by properly setting the (P–) relays. In this case, the (P1) and (P2) relays were operated to send the combination for the numeral 1. When the revolution is finished the stop contact will again close.

The distributor is equipped with two sets of auxiliary contacts, one make-before-break, and one straight transfer. These are called the universal contacts. The ground for operating the (P–) relays, by the character relays is obtained via the make-before-break contact of the distributor. When the distributor begins to rotate, and just before the first transmitting contact closes, the univeral contacts are actuated. The make-before-break contact, therefore, first locks the (P–) relays that are operated, through their associated varistors and resistors and then removes the operating ground from the (P–) relays. These (P–) relays, therefore, remain locked during the transmission of the five pulse combinations. The universal contacts are restored immediately after the fifth transmitting contact opens. The continuity combination then releases the operated (P–) relays and restores the operating ground. The character relays may be rearranged during the transmitting interval because the operating ground for the (P–) relays is removed. Because the character relays may have been arranged during the transmitting interval, when the (P–) relays are unlocked some may be required to release and others may be required to remain operated because of the new character relay that has been operated. The varistors are necessary, therefore, to prevent the transformer effect in these relays from slowing down those relays that are supposed to release.

The regular transfer contact on the distributor is the counting contact for the printer character sequence circuit.

Therefore, when the distributor moves forward, the character sequence circuit is stepped forward, removing the grounds from relay (1), thus releasing it, and applying ground to any other character relay that may be required next.

The (SH) relay 12107 causes the printer to move to the upper case.

The (UNSH) relay 12108 causes the printer to return to the lower case after having been shifted to the upper case.

The (SP) relay 12102 causes the printer carriage to step along one space without printing.

The (CRLF) relay 12100 causes the printer to feed the paper up one line and return the type basket to the left-hand side.

25.02 Upper case characters

Assume now that the (F) relay 9409 was operated. To print F it is necessary to move the printer to the upper case, print the letter F, and then return the carriage to the lower case. When, therefore, relay (F) is operated, it will close a circuit for operating (PA1) relay 11400 and prepare a path for the later operation of the (L) relay 11402, of which F is the upper case character.

Relay (PA1) operated:

1. Removes the make contact side of the transfer combination of the universal contacts of the distributor from the count control "SC" lead 11401, and connects it to a contact of (UC) relay 11403 for the later operation of the relay group (PA2) to (PA5).
2. Operates the (SH) relay 12107 via contacts on the (PA7) relay 12109 and the (PA2) relay 11404.

Relay (SH) operated, acts in the manner previously described to shift the printer to the upper case, and also connects the back contact of the transfer contact to the winding of the (UC) relay 11403. Now the (SH) relay is operated while a previous character is being transmitted, or it may be the first character transmitted. Assuming first that a previous character is being transmitted, when the distributor comes to the end of its revolution, the transfer contact will make on is back contact, causing the operation of the (UC) relay 11403.

The (UC) relay operated:

Connects the front contact of the transfer to relay (PA2), through back contact and armature 2 of (PA3) relay 11405, and locks up to relay (PA1) via contacts of the (PA7) relay 12109.

The (SH) relay 12107 being operated, the distributor sends the shift signal and the transfer contact making its front contact causes the operation of relay (PA2).

If the (SH) relay operation has been the first character sent, the distributor being at rest on its back contact of the transfer the (UC) relay would have operated immediately.

Relay (PA2) operated:

1. Will transfer the ground from relay (PA1) from the (SH) relay releasing it, to the (L) relay 11402 via (PA4) relay 11406 and (F) relay 9409 to operate it.
2. Will apply ground derived from relay (PA1) to one side of (PA3) relay 11405 but relay (PA3) cannot operate because ground is present on both sides of its winding.

Relay (L) which contains the code for character F in the upper case will operate.

At the end of the shift rotation the (P–) relays will take up the combination for relay (L), and the distributor will remove the ground from one side of relay (PA3) causing it to operate in series with (PA2) both of which are now locked to relay (PA1), relay (PA1) being held by relay (F) which has remained operated, because the printer character sequence circuit has not been permitted to step.

The distributor starts to transmit the L combination, and the transfer contact operates relay (PA4), causing relay (L) to release, and operating (UNSH) relay 12108, and applying ground to (PA5) relay 11407. At the end of the L revolution, relay (PA5) will operate in series with relay (PA4), locking to relay (PA1), and connecting the transfer contact to the printer character sequence circuit and to the primary winding of (PA7) relay 12109.

The distributor again starts to transmit the unshift signal. The operation of the transfer contacts causes the printer character sequence circuit to step, which releases relay (F) and in consequence relays (PA1) to (PA5). When the pulse is given the printer character sequence circuit via relay (PA5), relay (PA7) also operates, and locks to relays (PA2) to (PA5), and opens the ground lead releasing the (UNSH), (PA2) to (PA5) and (UC) relays. When the (PA2) to (PA5) relays are released the (PA7) will release, and if another upper case character immediately follows, the cycle can be repeated.

25.03 Manual printer stepping

It is sometimes desirable to be able to step the printer step by step manually. To do this, two keys are provided. The (Printer stop) key 12103 is first operated, which operates relay (PS) in this circuit. Relay (PS) operated opens the distributor magnet circuit, and connects the make contact of the transfer combination of the distributor to relay (PA6), and removes ground from the time-out alarm. Then the (Printer step) key 12104 is operated. This key operated will close the "A" and "B" leads to complete the magnet circuit to cause the distributor to start, if a character relay is operated. When the distributor moves, the transfer contact will operate relay (PA6), which will lock to the (Printer step) key on lead "LK," and open the magnet circuit. To again step, the printer step key must be released, releasing relay (PA6) and then be reoperated.

25.04 Emergency printer start

If the printer does not print for some reason, that is, the distributor does not start, the (Emerg. PTR start) key 12734 may be operated which will operate relay (PA9). Relay (PA9) operated will operate the (Star) relay 10601 via (PA8) relay 12110, will provide a locking path for relay (PA8), will lock to relay (PA8) released, and will provide a path for operating relay (PA8) from relay (PA5).

The star character is in the upper case. Therefore, it will be printed in the upper case, and when relay (PA5) operates, relay (PA8) will also operate, from the distributor contact. Relay (PA8) will lock if relay (PA9) is still up. If relay (PA9) is not held by the key it will release and release relay (PA8) releasing the (Star) relay. If the key is still held the (PA8) relay will stay locked to the (PA9) relay releasing the (Star) relay. To send the star again it is necessary to release and reoperate the (Emerg. PTR start) key.

25.5. Called office name translator

25.501 Purpose of circuit

The purpose of this circuit is to receive the three numerical digits representing the designa-

tion of the called central office and set up a series of three circuits such that when the printer arrives at that point in the printed line where the called office name or designation is to be entered, grounding of these three circuits in succession will cause the printing of characters, either letters or figures or combination of letters and figures which will represent the designation of the called central office.

25.503 Functions

3.1 Translates three numerical digits, the last of which may be zero into two letters and a figure representing the name of the called central office.

3.2 Translates three numerical digits, the middle of which is zero into two letters, or into one letter and a figure, or reproduce it as two characters representing the designation of the called central office.

3.3 Translates three numerical digits, the last two of which are zeroes into a letter or reproduce it as a character representing the designation of the called central office.

3.4 When three zeros are received no characters will be reproduced to represent the designation of the called central office.

3.5 Provides the same or different translation of the three digits for as many as ten dial areas.

3.6 Provides a check feature so that one and only one relay of each group of register relays and one and only one relay of the thirteen sequence relays have to be operated to be able to complete the proper functioning of the printer circuit.

3.7 Provides a means for printing Star characters if a no-check condition arises.

25.505 Description of operation—Central office with 3-digit designation

5.1 The called telephone number will be dialed as seven numbers, three to distinguish a particular central office and four to distinguish a particular telephone. Thus, in a call to Chelsea 3–1000, the number would be recorded as 243 1000, but to print the number it is desired to convert the first two digits to a C and H so that the printer circuit would show it as CH 3–1000. Since the "C" hole of the telephone dial has also A and B, and the "H" hole has G and I it is necessary to use the third digit which in this case is a 3 to select one of nine combinations of ABC and GHI.

5.2 The printer circuit will provide from the No. 3 storage circuit via the called office name translator circuit, Fig. 55, a ground on each of three groups of leads, one in the "B" group, one in the "C" group and one in the "D" group and for CH3, these leads would be "B2," "C4" and "D3" causing the operation of (DB2) relay 9600, (DC4) relay 9700 and (DD3) relay 9800; thus, the central office designation is registered in this translator circuit.

A ground from the back contact of (DB0) relay 11100 through a make contact of (DB2) relay 9600 operates the (S2) select magnets 11700 and 12300 of both cross bar switches (A) of Fig. 111 and (B) of Fig. 123. The select magnet off-normal contacts for magnets (2) will provide ground over lead (SX) through armature 6 and back contact of (X00) relay 9900, armature 6 and front make contacts of (DD3) relay 9800, armature 2 and back contacts of (X0X) relay 9901, armature 8 and front contact of (DC4) relay 9700 to hold (H4A) magnet 11701 of switch (A), operating it but leaving switch (B) unoperated. Off-normal contacts of (H4A) magnet 11701 will provide ground over lead "HX" to operate (HX) relay 11101. The purpose of relay (HX) is to insure the closure of all the 2–4 cross-points of the switch, before the ground on the armature of relay (HX) through armature 7 and front contact of (DD3) relay 9800 is applied over "W3" lead 9801 to all verticals of switches (A) and (B), through closed cross-point 243 to the 243 cross-connection terminal 12500. This ground now will be cross-connected to one of the thirteen sequence relays shown in Figs. 118 and 125. In the case for "CH3" translation it will be cross-connected to "32" terminal 12501 to operate (CB) relay 12502. With all operations proper to this point (NC) relay 9902 will be operated from the check circuit ground which in some cases may come from the ground 10100 and in other cases from the ground on armature 2 of the (A9) area relay 10000, thence through the one and one only check circuit of the (DB) relays in Figs. 96 and 108 and comprising in this case the front contact and armature 4 of the (DB2) relay 9600, and thence in series through the back contact and corresponding armatures of all the other (DB) relays to the back contact and armature 1 of the (DB0) relay 11100, thence through the one and one only check circuit of the (DC) relays in Figs. 97 and 109 transferring in this case through the armature 4 and front contact of the (DC4) relay 9700, thence through the one and one only check circuit of the (DD) relays shown in Figs. 98 and 110, transferring in this case through the front contact and armature 4 of the (DD3) relay 9800 to the back contact and armature 5 of the (X00) relay 9900, thence through the one and one only check circuit of the office sequence relays shown in Figs. 118 and 125, transferring in this case through the armature 2 and front contact of the (CB) relay 12502 to the winding of the (NC) relay 9902, thus causing the operation of this last relay. (NC) relay 9902 will provide ground on lead "ONC" to the printer circuit and will receive ground over leads "G1," "G2," and "G3" in succession for producing the three characters C, H and 3 in the printer circuit. If relay (NC) fails to operate, these three grounds will be sent back to the printer circuit over lead designated "Star." The "G1" ground through armature 1 and front contact of relay (NC), armature 2 and back contact of (DB0) relay 11100 over lead "GB" through armature 1 and front contact of (CB) relay 12502 over lead "3B" through armature 3 and front contact of (DB2) relay 9600 over lead "C" to the printer circuit to operate a relay in that circuit to produce the printer code for the letter C. The "G2" ground through armature 2 and front contact on relay (NC), armature 2 and back contact of (X00) relay 9900, over lead "GC" through armature 4 and front contact of relay (CB), over lead "2C," through armature 2 and front contact of (DC4) relay 9700, over lead "H" to the printer circuit to produce the letter H. The "G3" ground through armature 3 and front contact of relay (NC), armature 3 and front contact of relay (X00), armature 3 and back contact of relay (X0X) through armature 3 and front contact of relay (DD3) over lead "3" to the printer circuit will operate a relay in that circuit to produce figure 3. When these three characters have been printed the three grounds from the printer circuit on leads "B2," "C4" and "D3" are removed and all relays and switch magnets will release.

25.506 Central office with 2-digit designation

6.1 The called telephone number will be dialed

as six numbers, the first two being used to distinguish the particular central office. A call made as RE 1000 would be dialed as 7 3 1000 and would be recorded on the automatic accounting system tape as 7031000. It is desired to convert the 7 and 3 digits to R and E, respectively, and print them together with a space character between the E and 1.

6.2 The printer circuit will provide three grounds on leads "B7," "C0" and "D3" to operate relays (DB7), (DC0) and (DD3). With relay (DC0) operated, and relay (DD3) operated, relay (X0X) will be operated. A ground from armature 3 and back contact of relay (DB0) through armature 7 and front contact of relay (DB7) will operate both (S7) select magnets 11600 and 12300. When (X0X) relay 9901 operates a ground through its armature 1 and front contact from armature 4 and back contact of (X00) relay 9900, through armature 2 and front contact of (DD3) relay 9800 will operate (DC3) relay 9701. The select magnet off-normal contacts provide ground over lead "SX," through armature 6 and back contact of (X00) relay 9900, through armature 6 and front contact of (DD3) relay 9800, through armature 2 and front contact of relay (X0X) to operate (H0A) hold magnet 11702 of the (A) switch shown in Fig. 117. Its off-normal contacts provide ground over lead "HX" to operate relay (HX). The ground through the armatures of (HX) relay 11101, through the armature 7 and front contact of (DD3) relay 9800, over lead "W3" to all verticals of switch (A), through closed cross-point 703 to cross-connection terminal 11800. This ground now will be cross-connected to one of the thirteen sequence relays and in this case for "RE" translation it would be cross-connected to "22" terminal 11801 to operate (BB) relay 11802. For "R3" it would be connected to relay (BF), and for "73" it would be connected to relay (FF). With relay (NC) operated as explained above the two characters "R" and "E" will be produced in the printer circuit by grounds "G1" and "G2," and the "G3" ground will be connected back to the printer circuit over the lead designated "Space." When the three grounds are removed from leads "B7," "C0" and "D3," all relays and magnets will be released.

25.507 Central office with 1-digit designation

7.1 The called telephone number will be dialed as five numbers, the first to distinguish the particular central office. A call made as Y1000 would be dialed 91000 and would be recorded on the automatic accounting system tape 9001000. It is desired to convert the 9 to Y and print the Y character with two space characters following it.

7.2 The printer circuit will ground three leads "B9," "C0" and "D0," operating relays (DB9), (DC0) and (X00). Ground from armature 3 and back contact of (DB0) relay 11100, armature 7 and front contact of (DB9) relay 10800 will operate (S9) select magnets 11601 and 12301 of switches (A) and (B). Its off-normal contact over lead "SX" will provide ground, through armature 6 and front contact of (X00) relay 9900, over lead "H0A" to operate the (H0A) hold magnet 11702 of switch (A). Its off-normal contact will provide ground over lead "HX" to operate relay (HX). Ground from the armatures of relay (HX) through the armature 1 and front contact of relay (X00) over lead "W01" will be applied to vertical (0) of switch (A) only, and through closed 900 cross-point to "900" cross-connection terminal 12503. The ground now will be cross-connected to one of the thirteen sequence relays and in this case for "Y" translation it would it would be cross-connected to terminal 12504 to operate relay (CF). For "W" it would be connected to relay (AF); for "X" it would be connected to relay (BF); and for "9" it would be connected to relay (FF). With relay (NC) operated as explained above, the character "Y" will be produced in the printer circuit from ground "G1," and grounds "G2" and "G3" will be connected back to the printer circuit over the lead designated "Space." When the three grounds are removed from leads "B9," "C0" and "D0," all relays and magnets will be released.

25.508 Central office with no designation

8.1 The called telephone number will be dialed as four numbers, with no number to distinguish the central office. Such a call would be recorded on the automatic accounting system tape as 000 1000. Since there is no translation to be made, the operation of the switches is not needed, and three Space characters are set up by this circuit.

8.2 The printer circuit will ground three leads, "B0," "C0" and "D0" operating three relays, (DB0) relay 11100, (DC0) relay 11102 and (X00) relay 9900. These relays will close the check circuit for operating relay (NC). Then the three grounds "G1," "G2" and "G3" will be connected back to the printer circuit over lead designated "Space" to produce three spaces ahead of the telephone number. When the three grounds on leads "B0," "C0" and "D0" are removed, relays (DB0), (DC0), (DD0) and (NC) will be released.

25.509 Multiple dial areas

9.1 General

When the calls processed in an accounting office extend beyond the local dial area, it is necessary to distinguish between identical central office codes as used for the different areas. For this condition an optional is required and Figs. 100, 101, 112, 113, 119 and 120 are provided for the 0 area, and a set of tubes as shown in the lower parts of Figs. 101, 113 and 120 is provided for each additional area to which calls may be made. The area information is supplied by the printer circuit over the "A" leads, "A0" to "A9" into Fig. 100 depending upon the number of areas involved. The (0A) relay 10101 to (9A) relay 10000 provide an additional section in the check circuit, one of which has to be operated before relay (NC) can operate.

The cross-points of the switches (A) and (B) are wired through the cores of pick-up coils to ground as required to obtain the proper translation. As an example, lead 243 from the switch would pass through a coil in each of the groups representing an area in which the 243 combination occurs. Let us assume, by way of example, that the 243 combination wired to terminal 12500 (but not now cross-connected to terminal 12501) occurs in both the "0" and "1" areas shown but not in the "9" area. The conductor from terminal 12500 will, therefore, be threaded through coils 11300 and 11200 to ground. For this option, 60-cycle current will be passed through the front contacts of relay (HX), the 243 cross-points over lead 243 through the cores of all the coils involved as a single turn primary winding to ground. The coil as a transformer will apply alternating current voltage to its associated vacuum tube grid. If we now assume that the CH3 office is in the "0" area, then the tube 11301 will be activated but the tubes associated with the other coils through

which this 243 lead is threaded will not respond. This tube acting as an amplifier applies alternating current voltage through the input transformer 11302 to the grid of the associated gas tube 11303 which will then become conducting and cause the operation of one of the thirteen sequence relays (AA) to ((FF) in accordance with the run of the cross-connection lead 243. In this case the (CB) relay 12502 will be operated.

9.2 Multiarea office represented by three digits

For a call CH31000 in area 0, the printer circuit will provide grounds on four leads "A0," "B2," "C4" and "D3," operating (A0) relay 10101, (DB2) relay 9600, (DC4) relay 9700 and (DD3) relay 9800, thus the dial area and the central office designation are registered in this translator circuit. The operation of the circuit up to the closing of the switch cross-points is the same as explained for single dial area. For this case, cross-point lead "243" will pass through pick-up coil 11300. 60-cycle power from transformer "T2" through (R6) resistor 10102 to the make contacts of relay (HX) will connect to the verticals of the switch.

With relay (0A) operated, all the triodes associated therewith will be in condition to amplify, and coil 11300 only will be energized with alternating current. The grid of triode 11301 will receive 3 to 5 volts and with amplification in the triode and input transformer 11302 approximately 70 volts will be applied to the grid of the gas tube 11303. Thus, (CB) relay 12502 will be operated and grounds will be applied over leads "C," "H" and "3" to cause the printing of these three characters as a result of grounds "G1," "G2" and "G3" from the printer circuit, the same as for single dial area explained above. The removal of ground from the four leads "A0," "B2," "C4" and "D3" will release all relays and magnets, and extinguish the gas tube by the opening of its plate supply voltage.

When relay (A0) operated, the grid supply voltage for all amplifiers was changed from −48 volts to −1.8 volts by connecting the point between resistors 11103 and 11104 to conductor 11105, thus putting the tubes in a condition for passing 60-cycle alternating current. The amplifier tubes for operating the thirteen relays of Figs. 118 and 125, were left with a grid supply of −48 volts so that all such grids were beyond cut-off, and any coil enclosing lead "243" in area 1 or other areas would be blocked from causing the operation of any of the thirteen sequence relays as a result of alternating current over lead "243."

9.3 Multiarea office represented by two, one or no digits

For these office numbers, the operation is the same as for the single dial area explained above.

25.510 Cross-connection determination

The cross-connection scheme may be explained by the help of Fig. 132. The thirteen relays of Figs. 118 and 125 are arranged in a coordinate manner with the first digit characters of the office name vertically above them and the second digit characters of the office name horizontally to the right thereof. Through the operation of the relays (DB2) and (DC4) one of the points 240 to 249 of the cross bar switches is rendered active, in this case the point 243 since the relay (DD3) is also operated. Now, if this point 243 is connected to the (CB) relay the 243 will be translated to and printed as CH3. If, on the other hand, it is connected to the (BC) relay then the 243 will be translated to and printed as BI3. It may be noted that nine combinations are possible, as follows:

Relay	Translation
AA	AG3
BA	BG3
CA	CG3
AB	AH3
BB	BH3
CB	CH3
AC	AI3
BC	BI3
CC	CI3

Where the area arrangement is employed using the relays of the A group (Figs. 100 and 101), all these variations could be employed by threading the 243 conductor through selected coils. In the present case only two such combinations are shown, as:

Area Relay	Relay	Translation	Coil
A0	CB	CH3	11300
A1	BC	BI3	11200

By the same token, the two-digit office name RE, which it was explained was produced by the relays (DB7), (DC0) and (DD3) and by which the cross bar switch of Fig. 116 activated the lead 703 here connected to the cross-connecting point 11800, is capable of a number of translations, as follows, the variations shown in the area arrangement being included:

Area Relay	Relay	Translation	Coil
	AA	PD	
	BA	RD	
	CA	SD	
	AB	PE	
A0	BB	RE	11304
	CB	SE	
A1	AC	DF	10001
	BC	RF	
A9	CC	SF	11900

Again, in the case of the single-digit office where the relays (DB9), (DC0) and (X00) are operated the translations may be as follows, in this case only three being possible:

Area Relay	Relay	Translation	Coil
A1	AF	W	11901
A9	BF	X	11902
A0	CF	Y	12000

It may be noted that from a practical standpoint all the possible combinations will not be used, since (1) there are more than enough and (2) the translation has to be fitted to an office name as:

CH for Chelsea
CI for Circle
PE for Pennsylvania
RE for Rector or Regent

In the last case it might be:

RE7 for Regent 7 and
RE2 for Rector 2

26. Distributor circuit

26.01 General operation

The distributor is a unit of Teletype mechanism

designed to transmit teletypewriter signals at the rate of 100 words or 600 characters a minute.

This mechanism consists of six cam-driven contacts. These contacts are designated (Stop), 1, 2, 3, 4 and 5, and are set in line, controlled as to their time of closure by a set of cams on a common shaft.

The cam shaft is driven by an alternating current synchronous motor (261) which rotates at 1800 revolutions a minute. The motor is geared to the cam shaft by a three-to-one reduction set of gears, which causes the cam shaft to rotate at 600 revolutions a minute.

The cam shaft is connected to the motor through a toothed clutch, and when the distributor is at rest the clutch is held out of engagement by the armature of a magnet, which magnet when released causes a portion of the clutch to be cammed out of engagement, with the second portion of the clutch, against the tension of a spring.

When the distributor is at rest the (Stop) contact is closed and the 1, 2, 3, 4 and 5 contacts are open. The distributor makes 1 revolution to transmit one character to the printer.

When it is desired to send a character, the start magnet (260) is energized, which causes the clutch to engage and the cam shaft to begin to rotate. Shortly after the cam shaft begins to rotate the (Stop) contact opens, and it stays open for a time of approximately .079 second, and .0132 second must elapse before the No. 1 contact closes. Then the five contacts close in sequence each staying closed for approximately .0132 second. If the start magnet is released while this transmission is taking place, the cam shaft will stop after the fifth pulse and the (Stop) contact will close and stay closed. If, on the other hand, the start magnet had not been released, the stop contact will close for a time of approximately .0198 second and then open again.

The (Stop) contact always closes the circuit to the printer, but whether contacts 1 to 5 close the circuit to the printer depends upon the position of the relays (P1) to (P5) in Fig. 94 as has been explained in section 25.

The time division of the .100 second rotating time of the cam shaft is, therefore, as follows:

Stop contact	.0198
Start open interval	.0132
Contact No. 1	.0132
Contact No. 2	.0132
Contact No. 3	.0132
Contact No. 4	.0132
Contact No. 5	.0132

Also associated with the shaft are two transfer contacts, one a plain transfer and one a continuity contact. These transfer contacts are actuated at the time the No. 1 contact makes and releases at the time the No. 5 contact opens. These contacts are referred to as universal contacts.

These contacts are for the following purposes, which have been explained under other figures. The plain transfer is provided to actuate the printer character sequence circuit, while the continuity contact is provided to lock the (P1) to (P5) relays and to open their operating circuits during the time that transmission is taking place to the printer.

27. Printer circuit

27.01 General

The circuit of the printer is shown in Fig. 126 and the method of operation of this circuit is explained in sections 9 and 25.

28. Line pattern connector circuit, Figs. 31, 32, 33, 39, 40, 41, 46, 47 and 48

28.01 General

The function of this circuit is to operate in conjunction with the printer character count circuit, to guide the grounds applied by the printer character count circuit directly to the printer code translator circuit or to other circuits that will determine the character relay that is to be operated. The order of leads to be grounded is such that the printed characters will appear in the proper sequence to form either a title or line on the page or slip.

For a particular type of tape, the title sequence is determined by the setting of the tape type switch 500 in Fig. 5, and by the operated relays of Figs. 6 and 13. The sequence of characters for a line is determined by the setting of the tape type switch and the operated relays of the entry class register circuit in addition to those of the tape class connector circuit.

Referring to section 38, which shows the form and make-up of the printed lines and titles for the various forms of printing, the following table shows the relays in this circuit that are concerned with each line and title.

Relays used for titles

Type of Tape	Title Relay	Title Tens Relay
Verbatim		VBT
Summary	MUT	T9, T10
Toll	RDT	T1, T2
Message Unit Detail	MUDT	T1, T3, T4
Observing	LOT	T1, T5, T6
Straddle	STRT	T11, T12

Relays used for lines

Type of Tape	Type of Entry	Line Relay	Line Tens Relay—S. A.	Line Tens Relay—M. A.
Verbatim			VBL	VBL
Summary	Local	MUL1	L2, L1	L2, L1
	Extended	MUL2	L3, L4	L3, L4
Toll	Detail	RD	L15, L21, L16	L15, L21, L16
Mess. Unit Detail	Detail	MUDL	L15, L21, L17	L15, L21, L17, L1
Obs	Detail	MUDL	L15, L21, L17	L15, L21, L17, L1
	NON-ANS	OB	L18, L22	L18, L21, L22
Straddle	In. DET	SL1	L5, L6, L7, L8, L19, L20	L5, L6, L7, L8, L19, L20
	In. MU	SL2	L5, L6, L7, L8, L9	L5, L6, L7, L8, L9
	A and D	SL3	L5, L10, L11, L12, L13	L5, L10, L11, L12, L13
	Timing	SL4	L5, L23, L14, L7, L13	L5, L23, L14, L7, L13

It will be remembered from the description of the printer character sequence circuit that two grounded leads are always supplied to this circuit, one indicating the tens group, these leads being designated "GRO" to "GR50" and the

other indicating the units group designated "I" to "11." The "11" lead is used only for straddle initial detail entries in multiple areas as will be seen later.

The "T" lead (title) and "L" lead (line) from the printer control circuit are guided to this circuit by other circuit elements to operate either the title relays, or the line relays, depending upon whether a title or a line is to be printed. Either a title or a line relay operated connects six leads "GRO" to "GR50" to operate either title tens relays, or line tens relays as the case may be. When a tens relay is operated, it connects the unit leads "1" to "11" to the ultimate point where the character to be printed is determined.

In the case of verbatim, it is not necessary to use a title or line relay as the number of characters to be printed does not exceed ten. Therefore, the (VBT) relay 4600 or the (VBL) relay 4800 is operated directly from the "T" and "L" leads and the tens leads are not used.

The following list shows the various tens relays used for the different lines and titles, and the leads which are grounded to operate the character relays in the code relay circuit, Figs. 94, 95, 106, 107, 114, 115, 121 and 122.

	Count	Via Relay	Lead Used
Verbatim	1	VBT	CRLF
	2	VBT	CRLF
	3	VBT	CRLF
	4	VBT	CRLF
	5	VBT	ET
Summary Title	1	T9	CRLF
	2	T9	CRLF
	3	T9	CRLF
	4	T9	CRLF
	5	T9	P1
	6	T9	P2
	7	T9	P3
	8	T9	SP
	9	T9	C870
	10	T9	C871
	11	T10	C872
	12	T10	SP
	13	T10	P4
	14	T10	CR
	15	T10	ET
Toll Title	1	T1	C810
	2	T1	C811
	3	T1	C812
	4	T1	SP
	5	T1	C813
	6	T1	C814
	7	T1	C815
	8	T1	C816
	9	T1	SP
	10	T1	C870
	11	T2	C871
	12	T2	C872
	13	T2	CR
	14	T2	ET
Message Unit Detail Title	1	T1	C810
	2	T1	C811
	3	T1	C812
	4	T1	SP
	5	T1	C813
	6	T1	C814
	7	T1	C815
	8	T1	C816
	9	T1	SP
	10	T1	C870
	11	T2	C871
	12	T2	C872
	13	T2	SP
	14	T2	M
	15	T2	U
	16	T2	DASH
	17	T2	D
	18	T2	E
	19	T2	T
	20	T2	CR
	21	T4	ET
Observing Title	1	T1	C810
	2	T1	C811
	3	T1	C812
	4	T1	SP
	5	T1	C813
	6	T1	C814
	7	T1	C815
	8	T1	C816
	9	T1	SP
	10	T1	C870
	11	T5	C871
	12	T5	C872
	13	T5	SP

	Count	Via Relay	Lead Used
Observing Title—Continued	14	T5	L
	15	T5	I
	16	T5	N
	17	T5	E
	18	T5	SP
	19	T5	O
	20	T5	B
	21	T6	S
	22	T6	CR
	23	T6	ET
Straddle Title	1	T11	CRLF
	2	T11	CRLF
	3	T11	CRLF
	4	T11	CRLF
	5	T11	P5
	6	T11	P6
	7	T11	SP
	8	T11	C870
	9	T11	C871
	10	T11	C872
	11	T12	SP
	12	T12	P4
	13	T12	CR
	14	T12	ET
Verbatim Line	1	VBL	CS65
	2	VBL	CS60
	3	VBL	C861
	4	VBL	C862
	5	VBL	C863
	6	VBL	C864
	7	VBL	CR
	8	VBL	EL
Summary, Local Entry Line	1	L2	C813
	2	L2	C814
	3	L2	C815
	4	L2	C816
	5	L2	SP
	6	L2	C841
	7	L2	C842
	8	L2	C843
	9	L2	C844
	10	L2	CR
	11	L1	EL
Summary, Extended Entry Line	1	L3	C813
	2	L3	C814
	3	L3	C815
	4	L3	C816
	5	L3	SP
	6	L3	C841
	7	L3	C842
	8	L3	C843
	9	L3	C844
	10	L3	SP
	11	L4	C851
	12	L4	C852
	13	L4	C853
	14	L4	C854
	15	L4	CR
	16	L4	EL
Toll Line, Single Area	1	L15	C825
	2	L15	C822
	3	L15	SP
	4	L15	C826
	5	L15	C823
	6	L15	SP
	7	L15	C827
	8	L15	C824
	9	L15	SP
	10	L15	G1
	11	L21	G2
	12	L21	G3
	13	L21	SP
	14	L21	CS40
	15	L21	C841
	16	L21	CS42
	17	L21	CS45
	18	L21	C846
	19	L21	SP
	20	L21	C851
	21	L16	CS52
	22	L16	CR
	23	L16	EL
Toll Line, Multiple Area	1	L15	CS25
	2	L15	CS22
	3	L15	SP
	4	L15	CS26
	5	L15	CS23
	6	L15	SP
	7	L15	C827
	8	L15	CS24
	9	L15	SP
	10	L15	SP
	11	L21	CS30
	12	L21	SP
	13	L21	G1
	14	L21	G2
	15	L21	G3
	16	L21	SP
	17	L21	CS40
	18	L21	C841
	19	L21	C842
	20	L21	C845
	21	L16	C846
	22	L16	SP
	23	L16	C851
	24	L16	CS52
	25	L16	CR
	26	L16	EL

	Count	Via Relay	Lead Used
Mess. Unit Det. and Observing Line, Single Area	1	L15	CS25
	2	L15	CS22
	3	L15	SP
	4	L15	CS26
	5	L15	CS23
	6	L15	SP
	7	L15	CS27
	8	L15	CS24
	9	L15	SP
	10	L15	G1
	11	L21	G2
	12	L21	G3
	13	L21	SP
	14	L21	CS40
	15	L21	CS41
	16	L21	CS42
	17	L21	CS45
	18	L21	CS46
	19	L21	SP
	20	L21	CS51
	21	L17	CS52
	22	L17	SP
	23	L17	CS53
	24	L17	CS54
	25	L17	SP
	26	L17	CS55
	27	L17	CR
	28	L17	EL
Mess. Unit Det. and Observing Line, Multiple Area	1	L15	CS25
	2	L15	CS22
	3	L15	SP
	4	L15	CS26
	5	L15	CS23
	6	L15	SP
	7	L15	CS27
	8	L15	CS24
	9	L15	SP
	10	L15	SP
	11	L21	CS30
	12	L21	SP
	13	L21	G1
	14	L21	G2
	15	L21	G3
	16	L21	SP
	17	L21	CS40
	18	L21	CS41
	19	L21	CS42
	20	L21	CS45
	21	L17	CS46
	22	L17	SP
	23	L17	CS51
	24	L17	CS52
	25	L17	SP
	26	L17	CS53
	27	L17	CS54
	28	L17	SP
	29	L17	CS55
	30	L17	CR
	31	L1	EL
Non-Answered Observing Line, Single Area	1	L18	CS25
	2	L18	CS22
	3	L18	SP
	4	L18	CS26
	5	L18	CS23
	6	L18	SP
	7	L18	SP
	8	L18	SP
	9	L18	SP
	10	L18	G1
	11	L22	G2
	12	L22	G3
	13	L22	SP
	14	L22	CS40
	15	L22	CS41
	16	L22	CS42
	17	L22	CS45
	18	L22	CS46
	19	L22	CR
	20	L22	EL
Non-Answered Observing Line, Multiple Area	1	L18	CS25
	2	L18	CS22
	3	L18	SP
	4	L18	CS26
	5	L18	CS23
	6	L18	SP
	7	L18	SP
	8	L18	SP
	9	L18	SP
	10	L18	SP
	11	L21	CS30
	12	L21	SP
	13	L21	G1
	14	L21	G2
	15	L21	G3
	16	L21	SP
	17	L21	CS40
	18	L21	CS41
	19	L21	CS42
	20	L21	CS45
	21	L22	CS46
	22	L22	CR
	23	L22	EL

	Count	Via Relay	Lead Used
Straddle Initial Detail Line, Single Area	1	L5	CS55
	2	L5	SP
	3	L5	CS56
	4	L5	CS51
	5	L5	CS52
	6	L5	SP
	7	L5	CS53
	8	L5	CS54
	9	L5	SP
	10	L5	CS66
	11	L6	CS67
	12	L6	SP
	13	L6	CS61
	14	L6	CS62
	15	L6	SP
	16	L6	CS63
	17	L6	CS64
	18	L6	SP
	19	L6	SP
	20	L6	SP
	21	L7	SP
	22	L7	SP
	23	L7	SP
	24	L7	SP
	25	L7	SP
	26	L7	SP
	27	L7	SP
	28	L7	SP
	29	L7	SP
	30	L7	SP
	31	L8	SP
	32	L8	SP
	33	L8	CS10
	34	L8	CS11
	35	L8	CS12
	36	L8	SP
	37	L8	CS13
	38	L8	CS14
	39	L8	CS15
	40	L8	CS16
	41	L19	SP
	42	L19	SP
	43	L19	CS21
	44	L19	SP
	45	L19	CS28
	46	L19	CS29
	47	L19	SP
	48	L19	G1
	49	L19	G2
	50	L19	G3
	51	L20	SP
	52	L20	CS40
	53	L20	CS41
	54	L20	CS42
	55	L20	CS45
	56	L20	CS46
	57	L20	CR
	58	L20	EL
Straddle Initial Detail Line, Multiple Area	1	L5	CS55
	2	L5	SP
	3	L5	CS56
	4	L5	CS51
	5	L5	CS52
	6	L5	SP
	7	L5	CS53
	8	L5	CS54
	9	L5	SP
	10	L5	CS66
	11	L6	CS67
	12	L6	SP
	13	L6	CS61
	14	L6	CS62
	15	L6	SP
	16	L6	CS63
	17	L6	CS64
	18	L6	SP
	19	L6	SP
	20	L6	SP
	21	L7	SP
	22	L7	SP
	23	L7	SP
	24	L7	SP
	25	L7	SP
	26	L7	SP
	27	L7	SP
	28	L7	SP
	29	L7	SP
	30	L7	SP
	31	L8	SP
	32	L8	SP
	33	L8	CS10
	34	L8	CS11
	35	L8	CS12
	36	L8	SP
	37	L8	CS13
	38	L8	CS14
	39	L8	CS15
	40	L8	CS16
	41	L19	SP
	42	L19	SP
	43	L19	CS21
	44	L19	SP
	45	L19	CS28
	46	L19	CS29
	47	L19	SP
	48	L19	SP

	Count	Via Relay	Lead Used
Straddle Initial Detail Line, Multiple Area—Continued	49	L19	CS30
	50	L19	SP
	51	L20	G1
	52	L20	G2
	53	L20	G3
	54	L20	SP
	55	L20	C840
	56	L20	C841
	57	L20	C842
	58	L20	C845
	59	L20	C846
	60	L20	CR
	61	L20	EL
Straddle Mess. Unit Initial Line	1	L5	C855
	2	L5	SP
	3	L5	C856
	4	L5	C851
	5	L5	C852
	6	L5	SP
	7	L5	C853
	8	L5	C854
	9	L5	SP
	10	L5	C866
	11	L6	C867
	12	L6	SP
	13	L6	C861
	14	L6	C862
	15	L6	SP
	16	L6	C863
	17	L6	C864
	18	L6	SP
	19	L6	SP
	20	L6	SP
	21	L7	SP
	22	L7	SP
	23	L7	SP
	24	L7	SP
	25	L7	SP
	26	L7	SP
	27	L7	SP
	28	L7	SP
	29	L7	SP
	30	L7	SP
	31	L8	SP
	32	L8	SP
	33	L8	C810
	34	L8	C811
	35	L8	C812
	36	L8	SP
	37	L8	C813
	38	L8	C814
	39	L8	C815
	40	L8	C816
	41	L9	SP
	42	L9	SP
	43	L9	C821
	44	L9	SP
	45	L9	C828
	46	L9	C829
	47	L9	CR
	48	L9	EL
Straddle Answer-Disconnect Line	1	L5	C855
	2	L5	SP
	3	L5	C856
	4	L5	C851
	5	L5	C852
	6	L5	SP
	7	L5	C853
	8	L5	C854
	9	L5	SP
	10	L5	C866
	11	L6	CS67
	12	L6	SP
	13	L6	CS61
	14	L6	CS62
	15	L6	SP
	16	L6	CS63
	17	L6	C864
	18	L6	SP
	19	L6	C830
	20	L6	C831
	21	L11	C832
	22	L11	SP
	23	L11	C833
	24	L11	C834
	25	L11	SP
	26	L11	C840
	27	L11	C841
	28	L11	SP
	29	L11	C842
	30	L11	C843
	31	L12	C844
	32	L12	SP
	33	L12	SP
	34	L12	SP
	35	L12	SP
	36	L12	SP
	37	L12	SP
	38	L12	SP
	39	L12	SP
	40	L12	SP
	41	L13	SP
	42	L13	SP
	43	L13	SP
	44	L13	SP
	45	L13	CS28
	46	L13	CS29

	Count	Via Relay	Lead Used
Straddle Answer-Disconnect Line—Continued	47	L13	CR
	48	L13	EL
Straddle Timing Entry Line	1	L5	C855
	2	L5	SP
	3	L5	C856
	4	L5	C851
	5	L5	C852
	6	L5	SP
	7	L5	C853
	8	L5	C854
	9	L5	SP
	10	L5	C866
	11	L23	C867
	12	L23	SP
	13	L23	C861
	14	L23	C862
	15	L23	SP
	16	L23	C863
	17	L23	C864
	18	L23	SP
	19	L23	C820
	20	L23	C821
	21	L14	C822
	22	L14	SP
	23	L14	SP
	24	L14	SP
	25	L14	SP
	26	L14	SP
	27	L14	SP
	28	L14	SP
	29	L14	SP
	30	L14	SP
	31	L7	SP
	32	L7	SP
	33	L7	SP
	34	L7	SP
	35	L7	SP
	36	L7	SP
	37	L7	SP
	38	L7	SP
	39	L7	SP
	40	L7	SP
	41	L13	SP
	42	L13	SP
	43	L13	SP
	44	L13	SP
	45	L13	CS28
	46	L13	CS29
	47	L13	CR
	48	L13	EL

We will examine a typical title and line in detail, in order to show the general operation of this circuit.

28.02 Typical title

Summary title

The (MUT) relay 4700 is operated over the "T" lead 4910 from the printer control circuit. With this (MUT) relay operated and ground being present on the "GR0" lead from the back contact of armature 2 of (G10) relay 3500, (T9) relay 4603 operates. When relay (T9) operates, ground being present on lead "1," the (CRLF) relay 12100 is operated to send the carriage return line feed signal to the printer. The unit leads "2" to "4" are connected in sequence to the (CRLF) relay by the grounding of leads "2," "3" and "4." When this group of line feeds is in the printer, the paper is in the proper position for a new page. The "5," "6" and "7" leads are then guided via the office switch 1202 to print the office name. Lead "8" is connected to the (SP) relay 12102 to space the printer once, and leads "9" and "10" are connected via leads "CS70" and "CS71" to the month translator circuit, Figs. 51 and 52, to print the first two letters of the month.

(T9) relay 4603 is then released by the ground being withdrawn from the lead "GR0." The ground is then placed on lead "GR10" through the operation of (G10) relay 3500 which causes the operation of (T10) relay 4604. The "1" lead prints the last letter of the month, and lead "2" causes a space. Lead "3" prints the round numeral via the round switch 2002. Lead "4" returns the carriage and causes the line count circuit to register, and lead "5" indicates to the

printer control circuit that the title is complete by operating (ET) relay 4911.

28.03 Typical line

Local message unit entry

The (MUL1) relay 4100 is operated over the "L" lead 4913 from the printer control circuit. With the (MUL1) relay operated, the ground on lead "GR0" causes the operation of (L2) relay 3200. Leads "1," "2," "3" and "4" are guided through the No. 1 storage circuit to print the directory number, lead "5" causes a space to be printed, leads "6," "7," "8" and "9" via the No. 4 storage circuit cause the printing of the local message units, and lead "10" causes the return of the carriage and the registry of the line count. Relay (L2) is released and (L1) relay 3201 operated over lead "GR10." Lead "1" now indicates that the line is complete by operating (EL) relay 4907.

29. Month translator circuit, Figs. 51 and 52

29.01 Operation of the circuit

The month which is used in all titles, is set up on two switches 2000 and 2001 on the panel. These switches are known as the month tens which has two points, and the month units which has ten points. The twelve months may thus be represented by two digits, which must be translated into an abbreviation of the particular month in accordance with the following table:

Numerals	Abbreviation
01	JAN
02	FEB
03	MAR
04	APR
05	MAY
06	JUN
07	JUL
08	AUG
09	SEP
10	OCT
11	NOV
12	DEC

If the month tens switch is set on the 0 position (MTB) relay 5100 will be operated via contacts on (MTA) relay 5101. With this relay (MTB) operated, the position of the month units switch will determine which of the month relays (JAN) to (SEP) is operated, the 0 point not being active.

If the month tens switch 2000 is set on 1, then (MTC) relay 5102 will be operated via the contacts of (MTA) relay 5101. With relay (MTC) operated, 0, 1 and 2 will be available on the units switch to operate one of the relays (OCT), (NOV) or (DEC).

Three sequence leads extending from Figs. 31, 39 and 46 to Fig. 52 are provided, "CS70," "CS71" and "CS72," which when grounded in this order, will print the characters represented by the month relay operated, by operating corresponding relays in the printer code relay circuit.

Leads "TA1" and "TB1" via the tape class connector circuit form part of the title locking circuit for the printer control circuit. As long as these leads are closed, the same title will be repeated whenever a new title is required. Opening of these leads causes the printing of a new title. In printing slips, a change in month must be made, and the change in month must cause a new title to be printed.

As described in connection with the No. 2 storage circuit in the last round of a month, this round will lap over the new month, and whenever 0 appears in the tens digit of the day of the month, the month must be changed to the succeeding one. Two leads are provided from the No. 2 storage circuit to this circuit, one the "CM" lead which indicates a change to a new month, and the "NC" lead which indicates no change or a change back to the old month.

If lead "CM" is grounded (MTCM) relay 5103 will operate. Relay (MTCM) operated will operate (MTA) relay 5101. Relay (MTA) operated will substitute (MTD) relay 5200 and (MTE) relay 5201 for (MTB) relay 5100 and (MTC) relay 5102, and relay (MTD) or (MTE) will operate depending upon the position of the month tens switch. Relay (MTD) operated will connect the contacts of the month units switch to the (FEB) to (OCT) relays instead of the (JAN) to (SEP) relays, or relay (MTE) operated will connect to the (NOV) to (JAN) relays instead of the (OCT) to (DEC) relays. Hence, any month that has been set up will be advanced one month.

(MTCM) relay 5103 operated:

1. Operated (MTA) relay 5101 as just described.
2. Operated (MTF) relay 5105 which locks on its secondary winding to (MTNC) relay 5104 released.
3. Opened the locking circuit for (MTG) relay 5202.
4. Grounded "MCK" check lead 5204 for use with the No. 2 storage circuit.

Assuming that (MTH) relay 5203 was released, then leads "TA1" and "TB1" are open, and a new title is required. At the end of the title, lead "L03" will be grounded by the printer control circuit through the operation of (ET) relay 4911 which will cause (MTH) relay 5203 to operate and lock under the control of (MTF) relay 5105 which is operated.

Relay (MTH) operated:

1. Removes battery from the primary windings of both relays (MTF) and (MTG).
2. Locks to relay (MTG) or (MTF) whichever is operated.
3. Closes leads "TA1" and "TB1" to lock out the title change in the printer control circuit.

When the registration in the No. 2 storage circuit is removed, (MTCM) relay 5103 will release, but (MTF) relay 5105 will remain locked to (MTNC) relay 5104 and (MTH) relay 5203 will remain locked to (MTF) relay 5105.

If the next registration again operates relay (MTCM), relays (MTF) and (MTH) remain operated and no new title is inserted.

If, however, the next time registered in the No. 2 storage circuit is such as to ground the "NC" lead 5104, relay (MTNC) will operate. Relay (MTNC) operated will cause the release of relay (MTF), but relay (MTG) will not operate because the battery is off at relay (MTH). When relay (MTF) releases, relay (MTH) will release. When relay (MTH) releases, relay (MTG) will operate and lock to relay (MTCM) released. Leads "TA1" and "TB1" will open and cause a new title to be printed. At the end of the title, ground on lead "L03" will again operate relay (MTH) which will now lock to relay (MTG).

This arrangement insures that relay (MTH) releases before relay (MTG) operates, likewise the relay (MTH) releases before the relay (MTF) operates.

A check ground will only be applied to lead "MCK" when the proper memory relay (MTF) or (MTG) is operated. Thus, a memory is provided of the condition previously set up.

30. Storage circuit No. 1, Figs. 58, 59, 70, 71, 82 and 83

30.01 Operation of the circuit

This circuit is used to store the information received from the automatic accounting system tape in the following entries:

Line 1 of the detail entry
Line 1 of the non-answered entry
Line 1 of the local message unit entry
Line 1 of the local and extended message unit entry
Line 3 of the straddle initial detail entry
Line 3 of the straddle initial message unit entry

In the case of the printing of the toll, message unit detail and observing tapes which use both the detail and non-answered entries, the information contained therein is used to govern the title of the printed slips and, therefore, must be memorized in order to determine when a new title and new slip are required.

The circuit function is, therefore, to receive the "office" and "directory number" information from the reader relays, to provide a means for the proper guidance of the printing sequence leads, to print the proper information and under some conditions to memorize the condition that has been set up, and indicate to other circuits when a change of information takes place.

This storage circuit is brought into use by the operation of (S1A) relay 5800, (S1B) relay 8200 and (S1C) relay 8201 from ground, from the reader line count circuit, guided by the entry class register circuit. The count circuit paths are determined by the setting of the tape type switch 500, by the operated relays in the tape class connector circuit and by the identification of the entry in the reading relay translator circuit.

The operation of these relays connects the B, C, D, E and F groups of reading relays with five leads each to twenty-five relays in this circuit. These twenty-five relays are in five groups of five relays each:

(S1B0) to (S1B7)
(S1C0) to (S1C7)
(S1D0) to (S1D7)
(S1E0) to (S1E7)
(S1F0) to (S1F7)

In each group of five leads from the reading relays ground will be present on two and only two of the leads. Therefore, in each of the above groups of five relays, two and only two relays will operate. These relays when operated will lock at their armature 3 and front contact to the printer control circuit, the B, C and D groups over lead "LKA" and the E and F groups over lead "LKB," both grounded at a back contact of (UNLK) relay 5602.

The two relays operated represent one numeral from 0 to 9 depending upon the particular two relays operated in accordance with the code previously described. It is necessary here, that this two-out-of-five code be decoded to indicate the particular digit registered.

Each of these relays is equipped with a contact to ground to which a lamp can be connected by a relay in the lamp connector circuit for the purpose of reading the combination present in these relays.

We will examine the relays (S1B0) to (S1B7), by way of example, since the other four groups act in exactly the same manner.

The digit 1 is represented by the operation of (S1B0) relay 5801 and (S1B1) relay 5802. In any group of five relays where two out of five relays operated are taken to represent one of the possible ten combinations, it follows axiomatically, that the same number of combinations of three relays released will also represent the same combinations. Therefore, with relays (0) and (1) operated a circuit is complete from ground on the armature 6 and back contact of (S1B7) relay 5900 via armature 7 and back contact on (S1B4) relay 5901, armature 7 and back contact on (S1B2) relay 5803, armature 7 and front contact on (S1B1) relay 5802, armature 6 and front contact on (S1B0) relay 5801 to operate (S1BB) relay 5804 to battery through a contact on (S1BY) relay 5902. This operated (S1BB) relay locks on its secondary winding, through back contacts of relays (S1B2), (S1B4) and (S1B7) to the original operating ground.

Similar operating and locking paths are available for the other nine relays (S1BA) to (S1BK) for the other nine combinations of the five relays (S1B0) to (S1B7). When any combination of two relays is operated, there is one operating path and one locking path for only one of the relays (S1BA) to (S1BK), therefore, only one of these relays can operate and lock.

This action is true for all the units B, C, D, E and F.

Let us assume, for descriptive purposes, that line 1 of the detail entry is being stored, there is a numeral representing the directory number in groups C, D, E and F. Therefore, when all the numerals are stored, there are two relays operated in each group of five relays and one each in each group of ten storing relays. The office and directory number is now stored. When one of the (S1BA) to (S1BK) storing relays in each group is operated, a common relay in each group represented by the (S1BX) relay 5903 in the B group is operated. Therefore, when all the numerals are completely stored, five of these relays will be operated, which will close a circuit from ground 8302 on lead "B" of group F, through the similar relays in all other groups, and out of this circuit through the armature 1 and front contact of (S1C) relay 8201 on lead "S1C" to the entry class register circuit. Thus, the "S1C" lead is the check lead for indicating to the reader control circuit and the reader line count circuit that five digits have been registered in the storage circuit, and that the count may progress to the next line. When the count circuit progresses, (S1A) relay 5800, (S1B) relay 8200 and (S1C) relay 8201 release, leaving the operated relays in this circuit locked to the printer control circuit on leads "LKA" and "LKB." The "S1C" lead also indicates to the printer control circuit that enough information from an entry has been stored for the printing to start, that is, if this storage circuit receives the information that is required for the beginning of the printing of an entry. The entry class register circuit determines how much information is required before printing can start.

In order to accomplish the printing of the characters, leads "CS10" to "CS15" must be grounded in order, one at a time by the printer character sequence circuit. Arranging the order of the leads takes place in the line pattern

connector circuit. The "CS11" to "CS16" leads connect directly to the line pattern circuit but the "CS10" lead is carried through the printer control circuit where in titling slips, it is closed only if the slip is in position to receive the title informaton. The counting grounds for the "CS10," "CS11" and "CS12" leads are guided via (S1BX) relay **5903** operated and the one operated relay (S1BA) to (S1BK), which represents the office, via the marker group translator, Fig. 28, where the office is interpreted into its name, to the character relays of the printer code relay circuit. The counting grounds for the "CS13," "CS14," "CS15" and "CS16" leads are guided via operated (S1CX) relay **7100**, relays (S1DX), (S1EX) and (S1FX), respectively, through one relay operated in each of the four groups (S1CA) to (S1CK), (S1DA) to (S1DK), (S1EA) to (S1EK) and (S1FA) to (S1FK), to the numerical leads to the printer code translator circuit, which controls the printing of the four directory digits.

Any relay operated in the storing relays of all the groups, grounds "G" lead **4904** to the printer control circuit to lock the (IN) relay **4902** in that circuit until all operated relays in this and all other storage circuits required for the entry are released. Ground on lead "L02" operates (S1L) relay **8300** which in turn operates (S1BY) relay **5902**, (S1CY) relay **7101**, relays (S1DY), (S1EY) and (S1FY) which lock under the control of the one associated (S1A) to (S1K) relay that is operated.

The (S1BY) relay **5902** operated removes battery from the (S1BA) to (S1BK) relays but the one operated relay remains locked to the closed path in the (S1B0) to (S1B7) relays and partially closes the "TB" and "TB1" leads. The similar relays in the C, D, E and F groups similarly lock up and cut off battery, and the contacts of the four relays complete the closure of the "TB" and "TB1" leads in this circuit.

The circuit of the "TB" and "TB1" leads holds the (LK) relay **4912** and (SW) relay **4905** operated, thus preventing a new title from being printed as long as these leads remain intact.

When the printing of the whole detailed entry we have under contemplation is completed, ground is removed from the "LKA" and "LKB" leads through the operation of (UNLK) relay **5602** which releases all the storing relays in the five groups and the (S1BX) and similar relays. It will be noted, however, that the locking circuit of the operated numeral relay in the five groups is not disturbed by the release of these relays as they were locked to relays already released. Therefore, the circuit of the "TB" and "TB1" leads remains undisturbed, and relay (S1BY) and similar relays remain operated. Now a new entry is stored in this circuit from another detail entry. If the numerals are the same in each of the five groups, the "TB" and "TB1" leads remain closed in this circuit and no title is printed.

If, however, the new entry had a different office or a different directory number, in other words, a difference in any one of the digits, let us assume that it is in the office digit, group B, then the locking circuit for the relay that was operated is opened and it releases, releasing relay (S1BY). The new numeral relay cannot operate until relay (S1BY) is released. Therefore, the "TB" and "TB1" leads are opened, indicating that a new title is required. The printing cycle previously described is, therefore, repeated and this may occur from any one of the five digits. This circuit can, therefore, memorize any one of the ten thousand numbers representing the directory numbers and any one of ten offices.

It will be noted that all the "CS10" to "CS16" leads are normally connected via the (S1BX) and similar relays to a lead via a normally open contact on (S1S) relay **8203** to the "Star" lead to the printer code relay circuit. Again looking at relays (S1B0) to (S1B7) if one or three of these relays were operated, instead of two relays, relay (S1BX) would not operate and the check lead "S1C" would not be grounded and the printer control circuit would not receive a check.

This condition has probably become apparent in the reading relay circuit causing the circuit to stop. However, if not, the failure to close lead "S1C" will stop the circuit and cause a time-out alarm. The (Reader step) key **2607** may be operated momentarily providing an artificial check which permits the reader control circuit to proceed to the next line and to advance the reader line count circuit. This emergency start causes the reader control circuit to connect lead "S1B" to lead "S1" via contacts of (EM) relay **2608** causing (S1S) relay **8203** to operate and lock to the "LKB" lead. The operation of relay (S1S) closes the "Star" lead so that if ground is applied to a "CS" lead of which the associated (S1BX) or similar relay is not operated, a star will be printed.

If there is a discontinuity in one of the "CS" leads, printing will cease, the circuit will time out the (Falls to print) lamp **2513** will light to indicate that fact. The circuit can be started up and a star printed by operating the (Emerg. PTR start) key **12734** which operates the (Star) code relay directly.

The groups of relays in this circuit can be used for printing when no memory is required, as they are used in the summary and straddle applications. The circuit, however, acts in exactly the same way except that the "TB" and "TB1" leads are controlled in the tape class connector circuit so that control of the title is not at such time in this circuit.

In the summary applications, the B group is not used to print, but only to check in the zero or one in this group.

The lines that are registered in this circuit for the different entries contain information as given below.

Entry	B	C D E F	Entry Line
Detail	Office 0 to 9	(4-Digit Directory Number)	1
Non-Ans.	Office 0 to 9	(4-Digit Directory Number)	1
Local MU	0	(4-Digit Directory Number)	1
Ext. MU	1	(4-Digit Directory Number)	1
S. Int. DET	Office 0 to 9	(4-Digit Directory Number)	3
S. MU Int.	Office 0 to 9	(4-Digit Directory Number)	3

31. Storage circuit No. 2, Figs. 53, 54, 60, 61, 72, 73, 84 and 85

31.01 General

This circuit is used to store the information received from the automatic accounting system lines in the following entries:

Line **2** of the detail entry
Line **2** of the non-answered entry
Line **4** of the straddle initial detail entry
Line **4** of the straddle initial message unit entry
Line **5** of the straddle answer-disconnect entry
Line **3** of the straddle timing entry.

Line 2 of the detail and non-answered entries governs the registration of the time, which must be converted from a five-character tape registration to a six-digit registration for printing.

Line 4 of the straddle detail and message unit initial entries registers the message billing index in the C digit and the straddle charge index in the F digit.

Line 5 of the answer-disconnect straddle entry records the timed release index in digit E and the straddle charge index in the F digit.

Line 3 of the straddle timing entry records the minutes in digits B, C and D, the timed release index in digit E, while the straddle charge index is registered in digit F.

The digits are recorded in five groups of five relays each, denoted as groups B, C, D, E and F.

The B group of this figure consists of five basic relays (S2B0), (S2B1), (S2B2), (S2B4) and (S2B7), with two extra relays, the (S2BX) and (S2BW) relays, which are the check relays.

This storage circuit is brought into use by the operation of (S2A) relay 5300, (S2B) relay 7200 and (S2C) relay 8400 from ground in the reader line count circuit guided through the entry class register circuit. The count circuit paths are determined by the setting of the tape type switch 600, by the operated relays in the tape class connector circuit and by the identification of the entry in the reading relay translator circuit. The operation of these relays connects the B, C, D, E and F groups of reading relays with five leads each to the five groups of five relays in this circuit. Each of these twenty-five register relays is equipped with a contact to which a lamp may be connected by a relay in the lamp connector circuit for the purpose of reading the combination present in these relays.

These groups of five relays contain a basic check which in the B group begins at ground on armature 4 of (S2B2) relay 5303 and comprises armatures 5 and 6 of (S2B1) relay 5302, armatures 2, 5 and 9 of (S2B0) relay 5301, armatures 4 and 5 of (S2B7) relay 5401 and armature 5 of (S2B4) relay 5400 to the winding of (S2BX) relay 5402. This circuit is so arranged that relay (S2BX) can operate only when two and only two of the five relays are operated. Relay (S2BX) operated, operates (S2BW) relay 5403. Relay (S2BW) connects the character sequence lead to the groups of relays. This relay serves the purpose of keeping the leads to the printer code translator circuit separated under all conditions except when a proper numeral is registered in the group of relays.

In tracing this circuit, it will be noted that if all five relays are released, the circuit for relay (S2BX) is open at the contacts of the (S2B1) relay 5302, therefore relay (S2BX) cannot operate if all the five relays are released. If, however, two and only two relays are operated a circuit can be traced which will operate relay (S2BX). If, however, there are only one, or three or more relays operated, there is no circuit for relay (S2BX).

When relays (S2BX) and (S2BW) are operated, separate circuits are made available through the left-hand side of the group for the ten digits 0 to 9, and on the right-hand side other circuits are made available by means of which relays may be operated or direct connection can be made to the relays of the printer code relay circuit.

When all the groups of this storage circuit have been satisfied, all the relays (S2BW), (S2CW), (S2DW), (S2EW) and (S2FW) will be operated, and a circuit will be complete from ground received over the "B" lead from either the tape class connector circuit or the reading relay translator circuit to the "S2C" lead to the entry class register circuit. Thus, the "S2C" lead is the check lead for indicating to the reader control circuit that five digits have been registered in this storage circuit and that the reader may be advanced to the next line. When the reader line count circuit progresses, relays (S2A), (S2B) and (S2C) release, leaving the operated relays in this circuit locked to leads "LKA" and "LKB" grounded at (UNLK) relay 5622. The "S2C" lead also indicates to the printer control circuit when this line is required to determine the title, that enough information has been stored for the printing to start.

The explanation for the B group of relays in this circuit will serve for the rest of the groups and for all the other groups in the Nos. 3, 4, 5 and 6 storage circuits. The circuits of these groups will differ in detail, but essentially they perform the same function in the various storage circuits.

31.02 The use of this circuit to register the time

When this circuit is used to register line 2 of the detail and non-answered entries, it receives the day, hour and minute in five digits which must be translated so as to print six digits.

To completely describe this time translation, some consideration must be given to the method of entering the day, hour and minute in the tape on a five-digit basis. At the computer stage in the accounting office, the day, hour and minute which were received from the central office tape in six digits, is compressed into five digits in the following manner.

The six digits that are received by the computer are the day tens, day units, hour tens, hour units, minute tens and the minute units, an example of which would be 10, 14, 23 or the tenth day, fourteenth hour and twenty-third minute. The day, hour and minute units are entered in the D, E and F digits exactly as is. The day tens, hour tens and the minute tens are compressed into two digits and entered into the B and C digits, in the following manner and in accordance with the following table:

	Line Index	Combination of Day Tens and Minutes Tens				Combination of Hour Tens and Minutes Tens			Day Units	Hour Units	Minute Units
Tape Code Digit	A	B				C			D	E	F
Start Time Line	O										
Minute Tens	0	0	1	2	3	0	1	2			
	1	0	1	2	3	3	4	5			
	2	0	1	2	3	6	7	8			
	3	5	6	7	8	0	1	2			
	4	5	6	7	8	3	4	5			
	5	5	6	7	8	6	7	8			
		0	1	2	3	0	1	2			
		Day Tens				Hour Tens					

The interpretation of this arrangement is as follows. The tens of the hour is always limited to 0, 1 or 2. The C digit will, therefore, be 0, 3 or 6

if the hour tens is 0. It will be 1, 4 or 7 if the hour tens is 1, or it will be 2, 5 or 8 if the hour tens is 2. Which of these is used will be determined by the minute tens which may be 0, 1, 2, 3, 4 or 5. The C digit is, therefore, determined by the correlation of the hour and minute tens in accordance with the table. For instance, taking the time mentioned before 10, 14, 23, the hour tens is 1, therefore, the C digit will be 1, 4 or 7, the minute tens is 2, therefore, the C digit will be 7.

Now for the B digit. If the minute tens is 0, 1 or 2, the B digit will be 0, 1, 2, or 3, and if the minute tens is 3, 4 or 5, the B digit will be 5, 6, 7 or 8. Which one of these is used is determined by the day tens.

Now in the case in point, the minute tens is 2, therefore, the B digit will be 0, 1, 2 or 3. The day tens in the example is 1, therefore, the B digit will be 1. The time 10, 14, 23 translated to five digits is, therefore, 17043. It is in this form that this circuit receives the time. To print this time, however, the five-digit number must be converted back to the original six-digit number.

31.03 Translation of five digits to six digits

Now, if the B digit is 0, 1, 2 or 3, the minute tens must be 0, 1 or 2 and if the B digit is 5, 6, 7 or 8, the minute tens must be 3, 4 or 5. In our typical case, the B digit is 1, and, therefore, the minute tens is either 0, 1 or 2. The C digit is 7, and, therefore, from the table, the minute tens is 2 and the hour tens is 1. Because the B digit is 1, the day tens is 1.

31.04 Operation of the time translator circuit

The sequence circuit leads for the printing of the time will be in the following order: "CS25" to print the day tens, "CS22" to print the day units, "CS26" to print the hour tens, "CS23" to print the hour units, "CS27" to print the minute tens and "CS24" to print the minute units.

The digit registered in the B group will cause the operation of one of the relays, (S2BA) to (S2BJ), there being eight of these relays because numerals 4 and 9 are not used, and the relays are operated from ground on the armature 3 and front contact of the (S2BX) relay 5402.

If either 0 or 5 is present in this digit, lead "CS25" will be routed to cause the printing of the zero character, 1 or 6 would print 1, while 2 or 7 would print 2, and the 3 or 8 would print 3.

The character present in the B digit will govern what is printed in the minute tens. If 0, 1, 2 or 3 is present in digit B, either 0, 1 or 2 would be printed for the minute tens, while 5, 6, 7 or 8 in digit B would print 3, 4 or 5. Therefore, if relays (S2BF), (S2BG), (S2BH) or (S2BJ) are operated, (S2CZ) relay 6000 will be operated, but if relays (S2BA), (S2BB), (S2BC) or (S2BD) are operated, relay (S2CZ) will not be operated.

The C digit stored in the C group will operate one of the (S2CA) to S2CJ) relays, one of nine relays as the numeral 9 is not used. Lead "CS26" will be directed via the operated relay to print 0, 1, or 2 the hour tens. It will print 0 if 0, 3 or 6 is registered; 1 if 1, 4 or 7 is registered and 2 if 2, 5 or 8 is registered.

Lead "CS27" is routed via the (S2CA) to (S2CJ) relays and relay (S2CZ) to print 0, 1, 2, 3, 4 or 5 for the minute tens. If relay (S2CZ) is unoperated, 0, 1 or 2 in digit C will print 0, a 3, 4 or 5 will print 1 and a 6, 7 or 8 will print 2. If relay (S2CZ) is operated, 0, 1 or 2 will print 3, a 3, 4 or 5 will print 4 and a 6, 7 or 8 will print 5.

Thus, the two digits B and C are converted to three digits properly placed.

Each of the six leads "CS25," "CS22," "CS26," "CS23," "CS27" and "CS24" are routed through transfer contacts on relays (S2BY), (S2DX), (S2CY), (S2EX) and (S2FX), which will operate only when two of the register relays are operated in each group. These relays remove the sequence "CS" leads from the "Star" lead to the printer code translator circuit, and route them through the circuits previously described.

If one of these groups does not check, the "CS" lead involved will be connected to the "Star" lead which is open at the contacts of relay (S2S).

If one of these groups does not check, the "S2C" lead to the entry class register circuit will not receive the ground from this circuit derived over lead B. This condition has probably become apparent in the reader relay circuit, causing the circuit to stop. However, if not, the failure to close lead "S2C" will stop the circuit operation and cause a time-out alarm.

The (Reader Step) key 2607 is operated momentarily providing an artificial check which permits the reader control circuit to proceed to the next line and to advance the reader. Relay (S2S) will operate and lock to lead "LKB." The operation of this relay will cause stars to be printed by those "CS" leads associated with the groups that do not check.

If there is a discontinuity in one of the "CS" leads, printing will cease, the circuit will time out and the (Fails to print) lamp 2513 will light to indicate the fact. The circuit can be started up and a star printed by operating the (Emerg. PTR start) key 12734 which operates the Star code relay directly.

31.05 Time control of month translator

In the last round of the month, that round will lap over into the new month. Any entries, therefore, which are made in the new month, should have a new title showing the new month.

The time circuit must, therefore, recognize when the time entry is in the new month, or in other words, when the day tens is zero.

Relay (S2BA) operates when 0 is in the B digit and relay (S2BF) is operated when 5 is in the B digit. Both of these relays indicate a day tens unit of zero and all the other relays in this group indicate a day in the old month.

If either relay (S2BA) or (S2BF) is operated, ground is placed on the "CM" lead to the month translator circuit to operate a relay in that circuit to advance the month and to remember that it has advanced. The operation of any of the other relays in this group grounds lead "NC" to the month translator circuit which indicates to that circuit that no change must take place, or if a change has taken place, it must be changed back. This action, of course, is only effective when the round switch is in the last round position.

31.06 Line 4 of the straddle initial entries

To print the information from line 4 of these entries, leads "CS21," "CS26" and "CS29" are used. The 0 present in groups B, D and E will simply cause these units to properly check. Sequence lead "CS21" will print the figure registered in group C directly over leads "P0" to "P9".

Leads "CS28" and "CS29" are routed through relays (S2FB) to (S2FH) to print the symbol representing the straddle charge index. This index indicates any special charging action which may be required.

The numeral characters registered in the F group cause the following symbols to be printed representing the corresponding straddle charge index.

Relays (S2CX) and (S2FX) are used to remove the sequence leads from the "Star" lead.

Digit	Printed Characters		Charging Action
1	—	—	No trouble.
2	C	—	Cancel call.
3	—	C	Cancel overtime.
4	A	D	Cancel call if answer entry, cancel overtime if disconnect entry.
5	—	A	Cancel overtime if answer entry, no trouble if disconnect entry.
6	—	D	No trouble if answer entry, cancel overtime if disconnect entry.
7	T	Space	District test call.

31.07 Line 5 of answer-disconnect entry

This line was zeros in groups B, C and D for check purposes only.

Group E is used to register the timed release index, which has the following meaning:

0—The transmission circuit did not time out.

1—The transmission circuit did time out.

If 1 appears in the E digit, it will cause the operation of (S2FZ) relay 8401, while if 0 appears, the (S2FZ) relay will not be caused to operate. Whether relay (S2FZ) operates or not depends upon whether (S2FB) relay 8402 is operated or not.

The sequence leads used for this line are the "CS28" and "CS29," which print the symbols shown in the above table for the straddle charge index. If, however, 1 is present in the E digit when the (S2FB) relay is operated, the characters S, Space, will be printed to indicate the time out of the transmission circuit, under a no trouble condition.

31.8 Line 3 of a straddle timing entry

This entry in the E and F digits is the same as explained above. The B, C and D groups are used, however, to print the minute, in three characters exactly as received. The sequence leads used are "CS20," "CS21," "CS22," "CS28" and "CS29."

The lines registered in storage circuit No. 2 are as follows:

Entry	B	C	D	E	F	Line of Entry
Detail	(Five-Digit Start Time Line)					2
Non-Ans	(Five-Digit Start Time Line)					2
Straddle Int. Det.	0	Bill. Index 0 to 8	0	0	Charge Index 1-2-3-7	4
Straddle Int. MU.	0	Bill. Index 0 to 8	0	0	Charge Index 1-2-3-7	4
Straddle Ans.-Dis.	0	0	0	Time Rls. Index	Charge Index 1-2-3	5
Straddle Timing	(Minute)			Time Rls. Index	Charge Index 1-4-5-6	3

32. Storage circuit No. 3, Figs. 62, 63, 74, 75, 86 and 87

32.01 General

This circuit is used to store the information received from the automatic accounting system tape in the following entries:

Line 3 of the detail entry
Line 3 of the non-answered entry
Line 3 of the straddle answer-disconnect entry.
Line 5 of the straddle initial detail entry

This circuit consists of five groups of seven relays each, the main details of which have been described under storage circuit No. 2. These groups are the B, C, D, E and F.

The function of relays (S3A), (S3B) and (S3C) in bringing this circuit into use, and the use of relay (S3S) for printing a star are the same as for similar relays in storage circuits Nos. 1 and 2.

Line 3 of the detail and non-answered entries, and line 5 of the straddle initial detail entry cause the registration in group B of the area, in group C of the called number index and in groups D, E and F of the called office.

Line 3 of the straddle answer-disconnect entry causes the registration of the disconnect minute in groups B, C, and D and the answer day in groups E and F.

32.02 Line 3 of detail and non-answered and Line 5 of the initial straddle detail entries

To print the information from the above lines, the following sequence leads are used. "CS30" and the "G1," "G2" and "G3" leads of the printer translator circuit. When this storage circuit No. 3 is called into use for these particular lines, of these entries, leads "A0" to "A9," "FB0" to "FB9," "FC0" to "FC9" and "FD0" to "FD9" are connected" by means of the printer translator connector circuit, Fig. 55, to the printer translator or called office name translator circuit.

The figure character stored in group B will ground one of the leads "0A" to "9A" which, via leads "A0" to "A9" will operate the proper area relay in the printer translator circuit, if the circuit is equipped for more than one area. For single area printing, these leads are not used.

The character present in group C will ground one of the leads "NS0," "NS1" or "NS2" to condition the No. 4 storage circuit for a particular type of structure for the called number which will be explained under that circuit.

0 is for a 3-digit number.

1 is for a 4-digit number with or without a party designation.

2 is for a 5-digit number.

The D, E and F digits register the three digits of the called office name, and by grounding one each of the three groups of leads "FB0" to "FB9," "FC0" to "FC9" and "FD0" to "FD9," the called office name in a three-numeral form is stored in the printer translator, where it is translated into symbols representing the office, in order that it may be printed.

When all office digits have been stored and checked in this No. 3 storage circuit and when a proper translation has taken place in the printer translator circuit, a ground is received from that circuit, which is guided through the five (W) relays of this circuit and is applied to the "S3C" lead which is extended by one of the relays of the line pattern character sequence circuit and which advances the reader line count circuit and releases relays (S3A), (S3B) and (S3C).

The "Star" lead of the printer translator circuit is incorporated with the "Star" lead of this circuit, via relay (S3S), so that if no check is made either in this circuit or in the printer translator circuit, stars may be printed from either circuit by operating relay (S3S) from the reader control circuit.

The sequence lead "CS30" in this circuit prints the area number, via leads "P0" to "P9," if an area is to be printed, and leads "G1," "G2" and

"G3" of the printer translator route the sequence grounds for printing the office symbol.

32.03 Line 3 of straddle answer-disconnect entry

For this line, groups B, C and D register the disconnect minute, while groups E and F register the answer day. Using sequence leads "CS30," "CS31," "CS32," "CS33" and "CS34," these characters are printed directly via the "P0" to "P9" leads of the respective groups.

The lines registered in storage circuit No. 3 are as follows:

Entry	B	C	D	E F	Entry Line
Detail	Area Index 0 to 9	Called No. Index 0-1-2	(3-Digit Called Office)		3
Non-Ans.	Area Index 0 to 9	Called No. Index 0-1-2	(3-Digit Called Office)		3
Straddle Int. Det	Area Index 0 to 9	Called No. Index 0-1-2	(3-Digit Called Office)		5
Straddle	(Disc. Minute)			(Ans. Day)	3

33. Storage circuit No. 4, Figs. 64, 65, 76, 77, 88 and 89

33.01 General

This circuit is used to store the information received from the automatic accounting system tape in the following entries:

Line 4 of the detail entry
Line 4 of the non-answered entry
Line 2 of the local message unit entry
Line 2 of the local and extended message unit entry
Line 6 of the straddle initial detail entry
Line 4 of the straddle answer-disconnect entry

The functions of relays (S4A), (S4B) and (S4C) in bringing this circuit into use and the use of the relay (S4S) for printing stars, are the same as for the similar relays in the previously described storage circuits.

33.02 Line 4 of the detail and non-answered entry and line 6 of the straddle initial detail entry

For these lines this circuit is used to print the called number and the sequence leads used are the "CS40," "CS41," "CS42," "CS45" and "CS46."

The register groups B, C, D, E and F are essentially the same as were described for the No. 2 storage circuit.

Relays (NS0), (NS1) and (NS2) are actuated by the similarly designated leads from the No. 3 storage circuit as was there described. (NS0) is for a three-digit number, (NS1) for a four-digit number with or without party and the (NS3) for a five-digit number.

33.03 Three-digit number

Leads "CS40," "CS41" and "CS42" will print directly the digits stored in the B, C and D groups, but with relay (NS0) operated, leads "CS45" and "CS46" will cause spaces to be printed, thus printing a three-digit number. If relays (NS0), (NS1) or (NS2) should not be operated because of some failure in the No. 3 storage circuit, printing will cease and a time-out alarm will occur, and the (Fails to print) lamp 2513 will be caused to light, in response to the (Reader lamps) key 2201. The circuit can be started up and a star printed by operating the (Emerg. PTR start) key 12734 which operates the (S4S) relay 8800 connecting the "Star" lead. The path to the "Star" lead when these relays are not operated is through their back contacts.

33.04 Four-digit number with or without party

If relay (NS1) is operated, a four-digit number is indicated. The first three digits are printed as previously described, the fourth digit from lead "CS45" is printed from group E, while "CS46" is connected to the right-hand contacts of group F. This F group will determine the party, in accordance with the following table:

0 prints space indicating no party
5 prints J
6 prints M
7 prints R
9 prints W

Thus, the four-digit number is formed with or without a party letter.

33.05 Five-digit number

If relay (NS2) is operated, lead "CS45" causes the character to be printed that is present in group E, while "CS46" is connected to the left-hand contacts of the F group and, therefore, prints the numeral present in the F group. In this manner, the five-digit number is formed.

33.06 Line 2 of the message unit local and extended entries

When this circuit is used to print these entries, the numeral 3 or 4 is received in the B group which is used for check purposes only. The C, D, E and F groups are used to register the local message units, and sequence leads "CS41," "CS42," "CS43" and "CS44" are used to print them.

Also, when this circuit is being used to print message units, ground is applied to lead "S4L."

If all four numerals are significant, they will be printed exactly as recorded over the "P0" to "P9" leads of all four groups. For example, if the figures are 2345, 2005 or 2600, they will be printed as given.

Let us assume, however, that the figures registered are 0234, then 0 will appear in the C group. If 0 is registered in the C group, ground from a contact of (M1) relay 3000 or (M2A) relay 3001 over "S4L" lead 3003 will be connected by the (S4C4) relay 7701 and (S4C7) relay 7702 to operate (S4CZ) relay 7700 and will also be extended to the D group to operate the (S4DZ) relay in like manner. Relay (S4CZ) operated will disconnect lead "P0" from the "0" lead of the code relay circuit and will connect it to the "DASH" lead and the number will be printed "-234". If the registered number was 0034, then relay (S2DZ) will also operate and the ground on lead "S4L" will be extended to the E group, the number being printed --34. Continuing, number 0004 would be printed ---4, by the additional operation of the (S4EZ) relay. Finally, if the registered number was 0000, it would be printed ----, with all four relays operated including relay (S4FZ).

If the number was 0204, then it would be printed -204 as the 2 in the D group would block the progress of operating the (Z) relays.

33.07 Line 4 of the straddle answer-disconnect entry

The numerals registered in this line represent the answer hour in the B and C groups, while the answer minute is represented in the D, E and F groups. Using the "CS40," "CS41," "CS42," "CS43" and "CS44" leads, the numerals are printed as registered.

The operation of the (S4A), (S4B) and (S4C)

relays and the (S4S) relay is the same as has been described for other figures.

The lines registered in storage circuit No. 4 are as follows:

Entry	B	C	D E F	Line of Entry
Detail		(Called Number)		4
Non-Ans.		(Called Number)		4
MU Local	3-4	(Local Message Units)		2
MU L. & E.	3-4	(Local Message Units)		2
Straddle Int. Det.		(Called Number)		6
Straddle Ans.-Dis.	(Ans. Hour)	(Ans. Minute)		4

34. Storage circuit No. 5, Figs. 66, 67, 78, 79, 90, 91, 102 and 103

34.01 General

This circuit is used to store the information received from the automatic accounting system tape in the following entries:

Line 5 of the detail entry
Line 5 of the non-answered entry
Line 3 of the message unit local and extended entry
Line 1 of the straddle initial detail entry
Line 1 of the straddle initial message unit entry
Line 1 of the straddle answer-disconnect entry
Line 1 of the straddle timing entry

The functions of the (S5A), (S5B) and (S5C) relays in bringing this circuit into use and the (S5S) for printing stars are the same as for similar relays in the other circuits.

34.02 Line 5 of the detail entry

Line 5 of this entry registers the type of message units in group B, in which 0 represents the local units, printing L, 1 represents the extended units, type 1, printing E and 2 represents the extended units, type 2, also printing E. The numeral 3 represents a cancelled call and prints C.

The chargeable time is registered in groups C and D and the message units are registered in groups E and F.

Relay (S5L1) is operated by the relays in the entry class register circuit.

The sequence leads used are the "CS51," "CS52," "CS53," "CS54" and "CS55" and in this order.

The chargeable time is printed directly as registered over leads "P0" to "P9" of groups C and D. Ground, however, is applied by relay (S5L1) to groups C and E. Now, if the chargeable time registered is 05, relay (S5CZ) will be operated and the printing will be –5, and if it were 00, the printing would be ––, but group D has no effect on group E.

The message units are printed from groups E and F in exactly the same manner using relays (S5EZ) and (S5FZ).

The indication of the type of message units will be printed from the message unit index registered in group B, on leads "0A," "1A," "2A" and "3A." 0 prints L (for local), 1 and 2 print E (for extended), and 3 prints C (for cancel charges), all via relay (S5L1).

34.03 Line 5 of the non-answered entry

Line 5 of the non-answered entry is zero in all five digits, and it is registered only for the purpose of checking the presence of the fifth line in the entry and for progressing the circuit. In printing, this line is ignored by the line pattern connector circuit, the action of which is determined by the entry class register circuit.

34.04 Line 3 of the local and extended message unit entry

In this case, relay (S5L2) will be operated by the entry class register circuit. In printing this entry, leads "CS51," "CS52," "CS53" and "CS54" are used. Relay (S5L2) arranges the Z relays so that the four groups C, D, E and F will print Dash for the non-significant zeros in the same manner as heretofore described. The numeral 5 or 6 will register in group B for check purposes only.

34.05 Line 1 of the four straddle entries

Line 1 of these entries registers the type of entry in the B group. The types of entries and the symbols printed are as follows:

	Prints
0 Regular call	—
1 Observing call	L
3 Message unit call	—
4 Answer-disconnect	Space
5 Timing entry	Space

Groups C and D register the recorder number, while groups E and F register the call identity index.

Relay (S5L3) is operated by the (STR) relay 602 in the tape class connector circuit.

The recorder tens in group C is registered 0 or 1, or 5 or 6, or in the case of a mutilated or lost recorder number the numeral 2. There is a maximum of twenty recorders in a central office numbered 00 to 19. 0 and 5 are printed as 0, while 1 and 6 are printed as 1. 0 and 1 means that the call has been registered in the central office on the regular recorder, and in this circuit will provide for printing R. 5 and 6 means that the call has been registered on the emergency recorder and in this circuit will provide for printing E. However, if the recorder number is mutilated in the tape from the central office, the computer will replace the unknown number by an arbitrary number having 2 in the tens digit. For this condition, U will be printed.

The printing of this line is done over leads "CS55," "CS56," "CS51," "CS52," "CS53" and "CS54" in this order. Thus, the type of entry is printed via group B and relay (S5L3), the character E, R or U via group C, the recorder number tens and units via groups C and D and the call identity index via groups E and F.

The lines stored in this storage circuit No. 5 are as follows:

Entry	B	C	D	E	F	Entry Line
Detail	TMU 0-1-2	(Chargeable Time)		(Mess. Units)		5
Non-Ans.	0	0	0	0	0	5
MU L. & E.	5-6	(Extended Message Units)				3
Straddle Int. Det	TOE 0-1-2	(Recorder)		(Call Index)		1
Straddle Int. MU.	3	(Recorder)		(Call Index)		1
Straddle Ans.-Dis.	4	(Recorder)		(Call Index)		1
Straddle Timing	5	(Recorder)		(Call Index)		1

35. Storage circuit No. 6, Figs. 68, 69, 80, 81, 92, 93, 104 and 105

35.01 General

This circuit is used to store the information received from the automatic accounting system tape in the following entries:

Line 2 of the straddle initial detail entry
Line 2 of the straddle initial message unit entry
Line 2 of the answer-disconnect entry

Line 2 of the straddle timing entry
Line 1 of the verbatim entry

This circuit differs from the other storage circuits in that it has an A group of relays for use in verbatim printing.

The functions of the (S6A), (S6B) and (S6C) relays in bringing this circuit into use and the use of the (S6S) relay for printing a star are the same as for similar relays in the other circuits.

35.02 Line 2 of the four straddle entries

Group B registers the straddle index which serves as a guide to the other parts of the call. The numeral registered in this group has the following meaning:

Index	Prints
0, Previous tape	P, space
1, Previous and next tape	P, N
2, Previous and current	P, C
3, Current tape	C, space
4, Current and next tape	C, N
5, Current and current	C, C
6, Adjacent entry and next	A, N
7, Adjacent entry and current	A, C
8, Next tape	N, space
9, Adjacent entry	A, space

Groups C and D register the day and groups E and F register the hour which is printed directly as registered.

Sequence leads used for these lines are the "CS66," "CS67," "CS61," "CS62," "CS63" and "CS64" in this order.

Relays (S6BA) to (S6BK) are operated by the B group of the register relays. Relay (S6BY) is operated whenever a proper digit is registered in group B.

35.03 Verbatim printing

To print verbatim means to print each line of the automatic accounting system tape without any translation, that is, each line consists of six numerals and includes the A digit.

The A storage group consists of the three relays (S6A0), (S6A1) and (S6A2).

The check circuit begins at ground on armature 2 of (S6A1) relay 6802. If one relay is operated, a circuit is completed to operate (S6AX) relay 6900. If the three relays are operated, a circuit will also be completed to operate relay (S6AX). If, however, two relays are operated, no circuit will be completed.

Lead "P0" is completed by the operation of relay (S6A0), lead "P1" by the operation of relay (S6A1), lead "P2" by the operation of relay (S6A2), while lead "P3" is completed by the operation of all three relays.

The check lead to the entry class register circuit is the (S6CA) lead 6801 which includes all six digits.

The sequence leads used for verbatim printing are the "CS65," "CS60," "CS61," "CS62," "CS63," and "CS64" in this order.

The lines registered in storage circuit No. 6 are as follows:

Entry	A	B	C D	E F	Entry Line
Straddle Int. Det	0	L0E 0 to 9	(Day)	(Hour)	2
Straddle Int. MU	0	L0E 0 to 9	(Day)	(Hour)	2
Straddle Ans. Dis	0	L0E 0 to 9	(Disc. Day)	(Disc. Hour)	2
Straddle Timing	0	L0E 0 to 9	(Day)	(Hour)	2
Verbatim	(Six digits)				1

36. Marker group translator circuit, Fig. 28

36.01 Operation of the circuit

The calling office is identified either from the office switch 1202 or the B register group of relays in the No. 1 storage circuit by a single numeral. This single numeral in conjunction with the marker group number which is set up on the marker group switches 504 and 505 will completely identify the calling office and enable this circuit to print the abbreviation for the calling office name. The function of the relays of Fig. 28 is to set up the marker group number in such a way that the single digit registered elsewhere can be translated into the calling office name.

The number of relays such as (MGT) relay 2800 may vary from 1 to 10, and are numbered from (MGT0) to (MGT9). The equipment unit that has been designed and used in this circuit contains only one of these relays but more relays can be obtained by installing more of these units. The (MGT) relays are operated from the second section of the marker group tens switch 504, one for each point on the switch, and the relay operated represents the tens group of the marker group number.

The second section of the marker group units switch is multiplied to all the (MGT) relays, and via the contacts on the (MGT) relays will operate other relays. If there are ten (MGT) relays there are, of course, one hundred sets of contacts, which will represent the one hundred possible marker groups.

Each one of these one hundred marker groups can have ten offices, making a theoretical maximum of one thousand offices that could be identified by this circuit. As each office is identified in the printing by three characters, usually two letters and a figure, and these characters are purely arbitrary with respect to the marker group number and office designation, it must, therefore, be possible if required to operate up to three relays for each of the one hundred leads representing the one hundred marker groups on the (MGT) relays. Three relays are necessary because of the limitation on the number of contacts that can be obtained on a relay.

The (MGA) relays such as 2801 are used to identify offices 0 to 3, there being twelve leads from this relay to the office switch and to the B group of storage circuit No. 1. There may be a maximum of one hundred of these relays designated (MGA00) to (MGA99).

The (MGB) relays such as 2802 are used to identify offices 4 to 7, there being twelve leads from this relay to the office switch and to the B group of storage circuit No. 1. There may be a maximum of one hundred of these relays designated (MGB00) to (MGB99).

The (MGC) relays such as 2803 are used to identify offices 8 and 9, there being six leads from this relay to the office switch and to the B group of storage circuit No. 1. There may be a maximum of one hundred of these relays designated (MGC00) to (MGC99).

The (MGA), (MGB) and (MGC) relays representing a given marker group are connected in parallel. When the marker group is set up, therefore, there will be one (MGT) relay operated, and through one of the contacts on the operated (MGT) relay there will be three relays (MGA), (MGB) and (MGC), one of each operated. The printing sequence leads may then be guided by the setting of the office switch or

the B group of No. 1 storage circuit to three character relays in the printer code relay circuit through the contacts on the (MGA), (MGB) or (MGC) relays which are cross-connected to the relays of the printer code relay circuit.

The three leads for each office for each marker group on the (MG) relays are connected to a cross-connection field, which could have a theoretical maximum of three thousand terminals.

Each group of three terminals in this field which represents an office is cross-connected to a group of thirty-five terminals which represent the alphabet minus Q and Z, not used in any office names, the ten numerals, and a space. These three terminals are cross-connected in the order 1, 2, 3 to the proper terminals.

Thus, if the office was to be represented by (CH3), lead "1" would be connected to (C), lead "2" to (H) and lead "3" to (3) and in like manner for any office.

If the office name were (AB), the three leads would be connected to A, B and space.

Thus, when the sequence grounds are applied in the order 1, 2 and 3 the characters to which they are cross-connected will be printed.

37. Call entries

37.01 General

As has been indicated in precious discussion the main portion of the tape is made of what are called, call entries, and these entries consist of various numbers of lines in the automatic accounting system tape. These lines which make up a call entry contain information either concerning a single call, a summation of a number of calls or a part of a call.

Each of the types of tapes that have been discussed before have in general different types of entries. In some cases, however, the entries are alike but are treated differently in printing.

Below is given a discription of the different types of entries and the tapes in which they are encountered. The method of printing these entries is given in section 38.

37.02 Summary tape

The message unit summary tape contains two types of entries, the local only and the local and extended type. The information contained in these entries is shown below:

Summary entry, local only

	A	B	C D E F
Line 1	2	0	(Directory Number)
Line 2	0	3-4	(Local Message Units)

Summary entry, local and extended

	A	B	C D E F
Line 1	2	1	(Directory Number)
Line 2	0	3-4	(Local Message Units)
Line 3	0	5-6	(Extended Message Units)

37.03 Local only entry

Line 1 contains in digits A and B the numerals 20 which identify this particular entry. Digits C, D, E and F give the directory number of the calling party. The 2 in the A digit of the first line also indicates that this is the first line of the entry.

Line 2 contains in digit A, a 0, which indicates that this is a supplementary line of an entry. Digit B will contain either the numeral 3 or 4, neither of which is used in this circuit except for check. 3 means that there are less than one thousand local message units while 4 means that there are exactly one thousand local message units. Digits C, D, E and F are the summary of all the message units, local, for some definite period covered by the tape.

37.04 Local and extended entry

Line 1 contains in digits A and B the numerals 21 which identify this particular entry. Digits C, D, E and F give the directory number of the calling party.

Line 2 contains 0 in the A digit. Digit B contains either 3 or 4 which has the same meaning as in the local entry. Digits C, D, E and F give the summary of the local mesage units for some definite period of time.

Line 3 contains 0 in the A digit. Digit B will contain either a 5 or 6 which has the same meaning as 3 or 4 in the local only entry. Digits C, D, E and F give a summary of the extended message units for some definite period of time.

37.05 Toll tape

The toll tape contains one entry, the detail entry, which is shown below:

Toll entry

	A	B	C	D	E	F
Line 1	1	Office 0 to 9	(Directory Number)			
Line 2	0	(Time)				
Line 3	0	Area Index 0 to 9	CNS 0-1-2	(Called Office)		
Line 4	0	(Called Number)				
Line 5	0	TMU 0-1-2-3	(Chargeable Time)		(Message Units)	

37.06 Detail entry

Line 1 contains any numerals from 10 to 19 in the A and B digits which identify this entry as a detail entry. The toll tape contains only this entry since no specific identification is necessary. The 1, however, in the A digit indicates the first line of an entry. The B digit besides being a part of the entry identification also indicates the office in the marker group in which the call originates.

Line 2 contains 0 in the A digit, while digits B, C, D, E and F indicate the day, hour and minute in five digits which must be converted to six digits for printing.

Line 3 contains 0 in the A digit. Digit B shows the area index which must be combined with the called office indication to determine the exact office called, if multiple area printing is used. Digit C shows the call index, or called number structure for use in connection with line 4. Digits D, E and F give three numerals which represent the called office. These three numerals must be converted into the office name before printing.

Line 4 contains 0 in the A digit. Digits B, C, D, E and F show the called number.

Line 5 contains 0 in the A digit. Digit B shows the type of message units contained in digits E and F. Digits C and D show the chargeable time,

of the call in minutes, while digits E and F show the message units.

37.07 Message unit detail tapes

The message unit detail tapes contain the detail entry previously described. The only difference between this tape and the toll tape is that more of the information is printed.

37.08 Observing tapes

The observing tape contains two entries, the detail entry previously described, and the non-answered entry. The non-answered entry is given below:

Non-answered entry

	A	B	C	D	E	F
Line 1	3	Office 0 to 9	(Directory Number)			
Line 2	0		(Time)			
Line 3	0	Area Index 0 to 9	Call Number Index 0-1-2	(Called Office)		
Line 4	0		(Called Number)			
Line 5	0	0	0	0	0	0

37.09 Non-answered entry

The non-answered entry is identified by 3 in the A digit of the first line, and 0 to 9 in the B digit. This distinguishes it from the detail entry that appears in the same tape.

The information contained in the non-answered entry is the same as that in the detail entry except that line 5 contains 0 in all digits. This is obvious because if the call is not answered there is no chanrgeable time nor message units.

37.10 Straddle tapes

The straddle tape contains parts of calls that are not complete in the tapes received from the central office. There are two reasons for incompleteness. One reason is that if the call spans the 3:00 A. M. tape cutting hour, the call will be separated on two tapes. The other reason is that in case of trouble on the regular recorder in the central office, the emergency recorder is switched in and again the call will be separated between two tapes. These calls are known as straddle calls and must be printed in parts so that the complete call can be assembled manually. Calls over ninety-nine minutes also appear on this tape.

There are four types of entries involved in this tape, and these entries are shown below:

Straddle initial detail entry

	A	B	C	D	E	F
Line 1	2	TOE 0-1-2	(Recorder)		(Call Identity Index)	
Line 2	0	Straddle Index 0 to 9	(Day)		(Hour)	
Line 3	0	Office 0 to 9	(Directory Number)			
Line 4	0	0	Mess. Billing Index 0 to 9	0	0	Straddle Charge Index 1-2-3-7
Line 5	0	Area Index 0 to 9	Called Number Index 0-1-2	(Called Office)		
Line 6	0	(Called Number)				

Straddle initial message unit entry

	A	B	C	D	E	F
Line 1	2	3	(Recorder)		(Call Identity Index)	
Line 2	0	Straddle Index 0 to 9	(Day)		(Hour)	
Line 3	0	Office 0 to 9	(Directory Number)			
Line 4	0	0	Mess. Billing Index 1 to 8	0	0	Straddle Charge Index 1-2-3-7

Straddle answer-disconect entry

	A	B	C	D	E	F
Line 1	2	4	(Recorder)		(Call Identity Index)	
Line 2	0	Straddle Index 0 to 9	(Disc. Day)		(Disc. Hour)	
Line 3	0	(Disc. Minute)			(Ans. Day)	
Line 4	0	(Ans. Hour)			(Ans. Minute)	
Line 5	0	0	0	0	Times Rls. Index 0 to 9	Straddle Charge Index 1-2-3

Straddle timing entry

	A	B	C	D	E	F
Line 1	2	5	(Recorder)		(Call Identity Index)	
Line 2	0	Straddle Index 0 to 9	(Day)		(Hour)	
Line 3	0	(Minute)			Timed Rls. Index 0-1	Straddle Charge Index 1-4-5-6

37.11 Straddle initial detail entry

Line 1 contains the numeral 2 in the A digit and 0, 1 or 2 in the B digit. Therefore, 20 to 22 in these digits identifies this entry. Digits C and D show the recorder that has been used to record the call, and digits E and F show the call identity index.

Line 2 contains 0 in the A digit to indicate that this is a supplementary line. Digit B shows the location of other parts of the call, digits C and D indicate the day while digits E and F show the hour.

Line 3 contains 0 in the A digit, digit B shows the calling office, and digits C, D, E and F show the directory number.

Line 4 contains 0 in the A digit, indicates the message billing index in digit C, zero being present in the B digit. Digits D and E contain 0, while the F digit shows the method to be used in disposing of the call if there was trouble in the central office.

Line 5 contains 0 in the A digit, shows the area in the B digit, the called number index in digit C and the called office in digits D, E and F.

Line 6 contains 0 in the A digit and shows the called number in the B, C, D, E and F digits.

37.12 Straddle initial message unit entry

Line 1 contains 23 in the A and B digits to identify the entry, digits C and D show the recorder number, and the call identity index is shown in digits E and F.

Line 2 contains 0 in the A digit, the location of the other parts of the call in the B digit, the day in digits C and D and the hour in the E and F digits.

Line 3 contains 0 in the A digit, the calling office in digit B and the directory number in digits C, D, E and F.

Line 4 contains 0 in the A digit, and also in the B digit. The message billing index is shown in the C digit, 0 in the D and E digits and the disposal of the call in the F digit.

37.13 Answer-disconnect entry

Line 1 contains 24 in digits A and B to identify the entry, the recorder number is in the C and D digits and the call identity index in the E and F digits.

Line 2 contains 0 in the A digit, the location of the other parts of the call in the B digit, the disconnect day in the C and D digits and the disconnect hour in the E and F digits.

Line 3 contains 0 in the A digit, the disconnect minute in the B, C and D digits and the answer day in digits E and F.

Line 4 contains 0 in the A digit, the answer hour in digits B and C and the answer minute in digits D, E and F.

Line 5 contains 0 in the A, B, C and D digits, the timed release index in the E digit and the disposal of the call in the F digit.

37.14 Straddle timing entry

Line 1 contains 25 in the A and B digits, to identify the entry, the recorder number in the C and D digits, and the call identity index in the E and F digits.

Line 2 contains 0 in the A digit, the location of the other parts of the call in digit B, the answer or disconnect day in the C and D digits and the answer or disconnect hour in the E and F digits.

Line 3 contains 0 in the A digit, the answer or disconnect minute in digits B, C and D, the timed release index in digit E and the disposal of the call in digit F.

37.15 Verbatim tape

The verbatim entry which is given below contains six numerals which may be any of those indicated.

Verbatim

A	B	C	D	E	F
0 to 3	0 to 9	0 to 9	0 to 9	0 to 9	0 to 9

38.01 General

38. Printed records

The printed record is the output of the printer circuit and is the objective toward which the entire circuit is pointed.

Each type of tape has its own peculiar type of printed record and, therefore, each type of tape will be discussed separately.

38.02 Summary tape

The summary title and entries will be printed as shown below:

Message unit list printed copy

Title..... CH3 MAY 4
Local entry..... 0001 -188
Local and ext..... 0002 1000 -299
Char. count..... 1234567890 11111 01234

The paper will be continuous but folded in pages, the folds occurring every 11 inches. It will have sprocket holes punched ¼-inch from the left-hand edge spaced ½-inch apart. The folds when they occur will be located half-way between two sprocket holes, and the paper will be approximately 3 inches wide.

The printing will begin ⅞-inch from the upper fold and ⅝-inch from the left-hand edge.

The first line on the page will be the title which will contain the calling office, the month and the round to which this page is a summary.

The central office, month and round information is obtained from the setting of the office, month and marker group switches and the only thing that determines the insertion of a new title is the printing of forty lines on the 11-inch page. The paper is then stepped past a fold and a new title entered. There are fifteen elements in the summary title requiring 1.8 seconds for printing.

The printing of the local entry consists first of the directory number obtained from digits C, D, E and F of line 1, and the message units, local, obtained from digits C, D, E and F of line 2. This printed line contains eleven elements requiring 1.4 seconds to print. These figures for the message units are printed exactly as recorded except for the non-significant zeros.

The printing of the extended entry, consists first of the directory number obtained from the C, D, E and F digits of the first line, the local message units obtained from digits C, D, E and F of line 2, and the extended message units obtained from the digits C, D, E and F of line 3. This line contains sixteen elements requiring 1.9 seconds to print.

The sheet of drawings containing Figs. 133, 134 and 135 has been prepared to illustrate the appearance of a summary tape.

Fig. 133 shows the punched tape which is introduced into the reader of the device and shows the perforations in such tape though it does not illustrate the burred appearance thereof which is made by merely piercing the tape and which burrs, as has been explained hereinbefore, fit into the perforations of the drum and provide traction for the tape in the movement of the reader.

Fig. 134 is an illustration of a verbatim printing of the tape wherein the paper on which the printing was done has been drawn into short pieces in order to illustrate the continuity of the codes.

Fig. 135 is an illustration of the final product of this tape as produced by the printer. The title ME6 SEP 5 indicates that the printed record produced is one listing the message unit charges for a number of lines in the office ME6 (Media 6) in September and during the fifth round thereof. The list of message unit charges thereafter is made for various line numbers arranged in numerical order. This short piece of tape shown in Fig. 133 was especially prepared to illustrate the codes used for making various size charges. In actual practice such a list of message unit charges would be of a somewhat different aspect since the line numbers would be closer together than those herein shown and there would not be such a wide variation in the movement of message unit charges.

38.03 Toll tapes

The detail entries of this tape are printed on a slip which is 5 inches wide and 2½ inches long. The uncut paper is in rolls, but is cut in the 2½ inch lengths by a special cutter attached to the printer. There will be sprocket holes in the left-hand edge located in the same manner as the holes in the Message unit list.

The printing will begin ⅜-inch from the top edge of the slip and ⅝-inch from the left-hand edge.

Toll slip printed copy

	For Single Area
Title	CH3 1111 MAY
Entry	11 10 12 CH2 3456J 12

	For Multiple Area
Entry	11 10 12 2 CH2 3456J 12
Char. Count	123456789 11111111112222 2 012345678901234

The first line of the slip will be the title which will contain the calling office, the directory number and the month.

The office is obtained from a combination of digit B of line 1 and the setting of the marker group switches. The directory number is obtained from digits C, D, E and F of line 1, and the month from the month switches and the month translator circuit.

A new slip will be made for each subscriber, a new month or when the slip has nine total lines printed on it. This means that in some cases the office must be memorized and in all cases the directory number. In the last round of the month, when the entry laps over in the new month, it is also necessary to memorize the month.

The line consists of the time, day, hour and minute in six characters which are translated from the five digits B, C, D, E and F of line 2. The called area is obtained from digit B of line 3, the called office from the D, E and F digits of line 3, under the control of the area index, in the case of multiple area printing. The called number is obtained from digits B, C, D, E and F of line 4, which is printed under the control of the called number index digit C of line 3. The chargeable time is obtained from digits C and D of line 5.

The single area printing of this entry contains twenty-three elements requiring 2.6 seconds to print. The multiple area printing contains twenty-six elements requiring 2.9 seconds to print. The title contains fourteen elements requiring 1.7 seconds to print.

The sheet of drawings containing Figs. 136 and 137 has been prepared to illustrate several toll slips.

Fig. 136 is a verbatim printing of a tape very similar to the tape shown in Fig. 133 and the codes shown thereon include a number of the splice pattern codes followed by the nine codes of the tape identity group, then the codes which go to making up the toll slips, the nine codes of the tape identity group and finally several codes of the splice pattern code.

Fig. 137 is an illustration of three toll slips formed directly from the tape which produced the verbatim printing of Fig. 136. The first of these slips shows that against a station designated ME6 0019 in September there were two toll charges, one on the 26th at 9:54 A. M. to the called line KI5 4027 for which a charge of twelve message units was made and another on the 28th of that month at 4:12 P. M. (16:12) where a call was made to a station identified as MA5 9812 for which six message units have been charged. The other two toll slips are of the same nature and have been produced in sequence, the calling line numbers being in numerical order.

38.04 Message unit detail tapes

Message unit detail slip

	For Single Area
Title	CH3 1111 MAY MU—DET
Entry	11 10 12 CH2 3456 12 10 L

	For Multiple Area
Entry	11 10 12 1 CH2 3456J 12 10 L
Char. Count	123456789 11111111112222222222 0123456789012345678 9

The title is the same as for the toll slips except that it contains in addition the words MU—DET which extends the title to twenty-one elements requiring 2.4 seconds to print. The entry is the same as for the toll slips.

The line is the same as the line of the toll slips except that the message units are added, the information for which is obtained from digits E and F of line 5, and the type of message units is obtained from digit B of line 5. This line contains for the single area twenty-eight elements requiring 3.1 seconds to print while the multiple area printing requires thirty-one elements requiring 3.4 seconds to print.

The sheet containing Figs. 138, 139 and 140 is designed to show the input tape and the output message unit detailed slips together with a verbatim printing of the codes on the input tape.

Fig. 138 is very similar to Fig. 133 and shows the arrangement of the perforated holes in the input tape presented to the reader.

Fig. 139 shows a verbatim printing of this tape so that it can be seen that after a series of splice pattern codes there appear the nine codes of the tape identity followed by the various entries for producing the four digits shown in Fig. 140, then a repetition of the nine tape identity codes, the single code indicating that a splice pattern will follow and a number of the splice pattern codes. The message unit detailed slips shown in Fig. 140 may be read in very much the same way as the toll slips of Fig. 137 and follow the description of the slip given in the preceding paragraphs.

38.05 Observing tapes

The observing tape entries are printed on slips the same as the toll tapes.

Observing slip

	For Single Area
Title	CH3 1111 MAY LINE 0B8
Detail Entry	11 10 12 CH2 3456J 12 10 L
Non-Answered	11 10 CH2 3456J

	For Multiple Area
Detail Entry	11 10 12 1 CH2 3456J 12 10 L
Non-Answered	11 10 1 CH2 3456J
Char Count	123456789 11111111112222222222 0123456789012345678 9

The detail entry is printed exactly the same as for the message unit detail tapes.

The non-answered entry does not enter any chargeable time or message units, and prints spaces for the minutes of the time. The length of the non-answered line for single area is twenty elements requiring 2.3 seconds to print, while the multiple area is twenty-three elements requiring 2.6 seconds.

38.06 Straddle tapes

Printed record of straddle page

	Entry No.
FOR SINGLE AREA	
99 MAY 9	
L E48 20 NP 20 07 CH2 1000 2 AD CH3 5678J	#1
— R48 20 NP 16 10 CH2 1000 2 AD	#2
R48 20 NP 02 19 411 02 19 502 S	#3
R48 20 NP 02 19 411 S	#4

FOR MULTIPLE AREA

```
L  E48 20 NP 20 07                                                    #1
                CH2 1000 2 AD   3 CH3 5678J
123456789 1111111111222222222233333333344444444455555555555
          0123456789012345678901234567890123456789012345678
```

The entries shown printed above are numbered for convenience. No. 1 is the straddle initial detail entry, No. 2 is the straddle initial message unit entry, No. 3 is the straddle answer-disconnect entry and No. 4 is the straddle timing entry.

The straddle entries are printed on a page 7 inches wide but which in all other respects is the same as the message unit list.

The title contains the marker group number, the month and the round. This title is fourteen elements long requiring 1.7 seconds for printing.

38.07 Straddle initial detail entry

The printed line for entry No. 1 which is the initial detail entry contains the following information:

1. The type of entry obtained from digit B of line 1.
2. The recorder number and the regular or emergency designation from digits C and D of line 1.
3. The call identity index from digits E and F of line 1.
4. The straddle index from digit B of line 2.
5. The day and hour from digits C, D, E and F of line 2.
6. The calling office from digit B of line 3 in conjunction with the marker group number.
7. The directory number from digits C, D, E and F of line 3.
8. The message billing index from digit C of line 4.
9. The straddle charge index from digit F of line 4.
10. The area index from digit B of line 5, if multiple area.
11. The called office from digits D, E and F of line 5.
12. The called number from digits B, C, D, E and F of line 6.

This line requires for single area, fifty-eight elements requiring 6.1 seconds to print while the multiple area requires sixty-one elements, making 6.4 seconds.

38.08 Straddle initial message unit entry

The printed line for entry No. 2 which is the initial message unit entry contains the following information:

1. The type of entry, a dash, from digit B of line 1.
2. The recorder number from digits C and D of line 1.
3. The call identity index from digits E and F of line 1.
4. The straddle index from digit B of line 2.
5. The day and hour from digits C, D, E and F of line 2.
6. The calling office from digit B of line 3.
7. The directory number from digits C, D, E and F of line 3.
8. The message billing index from digit C of line 4.
9. The straddle charge index from digit F of line 4.

This line contains forty-eight elements which requires 5.1 seconds to print.

38.09 Straddle answer-disconnect entry

The printed line for entry No. 3 is the answer-disconnect entry and contains the following information:

1. The type of entry, from digit B of line 1.
2. The recorder number from the C and D digits of line 1.
3. The call identity index from the E and F digits of line 1.
4. The straddle index from the B digit of line 2.
5. The disconnect day and disconnect hour from the B, C, D, E and F digits of line 3.
6. The disconnect minute and the answer day from the B, C, D, E and F digits of line 3.
7. The answer hour and the answer minute from digits B, C, D, E and F of line 4.
8. The timed release index from digit E of line 5.
9. The straddle charge index from the F digit of line 5.

This line contains forty-eight elements requiring 5.1 seconds to print.

38.10 Straddle timing entry

The printed line for entry No. 4 is the timing entry and contains the following information:

1. The type of entry, a space, from the B digit of line 1.
2. The recorder number from the C and D digits of line 1.
3. The call identity index from digits E and F of line 1.
4. The straddle index from the B digit of line 2.
5. The day and hour from digits B, C and D of line 2.
6. The minute from the B, C and D digits of line 3.
7. The timed release index from the E digit of line 3.
8. The straddle charge index from the F digit of line 3.

This line contains forty-eight elements and requires 5.1 seconds to print.

The sheet of drawing containing Figs. 141 and 142 illustrates an especially prepared straddle page containing a large variety of the types of entries to be found on such a page. A showing of the tape which is placed in the reader is not made in this instance but will be very similar

in appearance to the tapes shown in Figs. 133 and 138.

Fig. 141, however, shows a verbatim printing of the codes contained in this tape and which, placed in the reader of the device, will produce the result shown in Fig. 142.

This figure has been ruled with light vertical and horizontal lines for the purpose of the following description in which a complete interpretation of the data on this straddle page is given.

In Fig. 141 the list of codes contains first the code 081010 which represents a long succession of these codes known as the splice code found in all accounting center tapes. Following this there are nine codes in the 2891 to 2899 series which present the tape identity information. In each of these codes the last two digits present a particular piece of information.

For instance, the first of these codes 289160 indicates in its last two digits the number 60 which is the tape index, meaning that this type 60 tape is one which has been produced by the computer to record items of information controlled by the straddle circuit and which tape will thereafter be presented to the printer for producing the straddle pages such as that shown in Fig. 142. The next item 289200 indicates that the marker group is that numbered 00. The next item 289300 indicates that the first recorder number is numbered 00 and the following item 289419 indicates that the last recorder number is 19. The code 289500 indicates in its fifth digit that the office code is 0. In this particular instance, the 0 office in the 00 marker group will be cross-connected in the printer circuit in such a way as to produce the office ME6 (Media 6).

The next code 289690 shows the thousands range to be between 9 and 0. The code 289756 shows that the first day of the round is 5 and the last day is 6. It may be explained that when the month is divided into six five-day rounds that this means that the fifth round may have either 3, 4, 5 or 6 days included therein. In the present case this straddle tape is for the month of October and, therefore, will contain six days, the 26th to the 31st, inclusive.

The next code 289805 shows in its fifth and sixth digits the tape section 0 and the round 5 and the last code 289910 shows the month 10 (October).

When this tape is to be placed in the printer the manual switches are set as follows:

Switch	Setting
Previous sort	Unsort
Tape type	Straddle
Marker group—Tens	0
Marker group—Units	0
Central office	0
Thousands—First	0
Thousands—Last	0
Month—Tens	1
Month—Units	0
Round	5

With the manual switches of the printer circuit set in the above manner then, this 60-type tape will be accepted by the printer and as soon as the reader has gone through this tape identity information in the 2891 to 2899 codes, the printer will produce the first line shown on the straddle page. It may be noted that the printer is arranged to print a given number of lines to form a page and that when this number of lines has been completed the printer will automatically operate through its carriage return and line feed functions several times and thereafter reproduce the information shown in line 1 of Fig. 142 provided, of course, that the number of items in the straddle tape is more than enough to fill a single straddle page. In the illustration here given no attempt has been made to show more than one page and, therefore, this title is only shown in one instance.

The information contained in this first line

00 OCT 5

is information all taken from the above tape identity information and means that this straddle page relates to information gathered from marker group 00 during the month of October and during the fifth round of that month. When this has been printed the printer circuit will scan, translate and print the other lines shown in Fig. 141. By scanning this list of codes it will be noted that there are fourteen groups of codes each starting with a line beginning with a 2 in the A digit and containing two or more supplementary lines each beginning with a 0. Each such group of codes is known as an entry and the first of these

255300
053010
046404

is an entry produced by the straddle circuit of the computer and contains the following information. The 5 in the B digit of the first of these lines is an entry index denoting in this case that the entry is a timing entry and that it is a straddle entry. The next two digits 53 in the C and D places indicate that the entry was made on emergency recorder No. 03. If this had been a regular recorder then the code would have been 03 instead of 53, the 0 in the tens place having been changed to 5 to indicate that the entry has been made on an emergency recorder. The last two digits 00 are known as the call identity index.

In the second line of this entry the 5 in the B digit is a straddle index and indicates that other straddle entries of the same call are located on the same straddle tape (probably two non-adjacent entries). The 30 in the C and D digits of this line indicates the day and the 10 in the fifth and sixth places indicates the hour during which this entry was made.

In the third line the 464 in the B, C and D digits of the lines indicates the minutes, that is, 46.4 minutes. The 0 in the fifth place is known as the time release index and is always 0 for normal calls. Lastly, the number 4 in the F digit of this last line is known as the straddle charge index and indicates that the call must be cancelled if this timing entry is an answer time and that the overtime must be cancelled if this timing entry is a disconnect time. With this information the line 2 in Fig. 142 will be printed. Its meaning is that emergency recorder No. 3 has recorded a timing entry having a call identity index 00 and which timing entry is one of three entries, the other two of which are to be found on the same straddle page, the entry having been made on the 30th of the month during the tenth hour at 46.4 minutes after the beginning of this hour and that the charges are to be treated as above denoted, that is, all charges are to be cancelled if this is an answer time but only the overtime charges are to be cancelled if this is a disconnect time.

In the list of codes shown in Fig. 141 there are, as above stated, fourteen of these groups of codes, each one of which carries the information for causing the printer to print each of the fourteen lines shown in Fig. 142. No detailed explanation will be given of the exact meaning of each of these codes but the interpretation of the code and the disposition of the information when the straddle page is placed in the hands of an operator will be explained instead in connection with Fig. 142.

For purposes of explanation the horizontal lines and the vertical columns of typing have been numbered outside the limits of the straddle page. The first line at the top of the page will always give the marker group (00), the month (OCT) and the round (5) and this information will be repeated at the top of each page if the information to be transcribed is more than enough to fill a single page. It may be noted that round 5 of a month divided into six rounds (counted 0, 1, 2, 3, 4 and 5) of five days each will include the 31st (in case the month is January, March, May, July, August, October or December) the 30th, the 29th, the 28th, the 27th and the 26th, and since the information has been assembled in the reverse order to that in which it was gathered, the calls will be listed in descending order. However, since all information from the emergency recorders are processed first, the assembly of the various items may appear somewhat scrambled. The first item (line 2) will naturally be the very last item recorded at the central office having the lowest numbered call identity index by one of the emergency recorders and the rest will follow in accordance with the ascending values of the call identity index.

An explanation of this straddle page may best be made by the following account of how the information is digested and disposed of by a clerk or operator. Such clerk will first (possibly) draw a line between items 7 and 8 to segregate all those items bearing the same (00) call identity index and will then attempt to dispose of each item. The first item (line 2) appears to be a timing item and may be either an answer or a disconnect time, known to be such (1) because there is no symbol in column 1, (2) because the minutes (tens, units and tenths) appear in columns 19, 20 and 21 and (3) because of the absence of any notations beyond column 21. This first item conveys the information that a call was either answered or disconnected at 46.4 minutes after 10:00 o'clock A. M. on the 30th and that the other elements of the call will be found (CC in columns 7 and 8) in the current period's record. In columns 45 and 46, the symbols AD mean that (A) if this is an answer time entry then all charges are to be cancelled, or alternatively (D) if this is a disconnect time entry then the calling subscriber must be charged for the initial period but that overtime charges must be cancelled.

Now the operator will couple this item with the other two elements of the call. By simple scanning these are found in lines 6 and 7 so that the complete call will appear as follows:

```
  E03 00 CC 30 10 464                    AD
  R03 00 AC 30 10 205                    -C
- R03 00 A  30 10       ME6 3647 6      -C
```

In the second item the C in column 11 indicates that the third item is to be found in the current period's list and the A in column 10 indicates that such item will be an adjacent item. In item 3, the initial entry of a regular call, indicated by the

– in column 1, it is indicated that the next or answer time entry is an adjacent item.

Now it will appear that since the first item bears the minutes as 46.4 and the second item bears the minutes as 20.5, that the second item must be the answer time and the first item the disconnect time. Therefore, only the overtime charges are to be cancelled, and this is confirmed by the symbols –C in columns 45 and 46 of both the second and third items which are interpreted to mean that overtime is to be cancelled. Now the operator will prepare a charge ticket – assessing against line ME6 3647 (columns 33 to 40) a charge of 2 message units. This value is derived from the fact that the message billing index 6 (column 43) within the marker group 00 indicates a rate of 2 message units for the first 5 minutes and 1 message unit for each 3 minutes thereafter, and although the call lasted apparently for 25.9 minutes (46.4—20.5) the fact that overtime was to be cancelled reduces the charge to the initial period rate of 2 message units.

This call, with all three elements appearing on the same straddle sheet, is the result of one of about one hundred and fifty-three different conditions which will cause a call to be diverted to the straddle tape. Though we are not at present concerned with the intricacies of the reasons, it does appear as a matter of interest that some trouble had occurred between the answer time and the disconnect time, when a switch was made from regular recorder 03 (R03) to the emergency recorder (E03) which cast doubt upon the validity of the time of the conversation, whereupon the signal for cancelling the overtime was given, which signal, it may be noted, would affect all calls at the time in a similar stage.

This call having now been completely disposed of, the operator may scratch the three items, lines 2, 6 and 7 and consider the next.

The next call is derived from lines 3 and 5 as follows:

```
- E01 00 C 30 04                    ME6 0110 8 --
  R01 00 C 30 04 222 30 04 247                C-
```

Here it appears that a switch from emergency recorder (E01) to a regular recorder (R01) took place between the initial entry, line 3, and the answer time which appears in columns 23 to 32 of line 5. Since some trouble had developed casting doubt on the validity of the call as a whole, a signal was given to cancel all the charges which appear in the symbols C– in columns 45 and 46 of line 5. Since all the charges are to be cancelled the operator will dispose of this call by scratching these items and proceeding to the next.

This leaves the single item shown in line 4:

```
L R01 00 N 31 02    ME6 1070 3 -- CU8 1763M
```

This is an initial entry of a line observing call. The symbol N in column 10 indicates that the remaining items of this call are to be found in the next period's entries and, therefore, the operator will make a note of these items and file the note away until the next period's straddle page comes to her attention so that the other elements of the call may be coupled with this and the full details of the call known. This disposes of the item, line 4.

The operator now scans the column of call identity indices, columns 7 and 8, and finds a single entry in line 8 which appears to be a disconnect time entry of a call the other elements of which appear on the previous period's records so that the operator will now search for a note previously made which will match this entry so that the de-

tails of the call may be properly disposed of. This completes the disposal of this item.

The operator next scans the column of call identity indices and finds four items all bearing the call identity index 26. The first item, line 9, will be found to be coupled with the item, line 12. Line 9 is an initial entry made on an emergency recorder and line 12 is a timing entry containing both the disconnect and answer times. From the answer and disconnect times in line 12 it appears that the conversation extended over 35.4 minutes and from the message billing index 7 in column 43 the charges will be at the rate of 3 message units for the first 5 minutes and 1 message unit for each 2 minutes thereafter. This would figure to be 18 message units. However, the symbol S in column 45 indicates that a certain amount of time is to be subtracted from the elapsed time due to the fact that in this case the called party disconnected first and, therefore, the running of time was not stopped immediately due to the control which the calling party has over the connection. This is known as a forced disconnect and for that reason .6 of a minute is subtracted making the elapsed time in this case 34.8 minutes which figures according to the rate above stated to be 17 message units. Therefore, the operator will make out a ticket assessing against the calling line number ME6 1987 a charge of 17 message units. Thus, the call expressed in lines 9 and 12 is disposed of.

This leaves the lines 10 and 11 as follows:

```
    R07 26 AN 31 02 594                    C-
  - R07 26 A  31 02       ME6 2432 8       C-
```

Here, we evidently have an initial entry of a call made from line ME6 2432 with an adjacent timing entry showing that the call was answered at 2:59.4 but that the disconnect time must be found on the next period's straddle page. This is logical since the central office tape is generally cut at 3:00 A. M. and this call was started just prior to this period so that the call actually straddles the cut in the tape. Although it appears from the symbols in columns 45 and 46 that some trouble has occurred which will cause the cancellation of all charges, the operator will nevertheless make a note of the details of this call and file it away until the next period's straddle page comes to attention. The operator will then scratch these two items and go on to the next.

Here we find two items in lines 13 and 14 as follows:

```
    R10 57 A 30 09 567 30 08 000          --
L   R10 57 A 30 07          ME6 0945 9 --  L04 4597
```

This appears to be the complete information for a line observing call made over the line of station ME6 0945. From the symbols in columns 45 and 46 it was a regular call in all respects except that being a line observing call the details will be sent to the line observing operator as well as the charges assessed against the calling subscriber. By figuring the elapsed time it appears that the call extended over a period of 116.7 minutes and since the computer is arranged to divert all calls longer than 99 minutes to the straddle tape, this particular call was, therefore, diverted in that way and appears now on this straddle page. Therefore, the operator will make out a charge ticket assessing against the calling line ME6 0945 the proper charge for a toll call (symbol 9 in column 43) extending for a period of 1 hour 56.7 minutes to a called subscriber L04 4597. The operator will have for her use a list of the toll rates from the marker group 00 to other points and will, therefore, be able to translate this elapsed time of 1 hour 56.7 minutes into the proper charge in message units or in dollars and cents. This call now having been completely digested the operator will scratch lines 13 and 14.

Lastly, the operator will scan line 15 of this page and may at once note from the symbol 0 in column 43 that this is a district test call and is, therefore, free, so that no charge will be assessed against the calling line. This is confirmed by the symbol T in column 45 which instructs the operator that this is a test call and that charges are to be cancelled. This item now having been digested the operator will scratch this last line.

The above-noted list of items has been chosen to illustrate certain typical examples of entries on a straddle page and an attempt has been made to explain briefly the reason for each entry and the manner in which it is disposed of.

38.11 Verbatim tapes

Printed record

Entry 289165

The verbatim list as it is known is printed on the same 3-inch paper as the message unit list. The line consists of eight elements requiring 1.1 seconds to print.

39. Description of trouble indication circuits

39.01 Indication of reader failure to step or to overstep

(A) Normal operation

In section 6 a complete description is given of the method whereby the stepping of the reader drum is controlled to allow an automatic accounting system line to be read when the circuit is ready to read a new line, and not to allow it to step until it is ready.

Due to trouble, however, it may happen that the reader does not step when required, or it steps when it should not. If either of these conditions exist an indication must be provided so that appropriate steps can be taken to cure the trouble.

(G1) relay 1110 and (G2) relay 1816 of the reader control circuit have been provided to indicate either of these troubles. As described in section 12 the reader is equipped with two sensing pins and contacts (G1) and (G2), which alternate as the drum rotates, into holes in the end of the drum, which holes are outside the area covered by the tape.

Also as has been explained in section 6, the indication by the circuit for the drum to step is the release of the (R2) relay 1104, the (R0), (R1), (S1) and (S2) relays being released. Under this condition either the (G1) or (G2) contacts of the reader will be closed. This is not a steady closure but a closure of about .040 second in every .060 second, because the contacts are continually in motion even though the drum does not move.

Under these conditions only one of these contacts will be active, however, and the corresponding relay will operate. We will assume for descriptive purposes that the (G1) contact is active. Relay (G1) will, therefore, follow the closure of this contact until relay (R1) operates at which time it will lock to relay (R1), on its secondary winding.

Relay (G1) operated:

1. Locks at its armature 3 and front contact to the armature 4 of relay (R1), and later when

relay (R2) operates the lock will be continued to armature 7 of relay (R2).

2. At its armature 1 it rearranges the lamp circuit.
3. At its armature 2 and back contact it removes one ground from the "CKD" lead.

When relay (R2) releases, the relays that are locked will release, ready for the next step. If the (G2) contact had been the one first closed, relay (G2) would have been the relay involved and it would act in the same way as was described for (G1).

(B) Failure to step

If the drum had failed to step relay (G2) would not operate and lock. The (CK) relay would not operate, and the circuit would time out. The operation of the (Reader lamps) key will provide ground on lead "PRG" which via the back contacts of relays (G2) and (G1) will light the (RDR step failed) (RSTP) lamp 1819.

(C) Action on the part of the operator

The lighting of either of the above trouble lamps, shall cause the operator to call the maintenance attendant, as this is a circuit trouble and should be cleared before processing should be allowed to proceed.

39.03 Time-out alarm

It will be recalled that relay (R2) controls the time-out alarm. Upon the reception of a new line, relay (R2) operates and initiates the timing of the alarm circuit by grounding the "T0" lead to the alarm circuit which is described in section 19.

If the line is not disposed of within 8 seconds, relay (R2) will not yet be released, and a general alarm will result, sounding the audible alarm, which is common to the office, and lighting the general alarm lamp as well as the machine pilot lamp. An exception is where the tape is being stepped manually. The extent of the progress of the circuit in disposing of a line may be indicated by the lighting of certain lamps from ground applied to the "PRG" lead by the (Reader lamps) key 2201. The circuits for lighting the various progress indicating lamps are described under the headings where they apply.

Normally the (R2) relay releases well within the 8 seconds to stop the timing.

39.04 Main type of trouble

The main type of trouble that it is expected will be encountered and which must be indicated as accurately as possible is the mutilation of the holes of the automatic accounting system tape of such a nature that the reading as received from the reader pins does not correctly designate a numeral. The assumption is made that in no case will a combination for one numeral be substituted for another, but only that a combination might appear that represents no numeral at all.

Combinations that do not produce numerals are two holes in the A digit, and one, three, four or five holes in the B, C, D, E and F digits.

We will now proceed along the tape to see what the possible errors are, what indications are given and what can be done about them.

39.05 The first line of leading end splice pattern is faulty

In this case we are only concerned that the A and B digits are 08. Assuming that these digits are so mutilated that relay (SKS) cannot operate, then the series of operations of (R2A) relay 1006, (S3) relay 1012 and (R3) relay 1011 cannot take place and the circuit will time out.

When the circuit has timed out, the operation of the (Reader lamps) key will ground the lamp lighting lead "PRG." Either of the relays (G1) or (G2) will be operated and the circuit through the contacts of these two relays may be traced further through normally closed contacts of relays (CK), (PR), (CKT), (STE) and (RRCK) to lead "FLR" to light the (Line NO CK IN RDR) lamp 2609. We will assume in all cases, in this discussion, that the circuit times out and gives the alarm.

It is immediately obvious from the tape that it is in the splice pattern, or the (RDR REG lamps) key can be operated to show that it is a splice entry with a mutilated 08, so it is only necessary to step the tape along to a good entry. To do this the (Reader step) key 2607 is operated momentarily, connecting together leads "EM1" and "S1" of the reader control circuit and grounding lead "EM" which causes (EM) relay 2608 to operate via the armature 2 and back contact of (BST) relay 2500 and via the normal contacts of armature 3 of relay (EM1).

Relay (EM) operated:

1. On its armature 2 and front contact completes a circuit beginning at ground on relay (S2) released, to operate relay (CK) thus satisfying the check requirement artificially.
2. Operates relay (RMS) at its armature 3 and front contact to restart the reader motor.
3. Removes the "CKD" ground lead from the (TIP), (G1) and (G2) relays from the rest of the (CKD) circuit, at its armature 0 and back contact.
4. Closes six contacts to operate the (S—S) relays in the storage circuits, when they are involved.

The operation of the (CK) relay clears the circuit to that relay (R2) can release, and initiate a new step of the tape. As relay (S1) operates in this process it applies ground, if the reader step key is still operated, to (EM1) relay 2608 via leads "S1" and "EM1."

Relay (EM1) operated:

1. Locks under the control of the reader step key on lead "EM," at its armature 3 and front contact.
2. Releases relay (EM) at its armature 3 and back contact of (S1) relay 1107.
3. Opens the "T0" lead to the timing circuit at its armature 1 and back contact.
4. Closes a possible locking circuit for itself to relay (BST).

Thus, with relay (EM) released the circuit is free to proceed in a normal manner. If the new line of perforations does not check, stepping can take place without waiting for an alarm, as a ground is available on the (Reader step) key as long as relay (STE) is released. If the new line is good the processing of the tape continues without further attention, that is, the A and B digits are recognized as 08 and the remaining splice entries are skipped over in the manner described in section 7.

39.06 First 289 line is not recognized as 289 following skipping

The first 289 line is the first line of the tape identity group, which should stop the skipping and cause the circuit to check the tape identity group. If this fails to stop the skipping, the

skipping will be stopped as explained in section 7. Operation of the (Reader lamps) key will apply ground to lead "PRG" and the circuit is as follows. One or the other of the (G1) or (G2) relays will be operated as the reader has stepped properly. Therefore, this (PRG) circuit is extended to relay (CK), this relay not being operated will extend the circuit through its armature 2 and back contact to relay (PR) not operated, through its armature 2 and back contact, then through the armature 6 and back contact of relay (CKT) not operated, the armature 4 and back contact of relay (STE) not operated, the armature 1 and back contact of relay (RRCK) not operated to light the (Line no check in reader) lamp 2609. This means that there is a line in the reader that cannot be recognized.

The tape identity group must be stepped through by the (Reader step) key 2607 a line at a time which operates as described above, until the first line of the following call entry is under the reader pins. Then the tape identity skip key 1114 is operated, starting the processing of the call entries.

Ground is present on the (Tape ident.) key 1114, because relay (CKT) has not operated. Operating this key operates (TP) relay 2604 which sets up the same condition as though the tape identity group had been properly checked. The circuit can then process the call entries in the regular manner.

39.07 Any 289 line is recognized as 289 but fails to check due to mutilation

In this case relay (CKT) is operated, but the tape identity circuit, Figs. 7 and 14, has failed to check the line due to the mutilation in the other digits of the line. Therefore, the circuit will time out.

With the (Progress lamps) key 2201 operated, the (PRG) ground will be routed via either the (G2) or the (G1) relay operated, the (CK) relay unoperated, the (FR) relay unoperated, the (CKT) relay operated and the (RRCK) relay unoperated to light the (TI NO CK IN reader) lamp 2610. This means that the line in the reader is a tape identity line, but it cannot be checked.

The same process for stepping by the tape identity group takes place as before, it being stepped by the (Reader step) key. The first time the (EM) relay is operated, it closes a circuit which starts from ground on the armature 8 and front contact of relay (CKT) operated, the armature 1 and front contact of relay (EM) operated, to operate (TIP) relay 2602.

Relay (TIP) operated:

1. Locks at its armature 5 and front contact to relay (TP) released.
2. Opens at its armature 3 and back contact the locking lead "LK" of the reader line count circuit causing the count circuit to release.
3. Opens at its armature 2 and back contact the "CT" lead so that the count circuit cannot be stepped.
4. Opens at its armature 4 and back contact the locking circuit of the (CKT) relay.
5. Applies at its armature 1 and front contact ground to the (CKD) system.
6. Opens at its armature 6 and back contact that part of the operating circuit to relay (TP) that is applied via (EC) relay 2506.

The tape identity group is stepped through by the (Reader step) key to the first line of the following call entry. Then the (Tape ident.) key is operated, which operates relay (TP) and releases relay (TIP) and processing continues.

39.08 Any 289 line is recognized as 289 but fails to check in the circuit

This condition is one brought about usually by a mismatch between the tape and the set-up switches. In this case relays (CKT) and (RRCK) will be operated but (TCK) relay 2605 will not be operated. The lamp lead is then routed to light the (Tape ident.) lamp 2611. This means there is no mutilation of the tape, and the setting of the switches or the selector, Fig. 21, must be checked. The circuit is again stepped through by the (Reader step) key and the (Tape ident.) key is operated.

39.09 Not enough lines in the tape identity group

If the first line of a call entry appears before the full number of lines of the tape identity group has been received, of course, no check will take place and the (STE) relay 2505 cannot operate, because the (CKT) relay 1702 is operated.

In this case, if it is decided that this is the proper tape, the reader cannot be stepped forward by the (Reader step) key as the line that we wish to read is under the reader pins. The following procedure shall take place:

1. Release the circuit by operating both the (Machine release) key 1818 and (Master release) key 1808.
2. Restore the (Master release) key.
3. Operate the (Motor start) key 1803.
4. Operate the (Machine start) key 1815.
5. Operate the (Tape ident.) key 1114.

This action removes the (CKT) relay and allows the (STE) relay to operate and print the line under the pins.

39.10 Too many lines in the tape identity group

In this case, we assume nine good lines in the proper order had been passed. If they had not, the operator's attention would have been directed to it before this point was reached, under conditions described elsewhere.

If the next line is recognized as a line of a tape identity group, the (CKT) relay will again operate and an attempt will be made to check another tape identity group., The result of this is a simple repetition of sections 39.07, 39.08 and 39.09.

In all cases, the tape must be checked to see if it is the right tape.

39.11 A 289 line following a regular entry is not recognized as a 289 line

In this case the (CKT) relay will not operate, therefore, the tape identity group will be stepped through by the (Reader step) key until the first line of a call entry appears. Then operating the (Tape ident.) key will cause the circuit to process the entries.

39.12 First line of a call entry not recognized as an entry following skipping

The only time that this condition can occur in normal practice is following a window splice, and under this condition the skipping should have been stopped by the second 287 line. If, however, it should get by the second 287 then some element in the entry line will stop the skipping. As we have assumed that this line is not recognized, relay (STE) will not be operated. Assuming also that the line did not check in the reader relay

circuit and that, therefore, relay (RRCK) will not be operated, the (Line NO CK IN RDR) lamp 2000 will light. The whole call entry will be stepped through by the (Reader step) key, taking a record of the entry. When the first line of the next entry is seen, the circuit will take up the processing automatically.

39.13 First line of a call entry not recognized as an entry

The action here is identical with the described in section 39.12.

39.14 First line of a call entry is recognized but the balance of the line fails to check

In this case the (STE) relay operates, but the (RRCK) relay does not operate and the lamp signal is (ENT 1st line NO CK IN RDR) 1700 lighted over lead "EL" when the (Progress lamps) key 2201 is operated.

Ground for lighting the lamp can be traced from the "PRG" lead at armature 4 of (LP) relay 1008 through contacts of the (G1) or (G2) relay, through contacts of the released (CK), (PR) and (CKT) relays, through armature 4 and front contact of the operated (STE) relay and contacts of the released (RRCK) and (CK1) relays to the "EL" lamp 1706. This line being recognized as an entry line will be transferred to the proper storage circuit but naturally cannot check in the storage circuit. The (Reader step) key 2607 is operated to step the reader forward to the next line. The (EM) relay has on it six make contacts which, when operated, connect the connecting relay operating leads of all storing circuits to an (S—S) relay in their respective circuits. Only one of these connecting relay operating leads has ground on it, however, so the (S—S) relay in the storage circuit in which the information is being stored is the only one operated. This (S—S) relay connects the "Star" character lead to the circuit so that when printing takes place those points in the circuit that do not check will print a star. This relay also supplies a false check for the storage circuit so that if this circuit is the one to start the printing the (IN) relay in the printer control circuit will operate.

When this first line is stepped by, the circuit picks up the second line of the entry and processing continues.

If the line checked in the reader relays but due to some fault did not check in the storage circuit, then the (STE) and (RRCK) relays would be operated but the (SCK) relay would not be operated. Consequently, the (Storage NO CK) (ELS) lamp 2612 will light when the (Reader lamps) key is operated. Ground for lighting this lamp can be traced from the "PRG" lead through contacts of the operated (G1) or (G2) relay through contacts of the released (CK), (PR) and (CKT) relays, through contacts of the operated (STE) and (RRCK) relays and through contacts of the released (SCK) relay to the "ELS" lamp 2612. The processing can be resumed by operating the (Reader step) key 2607, printing stars for the non-checked groups.

39.15 A supplementary line of entry not recognized as supplementary

This condition means that the (SLN) relay 1701 is not operated and, therefore, a check cannot be made. The (STE) and (CK1) relays are operated, therefore, the (ENT SUPP line NO CK IN RDR) (ELS) lamp 1707 will light when the reader lamps key is operated. Ground for lighting the lamp can be traced from the "PRG" lead through contacts of the released (CK), (PR) and (CKT) relays, contacts of the operated (STE) relay, contacts of the released (RRCK) relay and through contacts of the operated (CK1) relay to the (ESL) lamp 1707. The processing may be resumed by operating the (Reader step) key. In this case, it was assumed that the (RRCK) relay does not operate as the line did not check.

39.16 A supplementary line of entry is recognized as supplementary but the balance of the line does not check

This condition is the same as the previous condition except that the (SLN) relay is operated. The same indication is given, and the same procedure should be followed.

39.17 Too few lines in the entry

In this case a good first line of an entry appears before the complete count of the previous entry. The (CK1), (STE), (RRCK) relays will be operated. The (SLN) relay will not be operated. Ground on the "PRG" lead applied by the (Reader lamps) key will be routed via either relay (G1) or (G2) operated, the (CK) relay unoperated, the (PR) relay unoperated, the (CKT) relay released, the (STE) relay operated, the (RRCK) relay operated, and (CK1) relay operated, and the (SLN) relay unoperated to operate (BST) relay 2500.

Relay (BST) operated:

1. Locks at its armature 4 and front contact to the (EL) relay of the printer control circuit.
2. At its armature 1 and front contact provides a lock circuit for relay (EM1).
3. At its armature 2 and back contact disconnects the "EM" lead from the (RDR step) key, from relay (EM) and at its front contact connects it to the winding of the (L0E) relay 2613.
4. At its armature 11 and front contact partially closes a circuit to provide ground on the "S1" lead from relay (RMS) for the (Reader step) key.
5. At its armature 8 contacts provides a circuit for lighting the (Missing line) (L0E) lamp 2510 when (LP) relay 1008 is operated.
6. At its armature 9 and back contact opens the locking circuit for (EC) relay 2505.
7. At its armature 10 and front contact provides a locking circuit for relay (RMS).

Thus, by lighting the (Missing line) lamp 2510, an indication is given the operator that a line or more is out of the entry.

The operator simply operates the (Reader step) key 2607 which over the "EM" lead operates the (L0E) relay 2613.

The (L0E) relay operated:

1. At its armature 3 and front contact operates (IN) relay 4902 if it is not already operated.
2. At its armature 1 and front contact operates relay (PR) which locks to (IN) relay 4902.
3. At its armature 2 and front contact operates the (RMS) relay which locks temporarily to relay (BST).
4. At its armature 4 and front contact and its five bottom contacts applies ground to operate the (S1S), (S2S), (S3S), (S4S), (S5S) and the (S6S) relays in the six storage circuits, inclusive.

The (EM1) relay operates, cutting off the operating circuit of relay (L0E) and locking to lead "EM," causing relay (L0E) to release.

The printer is now enabled to print stars on all points in the balance of the line being printed, to which the sequence circuit directs the operating grounds. When the line is completely starred out, the circuit is released and the first line of the new entry, which is in the reader relays is allowed to enter the proper storage circuit.

When relay (PR) is released the reader line count circuit already being released, the No. 1 count is set up in that circuit, which lets the new line into its storage circuit. When this line properly checks relay (BT) releases and the circuit progresses.

39.18 Too many lines in the entry

In this case another supplementary line appears immediately following a full count of an entry. In this condition the (CKT) and (STE) relays will be released and the (RRCK) relay operated. The (Extra line) lamp **2511** will light when the (Reader lamps) key is operated. Ground for lighting the lamp can be traced from the "PRG" lead through contacts of the operated relays (G1) and (G2), the released (CK), (PR), (CKT) and (STE) relays and the operated (RRCK relay to the (EXLE) lamp **2511**. Manual stepping by the (Reader step) key will bring up the first line of the next entry, and processing will continue. The entry that has just been printed, however, should be marked as the information contained therein may not be right.

39.19 Printer fails to print

As described above, the reader control circuit after it has directed the storing of an entry, will step the reader to the next line and wait until the previous entry has been printed before directing the disposal of the new line. While the reader control circuit is waiting relay (R2) will be operated. If the completion of printing is delayed for more than 8 seconds, the circuit closed to the "T0" lead will cause the time-out alarm to function. Relay (CK) being released and relay (PR) operated, the (Fails to print) (FTP) lamp **2513** will light when the (Reader lamps) key is operated. Ground for lighting this lamp can be traced from the "PRG" lead through contacts of the operated (G1) or (G2) relay, released (CK) relay and the operated (PR) relay to (FTP) lamp **2513**. To clear this condition the (Emerg. PTR start) key **12734** is operated which causes a Star to be printed and steps the printer circuit along to the next point in the sequence, after which it should continue to print if no other open circuit condition is met. This condition usually is due to a circuit fault.

39.20 Circuit does not check down

If all parts of the circuit function properly and the (CK) relay operates, but due to some fault, some relay sticks preventing the clearance of the "CKD" lead, the (R2) relay cannot release. The (NO check down) (NCKD) lamp **2512** will light when the (Reader lamps) key is operated. Ground for lighting this lamp may be traced from the "PRG" lead through the contacts of the operated (G1) or (G2) relay and the (CK) relay to the (NCKD) lamp **2512**. To clear this trouble the relay that is stuck must be found and released.

39.21 Manual stepping of reader for test.

It is highly desirable for some tests that the reader be stepped along manually line by line and that the rest of the circuit should follow this stepping. To do this the (Line stop) key **1115** is operated. This is a locking key. This key when operated, closes the "CKD" lead to the "LS1" lead which receives ground from relay (LS1). This ground prevents the automatic release of the (R2) relay. The (Line stop) key **1115** also opens the "T0" lead to the alarm circuit.

The (Line step) key **1116** is then operated once for each line. The operation of the (Line step) key grounds lead "LS2." With relay (R2) operated, this ground operates (LS1) relay **1817** via contacts on (LS2) relay **1113**.

Relay (LS1) operated:

1. Locks under the control of relay (LS2).
2. Prepares a locking circuit for relay (LS2).
3. Removes ground from the "CKD" lead.

The removal of ground from the "CKD" lead if all other grounds are clear will release relay (R2) and permit the reader to take a step. When relay (R2) releases it closes the ground on lead "LS2" to relay (LS2) causing it to operate.

Relay (LS2) operated:

1. Locks under the control of the operated key and the operated relay (LS1).
2. Opens the locking path of the (LS1) relay.
3. Opens the operating path of the (LS1) relay.

Thus, relay (LS1) is released reapplying ground to the "CKD" lead, and it cannot again be operated until the (Line step) key is released, which releases the (LS2) relay and is again operated.

39.22 Function of the (CK1) relay

(CK1) relay **1703** operates when the second line of a call entry is being brought under the pins of the reader, and its function is to introduce the (SLN) relay into the check circuit. Relay (SLN) operates on the zero in the A digit. The presence of this (SLN) relay in the check circuit, therefore, insures that the subsequent lines after the first line of a call entry are supplementary lines. The (STE) and (CK) relays must be operated, then when (R0) relay **1106** operates in the next reader sequence the (CK1) relay will operate the lock to relay (STE). This relay operated introduces the (SLN) relay into the check circuit and also rearranges the lamp circuit so that the lamp lighted will indicate a supplementary line.

40. List of relay functions

Designation	Fig.	Function
0 to 9	94 and 106	Numeral (0 to 9) code relays.
08	17	Splice pattern indicator.
A	106	Letter A code relay.
A0	101	Area 0—called office name.
A0, 1, 2	9	"A" digit reading relays.
A1 to A9	100	Area 1 to 9—called office name.
AA, AB, AC	118	Coordinate relays—called office translator.
ACK	14	"A" digit identity check.
ALCO	127	Alarm cut-off.
APR	51	April month relay.
AUG	51	August month relay.
AUX	23	Entry auxiliary relay.
B	106	Letter B code relay.
B0, 1, 2, 4, 7	9	"B" digit reading relays.
BA, BB, BC	118	Coordinate relays—called office translator.
BCK	14	"B" digit identity check.
BSDY	25	Missing line indicator.
C	106	Letter C code relay.
C0, 1	16	"C" digit reading relays.
C1A	34	Character first count auxiliary.
C2	16	"C" digit reading relay.
C2A	34	Character second count auxiliary.
C3A	34	Character third count auxiliary.
C4	16	"C" digit reading relay.
C4A	34	Character fourth count auxiliary.
C5A	34	Character fifth count auxiliary.
C6A	42	Character sixth count auxiliary.
C7	16	"C" digit reading relay.

Designation	Fig.	Function
C7A	42	Character seventh count auxiliary.
C8A	42	Character eighth count auxiliary.
C9A	42	Character ninth count auxiliary.
CA	118	Coordinate relay—called office translator.
CALM	127	Common alarm.
CB	125	Coordinate relay—called office translator.
CC	125	Do.
CC1 to CC5	34	Character unit count relays.
CC6 to CC9	42	Do.
CCK	14	"C" digit identity check.
CK	26	Check relay.
CK1	17	Auxiliary check for supplementary line.
CKT	17	Tape identity indicator.
CL1 to CL6	50	Printer line unit count.
CL7 to CL9	57	Do.
CNR	56	Cutter non-release.
C0A to C0D	55	Printer translator connectors.
COM	13	Common function relay.
CRLF	121	Carriage return line feed code relay.
CT	56	Line count actuator.
CTA to CTE	36	Reader lines 1 to 5 count relays.
CTF to CTJ	42	Reader lines 6 to 9 count relays.
CTX	49	Character count release lock.
CUT	125	Cutter magnet actuator.
D	106	Letter D code relay.
D0, 1	16	"D" digit reading relays.
D1A, B	38	Detail entry pattern relays.
D2	16	"D" digit reading relay.
D2A, B	38	Non-answered entry pattern relays.
D4, 7	16	"D" digit reading relays.
DASH	121	Dash code relay.
DB0	111	First digit—called office translator.
DB2 to DB5	96	Do.
DB6 to DB9	108	Do.
DC0	111	Second digit—called office translator.
DC2 to DC5	97	Do.
DC6 to DC9	109	Do.
DCK	14	"D" digit identity check.
DCP	127	48-Volt potential control.
DD1 to DD5	98	Third digit—called office translator.
DD6 to DD0	110	Do.
DEC	52	December month relay.
DET	13	Toll tape set-up relay.
DP	101	Direct potential for translator tubes—connector.
DPP	127	Printer and distributor motor alternating current relay.
E	106	Letter E code relay.
E0, 1, 2, 4, 7	24	"E" digit reading relays.
EC	26	End of entry line count.
ECK	14	"E" digit identity check.
EL	49	End of printer line relay.
ELP	21	Tape section lamp connector.
EM	26	Reader step under trouble conditions.
EM1	26	One reader step insurance under trouble conditions.
ET	49	End of printer title.
ETA	49	Carriage return timing.
F	94	Letter F code relay.
F0, 1, 2, 4, 7	24	"F" digit reading relays.
FA	125	Coordinate relay—called office translator.
FB	125	Do.
FC	125	Do.
FCK	14	"F" digit identity check.
FEB	51	February month relay.
FF	125	Coordinate relay—called office translator.
FTH	23	First section relay.
G	94	Letter G code relay.
G1	11	Reader step indicator.
G2	18	Do.
G10, 20, 30, 40, 50	35	Character decade counters.
GA10, 20, 30, 40, 50	35	Character decade count auxiliaries.
H	106	Letter H code relay.
HX	111	Called office name—cross bar switch point connector.
I	114	Letter I code relay.
IN	49	Printing information in storage.
J	114	Letter J code relay.
JAN	51	January month relay.
JUL	52	July month relay.
JUN	51	June month relay.
K	94	Letter K code relay.
L	114	Letter L code relay.
L1 to L4	32	Printed line pattern relays.
L5 to L8	40	Do.
L9 to L12	47	Do.
L13 to L16	33	Do.
L17 to L20	41	Do.
L21 to L23	48	Do.
LA1, 2, 3	1	Lamp connectors for reader pins.
LB1, 2, 3	2	Lamp connectors for reader relays.
LC	56	End of page or slip indicator.
LC1, 2, 3	1	Lamp connectors for storage circuit No. 1.
LC9	57	Ninth printer line count.
LC18	57	Eighteenth printer line count.
LC27	57	Twenty-seventh printer line count.
LC36	57	Thirty-sixth printer line count.
LCR	49	Full page or slip line count release.
LCT	49	New slip line count release.
LD1, 2, 3	2	Lamp connectors for storage circuit No. 2.
LE1, 2, 3	3	Lamp connectors for storage circuit No. 3.
LF1, 2, 3	4	Lamp connectors for storage circuit No. 4.
LG1, 2, 3	3	Lamp connectors for storage circuit No. 5.
LH1, 2, 3	4	Lamp connectors for storage circuit No. 6.
LK	49	Title lock relay.
LN1 to LN6	7	Tap identity connectors for lines 1 to 6.
LN7	14	Tape identity connector for line 7.
LN8A	14	Tape identity connector for line 8 without section check.
LN8B	14	Tape identity connector for line 8 with section check.
LN9	14	Tape identity connector for line 9.
LO	13	Observing tape set-up relay.
LOE	26	Missing line step relay.
LOT	40	Sequence for observing title.
LP	10	Energizes trouble lamps.
LP1, 2, 3	50	Unit count auxiliary relays.
LP9, 18, 27	57	Summation count auxiliary relays.
LPC	22	Trouble lamp connector.
LRD	13	Last round.
LS1	18	Reader step relay before processing.
LS2	11	Do.
M	114	Letter M code relay.
M1	30	Local message unit pattern relay.
M2A, B	30	Extended message unit pattern relays.
MAR	51	March month relay.
MAY	51	May month relay.
MGA	28	Translator relay for offices 0 to 3.
MGB	28	Translator relay for offices 4 to 7.
MGC	28	Translator relay for offices 8 and 9.
MGT0	28	Marker group tens relay.
MOT	127	Reader motor alternating current relay.
MTA, B, C	51	Month translator connector relays.
MTCM	51	Change month indicator.
MTD, E	52	Month translator connector relays.
MTF	51	Change month lock-out.
MTG	52	No change month lock-out.
MTH	52	Battery cut-off relay.
MTNC	51	No change month indicator.
MU	6	Summary tape set-up relay.
MUD	6	Message unit detail set-up relay.
MUDL	33	Line sequence for message unit detail.
MUDT	32	Title sequence for message unit detail.
MUL1	41	Line sequence for local message unit summary.
MUL2	41	Line sequence for extended message unit summary.
N	114	Letter N code relay.
NA0 to NA3	19	"A" digit entry indicators.
NB0 to NB3	19	"B" digit entry indicators.
NB4 to NB9	27	Do.
NC	99	Called office name—print connector.
NC5, 7, 9	27	"C" digit entry indicators.
NCK	22	Tape section check.
NOV	52	November month relay.
NB0, 1, 2	65	Called number structure.
O	114	Letter O code relay.
OB	33	Observing line sequence.
OCT	52	October month relay.
OUT	49	Printing complete.
P	114	Letter P code relay.
P1 to P5	94	Distributor pulse control.
PA1	114	Upper case indicator.
PA2, 3, 4, 5	114	Upper case count.
PA6	121	Single character print guarantee.
PA7	121	Upper case count complete.
PA8	121	Single star print guarantee.
PA9	121	Printer star under trouble conditions.
PC1	8	Reading relay connector.
PC2	15	Do.
PC3	23	Do.
PM8	18	Printer motor start.
PR	25	Printing in process.
P8	121	Character a time print.
Q	94	Letter Q code relay.
R	114	Letter R code relay.
R0	11	First reading pulse indicator.
R1	11	Second reading pulse indicator.
R2	11	Reader step control relay.
R2A	10	Third reading pulse indicator for skipping.
RD	33	Line sequence for toll entries.
RDT	32	Title sequence for toll entries.
RL	42	Character count release.
RL8	17	Machine release relay.
RLX	10	Machine release auxiliary relay.
RM8	18	Reader motor start.
RRA, B	9	Reading relay checks for digits A and B.
RRC	16	Reading relay check for digit C.
RRCK	26	Reading relay check.
RRCO	21	Reading relay cut-off.
RRD	16	Reading relay check for digit D.
RRE, F	24	Reading relay checks for digits E and F.
RRLK	10	Reading relay lock.
S	121	Letter S code relay.
S1	11	First stepping pulse indicator.
S1A	58	Connector relay.
S1B	82	Do.
S1B0, 1, 2	58	"B" digit registers.
S1B4, 7	59	Do.
S1BA to S1BF	58	"B" digit translators.
S1BG to S1BK	59	Do.
S1BX	59	"B" digit register check.
S1BY	59	"B" digit battery cut-off.

Designation	Fig.	Function
S1C	82	Connector.
S1C0, 1, 2	70	"C" digit registers.
S1C4, 7	71	Do.
S1CA to S1CF	70	"C" digit translators.
S1CG to S1CK	71	Do.
S1CX	71	"C" digit register check.
S1CY	71	"C" digit battery cut-off.
S1D0, 1, 2	82	"D" digit registers.
S1D4, 7	83	Do.
S1DA to S1DF	82	"D" digit translators.
S1DG to S1DK	83	Do.
S1DX	83	"D" digit register check.
S1DY	83	"D" digit battery cut-off.
S1E0, 1, 2	82	"D" digit registers.
S1E4, 7	83	Do.
S1EA to S1EF	82	"D" digit translators.
S1EG to S1EK	83	Do.
S1EX	83	"E" digit register check.
S1EY	83	"E" digit battery cut-off.
S1F0, 1, 2	82	"F" digit registers.
S1F4, 7	83	Do.
S1FA to S1FF	82	"F" digit translators.
S1FG to S1FK	83	Do.
S1FX	83	"F" digit register check.
S1FY	83	"F" digit battery cut-off.
S1L	83	Title lock-out.
S1S	82	Star connector.
S2	11	Second stepping pulse indicator.
S2A	53	Connector.
S2B	72	Do.
S2B0, 1, 2	53	"B" digit registers.
S2B4, 7	54	Do.
S2BA to S2BF	53	"B" digit time translators.
S2BG	54	"B" digit time translator.
S2BH	54	Do.
S2BJ	54	Do.
S2BW	54	"B" digit auxiliary check.
S2BX	54	"B" digit check.
S2BY	54	"B" digit translator check.
S2C	84	Connector.
S2C0, 1, 2	60	"C" digit registers.
S2C4, 7	61	Do.
S2CA to S2CE	60	"C" digit time translators.
S2CF to S2CJ	61	Do.
S2CW	61	"C" digit auxiliary check.
S2CX	61	"C" digit check.
S2CY	61	"C" digit translator check.
S2CZ	60	"C" digit time translator.
S2D0, 1, 2	72	"D" digit registers.
S2D4, 7	73	Do.
S2DW	73	"D" digit auxiliary check.
S2DX	73	"D" digit check.
S2E0, 1, 2	72	"E" digit registers.
S2E4, 7	73	Do.
S2EW	73	"E" digit auxiliary check.
S2EX	73	"E" digit check.
S2F0, 1, 2	84	"F" digit registers.
S2F4, 7	85	Do.
S2FB, C, D	84	"F" digit straddle charge index translators.
S2FE, F, G, H	85	Do.
S2FW	85	"F" digit auxiliary check.
S2FX	85	"F" digit check.
S2FY	85	"F" digit translator check.
S2FZ	84	"F" digit, timed release translator.
S2S	84	Star connector.
S3	10	Third stepping pulse indicator.
S3A, B	62	Connectors.
S3B0, 1, 2	62	"B" digit registers.
S3B4, 7	63	Do.
S3BW	63	"B" digit auxiliary check.
S3BX	63	"B" digit check.
S3C	86	Connector.
S3C0, 1, 2	74	"C" digit registers.
S3C4, 7	75	Do.
S3CW	75	"C" digit auxiliary check.
S3CX	75	"C" digit check.
S3D0, 1, 2	74	"D" digit registers.
S3D4, 7	75	Do.
S3DW	75	"D" digit auxiliary check.
S3DX	75	"D" digit check.
S3E0, 1, 2	86	"E" digit registers.
S3E4, 7	87	Do.
S3EW	87	"E" digit auxiliary check.
S3EX	87	"E" digit check.
S3F0, 1, 2	86	"F" digit registers.
S3F4, 7	87	Do.
S3FW	87	"F" digit auxiliary check.
S3FX	87	"F" digit check.
S3S	86	Star connector.
S4A	64	Connector.
S4B	76	Do.
S4B0, 1, 2	64	"B" digit registers.
S4B4, 7	65	Do.
S4BW	65	"B" digit auxiliary check.
S4BX	65	"B" digit check.
S4C	88	Connector.
S4C0, 1, 2	76	"C" digit registers
S4C4, 7	77	Do.
S4CW	77	"C" digit auxiliary check.
S4CX	77	"C" digit check.
S4CZ	77	"C" digit 0 translator.
S4D0, 1, 2	76	"D" digit registers.
S4D4, 7	77	Do.
S4DW	77	"D" digit auxiliary check.
S4DX	77	"D" digit check.
S4DZ	77	"D" digit 0 translator.
S4E0, 1, 2	88	"E" digit registers.
S4E4, 7	89	"E" Digit registers.
S4EW	89	"E" digit auxiliary check.
S4EX	89	"E" digit check.
S4EZ	89	"E" digit 0 translator.
S4F0, 1, 2	88	"F" digit registers.
S4F4, 7	89	"F" digit registers.
S4FW	89	"F" digit auxiliary check.
S4FX	89	"F" digit check.
S4FZ	89	"F" digit 0 translator.
S4S	88	Star connector.
S5A	66	Connector.
S5B	90	Do.
S5B0, 1, 2	66	"B" digit registers.
S5B4, 7	67	Do.
S5BW	67	"B" digit auxiliary check.
S5BX	67	"B" digit check.
S5C	102	Connector.
S5C0, 1, 2	78	"C" digit registers.
S5C4, 7	79	Do.
S5CW	79	"C" digit auxiliary check.
S5CX	79	"C" digit check.
S5CZ	79	"C" digit 0 translator.
S5D0, 1, 2	90	"D" digit registers.
S5D4, 7	91	Do.
S5DW	91	"D" digit auxiliary check.
S5DX	91	"D" digit check.
S5DZ	90	"D" digit 0 translator.
S5E0, 1, 2	90	"E" digit registers.
S5E4, 7	91	Do.
S5EW	91	"E" digit auxiliary check.
S5EX	91	"E" digit check.
S5EZ	90	"E" digit 0 translator.
S5F0, 1, 2	102	"F" digit registers.
S5F4, 7	103	Do.
S5FW	103	"F" digit auxiliary check.
S5FX	103	"F" digit check.
S5FZ	102	"F" digit 0 translator.
S5L1	79	"B" digit type of message unit translator.
S5L2	79	0 translator indicator.
S5L3	79	Recorder type register.
S5S	102	Star connector.
S6A	68	Connector.
S6A0, 1, 2	68	"A" digit registers.
S6AX	69	"A" digit check.
S6B	80	Connector.
S6B0, 1, 2	68	"B" digit registers.
S6B4, 7	69	Do.
S6BA to S6BF	80	"B" digit straddle index translators.
S6BG to S6BK	81	Do.
S6BW	69	"B" digit auxiliary check.
S6BX	69	"B" digit check.
S6BY	81	"B" digit translator check.
S6C	92	Connector.
S6C0, 1, 2	80	"C" digit registers.
S6C4, 7	81	Do.
S6CW	81	"C" digit auxiliary check.
S6CX	81	"C" digit check.
S6D0, 1, 2	92	"D" digit registers.
S6D4, 7	93	Do.
S6DW	93	"D" digit auxiliary check.
S6DX	93	"D" digit check.
S6E0, 1, 2	92	"E" digit registers.
S6E4, 7	93	Do.
S6EW	93	"E" digit auxiliary check.
S6EX	93	"E" digit check.
S6F0, 1, 2	102	"F" digit registers.
S6F4, 7	103	Do.
S6FW	103	"F" digit auxiliary check.
S6FX	103	"F" digit check.
S6S	102	Star connector.
SCK	26	Storage check relay.
SEP	52	September month relay.
SH	121	Shift code relay.
SKFS	10	Skipping auxiliary.
SKS	10	Skip relay.
SL1	41	Line sequence for straddle initial detail entry.
SL2	41	Line sequence for straddle initial message unit entry.
SL3	48	Line sequence for straddle answer-disconnect entry.
SL4	48	Line sequence for straddle timing entry.
SLN	17	Supplementary line relay.
SP	121	Space code relay.
SPA to SPE	36	Reader line count relays
SPF, G, H, J	43	Do.
SR	22	Restore relay.
ST	10	Start relay.
ST1A, B	29	Straddle initial detail entry relay.
ST2A, B	37	Straddle initial message unit entry relay.
ST3A, B	37	Straddle answer-disconnect entry relay.
ST4A, B	44	Straddle tuning entry relay.
STAR	106	Star code relay.
STE	25	Entry indicator.
STEP	22	Step start relay.
STOP	11	Stop control relay.
STR	6	Straddle set-up relay.
STRT	47	Title sequence for straddle.
STUFF	126	Stuffer actuator.
SW	49	Title to line switch.
T	121	Letter T code relay.
T1 to T4	31	Title sequence relays.
T5 to T8	39	Do.
T9 to T12	46	Do.

Designation	Fig.	Function
TB	22	Tape beginning relay.
TC	42	Tenth character count.
TC1, TC2	6	Section check set-up relays.
TC3, TC4	13	Do.
TCC	7	Identity check connector.
TCK	26	Identity check.
TE	22	Tape end relay.
TIP	26	Tape identity complete.
TK1 to TK5	56	Cutter and stuffer control.
TMOA	127	Time out alarm.
TOA	127	Tape out alarm.
TP	26	Tape identity release.
TPOA	127	Tape out alarm.
U	121	Letter U code relay.
UC	114	Upper case start.
UNLK	56	Storage unlock.
UNSH	121	Unshift code relay.
V	94	Letter V code relay.
VB	13	Verbatim set-up relay.
VBL	48	Verbatim line sequence.
VBM	29	Verbatim entry relay.
VBT	46	Verbatim title sequence.
W	106	Letter W code relay.
X	106	Letter X code relay.
X00	99	Single-digit—called office name.
X0X	99	Two-digit—called office name.
Y	106	Letter Y code relay.
Z	106	Letter Z code relay.

What is claimed is:

1. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers in sequence, a code relay circuit for translating the codes of said lines to other codes suitable for the operation of a code controlled printer, another translator for translating parts of the codes of said lines into data characters, a sequence circuit for sequentially and selectively connecting said code relay circuit directly to said registers or alternatively to said registers through said other translator and a code controlled printer responsive to said code relay circuit.

2. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers in sequence, a primary count circuit for counting the number of lines in an entry, a steering circuit responsive thereto for sequentially interconnecting said reader to said registers to register each sensed line of an entry in a different one of said registers, a code relay circuit for translating the codes of said lines to other codes suitable for the operation of a code controlled printer, another translator for translating parts of the codes of said lines into data characters, a sequence circuit for sequentially and selectively connecting said code relay circuit directly to said registers or alternatively to said registers through said other translator and a code controlled printer responsive to said code relay circuit.

3. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers in sequence, a code relay circuit for translating the codes of said lines to other codes suitable for the operation of a code controlled printer, another translator for translating parts of the codes of said lines into data characters, a sequence circuit for sequentially and selectively connecting said code relay circuit directly to said registers or alternatively to said registers through said other translator and a code controlled printer responsive to said code relay circuit, a character count circuit for controlling said sequence circuit for deriving each character in a typed line in sequence from a predetermined source, and a code controlled printer responsive to said code relay circuit.

4. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, each said entry tape having entries in three divisions, first, a group of tape identity entries containing information identifying the source of the tape and other information common to all individual charge entries, second, a plurality of individual charge entries and third, a group of tape identity entries identical with said first group, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest individual charge entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers in sequence, a set of manual tape identity switches for controlling matching circuits, said switches settable to express tape identity information matching that expected to be perforated in an entry tape, matching circuits jointly controlled by said switches and said reader when said reader senses said tape identity entries, alarm means responsive to failure of said matching circuit to report correspondence between said tape identity information in said tape identity entries and that established by the setting of said switches, a code relay circuit for translating the codes of said lines to other codes suitable for the operation of a code controlled printer, another translator for translating parts of the codes of said lines into data characters, a sequence circuit for sequentially and selectively connecting said code relay circuit directly to said registers or to said switches or alternatively to said registers and said switches through said other translator and a code con-

trolled printer responsive to said code relay circuit.

5. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, each said entry tape having entries in three divisions, first, a group of tape identity entries containing information identifying the source of the tape and other information common to all individual charge entries, second, a plurality of individual charge entries and third, a group of tape identity entries identical with said first group, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest individual charge entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers in sequence, a set of manual tape identity switches for controlling matching circuits, said switches settable to express tape identity information matching that expected to be perforated in an entry tape, matching circuits jointly controlled by said switches and said reader when said reader senses said tape identity entries, alarm means responsive to failure of said matching circuit to report correspondence between said tape identity information in said tape identity entries and that established by the setting of said switches, a code relay circuit for translating the codes of said lines to other codes suitable for the operation of a code controlled printer, another translator for translating parts of the codes of said lines into data characters, a sequence circuit for sequentially and selectively connecting said code relay circuit directly to said registers or to said switches or alternatively to said registers and said switches through said other translator, a control circuit including a character count circuit for controlling the said sequence circuit for deriving each character in a typed data line in sequence from a predetermined one of said sources, means controlled by said manual switches for determining the pattern of operation of said control circuit, and a code controlled printer responsive to said code relay circuit.

6. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, each said entry tape having entries in three divisions, first, a group of tape identity entries containing information identifying the source of the tape and other information common to all individual charge entries, second, a plurality of individual charge entries and third, a group of tape identity entries identical with said first group, the said device comprising a reader for sensing the codes of said lines in sequence, means for disposing of the information sensed by said reader, a set of manual tape identity switches settable to express tape identity information furnished with said tape, matching circuits jointly controlled by said switches and said means for disposing of the information sensed by said reader, alarm means responsive to failure of said matching circuits to report correspondence between said tape identity information in said tape identity entries and that established by the setting of said switches, means for thereafter operating said disposal means under control of said manual tape identity switches, a translator for translating said entries into billing data characters responsive to said disposal means and a printer responsive to said translator for typing said billing data characters.

7. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, each said entry tape having entries in three divisions, first, a group of tape identity entries containing information identifying the source of the tape and other information common to all individual charge entries, second, a plurality of individual charge entries and third, a group of tape identity entries identical with said first group, the said device comprising a reader for sensing the codes of said lines in sequence, means for disposing of the information sensed by said reader, a set of manual tape identity switches settable to express tape identity information furnished with said tape, an acceptance circuit controlled by said tape identity switches and responsive to said tape identity entries sensed by said reader, for rendering said disposal means operative to respond to said individual charge entries, a translator for translating said entries into billing data characters responsive to said disposal means and a printer responsive to said translator for typing said billing data characters.

8. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a sequence circuit for controlling the sequence of operation of said code relays, and a translator for translating portions of a registered code into a called office designation each character of which may be translated into a plurality of different characters for each registered code, the said translator comprising a register for each place of the said called office designation, a switch responsive to said registers for electrically characterizing a single one of a large plurality of points, a group of selector relays each cross-connected to a plurality of said points each for selecting a particular character from the said plurality of different characters

for each said registered code and circuits jointly controlled by said selector relays and said translator register relays for selectively and sequentially operating said code relays.

9. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a sequence circuit for controlling the sequence of operation of said code relays, and a translator for translating portions of a registered code into a called office designation each character of which may be translated into a plurality of different characters for each registered code, the said translator comprising a register for each place of the said called office designation, a switch responsive to said registers for electrically characterizing a single one of a large plurality of points, a group of selector relays each for selecting a particular character from the said plurality of different characters for each said registered code, circuits jointly controlled by said selector relays and said translator register relays for selectively and sequentially operating said code relays, an additonal translator register having a plurality of place relays, means controlled by each of said place relays for controlling each of said selector relays and means for associating each one of said points with a different corresponding one of said selector relay controlling means whereby a different one of said selector relays may be selected by each of said additional translator register relays to translate a said portion of a registered code into different called office designations.

10. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a sequence circuit for controlling the sequence of operation of said code relays, and a translator for translating portions of a registered code into a called office designation each character of which may be translated into a plurality of different characters for each registered code, the said translator comprising a register for each place of the said called office designation, a switch responsive to said registers for electrically characterizing a single one of a large plurality of points, a group of selector relays each for selecting a particular character from the said plurality of different characters for each said registered code, circuits jointly controlled by said selector relays and said translator register relays for selectively and sequentially operating said code relays, an area register comprising a plurality of relays and a set of control elements associated with and corresponding to each of said selector relays for each of said area register relays, said control elements being operative only under control of their associated area register relays, and means for connecting any one of said points with a different corresponding one of said control elements in each of a plurality of area register relay sets whereby a given called office designation may be differently translated for each said area so provided.

11. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a sequence circuit for controlling the sequence of operation of said code relays, and a translator for translating portions of a registered code into a called office designation each character of which may be translated into a plurality of different characters for each registered code, the said translator comprising a register for each place of the said called office designation, a switch responsive to said registers for electrically characterizing a single one of a large plurality of points, a group of selector relays each for selecting a particular character from the said plurality of different characters for each said registered code, circuits jointly controlled by said selector relays and said translator register relays for selectively and sequentially operating said code relays, an area register comprising a plurality of relays and a set of control elements associated with and corresponding to each of said selector relays for each of said area register relays, each said control element consisting of an electronic tube rendered active by its associated relay and a coil interlinked with a magnetic core through which a plurality of conductors may be threaded, said coils being operative to respond to the electrical characterization of a conductor threaded through its said core when its said associated electronic tube is rendered active to selectively operate said selector relays, and means comprising a conductor connected to any one of said points and threaded through the cores of a coil in a plurality of said sets for causing a registered called office designation code to be translated differently for each of said areas.

12. In an automatic accounting system, a proc-

essing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a sequence circuit for controlling the sequence of operation of said code relays, and a translator for translating portions of a registered code into a called office designation each character of which may be translated into a plurality of different characters for each registered code, the said translator comprising a register for each place of the said called office designation, a source of alternating current, a switch responsive to said registers for connecting said source of alternating current to a single one of a large plurality of points, a group of selector relays each for selecting a particular character from the said plurality of different characters for each said registered code, circuits jointly controlled by said selector relays and said translator register relays for selectively and sequentially operating said code relays, an area register comprising a plurality of relays and a set of control elements associated with and corresponding to each of said selector relays for each of said area register relays, each said control element consisting of an electronic tube rendered active by its associated relay and a coil interlinked with a magnetic core through which a plurality of conductors may be threaded, said coils being operative to respond to alternating current applied to a conductor threaded through its said core when its said associated electronic tube is rendered active to selectively operate said selector relays, and means comprising a conductor connected to any one of said points and threaded through the cores of a coil in a plurality of said sets for causing a registered called office designation code to be translated differently for each of said areas.

13. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a sequence circuit for controlling the sequence of operation of said code relays, each said register including a set of relays for each code digit registered therein, and a translator for translating a five-digit code registered in one of said registers into a six-digit line of billing data comprising a set of translator relays each associated with and responsive to a said set of register relays and circuits jointly controlled by said sets of translator relays for sequentially and selectively operating a number of said code relays greater than the number of said sets of translator relays.

14. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a printer control circuit for controlling the sequence of operation of said code relays, each said register including a set of relays for each code digit registered therein, and in one of said registers, a group of memory relays auxiliary to each said set of register relays, a group master relay for each said group of memory relays, said group master relays jointly exercising a control in said printer control circuit, each said group master relays being controlled by each of the said memory relays of a said group and in turn controlling every memory relay of a said group whereby after one of said memory relays has been operated, no other memory relay can be operated until the first said operated relay has been completely released, an operating circuit for each of said memory relays responsive to the simultaneous operation of a predetermined number of said register relays, a locking circuit for each of said memory relays responsive to the continued deenergization of all of said register relays other than the said predetermined number operated, whereby upon the operation of said memory relays the said register may be repeatedly released and reoperated, and whereby said control in said printer control circuit will thereby respond only to a change in the pattern of operation of said register relays.

15. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code

relays for typing billing data from said translated codes, a printer control circuit for controlling the sequence of operation of said code relays, the spacing and marginal arrangement of the said typed billing data and the inclusion or omission of a title accompanying a line of typed billing data, a cutter and a stuffer associated with said printer for cutting the paper on which billing data is typed into uniformly sized slips and for stuffing said cut slips into a receptacle respectively, means under control of said printer control circuit for starting the typing of a new slip with the typing of a title gleaned from certain of said registers before the typing of the first line of billing data thereon, and a memory circuit associated with the register from which said title is gleaned, to control said printer control circuit to omit the typing of a title if the setting of said register on the next entry is the same as the previous setting thereof, and to otherwise control said printer control circuit to operate said cutting and stuffing means and to type a title before the next typed line of billing data.

16. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers sufficient in number to register each line of an entry of the longest expected entry, a tape identity and common information circuit, with means for setting said circuit manually to given information and a proof circuit responsive to a special tape identity entry perforated at the beginning of said entry tape for checking the correspondence between said manually set tape identity information and the tape identity information contained in said special entry, a code relay circuit for translating codes of registered information in said tape identity circuit and in said registers to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a printer control circuit for controlling the sequence of operation of said code relays, pattern means controlled by said tape identity circuit for controlling the selection of information to be typed from said tape identity circuit and said registers and memory circuit means for modifying the operation of said pattern means whereby the typing of billing data lines may be grouped under different titles, each title containing billing data common to the data of all lines typed thereunder.

17. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers sufficient in number to register each line of an entry of the longest expected entry, a tape identity and common information circuit, with means for setting said circuit manually to given information and a proof circuit responsive to a special tape identity entry perforated at the beginning of said entry tape for checking the correspondence between said manually set tape identity information and the tape identity information contained in said special entry, a code relay circuit for translating codes of registered information in said tape identity circuit and in said registers to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a printer control circuit for controlling the sequence of operation of said code relays, pattern means controlled by said tape identity circuit for controlling the selection of information to be typed from said tape identity circuit and said registers, a circuit herein called a month circuit controlled by said tape identity and common information circuit and responsive to said tape identity entries, and memories circuit means associated in part with said month circuit for modifying the operation of said pattern means whereby the typing of billing data lines may be grouped under different titles, each title containing identification of the month and other pertinent billing data common to the data of all lines typed thereunder.

18. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a set of reading relays equal in number to the number of reading pins on said reader, one of said reading pins being provided for each code place in a said transverse line of perforations, the said reader being arranged to operate at a constant speed and to reciprocate said pins in cycles the said pins being in a reading position during a given part of a cycle and withdrawn from a reading position during the remainder of a cycle, said reader also being provided with a plurality of auxiliary contacts, some being closed during the reading portion of the cycle and others being closed during the said remaining portion of the cycle, a circuit arrangement for insuring a connection between said reading pins and the corresponding reading relays during a complete reading interval, consisting of a plurality of relays, a first of said relays (R0) being responsive to an auxiliary contact closed during a reading portion of a cycle and operating to control a second of said relays, a second of said relays (S1) being responsive to an auxiliary contact closed during a remaining part of a cycle and operating to control a third of said relays, a third of said relays (R1) being responsive to an auxiliary contact closed during a reading portion of a cycle and operating to control a fourth of said relays, a fourth of said relays (S2) being responsive to an auxiliary contact closed during a remaining part of a cycle and operating to control a fifth of said relays, a fifth of said relays (R2) being responsive to an auxiliary contact closed during a reading portion of a cycle and operating to release the said first (R0), second (S1), third (R1) and fourth (S2) of said relays, connector relays for interconnecting said reader pins and said reader relays, validity check

circuits controlled by said reader relays, said connector relays and said fifth relay (R2) being controlled by said validity check circuits whereby the interconnection between said reader pins and said reader relays is established in advance of the period of use of said connection and maintained until the validity of the operation of said reader relays is established, a plurality of registers each for registering a line of an entry under control of said reading relays, a control circuit for selecting items of information from said registers for typing and a printer for typing said selected items of information as billing data.

19. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a set of reading relays equal in number to the number of reading pins on said reader, one of said reading pins being provided for each code place in a said transverse line of perforations, the said reader being arranged to operate at a constant speed and to reciprocate said pins in cycles the said pins being in a reading position during a given part of a cycle and withdrawn from a reading position during the remainder of a cycle, said reader also being provided with a plurality of auxiliary contacts, some being closed during the reading portion of the cycle and others being closed during the said remaining portion of the cycle, a circuit arrangement for insuring a connection between said reading pins and the corresponding reading relays during a complete reading interval, consisting of a plurality of relays connected in cascade, each controlling the next, alternate relays being responsive one to an auxiliary contact closed during a reading interval and the next during a remaining interval of a cycle, connector relays for interconnecting the said reader pins and the said reader relays, the said connector relays being operated by one of the later operated of said relays responsive to a remaining interval of a cycle, whereby said reading relays are connected and responsive to said reading pins in advance of the functioning thereof, a plurality of registers each for registering a line of an entry under control of said reading relays, a control circuit for selecting items of information from said registers for typing and a printer for typing said selected items of information as billing data.

20. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a set of reading relays equal in number to the number of reading pins on said reader, one of said reading pins being provided for each code place in a said transverse line of perforations, the said reader being arranged to operate at a constant speed and to reciprocate said pins in cycles the said pins being in a reading position during a given part of a cycle and withdrawn from a reading position during the remainder of a cycle, said reader also being provided with a plurality of auxiliary contacts, some being closed during the reading portion of the cycle and others being closed during the said remaining portion of the cycle, a circuit arrangement for insuring a connection between said reading pins and the corresponding reading relays during a complete reading interval, consisting of a plurality of relays connected in cascade, each controlling the next, alternate relays being responsive one to an auxiliary contact closed during a reading interval and the next during a remaining interval of a cycle, the last of said relays releasing all prior operated relays, connector relays for interconnecting the said reader pins and the said reader relays, the said connector relays being operated by the next to the last of said relays during a remaining portion of a cycle, a check relay responsive to said reading relays operated only when said reading relays have been operated in a valid pattern, said last relay and said connector relays being locked under control of said check relay, whereby the connections between said reading pins and said reading relays are established in advance of a reading interval and maintained until it is certain that said reading relays have been properly operated, a plurality of registers each for registering a line of an entry under control of said reading relays, a control circuit for selecting items of information from said registers for typing and a printer for typing said selected items of information as billing data.

21. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a tape identification circuit for determining the form of the typed billing data produced by said printer, the said form including the columnar arrangement of the typed data, a line character count circuit for counting the characters of a typed line, relay means for each predetermined form of line, each said relay means controlling a plurality of connections to said code relays, some of said connections extending directly to said code relays, and others extending thereto through predetermined circuits of said registers, said plurality of connections including one connection for each columnar place of a line including characters, numerals, spaces and finally a connection to a carriage return line feed relay among said code relays, a transmitting means responsive to said code relays for controlling said printer, said transmitting means having control over said line character count circuit, said line character count circuit responding to the completed transmission of each character to ad-

vance the count thereof to sequentially enable each of said relay connections.

22. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a tape identification circuit for determining the form of the typed billing data produced by said printer, the said form including the columnar arrangement of the typed data, a line character count circuit for counting the characters of a typed line, relay means for each predetermined form of line, each said relay means controlling a plurality of connections to said code relays, some of said connections extending directly to said code relays, and others extending thereto through predetermined circuits of said registers, said plurality of connections including one connection for each columnar place of a line including characters, numerals, spaces and finally a connection to a carriage return line feed relay among said code relays, a transmitting means responsive to said code relays for controlling said printer, said transmitting means having control over said line character count circuit, said line character count circuit responding to the completed transmission of each character to advance the count thereof to sequentially enable each of said relay connections, and a one and one only circuit controlled by said code relays for enabling said transmitter.

23. In an automatic accounting system, a processing device for converting items of information contained in an entry tape into typed billing data, the said entry tape consisting of a strip having perforated therein a plurality of groups of transverse lines of coded information, each said transverse line being referred to hereinafter as a line and each said group of such lines being referred to hereinafter as an entry, the said device comprising a reader for sensing the codes of said lines in sequence, a plurality of registers in number equal to the number of lines in the longest entry which may be encountered, circuit means between said reader and said registers for registering said lines in said registers, a code relay circuit for translating the codes of said registered lines to other codes suitable for the operation of a printer, a printer responsive to said code relays for typing billing data from said translated codes, a tape identification circuit for determining the form of the typed billing data produced by said printer, the said form including the columnar arrangement of the typed data, a line character count circuit for counting the characters of a typed line, relay means for each predetermined form of line, each said relay means controlling a plurality of connections to said code relays, some of said connections extending directly to said code relays, and others extending thereto through predetermined circuits of said registers whereby a single line of billing data is composed from information registered in a plurality of registers by a multiple line entry, said plurality of connections including one connection for each columnar place of a line including characters, numerals, spaces and finally a connection to a carriage return line feed relay among said code relays, a transmitting means responsive to said code relays for controlling said printer, said transmitting means having control over said line character count circuit, said line character count circuit responding to the completed transmission of each character to advance the count thereof to sequentially enable each of said relay connections.

24. In combination, a register and translating system controlled by a record sensing device, said system including a plurality of registers, settable elements, means controlled by different settings of said elements for successively and selectively storing information sensed by said device in said registers on a wholly numerical basis, means for translating such information into partly numerical and partly alphabetical data, said translating means being also under control of said settable elements and a mechanism controlled by said translating means for recording said numerical and alphabetical data.

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