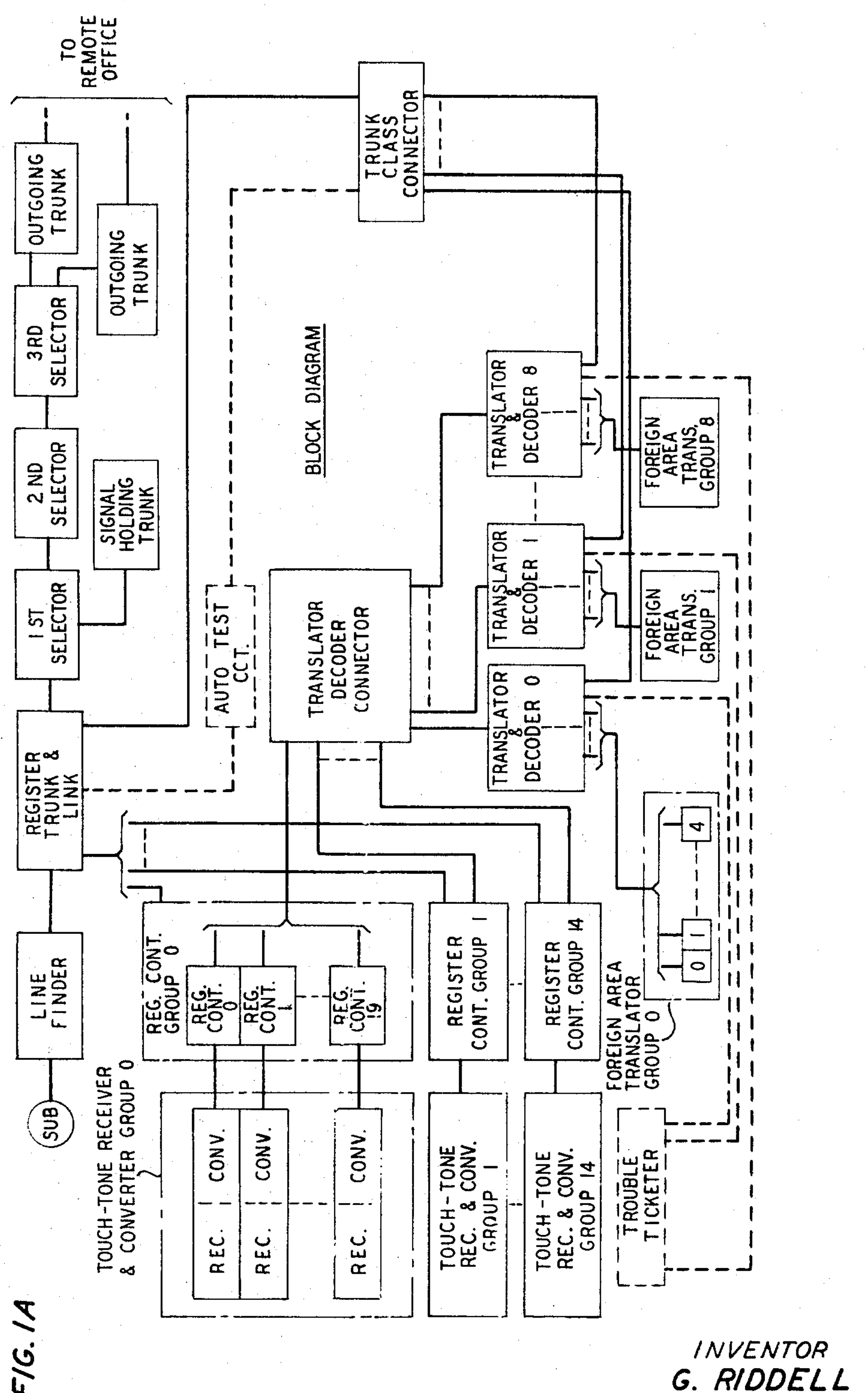


FIG. 1A

INVENTOR
G. RIDDELL
BY [signature]
ATTORNEY

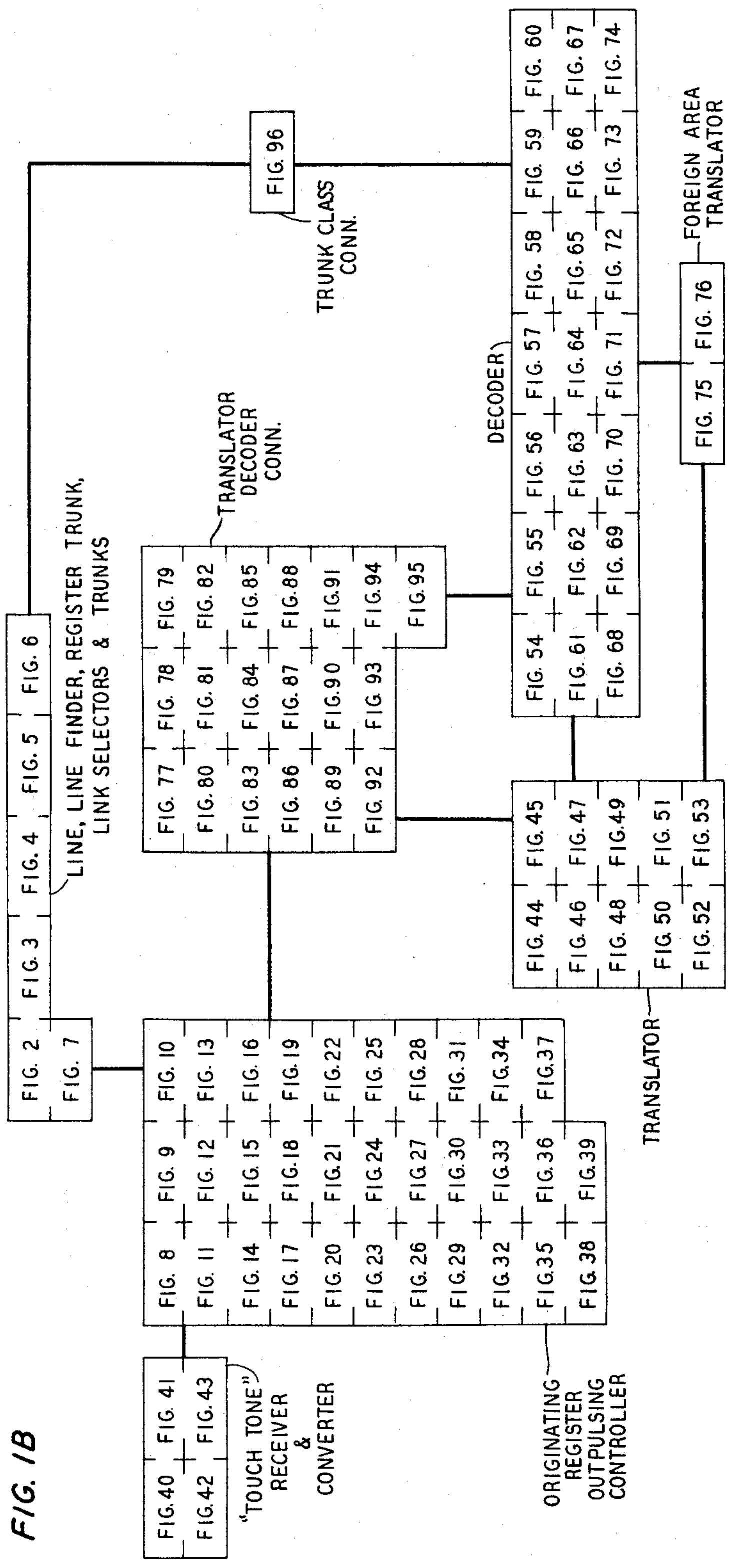
LINE, LINE FINDER, REGISTER TRUNK, LINK SELECTORS & TRUNKS
TRUNK CLASS CONN.
TRANSLATOR DECODER CONN.
DECODER
FOREIGN AREA TRANSLATOR
TRANSLATOR
"TOUCH TONE" RECEIVER & CONVERTER
ORIGINATING REGISTER OUTPULSING CONTROLLER

FIG. 1B

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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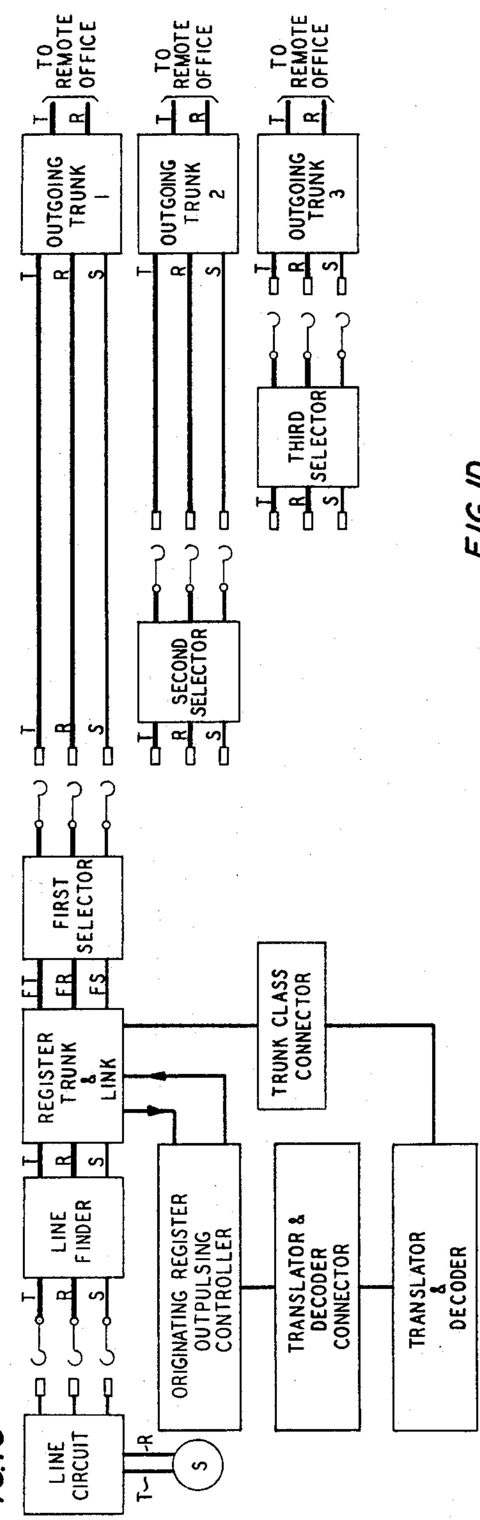



FIG. 1C

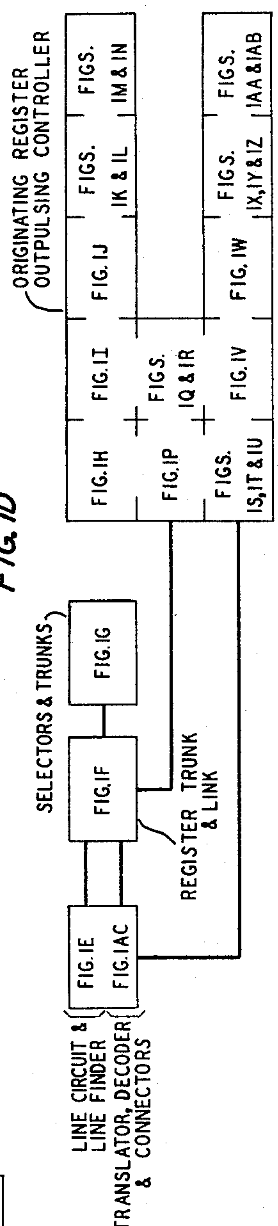



FIG. 1D

FIG. 1E

LINE CIRCUIT & LINE FINDER

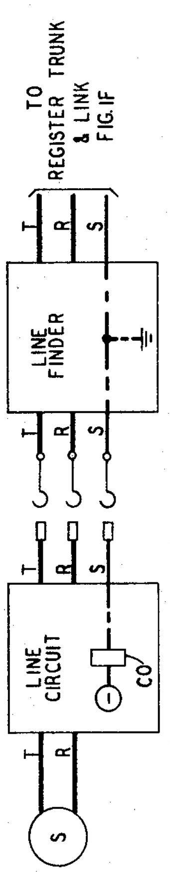
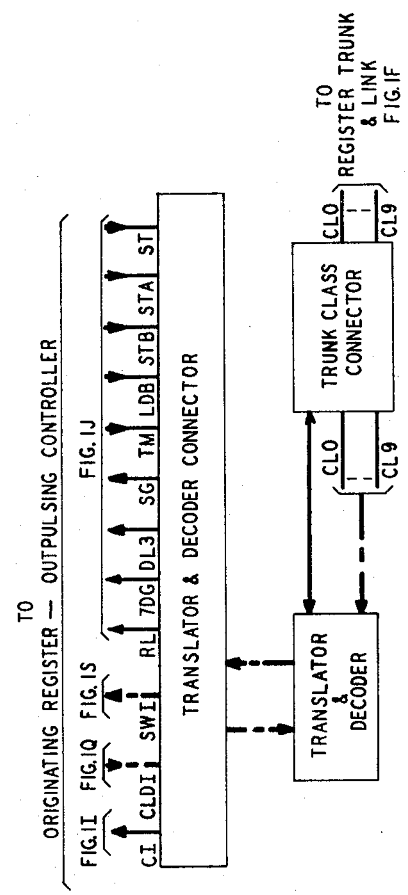



FIG. 1AC

TRANSLATOR DECODER
& CONNECTORS



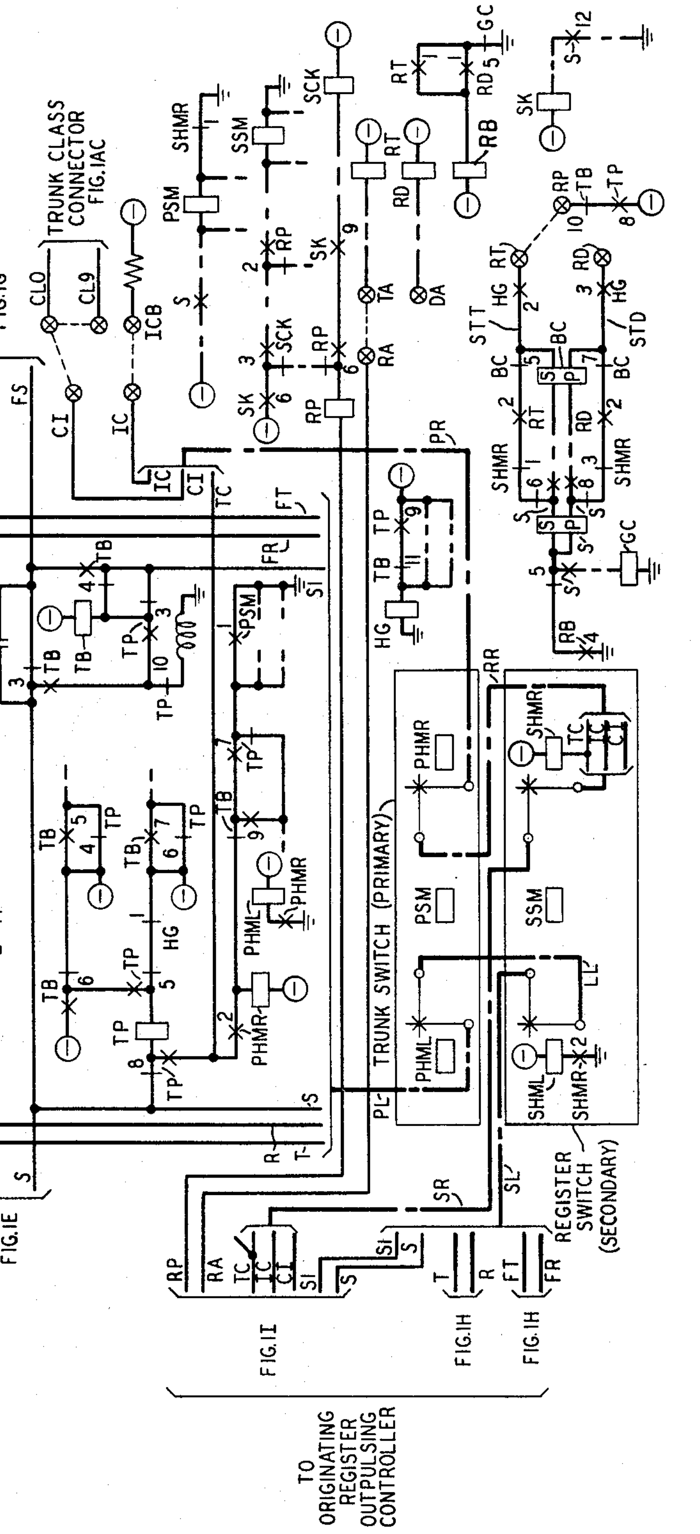



FIG. 1F

REGISTER TRUNK & LINK

SELECTORS & TRUNKS

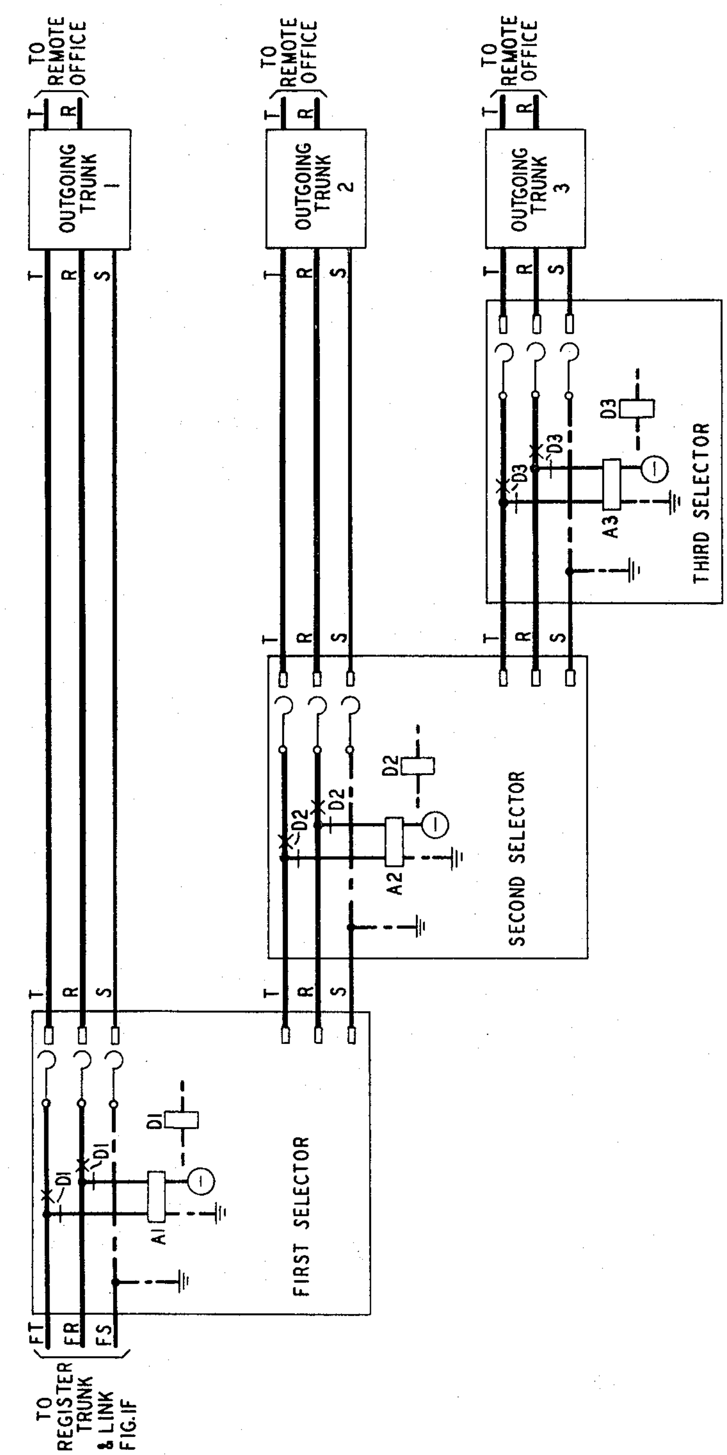



FIG.1G

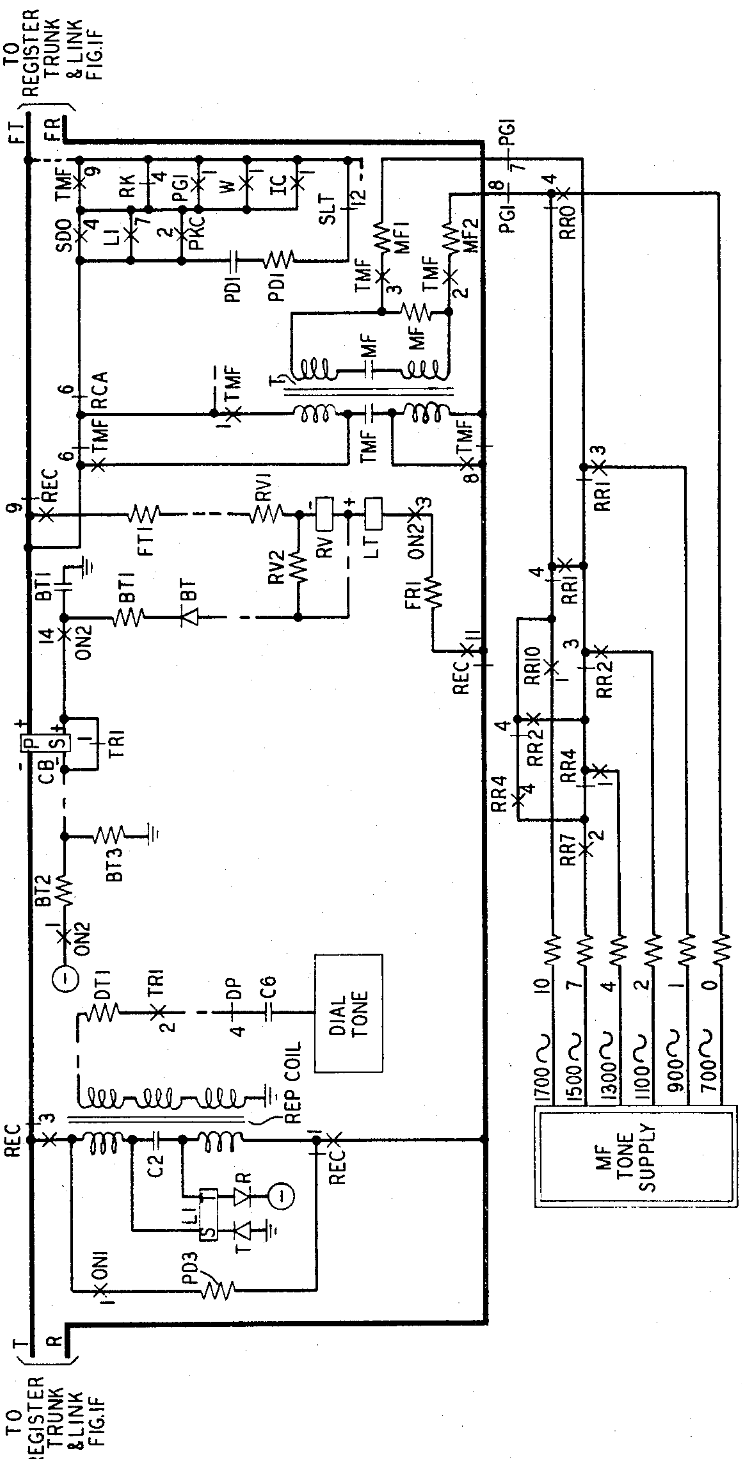

TO REGISTER TRUNK & LINK FIG.1F
TIP-RING CIRCUIT
DIAL TONE
REP COIL
MF TONE SUPPLY
1700~
1500~
1300~
1100~
900~
700~

FIG. 1H

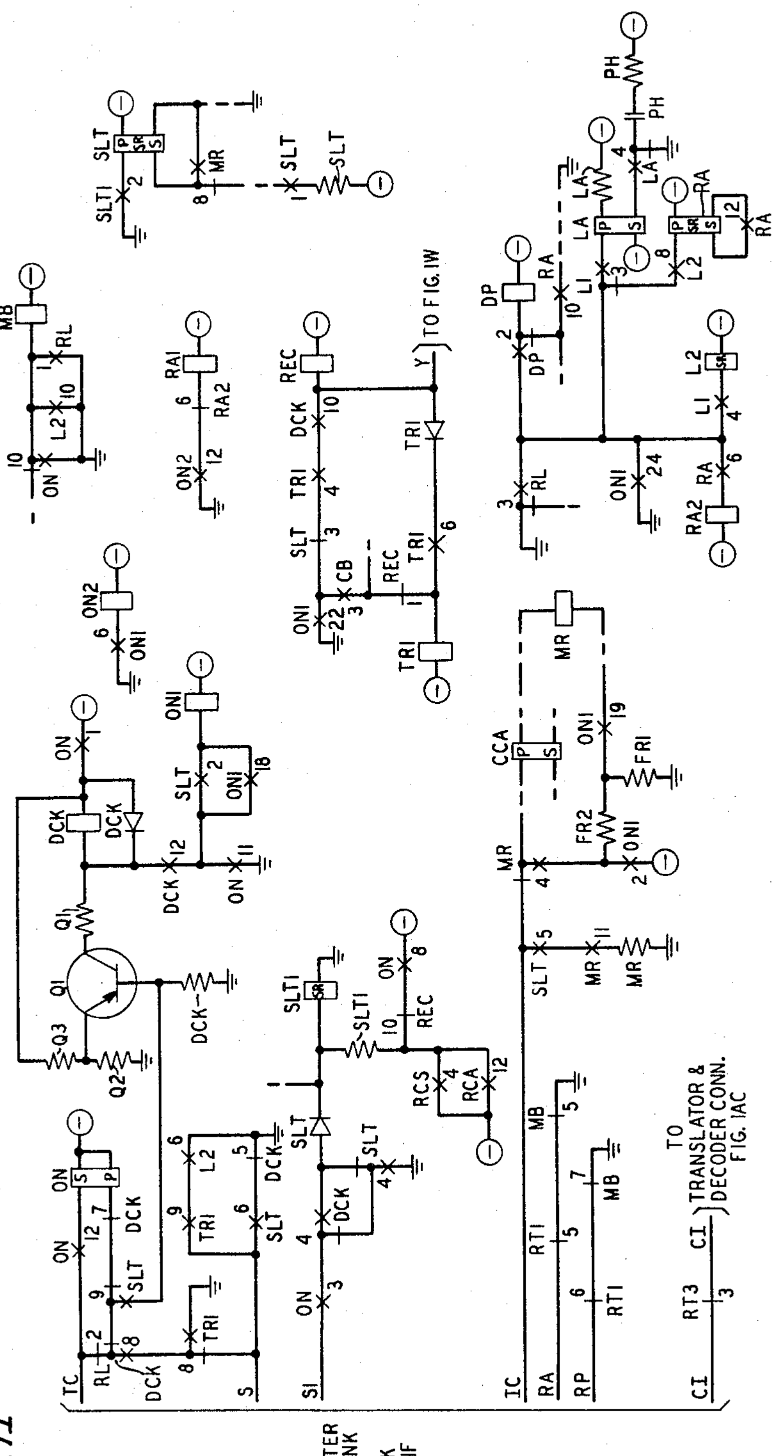

TIP-RING & LINK CONTROL
TO REGISTER TRUNK & LINK FIG. IF
TO TRANSLATOR & DECODER CONN. FIG. IAC
TO FIG. IW

FIG. II

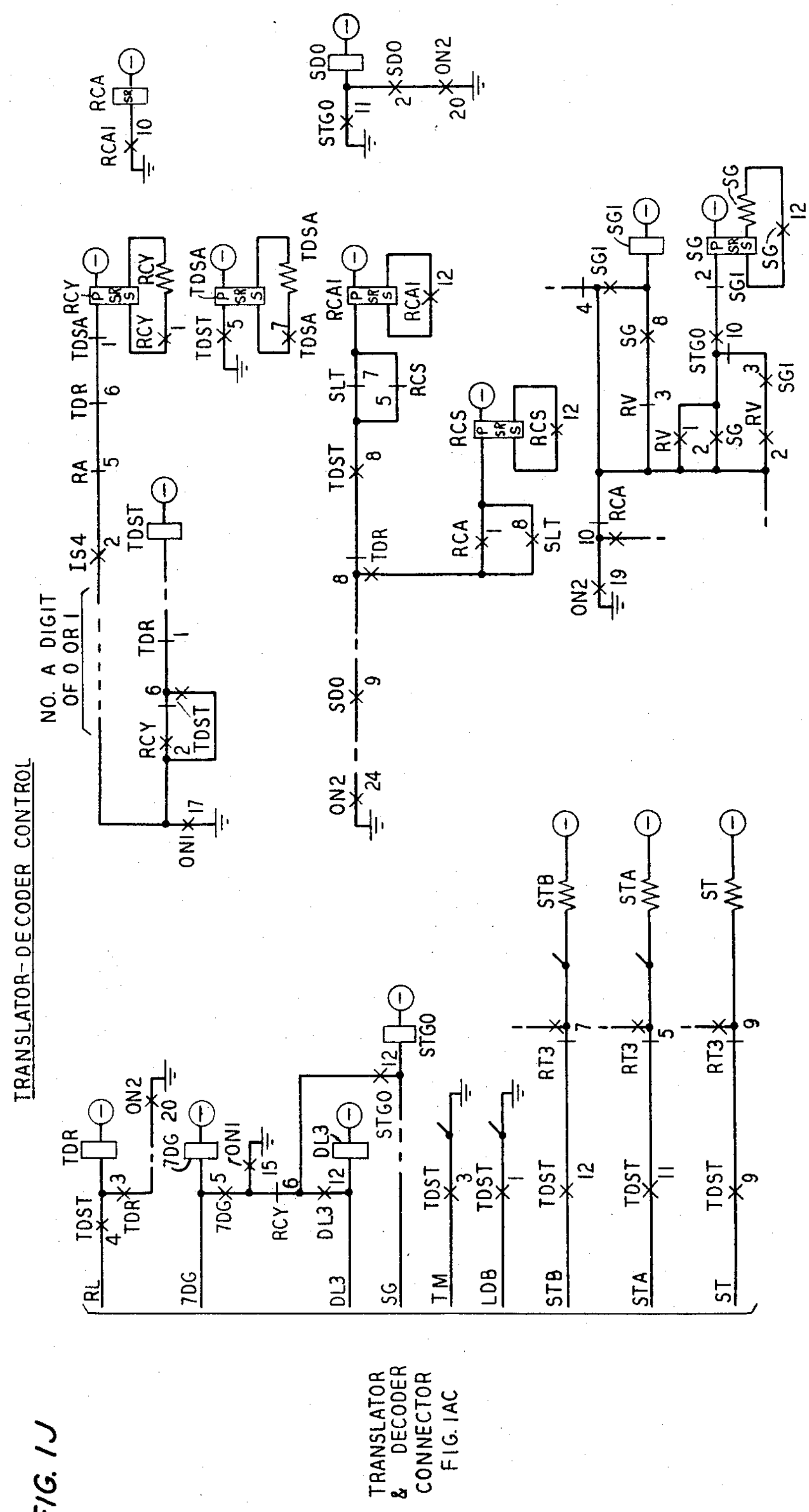

TRANSLATOR-DECODER CONTROL
NO. A DIGIT OF 0 OR 1
TRANSLATOR & DECODER CONNECTOR FIG. 1AC

FIG. 1J

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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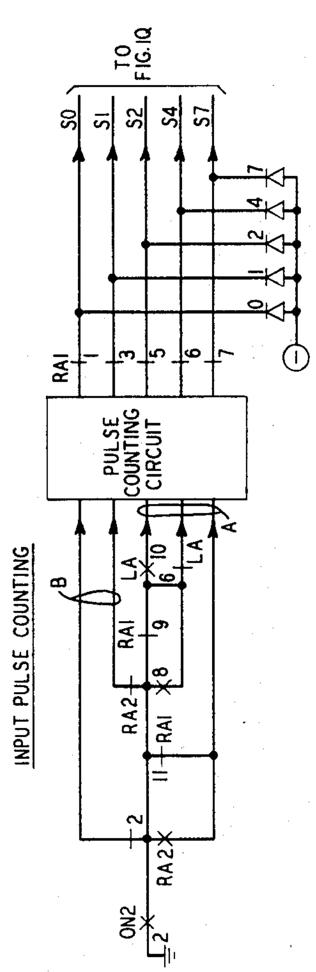



FIG. 1K

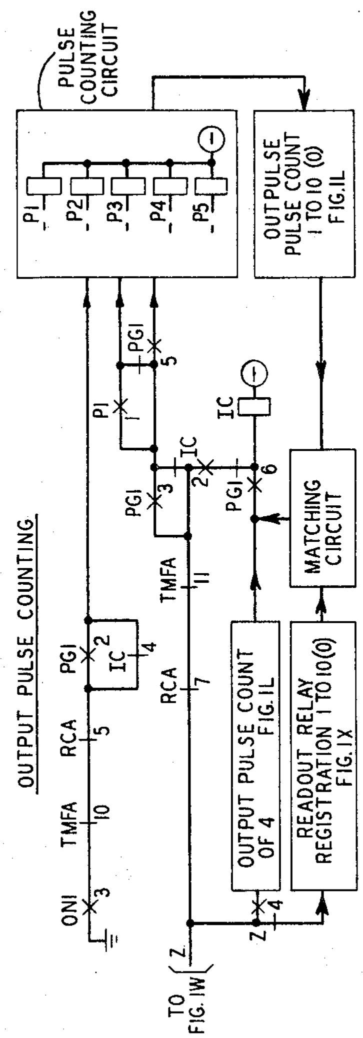



FIG. 1L

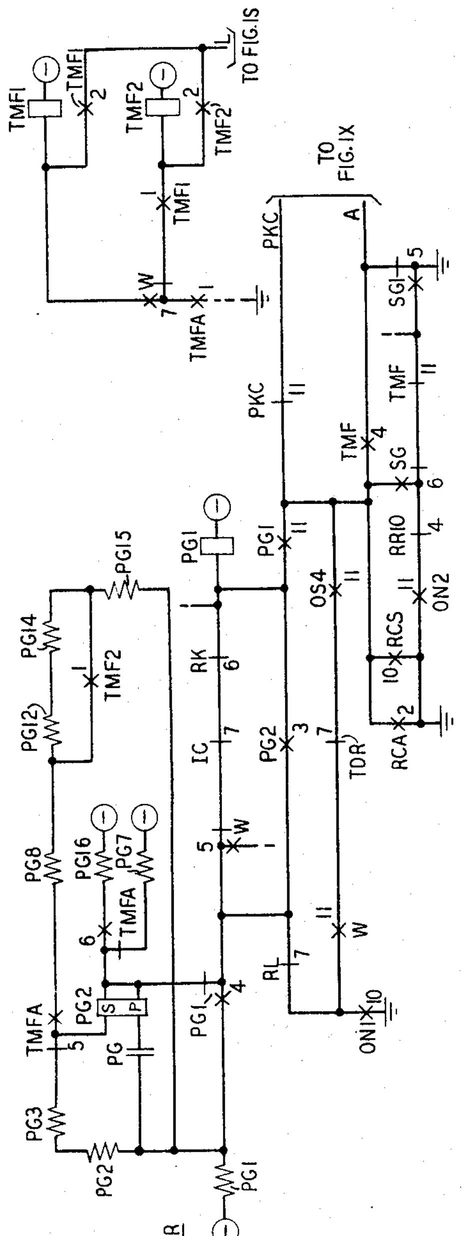


FIG. 1M

PULSE GENERATOR

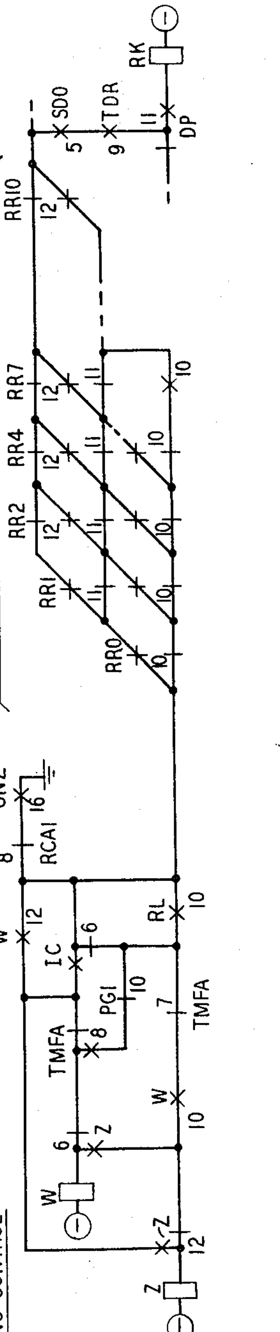


FIG. 1N

OUTPULSING CONTROL

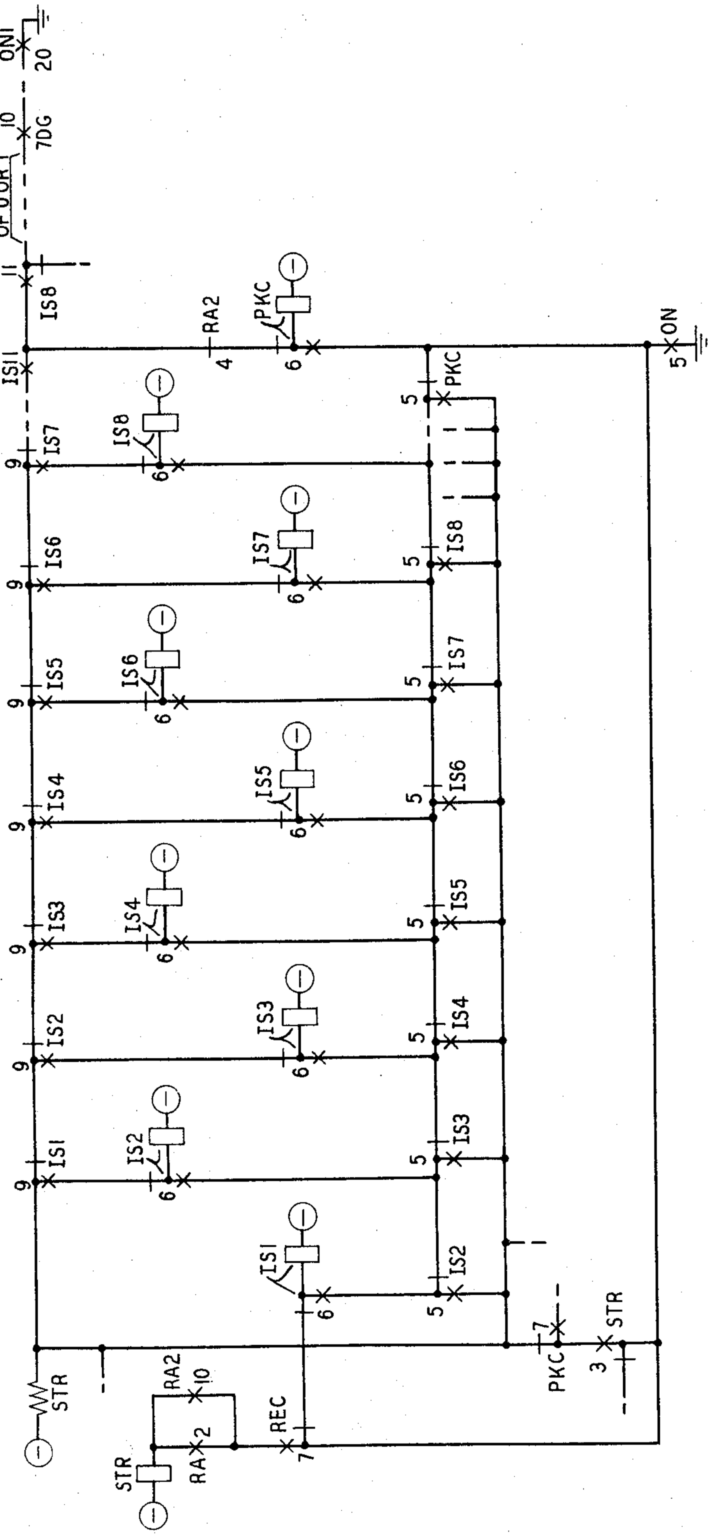



FIG. 1P

INPUT DIGIT REGISTRATION

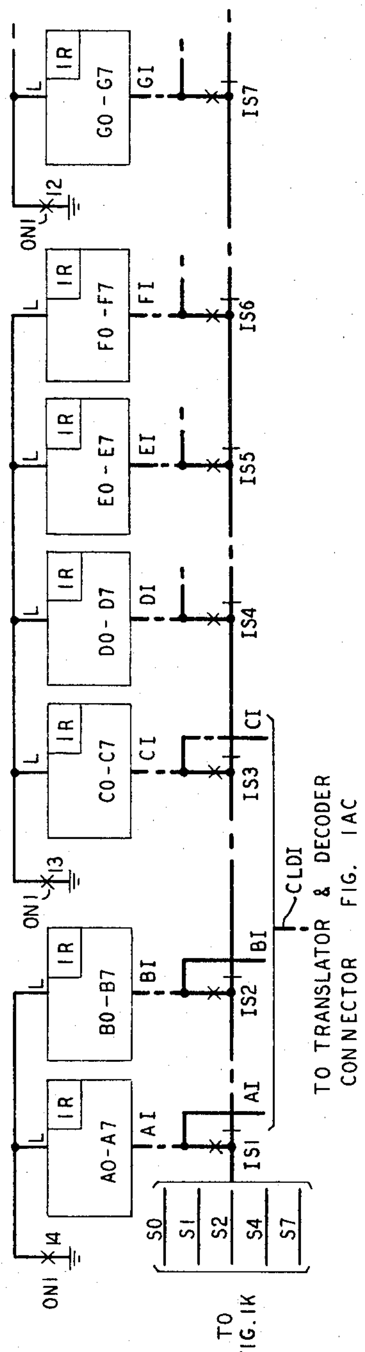
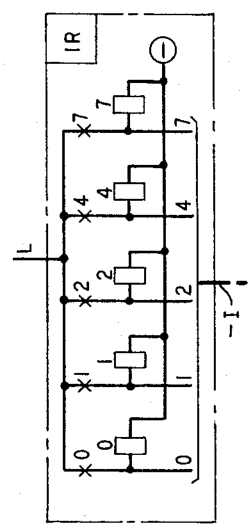



FIG. 1Q




DIGIT REGISTER IR

FIG. 1R

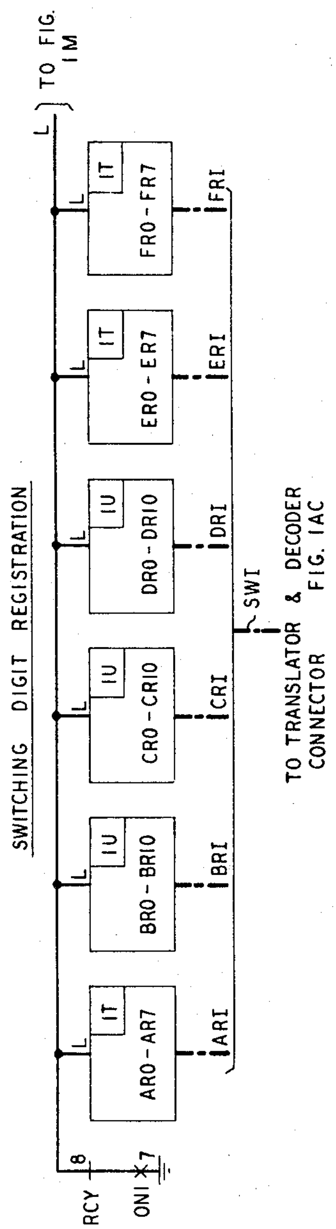



FIG. 1S

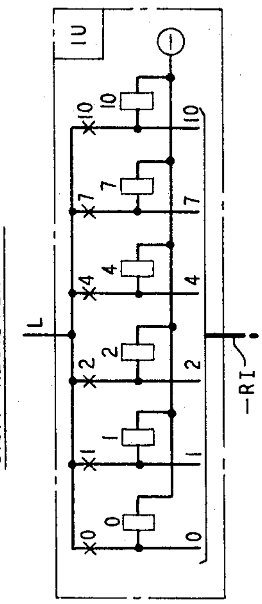



FIG. 1U

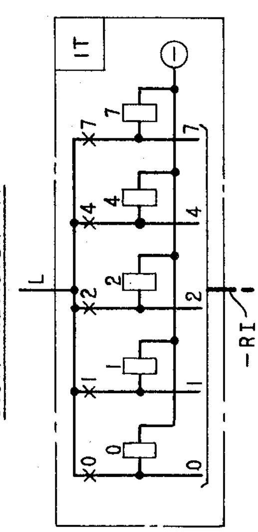



FIG. 1T

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SWITCHING DIGIT OUTSTEERING

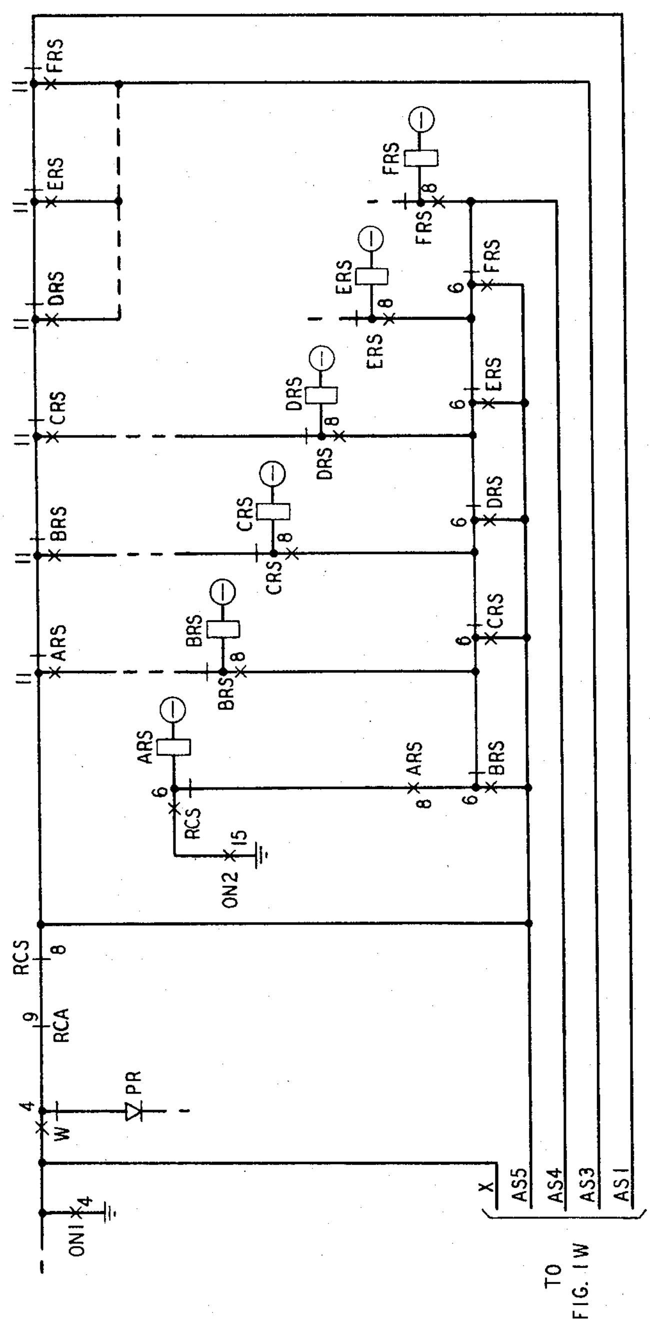
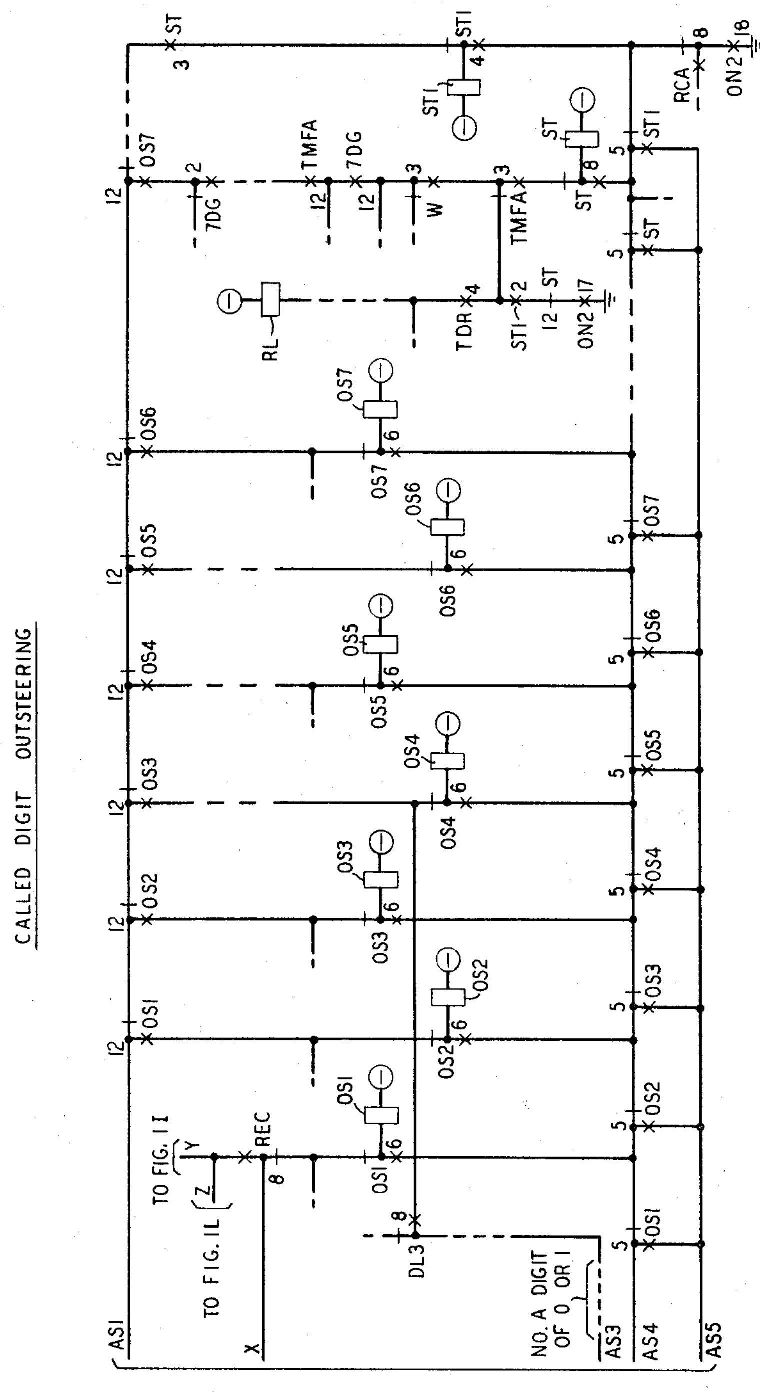



FIG. 1V




TO FIG. IV

FIG. 1W

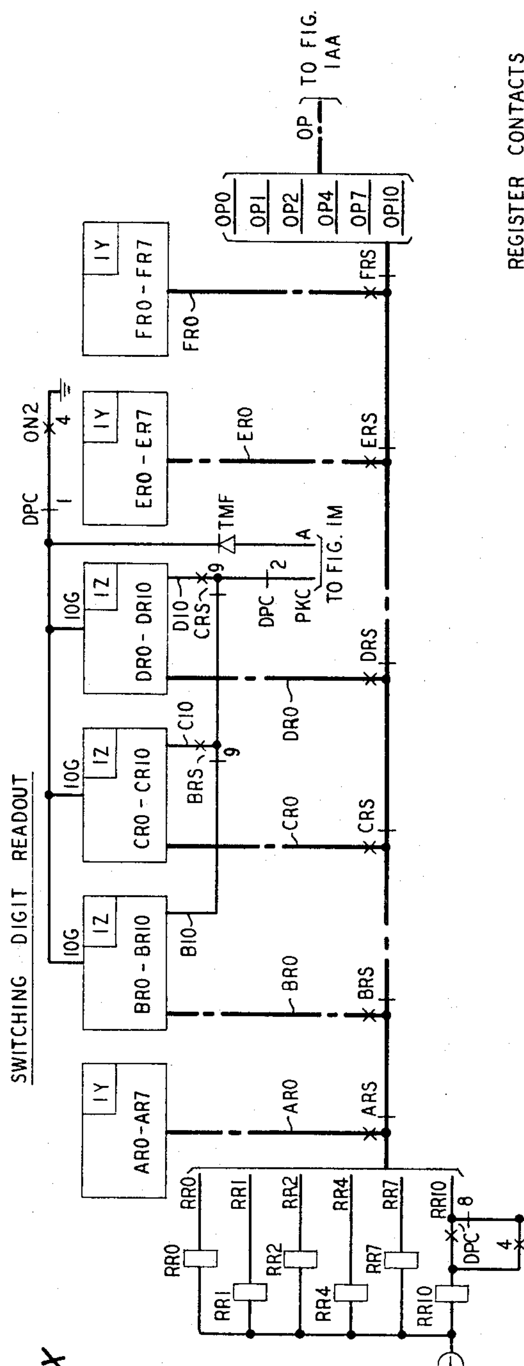



FIG. 1X

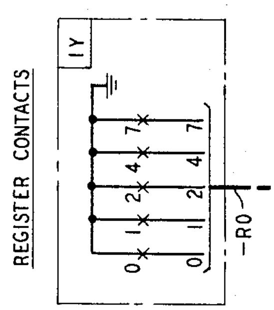



FIG. 1Y

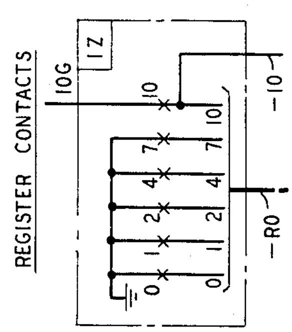



FIG. 1Z

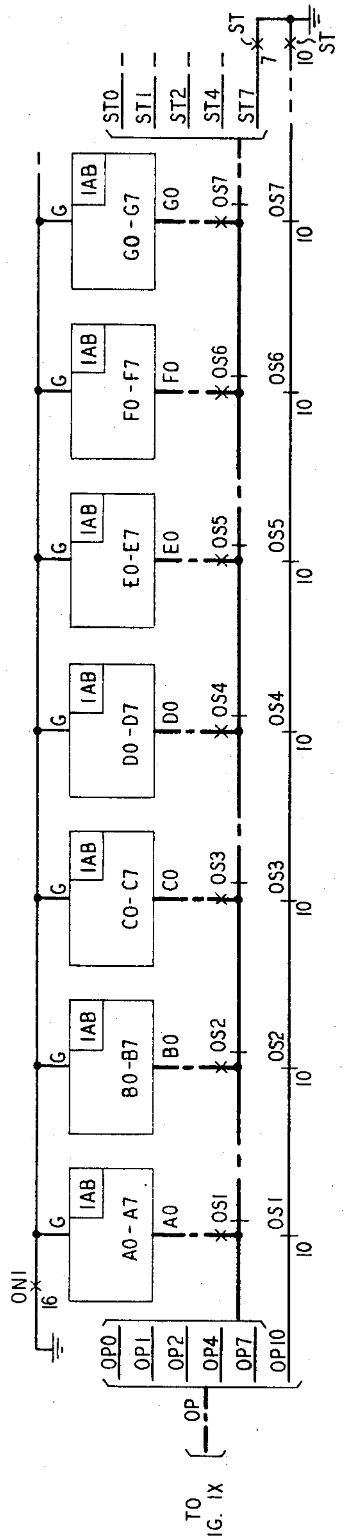



FIG. 1AA

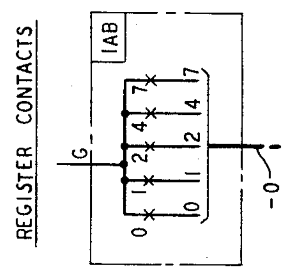



FIG. 1AB

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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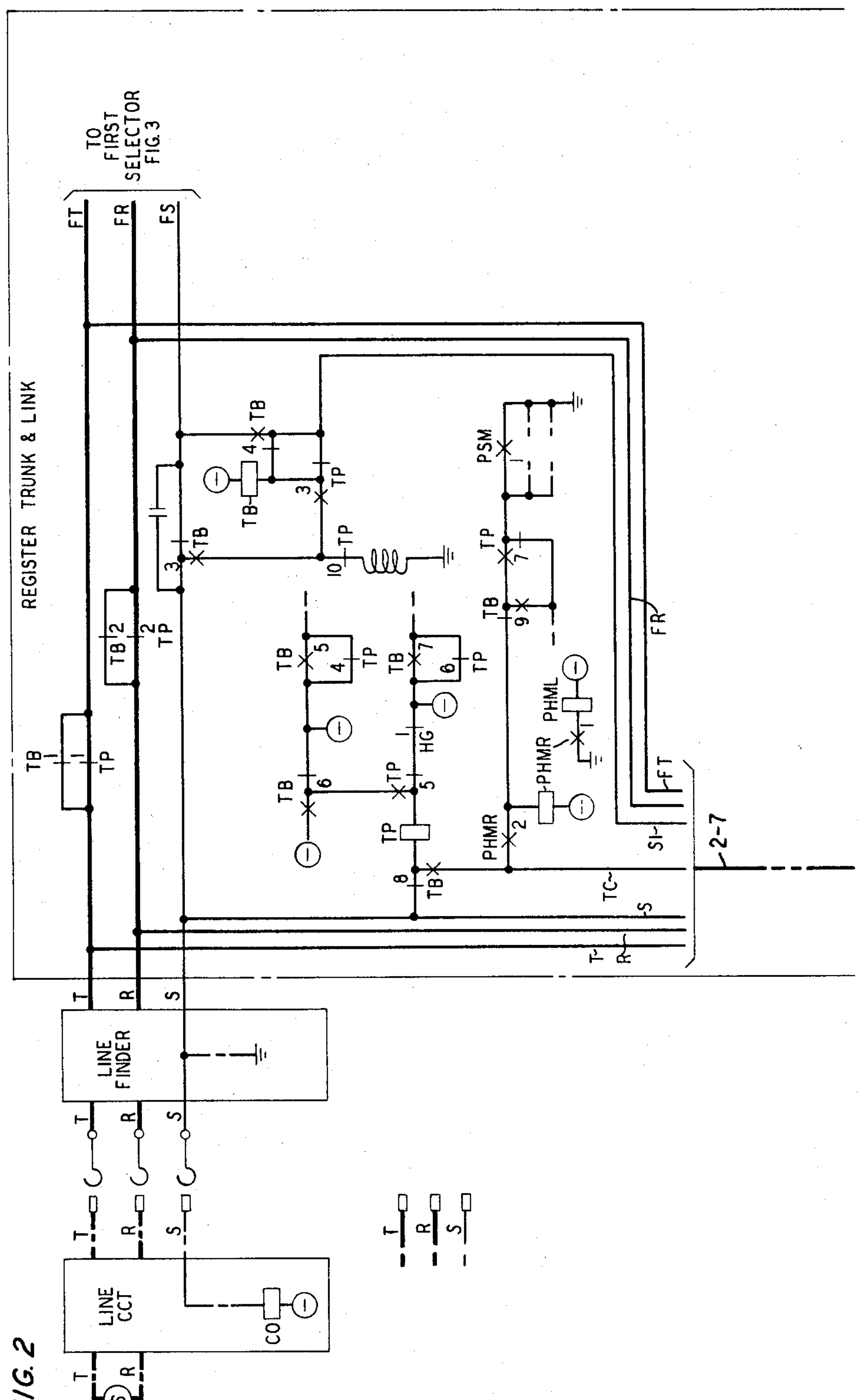


FIG. 2

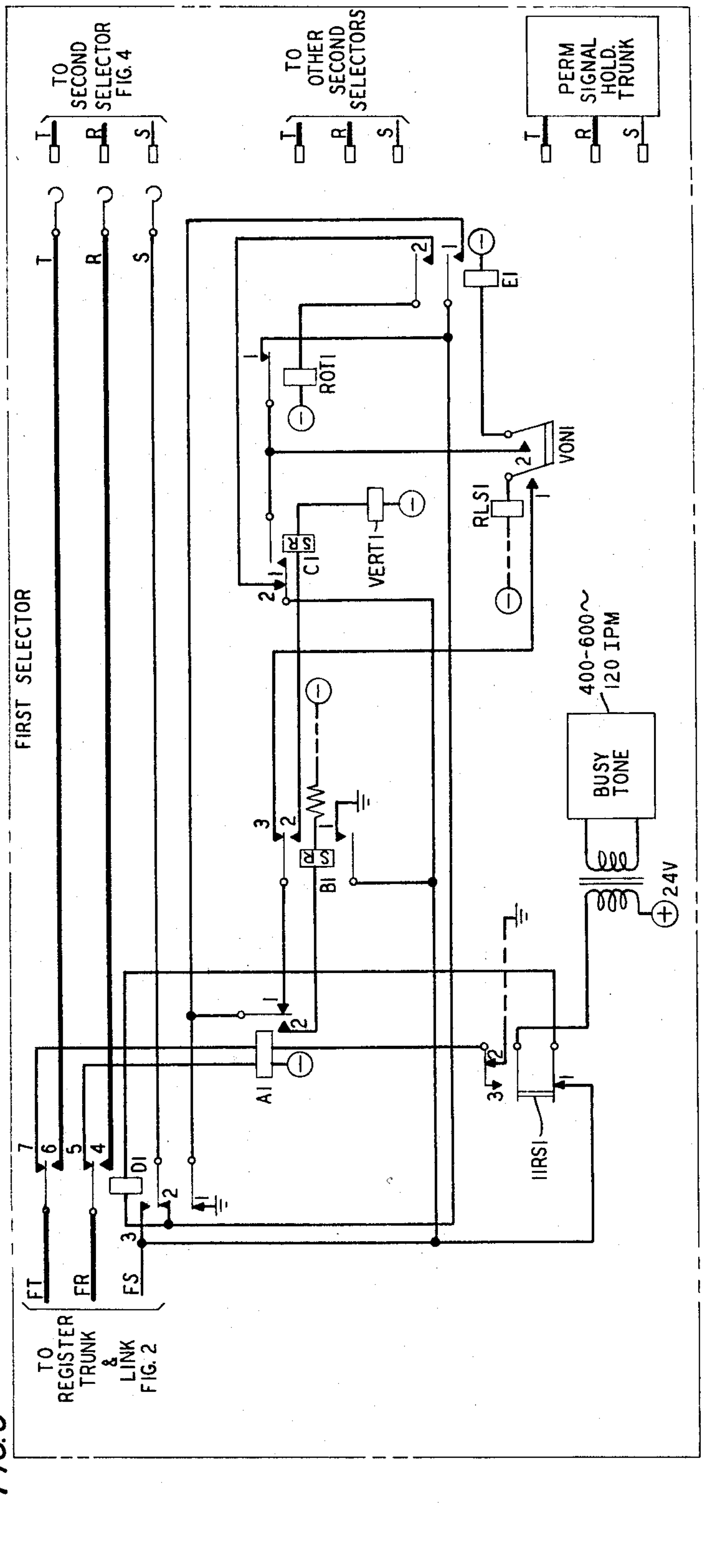
FIRST SELECTOR
TO SECOND SELECTOR FIG. 4
TO OTHER SECOND SELECTORS
PERM SIGNAL HOLD. TRUNK
T
R
S
EI
ROTI
VONI
RLSI
CI
VERTI
BI
AI
DI
IIRSI
BUSY TONE
400-600~ 120 IPM
24V
FT
FR
FS
TO REGISTER TRUNK & LINK FIG. 2

FIG. 3

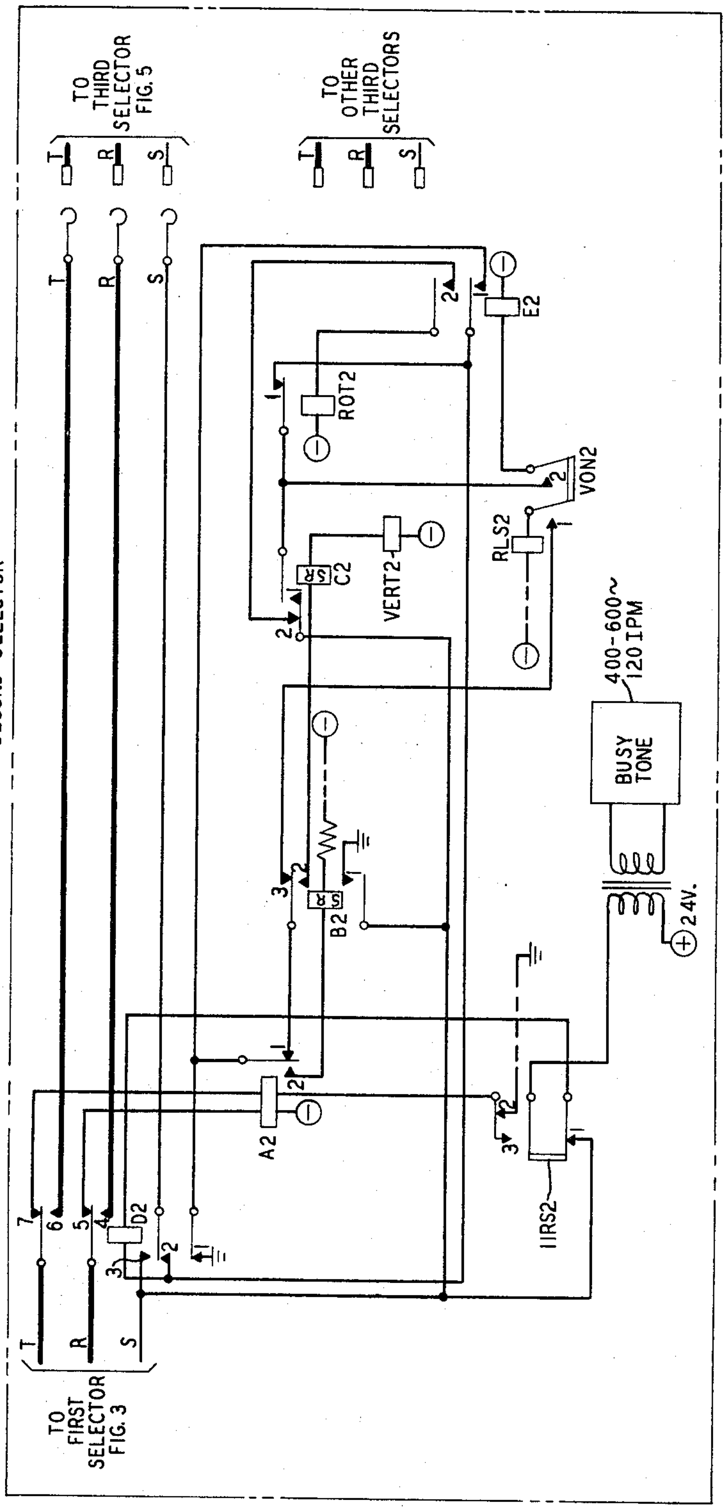
TO THIRD SELECTOR FIG. 5
TO OTHER THIRD SELECTORS
SECOND SELECTOR
E2
ROT2
VON2
RLS2
C2
VERT2
400-600~ 120 IPM
BUSY TONE
24V.
B2
A2
D2
IIRS2
TO FIRST SELECTOR FIG. 3

FIG. 4

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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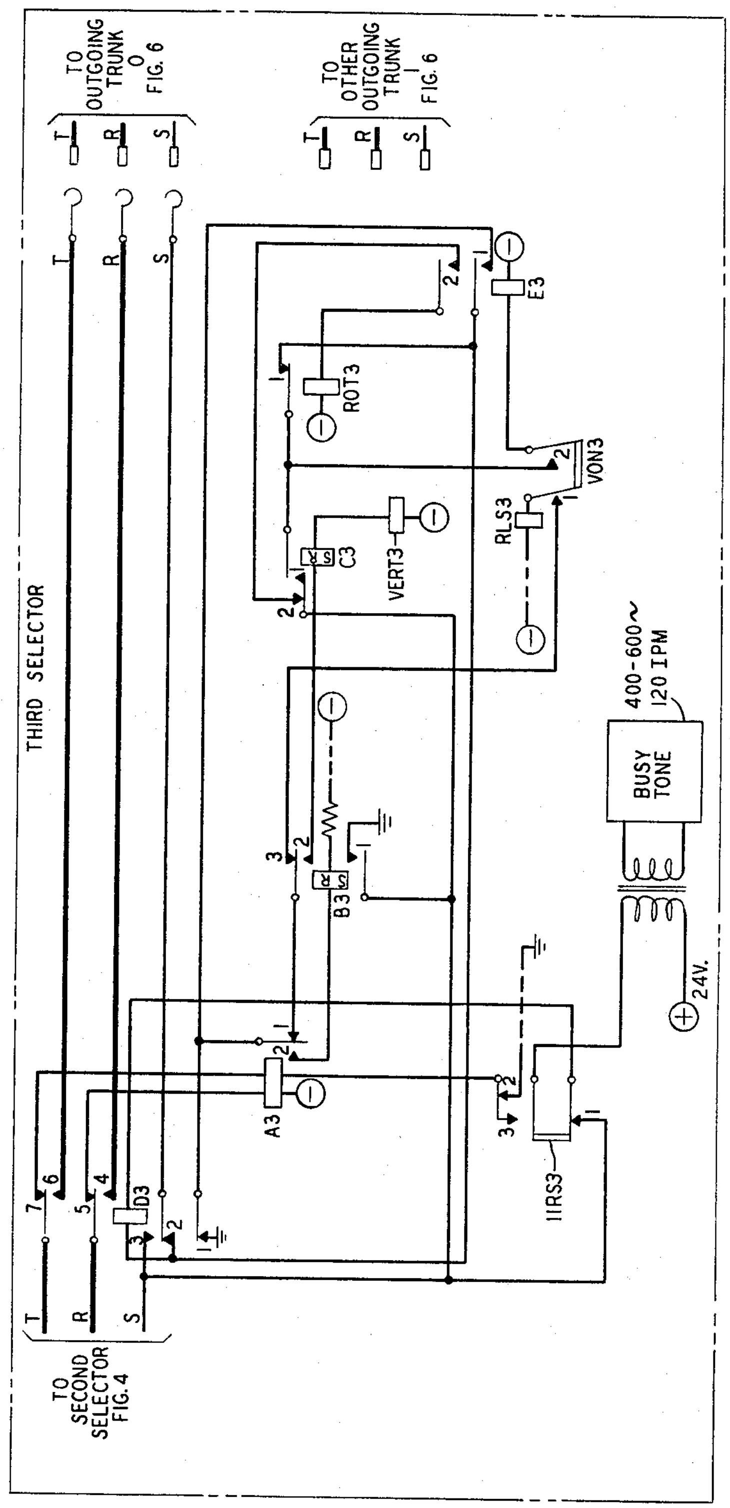


FIG. 5

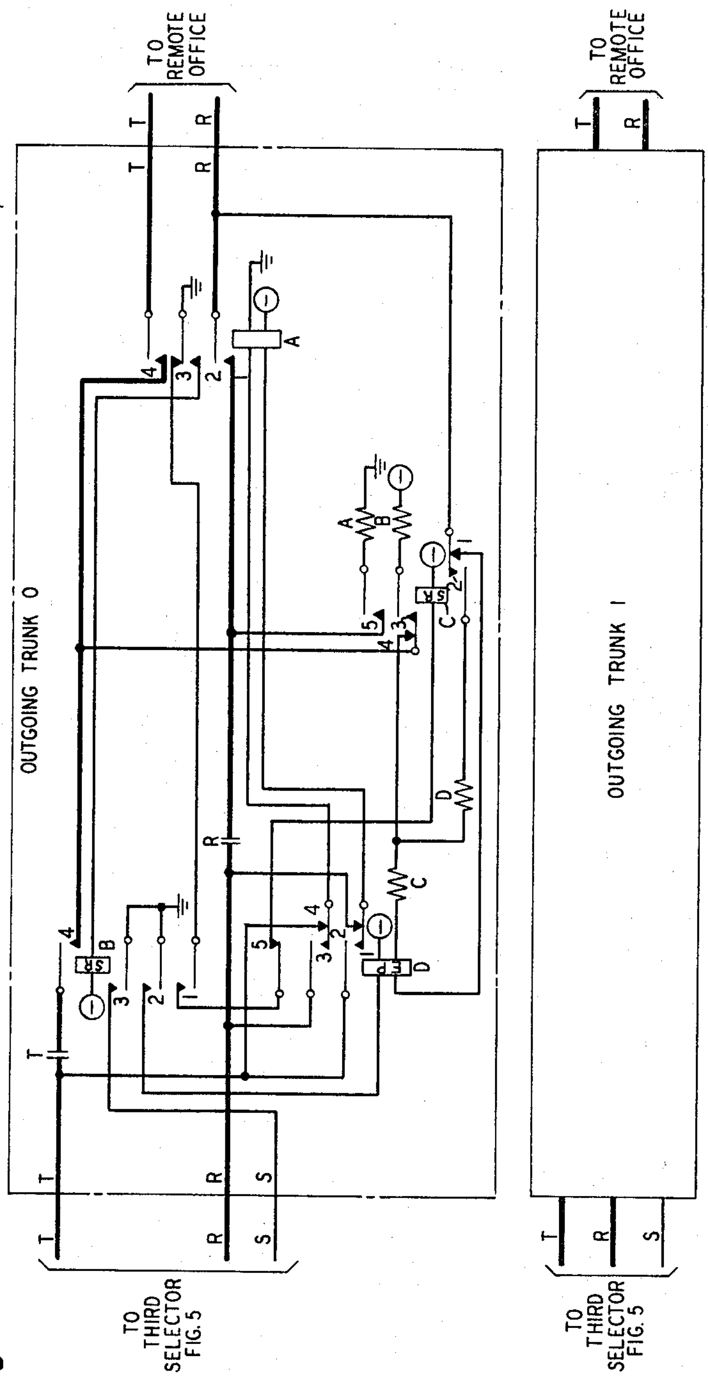
TO REMOTE OFFICE
OUTGOING TRUNK 0
TO THIRD SELECTOR FIG. 5
TO REMOTE OFFICE
OUTGOING TRUNK 1
TO THIRD SELECTOR FIG. 5

FIG. 6

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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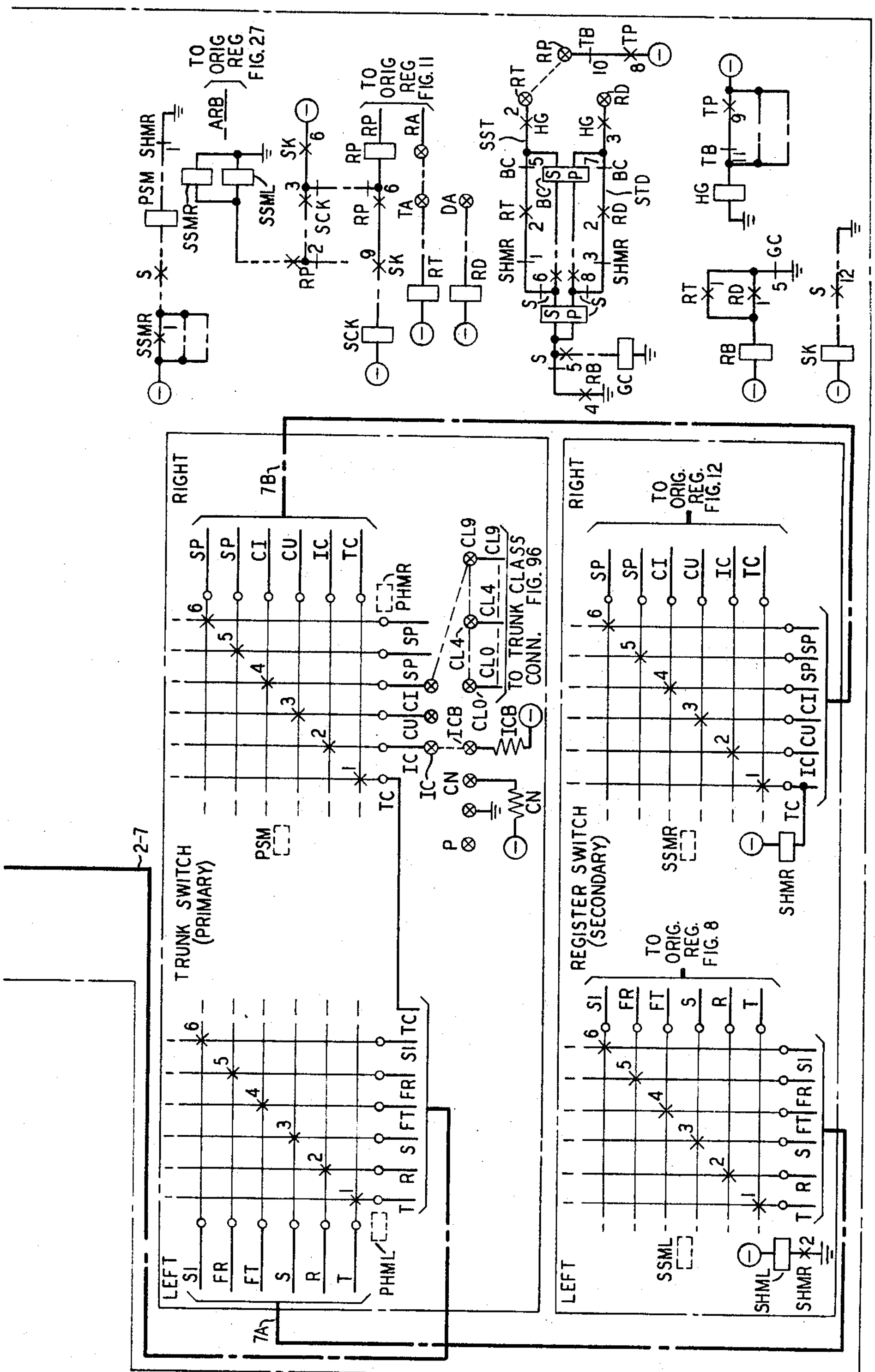

FIG. 7

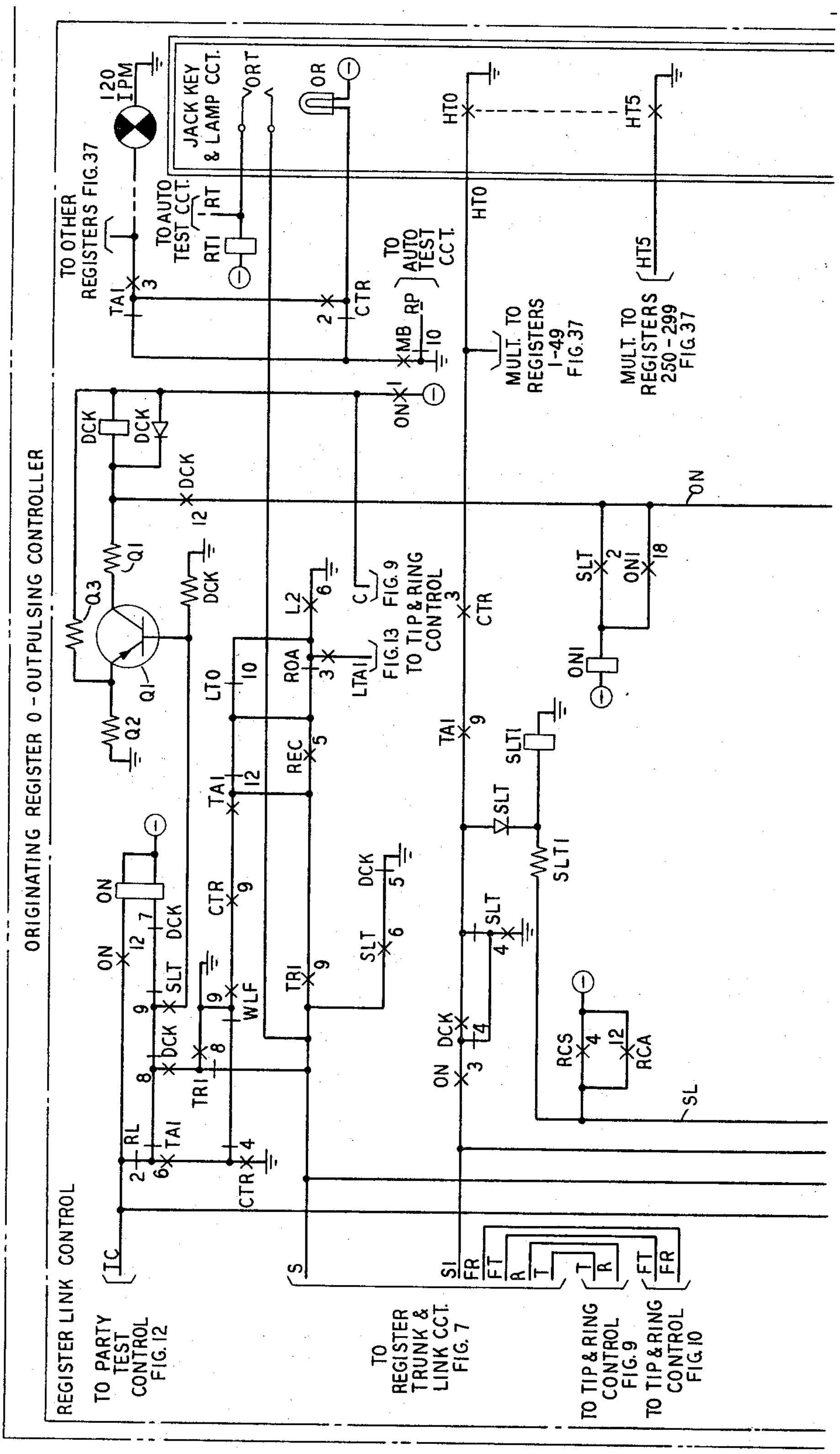
ORIGINATING REGISTER 0-OUTPULSING CONTROLLER
REGISTER LINK CONTROL
JACK KEY & LAMP CCT.
TO OTHER REGISTERS FIG.37
TO AUTO TEST CCT.
MULT. TO REGISTERS 1-49 FIG.37
MULT. TO REGISTERS 250-299 FIG.37
FIG.9 TO TIP & RING CONTROL
FIG.13 TO TIP & RING CONTROL
TO PARTY TEST CONTROL FIG.12
TO REGISTER TRUNK & LINK CCT. FIG. 7
TO TIP & RING CONTROL FIG.9
TO TIP & RING CONTROL FIG.10
120 IPM

FIG. 8

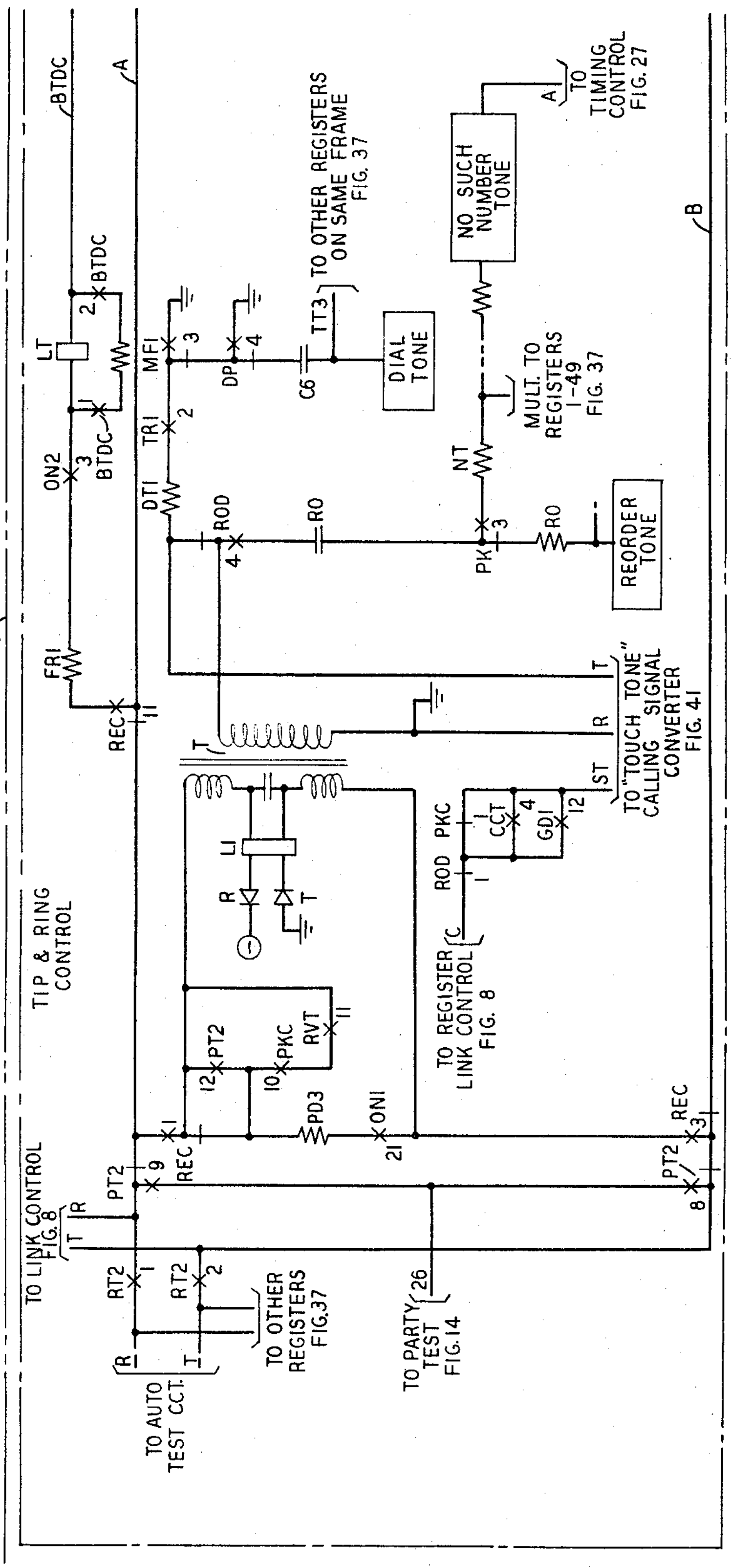
REGISTER 0
TIP & RING CONTROL
BTDC
A
B
LT
ON2
FR1
REC
MF1
TR1
DT1
DP
C6
TT3
TO OTHER REGISTERS ON SAME FRAME FIG. 37
DIAL TONE
ROD
RO
PK
NT
REORDER TONE
NO SUCH NUMBER TONE
TO TIMING CONTROL FIG. 27
MULT. TO REGISTERS 1-49 FIG. 37
TO "TOUCH TONE" CALLING SIGNAL CONVERTER FIG. 41
L1
PKC
CCT
GD1
TO REGISTER LINK CONTROL FIG. 8
PT2
RVT
PD3
ON1
TO LINK CONTROL FIG. 8
RT2
TO OTHER REGISTERS FIG. 37
TO PARTY TEST FIG. 14
TO AUTO TEST CCT.

FIG. 9

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING
MEANS FOR DERIVING SWITCHING CODES
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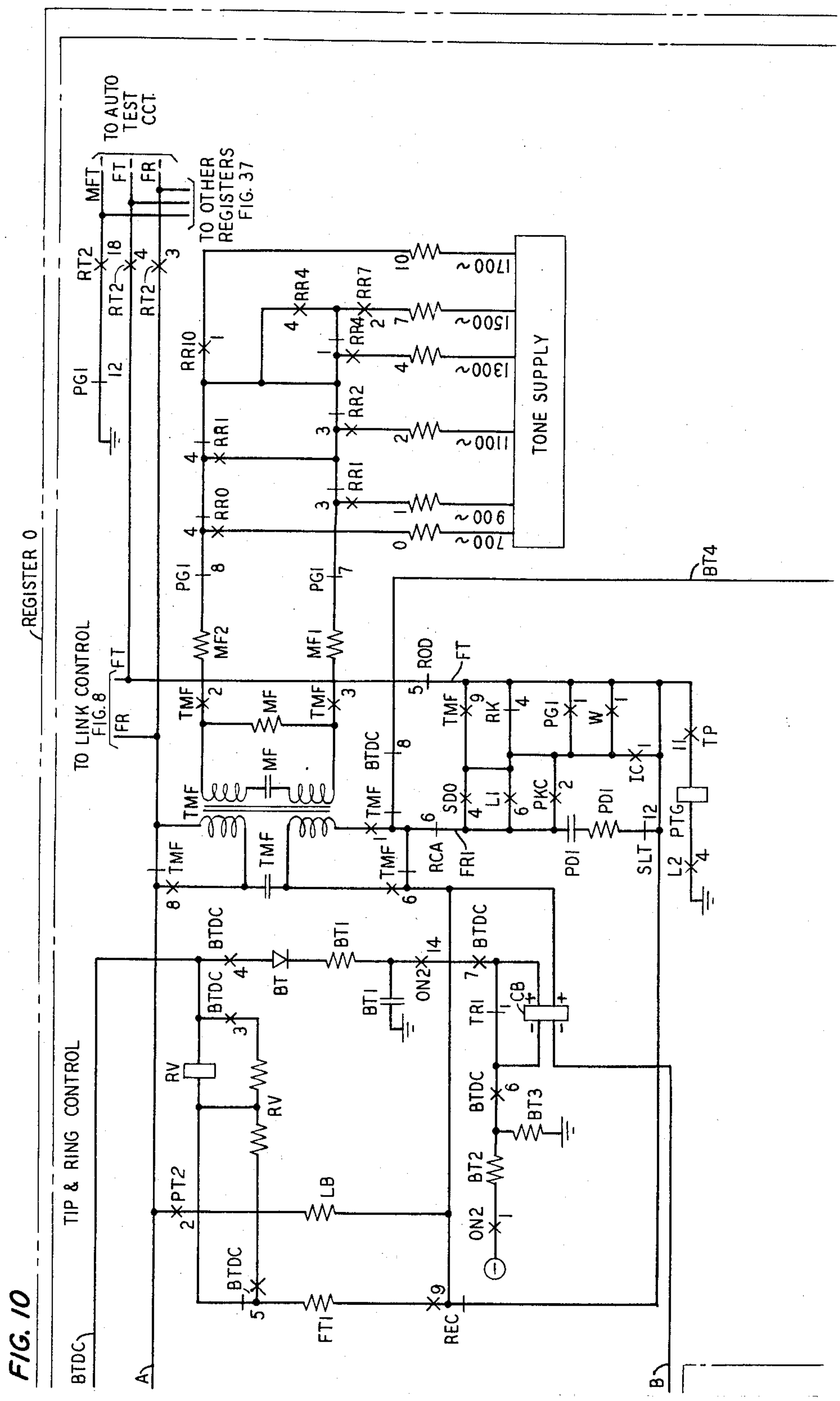


FIG. 10

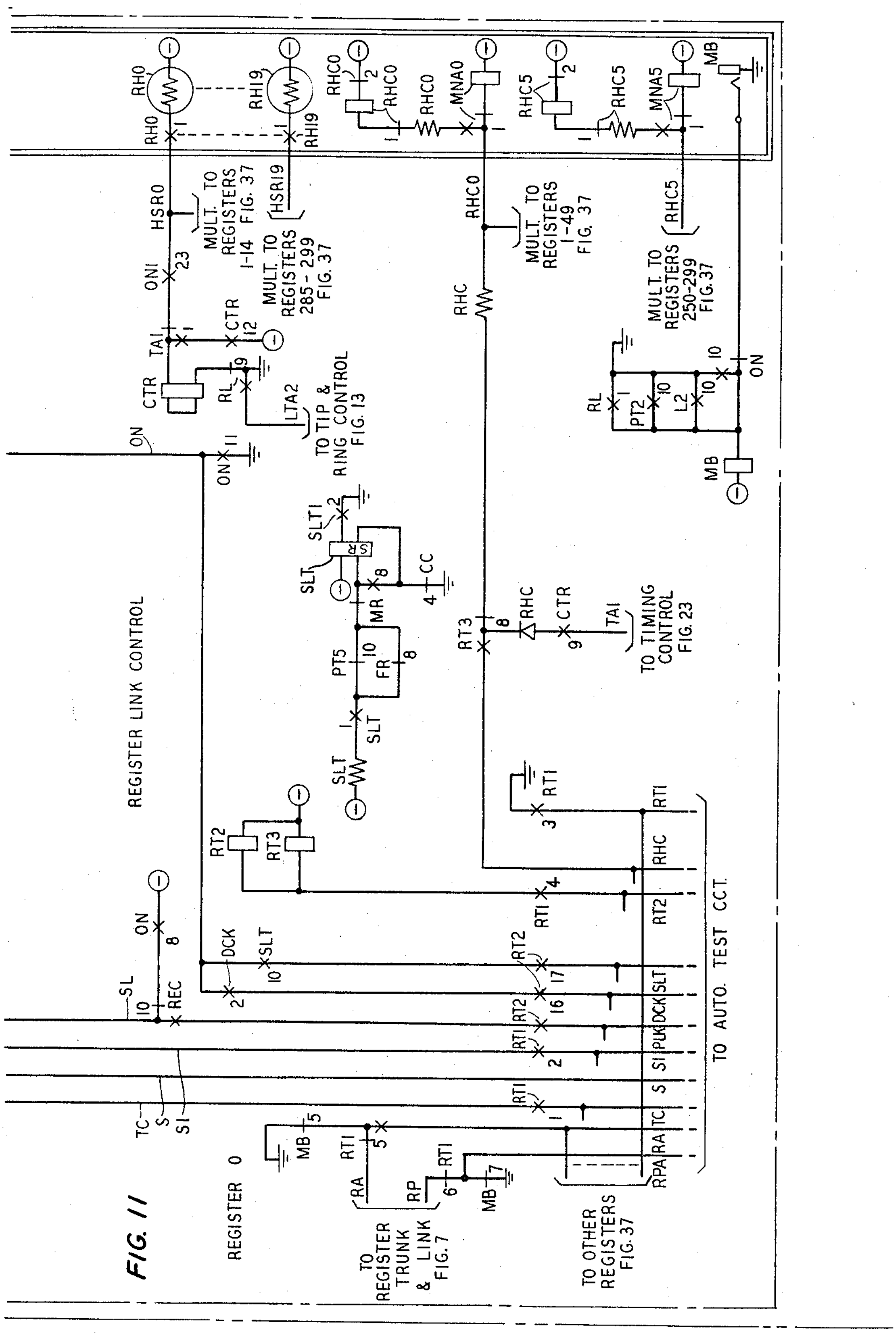
REGISTER 0
REGISTER LINK CONTROL
TO AUTO. TEST CCT.
TO OTHER REGISTERS FIG. 37
TO REGISTER TRUNK & LINK FIG. 7
TO TIMING CONTROL FIG. 23
TO TIP & RING CONTROL FIG. 13
MULT. TO REGISTERS 1-14 FIG. 37
MULT. TO REGISTERS 285-299 FIG. 37
MULT. TO REGISTERS 1-49 FIG. 37
MULT. TO REGISTERS 250-299 FIG. 37

FIG. 11

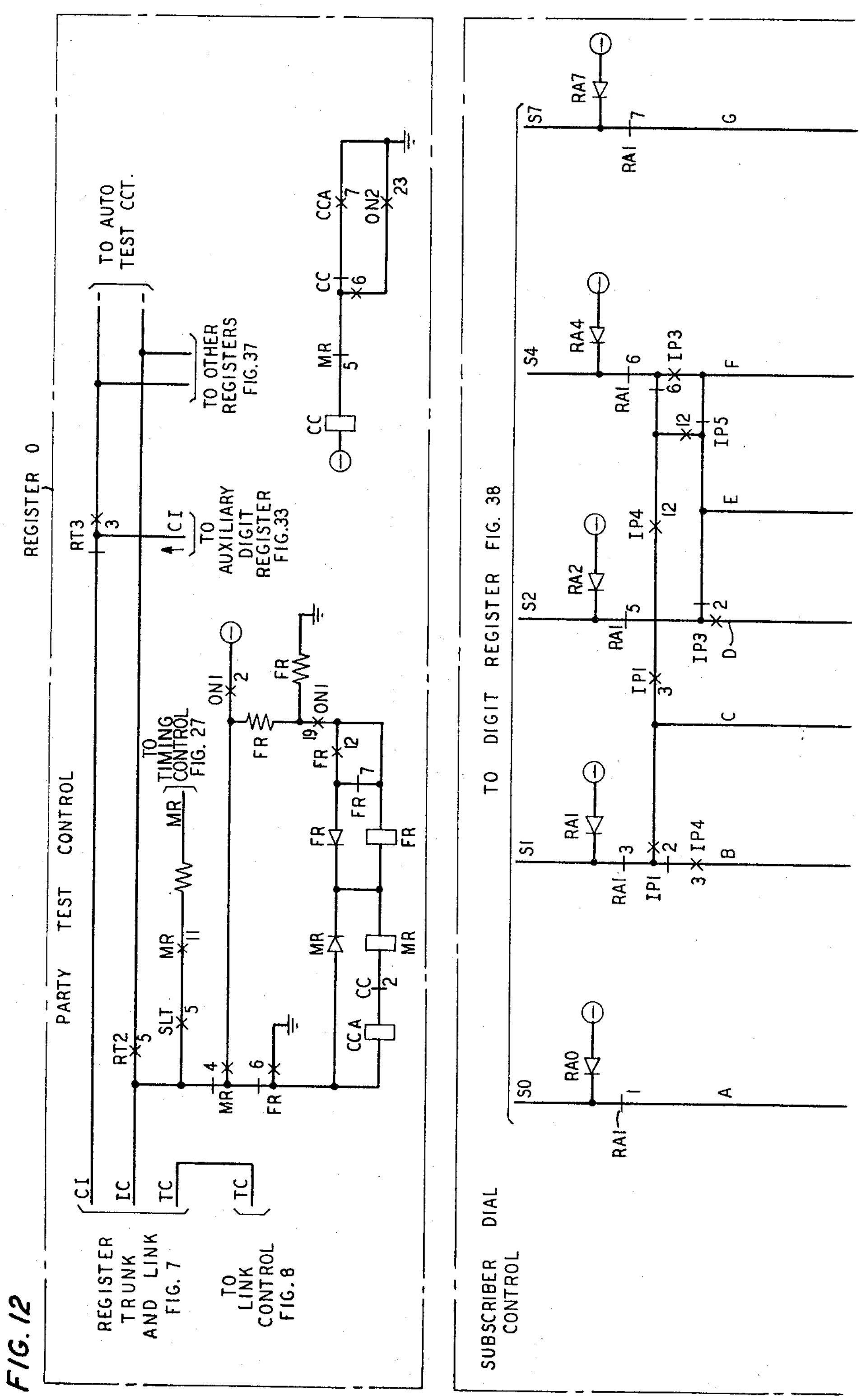
FIG. 12
REGISTER 0
PARTY TEST CONTROL
TO AUTO TEST CCT.
TO OTHER REGISTERS FIG. 37
TO AUXILIARY DIGIT REGISTER FIG. 33
TO TIMING CONTROL FIG. 27
REGISTER TRUNK AND LINK FIG. 7
TO LINK CONTROL FIG. 8
TO DIGIT REGISTER FIG. 38
SUBSCRIBER DIAL CONTROL

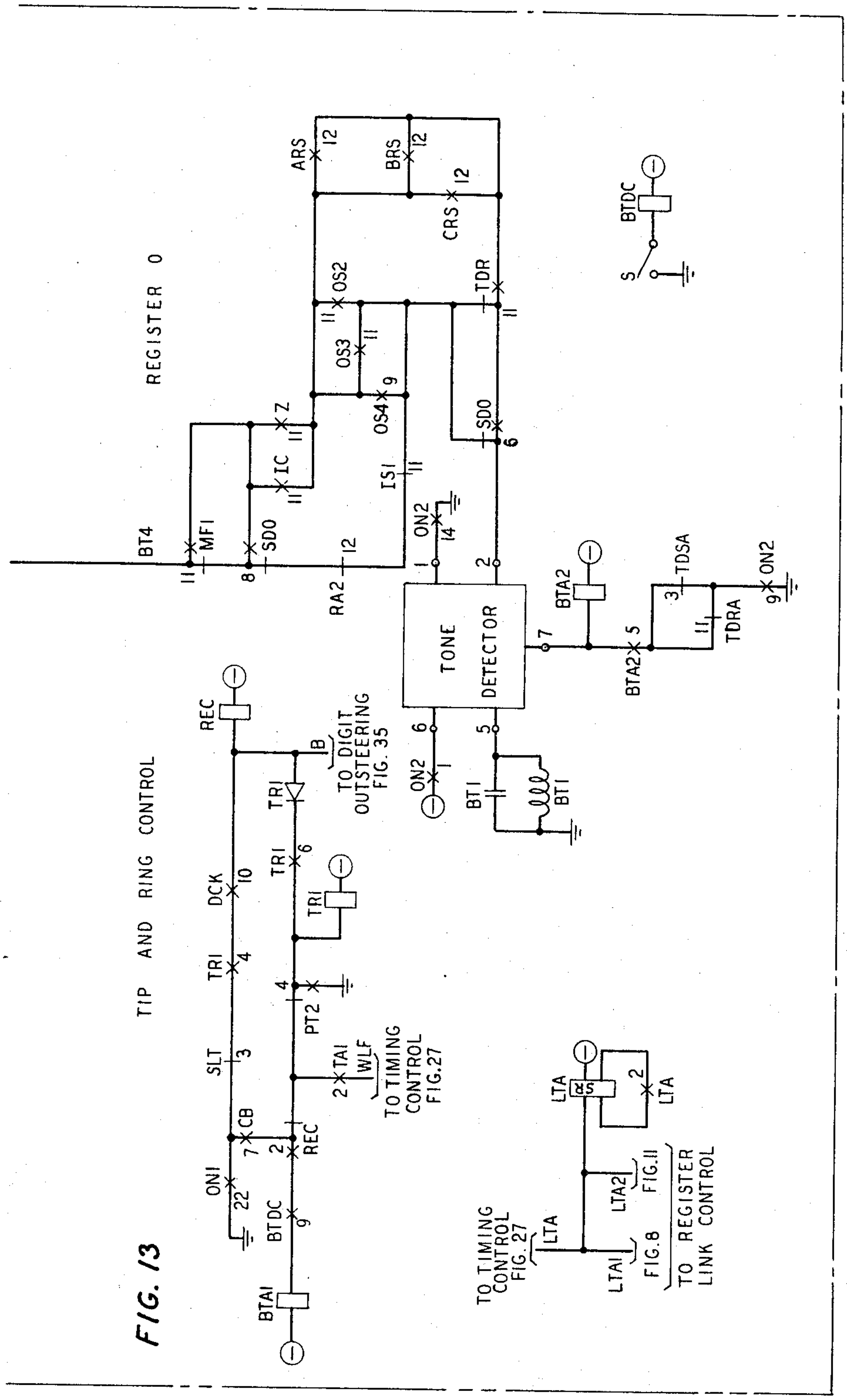
REGISTER 0
TIP AND RING CONTROL
TONE
DETECTOR
TO DIGIT
OUTSTEERING
FIG. 35
TO TIMING
CONTROL
FIG. 27
TO REGISTER
LINK CONTROL
FIG. 8
FIG. 11

FIG. 13

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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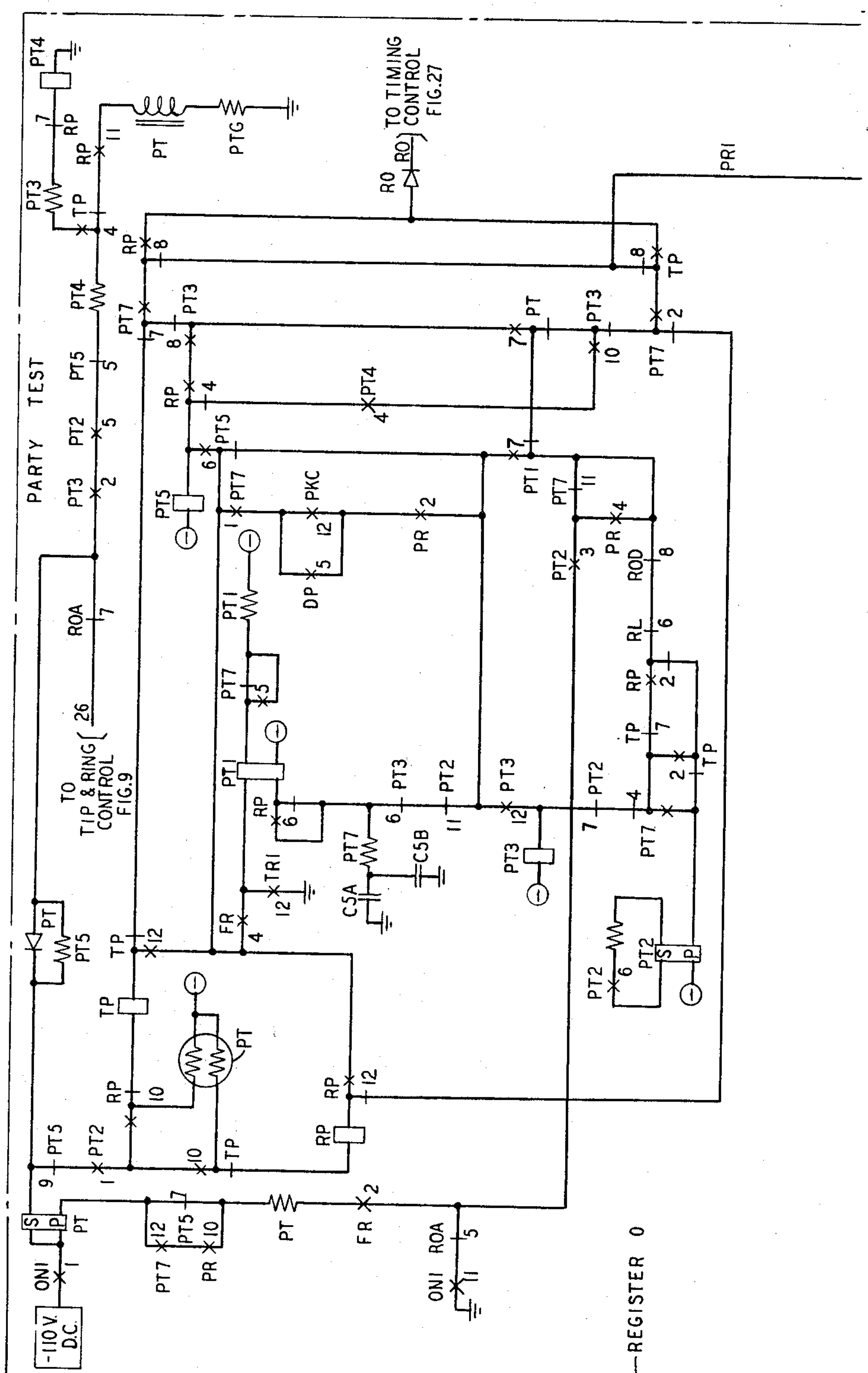


FIG. 14

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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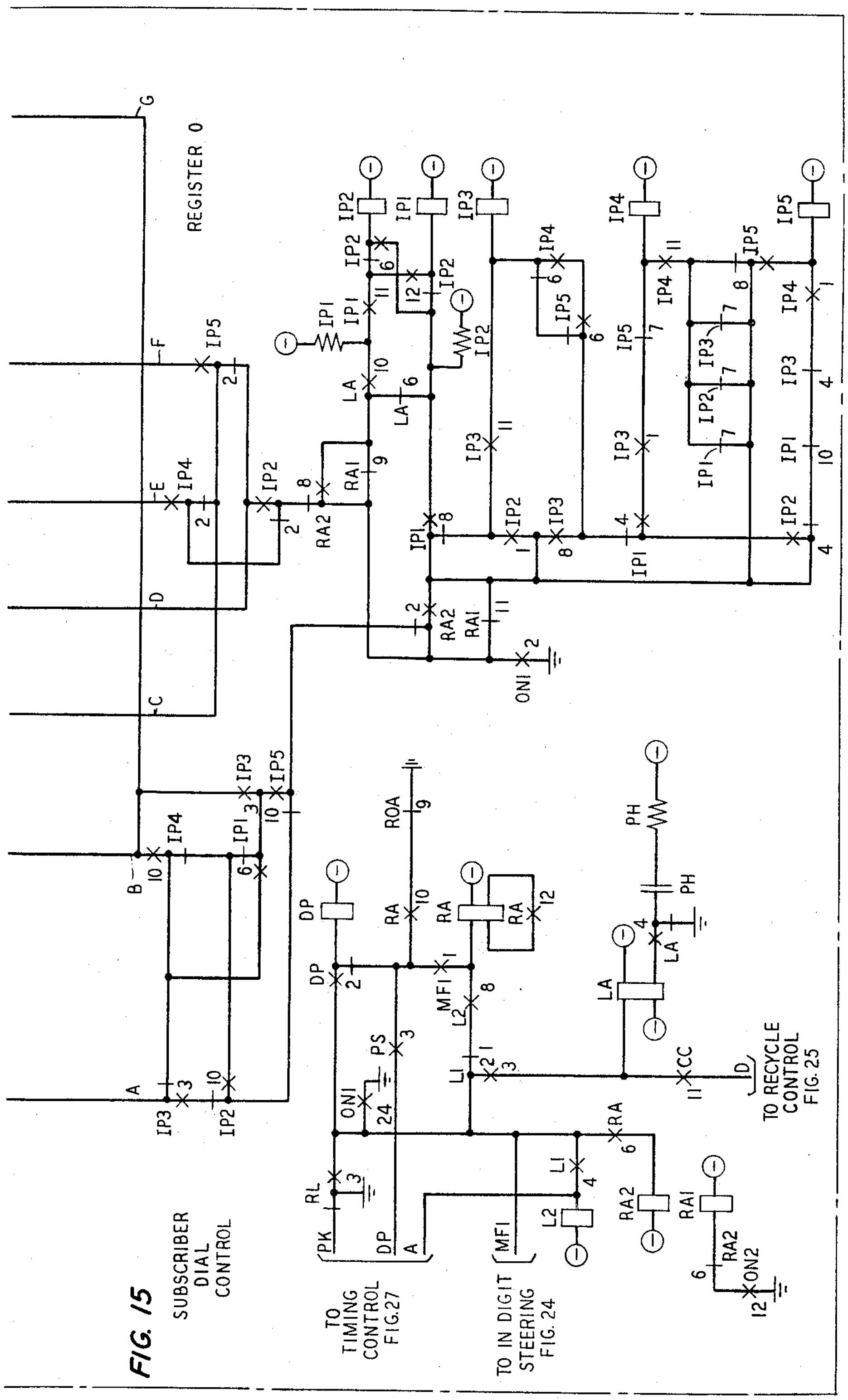


FIG. 15

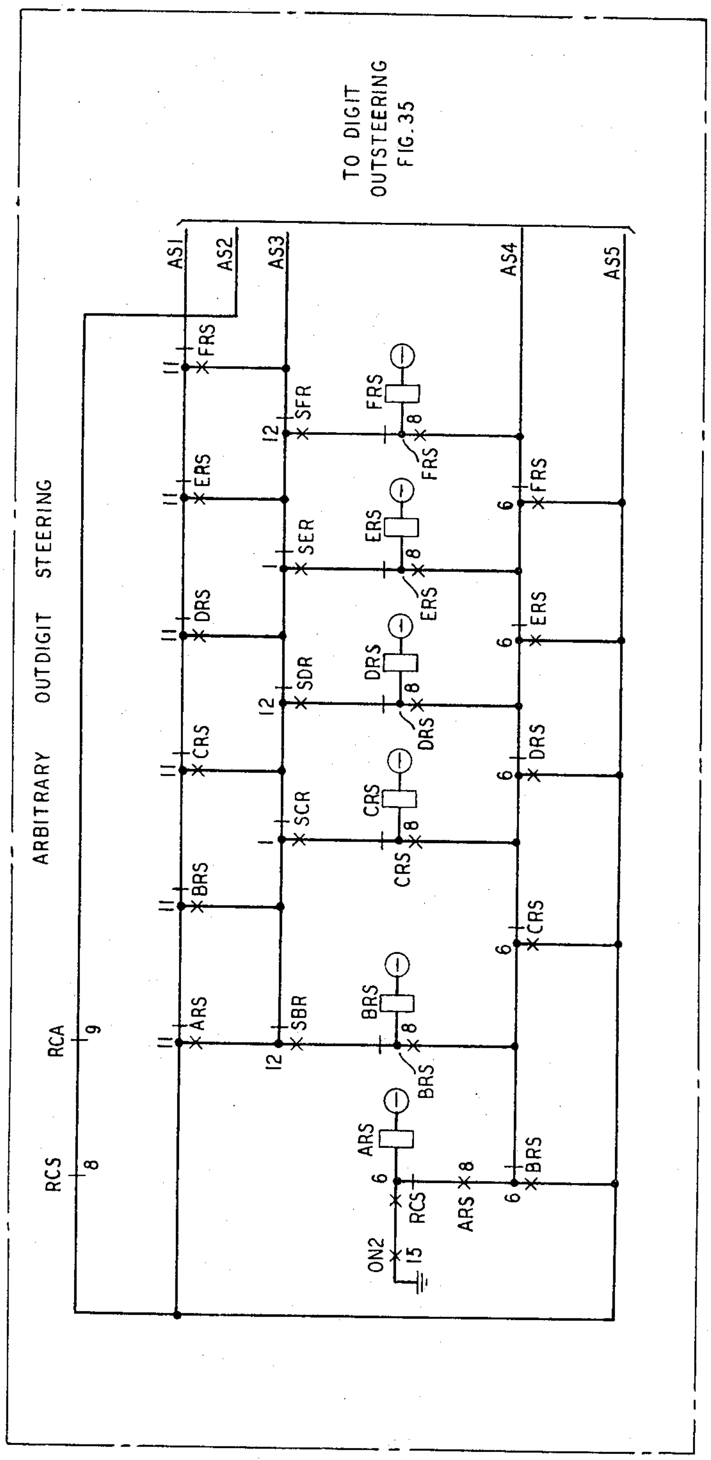
REGISTER 0
ARBITRARY OUTDIGIT STEERING
TO DIGIT OUTSTEERING FIG. 35
AS1
AS2
AS3
AS4
AS5
RCA
RCS
ON2
ARS
BRS
CRS
DRS
ERS
FRS
SBR
SCR
SDR
SER
SFR

FIG. 16

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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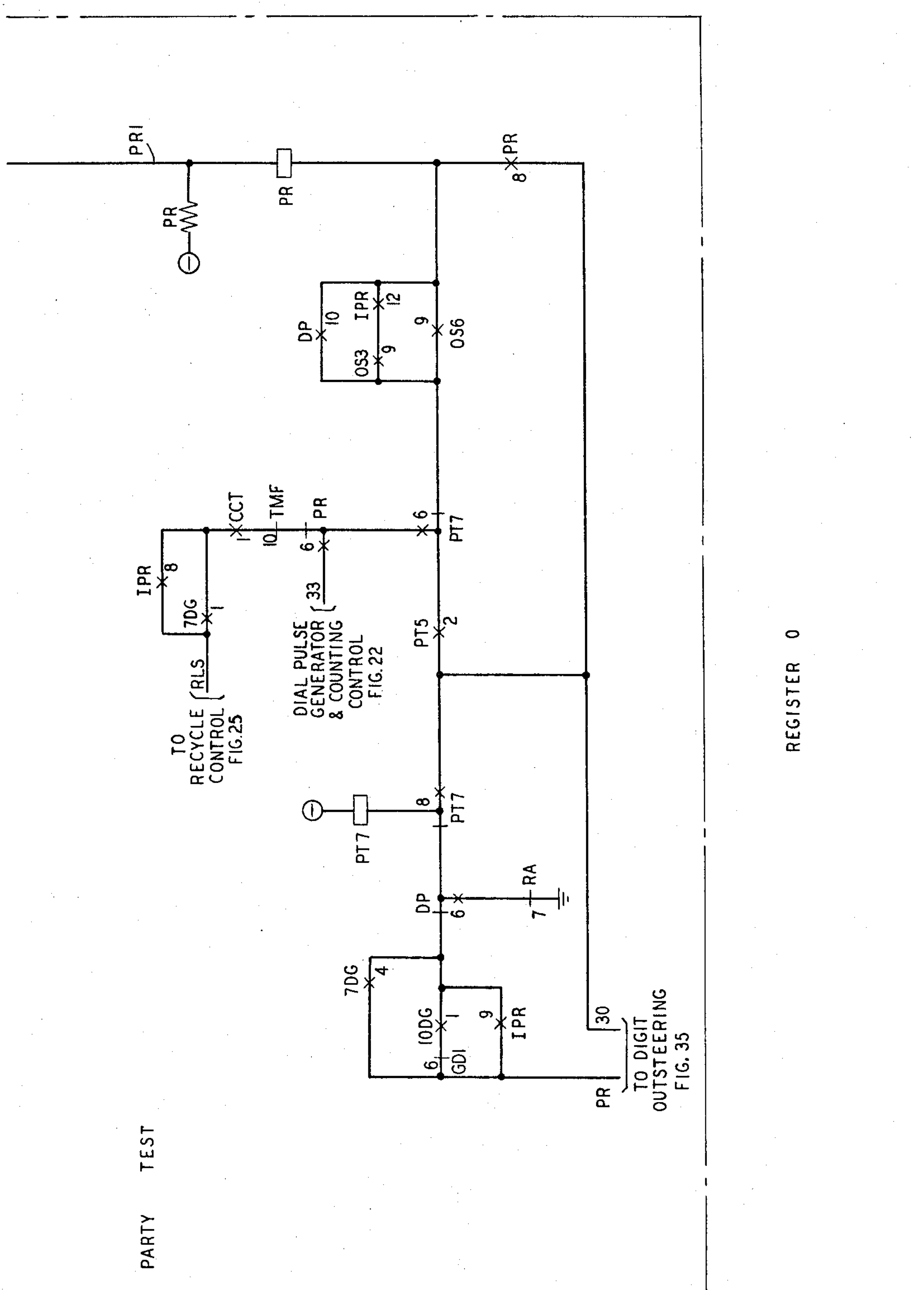


FIG. 17

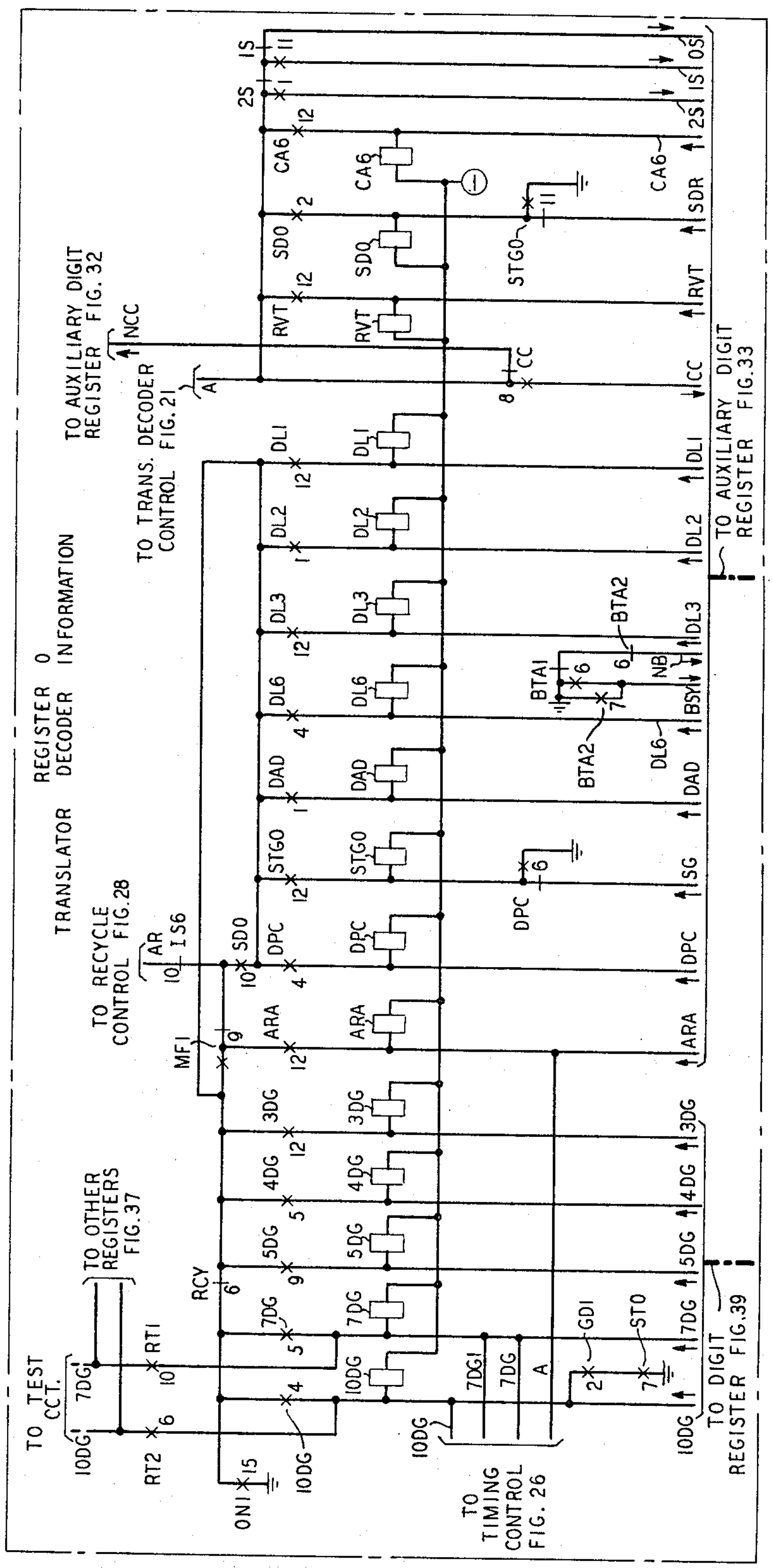
TRANSLATOR
REGISTER 0
DECODER INFORMATION
TO AUXILIARY DIGIT REGISTER FIG. 32
NCC
TO TRANS. DECODER CONTROL FIG. 21
TO RECYCLE CONTROL FIG. 28
AR
IS6
SDO
MFI
RCY
TO OTHER REGISTERS FIG. 37
TO TEST CCT.
7DG
10DG
RT1
RT2
ON1
CA6
SDO
RVT
CC
DL1
DL2
DL3
DL6
DAD
STGO
DPC
ARA
3DG
4DG
5DG
1S
2S
0S
SDR
BTA1
BTA2
NB
BSY
SG
GD1
ST0
7DG1
A
TO AUXILIARY DIGIT REGISTER FIG. 33
TO DIGIT REGISTER FIG. 39
TO TIMING CONTROL FIG. 26

FIG. 18

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

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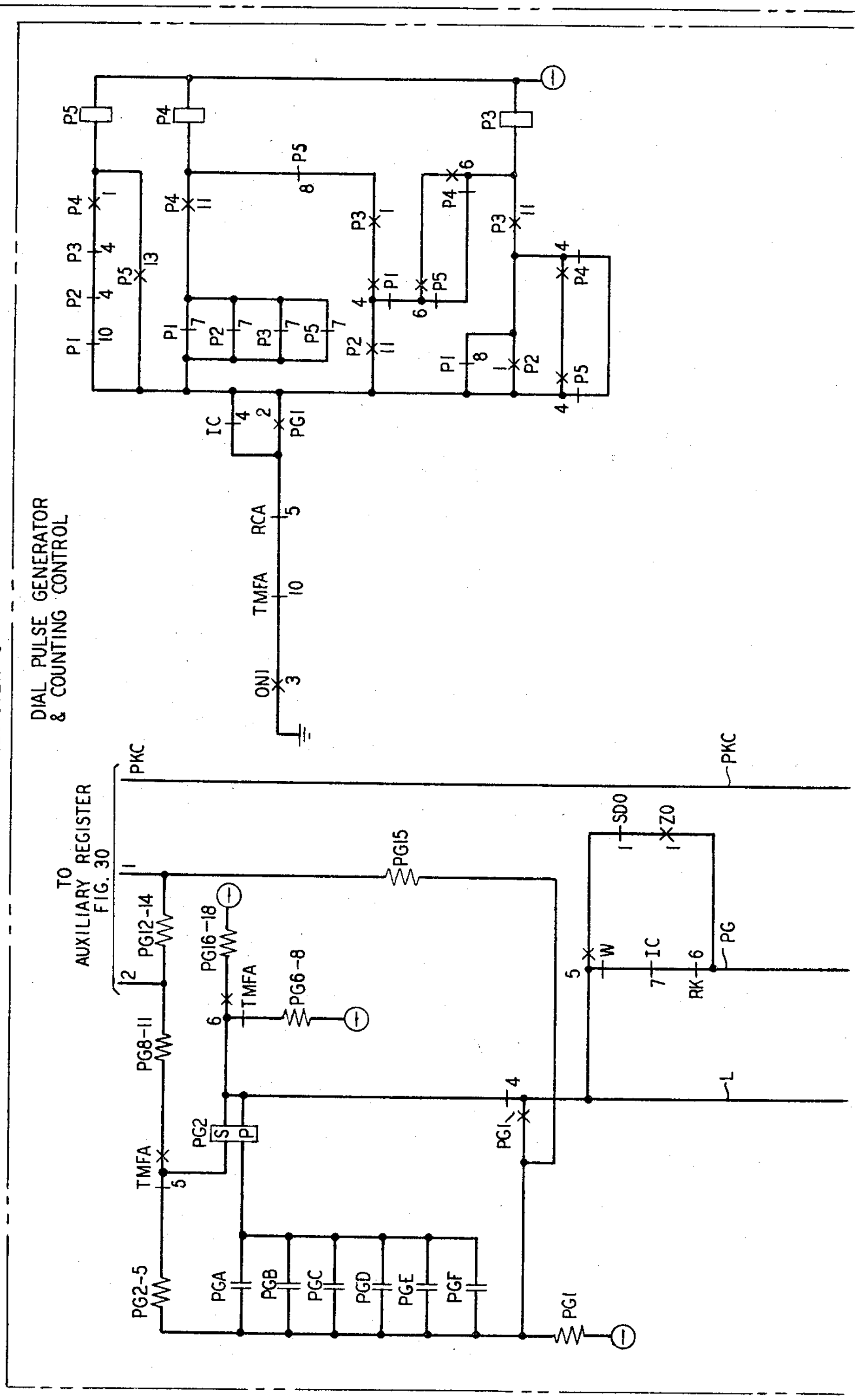



FIG. 19

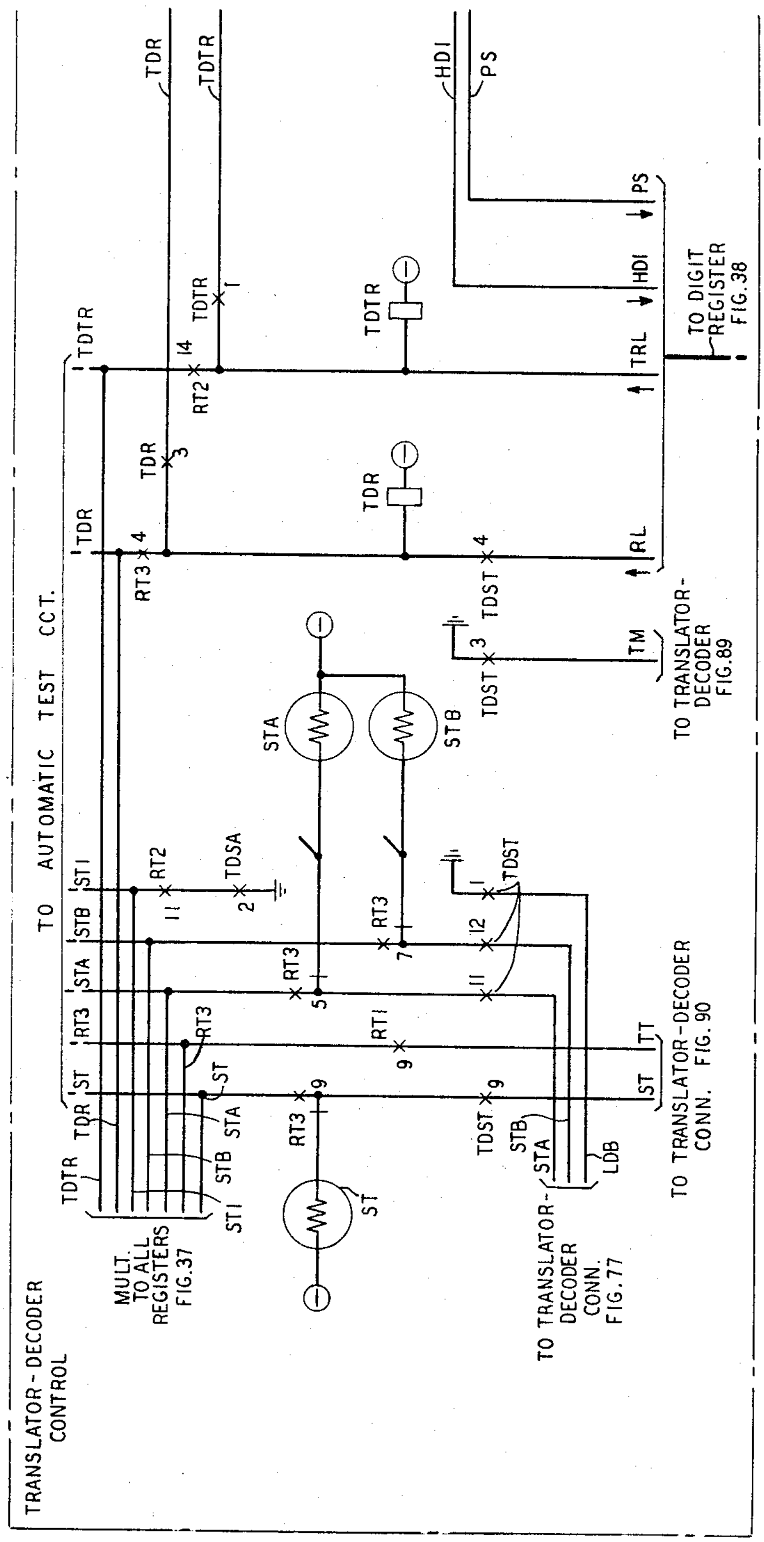

REGISTER 0
TO AUTOMATIC TEST CCT.
TRANSLATOR-DECODER CONTROL
MULT. TO ALL REGISTERS FIG.37
TO TRANSLATOR-DECODER CONN. FIG.77
TO TRANSLATOR-DECODER CONN. FIG. 90
TO TRANSLATOR-DECODER FIG.89
TO DIGIT REGISTER FIG.38
TDR
TDTR
HDI
PS
TRL
RL
TM
TT
ST
STA
STB
ST1
RT3
RT2
RT1
TDSA
TDST
LDB

FIG. 20

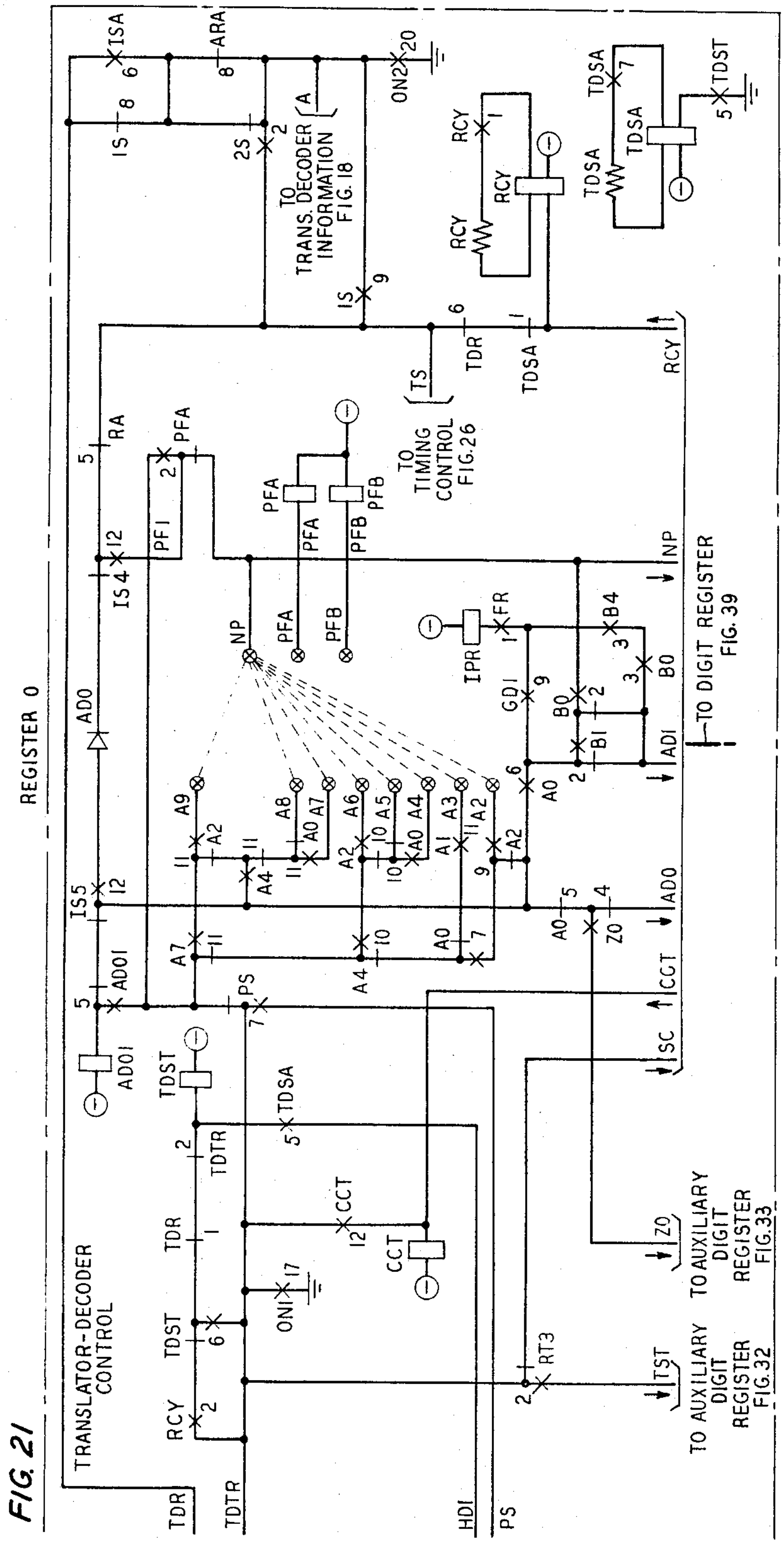

REGISTER 0
TRANSLATOR-DECODER CONTROL
TO TRANS. DECODER INFORMATION FIG. 18
TO TIMING CONTROL FIG. 26
TO DIGIT REGISTER FIG. 39
TO AUXILIARY DIGIT REGISTER FIG. 33
TO AUXILIARY DIGIT REGISTER FIG. 32

FIG. 21

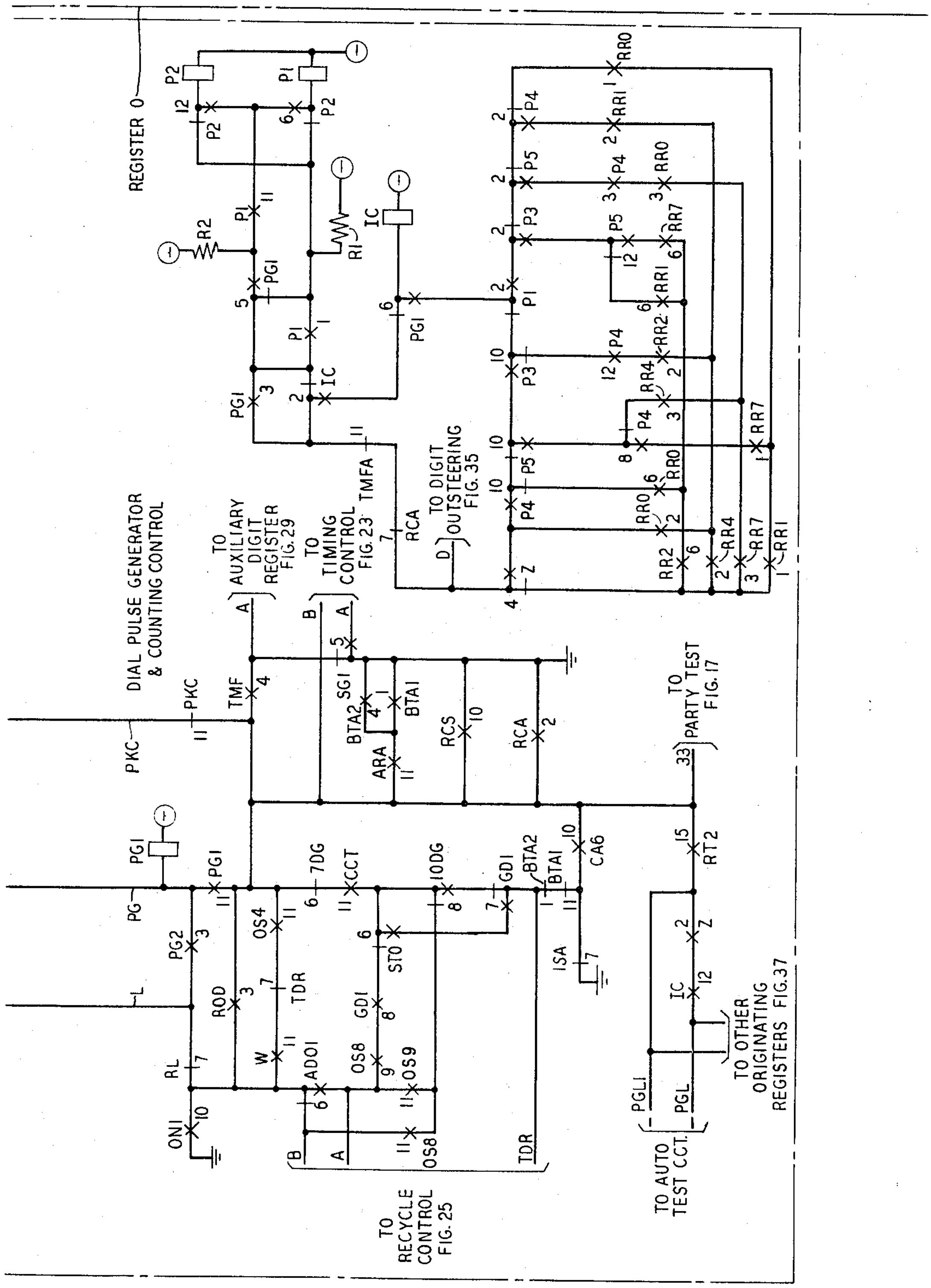

REGISTER 0
DIAL PULSE GENERATOR & COUNTING CONTROL
TO AUXILIARY DIGIT REGISTER FIG.29
TO TIMING CONTROL FIG.23
TO DIGIT OUTSTEERING FIG.35
TO PARTY TEST FIG.17
TO OTHER ORIGINATING REGISTERS FIG.37
TO AUTO TEST CCT.
TO RECYCLE CONTROL FIG.25

FIG. 22

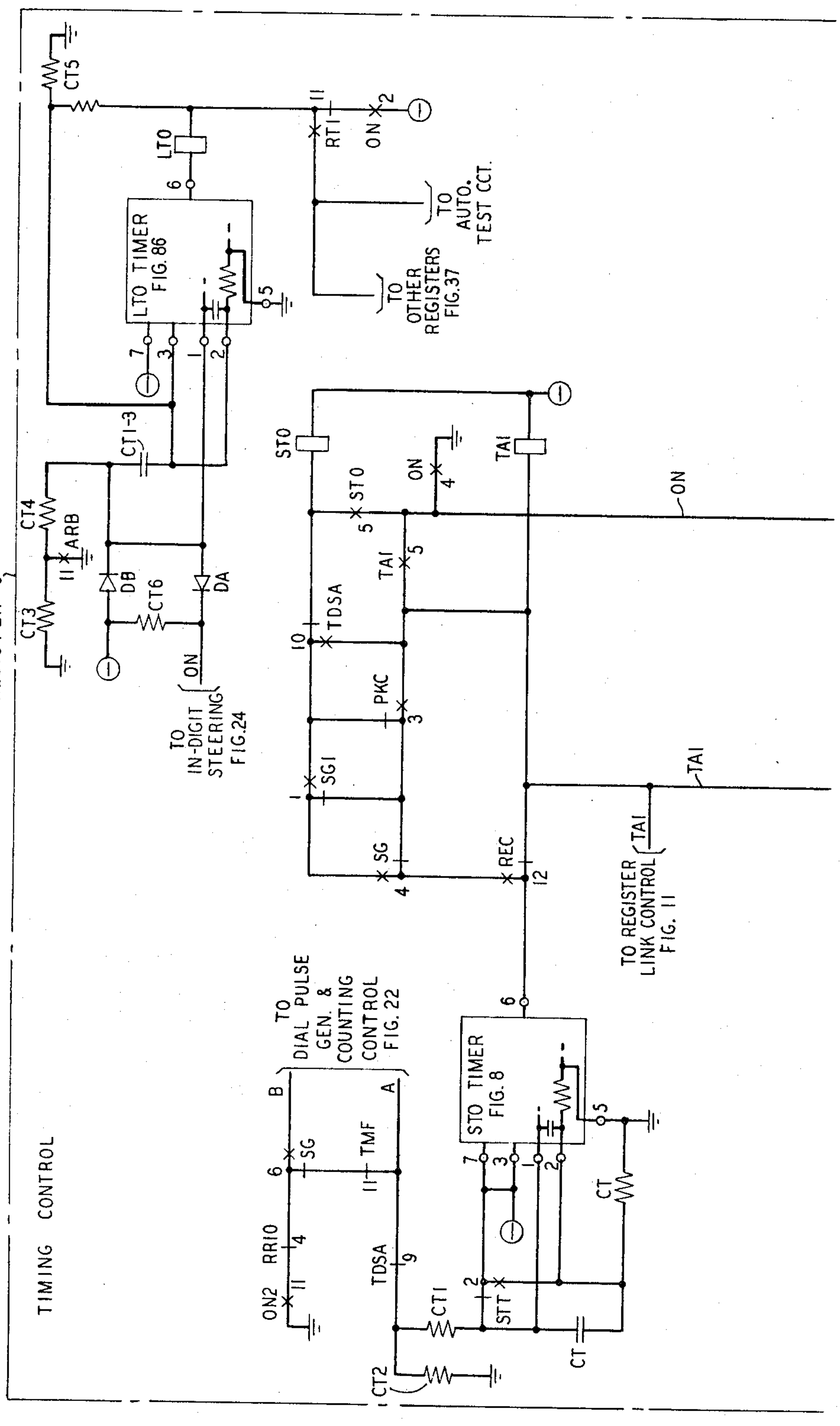
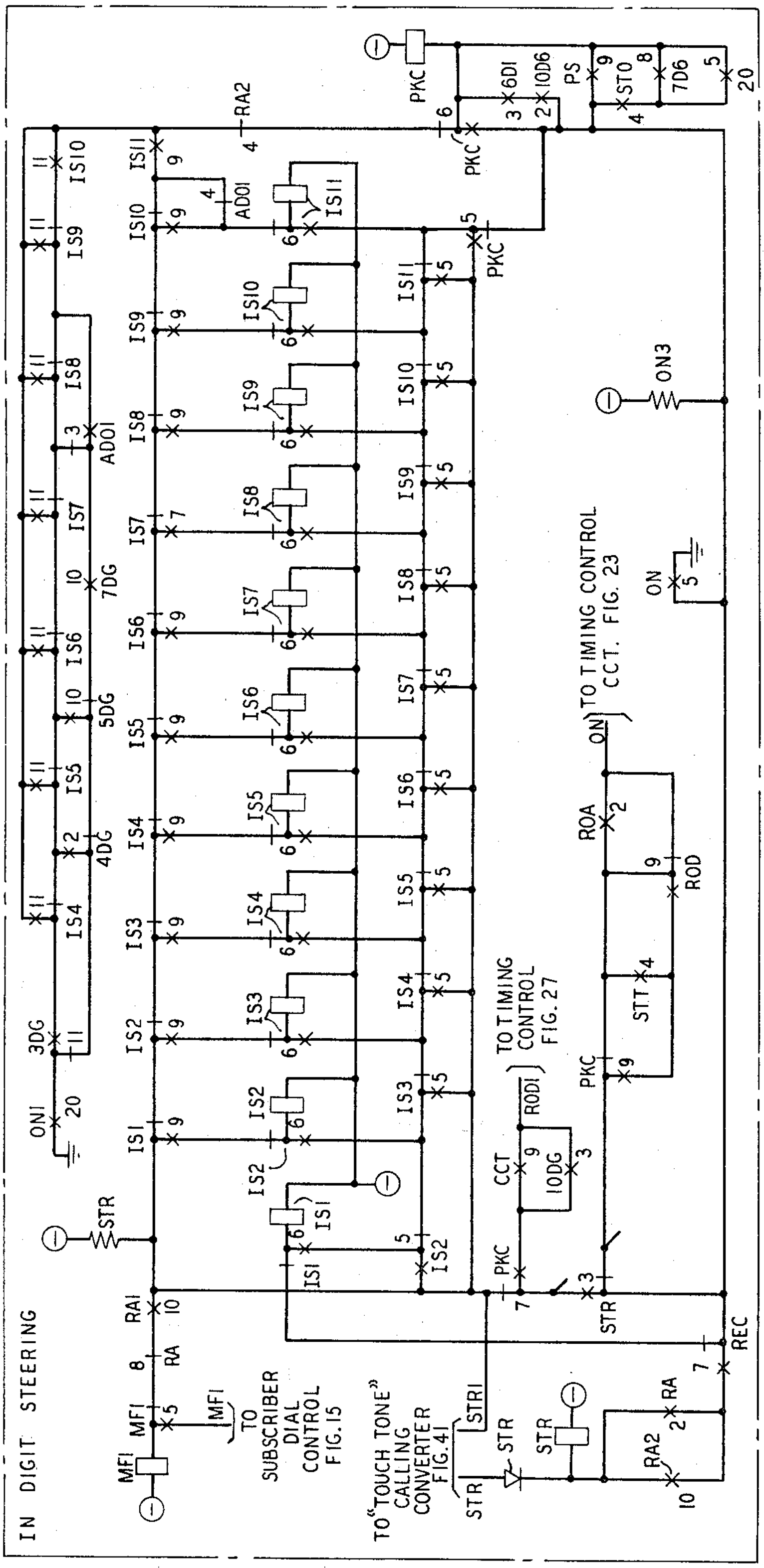

REGISTER 0
TIMING CONTROL
LTO TIMER FIG. 86
STO TIMER FIG. 8
TO AUTO. TEST CCT.
TO OTHER REGISTERS FIG. 37
TO IN-DIGIT STEERING FIG. 24
TO DIAL PULSE GEN. & COUNTING CONTROL FIG. 22
TO REGISTER LINK CONTROL FIG. 11
ON
TAI

FIG. 23

FIG. 24


IN DIGIT STEERING
REGISTER 0
TO SUBSCRIBER DIAL CONTROL FIG.15
TO "TOUCH TONE" CALLING CONVERTER FIG.41
TO TIMING CONTROL FIG.27
TO TIMING CONTROL CCT. FIG. 23

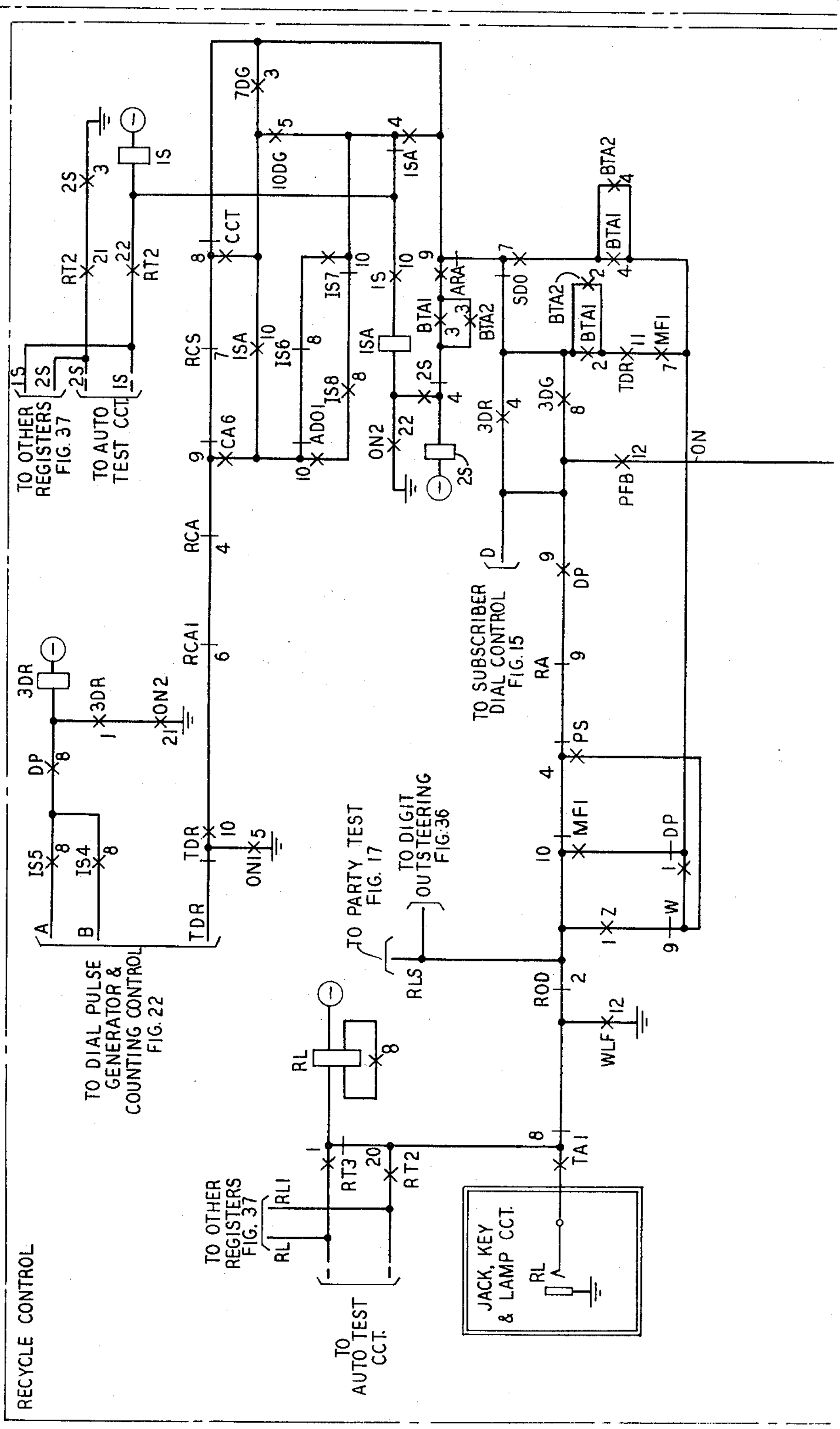

REGISTER 0
RECYCLE CONTROL
TO OTHER REGISTERS FIG. 37
TO AUTO TEST CCT.
TO DIAL PULSE GENERATOR & COUNTING CONTROL FIG. 22
TO SUBSCRIBER DIAL CONTROL FIG. 15
TO PARTY TEST FIG. 17
TO DIGIT OUTSTEERING FIG. 36
JACK, KEY & LAMP CCT.

FIG. 25

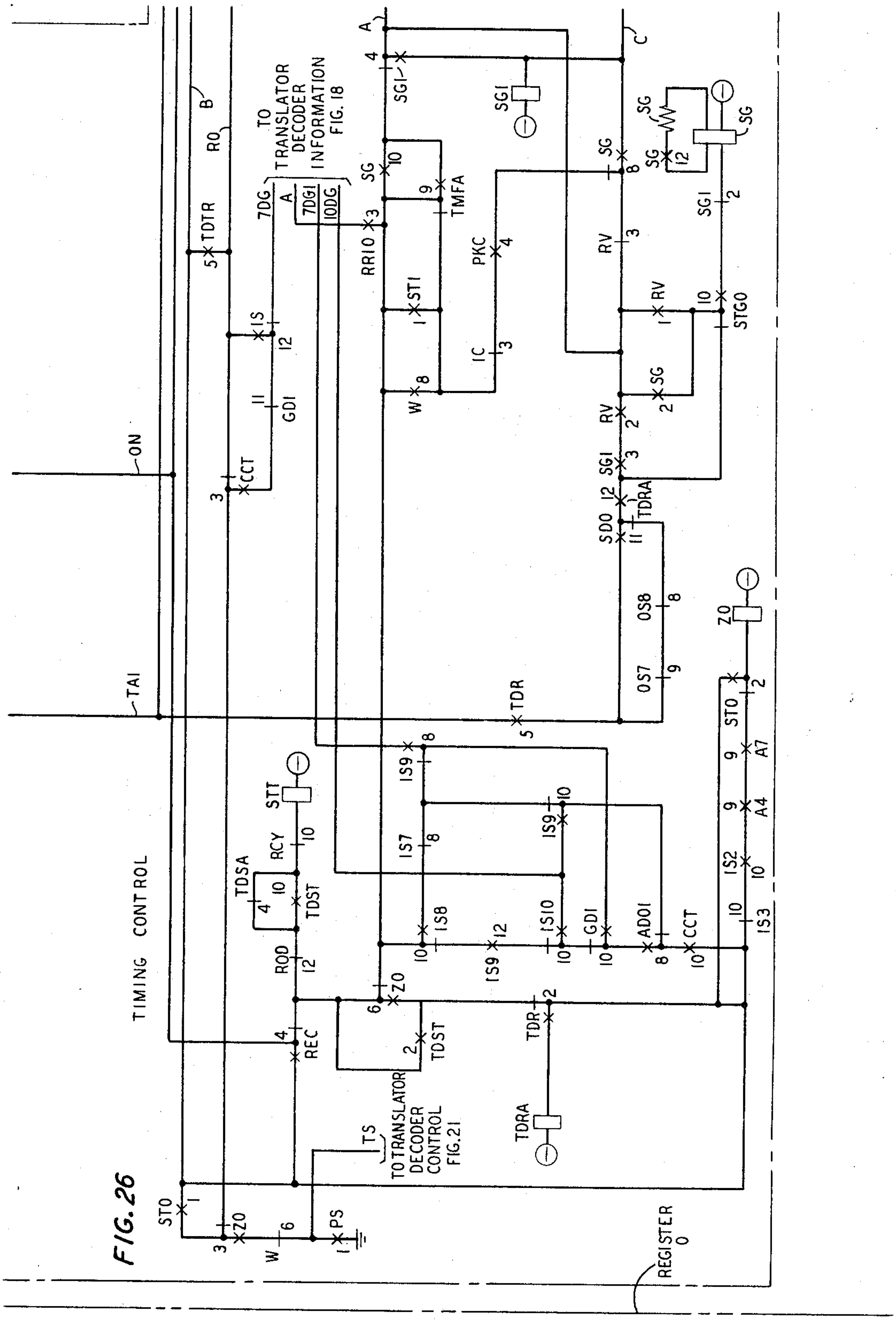
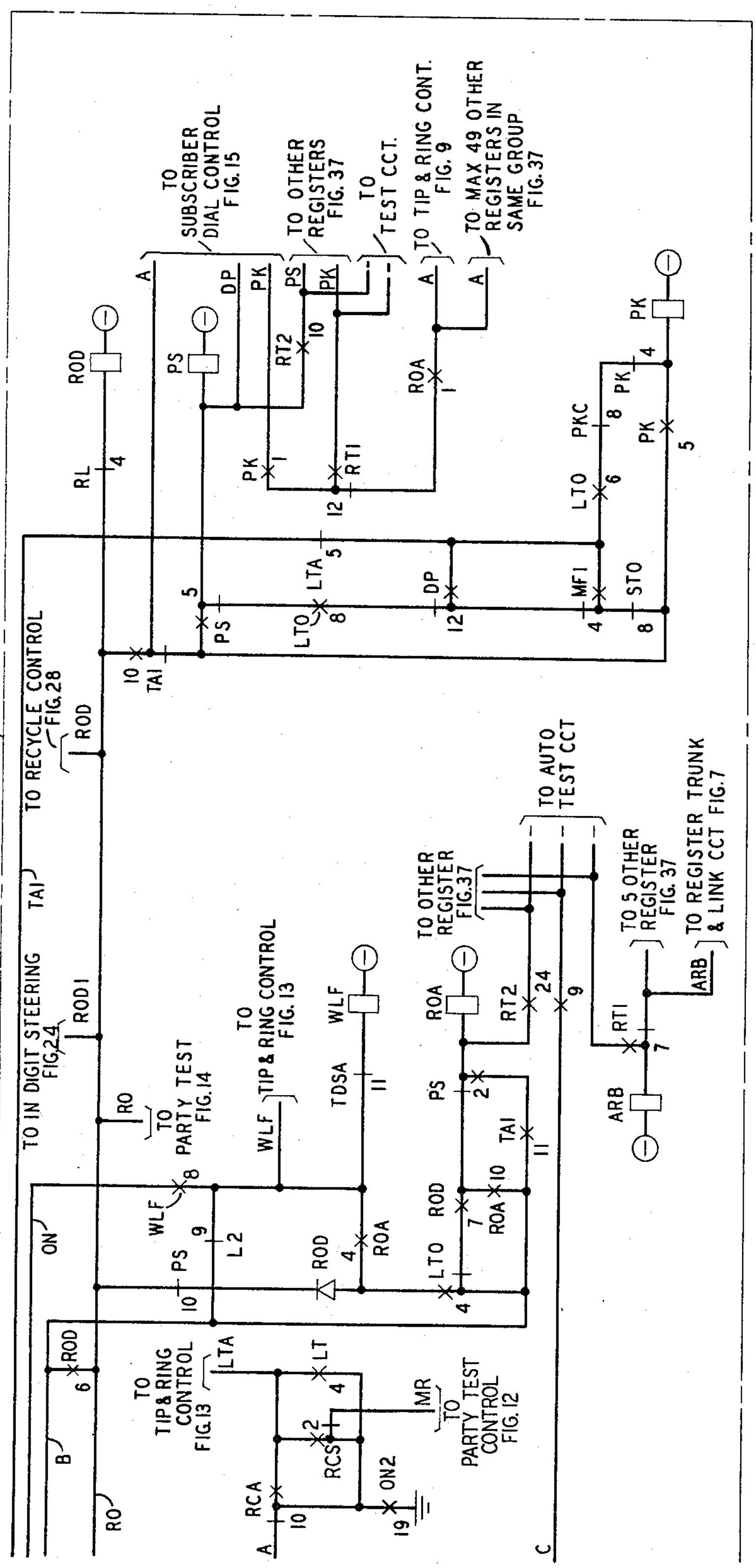

TIMING CONTROL
TO TRANSLATOR DECODER INFORMATION FIG. 18
TO TRANSLATOR DECODER CONTROL FIG. 21
REGISTER 0

FIG. 26


REGISTER O
TIMING CONTROL
TO SUBSCRIBER DIAL CONTROL FIG.15
TO OTHER REGISTERS FIG. 37
TO TEST CCT.
TO TIP & RING CONT. FIG. 9
TO MAX 49 OTHER REGISTERS IN SAME GROUP FIG.37
TO RECYCLE CONTROL FIG.28
TO IN DIGIT STEERING FIG.24
TO PARTY TEST FIG.14
TO TIP & RING CONTROL FIG. 13
TO OTHER REGISTER FIG.37
TO AUTO TEST CCT
TO 5 OTHER REGISTER FIG. 37
TO REGISTER TRUNK & LINK CCT FIG.7
TO TIP & RING CONTROL FIG.13
TO PARTY TEST CONTROL FIG. 12
ROD
PS
PK
RL
RT2
RT1
ROA
PKC
LTO
STO
MF1
DP
LTA
TA1
ROD1
RO
WLF
TDSA
ARB
L2
LT
MR
RCS
RCA
ON2
ON
B
A
C
FIG. 27

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

Filed Sept. 24, 1965 113 Sheets-Sheet 45

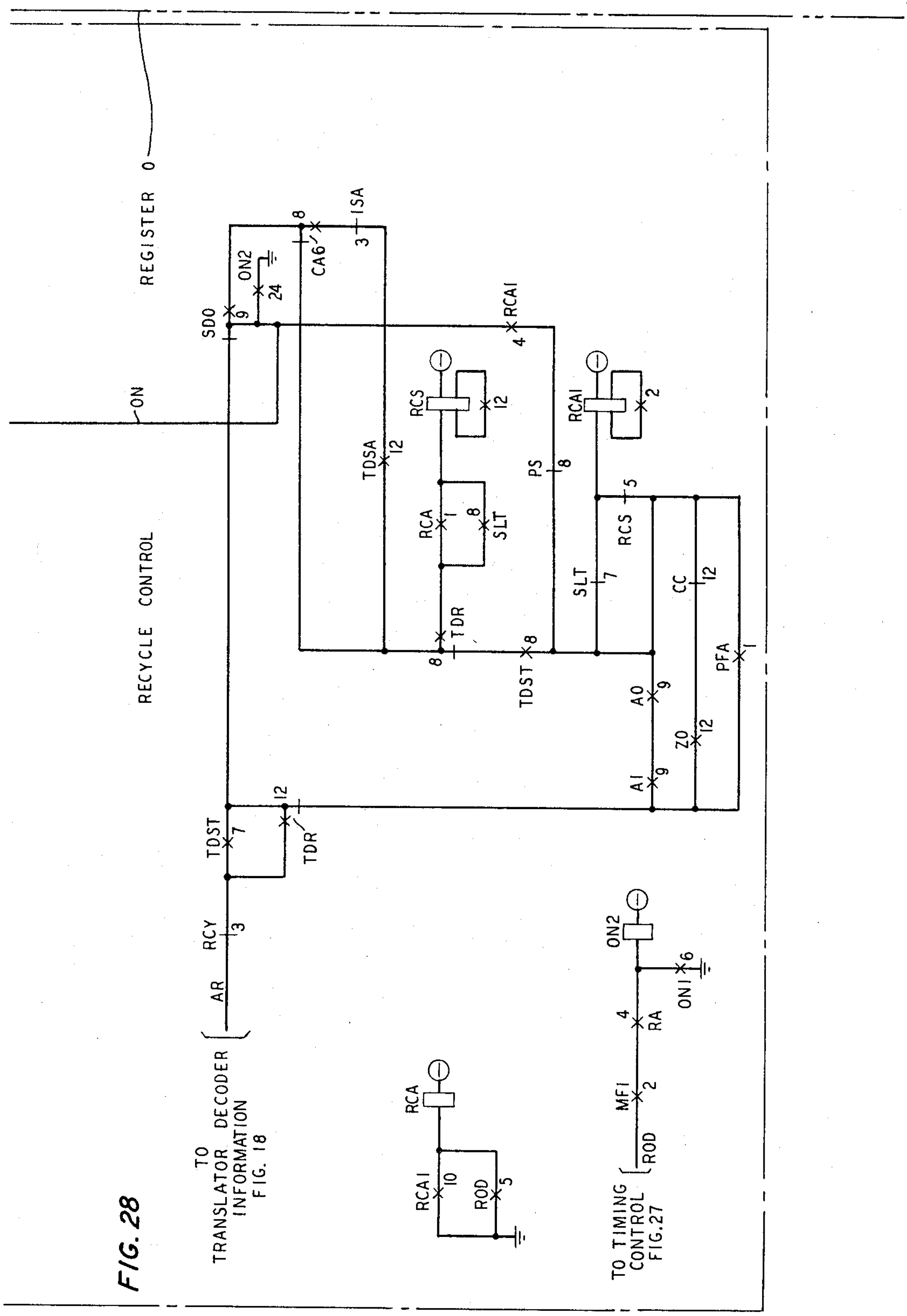



FIG. 28

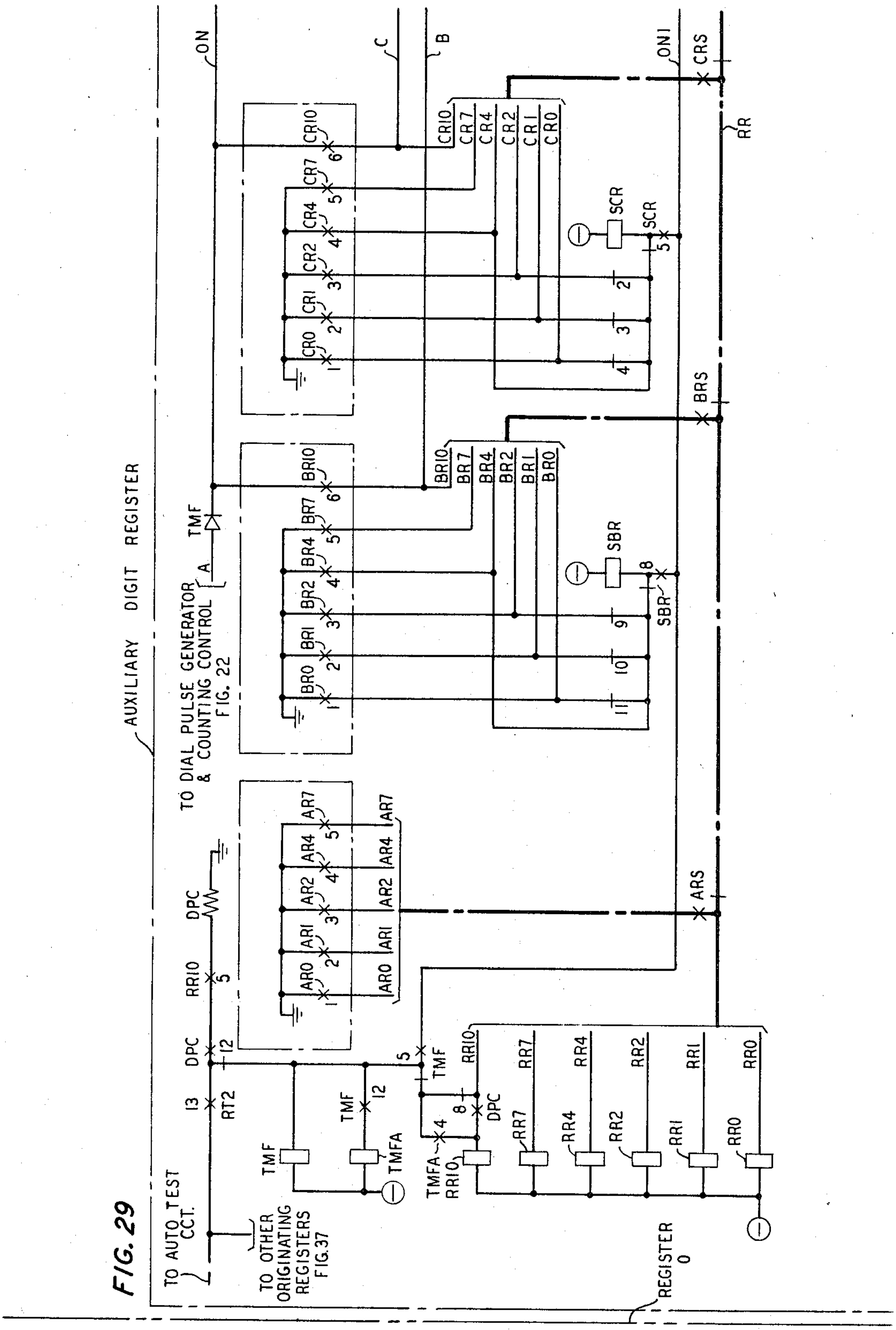

AUXILIARY DIGIT REGISTER
TO DIAL PULSE GENERATOR & COUNTING CONTROL FIG. 22
TO AUTO TEST CCT.
TO OTHER ORIGINATING REGISTERS FIG.37
REGISTER 0
ON
ON1
CRS
BRS
ARS
RR
SCR
SBR
TMF
TMFA
DPC
RT2

FIG. 29

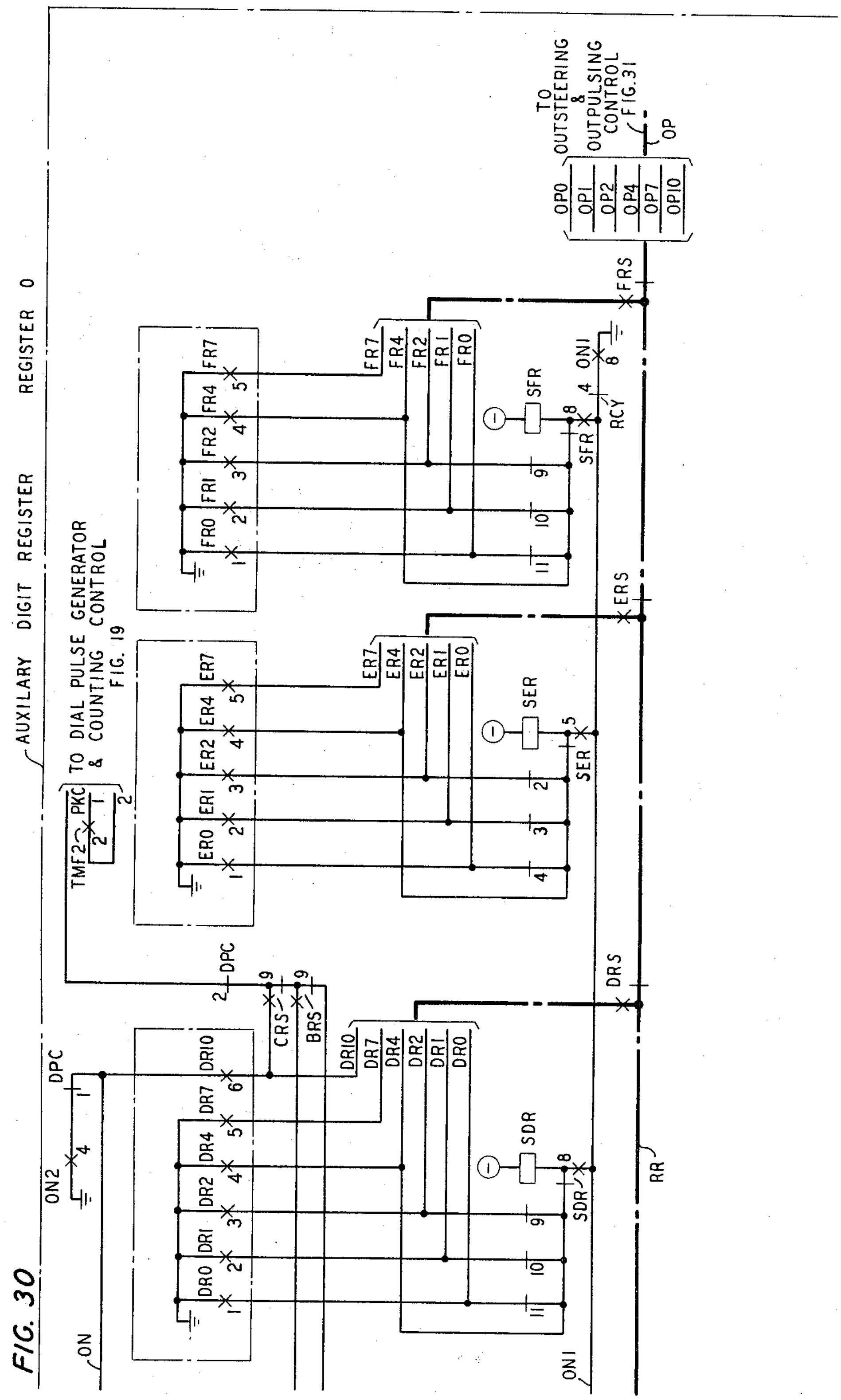
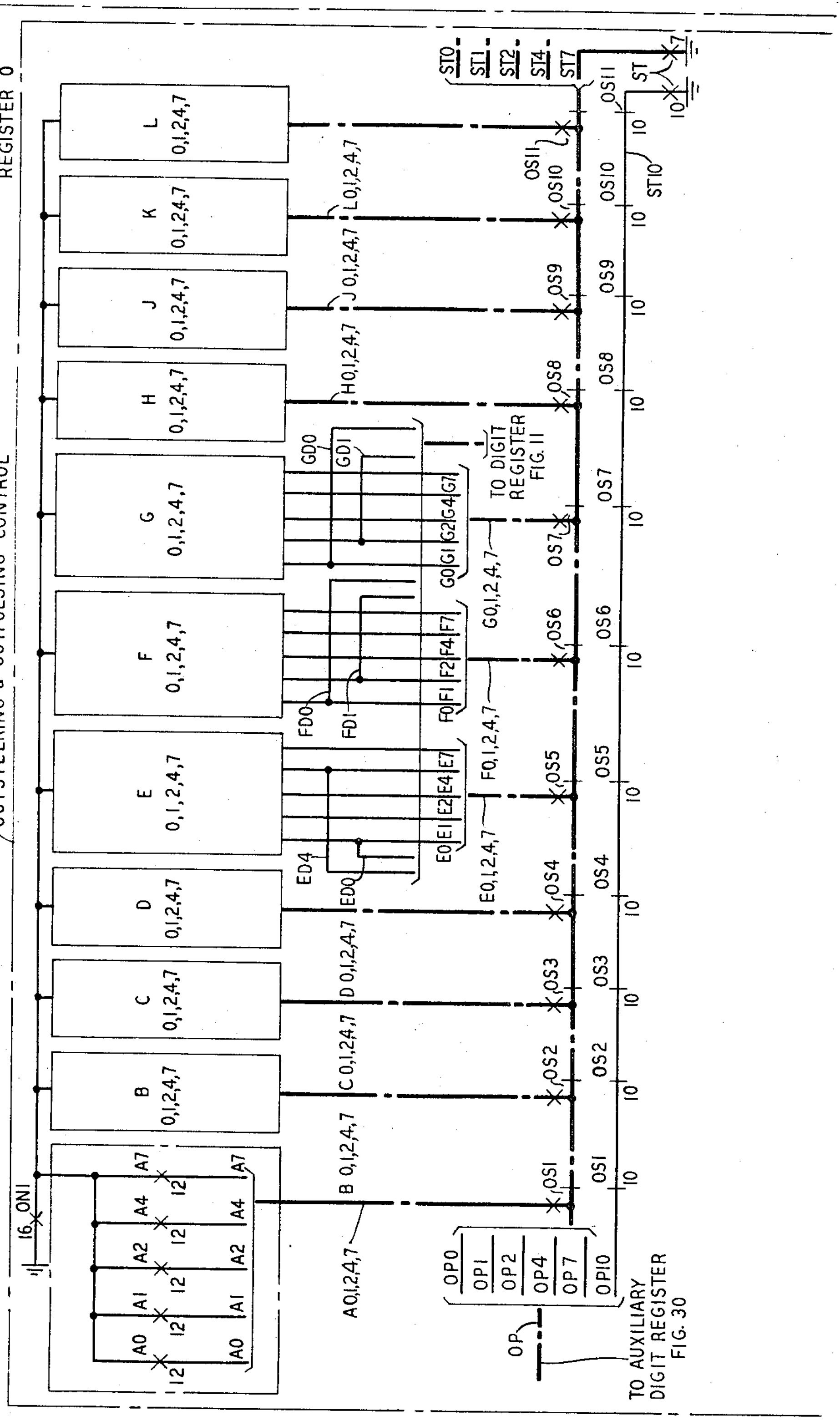

AUXILARY DIGIT REGISTER REGISTER 0
TO DIAL PULSE GENERATOR & COUNTING CONTROL FIG. 19
TO OUTSTEERING & OUTPULSING CONTROL FIG. 31
OP0 OP1 OP2 OP4 OP7 OP10
OP
FRS
ERS
DRS
SFR
SER
SDR
RCY
DPC
CRS
BRS
TMF2
PKC
ON
ON1
ON2
RR

FIG. 30



REGISTER O
OUTSTEERING & OUTPULSING CONTROL
L 0,1,2,4,7
K 0,1,2,4,7
J 0,1,2,4,7
H 0,1,2,4,7
G 0,1,2,4,7
F 0,1,2,4,7
E 0,1,2,4,7
D 0,1,2,4,7
C 0,1,2,4,7
B 0,1,2,4,7
TO DIGIT REGISTER FIG. 11
TO AUXILIARY DIGIT REGISTER FIG. 30


FIG. 31

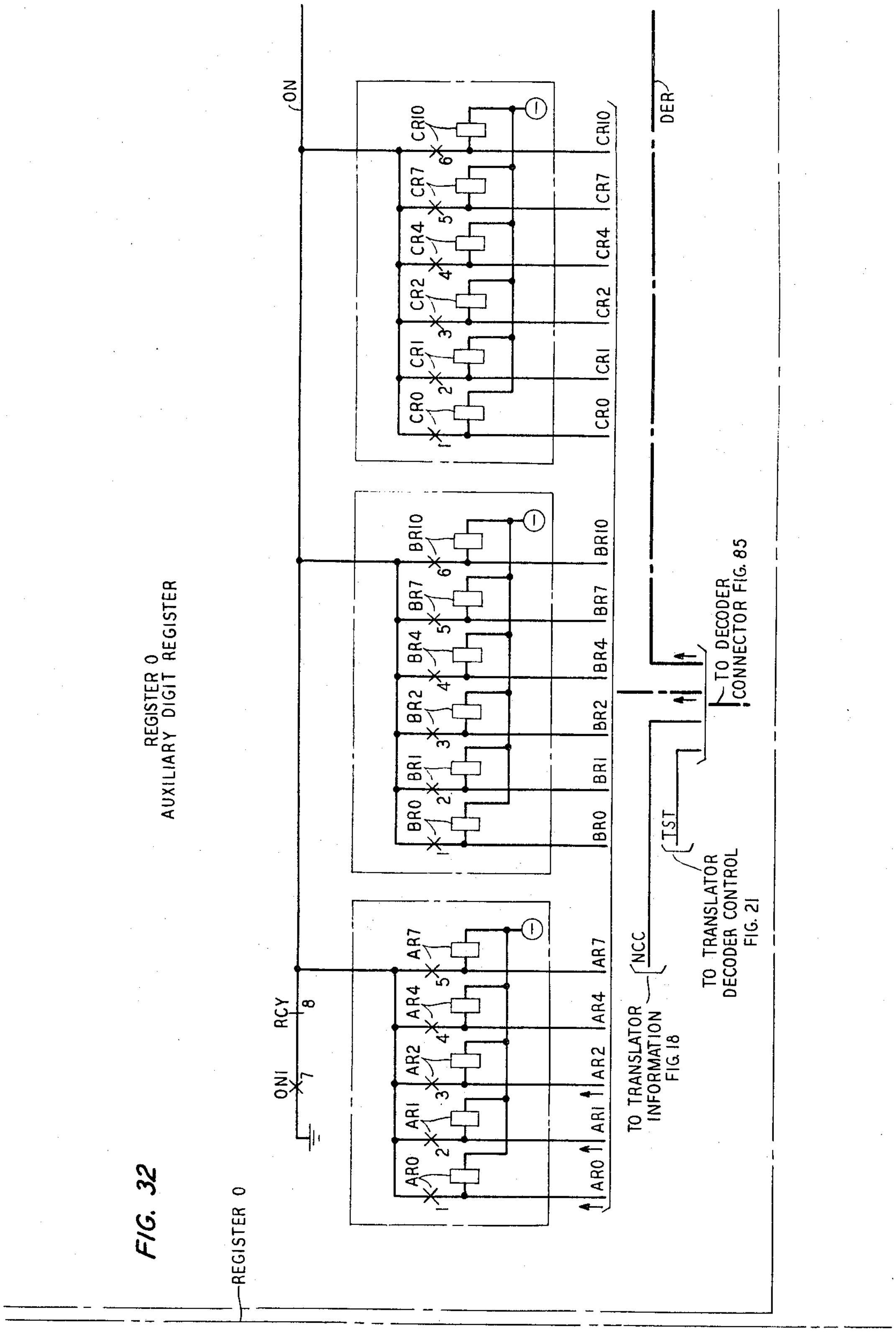

REGISTER 0
AUXILIARY DIGIT REGISTER
ON
CR10
CR7
CR4
CR2
CR1
CR0
DER
BR10
BR7
BR4
BR2
BR1
BR0
AR7
AR4
AR2
AR1
AR0
RCY
ONI
TO DECODER
CONNECTOR FIG. 85
TST
TO TRANSLATOR
DECODER CONTROL
FIG. 21
NCC
TO TRANSLATOR
INFORMATION
FIG. 18
REGISTER 0

FIG. 32

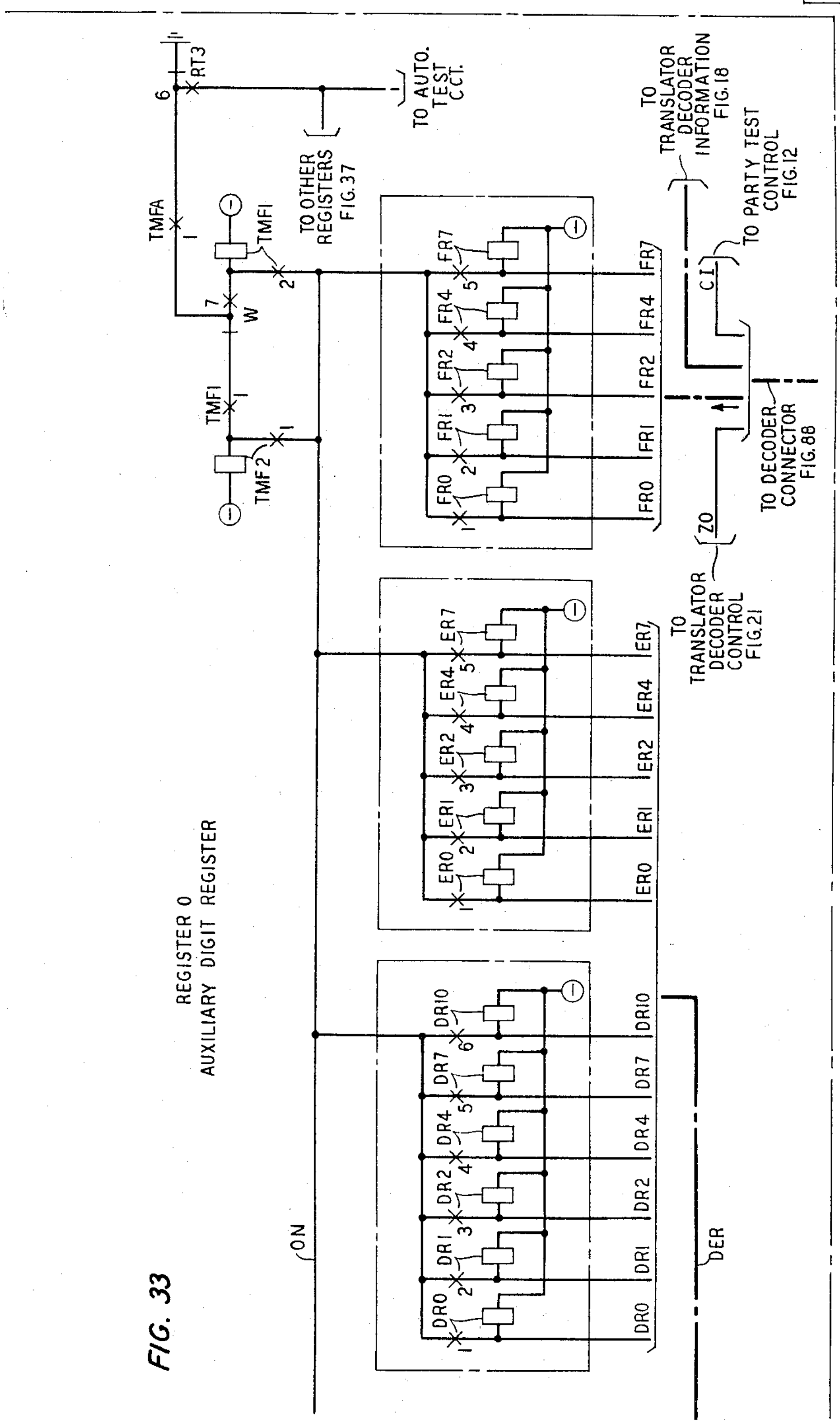

REGISTER 0
AUXILIARY DIGIT REGISTER
TO AUTO. TEST CCT.
TO OTHER REGISTERS FIG.37
TO TRANSLATOR DECODER INFORMATION FIG.18
TO PARTY TEST CONTROL FIG.12
TO DECODER CONNECTOR FIG.88
TO TRANSLATOR DECODER CONTROL FIG.21

FIG. 33

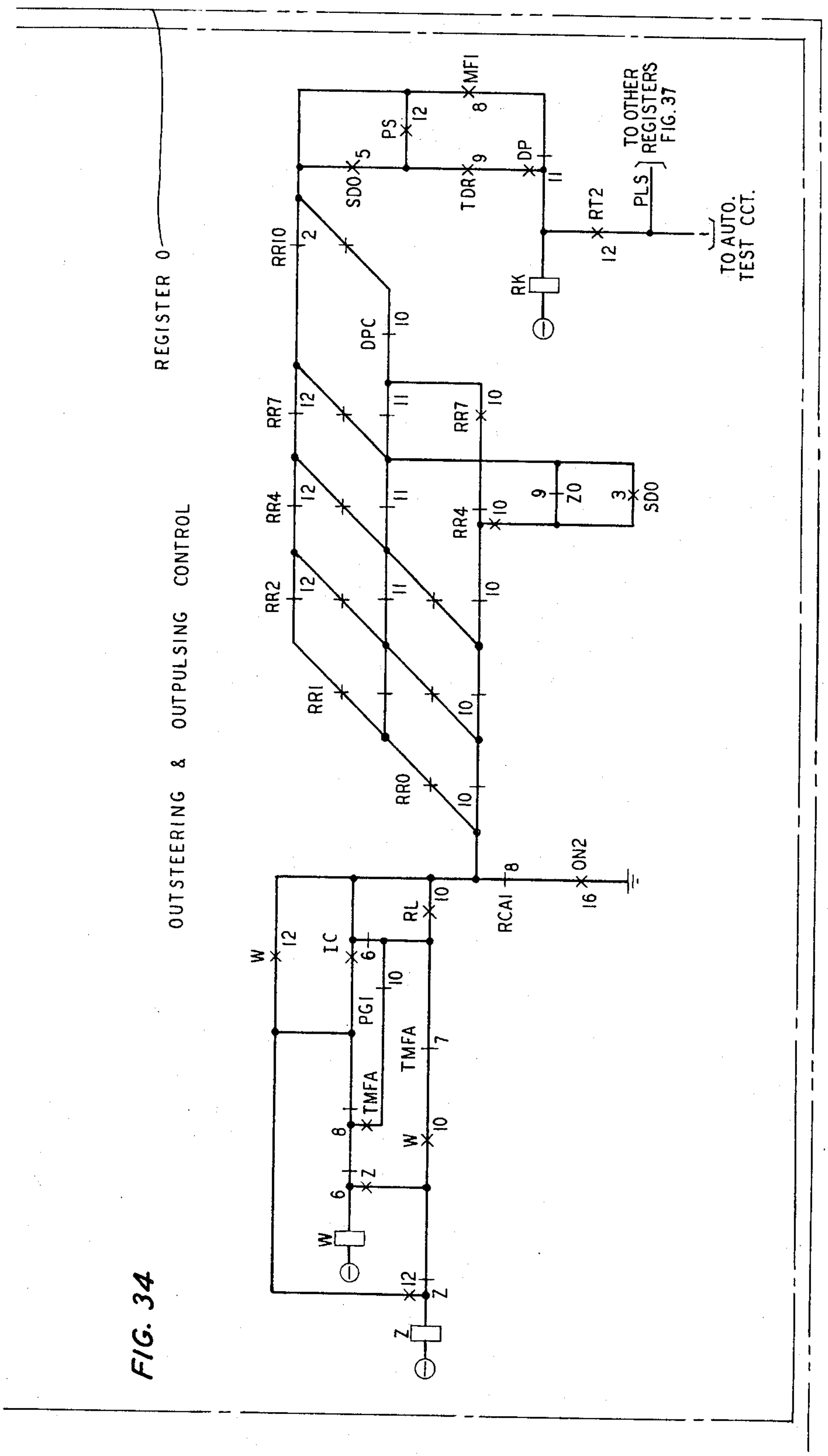

REGISTER 0
OUTSTEERING & OUTPULSING CONTROL
TO OTHER REGISTERS FIG. 37
PLS
TO AUTO. TEST CCT.
MFI
PS
SDO
TDR
DP
RT2
RK
RR10
DPC
RR7
RR4
RR2
RR1
RR0
ZO
ON2
RCAI
RL
IC
PGI
TMFA
W
Z

FIG. 34

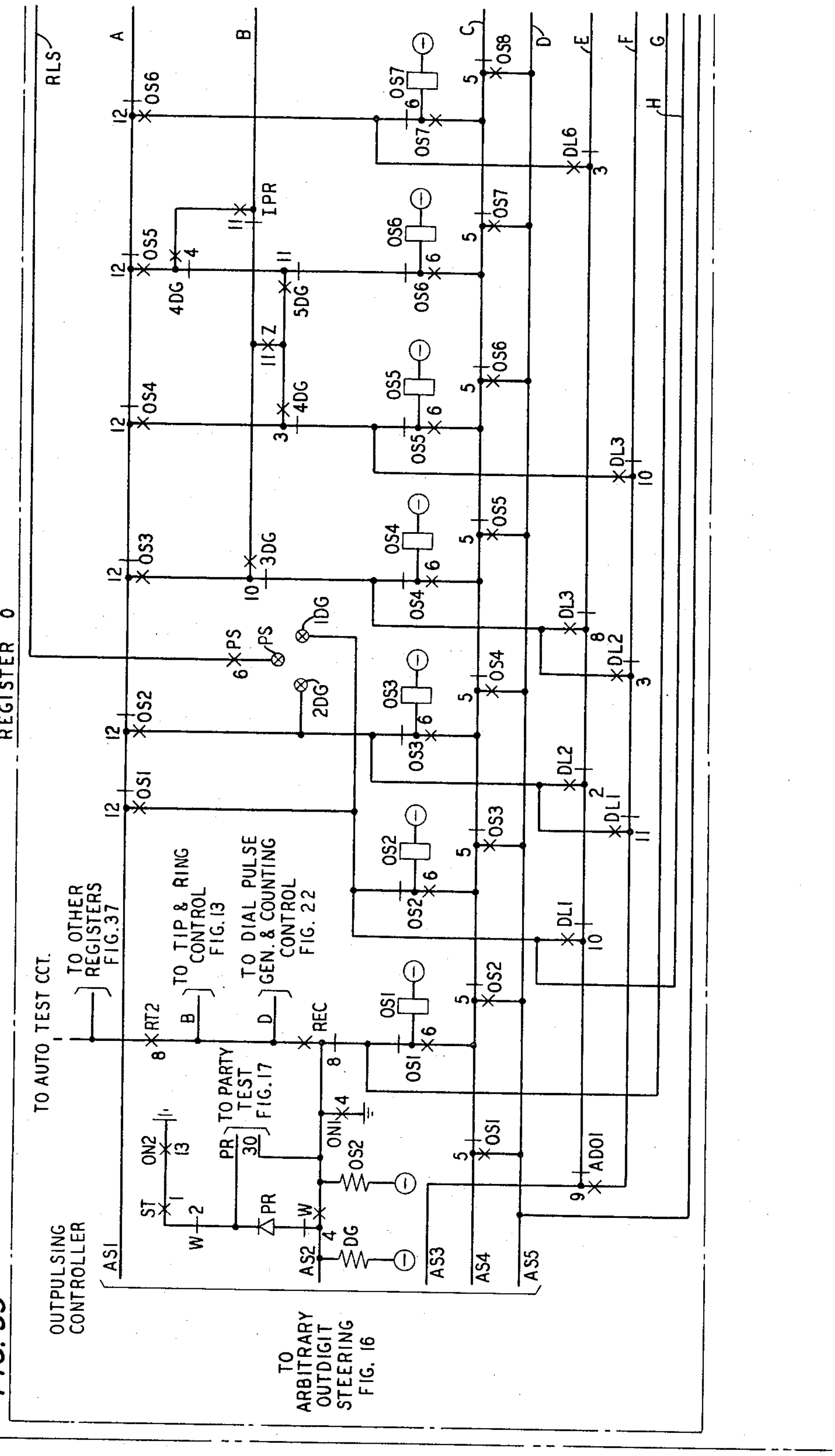

REGISTER 0
OUTPULSING CONTROLLER
TO ARBITRARY OUTDIGIT STEERING FIG. 16
TO AUTO TEST CCT.
TO OTHER REGISTERS FIG. 37
TO TIP & RING CONTROL FIG. 13
TO DIAL PULSE GEN. & COUNTING CONTROL FIG. 22
TO PARTY TEST FIG. 17
RLS
AS1
AS2
AS3
AS4
AS5

FIG. 35

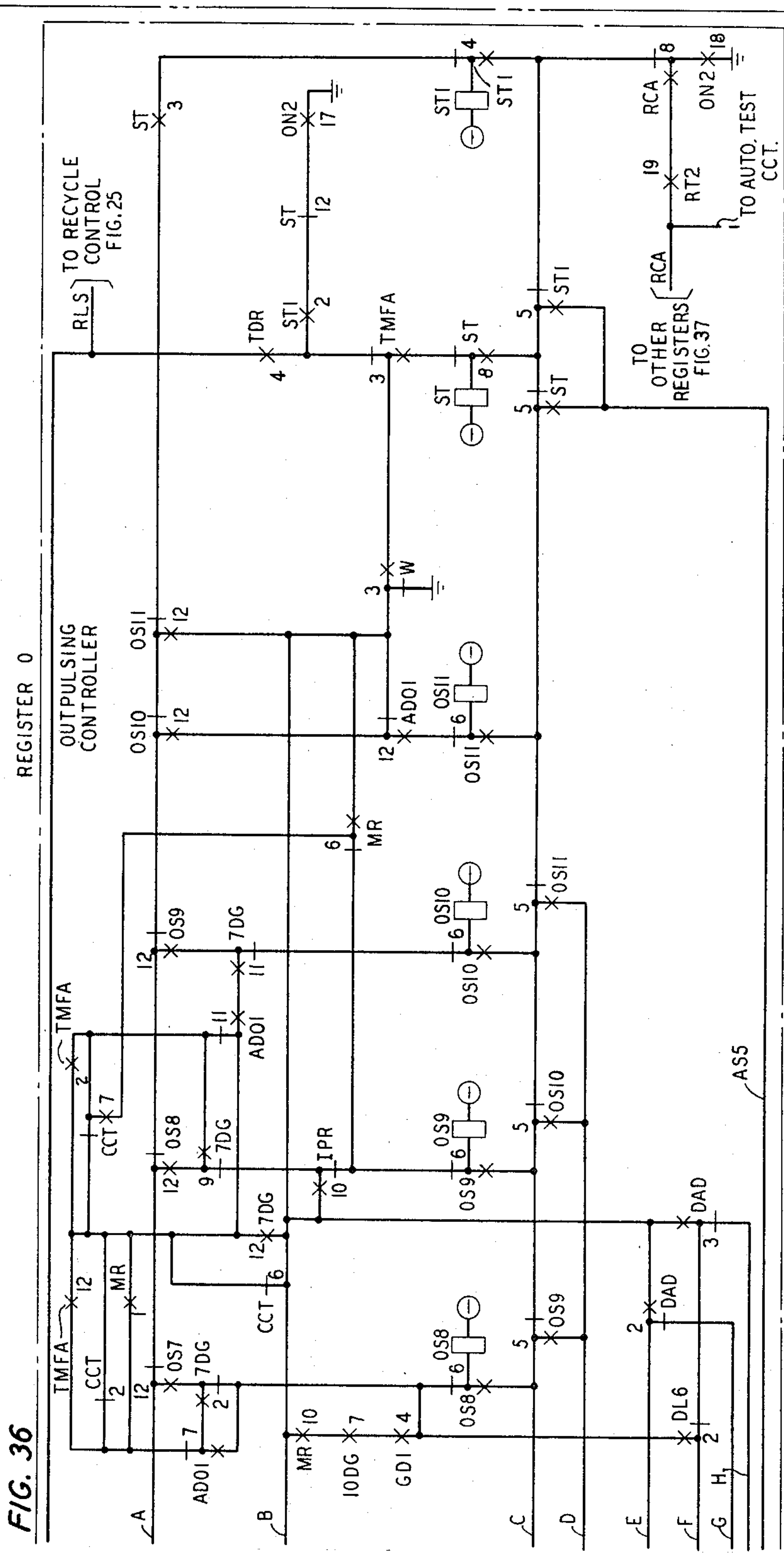
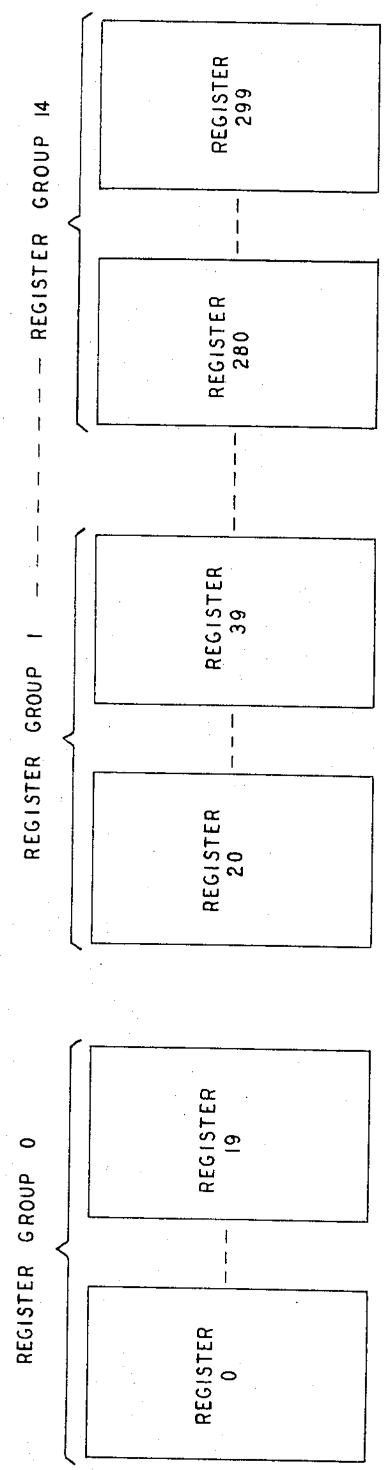

REGISTER 0
OUTPULSING CONTROLLER
TO RECYCLE CONTROL FIG. 25
TO OTHER REGISTERS FIG. 37
TO AUTO. TEST CCT.

FIG. 36

FIG. 37


REGISTER GROUP 0
REGISTER 0
REGISTER 19
REGISTER GROUP 1
REGISTER 20
REGISTER 39
REGISTER GROUP 14
REGISTER 280
REGISTER 299

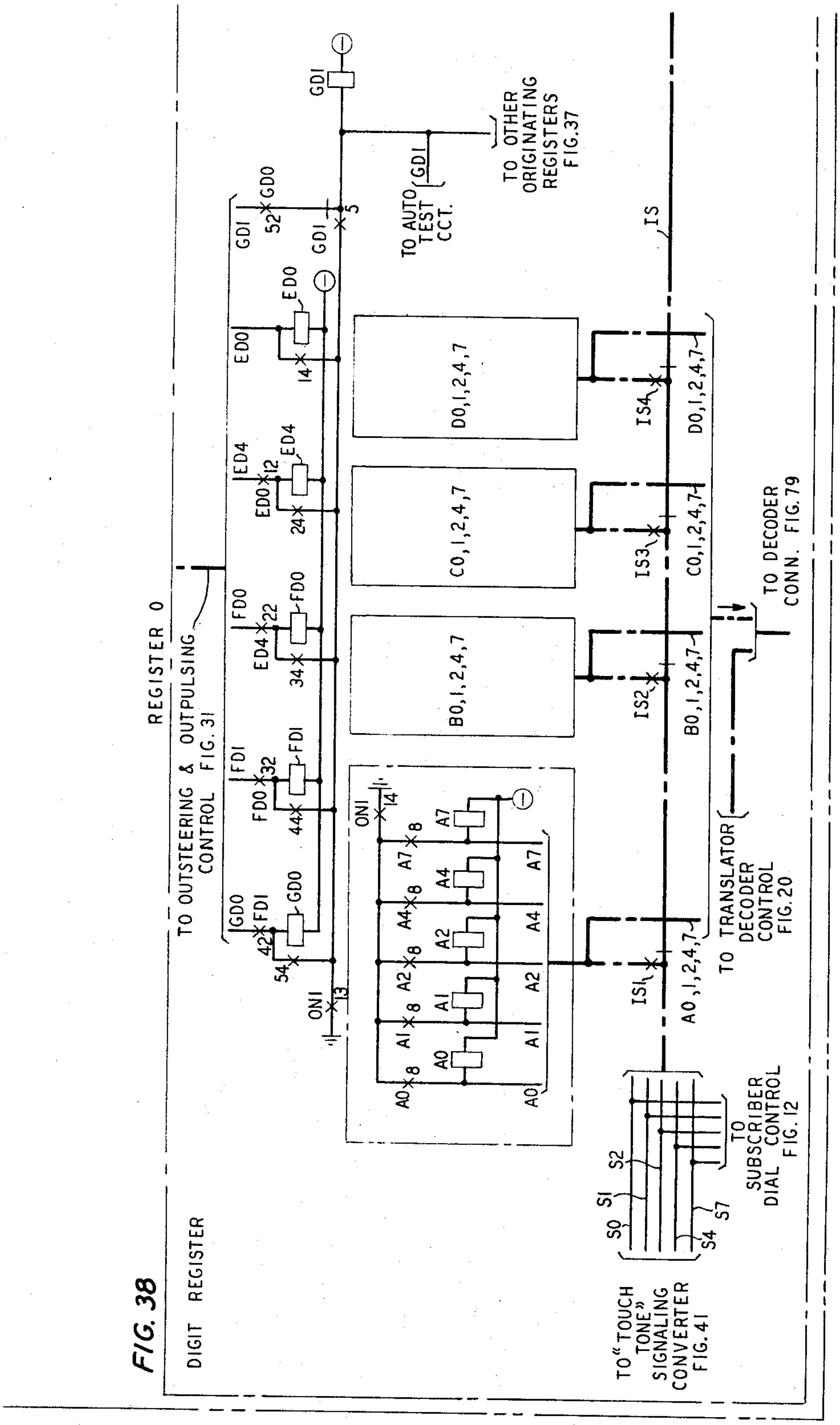

DIGIT REGISTER
REGISTER 0
TO OUTSTEERING & OUTPULSING CONTROL FIG. 31
TO AUTO TEST CCT.
TO OTHER ORIGINATING REGISTERS FIG.37
D0,1,2,4,7
C0,1,2,4,7
B0,1,2,4,7
A0,1,2,4,7
TO DECODER CONN. FIG.79
TO TRANSLATOR DECODER CONTROL FIG.20
TO SUBSCRIBER DIAL CONTROL FIG.12
TO "TOUCH TONE" SIGNALING CONVERTER FIG.41

FIG. 38

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING
MEANS FOR DERIVING SWITCHING CODES
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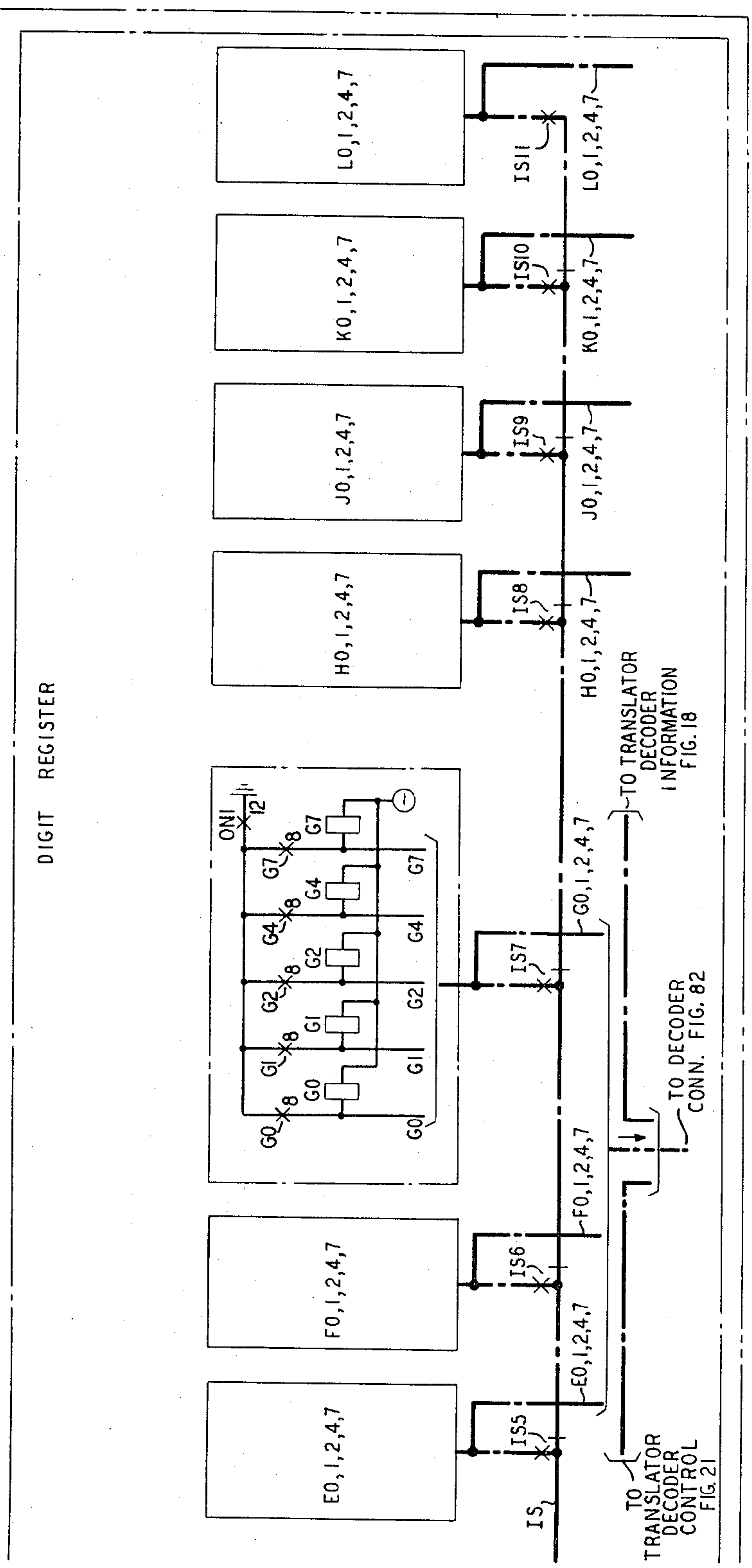


FIG. 39

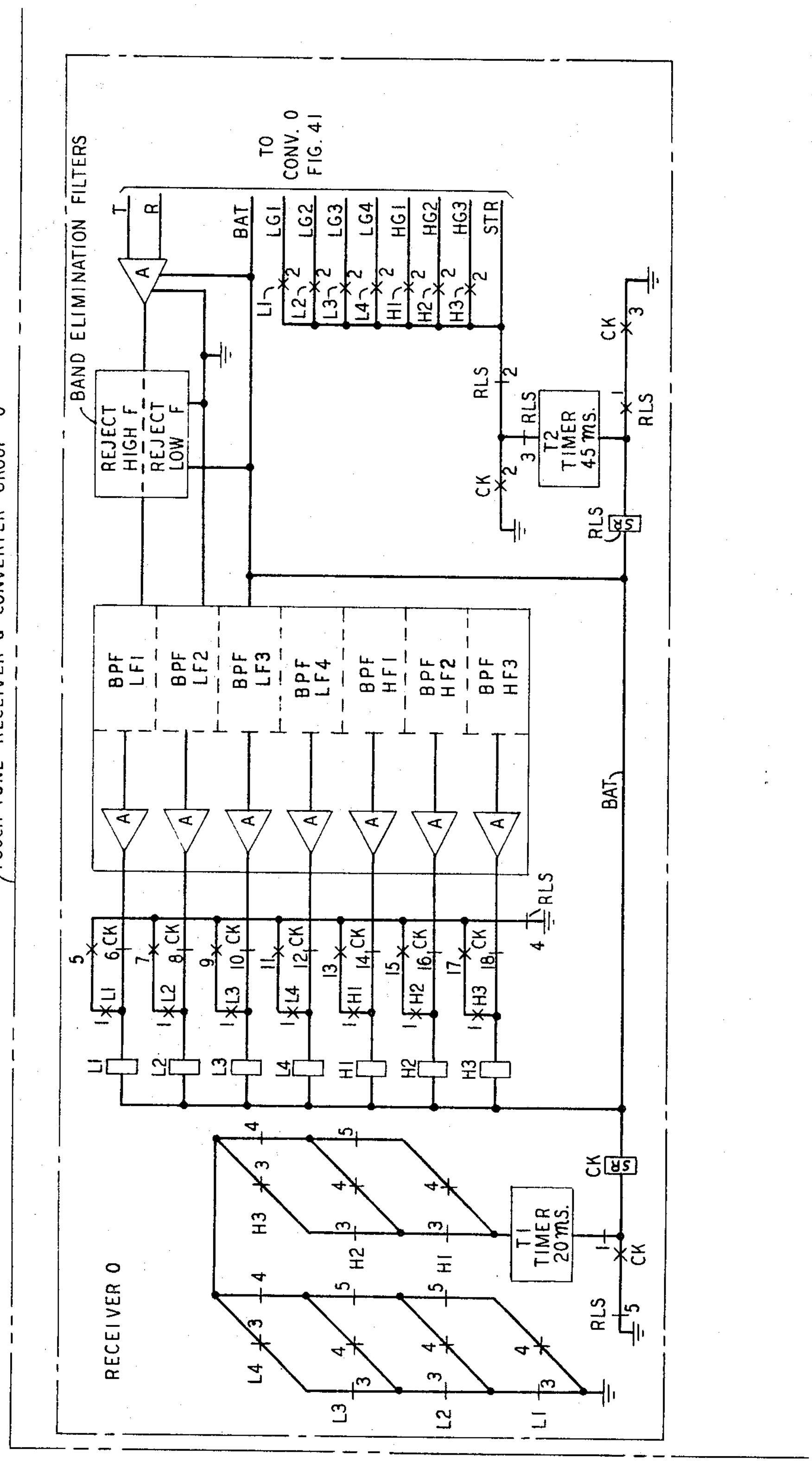
"TOUCH-TONE" RECEIVER & CONVERTER GROUP 0
BAND ELIMINATION FILTERS
TO CONV. 0 FIG. 41
REJECT HIGH F
REJECT LOW F
BPF LF1
BPF LF2
BPF LF3
BPF LF4
BPF HF1
BPF HF2
BPF HF3
T2 TIMER 45 ms.
T1 TIMER 20 ms.
RECEIVER 0

FIG. 40

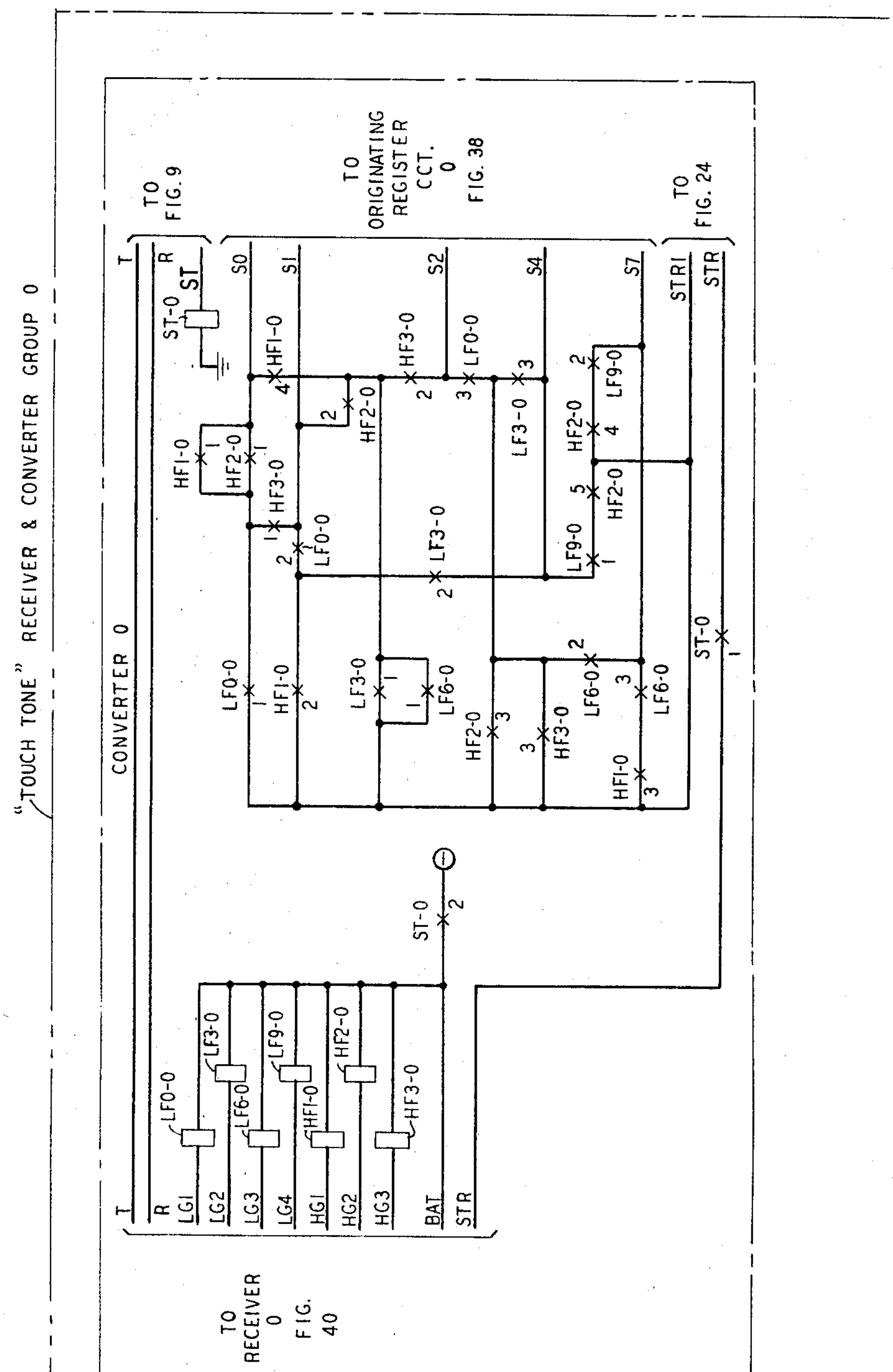
"TOUCH TONE" RECEIVER & CONVERTER GROUP 0
CONVERTER 0
TO FIG. 9
TO ORIGINATING REGISTER CCT. 0 FIG. 38
TO FIG. 24
TO RECEIVER 0 FIG. 40

FIG. 41

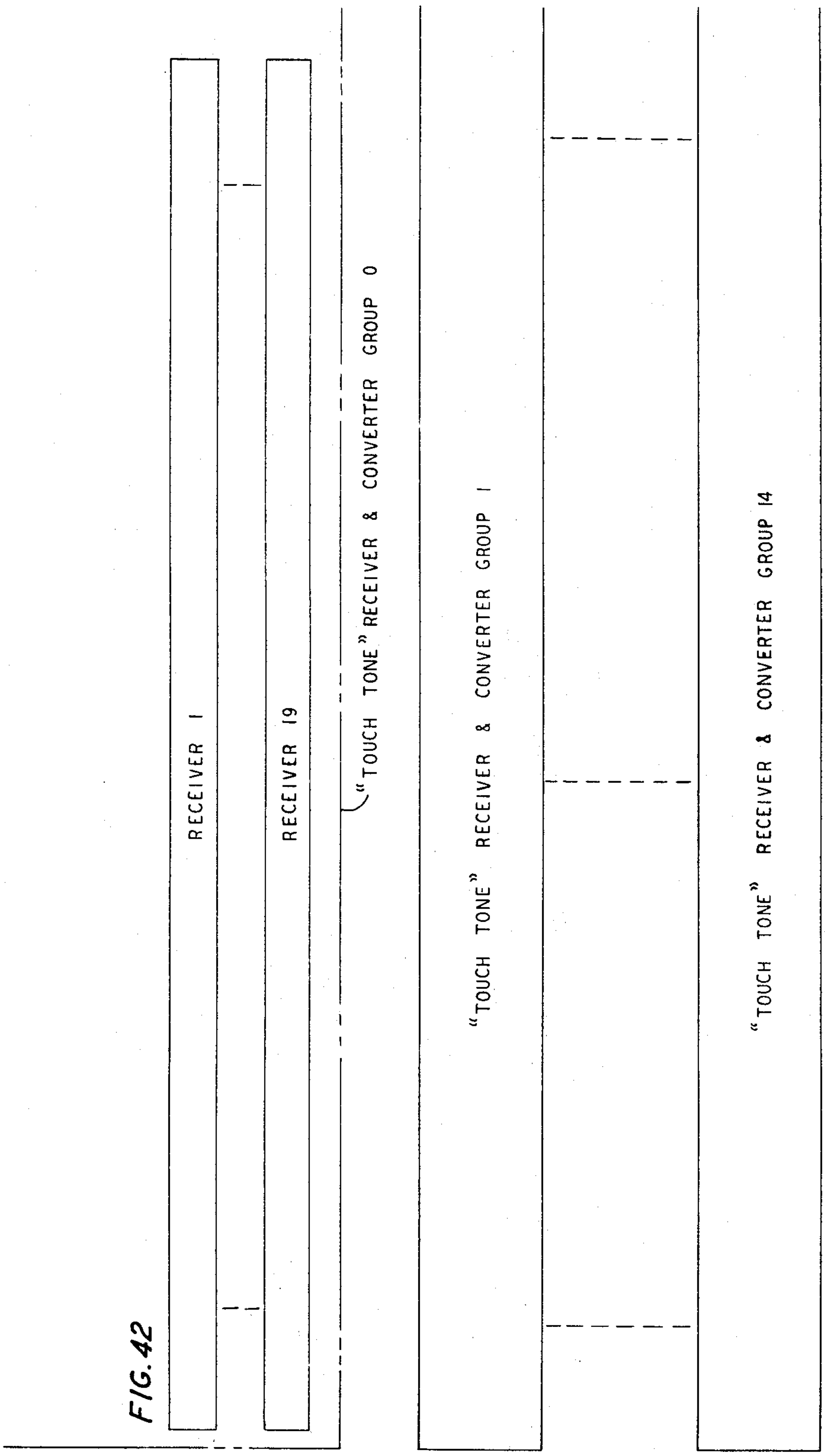
RECEIVER 1
RECEIVER 19
"TOUCH TONE" RECEIVER & CONVERTER GROUP 0
"TOUCH TONE" RECEIVER & CONVERTER GROUP 1
"TOUCH TONE" RECEIVER & CONVERTER GROUP 14

FIG. 42

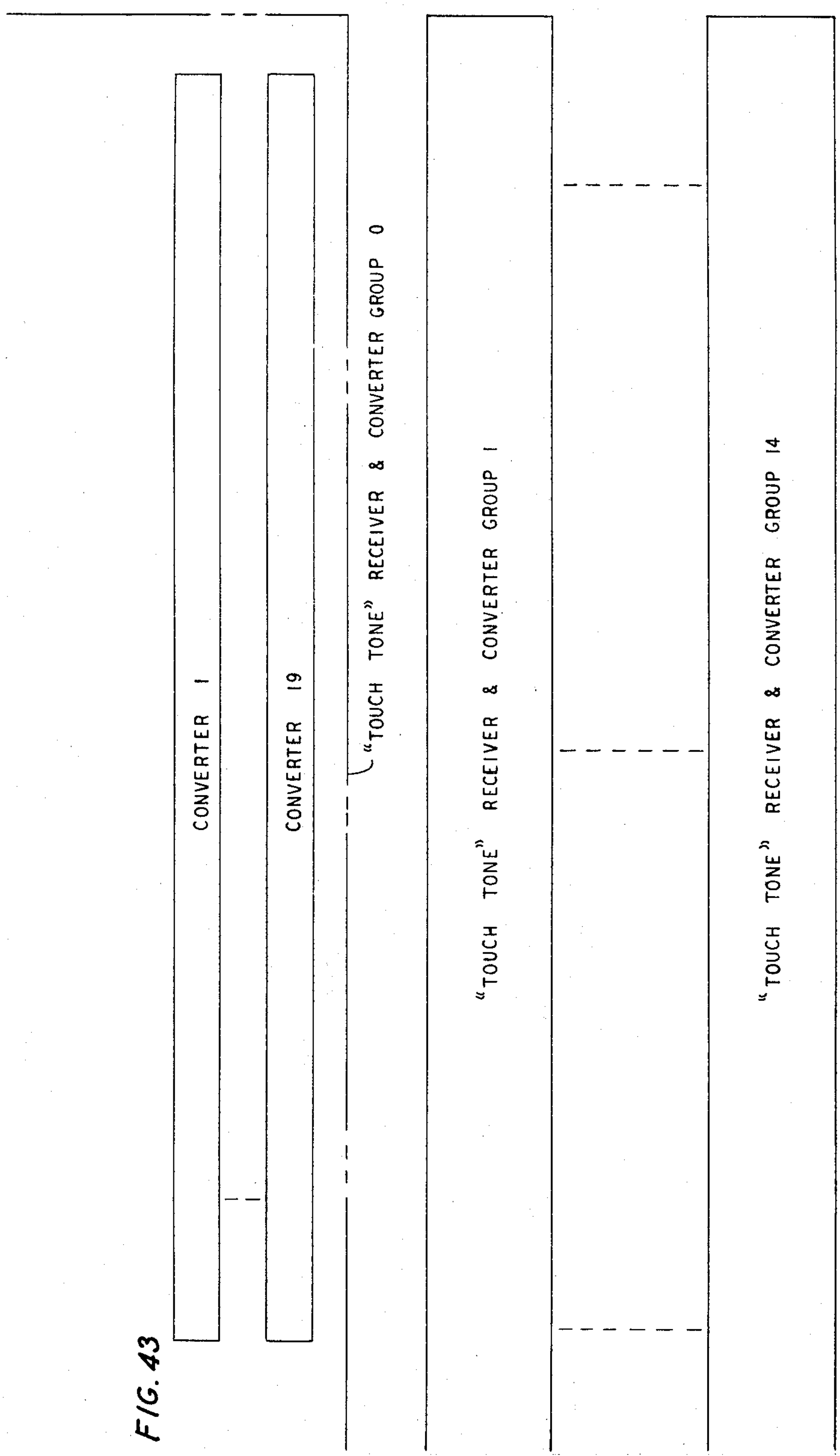
CONVERTER 1
CONVERTER 19
"TOUCH TONE" RECEIVER & CONVERTER GROUP 0
"TOUCH TONE" RECEIVER & CONVERTER GROUP 1
"TOUCH TONE" RECEIVER & CONVERTER GROUP 14

FIG. 43

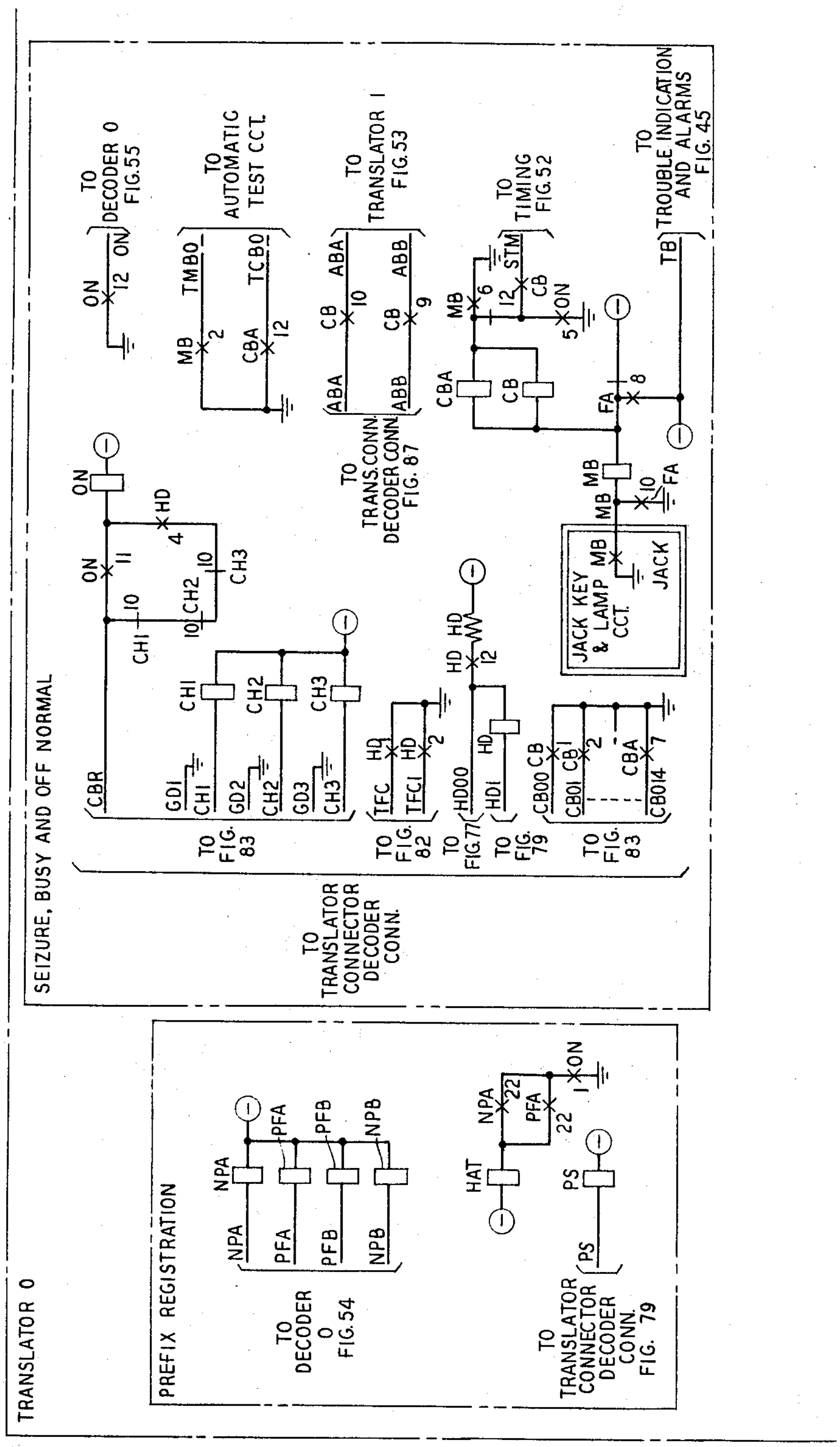
TRANSLATOR 0
SEIZURE, BUSY AND OFF NORMAL
TO DECODER 0 FIG.55
TO AUTOMATIC TEST CCT.
TO TRANSLATOR 1 FIG.53
TO TIMING FIG.52
TO TROUBLE INDICATION AND ALARMS FIG. 45
TO TRANS.CONN. DECODER CONN. FIG. 87
JACK KEY & LAMP CCT.
JACK
TO FIG. 83
TO FIG. 82
TO FIG.77
TO FIG. 79
TO FIG. 83
TO TRANSLATOR CONNECTOR DECODER CONN.
PREFIX REGISTRATION
TO DECODER 0 FIG.54
TO TRANSLATOR CONNECTOR DECODER CONN. FIG. 79

FIG. 44

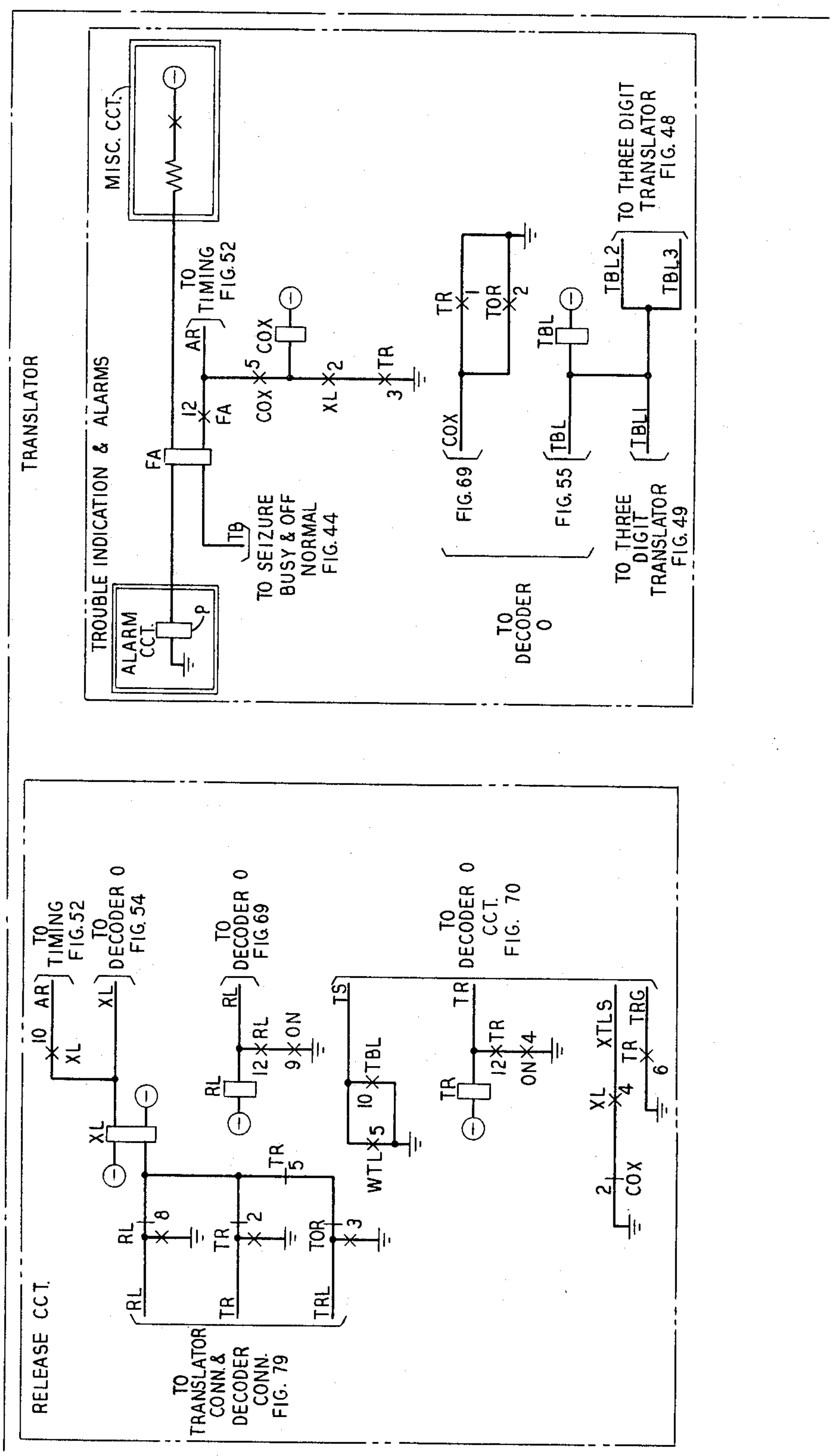
TRANSLATOR
TROUBLE INDICATION & ALARMS
MISC. CCT.
ALARM CCT.
TO TIMING FIG. 52
TO SEIZURE BUSY & OFF NORMAL FIG. 44
TO THREE DIGIT TRANSLATOR FIG. 48
TO THREE DIGIT TRANSLATOR FIG. 49
FIG. 69
FIG. 55
TO DECODER 0
RELEASE CCT.
TO TIMING FIG. 52
TO DECODER 0 FIG. 54
TO DECODER 0 FIG. 69
TO DECODER 0 CCT. FIG. 70
TO TRANSLATOR CONN. & DECODER CONN. FIG. 79

FIG. 45

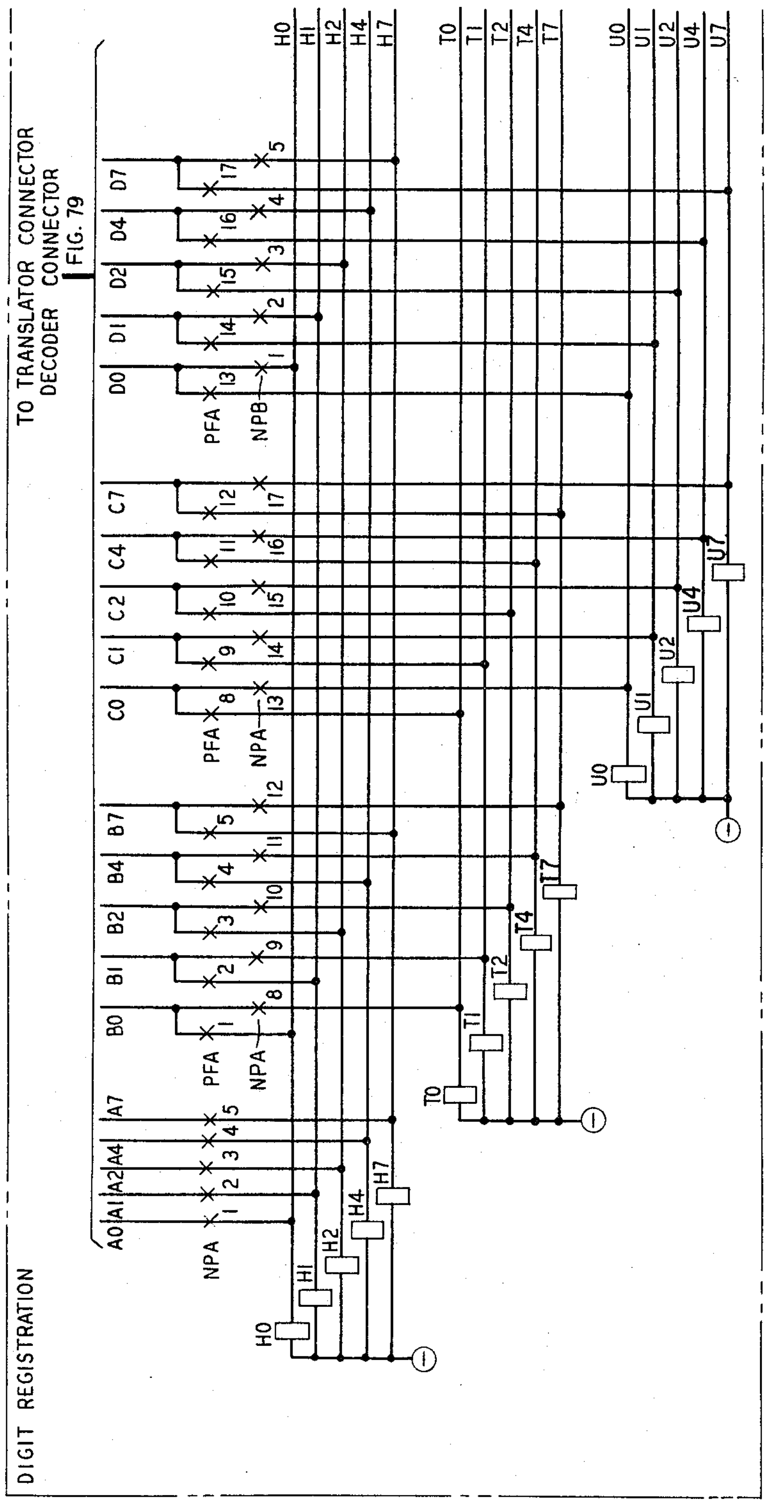
TO TRANSLATOR CONNECTOR
DECODER CONNECTOR
FIG. 79
DIGIT REGISTRATION
H0 H1 H2 H4 H7
T0 T1 T2 T4 T7
U0 U1 U2 U4 U7
A0 A1 A2 A4 A7
B0 B1 B2 B4 B7
C0 C1 C2 C4 C7
D0 D1 D2 D4 D7
PFA
NPA
NPB

FIG. 46

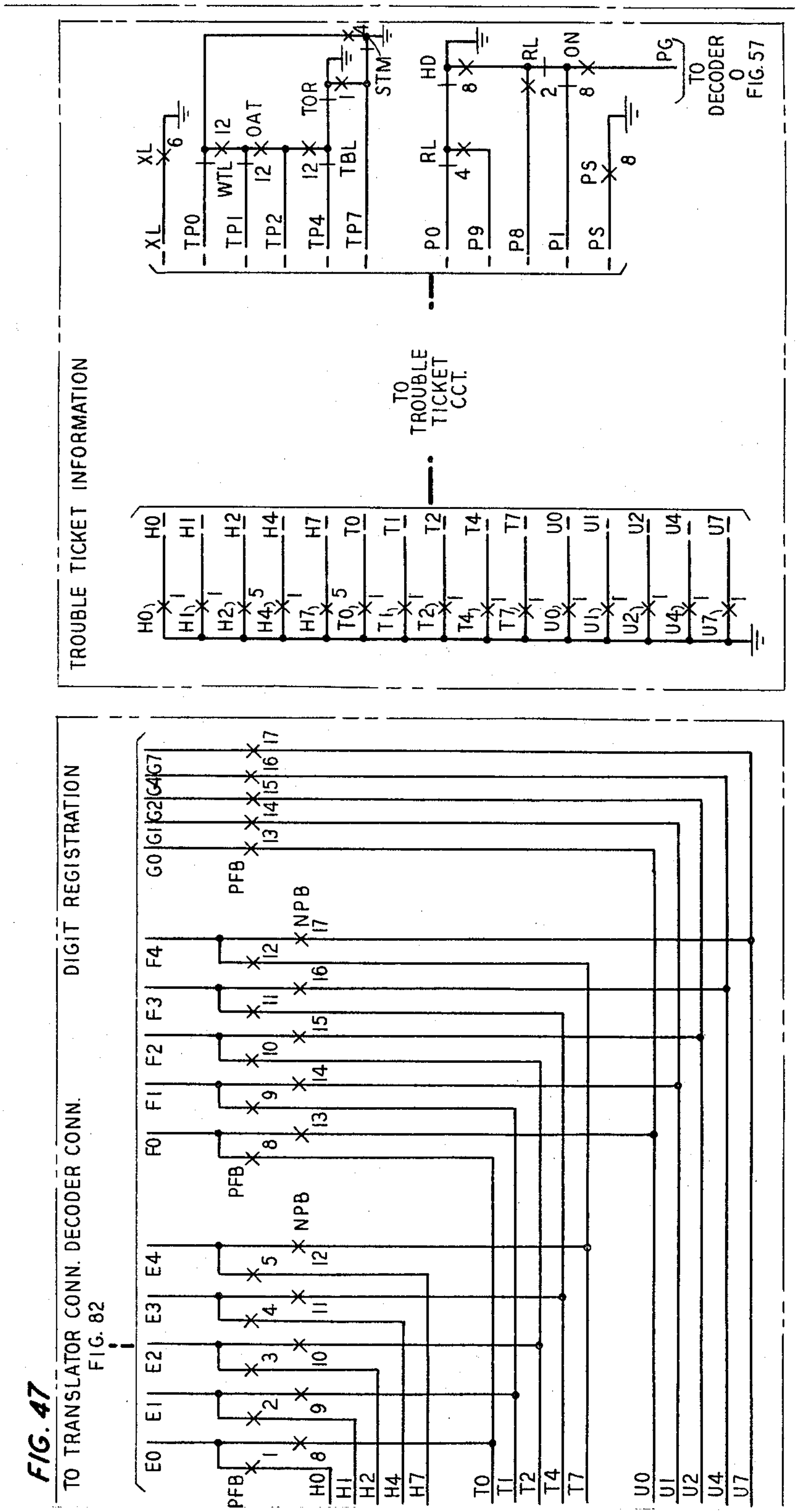
TROUBLE TICKET INFORMATION
TO TROUBLE TICKET CCT.
TO DECODER O FIG. 57
DIGIT REGISTRATION
TO TRANSLATOR CONN. DECODER CONN. FIG. 82

FIG. 47

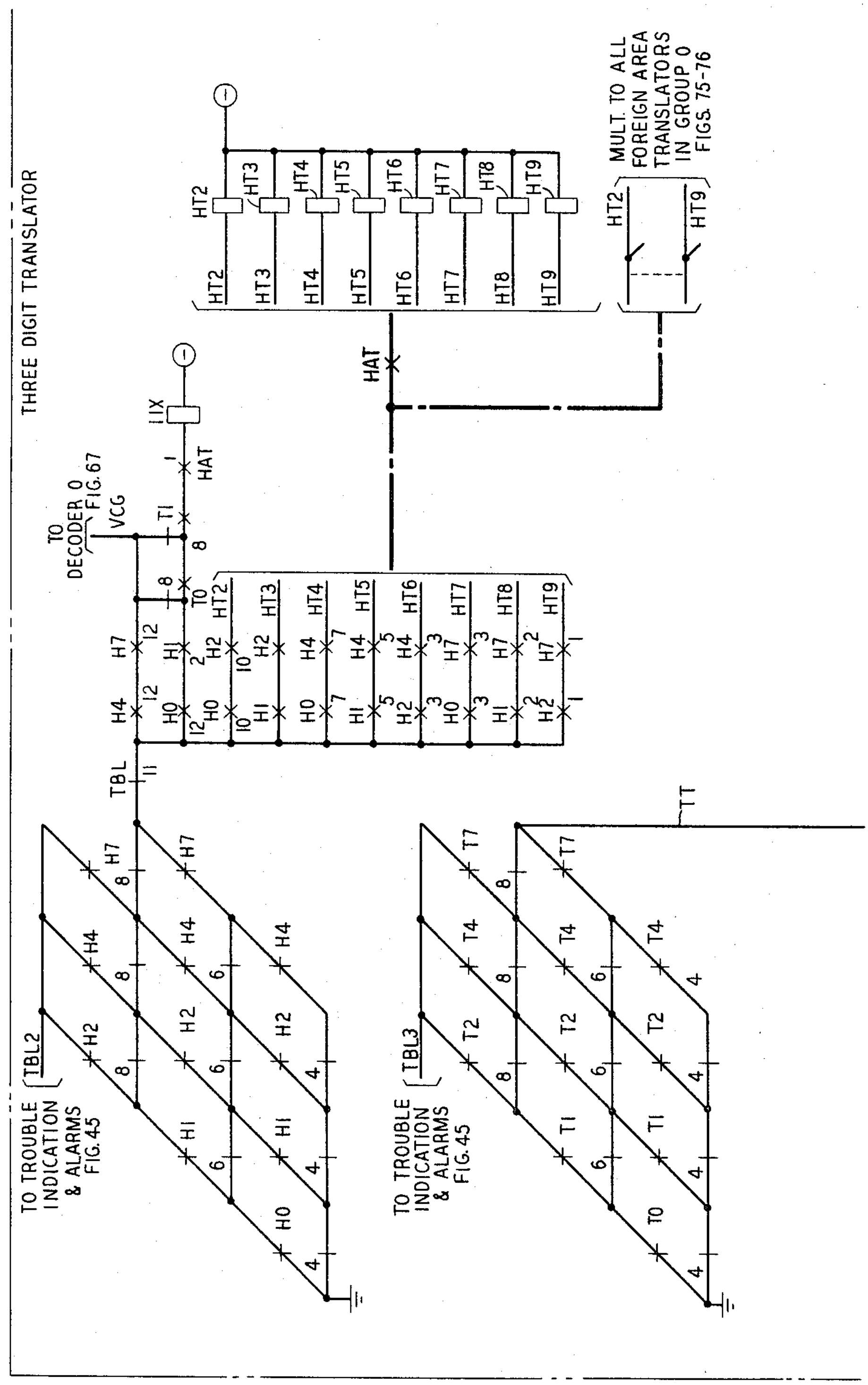
THREE DIGIT TRANSLATOR
MULT. TO ALL FOREIGN AREA TRANSLATORS IN GROUP 0 FIGS. 75-76
TO DECODER 0 FIG. 67
VCG
HAT
TBL
TO HT2
TO TROUBLE INDICATION & ALARMS FIG. 45
TBL2
TO TROUBLE INDICATION & ALARMS FIG. 45
TBL3
TT

FIG. 48

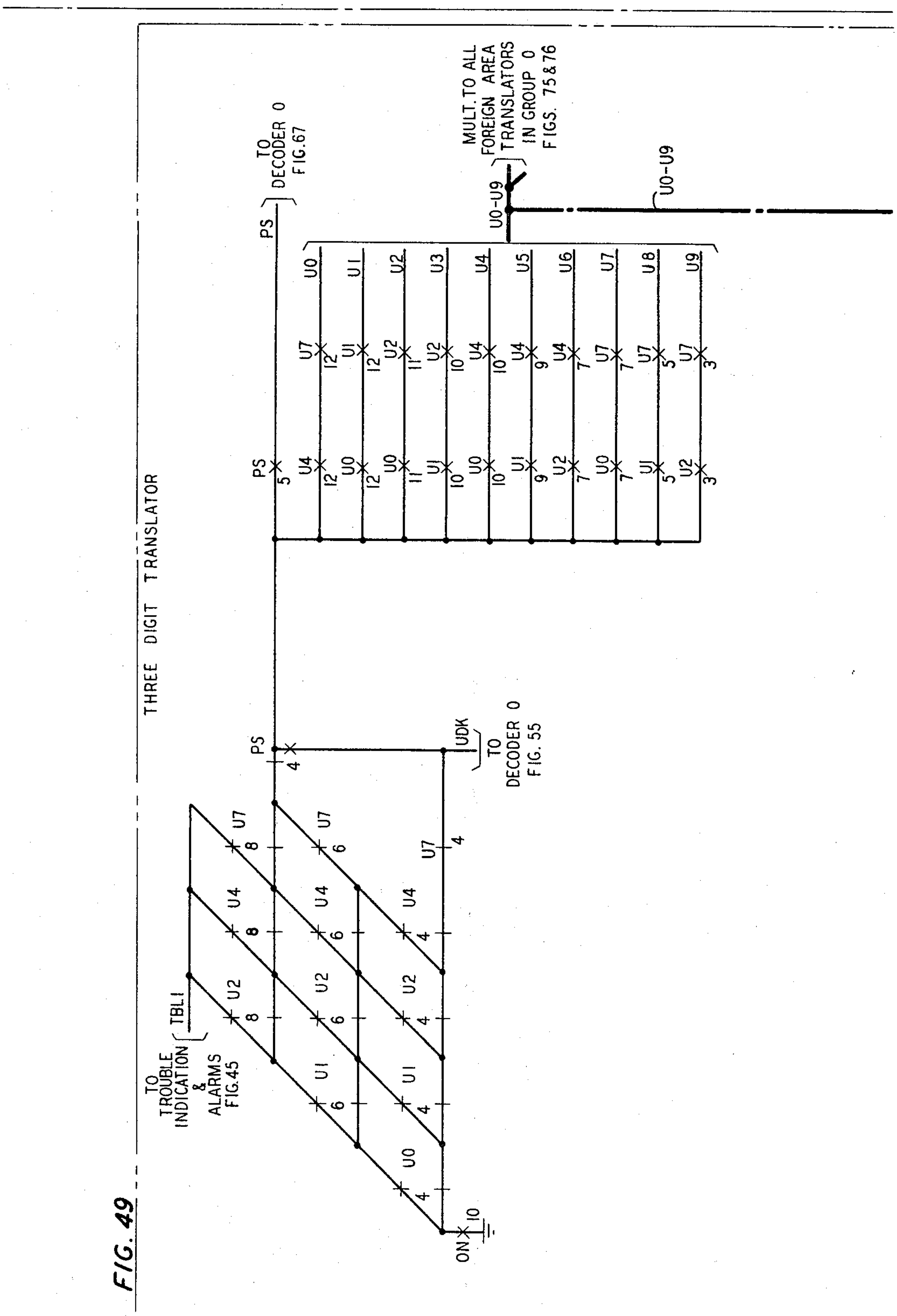
THREE DIGIT TRANSLATOR
TO DECODER 0 FIG. 67
MULT. TO ALL FOREIGN AREA TRANSLATORS IN GROUP 0 FIGS. 75 & 76
U0-U9
PS
UDK
TO DECODER 0 FIG. 55
TBL1
TO TROUBLE INDICATION & ALARMS FIG. 45
ON

FIG. 49

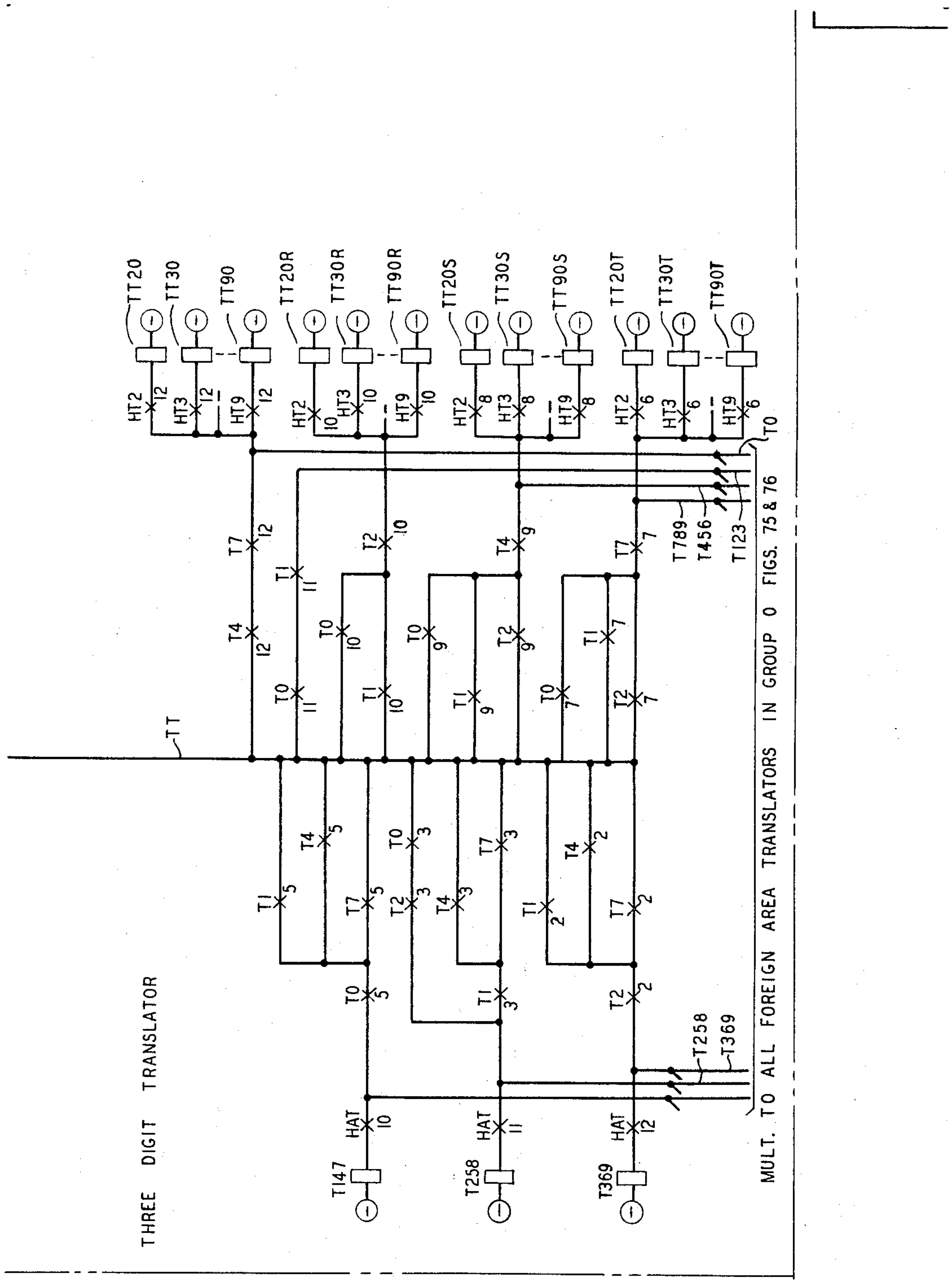
THREE DIGIT TRANSLATOR
MULT. TO ALL FOREIGN AREA TRANSLATORS IN GROUP 0 FIGS. 75 & 76
TT
T147
T258
T369
T123
T456
T789
TO

FIG. 50

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

Filed Sept. 24, 1965 113 Sheets-Sheet 68

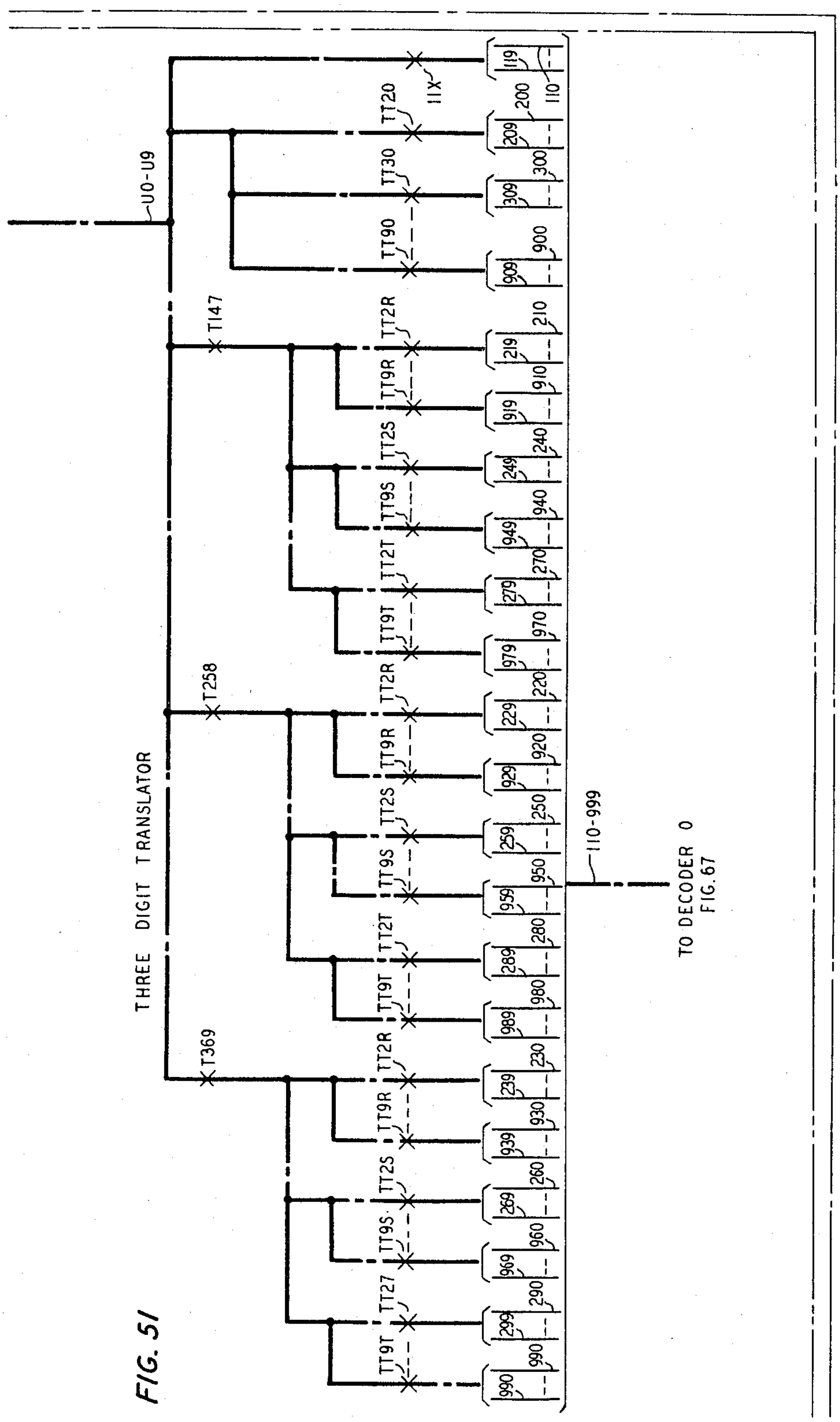



FIG. 51

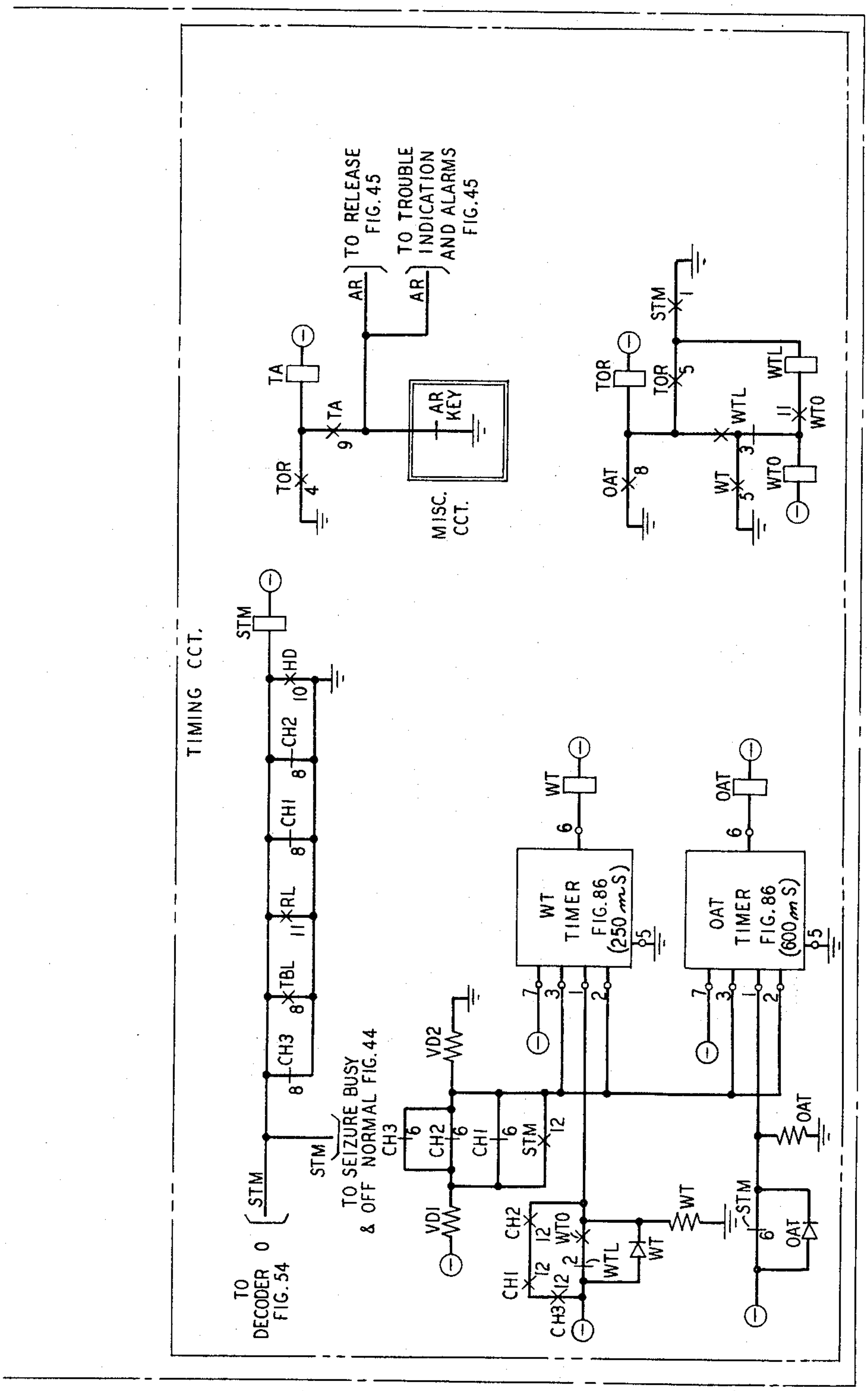

TIMING CCT.
TO RELEASE FIG. 45
TO TROUBLE INDICATION AND ALARMS FIG. 45
AR KEY
MISC. CCT.
TO DECODER 0 FIG. 54
TO SEIZURE BUSY & OFF NORMAL FIG. 44
WT TIMER FIG. 86 (250 mS)
OAT TIMER FIG. 86 (600 mS)

FIG. 52

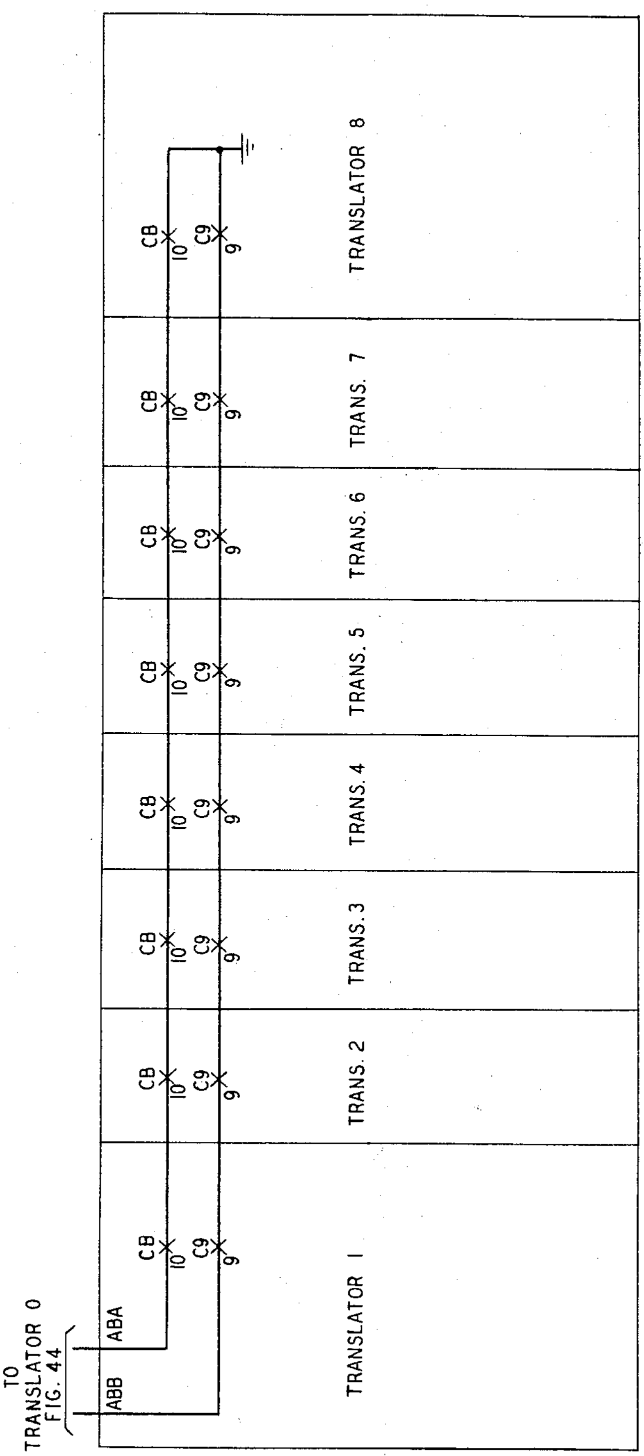

TRANSLATOR 8
TRANS. 7
TRANS. 6
TRANS. 5
TRANS. 4
TRANS. 3
TRANS. 2
TRANSLATOR 1
CB
C9
10
9
ABA
ABB
TO TRANSLATOR 0 FIG. 44

FIG. 53

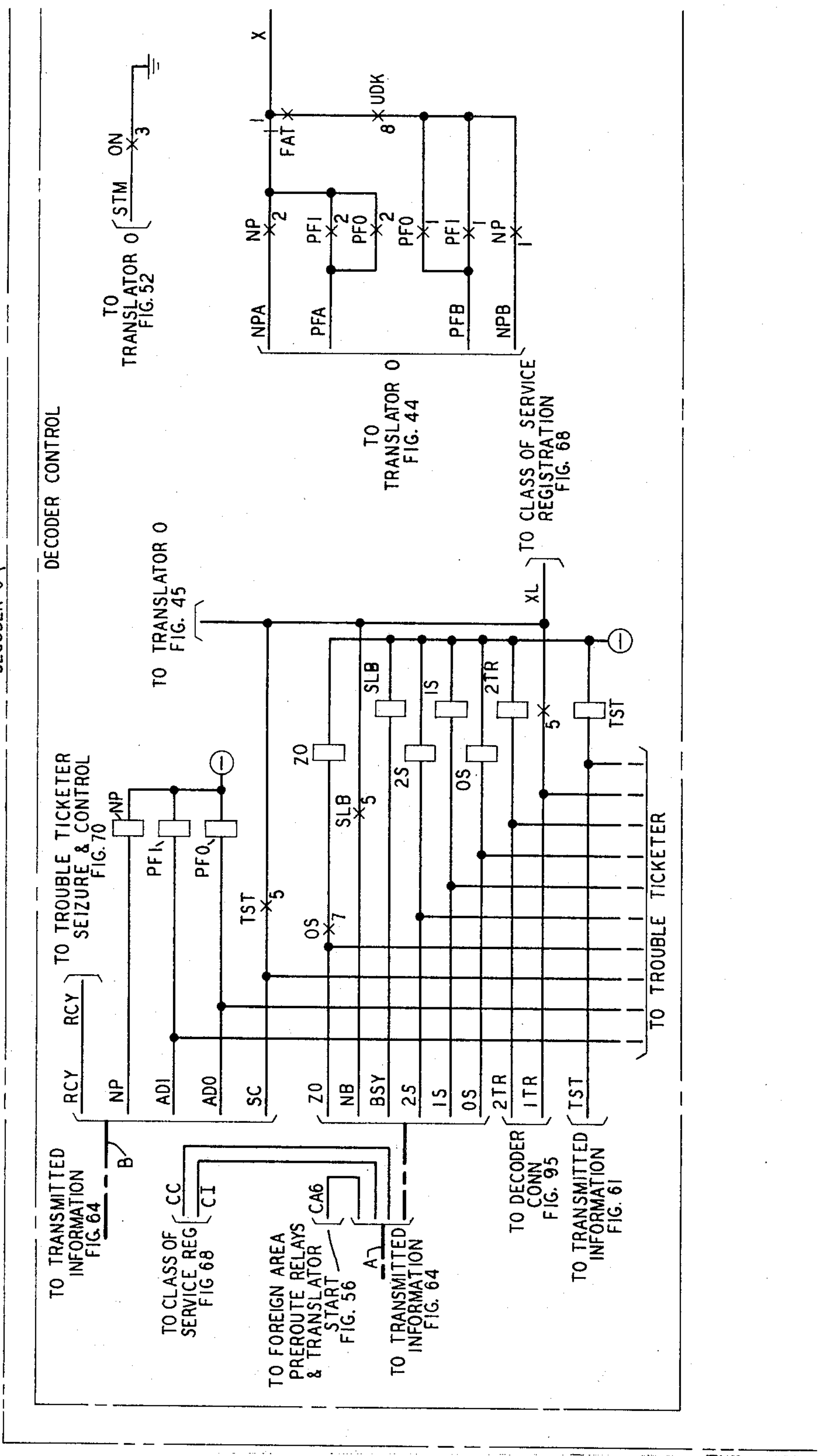

DECODER 0
DECODER CONTROL
TO TRANSLATOR 0 FIG. 52
STM
ON
TO TRANSLATOR 0 FIG. 44
TO CLASS OF SERVICE REGISTRATION FIG. 68
TO TRANSLATOR 0 FIG. 45
TO TROUBLE TICKETER SEIZURE & CONTROL FIG. 70
TO TROUBLE TICKETER
TO TRANSMITTED INFORMATION FIG. 64
TO CLASS OF SERVICE REG FIG 68
TO FOREIGN AREA PREROUTE RELAYS & TRANSLATOR START FIG. 56
TO TRANSMITTED INFORMATION FIG. 64
TO DECODER CONN FIG. 95
TO TRANSMITTED INFORMATION FIG. 61
NPA
PFA
PFB
NPB
XL
X
FAT
UDK
RCY
NP
ADI
ADO
SC
ZO
NB
BSY
2S
IS
OS
2TR
ITR
TST
SLB
PFI
PFO
CC
CI
CA6

FIG. 54

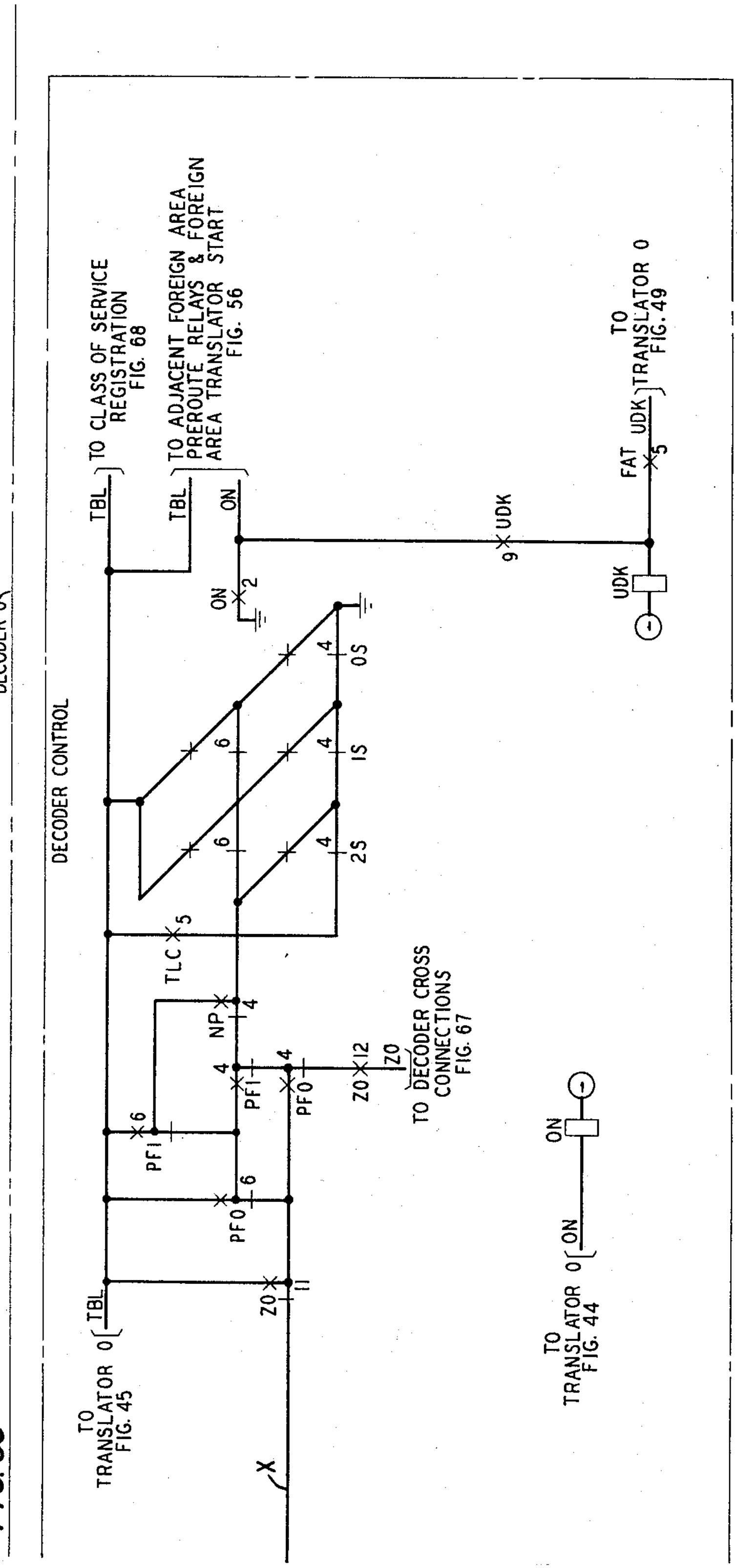

DECODER 0
DECODER CONTROL
TO CLASS OF SERVICE REGISTRATION FIG. 68
TO ADJACENT FOREIGN AREA PREROUTE RELAYS & FOREIGN AREA TRANSLATOR START FIG. 56
TO TRANSLATOR 0 FIG. 49
TO DECODER CROSS CONNECTIONS FIG. 67
TO TRANSLATOR 0 FIG. 45
TO TRANSLATOR 0 FIG. 44
TBL
ON
UDK
FAT
TLC
NP
PF1
PF0
Z0
0S
1S
2S
X

FIG. 55

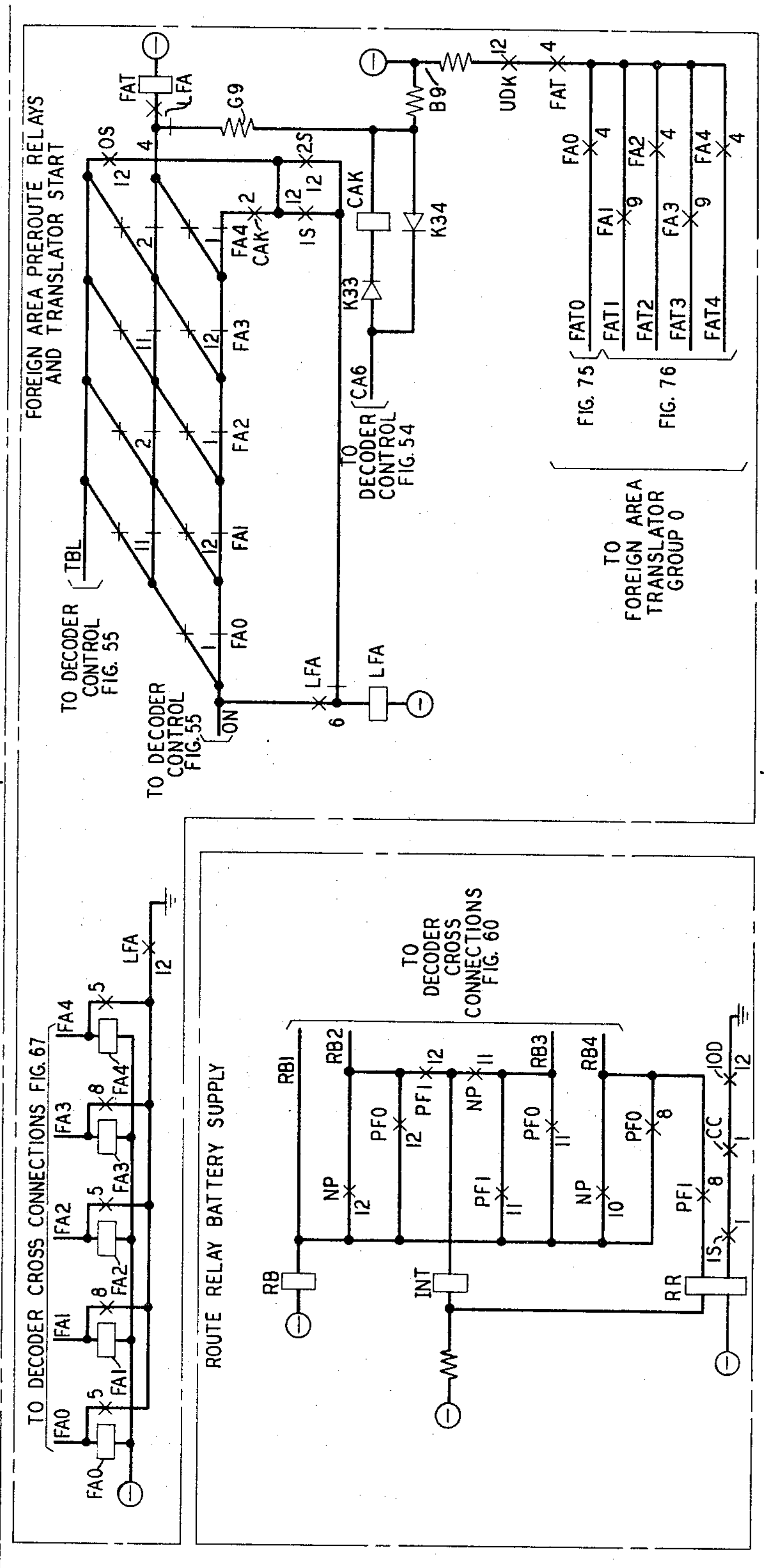

FOREIGN AREA PREROUTE RELAYS AND TRANSLATOR START
TO DECODER CONTROL FIG. 55
TO DECODER CONTROL FIG. 55
TO DECODER CONTROL FIG. 54
FIG. 75
FIG. 76
TO FOREIGN AREA TRANSLATOR GROUP 0
DECODER 0
TO DECODER CROSS CONNECTIONS FIG. 67
ROUTE RELAY BATTERY SUPPLY
TO DECODER CROSS CONNECTIONS FIG. 60

FIG. 56

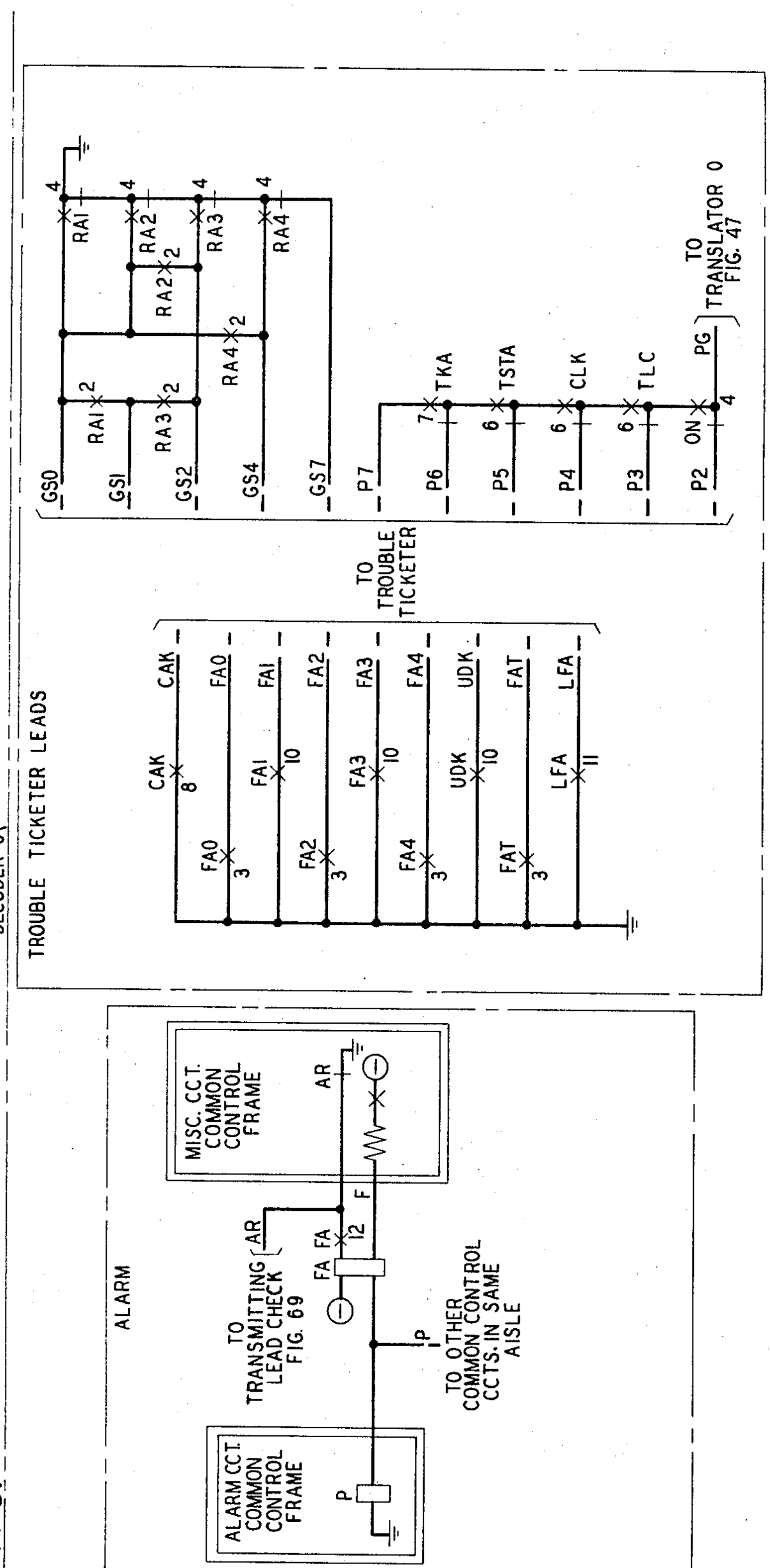

DECODER 0
TROUBLE TICKETER LEADS
TO TRANSLATOR 0 FIG. 47
TO TROUBLE TICKETER
ALARM
MISC. CCT. COMMON CONTROL FRAME
TO TRANSMITTING LEAD CHECK FIG. 69
TO OTHER COMMON CONTROL CCTS. IN SAME AISLE
ALARM CCT. COMMON CONTROL FRAME

FIG. 57

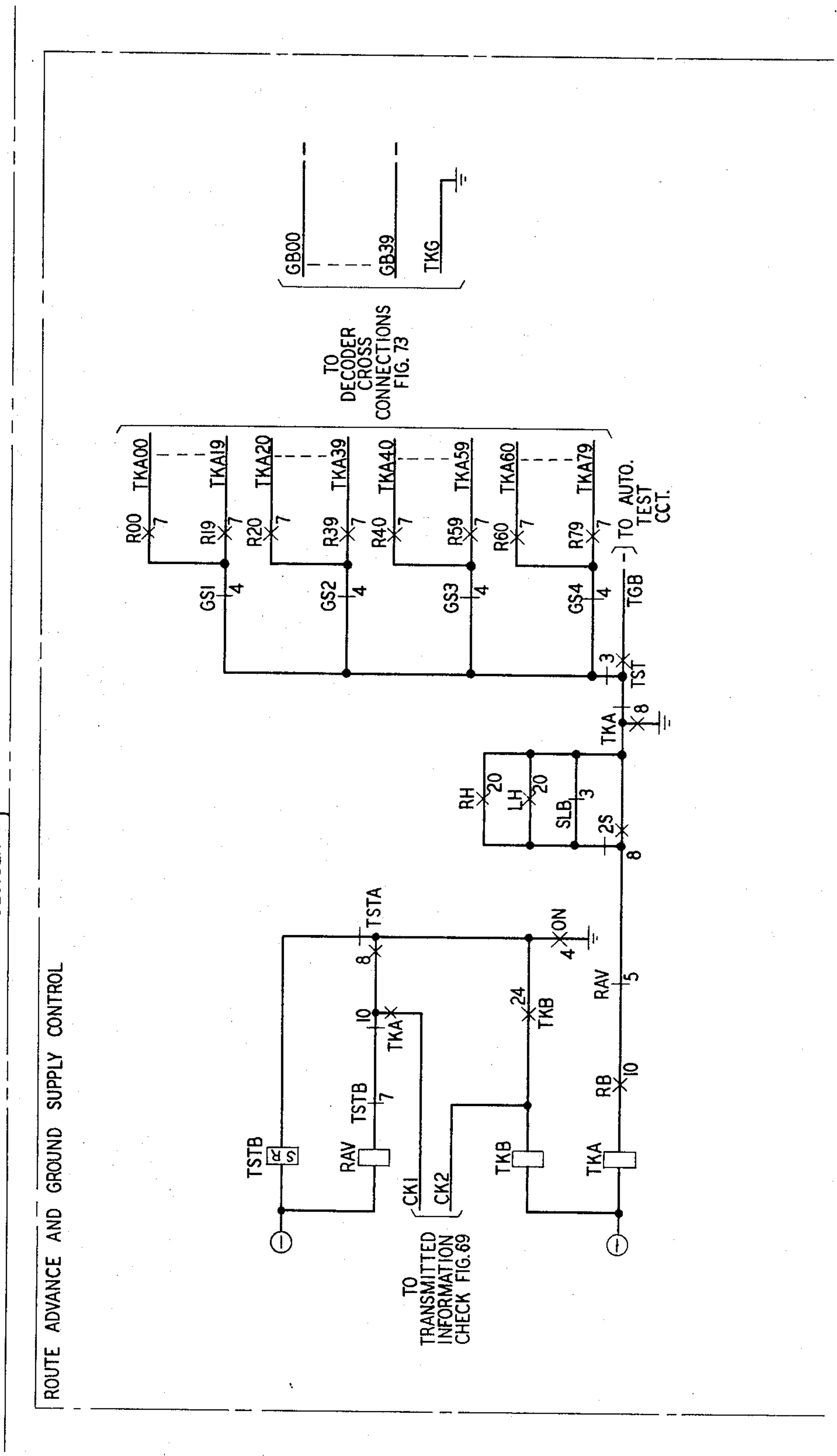

DECODER 0
ROUTE ADVANCE AND GROUND SUPPLY CONTROL
GB00
GB39
TKG
TO DECODER CROSS CONNECTIONS FIG. 73
TKA00
TKA19
TKA20
TKA39
TKA40
TKA59
TKA60
TKA79
R00
R19
R20
R39
R40
R59
R60
R79
TO AUTO. TEST CCT.
GS1
GS2
GS3
GS4
TGB
TST
TKA
RH
LH
SLB
2S
TSTA
ON
RAV
TKB
RB
TSTB
CK1
CK2
TO TRANSMITTED INFORMATION CHECK FIG.69

FIG. 58

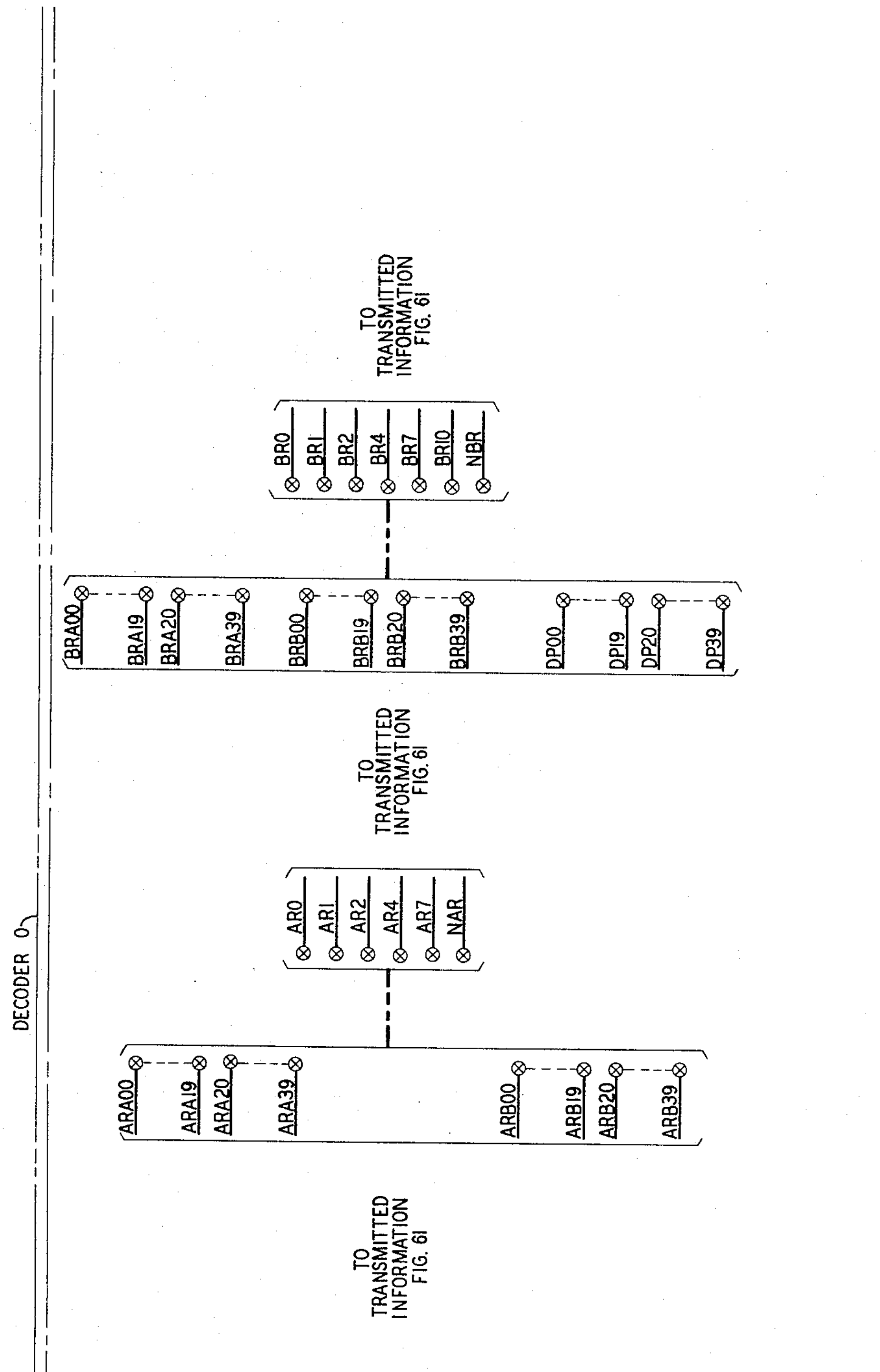

TO
TRANSMITTED
INFORMATION
FIG. 61
BR0
BR1
BR2
BR4
BR7
BR10
NBR
BRA00
BRA19
BRA20
BRA39
BRB00
BRB19
BRB20
BRB39
DP00
DP19
DP20
DP39
TO
TRANSMITTED
INFORMATION
FIG. 61
AR0
AR1
AR2
AR4
AR7
NAR
ARA00
ARA19
ARA20
ARA39
ARB00
ARB19
ARB20
ARB39
TO
TRANSMITTED
INFORMATION
FIG. 61
DECODER 0

FIG. 59

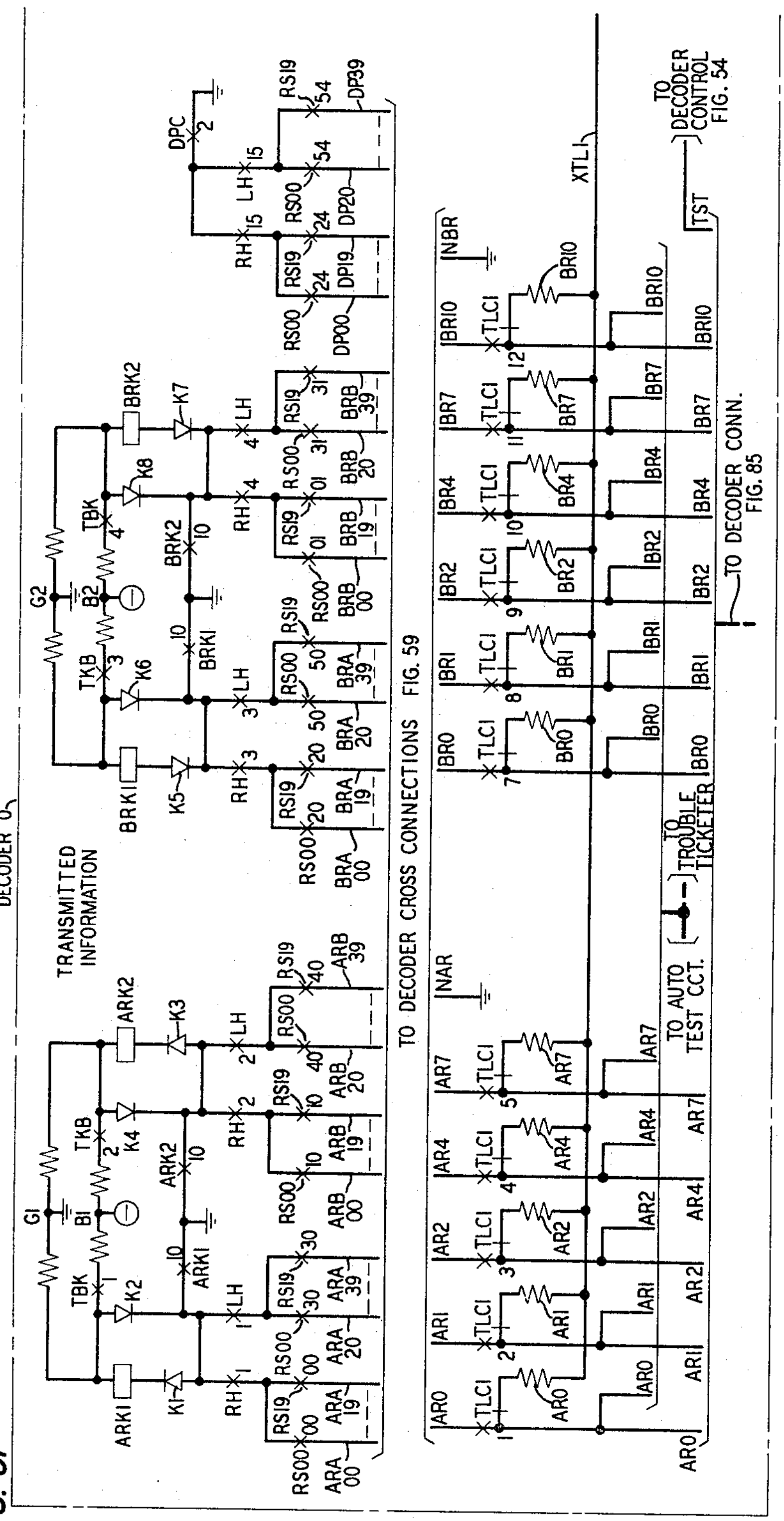
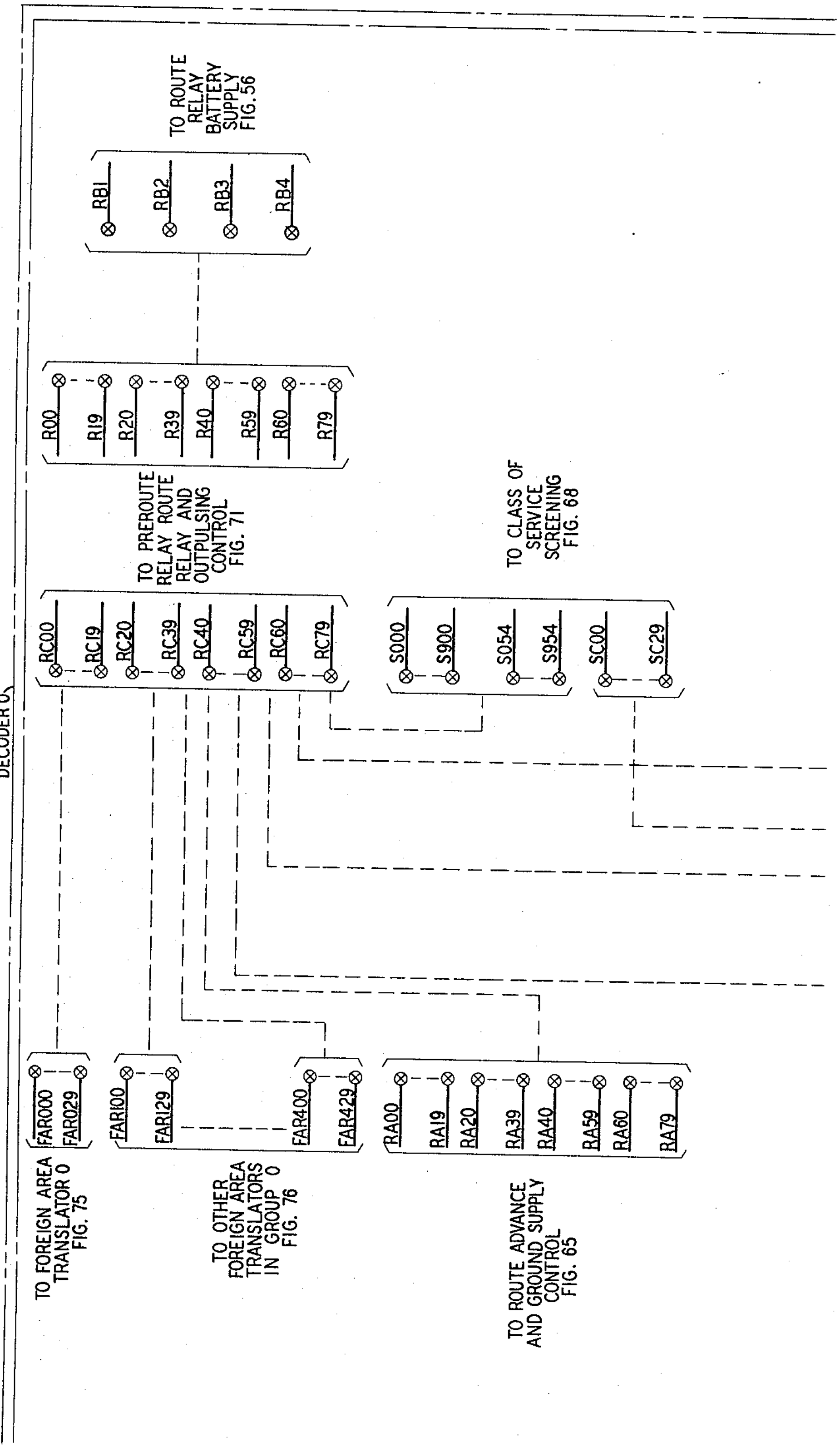


FIG. 61



TO ROUTE RELAY BATTERY SUPPLY FIG. 56
RB1
RB2
RB3
RB4
R00
R19
R20
R39
R40
R59
R60
R79
TO PREROUTE RELAY ROUTE RELAY AND OUTPULSING CONTROL FIG. 71
TO CLASS OF SERVICE SCREENING FIG. 68
RC00
RC19
RC20
RC39
RC40
RC59
RC60
RC79
S000
S900
S054
S954
SC00
SC29
DECODER 0
FAR000
FAR029
FAR100
FAR129
FAR400
FAR429
RA00
RA19
RA20
RA39
RA40
RA59
RA60
RA79
TO FOREIGN AREA TRANSLATOR 0 FIG. 75
TO OTHER FOREIGN AREA TRANSLATORS IN GROUP 0 FIG. 76
TO ROUTE ADVANCE AND GROUND SUPPLY CONTROL FIG. 65


FIG. 60

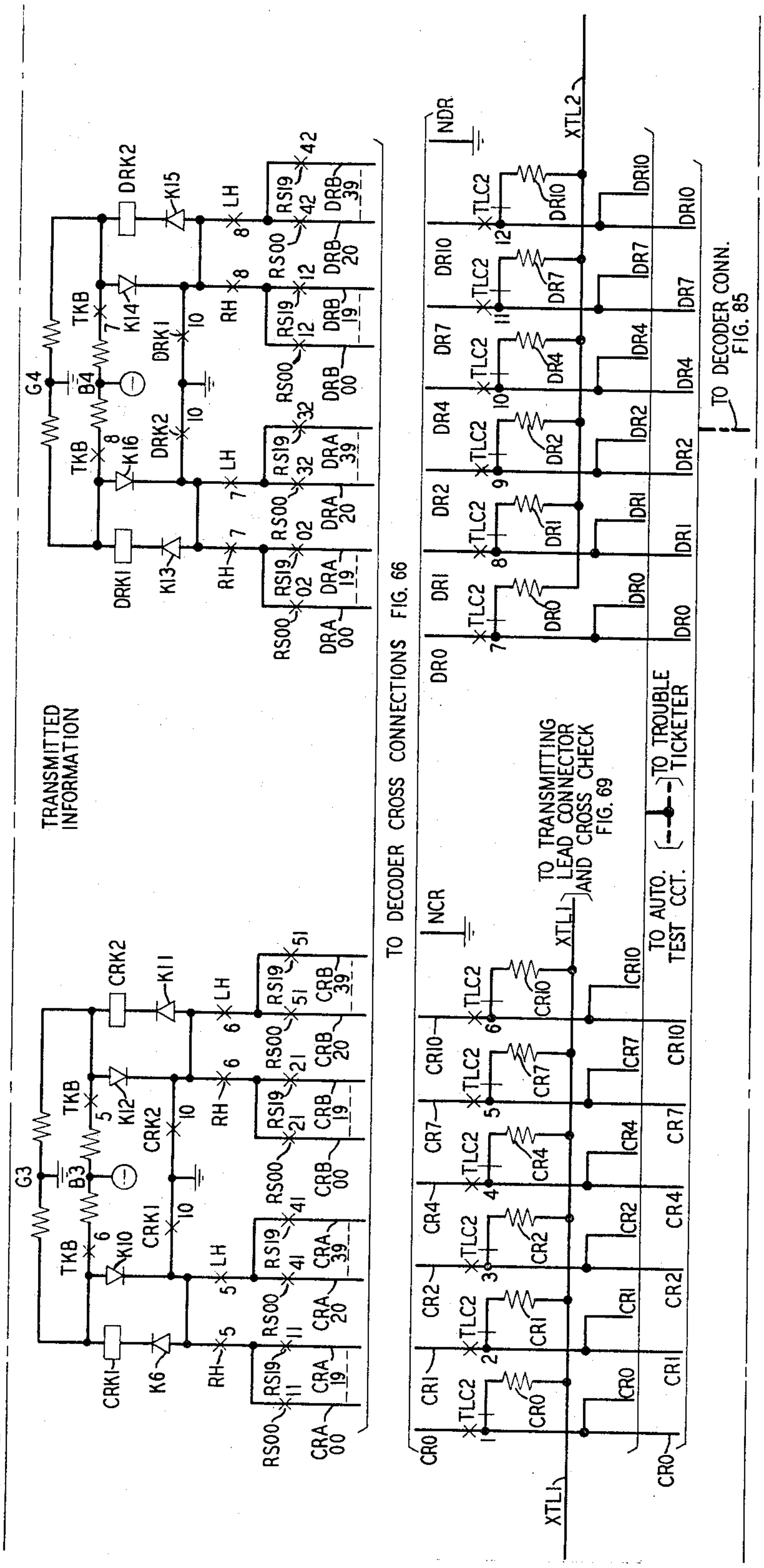


FIG. 62

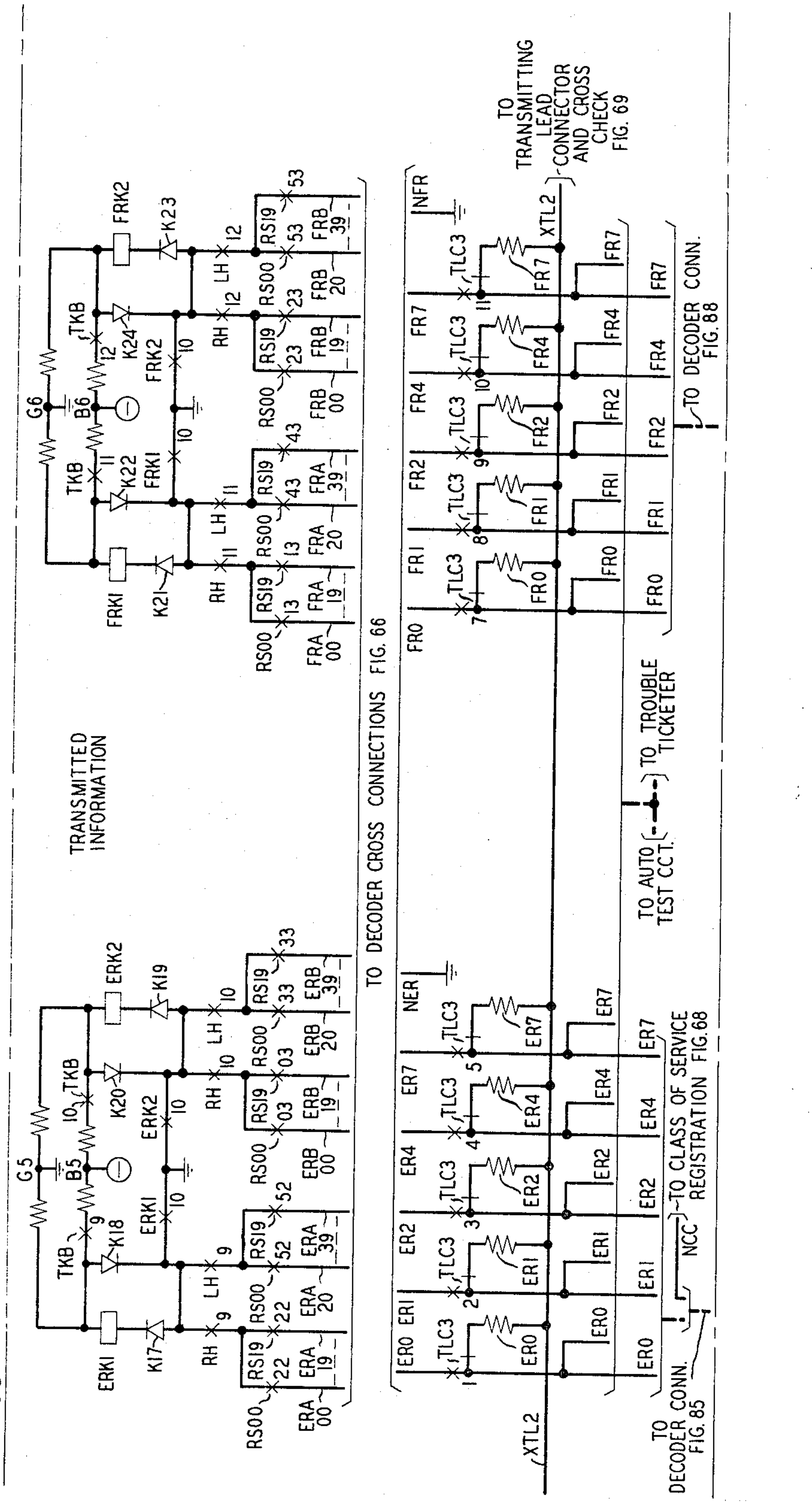

TRANSMITTED INFORMATION
TO DECODER CROSS CONNECTIONS FIG. 66
TO TRANSMITTING LEAD CONNECTOR AND CROSS CHECK FIG. 69
TO DECODER CONN. FIG. 88
TO TROUBLE TICKETER
TO AUTO TEST CCT.
TO CLASS OF SERVICE REGISTRATION FIG. 68
TO DECODER CONN. FIG. 85

FIG. 63

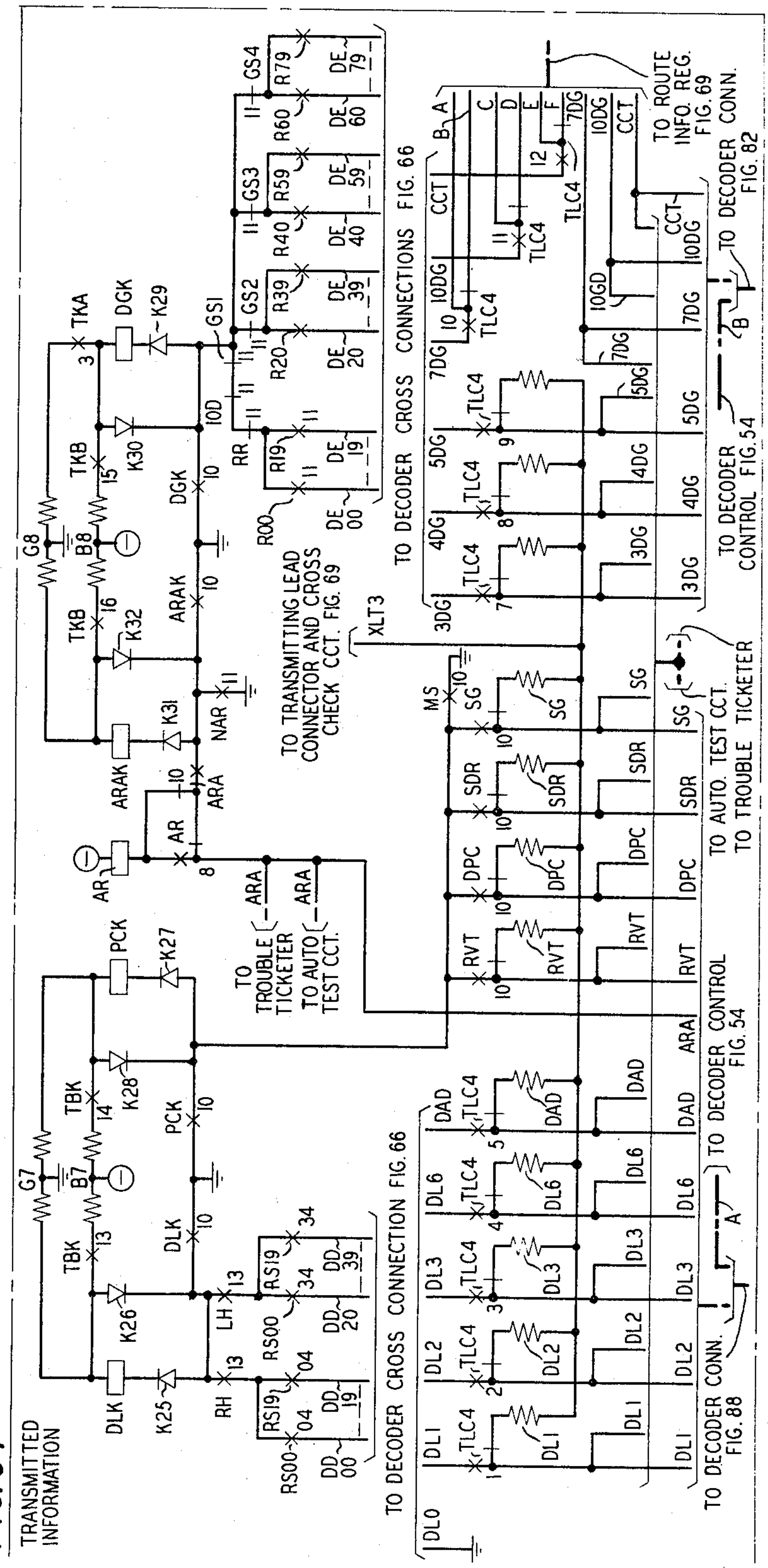


FIG. 64

ROUTE ADVANCE AND GROUND SUPPLY CONTROL

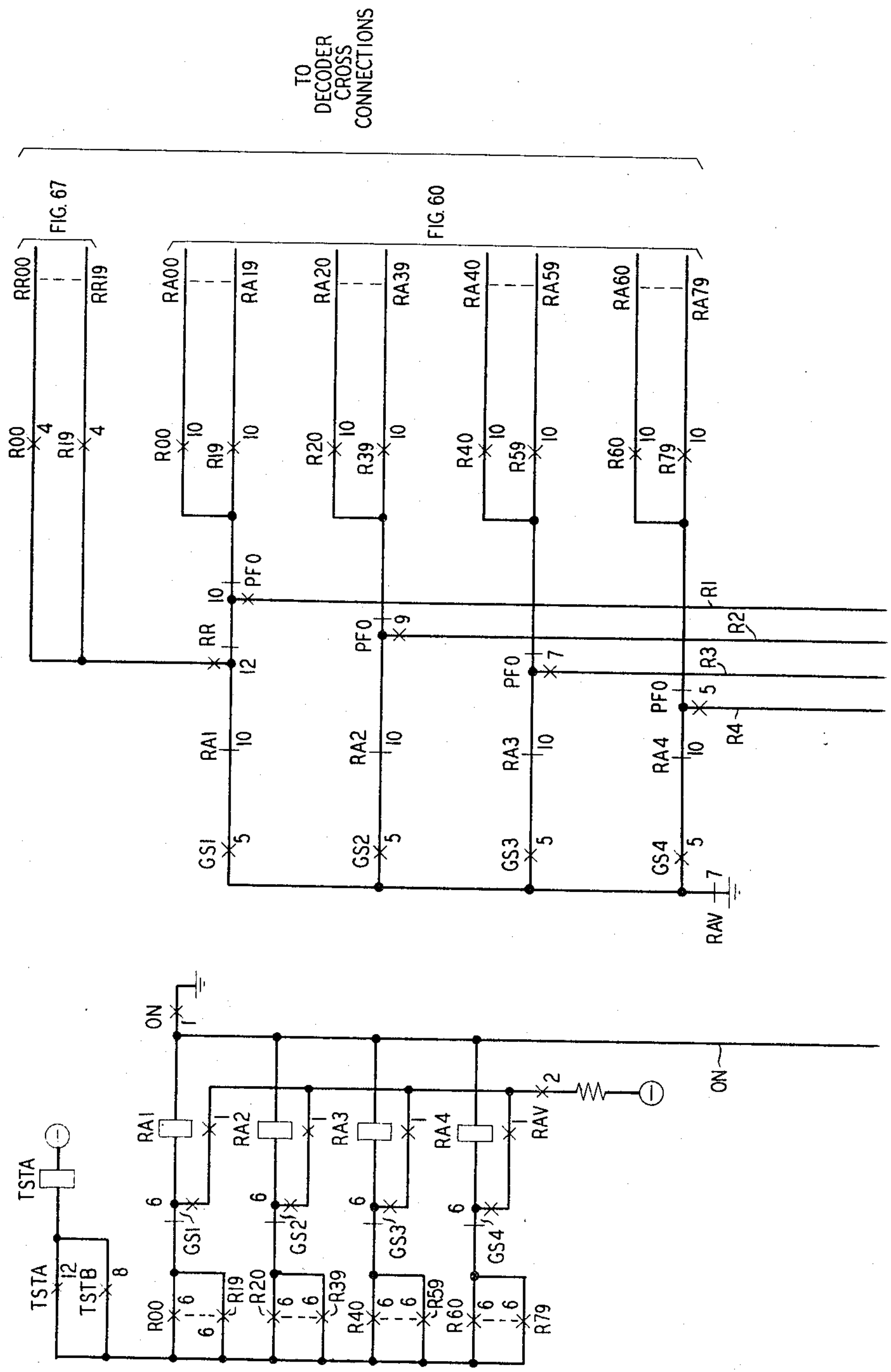



FIG. 65

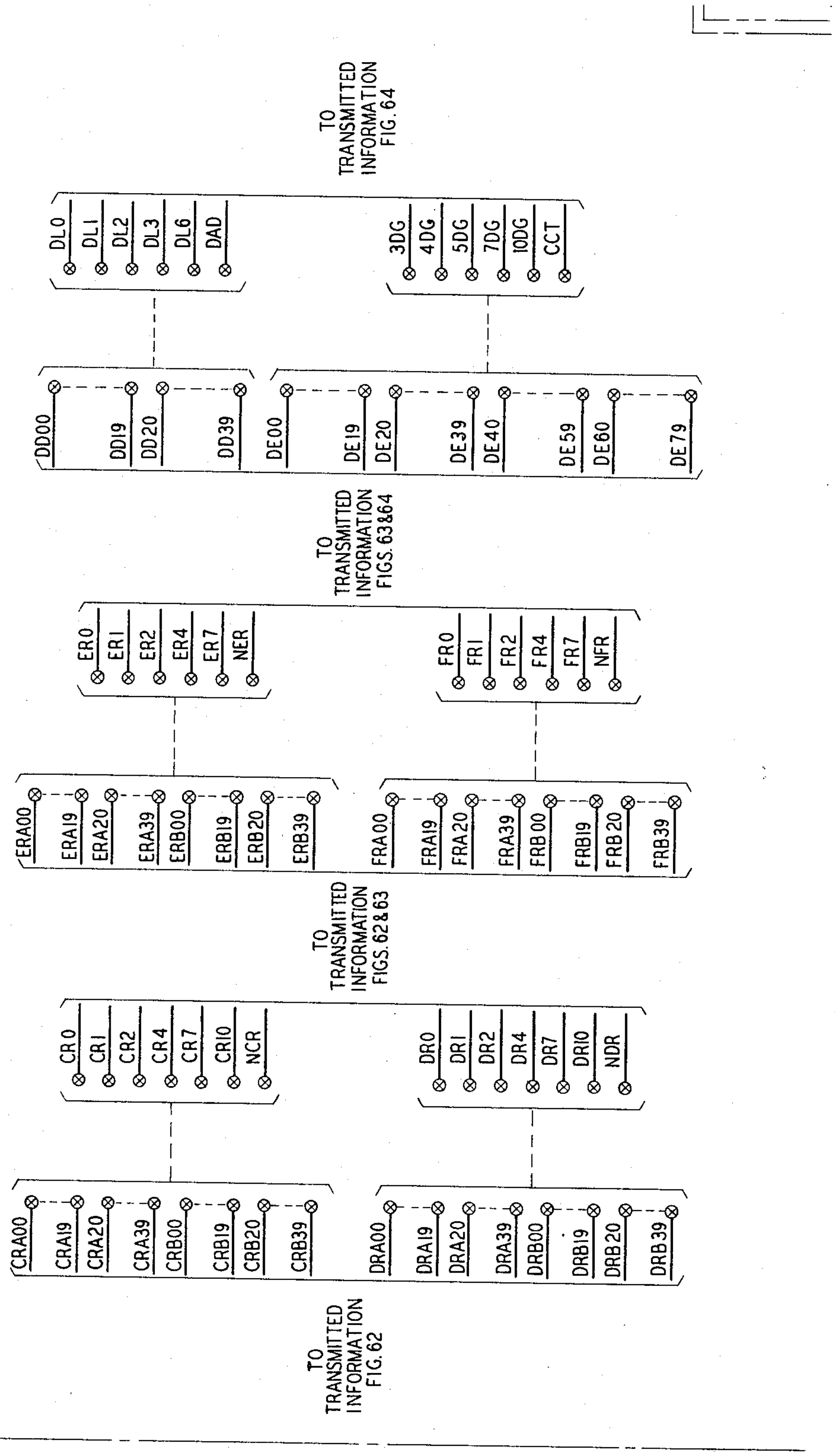

TO TRANSMITTED INFORMATION FIG. 64
DL0
DL1
DL2
DL3
DL6
DAD
3DG
4DG
5DG
7DG
10DG
CCT
DD00
DD19
DD20
DD39
DE00
DE19
DE20
DE39
DE40
DE59
DE60
DE79
TO TRANSMITTED INFORMATION FIGS. 63&64
ER0
ER1
ER2
ER4
ER7
NER
FR0
FR1
FR2
FR4
FR7
NFR
ERA00
ERA19
ERA20
ERA39
ERB00
ERB19
ERB20
ERB39
FRA00
FRA19
FRA20
FRA39
FRB00
FRB19
FRB20
FRB39
TO TRANSMITTED INFORMATION FIGS. 62&63
CR0
CR1
CR2
CR4
CR7
CR10
NCR
DR0
DR1
DR2
DR4
DR7
DR10
NDR
CRA00
CRA19
CRA20
CRA39
CRB00
CRB19
CRB20
CRB39
DRA00
DRA19
DRA20
DRA39
DRB00
DRB19
DRB20
DRB39
TO TRANSMITTED INFORMATION FIG. 62

FIG. 66

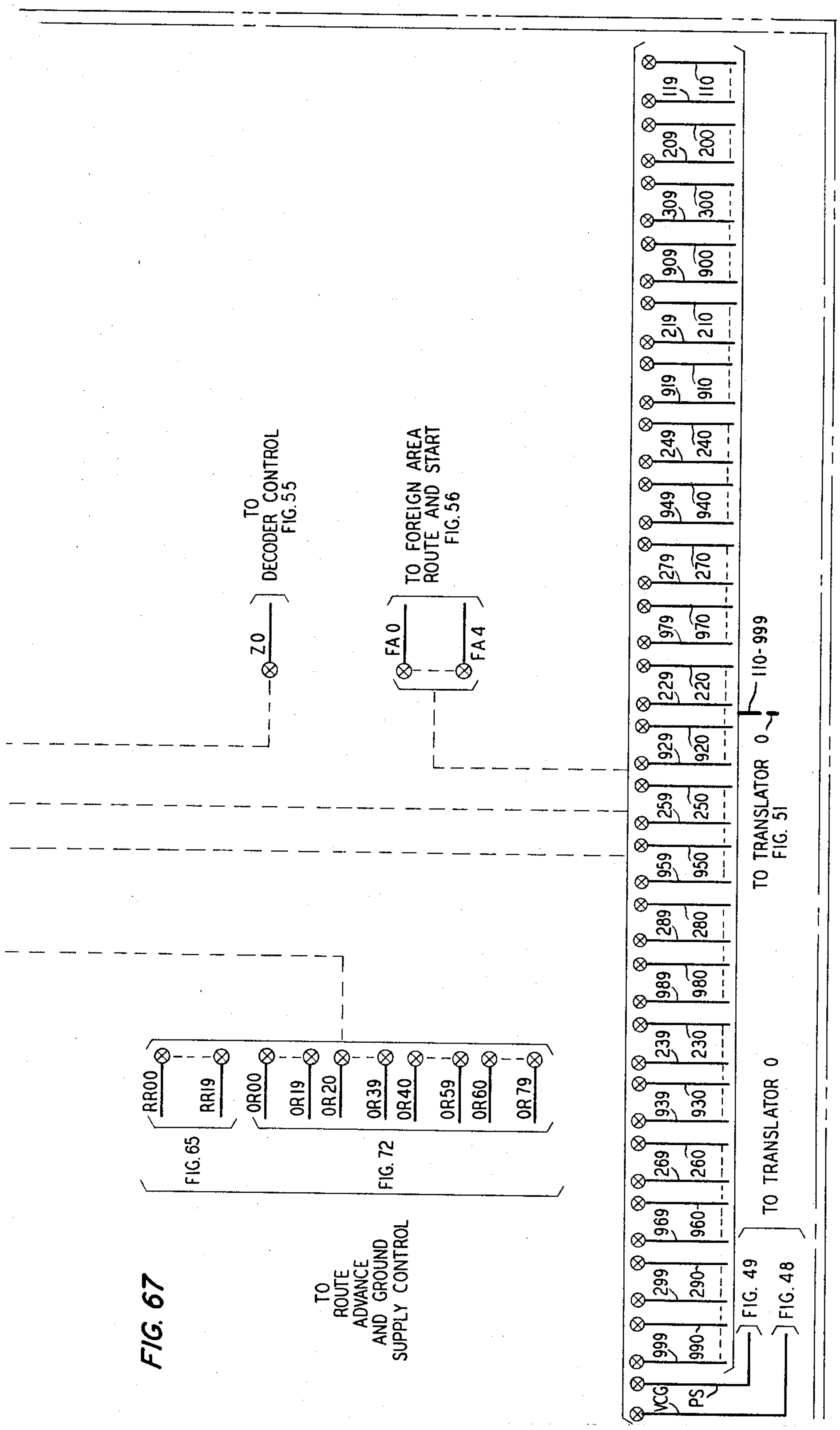

TO DECODER CONTROL FIG. 55
Z0
TO FOREIGN AREA ROUTE AND START FIG. 56
FA0
FA4
110-999
TO TRANSLATOR 0 FIG. 51
TO TRANSLATOR 0
TO TRANSLATOR
FIG. 49
FIG. 48
VCG
PS
RR00
RR19
OR00
OR19
OR20
OR39
OR40
OR59
OR60
OR79
FIG. 65
FIG. 72
TO ROUTE ADVANCE AND GROUND SUPPLY CONTROL

FIG. 67

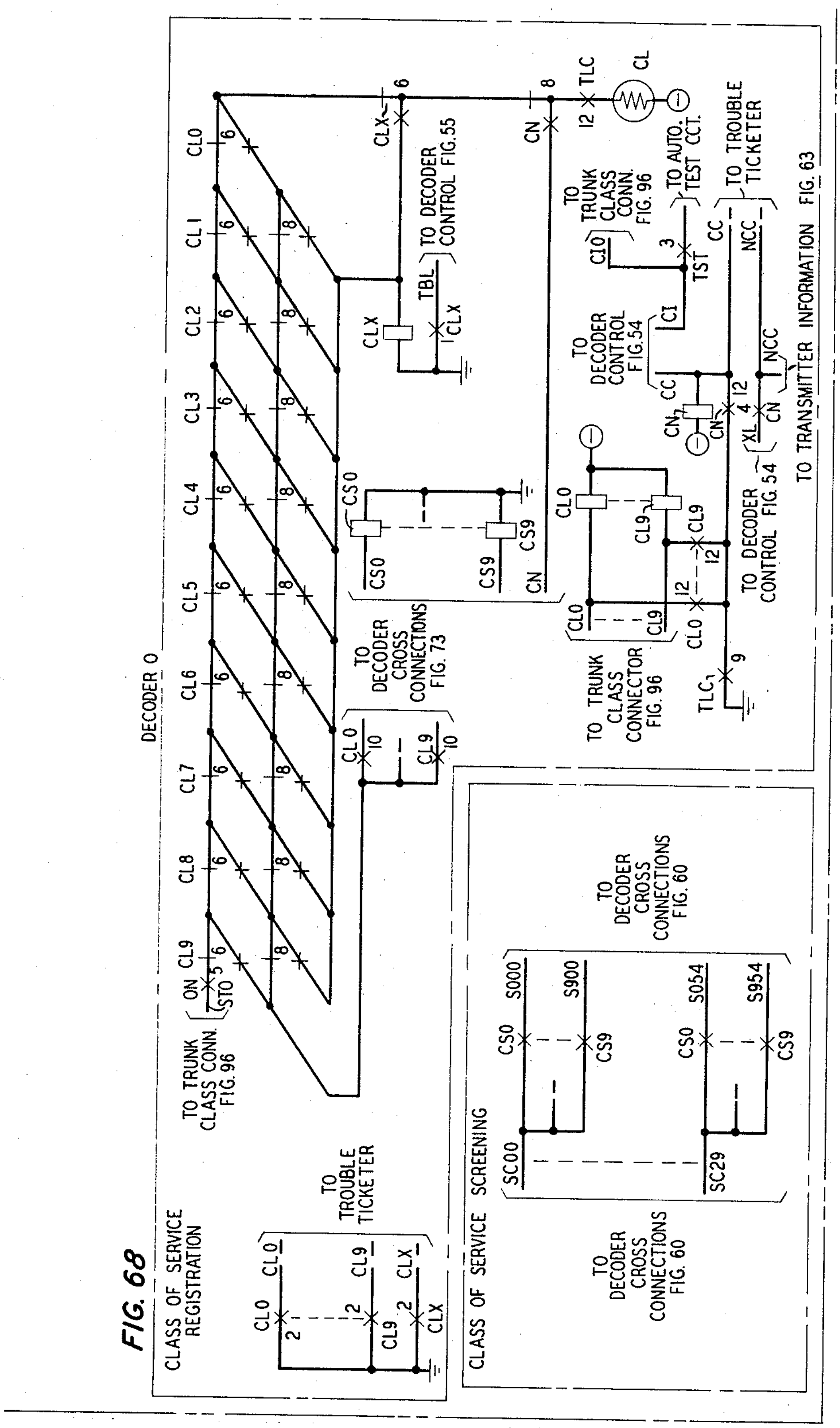

DECODER 0
CLASS OF SERVICE REGISTRATION
CLASS OF SERVICE SCREENING
TO TRUNK CLASS CONN. FIG. 96
TO TROUBLE TICKETER
TO DECODER CONTROL FIG. 55
TO DECODER CROSS CONNECTIONS FIG. 73
TO TRUNK CLASS CONNECTOR FIG. 96
TO DECODER CONTROL FIG. 54
TO TRUNK CLASS CONN. FIG. 96
TO AUTO. TEST CCT.
TO TROUBLE TICKETER
TO TRANSMITTER INFORMATION FIG. 63
TO DECODER CONTROL FIG. 54
TO DECODER CROSS CONNECTIONS FIG. 60
TO DECODER CROSS CONNECTIONS FIG. 60

FIG. 68

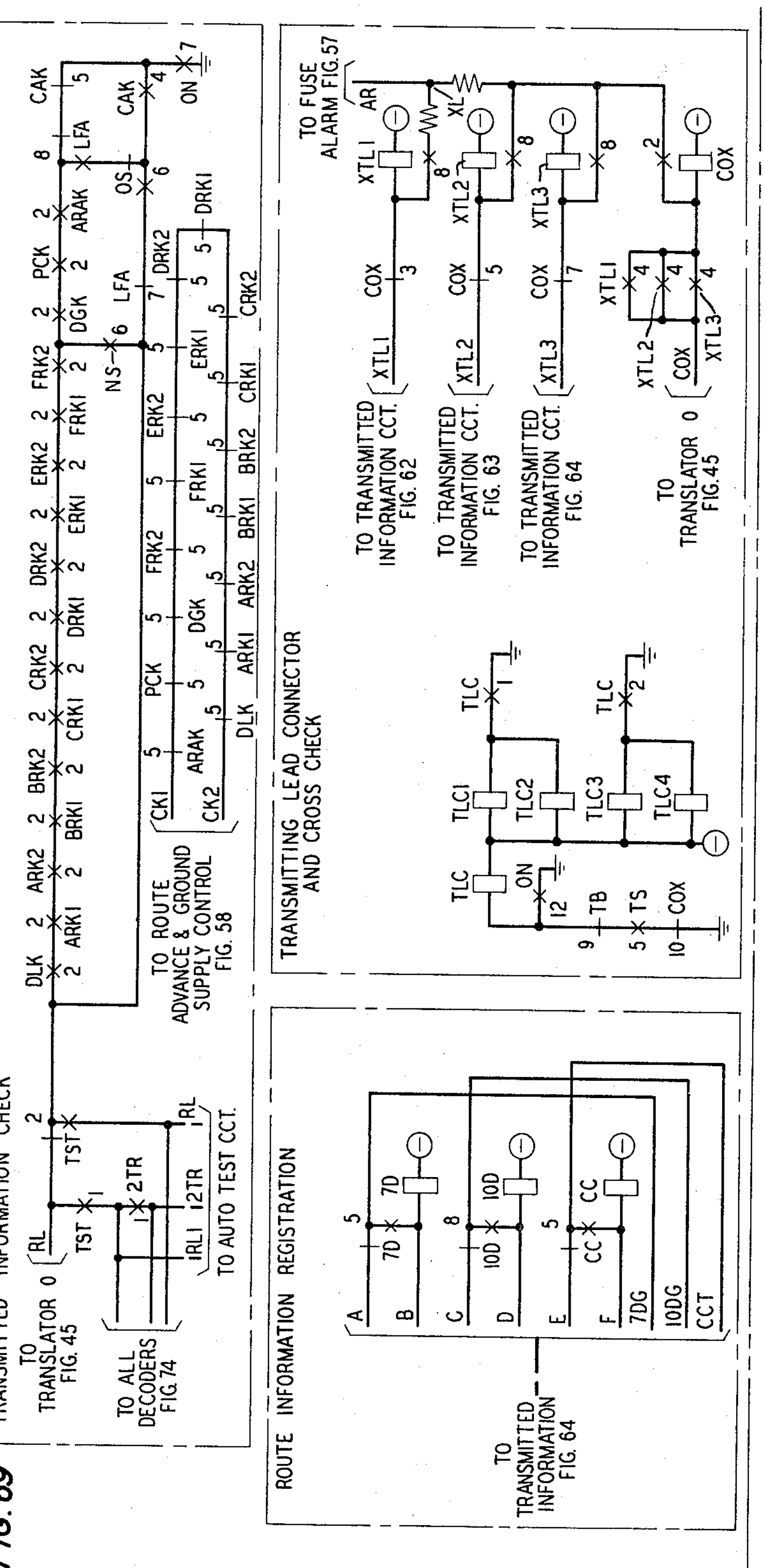


FIG. 69

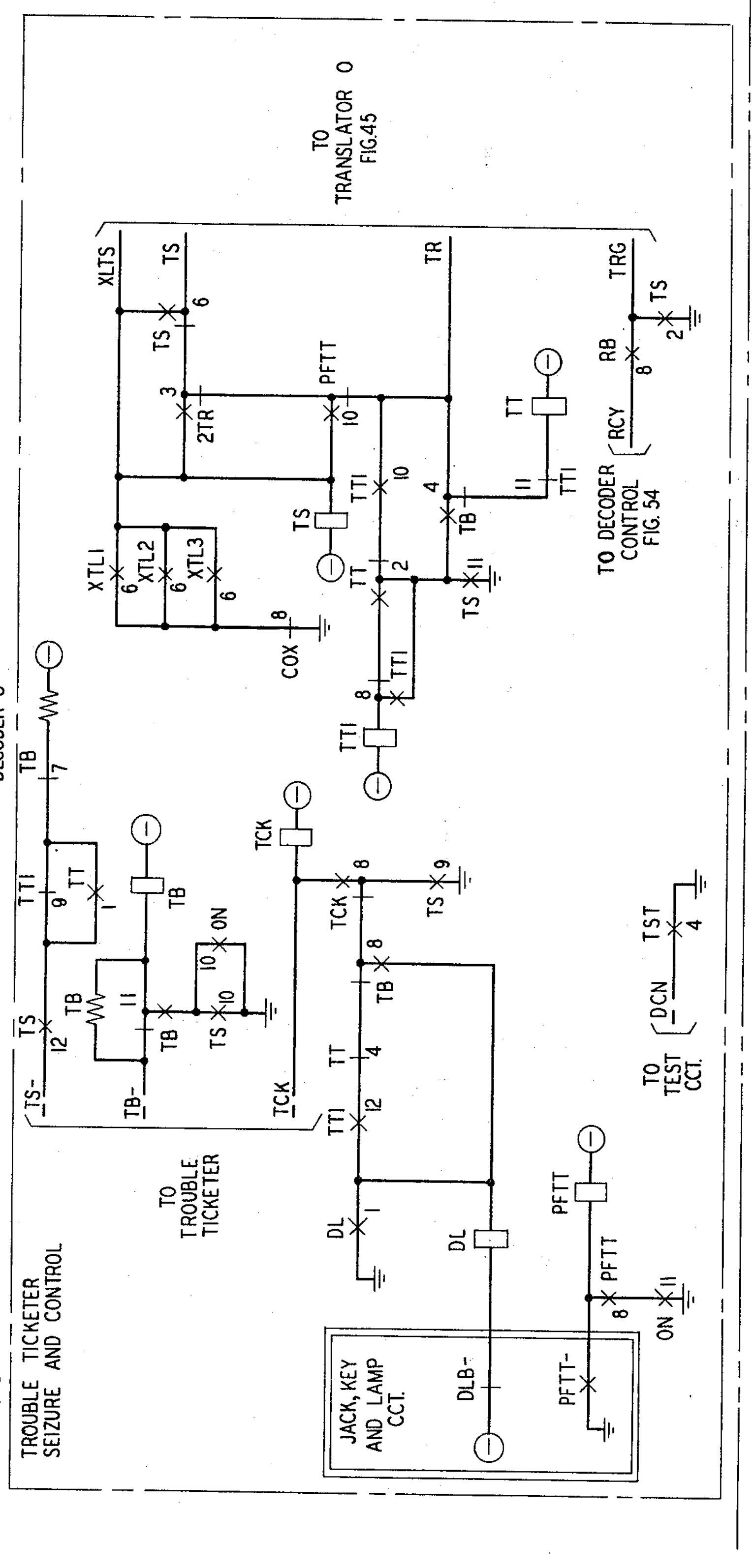



FIG. 70
TROUBLE TICKETER SEIZURE AND CONTROL

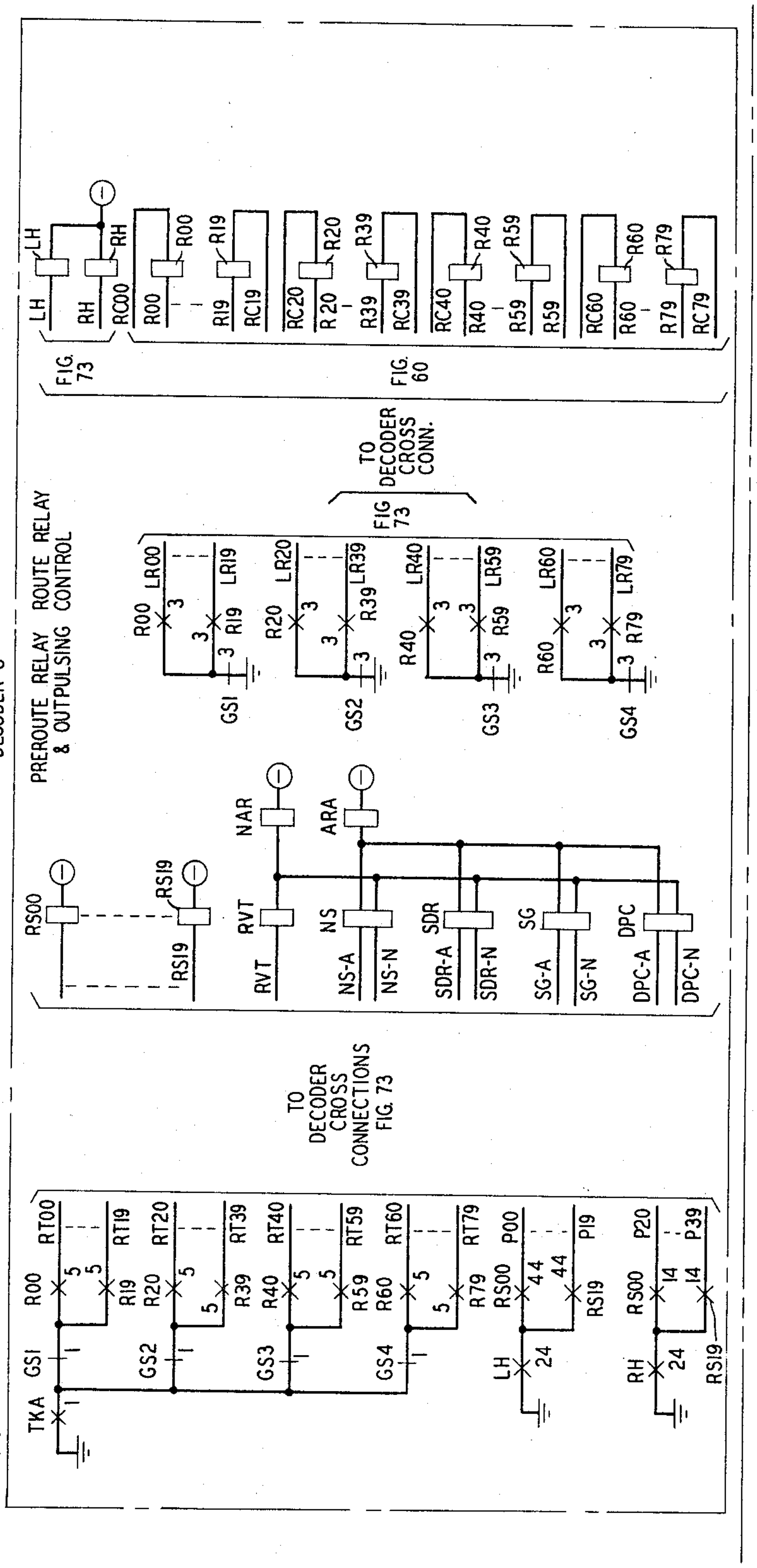

DECODER O
PREROUTE RELAY ROUTE RELAY
& OUTPULSING CONTROL
TO DECODER CROSS CONN.
FIG 73
FIG. 73
FIG. 60
TO DECODER CROSS CONNECTIONS FIG. 73

FIG. 71

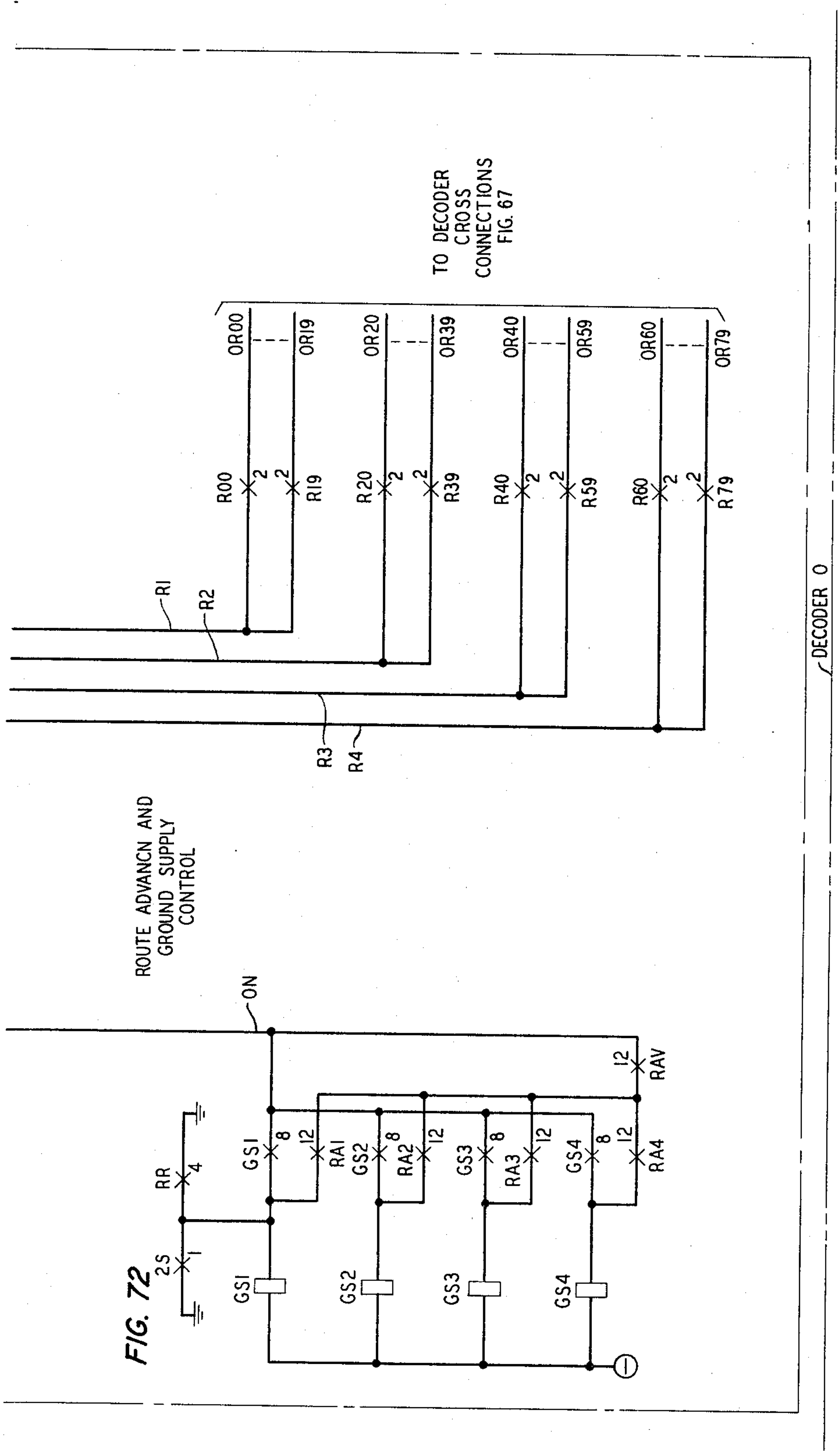

TO DECODER
CROSS
CONNECTIONS
FIG. 67
OR00
OR19
OR20
OR39
OR40
OR59
OR60
OR79
R00
R19
R20
R39
R40
R59
R60
R79
R1
R2
R3
R4
DECODER 0
ROUTE ADVANCN AND
GROUND SUPPLY
CONTROL
ON
RAV
RR
2S
GS1
RA1
GS2
RA2
GS3
RA3
GS4
RA4

FIG. 72

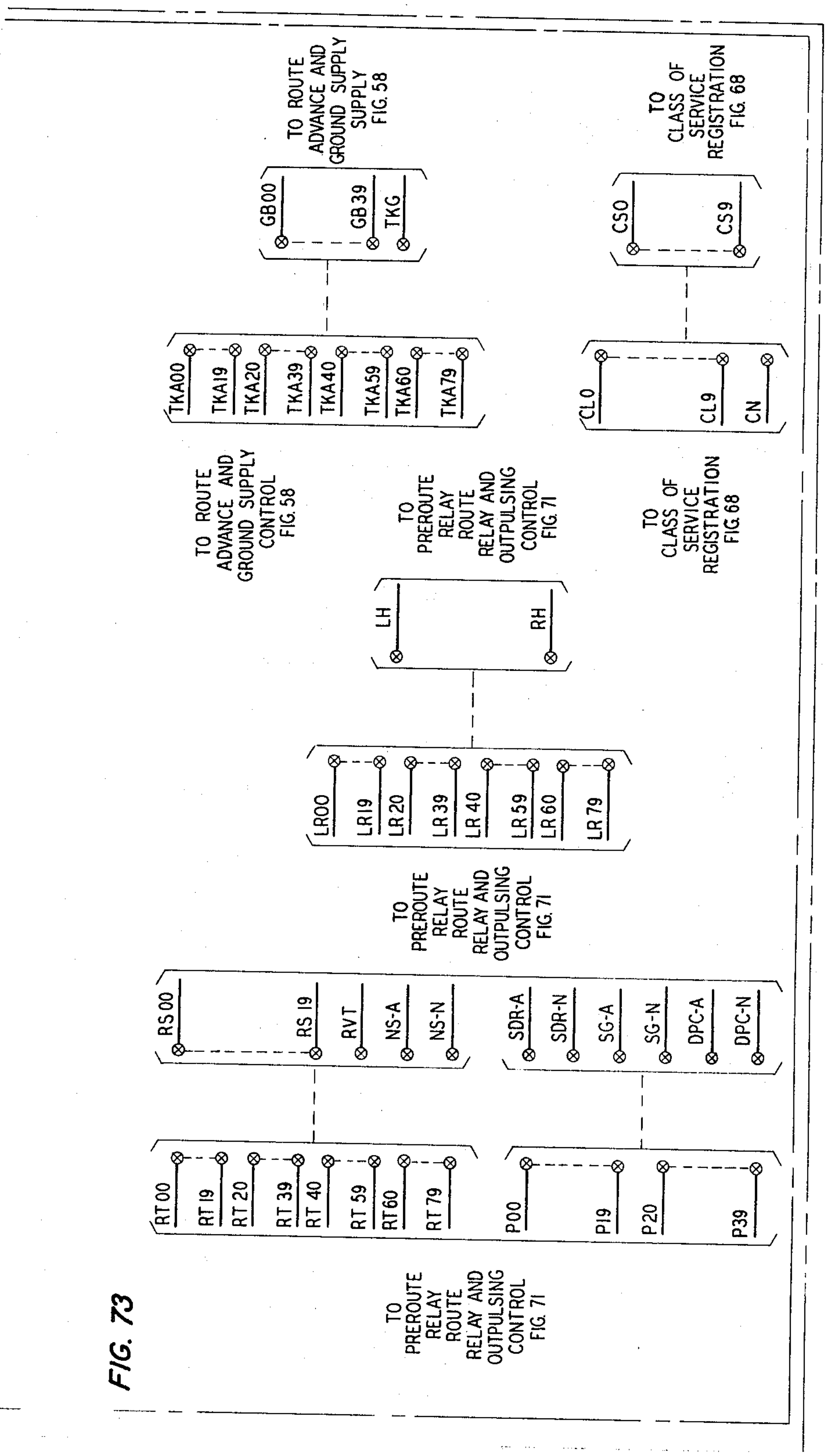

TO ROUTE ADVANCE AND GROUND SUPPLY SUPPLY FIG. 58
GB00
GB39
TKG
TKA00
TKA19
TKA20
TKA39
TKA40
TKA59
TKA60
TKA79
TO ROUTE ADVANCE AND GROUND SUPPLY CONTROL FIG. 58
TO CLASS OF SERVICE REGISTRATION FIG. 68
CS0
CS9
CL0
CL9
CN
TO CLASS OF SERVICE REGISTRATION FIG. 68
TO PREROUTE RELAY ROUTE RELAY AND OUTPULSING CONTROL FIG. 71
LH
RH
LR00
LR19
LR20
LR39
LR40
LR59
LR60
LR79
TO PREROUTE RELAY ROUTE RELAY AND OUTPULSING CONTROL FIG. 71
RS00
RS19
RVT
NS-A
NS-N
SDR-A
SDR-N
SG-A
SG-N
DPC-A
DPC-N
RT00
RT19
RT20
RT39
RT40
RT59
RT60
RT79
P00
P19
P20
P39
TO PREROUTE RELAY ROUTE RELAY AND OUTPULSING CONTROL FIG. 71

FIG. 73

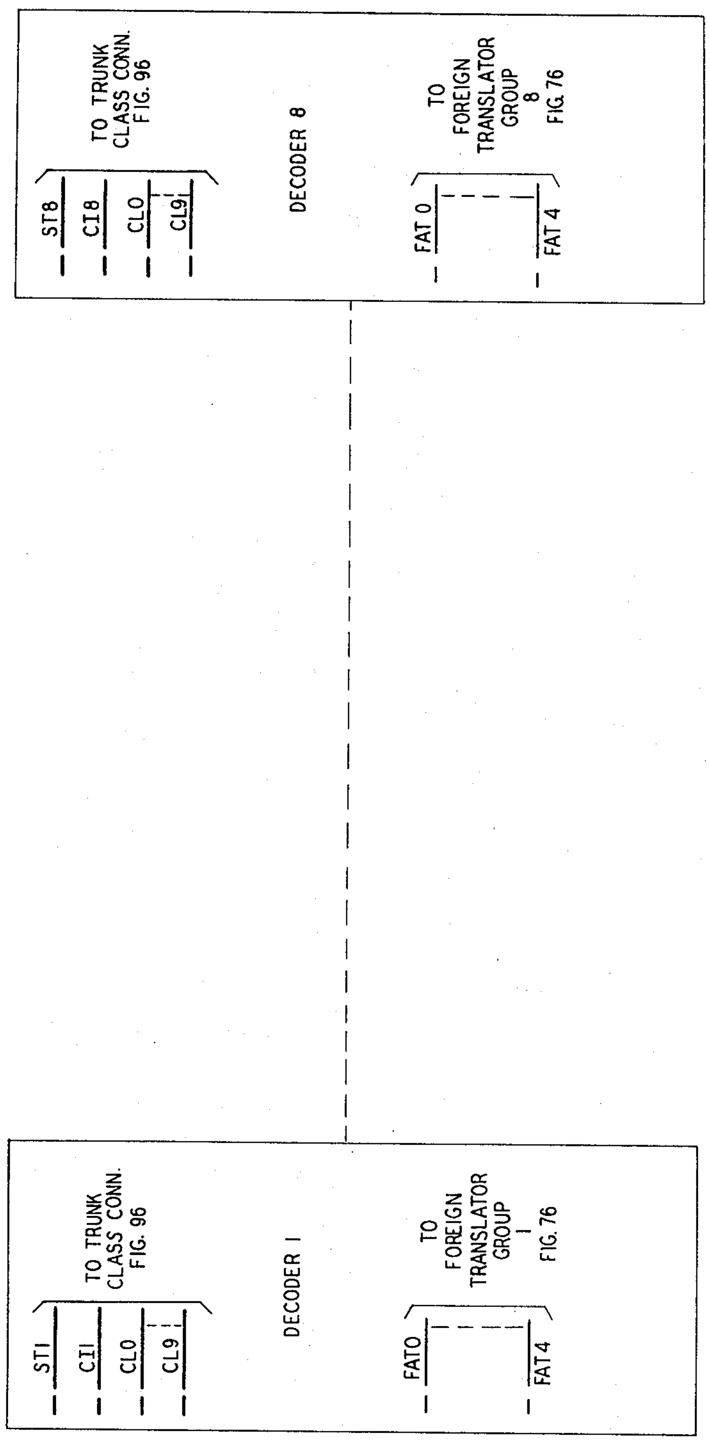

TO TRUNK CLASS CONN. FIG. 96
ST8
CI8
CL0
CL9
DECODER 8
TO FOREIGN TRANSLATOR GROUP 8 FIG 76
FAT 0
FAT 4
TO TRUNK CLASS CONN. FIG. 96
ST1
CI1
CL0
CL9
DECODER 1
TO FOREIGN TRANSLATOR GROUP 1 FIG. 76
FAT0
FAT4

FIG. 74

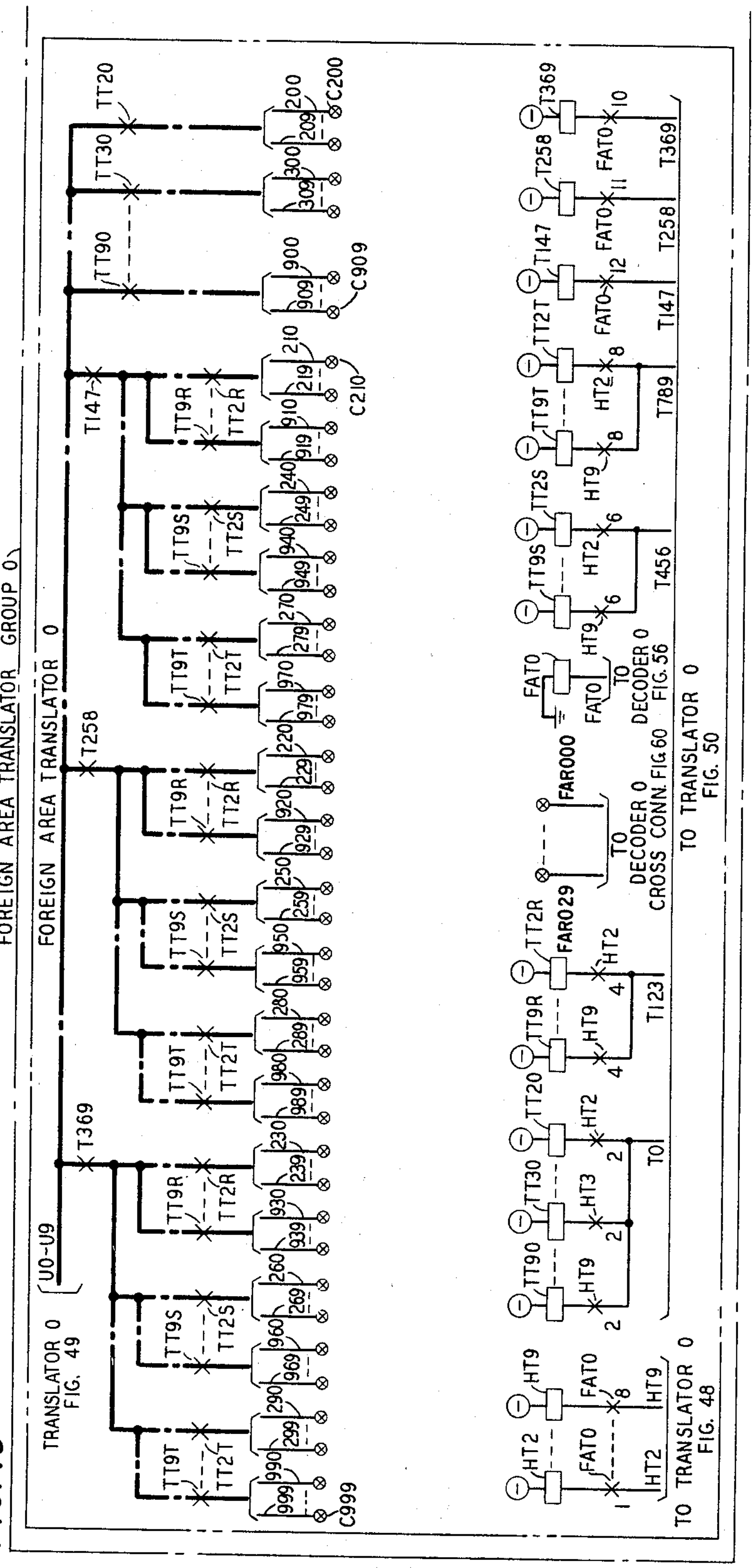

FOREIGN AREA TRANSLATOR GROUP 0
FOREIGN AREA TRANSLATOR 0
TRANSLATOR 0
FIG. 49
U0-U9
T369
T258
T147
TT20
TT30
TT90
C200
C909
C210
C999
FAR000
FAR029
TO DECODER 0 CROSS CONN. FIG. 60
TO DECODER 0 FIG. 56
TO TRANSLATOR 0 FIG. 50
TO TRANSLATOR 0 FIG. 48

FIG. 75

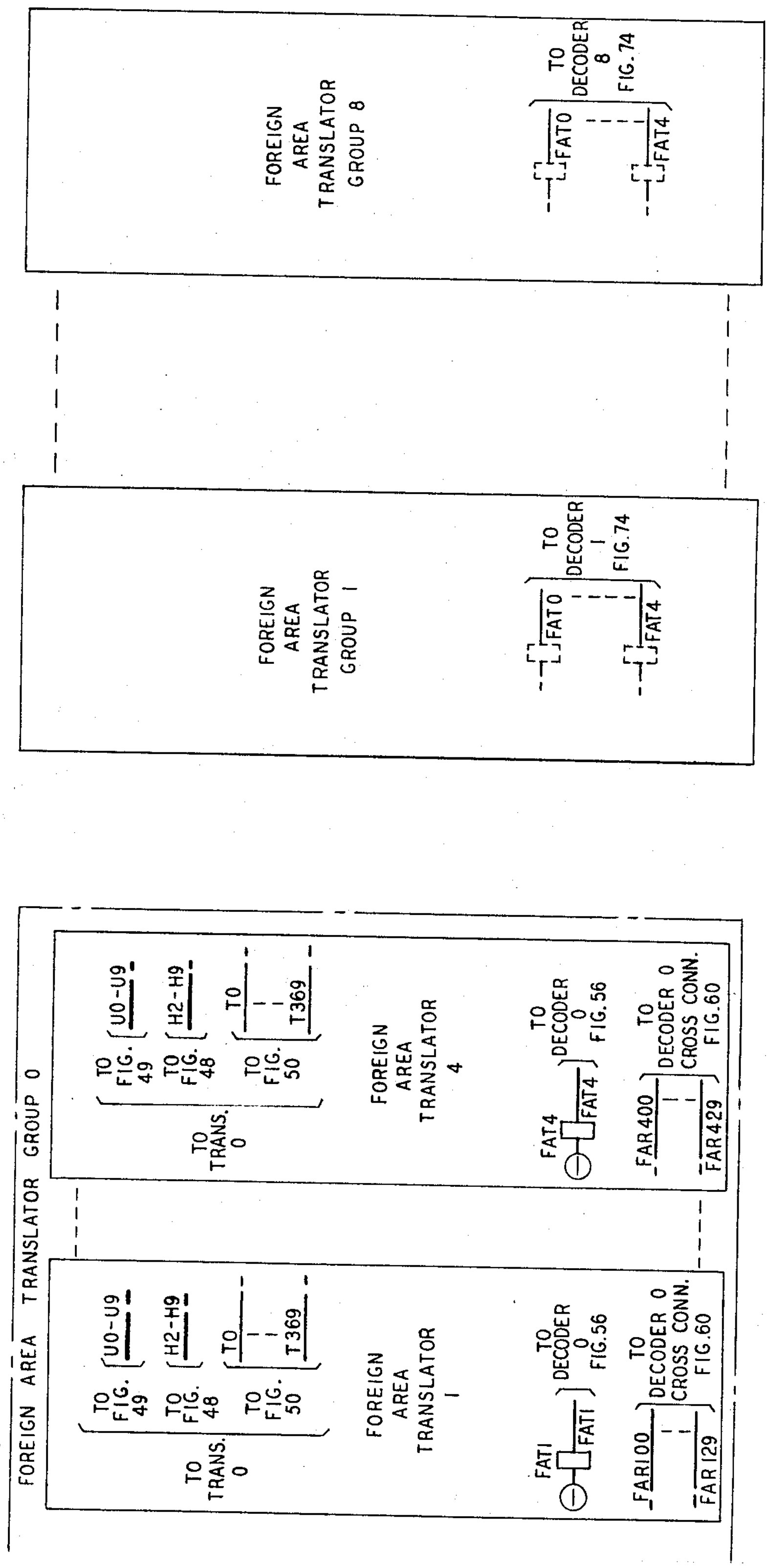

FOREIGN AREA TRANSLATOR GROUP 8
TO DECODER 8 FIG. 74
FAT0
FAT4
FOREIGN AREA TRANSLATOR GROUP 1
TO DECODER 1 FIG. 74
FAT0
FAT4
FOREIGN AREA TRANSLATOR GROUP 0
TO TRANS. 0
TO FIG. 49
U0-U9
TO FIG. 48
H2-H9
TO FIG. 50
TO
T369
FOREIGN AREA TRANSLATOR 4
TO DECODER 0 FIG. 56
FAT4
TO DECODER 0 CROSS CONN. FIG. 60
FAR400
FAR429
FOREIGN AREA TRANSLATOR 1
TO DECODER 0 FIG. 56
FAT1
TO DECODER 0 CROSS CONN. FIG. 60
FAR100
FAR129

FIG. 76

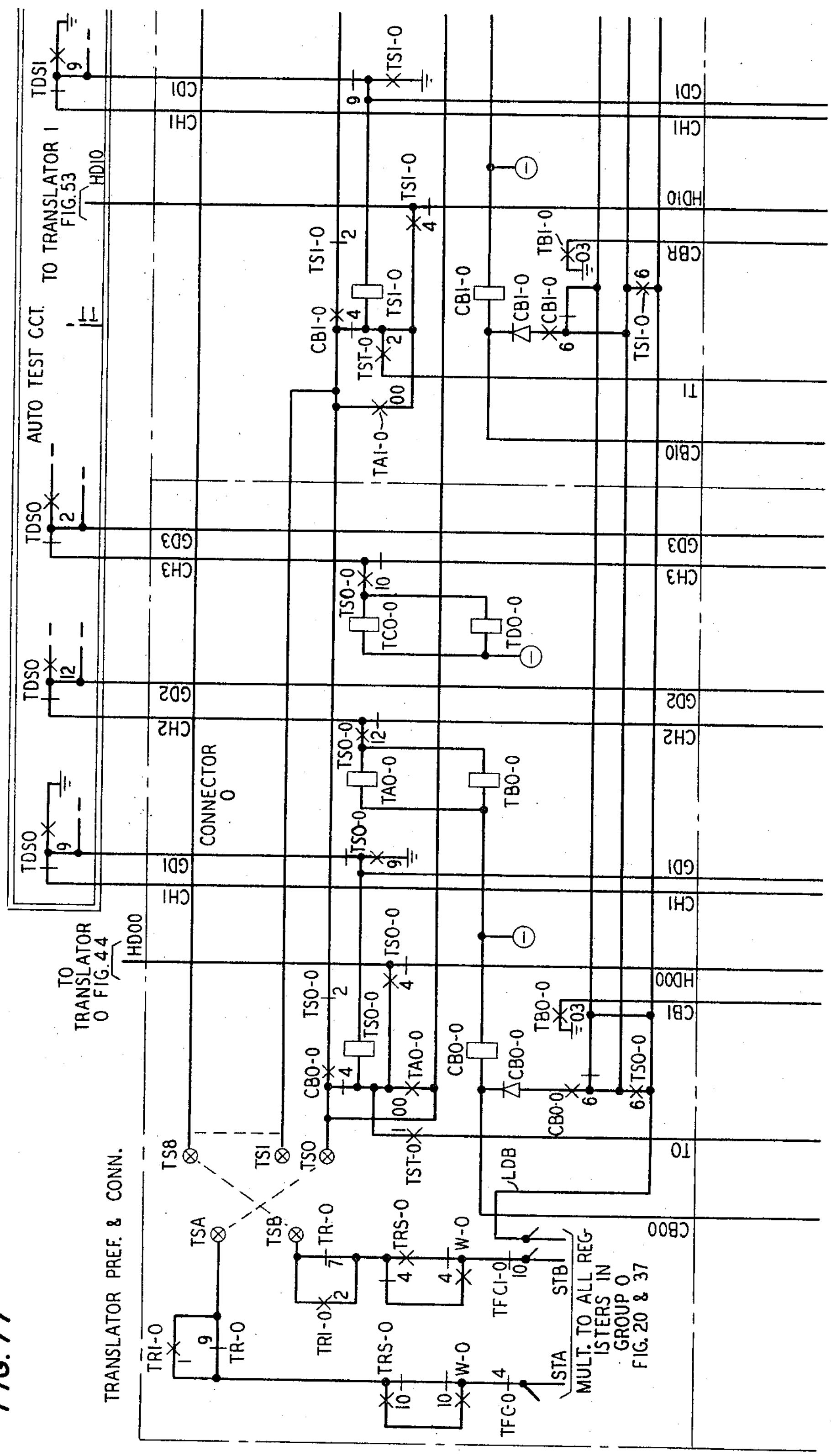

AUTO TEST CCT.
TO TRANSLATOR 1 FIG. 53
HD10
TO TRANSLATOR 0 FIG. 44
HD00
CONNECTOR 0
TRANSLATOR PREF. & CONN.
MULT. TO ALL REGISTERS IN GROUP 0 FIG. 20 & 37
GD1
CH1
CBR
T1
CB10
GD3
CH3
GD2
CH2
CB1
T0
CB00

FIG. 77

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STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

Filed Sept. 24, 1965 113 Sheets-Sheet 95

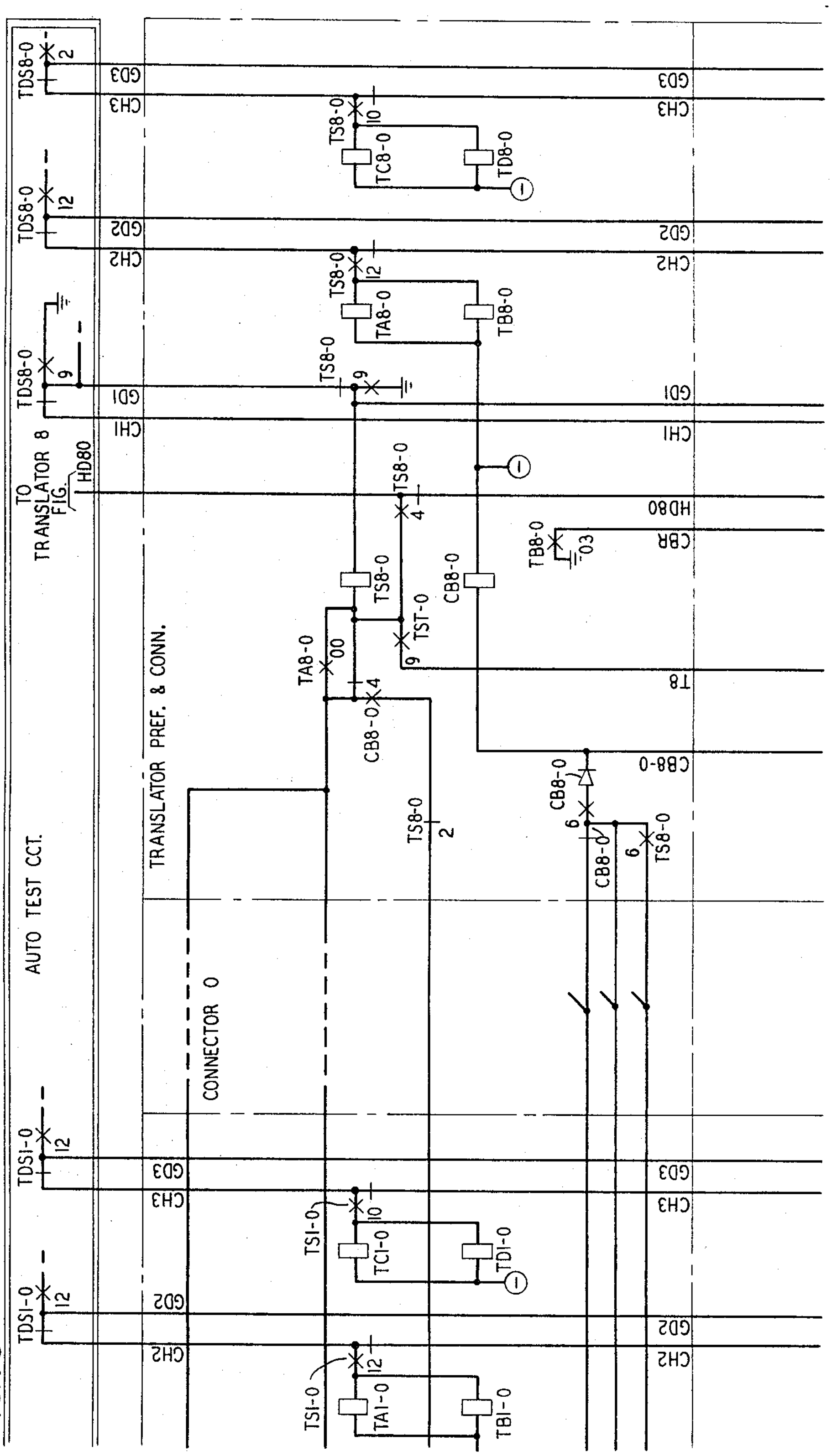
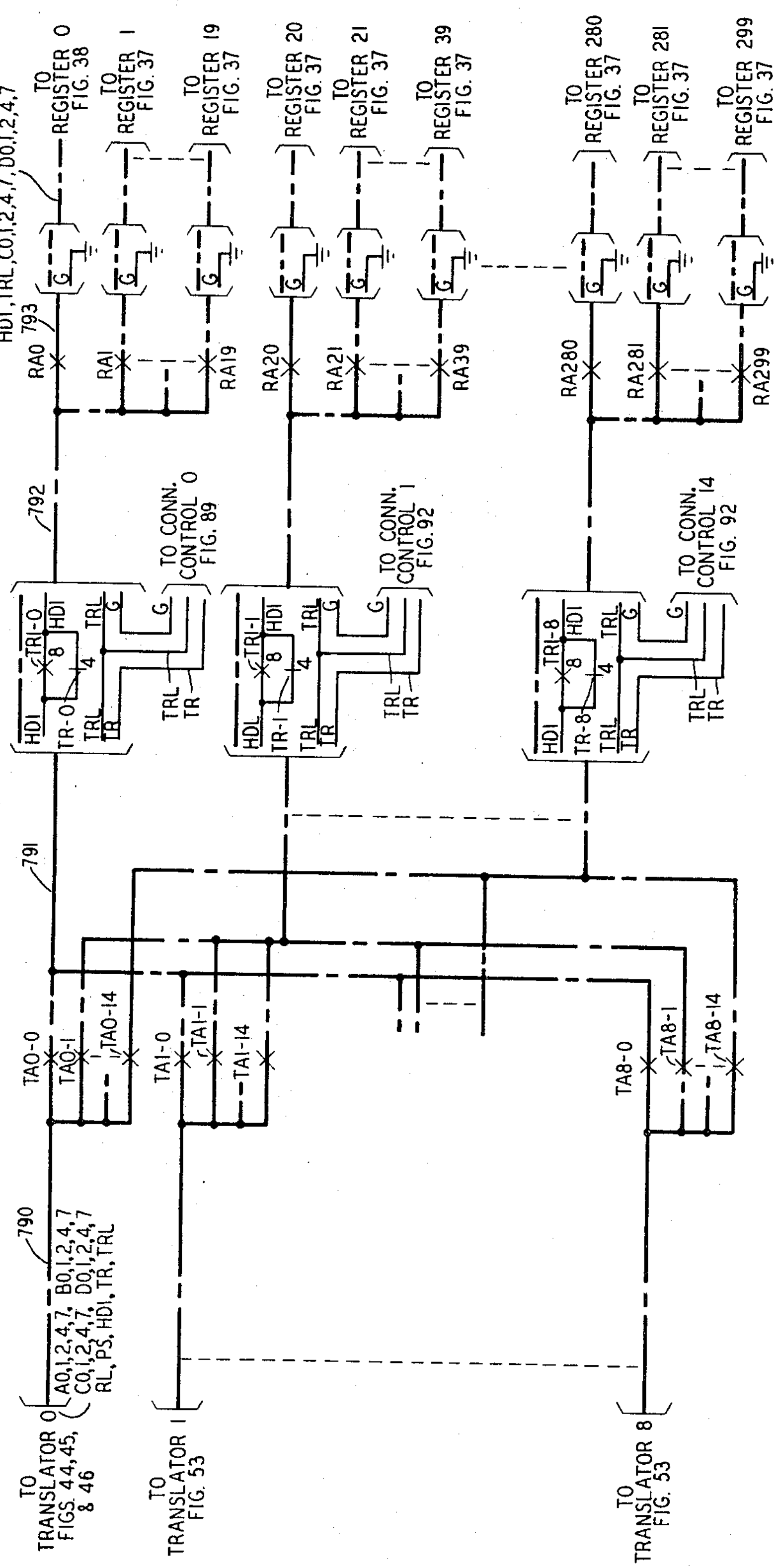



FIG. 78

FIG. 79


TO REGISTER 0 FIG. 38
TO REGISTER 1 FIG. 37
TO REGISTER 19 FIG. 37
TO REGISTER 20 FIG. 37
TO REGISTER 21 FIG. 37
TO REGISTER 39 FIG. 37
TO REGISTER 280 FIG. 37
TO REGISTER 281 FIG. 37
TO REGISTER 299 FIG. 37
RL, PS, A0,1,2,4,7, B0,1,2,4,7
HDI, TRL, C0,1,2,4,7, D0,1,2,4,7
793
RA0
RA1
RA19
RA20
RA21
RA39
RA280
RA281
RA299
G
792
TO CONN. CONTROL 0 FIG. 89
TO CONN. CONTROL 1 FIG. 92
TO CONN. CONTROL 14 FIG. 92
TRI-0
TRI-1
TRI-8
HDI
TR-0
TR-1
TR-8
TRL
TR
8
4
791
DECODER CONNECTORS
TA0-0
TA0-1
TA0-14
TA1-0
TA1-1
TA1-14
TA8-0
TA8-1
TA8-14
790
A0,1,2,4,7, B0,1,2,4,7
C0,1,2,4,7, D0,1,2,4,7
RL, PS, HDI, TR, TRL
TO TRANSLATOR 0 FIGS. 44, 45, & 46
TO TRANSLATOR 1 FIG. 53
TO TRANSLATOR 8 FIG. 53

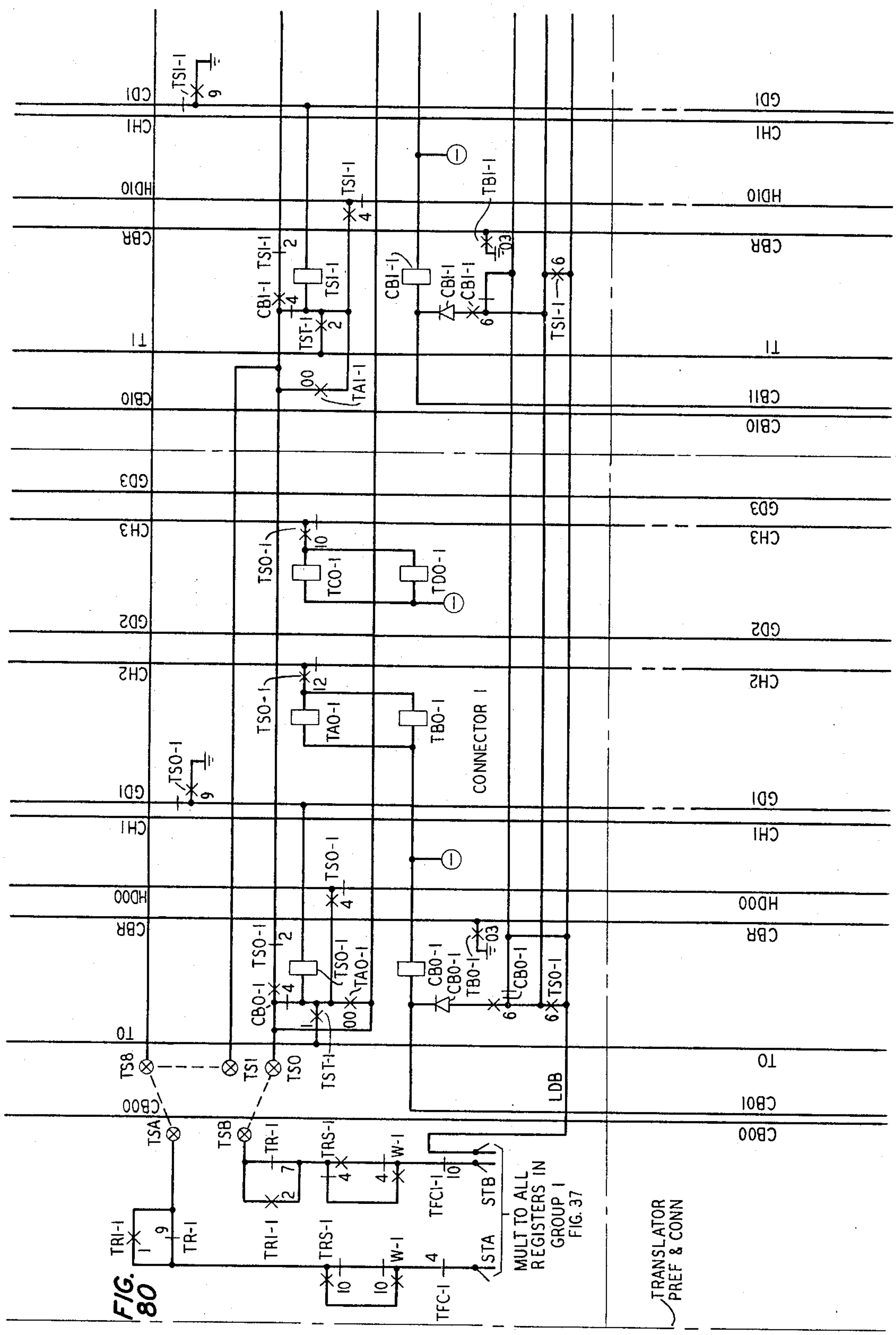

GD1
CH1
HD10
CBR
T1
CB10
CB11
GD3
CH3
GD2
CH2
HD00
T0
CB01
CB00
TSI-1
CBI-1
TST-1
TAI-1
TBI-1
TSO-1
TCO-1
TDO-1
TAO-1
TBO-1
CBO-1
CONNECTOR 1
TS8
TSI
TSO
TST-1
LDB
TSA
TSB
TR-1
TRI-1
TRS-1
W-1
TFC1-1
TFC-1
STB
STA
MULT TO ALL REGISTERS IN GROUP 1 FIG. 37
TRANSLATOR PREF & CONN

FIG. 80

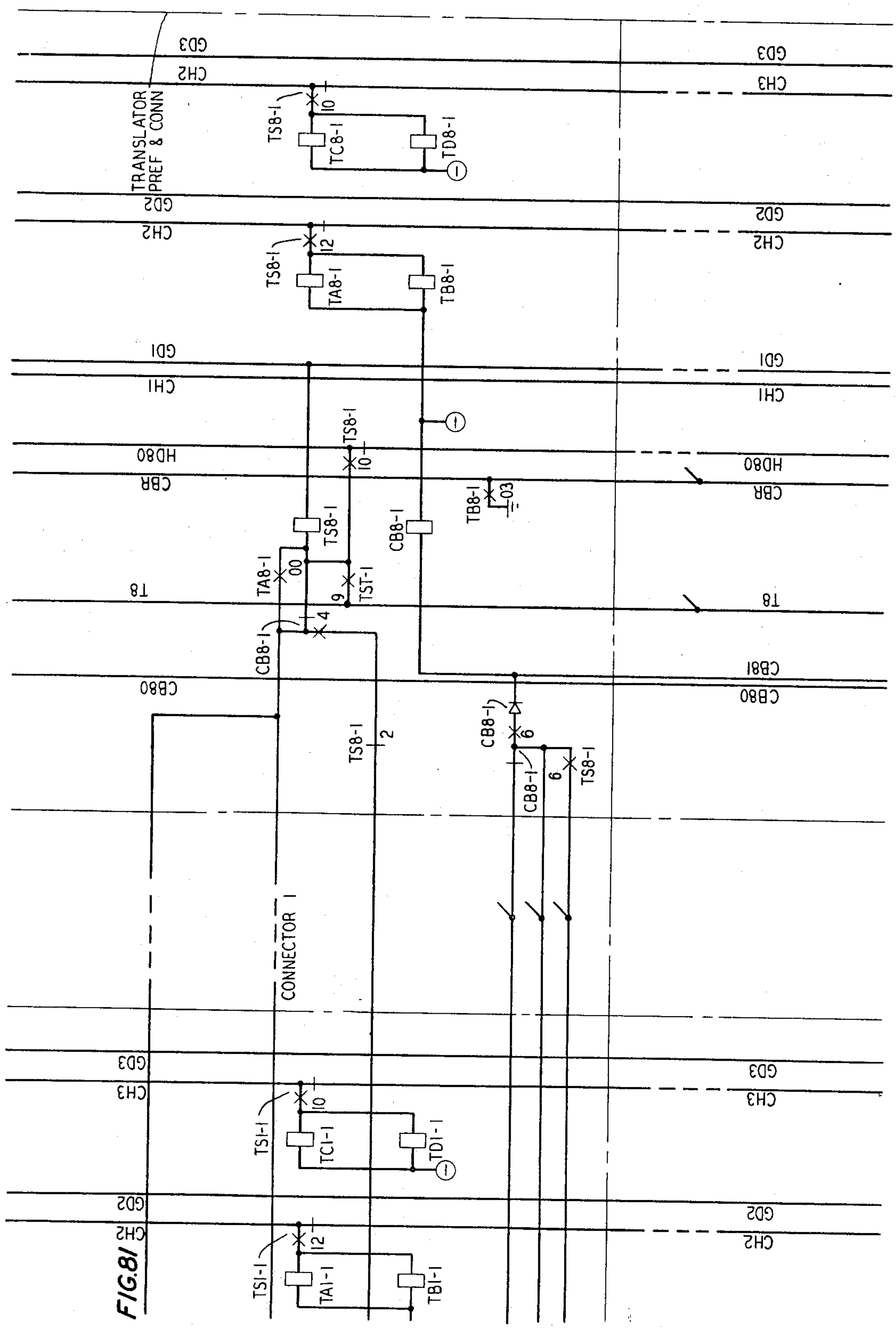

TRANSLATOR PREF & CONN
GD3
CH3
GD2
CH2
GD1
CH1
HD80
CBR
T8
CB81
CB80
CONNECTOR 1
TS8-1
TC8-1
TD8-1
TA8-1
TB8-1
CB8-1
TST-1
TS1-1
TC1-1
TD1-1
TA1-1
TB1-1

FIG. 81

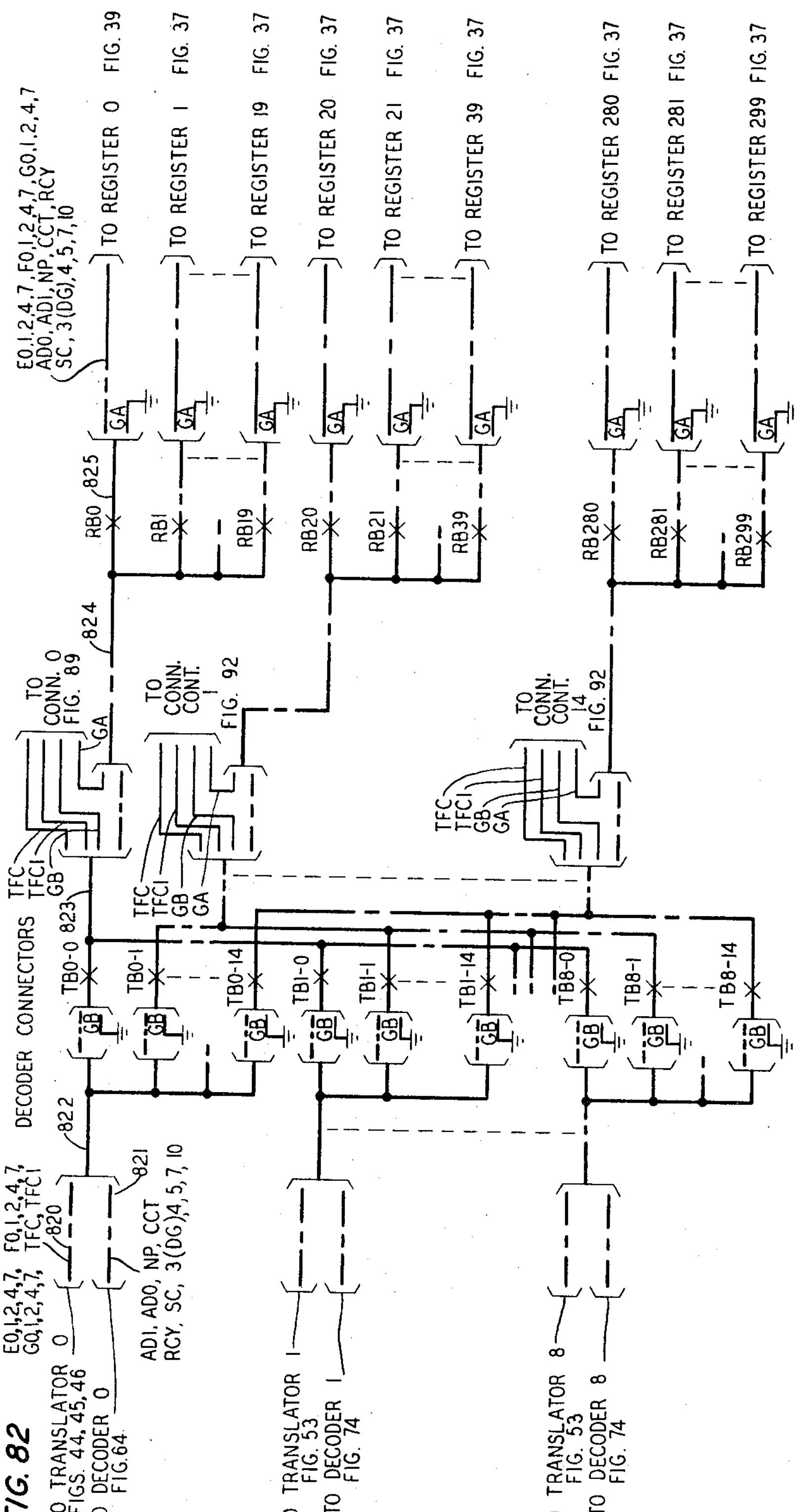

TO REGISTER 0 FIG. 39
TO REGISTER 1 FIG. 37
TO REGISTER 19 FIG. 37
TO REGISTER 20 FIG. 37
TO REGISTER 21 FIG. 37
TO REGISTER 39 FIG. 37
TO REGISTER 280 FIG. 37
TO REGISTER 281 FIG. 37
TO REGISTER 299 FIG. 37
E0,1,2,4,7, F0,1,2,4,7, G0,1,2,4,7
ADO, ADI, NP, CCT, RCY
SC, 3(DG), 4,5,7,10
GA
RB0
825
RB1
RB19
RB20
RB21
RB39
RB280
RB281
RB299
824
TO CONN. 0 FIG. 89
TO CONN. CONT. 1 FIG. 92
TO CONN. CONT. 14 FIG. 92
TFC
TFC1
GB
823
DECODER CONNECTORS
TB0-0
TB0-1
TB0-14
TB1-0
TB1-1
TB1-14
TB8-0
TB8-1
TB8-14
822
820
821
E0,1,2,4,7, F0,1,2,4,7
G0,1,2,4,7, TFC, TFC1
ADI, ADO, NP, CCT
RCY, SC, 3(DG),4,5,7,10
TO TRANSLATOR 0
FIGS. 44, 45, 46
TO DECODER 0
FIG. 64
TO TRANSLATOR 1
FIG. 53
TO DECODER 1
FIG. 74
TO TRANSLATOR 8
FIG. 53
TO DECODER 8
FIG. 74

FIG. 82

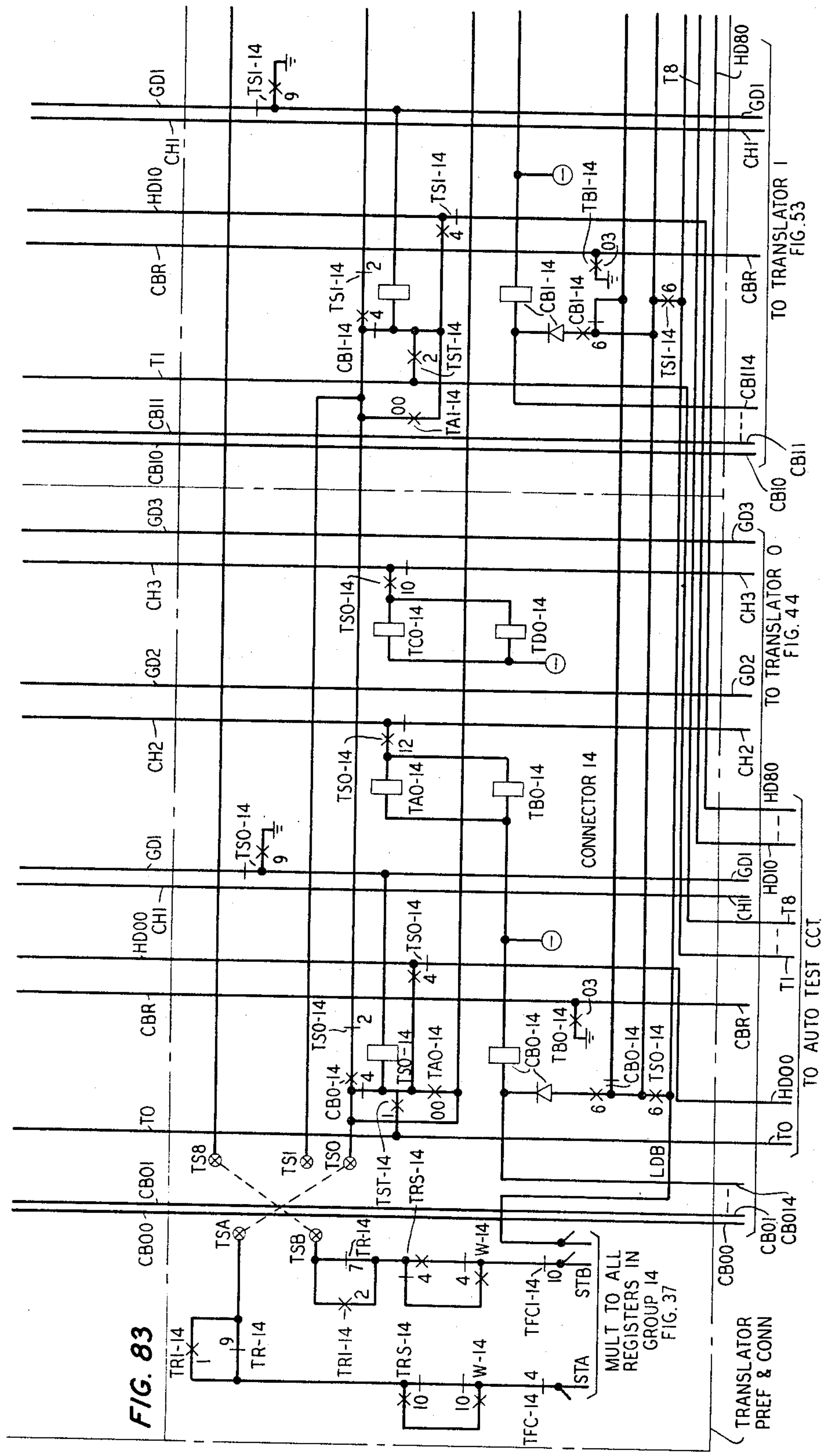

CONNECTOR 14
TO TRANSLATOR I FIG. 53
TO TRANSLATOR O FIG. 44
TO AUTO TEST CCT.
MULT TO ALL REGISTERS IN GROUP 14 FIG. 37
TRANSLATOR PREF & CONN

FIG. 83

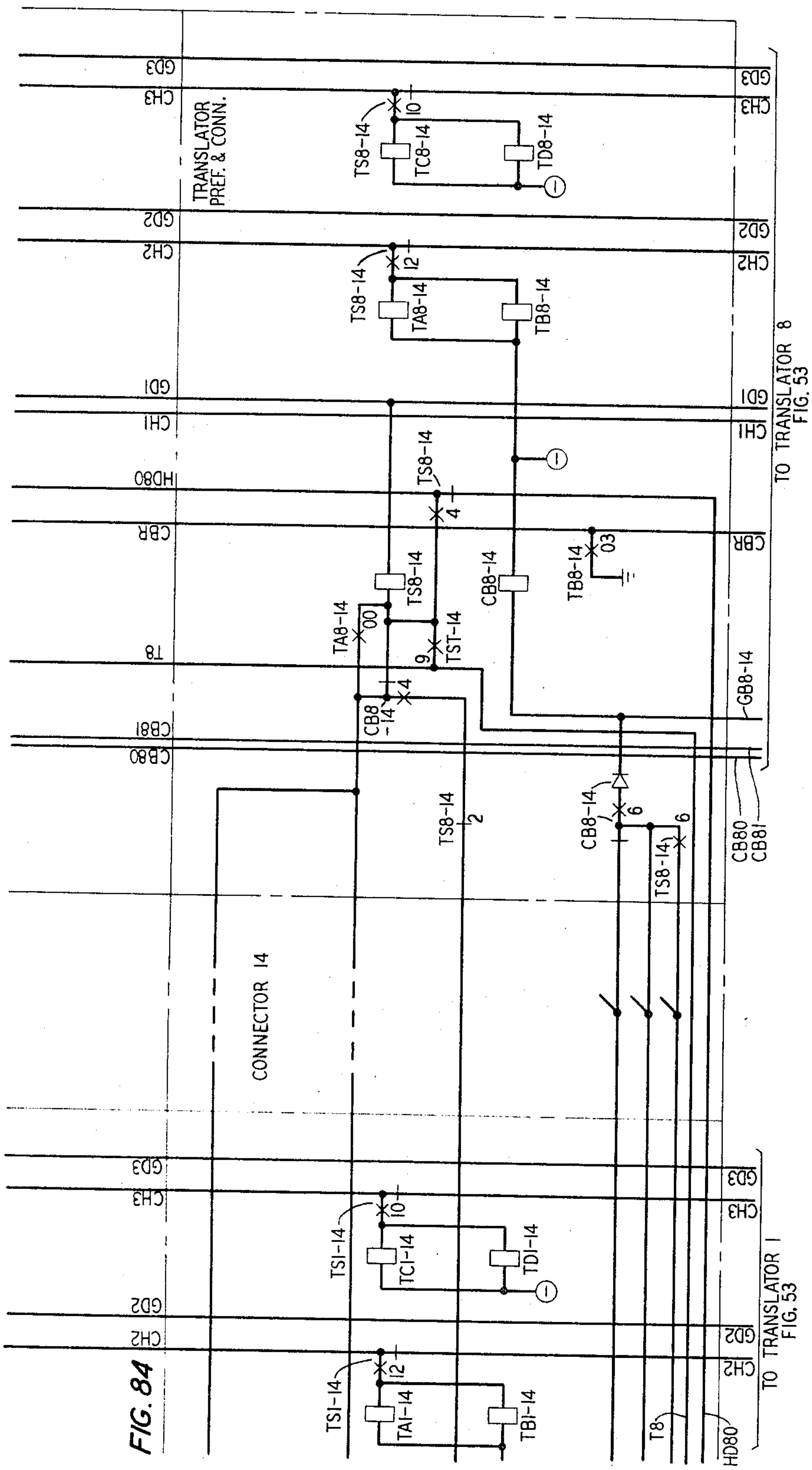

TRANSLATOR PREF. & CONN.
TO TRANSLATOR 8 FIG. 53
CONNECTOR 14
TO TRANSLATOR 1 FIG. 53

FIG. 84

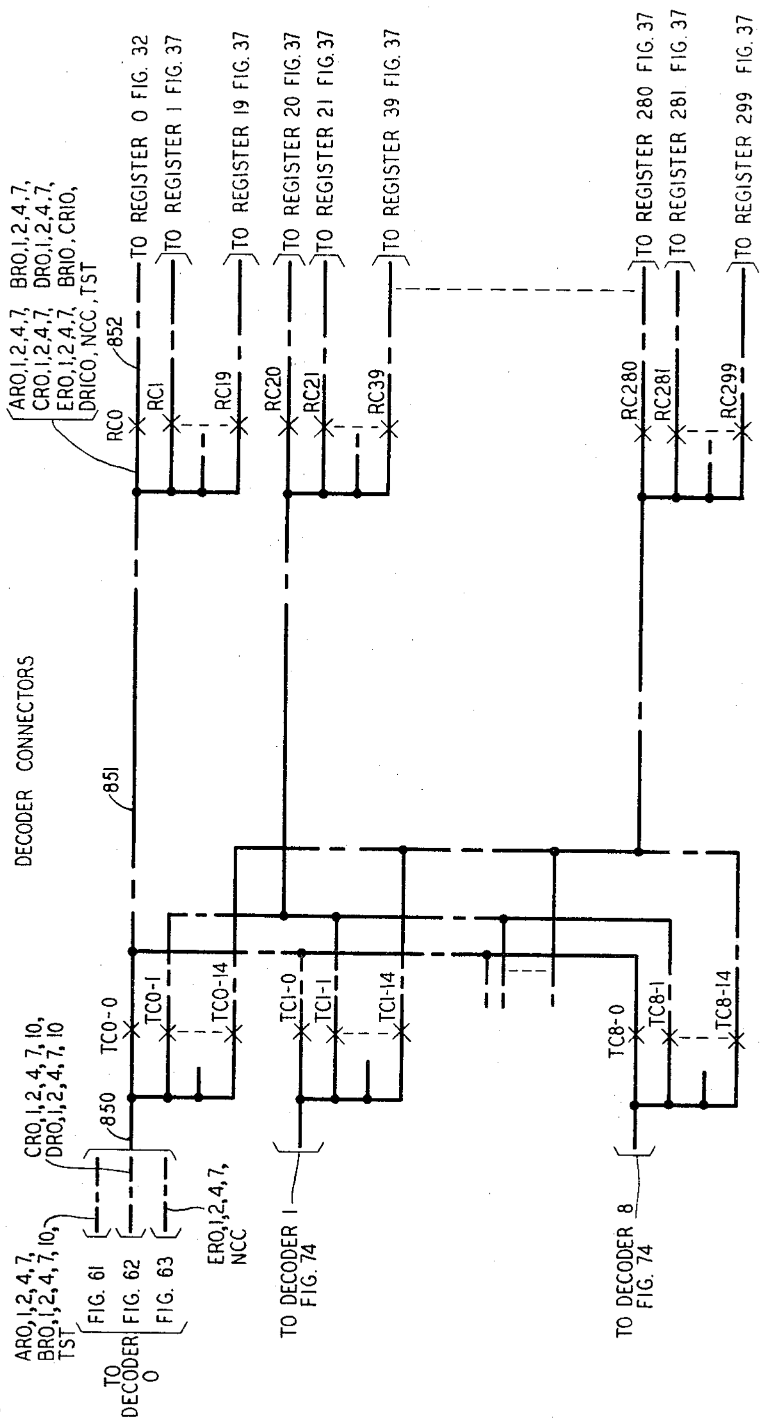

DECODER CONNECTORS
TO REGISTER 0 FIG. 32
TO REGISTER 1 FIG. 37
TO REGISTER 19 FIG. 37
TO REGISTER 20 FIG. 37
TO REGISTER 21 FIG. 37
TO REGISTER 39 FIG. 37
TO REGISTER 280 FIG. 37
TO REGISTER 281 FIG. 37
TO REGISTER 299 FIG. 37
ARO,1,2,4,7, BRO,1,2,4,7,
CRO,1,2,4,7, DRO,1,2,4,7,
ERO,1,2,4,7, BRIO, CRIO,
DRICO, NCC, TST
852
RC0
RC1
RC19
RC20
RC21
RC39
RC280
RC281
RC299
851
TC0-0
TC0-1
TC0-14
TC1-0
TC1-1
TC1-14
TC8-0
TC8-1
TC8-14
850
CRO,1,2,4,7,10,
DRO,1,2,4,7,10
ARO,1,2,4,7,
BRO,1,2,4,7,10,
TST
ERO,1,2,4,7,
NCC
FIG. 61
FIG. 62
FIG. 63
TO DECODER 0
TO DECODER 1 FIG. 74
TO DECODER 8 FIG. 74

FIG. 85

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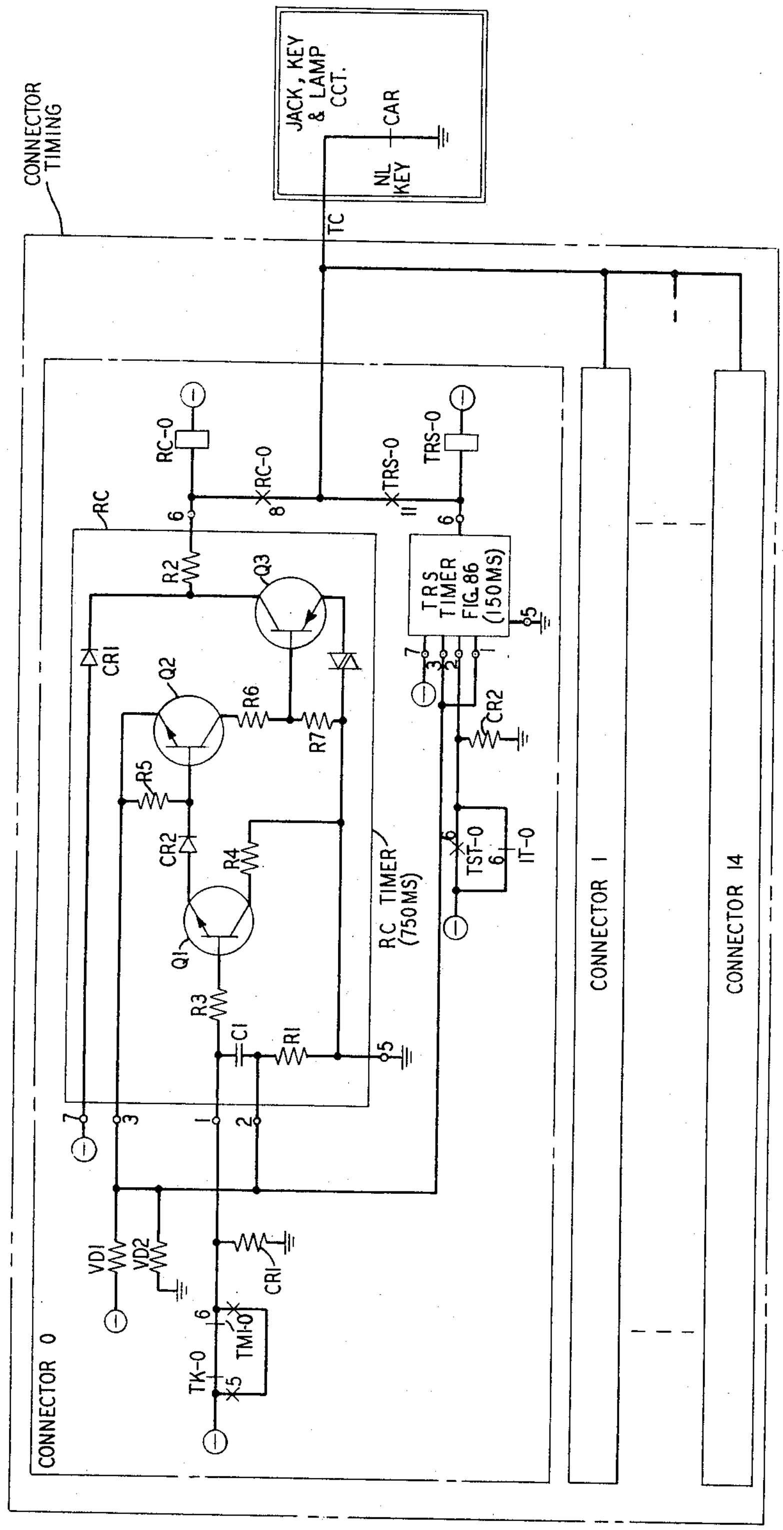



FIG. 86

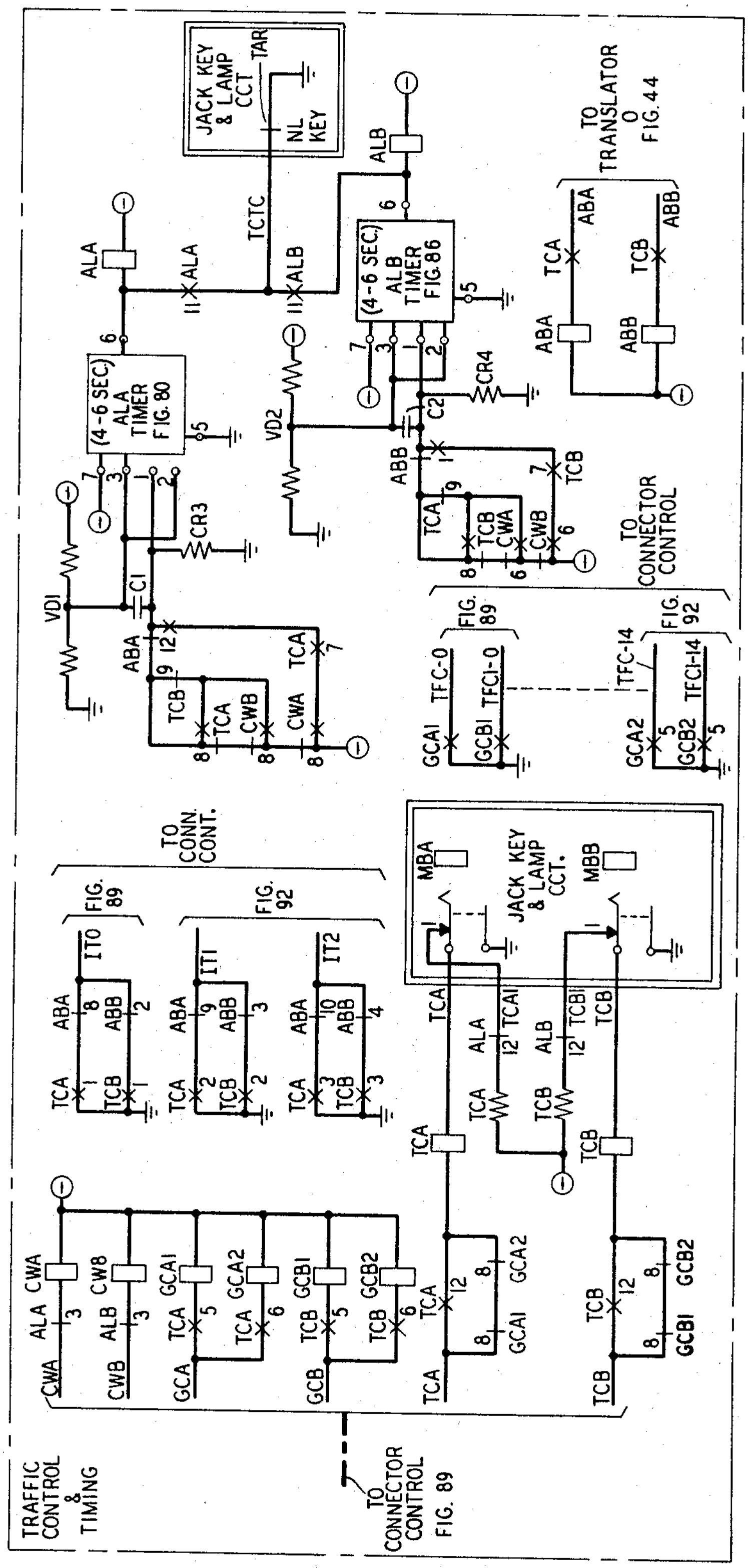
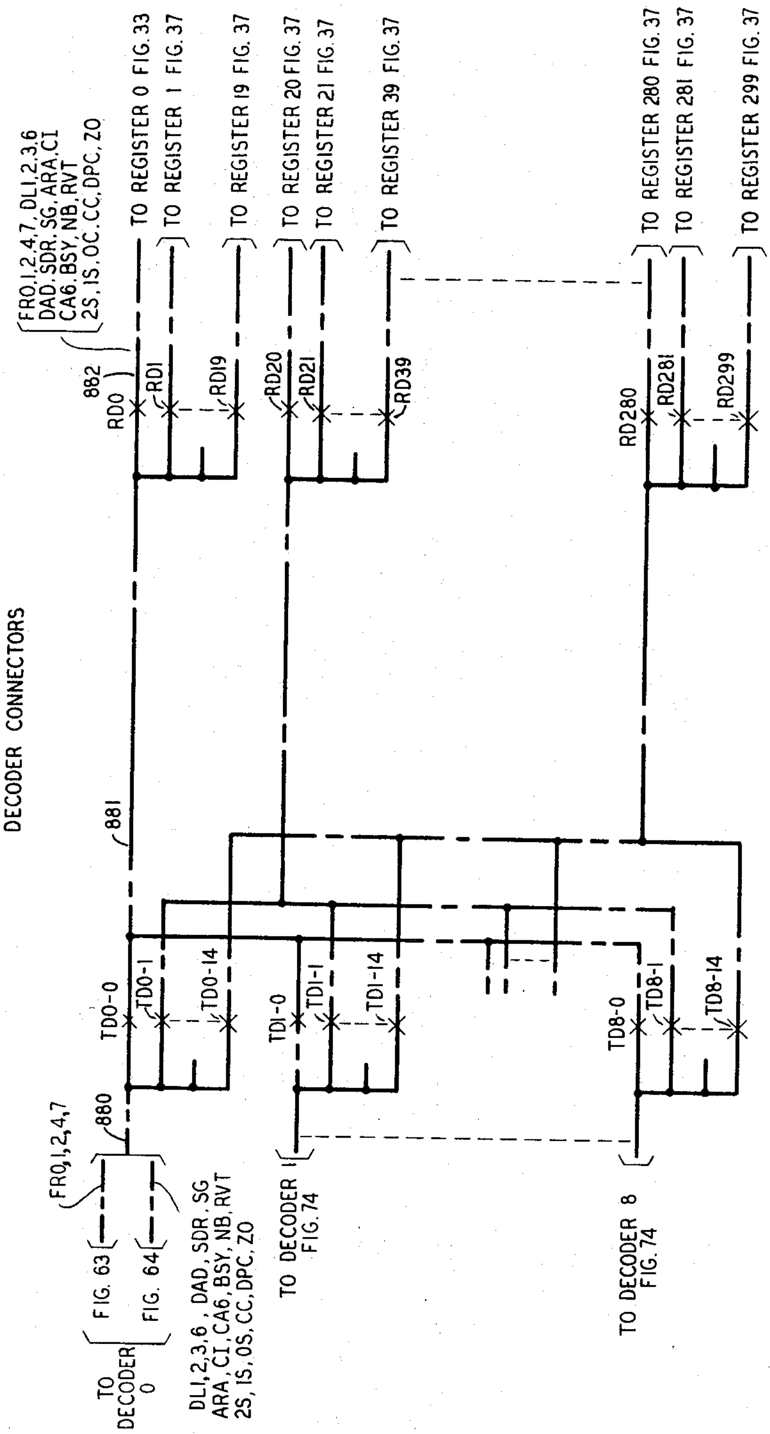


FIG. 87


DECODER CONNECTORS
FR0,1,2,4,7, DL1,2,3,6
DAD, SDR, SG, ARA, CI
CA6, BSY, NB, RVT
2S, 1S, OC, CC, DPC, ZO
882
881
880
TO REGISTER 0 FIG. 33
TO REGISTER 1 FIG. 37
TO REGISTER 19 FIG. 37
TO REGISTER 20 FIG. 37
TO REGISTER 21 FIG. 37
TO REGISTER 39 FIG. 37
TO REGISTER 280 FIG. 37
TO REGISTER 281 FIG. 37
TO REGISTER 299 FIG. 37
RD0
RD1
RD19
RD20
RD21
RD39
RD280
RD281
RD299
TD0-0
TD0-1
TD0-14
TD1-0
TD1-1
TD1-14
TD8-0
TD8-1
TD8-14
FR0,1,2,4,7
FIG. 63
FIG. 64
TO DECODER 0
DL1,2,3,6, DAD, SDR, SG
ARA, CI, CA6, BSY, NB, RVT
2S, 1S, OS, CC, DPC, ZO
TO DECODER 1 FIG. 74
TO DECODER 8 FIG. 74
FIG. 88

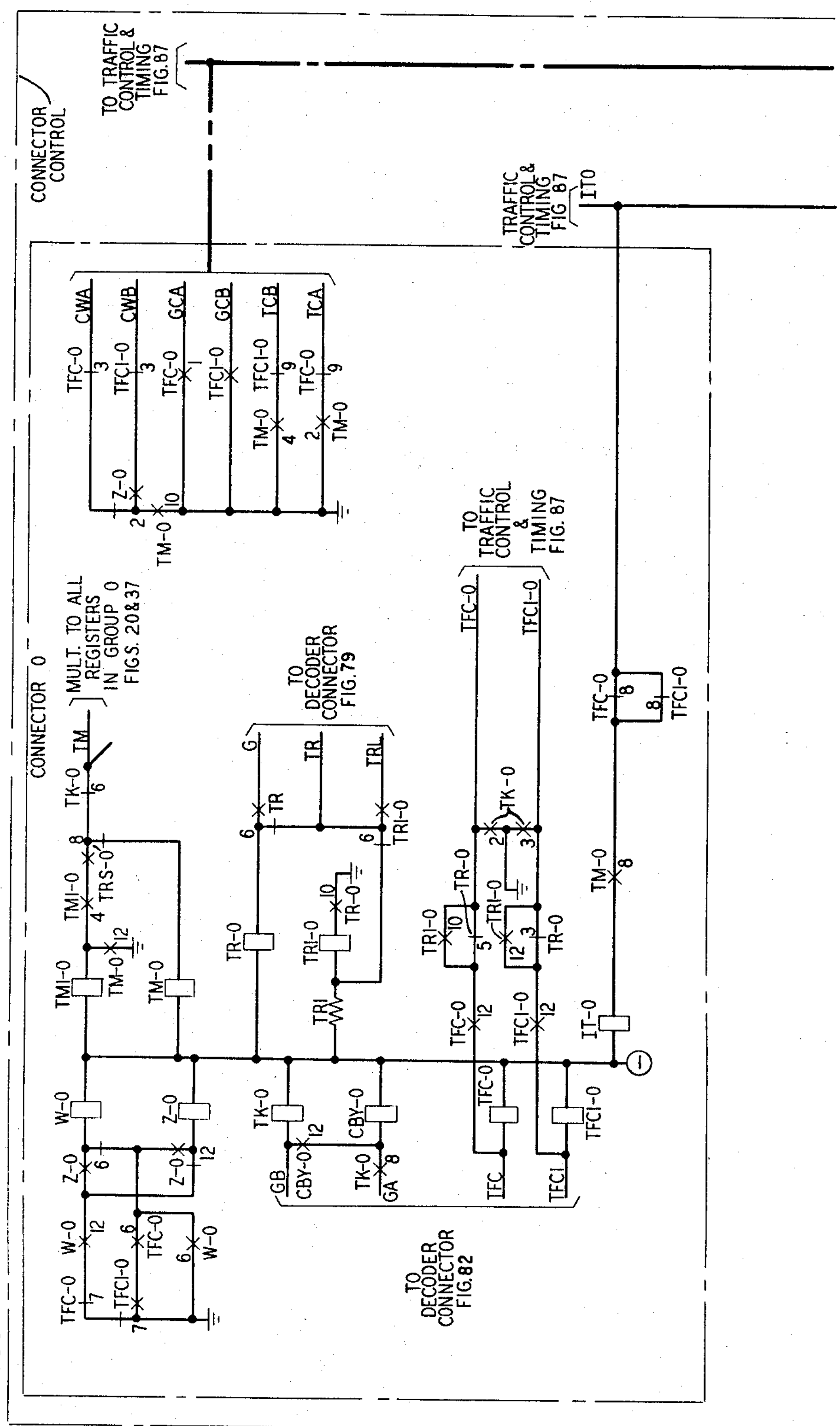

CONNECTOR CONTROL
TO TRAFFIC CONTROL & TIMING FIG.87
TRAFFIC CONTROL & TIMING FIG 87
ITO
CONNECTOR 0
MULT. TO ALL REGISTERS IN GROUP 0 FIGS. 20&37
TO DECODER CONNECTOR FIG.79
TO TRAFFIC CONTROL & TIMING FIG. 87
TO DECODER CONNECTOR FIG.82

FIG. 89

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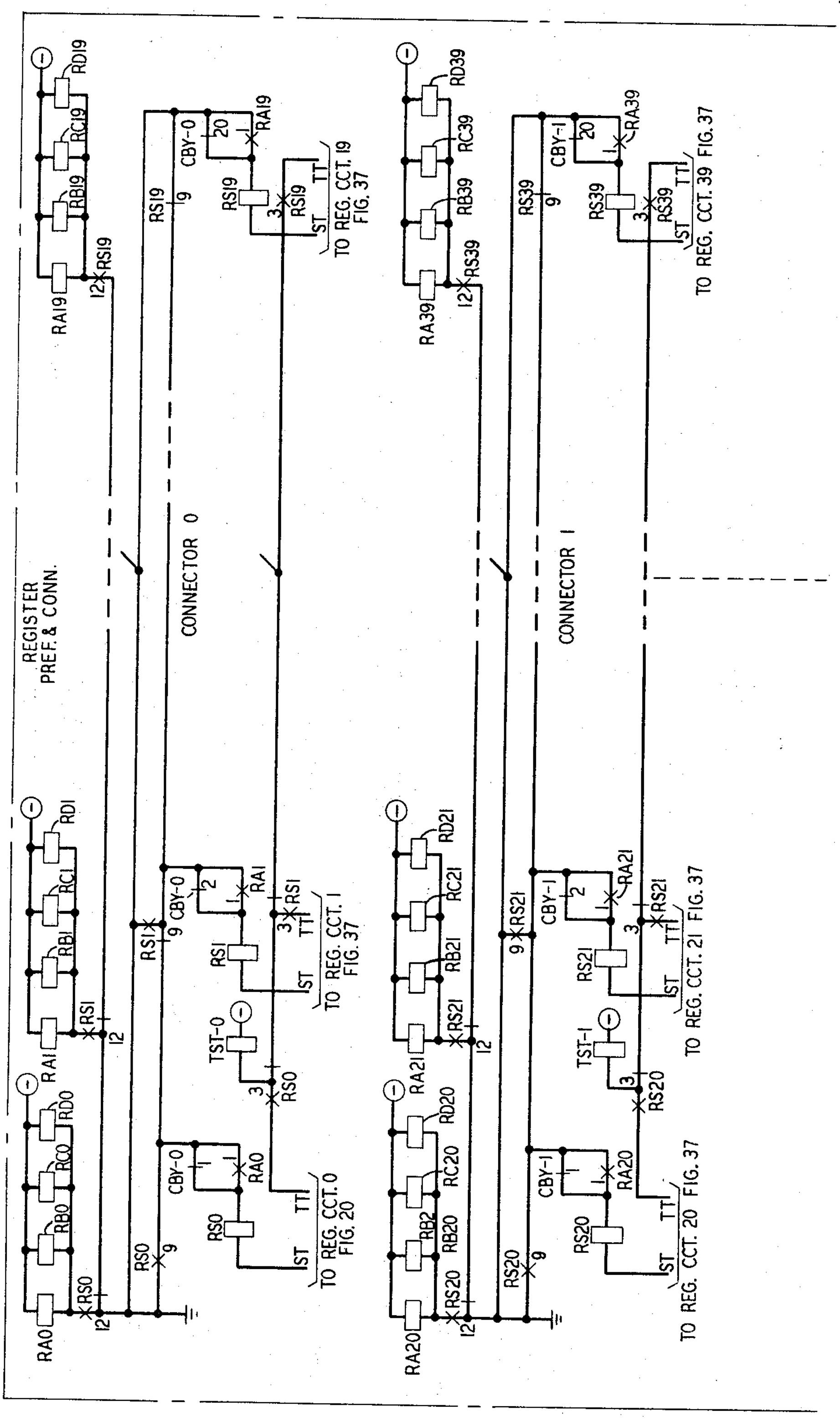


FIG. 90

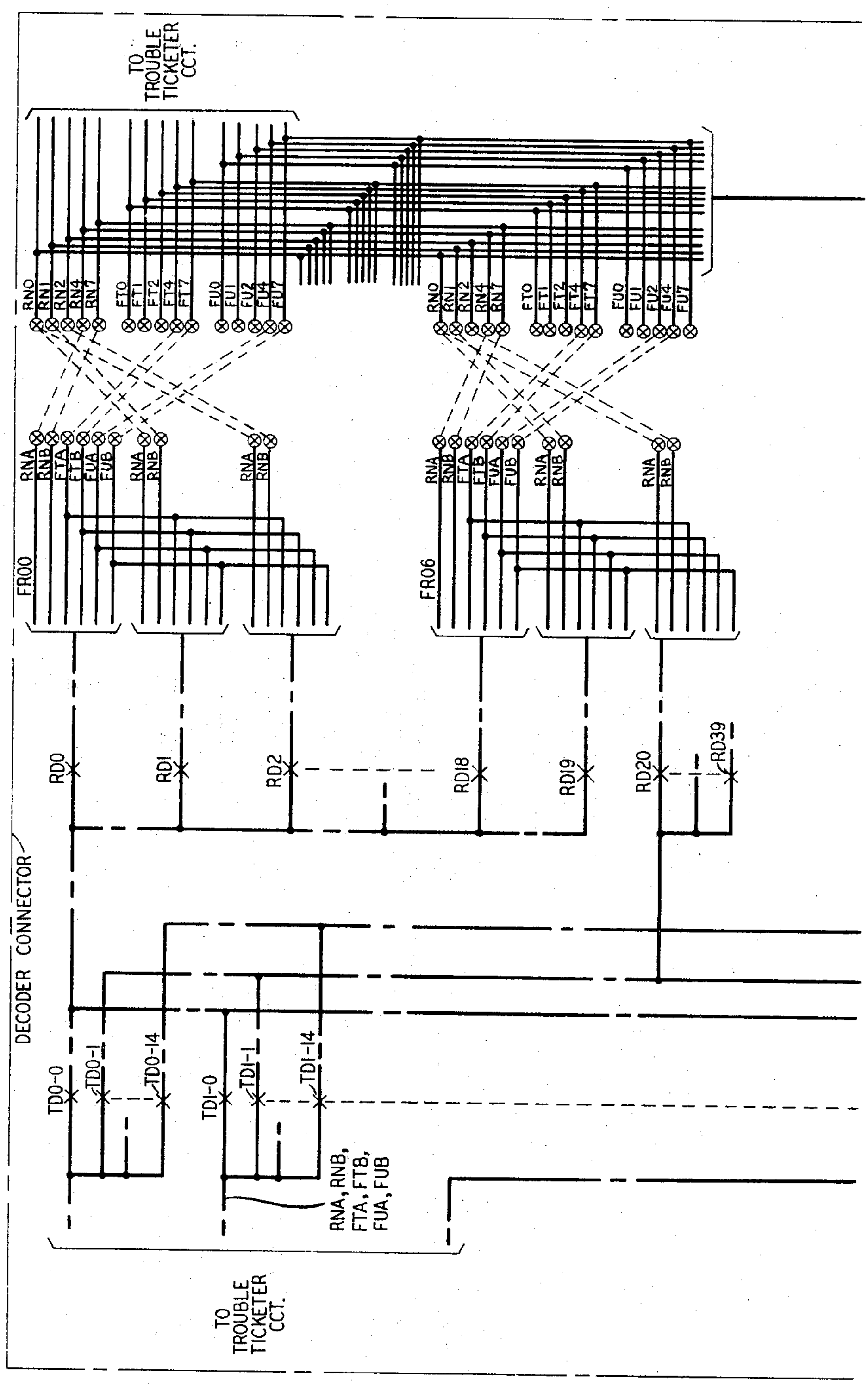
TO TROUBLE TICKETER CCT.
RN0
RN1
RN2
RN4
RN7
FT0
FT1
FT2
FT4
FT7
FU0
FU1
FU2
FU4
FU7
RNA
RNB
FTA
FTB
FUA
FUB
FR00
FR06
RD0
RD1
RD2
RD18
RD19
RD20
RD39
DECODER CONNECTOR
TD0-0
TD0-1
TD0-14
TD1-0
TD1-1
TD1-14
RNA, RNB, FTA, FTB, FUA, FUB
TO TROUBLE TICKETER CCT.

FIG. 91

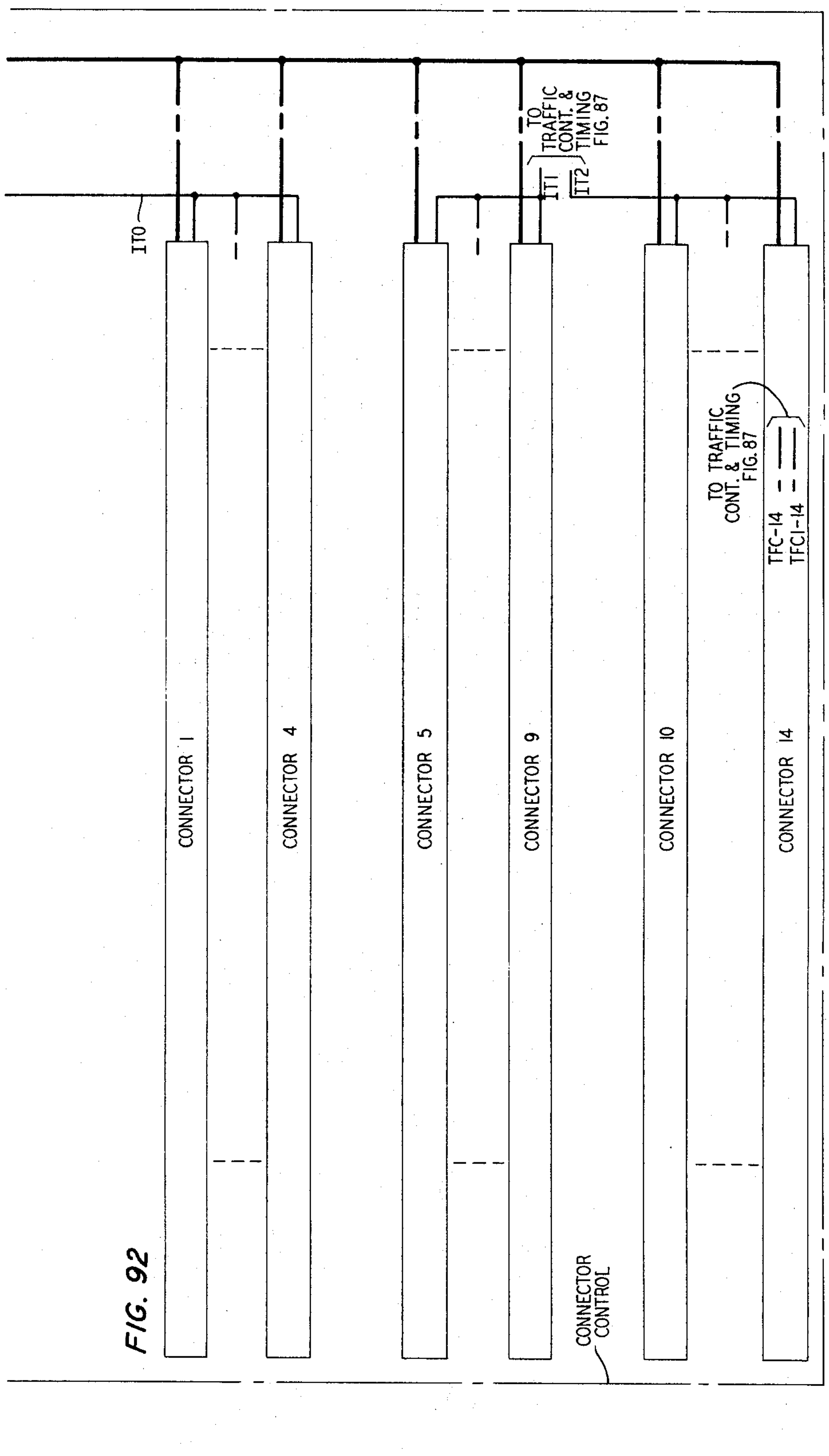
TO TRAFFIC CONT. & TIMING FIG. 87
IT1
IT2
IT0
TO TRAFFIC CONT. & TIMING FIG. 87
TFC-14
TFC1-14
CONNECTOR 1
CONNECTOR 4
CONNECTOR 5
CONNECTOR 9
CONNECTOR 10
CONNECTOR 14
CONNECTOR CONTROL

FIG. 92

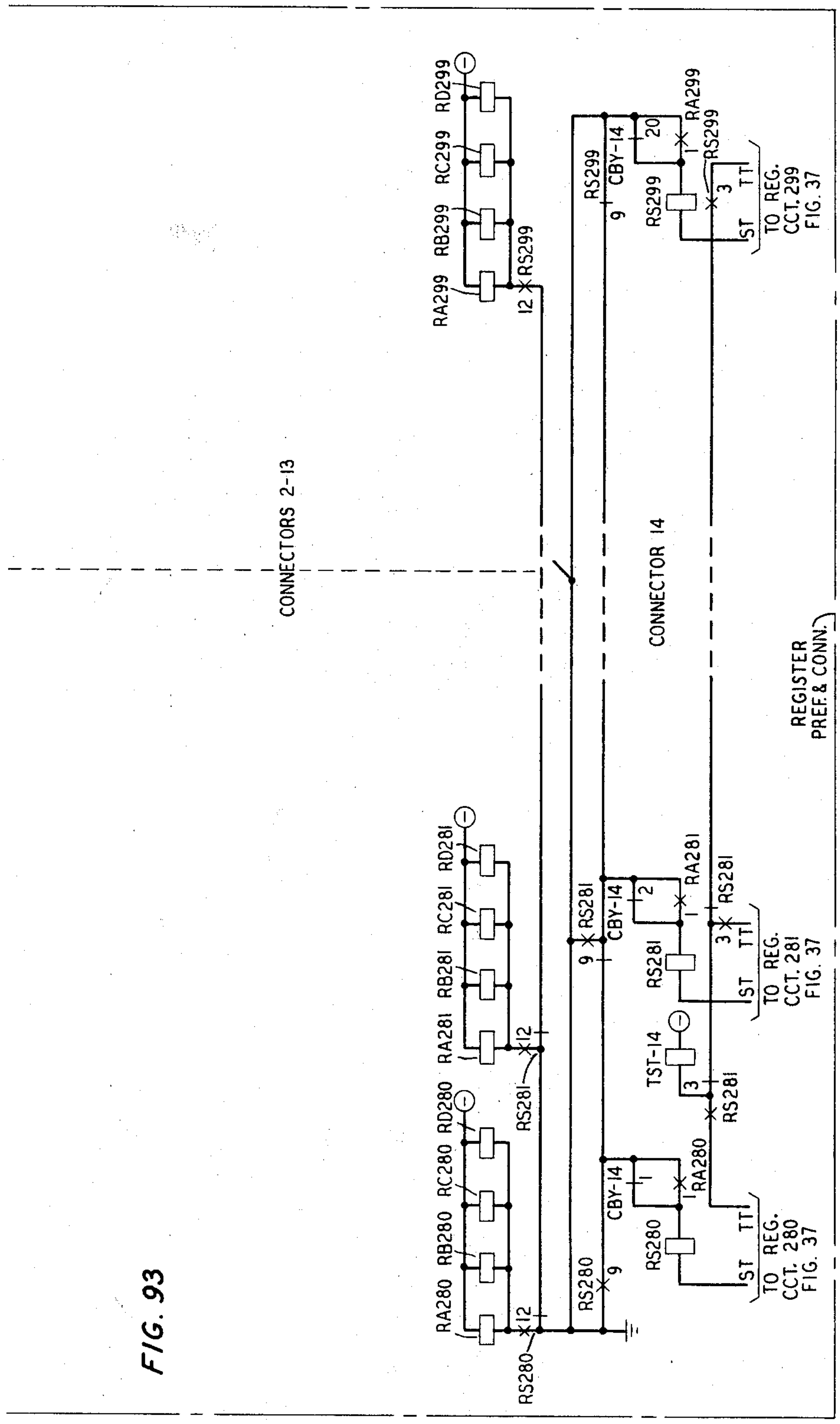
CONNECTORS 2-13
CONNECTOR 14
REGISTER
PREF. & CONN.
RA299 RB299 RC299 RD299
RA281 RB281 RC281 RD281
RA280 RB280 RC280 RD280
RS299
RS281
RS280
CBY-14
TST-14
TO REG. CCT. 299 FIG. 37
TO REG. CCT. 281 FIG. 37
TO REG. CCT. 280 FIG. 37
ST
TT

FIG. 93

Nov. 26, 1968 G. RIDDELL 3,413,422

STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

Filed Sept. 24, 1965

113 Sheets-Sheet 111

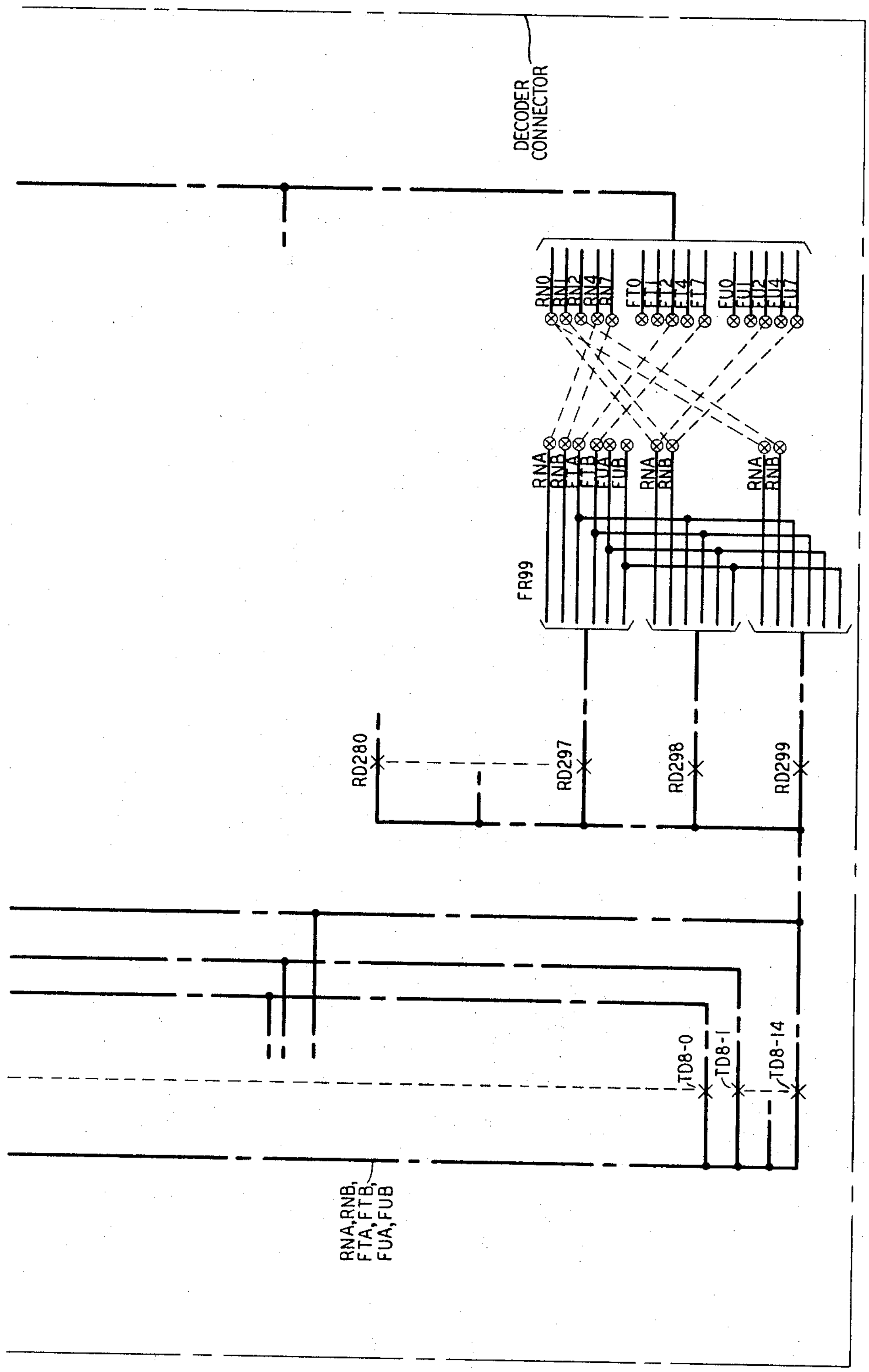


FIG. 94

Nov. 26, 1968 G. RIDDELL 3,413,422
STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING
MEANS FOR DERIVING SWITCHING CODES
Filed Sept. 24, 1965
113 Sheets-Sheet 112

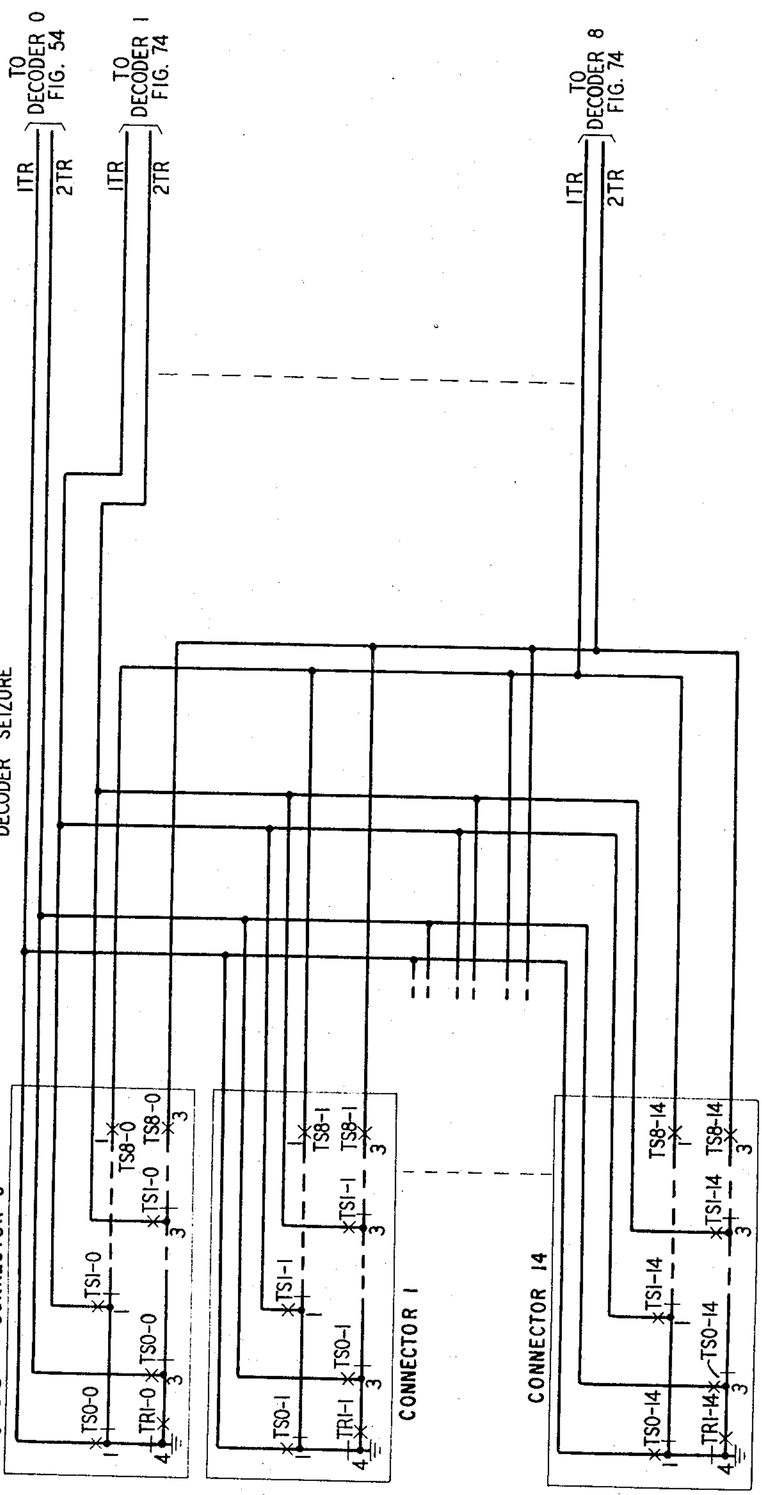


FIG. 95

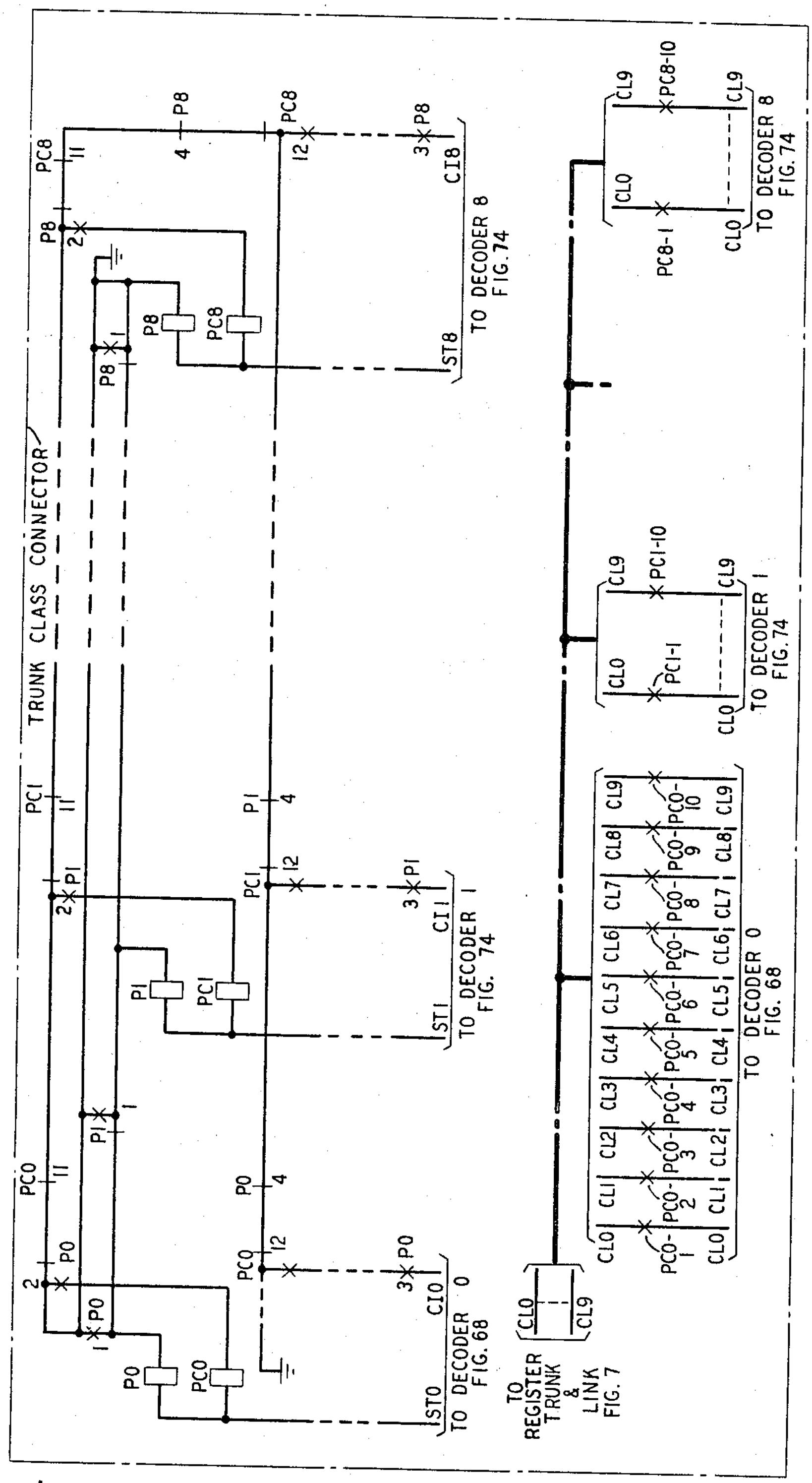
TRUNK CLASS CONNECTOR
TO DECODER 8
FIG. 74
TO DECODER 1
FIG. 74
TO DECODER 0
FIG. 68
TO REGISTER TRUNK & LINK
FIG. 7

FIG. 96

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3,413,422

# STAGE BY STAGE SWITCHING SYSTEM HAVING TRANSLATING MEANS FOR DERIVING SWITCHING CODES

George Riddell, Lincroft, N.J., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

Filed Sept. 24, 1965, Ser. No. 489,807
27 Claims. (Cl. 179—18)

## ABSTRACT OF THE DISCLOSURE

A stage by stage switching system having a plurality of registering means and translator means wherein serially related switching stages are settable under control of a plural digit address code to establish a tandem connection through to a terminating stage. Apparatus is provided which permits initial switching digits to set initial switching stages independently of the complete address code registration and to prevent the last switching digit from setting the last switching stage until the address code registration is completed.

This invention relates generally to switching systems wherein a plurality of serially related switching stages is settable under control of a plural digit address code to select and establish a tandem connection through to a terminating line.

The invention relates more particularly to such systems using code conversion wherein the address code is used to derive a plural digit switching code which in turn is used to set the switching stages.

The invention relates specifically to such code conversion systems wherein the derived switching code comprises a last switching digit and a variable number of initial switching digits, wherein the number of initial switching digits in a derived switching code is used initially to set a corresponding number of switching stages in tandem, and wherein the last switching digit in a derived switching code is used subsequently to set a terminating line-seizure stage.

One well-known example of such a switching system, the one used herein as an exemplary embodiment of the invention, is a step-by-step telephone switching system using common control circuitry. Well known to the art are such step-by-step systems wherein the common control comprises the combination of a register-sender of some type and a route translator or decoder for (1) registering a plural digit address code, (2) deriving from the address code, or a portion thereof, a plural digit switching code, (3) using the switching digits to set the switch train to seize an outgoing trunk, and (4) transmitting over the seized trunk data including all or some of the registered address digits or of some data exclusive of the address digits.

Heretofore, in such systems involving the setting-up of a number of switching stages in tandem, it has been considered advisable to wait until all address code digits have been received before controlling the switching stages in accordance with the derived switching code. One basic reason for this delay is the uncertainty of the speed with which the address digits may arrive and the uncertainty of the ultimate receipt of a complete address code. If, as is usually the case, the first few address code digits are used to derive the switching digits (generally one or two or three), the latter are available for use very quickly such that, if used when available, trunk seizure could take place a substantial time prior to when complete address code registration is effected. Such a situation could unduly tie up an outgoing trunk and some expensive central office equipment on the other end of the seized trunk when perhaps the entire connection might need to be released if for some reason address code registration actually never became complete. On the other hand, where all or some of the address digits are ultimately to be transmitted forward on a relatively fast multifrequency (MF) signaling basis following the setting of a switch train, it is possible, particularly where the address code is being received on the relatively slow dial pulse (DP) signaling basis, for MF outpulsing to catch up to the receiving sequence of address code digits, whereby the entire outpulsing machinery (and the remote receiving equipment on the other end of the trunk) is held up waiting for completion of address code registration.

It is the main object of the present invention to make use of some of the time normally wasted in waiting for complete address code registration and to do so without unduly engaging expensive circuits.

This object is attained according to a basic feature of the invention by the provision of means to allow initial switching digits to set initial switching stages independently of complete address code registration and to prevent the last switching digit from setting the last switching stage until address code registration is complete.

In such a system where the number of switching digits to be used in setting the switching stages may be a fixed number, the common control could be adjusted to accomplish the above object independently of other factors. However, where the number of switching digits, commonly referred to as exit digits, can vary, say from one to three, it is necessary for the common control to have embodied therein some logic for ascertaining in each instance which exit digit will cause trunk seizure, for instance.

It is another feature of the present invention to enable the common control to ascertain the variable digit position among the exit digits of the last or trunk seizure digit by the provision of means controlled incident to code conversion to ascertain such information.

Generally, in such systems, and particularly where one employs code conversion to derive exit digits, after the last exit digit is used to seize an outgoing circuit, such as a trunk to a remote office, some data is transmitted over the seized trunk. This data usually consists of one or more digits of the address code; and, in systems using MF outpulsing, it is usual to transmit an initial "readying signal" to prepare the remote MF receiving circuitry. The outpulsing position of such a data signal or digit is determined by the number of exit digits, such data digit being usually derived as an incident to the code conversion operation. The common control circuitry employed for the generation of exit digits and for outpulsed data digit information generally takes the form of a series of digit registers wherein the exit digits and such a data digit are registered incident to the code conversion operation and a signal generator controlled sequentially by such registers according to a prescribed order of registration.

Another feature of the present invention is the provision of means to allow each exit digit register in sequence to control the signal generator independently of complete address code registration except the register containing the last exit digit, the latter being prevented from controlling the signal generator until address code registration is complete.

A particular feature related to the immediately foregoing feature is the provision of means for indicating whether or not address code registration is complete and for controlling the outpulsing accordingly.

In such outpulsing arrangements some sequencing circuitry is usually employed for placing the signal generator successively under the control of successive exit digit registers in a given sequence. It becomes necessary, therefore, in order to accomplish the main object of the present invention, for the sequencing circuit to know when the last of the initial exit digit registers will control the signal generator, in order for outpulsing of the last exit digit to be placed under the control of complete address code registration.

Another feature of the present invention is the provision of means enabling the outpulsing sequence circuit to "look ahead" to ascertain the outpulsing position of the last exit digit. Such action may be conveniently entitled a "sniffing" function—to sniff ahead of the outpulsing sequence to ascertain the outpulsing position of the last exit digit.

Where, as for example in a step-by-step system, exit digits are generally decimal digits of from 1 to 0 (ten) pulses, it is not usual to alter such digit registrations so as to include therein information in addition to the digital value. Thus, it is virtually impossible to distinguish per se an initial exit digit registration from a last exit digit registration. However, where the outpulsing sequence is to include a data digit or data signal following the last exit digit, and particularly where such data digit can be characterized or distinguished as such, the sniffing operation can, by sniffing ahead in the outpulsing sequence, ascertain the outpulsing position of such a data digit, thereby to ascertain the position (immediately preceding the data digit) of the last exit digit.

Another feature of the present invention is the provision of means for specially marking a data digit in the outpulsing sequence immediately following the last exit digit, whereby the sniffing circuitry can ascertain the outpulsing position of the last exit digit.

The embodiment of the invention chosen for exemplary purposes herein is a common control step-by-step telephone switching system including a register-translator-sender type of control whereby code conversion can be effected. An address code digit register is provided for registering a complete plural digit address code, such as the usual seven-digit directory number of a called party. The first three registered digits are transmitted to the translator (actually a combined translator and decoder) where they are used to derive switching digit or exit digit information. The disclosure assumes three selector groups presupposing trunk access by one or two or three exit digits. One typical example of the code conversion would be where three dial pulse digits are required for outgoing trunk seizure followed by MF outpulsing of all seven address code digits, the MF outpulsing requiring the sending (prior to digital transmission) of a so-called KP pulse to condition the remote receiving equipment for receiving the address code digits sent thereto on an MF basis. The three arbitrary exit digits and the KP signal, both derived from the code conversion operation, are registered in four arbitrary digit registers, the KP signal appearing in the fourth outpulsing position following the outpulsing position of the last of the three switching digits. The registration of the KP signal is marked as such in a manner to distinguish it from a normal decimal digital registration.

As soon as the arbitrary digits and the KP signal (or pulse) are registered, the outpulsing circuitry immediately starts an outpulsing sequence whereby the first exit digit controls a first selector on a dial pulse basis to seize an idle second selector, the second exit digit controls a second selector on a dial pulse basis to seize an idle third selector, and the third exit digit controls the third selector on a dial pulse basis to seize an idle outgoing trunk. Thereafter, the outpulsing will continue, assuming that the remote receiving equipment has been attached, to transmit on an MF signalling basis the KP pulse followed by the seven address code digits. Means is used to ascertain when complete address code registration is complete; however, the outpulsing of the initial (all but the last one) switching digits takes place regardless of the completeness of address code registration.

The outpulsing of the third or last switching digit, the one which will cause outgoing trunk seizure, is not allowed to take place unless and until address code digit registration is complete. When this takes place and trunk seizure occurs, it is expected that a "stop" signaling condition will prevail on the trunk, whereupon the outpulsing of the KP pulse on an MF basis will be held up until the remote equipment changes the stop condition to a "go" condition. This is then followed by the MF outpulsing of the KP pulse followed by the seven address code digits and ending with a STOP signal or ST pulse to inform the remote equipment that outpulsing is complete.

The registration of decimal digits is done on the well-known two-out-of-five basis where fine digit relays designated, 0, 1, 2, 4 and 7 are provided and where the value of the registered digit is determined by the following two-out-of-five operated relay coding:

| Digit: | Relays operated |
|---|---|
| 1 | 0, 1 |
| 2 | 0, 2 |
| 3 | 1, 2 |
| 4 | 0, 4 |
| 5 | 1, 4 |
| 6 | 2, 4 |
| 7 | 0, 7 |
| 8 | 1, 7 |
| 9 | 2, 7 |
| 0 (10) | 4, 7 |

For MF digital outpulsing, a tone supply is provided having five separate frequencies representing the above 0, 1, 2, 4 and 7 coding as follows:

| Coding: | Frequency, c.p.s. (cycles per second) |
|---|---|
| 0 | 700 |
| 1 | 900 |
| 2 | 1100 |
| 4 | 1300 |
| 7 | 1500 |

Whenever a decimal digit is to be transmitted on an MF signalling basis one pulse of two-out-of-five tones is transmitted with the same coding as indicated above for two-out-of-five relay registration of decimal digits.

Where MF pulsing is used, such transmissions over an outgoing trunk must be preceded by an MF signal which is used at the remote equipment to make ready the circuitry necessary for receiving such signals. This data signal, called a KP pulse, is composed of two frequencies—one is 1100 c.p.s. and the other is 1700 c.p.s.—a coding of 2 and 10—the latter being a sixth frequency supplied by the tone supply and identified as a coding of 10 in the above coding-versus-frequency table. The presence of the coding 10 in the KP pulse distinguishes it from a decimal MF pulse since the latter never include any coding except 0, 1, 2, 4, or 7. This distinguishing coding or mark is used by the outpulsing sequence circuitry to detect the variable position of the KP pulse, thus to detect the outpulsing position of the last switching digit since the latter is registered in the arbitrary register immediately precedng in the outpulsing sequence the one containing the KP pulse.

The conclusion of MF outpulsing is followed (that is, after the address code digits) by the transmission of a signal indicating to the remote equipment the end of pulsing. This signal, designated an ST pulse, consists of the two frequencies 1500 c.p.s. and 1700 c.p.s.—a coding of 7 and 10.

As the outpulsing sequence circuitry is about to use each arbitrary exit digit on a dial pulse basis to control a selector, it looks ahead or sniffs ahead one arbitrary digit register to see if the coding 10 is involved. If the 10 coding is detected, such as in the fourth register position (KP pulse) of the assumed example, the third register containing the last decimal exit digit will not be used unless or until address code registration is complete.

In this manner each initial exit digit is used in sequence as soon as the switching code is available from the decoding process; but, actual trunk seizure is prevented until address code registration is complete. Thus, time is saved by making a partial setting of the switch train, followed by the quick use of a single trunk seizure digit as soon as address code registration is complete.

A number of advantages flow from the above partial setting of the switch train. First of all, regardless of how many exit digits are involved in the arbitrary switching code, trunk seizure can take place by the use of a single selector controlling digit as soon as address code registration is complete, thus reducing the holding time of the common control circuitry. Secondly, stopping selector control one exit digit prior to trunk seizure precludes engagement of remote equipment until there is reasonable assurance (complete address code registration) that the call is actually to be completed, thus for instance eliminating additional time and circuitry necessary for a partial dial release. Thirdly, where the relatively rapid MF type of outpulsing is used in conjunction with a relatively slow DP type of inpulsing, delaying trunk seizure until address code registration is complete prevents MF outpulsing from overtaking DP inpulsing, thus allowing MF signaling to proceed at a rapid uninterrupted rate once it begins. Other advantages will be apparent to those skilled in the art.

## THE DRAWINGS

The exemplary embodiment is shown in two parts, one being a complete detailed disclosure of the above-mentioned common control step-by-step telephone switching system, the other being a highly skelentonized feature sketch based on the more complete circuitry. The total drawing disclosure consists of FIGS. 1A through 1N, 1P through 1Z,1AA through 1AC and 2 through 96 wherein:

FIG. 1A is a functionally connected block diagram of the complete detailed disclosure;

FIG. 1B shows the arrangement of FIGS. 2 through 96 to disclose the detailed circuitry; and

FIGS. 1C–1N, 1P–1Z and 1AA and 1AC (same sheet as FIG. 1E) make up the feature sketch.

The detailed disclosure of FIGS. 2 through 96 is composed of eight major circuit divisions as identified in FIG. 1B. While FIG. 1A indicates the presence of a plurality of like circuits, such as TOUCH-TONE receivers and converters, registers, translators, and decoders, only one such equipment is shown in detail. In this regard, the register trunk and link circuit shown in a simplified form in FIGS. 2 and 7 is more fully disclosed and is claimed in Patent 3,159,716 to G. Riddell and C. A. Throckmorton of Dec. 1, 1964.

## THE DESCRIPTION ARRANGEMENT

The description to follow is arranged according to the following outline:





## INTRODUCTION

At the outset it is considered advisable to explain some conventions and symbols used throughout the circuitry:

### Circuit conventions

Generally, the detached contact type of schematic is used wherein the contacts controlled by a relay winding are not necessarily physically attached to or associated on the drawing with the winding itself. For instance, in FIG. 1I the winding of the SLT relay is shown in the top right of the sheet and various contacts controlled by the SLT relay appear on FIG. 1I at different places and appear even on different sheets. On FIG. 1I, in circuit with the bottom winding of relay SLT is an X appearing on the lead from resistance SLT: this X is marked with a **1** and with the letters SLT, indicating the No. **1** contact controlled by relay winding SLT and indicating a make or front contact which is open when relay SLT is released and closed when relay SLT is operated. In the right center of FIG. 1I is the winding of relay REC: in circuit therewith is a short dash line marked with a **3** and with the letters SLT, indicating the No. **3** contact controlled by the relay winding SLT and indicating a break or back contact which is closed when relay SLT is released and open when relay SLT is operated. In the upper left of FIG. 1I, in circuit with the lower winding of relay ON is shown an X and a short dash line marked with a **9** and with the letters SLT: this indicates a set of transfer contacts controlled by relay SLT and which may be referred to as make or front contact **9** and break or back contact **9** of relay SLT. On FIG. 1J, make contact **8** of relay SLT is in circuit with the upper winding of relay RCS. Immediately following this introduction is a collection of relay tables indicating the drawing location of each relay winding.

The small dash line (or minus sign) inside of a circle, such as connected to the right hand terminal of the ON1 relay winding in FIG. 1I, indicates the negative terminal of a direct current power source, such as a 48 volt battery, it being understood that the positive terminal is grounded.

Cabled contacts are used to save space. On FIG. 1Q, for instance, the cable AI (including five conductors—see FIG. 1R) is shown extending over a single make contact of relay IS1: this indicates five separate make contacts of relay IS1, one make contact for each of the five leads in the cable AI.

In the lower left part of FIG. 1F is shown a representation of a crossbar switch array wherein, as is well known, a multicontact crosspoint is closed by the operation of a select magnet, such as PSM, followed by the operation of a hold magnet, such as PHMR. The horizontal and vertical wires of the crossbar switch are shown by horizontal and vertical lines ending in small circles: the X at the intersection of a pair of such coordinate wires indicates a crosspoint, in this case representing a 6-wire switch or a 6-contact crosspoint.

Dotted lines in some cases indicate the presence of additional circuitry not of immediate interest. For instance, in FIG. 1I the windings of relays CCA and MR are interconnected by a line including a dotted portion: this indicates the presence of additional circuitry which is of no particular interest at the moment.

### Circuit symbols

In some cases a dotted line is used to indicate the repetitive nature of a circuit or group of circuits, the details of which have been shown at least once. For instance, in FIG. 75 two relay windings HT2 and HT9 are shown connected by a dotted line: this indicates that relays HT3 through HT8 are also present and with a circuit arrangement similar to that of the windings HT2 and HT9 which are shown.

Double line boxes, such as the one on FIG. 1H marked "MF TONE SUPPLY," indicate circuits not part of the one shown. In some instances, such as the one referred to, no details are shown inside of the box since the contents may be any known such circuit. In other cases, some circuit details may be shown where pertinent to the detailed circuit description.

Single line boxes are generally used to indicate functional groups of circuits or parts of a circuit. Again, details are shown or not inside the boxes depending upon whether or not such information is considered pertinent. For instance, in FIG. 1H the box marked "DIAL TONE" is considered self-explanatory, as is the box in FIG. 40 marked "T1 TIMER," which can be a timer of conventional design. In some instances, the details of a box are shown elsewhere, such as the box in FIG. 52 marked "TIMER FIG. 86," indicating that this timer of FIG. 52 is of similar construction to the one shown in detail in FIG. 86: the box in FIG. 1Q marked "A0–A7" with a "1R" in the upper right hand corner indicates circuit detail of the kind shown in FIG. 1R, et cetera.

### RELAY WINDINGS

The following tables indicate, for the various major subdivisions of circuitry, the relay designations in alphabetical order with the figure number upon which the winding appears. These tables enable the location of any winding which controls any contact thereof and which may be shown physically detached therefrom. The tables are identified as follows:

#### FEATURE SKETCH (FIGS. 1C–1N, 1P–1Z AND 1AA–1AC)

Table 1 (FIG. 1G)—Selectors
Table 2 (FIG. 1F)—Register Trunk and Link
Table 3 (FIGS. 1H–1N, 1P–1Z, 1AA and 1AB)—Originating Register-Outpulsing Controller

#### DETAILED DRAWINGS (FIGS. 2 THROUGH 96)

Table 4 (FIGS. 2–7)—Line, Line Finder, Register Trunk and Link, Selectors Outgoing Trunks
Table 5 (FIGS. 8–39)—Originating Register-Outpulsing Controller
Table 6 (FIGS. 40–43)—"Touch-Tone" Receiver and Converter
Table 7 (FIGS. 44–53)—Translator
Table 8 (FIGS. 54–74)—Decoder
Table 9 (FIGS. 75 and 76)—Foreign Area Translator
Table 10 (FIGS. 77–95)—Translator Connector-Decoder Connector
Table 11 (FIG. 96)—Trunk Class Connector

TABLE 1 (FIG. 1G).—SELECTORS

| Designation: | Function |
|---|---|
| A1, A2, A3 | Line supervisory. |
| D1, D2, D3 | Cut-through. |

TABLE 2 (FIG. 1F).—REGISTER TRUNK AND LINK

| Designation: | Function |
|---|---|
| BC | Battery control. |
| GC | Ground control. |
| HG | Horizontal group. |
| PHML | Primary hold magnet—left. |
| PHMR | Primary hold magnet—right. |
| PSM | Primary select magnet. |
| RB | Register both. |
| RD | Register dial. |
| RP | Register preference. |
| RT | Register tone. |
| S | Select. |
| SCK | Selection check. |
| SHML | Secondary hold magnet—left. |
| SHMR | Secondary hold magnet—right |
| SK | Secondary switch check. |
| SSM | Secondary select magnet. |
| TB | Trunk busy. |
| TP | Trunk preference. |

TABLE 3 (FIGS. 1H–1N, 1P–1Z, 1AA AND 1AB).—ORIGINATING REGISTER-OUTPULSING CONTROLLER

| Designation | Function | FIG. |
|---|---|---|
| A0–A7 | A digit storage | 1Q and 1R. |
| AR0–AR7 | A switching digit | 1S and 1T. |
| ARS | A switch digit steer | 1V. |
| B0–B7 | B digit storage | 1Q and 1R. |
| BR0–BR10 | B switching digit | 1S and 1U. |
| BRS | B switch digit steer | 1V. |
| C0–C7 | C digit storage | 1Q and 1R. |
| CB | Loop test | 1H. |
| CCA | Coin control | 1I. |
| CR0–CR10 | C switching digit | 1S and 1U. |
| CRS | C switch digit steer | 1V. |
| D0–D7 | D digit storage | 1Q and 1R. |
| DCK | Double connection check | 1I. |
| DL3 | Delete three digits | 1J. |
| DP | Rotary dial call | 1I. |
| DR0–DR10 | D switching digit | 1S and 1U. |
| DRS | D switch digit steer | 1V. |
| E0–E7 | E digit storage | 1Q and 1R. |
| ER0–ER7 | E switching digit | 1S and 1T. |
| ERS | E switch digit steer | 1V. |
| F0–F7 | F digit storage | 1Q and 1R. |
| FR0–FR7 | F switching digit | 1S and 1T. |
| FRS | F switch digit steer | 1V. |
| G0–G7 | G digit storage | 1Q and 1R. |
| IC | Interdigital timing control | 1L. |
| IS1–IS8 | In-digit steering | 1P. |
| L1 | Line supervisory | 1H. |
| L2 | do | 1I. |
| LA | do | 1I. |
| LT | Loop test | 1H. |
| MB | Make register busy | 1I. |
| MR | Message rate subscriber | 1I. |
| ON | Off-normal | 1I. |
| ON1 | do | 1I. |
| ON2 | do | 1I. |
| OS1–OS7 | Out-digit steering | 1W. |
| P1–P5 | Out-digit pulse count | 1L. |
| PG1 | Pulse generator | 1M. |
| PG2 | do | 1M. |
| PKC | Partial key check | 1P. |
| RA | Register advance | 1I. |
| RA1 | do | 1I. |
| RA2 | do | 1I. |
| RCA | Recycle switch train | 1J. |
| RCA1 | do | 1J. |
| RCS | Recycle steering | 1J. |
| RCY | Recycle control | 1J. |
| REC | Cut-through | 1I. |
| RK | Readout check | 1N. |
| RL | Register release | 1W. |
| RR0–RR10 | Readout relays | 1X. |
| RV | Trunk or sender reversal | 1H. |
| SDO | Sender class call | 1J. |
| SG | Stop-go control | 1J. |
| SG1 | do | 1J. |
| SLT | Sleeve lead test | 1I. |
| SLT1 | do | 1I. |
| ST | Start pulse steering | 1W. |
| ST1 | End of MF pulsing | 1W. |
| STGO | Prepare for stop-go | 1J. |
| STR | In-digit steering advance | 1P. |
| TDR | Translator-decoder release | 1J. |
| TDSA | Translator-decoder start | 1J. |
| TDST | do | 1J. |
| TMF | Transfer to MF pulsing | 1X. |
| TMFA | do | 1X. |
| TMF1 | do | 1M. |
| TMF2 | do | 1M. |
| TR1 | Tip-ring continuity | 1I. |
| W | Out-digit steering control | 1N. |
| Z | do | 1N. |
| 7DG | Seven digit call | 1J. |

TABLE 4 (FIGS. 2-7).—LINE, LINE FINDER, REGISTER TRUNK AND LINK, SELECTORS, OUTGOING TRUNKS

| Designation | Function | FIG. |
|---|---|---|
| A | Trunk line supervisory | 6 |
| A1 | | 3 |
| A2 | Selector line supervisory | 4 |
| A3 | | 5 |
| B | Trunk hold | 6 |
| B1 | | 3 |
| B2 | Selector hold | 4 |
| B3 | | 5 |
| C | Trunk pulse help | 6 |
| C1 | | 3 |
| C2 | Selector vertical control | 4 |
| C3 | | 5 |
| D | Trunk answer supervisory | 6 |
| D1 | | 3 |
| D2 | Selector cut-through | 4 |
| D3 | | 5 |
| E1 | | 3 |
| E2 | Selector rotary control | 4 |
| E3 | | 5 |
| HG | Horizontal group | 7 |
| PHML | Primary hold magnet—left | 2 |
| PHMR | Primary hold magnet—right | 2 |
| PSM | Primary select magnet | 7 |
| RLS1 | | 3 |
| RLS2 | Selector release | 4 |
| RLS3 | | 5 |
| ROT1 | | 3 |
| ROT2 | Selector rotary step | 4 |
| ROT3 | | 5 |
| RP | Register preference | 7 |
| SHML | Secondary hold magnet—left | 7 |
| SHMR | Secondary hold magnet—right | 7 |
| SSML | Secondary select magnet | 7 |
| SSMR | Secondary select magnet—right | 7 |
| TB | Trunk busy | 2 |
| TP | Trunk preference | 2 |
| VERT1 | | 3 |
| VERT2 | Selector vertical step | 4 |
| VERT3 | | 5 |

TABLE 5 (FIGS. 8 TO 39).—ORIGINATING REGISTER-OUT PULSING CONTROLLER

| Designation | Function | FIG. |
|---|---|---|
| 1S | First reseizure | 25 |
| 1SA | do | 25 |
| 2S | Second reseizure | 25 |
| 3DG | Three digit call | 18 |
| 3DR | Three digits registered | 25 |
| 4DG | Four digit call | 18 |
| 5DG | Five digit call | 18 |
| 7DG | Seven digit call | 18 |
| 10DG | Ten digit call | 18 |
| A0–A7 | A digit storage | 38 |
| AD01 | A digit 0 or 1 | 21 |
| AR0–AR7 | A arbitrary digit register | 32 |
| ARA | Alternate route | 18 |
| ARB | All registers busy | 27 |
| ARS | A arbitrary digit steering | 16 |
| B0–B7 | B digit storage | 38 |
| BR0–BR10 | B arbitrary digit register | 32 |
| BRS | B arbitrary digit steering | 16 |
| BTA1 | Busy test | 13 |
| BTA2 | | |
| BTDC | do | 13 |
| C0–C7 | C digit storage | 38 |
| CA6 | Come-again-six | 18 |
| CB | Continuity test | 10 |
| CC | Coin control | 12 |
| CCA | do | 12 |
| CCT | Code timing | 21 |
| CR0–CR10 | C arbitrary digit register | 32 |
| CRS | C arbitrary digit steering | 16 |
| CTR | Cancel timed release | 11 |
| D0–D7 | D digit storage | 38 |
| DAD | Delete all digits | 18 |
| DCK | Double connection check | 8 |
| DL1 | Delete one digit | 18 |
| DL2 | Delete two digits | 18 |
| DL3 | Delete three digits | 18 |
| DL6 | Delete six digits | 18 |
| DP | Rotary dial call | 15 |
| DPC | Dial pulse control | 18 |
| DR0–DR10 | D arbitrary digit register | 33 |
| DRS | D arbitrary digit steering | 16 |
| E0–E7 | E digit storage | 39 |
| ED0 | do | 38 |
| ED4 | | |
| ER0–ER7 | E arbitrary digit register | 33 |
| ERS | E arbitrary digit steering | 16 |
| F0–F7 | F digit storage | 39 |
| FD0 | do | 38 |
| FD1 | | |
| FR | Flat rate subscriber | 12 |
| FR0–FR7 | F arbitrary digit register | 33 |
| FRS | F arbitrary digit steering | 16 |
| G0–G7 | G digit storage | 39 |
| GD0 | do | 38 |
| GD1 | | |
| H0–H7 | H digit storage | 39 |
| IC | Interdigital timing control | 22 |
| IP1–IP5 | Incoming dial pulse count | 15 |
| IPR | Party retest | 21 |
| IS1–IS11 | In digit steering | 24 |
| J0–J7 | J digit storage | 39 |
| K0–K7 | K digit storage | 39 |
| L0–L7 | L digit storage | 39 |
| L1 | Line supervisory | 9 |
| L2 | do | 15 |
| LA | do | 15 |
| LT | Loop test | 9 |
| LTA | do | 13 |
| LTO | Long time out | 23 |
| MB | Make busy | 11 |
| MF1 | "TOUCH-TONE" call | 24 |
| MR | Message rate | 12 |
| ON | Off-normal | 8 |
| ON1 | do | 8 |
| ON2 | do | 28 |
| OS1–OS7 | Out-digit steering | 35 |
| OS8–OS11 | do | 36 |
| P1, P2 | Out-digit pulse count | 22 |
| P3–P5 | do | 19 |
| PFA | A digit translation | 21 |
| PFB | | |
| PG1 | Pulse generator | 22 |
| PG2 | | 19 |
| PK | Partial dial | 27 |
| PKC | Partial dial check | 24 |
| PR | Party retest | 17 |
| PS | Permanent signal | 27 |
| PT | Party test | 14 |
| PT1 | Party test timing | 14 |
| PT2 | Party test | 14 |
| PT3 | do | 14 |
| PT4 | do | 14 |
| PT5 | do | 14 |
| PT7 | | 17 |
| PTG | Party test ground | 10 |
| RA | | |
| RA1 | Register advance | 15 |
| RA2 | | |
| RCA | Recycle | 28 |
| RCA1 | do | 28 |
| RCS | Recycle steering | 28 |
| RCY | Recycle control | 21 |
| REC | Receiver cut-through | 13 |
| RL | Release | 25 |
| ROA | Reorder | 27 |
| ROD | Reorder tone | 27 |
| RT1 | | 8 |
| RT2 | Register test | 11 |
| RT3 | | 11 |
| RK | Registration check | 34 |
| RP | Ring party | 14 |
| RR0–RR10 | Digit readout | 29 |
| RV | Reversal | 10 |
| RVT | Reverting call | 18 |
| SBR | Send BR digit | 29 |
| SCR | Send CR digit | 29 |
| SDO | Sender class | 18 |
| SDR | Send DR digit | 30 |
| SER | Send ER digit | 30 |
| SFR | Send FR digit | 30 |
| SG | Stop-go | 26 |
| SG1 | do | 26 |
| SLT | Sleeve lead test | 11 |
| SLT1 | do | 8 |
| ST | Start pulse steering | 36 |
| STO | Short time-out | 23 |
| ST1 | End of MF pulsing | 36 |
| STGO | Prepare for stop-go | 18 |
| STR | In-digit steering | 24 |
| STT | Start timing | 26 |
| TA1 | Trouble time-out | 20 |
| TDR | Translator-decoder release | 23 |
| TDRA | | 26 |
| TDSA | Translator-decoder start | 21 |
| TDST | do | 21 |
| TDTR | Translator-decoder trouble release | 20 |
| TMF | | 29 |
| TMF1 | Transfer to MF outpulsing | 33 |
| TMF2 | | 33 |
| TMFA | | 29 |
| TP | Tip party | 14 |
| TR1 | Verification check | 13 |
| W | Interdigital time control | 34 |
| WLF | Wink-off line finder | 27 |
| Z | Interdigital time control | 34 |
| ZO | Zero operator | 26 |

TABLE 6 (FIGS. 40 TO 43).—"TOUCH-TONE" RECEIVER AND CONVERTER

| Designation | Function | FIG. |
|---|---|---|
| CK | Check | 40 |
| H1 | | |
| H2 | High group | 40 |
| H3 | | |
| HF1-0 | | |
| HF2-0 | High group repeater | 41 |
| HF3-0 | | |
| L1–L4 | Low group | 40 |
| LF0-0 | | |
| LF3-0 | Low group repeater | 41 |
| LF6-0 | | |
| LF9-0 | | |
| RLS | Release | 40 |
| ST-0 | Start | 41 |

TABLE 7 (FIGS. 44 TO 53).—TRANSLATOR

| Designation | Function | FIG. |
|---|---|---|
| 11X | One-one prefix | 48 |
| CB | Circuit busy | 44 |
| CBA | do | 44 |
| CH1 | Chain check | 44 |
| CH2 | | |
| CH3 | | |
| COX | Cut-off cross | 45 |
| FA | Fuse alarm | 45 |
| H0-H7 | Hundreds register | 46 |
| HAT | Home area translator | 44 |
| HD | Hold | 44 |
| HT2-HT9 | Hundreds translation | 48 |
| MB | Make busy | 44 |
| NPA | No prefix | 44 |
| NPB | | |
| OAT | Over-all timing | 52 |
| ON | Off-normal | 44 |
| PFA | Prefix | 44 |
| PFB | do | 44 |
| PS | Permanent signal | 44 |
| RL | Release | 45 |
| STM | Start over-all timing | 52 |
| T0-T7 | Tens register | 46 |
| T147 | Tens partial translation | 50 |
| T258 | | |
| T369 | | |
| TA | Time alarm | 52 |
| TBL | Trouble | 45 |
| TOR | Time out trouble | 52 |
| TR | Trouble release | 45 |
| TT20 | Tens digit zero | 50 |
| TT30-TT90 | | |
| TT20R | Tens digit | 50 |
| TT30R-TT90R | | |
| TT20S | | |
| TT30S-TT90S | | |
| TT20T | | |
| TT30T-TT90T | | |
| U0-U7 | Units register | 46 |
| WT | Work timing | 52 |
| WTL | Work timer lock | 52 |
| WTO | Work timer operate | 52 |
| XL | Crossed leads | 45 |

TABLE 8 (FIGS. 54 to 74).—DECODER

| Designation | Function | FIG. |
|---|---|---|
| OS | Original seizure | 54 |
| 1S | First seizure | 54 |
| 2S | Second seizure | 54 |
| 2TR | Second trial seizure | 54 |
| 7D | 7 digit route | 69 |
| 10D | 10 digit route | 69 |
| AR | Alternate route | 64 |
| ARA | do | 71 |
| ARAK | Alternate route check | 64 |
| ARK1 | First arbitrary digit check | 61 |
| ARK2 | do | 61 |
| BRK1 | Second arbitrary digit check | 61 |
| BRK2 | do | 61 |
| CAK | Come again check | 56 |
| CC | Conflicting code | 69 |
| CL0-CL9 | Class | 68 |
| CLX | Class cross | 68 |
| CN | Coin | 68 |
| COX | Cut-off | 69 |
| CRK1 | Third arbitrary digit check | 62 |
| CRK2 | do | 62 |
| CS0-CS9 | Class screening | 68 |
| DGK | Expected digits check | 64 |
| DL | Display lost | 70 |
| DLK | Delete digits check | 64 |
| DPC | Controlled dial pulsing | 71 |
| DRK1 | Fourth arbitrary digit check | 62 |
| DRK2 | do | 62 |
| ERK1 | Fifth arbitrary digit check | 63 |
| ERK2 | do | 63 |
| FA | Fuse alarm | 57 |
| FA0-FA4 | Foreign area | 56 |
| FAT | Foreign area translator | 56 |
| FRK1 | Sixth arbitrary digit check | 63 |
| FRK2 | do | 63 |
| GS1-GS4 | Ground supply | 72 |
| INT | Intercept route | 56 |
| LFA | Lock foreign area | 56 |
| LH | Left half | 71 |
| NAR | No alternate route | 71 |
| NP | No prefix | 54 |
| NS | No controlled outpulsing | 71 |
| ON | Off-normal | 55 |
| PCK | Pulsing class check | 64 |
| PF0 | Prefix 0 | 54 |
| PF1 | Prefix 1 | 54 |
| PFTT | Print first trial ticket | 70 |
| R00-R79 | Route relay | 70 |
| RA1-RA4 | Route advance | 61 |
| RAV | do | 56 |
| RB | Route battery | 51 |
| RH | Right half | 76 |
| RR | Reroute | 51 |
| RS00-RS19 | Route relay | 75 |
| RVT | Reverting call | 78 |
| SDR | SXS dial pulsing | 15 |
| SG | Multifrequency pulsing | 17 |
| SLB | Selector level busy | 17 |
| TB | Ticketer busy | 47 |
| TCK | Ticketer check | 70 |

| Designation | Function | FIG. |
|---|---|---|
| TKA | Trunk available | 58 |
| TKB | Transmitting check battery | 58 |
| TLC | Transmitting leads control | 69 |
| TLC1-TLC4 | Transmitting leads connector | 69 |
| TS | Ticketer start | 70 |
| TST | Test call | 54 |
| TSTA | Trunk seizure test | 65 |
| TSTB | do | 58 |
| TT | Ticketer timing | 70 |
| TT1 | do | 70 |
| UDK | Units down check | 55 |
| XTL1-XTL3 | Crossed transmitting leads | 69 |
| ZO | Zero operator | 54 |

TABLE 9 (FIGS. 75 and 76).—FOREIGN AREA TRANSLATORS

| Designation | Function | FIG. |
|---|---|---|
| FAT0 | Foreign area translator | 75 |
| FAT1-FAT4 | | 76 |
| HT2-HT9 | Hundreds digit | 75 |
| T147 | Partial tens digit | 75 |
| T258 | | |
| T369 | | |
| TT2R-TT9R | do | 75 |
| TT2S-TT9S | | |
| TT2T-TT9T | | |
| TT20 | Zero tens digit | 75 |
| TT30-TT90 | | |

TABLE 10 (FIGS. 77-95).—TRANSLATOR CONNECTOR-DECODER CONNECTOR

| Designation | Function | FIG. |
|---|---|---|
| ABA | All translators busy | 87 |
| ABB | do | 87 |
| ALA | Traffic control alarm | 87 |
| ALB | do | 87 |
| CB0-14 | Connector busy | 83 |
| CB1-1 CB8-1 | | 80 and 81 |
| CB0-0 | | 77 |
| CB0-1 | | 80 |
| CB1-0 CB8-0 | | 77 and 78 |
| CB1-14 CB8-14 | | 83 and 84 |
| CBY-0 | do | 89 |
| CWA | Calls waiting | 87 |
| CWB | do | 87 |
| GCA1 | Group control | 87 |
| GCA2 | | |
| GCB1 | do | 87 |
| GCB2 | | |
| IT-0 | Idle translator | 89 |
| MBA | Make busy | 87 |
| MBB | | |
| RA0 | Register connector | 90 |
| RA1-RA19 | | 90 |
| RA20 | | 90 |
| RA21-RA39 | | 90 |
| RA280 | | 93 |
| RA281-RA299 | | 93 |
| RB0 | | 90 |
| RB1-RB19 | | 90 |
| RB20 | | 90 |
| RB21-RB39 | | 90 |
| RB280 | | 93 |
| RB281-RB299 | | 93 |
| RC-0 | Recycle time-out | 86 |
| RC0 | Register connector | 90 |
| RC1-RC19 | | 90 |
| RC20 | | 90 |
| RC21-RC39 | | 90 |
| RC280 | | 93 |
| RC281-RC299 | | 93 |
| RD0 | | 90 |
| RD1-RD19 | | 90 |
| RD20 | | 90 |
| RD21-RD39 | | 90 |
| RD280 | | 93 |
| RD281-RD299 | | 93 |
| RS0 | Register start | 90 |
| RS1-RS19 | | 90 |
| RS20 | | 90 |
| RS21-RS39 | | 90 |
| RS280 | | 93 |
| RS281-RS299 | | 93 |
| TA0-0 | Translator-decoder | 77 |
| TA0-1 | | 80 |
| TA0-14 | | 83 |
| TA1-0 TA8-0 | | 78 |
| TA1-1 TA8-1 | | 81 |
| TA1-14 TA8-14 | | 84 |
| TB0-0 | | 77 |
| TB0-1 | | 80 |
| TB0-14 | | 83 |
| TB1-0 TB8-0 | | 78 |
| TB1-1 TB8-1 | | 81 |
| TB1-14 TB8-14 | | 84 |

| Designation | Function | FIG. |
|---|---|---|
| TCA | Traffic control | 87 |
| TCB | | |
| TC0-0 | Translator-decoder connector | 77 |
| TC0-1 | | 80 |
| TC0-14 | | 83 |
| TC1-0 TC8-0 | | 78 |
| TC1-1 TC8-1 | | 81 |
| TC1-14 TC8-14 | | 84 |
| TD0-0 | | 77 |
| TD0-1 | | 80 |
| TD0-14 | | 83 |
| TD1-0 TD8-0 | | 78 |
| TD1-1 TD8-1 | | 81 |
| TD1-14 TD8-14 | | 84 |
| TFC-0 | Traffic control gate | 89 |
| TFC1-0 | | |
| TK-0 | Cut-through check | 89 |
| TM-0 | Connector timing | 89 |
| TM1-0 | | |
| TR-0 | Trouble release | 89 |
| TR1-0 | | |
| TRS-0 | Transfer time-out | 86 |
| TS0-0 | Translator preference | 77 |
| TS0-1 | | 80 |
| TS0-14 | | 83 |
| TS1-0 | | 77 |
| TS1-1 | | 80 |
| TS1-14 | | 83 |
| TS8-0 | | 78 |
| TS8-1 | | 81 |
| TS8-14 | | 84 |
| TST-0 | Test | 90 |
| TST-1 TST-14 | do | 90 and 93 |
| W-0 | Translator steering | 89 |
| Z-0 | | |

TABLE 11 (FIG 96).—TRUNK CLASS CONNECTOR

| Designation | Function | FIG. |
|---|---|---|
| P0 | Decoder preference | 96 |
| P1-P8 | do | 96 |
| PC0 | Decoder connector | 96 |
| PC1-PC8 | | |

## FEATURE DESCRIPTION

The feature sketch of FIGS. 1C–1N, 1P–1Z and 1AA–1AC will be used to describe a specific switching situation in order to render a simplified understanding of the exemplary embodiment devoid of control complexity. Considerable liberty has been taken in omission of circuit detail otherwise shown in the complete detailed layout of FIGS. 2–96 to be described hereinafter.

The specific situation to be described here is based upon the following assumptions (see FIG. 1C): the calling party S is using a rotary dial to transmit by dial pulse (DP) signaling the directory number 243–0123 of a desired called party in a remote office, access to which is available over outgoing trunk **3** from a third selector; and the first three digits 243 are cross-connected in the translator-decoder to furnish the originating register-outpulsing controller with the following instructions:

(1) Delete the code 243 and use the three arbitrary exit digits 238 to seize a trunk.

(2) The complete address to be received will consist of seven digits.

(3) Release the switch train (selectors)—set by repeating thereto of the dialed code 243—and reset the selector train with the exit code 238.

(4) Use DP signaling to effect trunk seizure.

(5) Stop outpulsing exit digits after the first two until address code registration is complete.

(6) Expect a "STOP" condition upon trunk seizure.

(7) Delete three digits when outpulsing beyond.

(8) Outpulse beyond on a multifrequency (MF) basis the KP start pulse, then the four numericals 0123, followed by the ST stop pulse.

*Block diagram (FIG. 1C)*

When the calling party S goes off-hook, the usual line finder operation takes place to find the calling line, to cause the register trunk and link to select a suitable idle originating register-outpulsing controller (hereinafter referred to as a register-outpulser) and connect it to the line finder, and to split the connection between the line finder and first selector. The register-outpulser will thereupon return dial tone to the calling party S.

At this point a relay in the register-outpulser will respond to dial pulses, will cause the successively dialed digits to be registered therein, and will repeat the dial pulses to the first and succeeding selectors. At the end of the third dialed digit, a third selector will have been stepped vertically to the specified trunk hunting level and will cause its stepping circuitry to initiate a change-over from vertical to rotary stepping. While this selector action is taking place, and usually before rotary trunk hunting can become effective, the rest of the basic code conversion action takes place.

At the end of the third dialed digit, the register-outpulser will seek connection with an idle translator-decoder circuit to ascertain switching instructions. This operation, to be described presently, takes place very quickly so that actual seizure by the third selector of outgoing trunk 3 will not be effected. The register-outpulser transmits the first three digits (243) to the translator-decoder, to which is also supplied, through the trunk class connector, class information used in the code conversion operation. The translator-decoder will transmit back to the register-outpulser the assumed information; namely, release the switch train, reset the selectors according to the arbitrary exit digits 238, do not actuate the third selector with the third exit digit 8 until all dialed digits (243–0123) have been received in the register-outpulser, expect to find a stop-go condition upon seizing outgoing trunk 3, and then transmit over outgoing trunk 3 on an MF signaling basis the KP pulse followed by the four dialed numericals (0123) and the ST pulse—the register-outpulser having been instructed to delete three digits (the dialed 243 code) when outpulsing.

The translator-decoder and trunk class connector will be released as soon as the above information is properly registered in the register-outpulser. The holding time of these circuits can be expected not to exceed perhaps 100 milliseconds (ms.), which is hardly enough time for the third selector to start hunting for a trunk, let alone to actually cause seizure of one. Thus, the register-outpulser will receive the signal to release the switch train before any selection beyond can take place incident to the repeating of dialed digits into the selector train.

The register-outpulser will release the previously set selectors and will proceed with the selector resetting operation. Since the exit code contains three digits (238), the register-outpulser is permitted to set a first and a second selector according to the respective exit digits 2 and 3 independently of whether or not the calling party S has completed sending all seven address digits (243–0123) to the register-outpulser. Actually, the very short holding time of the translator-decoder will most likely expire before the calling party even dials the fourth digit. In any event, the first two exit digits are used without regard to completeness of address code registration. The third, or last, or trunk seizure exit digit 8 is not permitted to be used to control the third selector until or unless address code registration is complete.

When address code registration becomes completed, the register-outpulser will control the third selector with the digit 8 and will expect to find a "stop" condition on the trunk. This signal will prevent any further outpulsing until the trunk changes to a "go" condition. At that time the register-outpulser will proceed to MF outpulse the KP signal, the four numericals (0123) of the address code—having deleted three digits thereof (243)—and the ST pulse. Having completed its registering and outpulsing functions, the register-outpulser will release leaving the register trunk and link circuit cut-through between the line finder and the first selector.

The circuit operations which take place to effect the above operations will now be described in connection with the skeletonized showing of FIGS. 1E–1N, 1P–1Z and 1AA–1AC arranged as shown in FIG. 1D.

*Dial tone connection*

When the calling party S of FIG. 1E goes off-hook to initiate a call through the system, circuit operations take place within the line circuit of FIG. 1E to extend battery through the winding of relay CO to the sleeve conductor S, and the line finder of FIG. 1E is started in the well-known manner to find the calling line. As soon as the line finder operation is started, the line finder will ground the sleeve conductor, the effect of which will be described presently. Upon finding the calling line circuit, the line finder of FIG. 1E extends the tip, ring and sleeve conductors T, R and S into the register trunk and link circuit of FIG. 1F, thence in an obvious manner over back contacts of relays TB and TP to the tip, ring and sleeve conductors FT, FR and FS extending into the first selector circuit of FIG. 1G. At this point relay A1 of the first selector will operate in a circuit extending from ground in FIG. 1G, through the left winding of relay A1, over a break contact of relay D1, thence over the tip conductor FT, back into FIG. 1F and over the parallel break contacts **1** of relays TP and TB, to the tip conductor T extending into the line finder of FIG. 1E, thence through the line circuit, over the calling party loop, and back over the ring lead R to the line circuit and line finder, into the register trunk and link of FIG. 1F, thence over the parallel break contacts **2** of relays TP and TB, over the ring conductor FR to the first selector of FIG. 1G, and thence through a break contact of relay D1 to battery through the right hand winding of relay A1. The operation in FIG. 1G of relay A1 of the first selector initiates circuit operations in the first selector as is well known in the art to accomplish a number of switching operations to prepare the first selector for receiving the first dial pulse. One of the operations which takes place in the first selector is the grounding of the sleeve conductor FS back into the register trunk and link of FIG. 1F and into the line finder and line circuit of FIG. 1E to hold operated the switch train which has been established to this point.

The grounding of the sleeve conductor S of FIG. 1F from the line finder of FIG. 1E initiates circuit operations for seizing an appropriate register-outpulser illustrated in the circuitry set forth in FIGS. 1H through 1N, through 1Z, 1AA and 1AB. At this point the circuits will already have been completed for operating in FIG. 1F the relays RT and RB. Relay RT is operated in a circuit extending from ground in FIG. 1I, over break contact **5** of relay MB, break contact **5** of relay RT1, conductor RA extending into FIG. 1F to the punching RA which is cross connected to punching TA (indicating that the particular register-outpulser is capable of handling both dial tone and TOUCH-TONE traffic), thence to negative battery through the winding of relay RT. Relay RT, in operating, completes an obvious circuit in FIG. 1F for operating relay RB in a circuit extending from ground in FIG. 1F, over break contact **5** of relay GC, make contact **1** of relay RT, to battery through the winding of relay RB. Ground on the sleeve conductor S of FIG. 1F causes the operation in FIG. 1F of the trunk preference relay TP in a circuit extending from ground on the sleeve conductor S over break contact **8** of relay TB, through the winding of relay TP, break contact **5** of relay TP, break contact **1** of relay HG, to negative battery. Relay TP, in operating, extends a locking circuit for itself over its make contact **5** to negative battery over break contact **6** of relay TB, and causes the operation in FIG. 1F of relay HG in a circuit extending from ground, through the winding of relay HG, thence through break contact **11** of relay TB and make contact **9** of relay TP to negative battery. A circuit is now completed in FIG. 1F for causing the operation of relay S over its upper or secondary winding, the circuit extending from ground in FIG. 1F, over make contact **4** of relay RB, break contact **5** of relay S, through the upper winding of relay S, over break contact **6** of relay S, break contact **1** of the hold magnet SHMR, make contact **2** of relay RT, break contact **5** of relay BC, make contact **2** of relay HG, to the RT punching which is cross connected to the RP punching (indicating that this particular register-outpulser is arranged to handle both DP and TT calling), thence through break contact **10** of relay TB, to negative battery over make contact **8** of relay TP. Relay S, in operating, completes a locking circuit for itself including the windings of relays GC and BC (both of which will operate in this locking circuit), the locking circuit extending from ground in FIG. 1F, through the winding of relay GC, make contact **5** of relay S, the upper winding of relay S, make contact **6** of relay S, to the upper or secondary winding of relay BC, and thence over make contact **2** of relay HG to negative battery on punching RT, relays BC and GC operating in this locking circuit through the upper winding of relay S, and the operation of relay GC causing the release of relay RB.

The operation of relay S in FIG. 1F completes an obvious circuit in FIG. 1F over its make contact **12** to cause the operation of relay SK, the operation of which initiates circuit operations for causing the operation of the select and hold magnets of the trunk and register crossbar switches indicated in FIG. 1F. Relay SK, in operating, completes a circuit for causing the operation in FIG. 1F of the register preference relay RP, the circuit extending from ground in FIG. 1I, over break contact **7** of relay MB, break contact **6** of relay RT1, conductor RP extending into FIG. 1F, thence through the winding of relay RP, break contact **6** of relay RP, break contact **3** of relay SCK, to negative battery over make contact **6** of relay SK. Relay RP, in operating, locks in a circuit including the winding of relay SCK (which operates in this locking circuit) extending from the right hand side of the winding of relay RP, over make contact **6** of relay RP, make contact **9** of relay SK, to negative battery through the winding of relay SCK. With relays SCK and RP operated, the secondary select magnet SSM in FIG. 1F is operated in a circuit extending from battery in FIG. 1F, over make contact **6** of relay SK, make contact **3** of relay SCK, make contact **2** of relay RP, to ground through the winding of the select magnet SSM. The operation of the select magnet SSM will condition a set of crosspoints in the register switch of FIG. 1F such that upon the operation of suitable hold magnets connections will be completed between the register trunk and link of FIG. 1F and the selected register-outpulser. Subsequent to the operation of the secondary select magnet SSM of FIG. 1F, a circuit is completed for causing the operation in FIG. 1F of the primary select magnet PSM extending from negative battery, through a make contact of relay S, through the winding of the select magnet PSM, to ground through break contact **1** of the secondary hold magnet SHMR, thereby preparing the crosspoints of the trunk switch of FIG. 1F for the completing circuits over this set of crosspoints. Upon the operation of the select magnet PSM, circuts are completed in FIG 1F for causing the operation of the primary hold magnets PHMR and PHML. Hold magnet PHMR is operated in a circuit extending from ground in FIG. 1F, over make contact **1** of select magnet PSM, make contact **7** of relay TP, break contact **9** of relay TB, to negative battery through the winding of the hold magnet PHMR which, in operating completes an obvious circuit over its make contact **1** to course the operation of the hold magnet PHML. In well-known fashion the operation of the left and right primary hold magnets PHML and PHMR close the corresponding crossbar switch crosspoints of the primary or trunk switch. Upon the closure of the right hand primary switch crosspoint, a circuit is completed for causing the operation of the secondary switch left and right hold magnets SHML and SHMR extending from ground on the upper side of the winding of primary hold magnet PHMR, thence over make contact **2** of hold magnet PHMR, conductor TC, cable PR, over the primary right crosspoint, cable RR, conductor

TC, to negative battery through the winding of the right hand secondary hold magnet SHMR which, in operating, completes an obvious circuit over its make contact **2** for causing the operation of the left hand secondary hold magnet SHML. The operation of the right and left hand hold magnets of both the primary and secondary switches completes obvious circuits interconnecting the conductors of cables PR, RR and SR extending between the register trunk and link of FIG. 1F and the register-outpulser and interconnecting the conductors of cables PL, LL and SL extending between the same two circuits. The release of the primary and secondary select magnets PSM and SSM take place as a result of circuit description to be described below. As far as over-all circuit timing is concerned it is at about this point, namely the closing of the crosspoints on the primary and secondary crossbar switches of FIG. 1F, when the line finder of FIG. 1E will have found the calling line circuit and will have cut through the circuit to the first selector of FIG 1G and will have operated the A**1** relay therein.

Upon the closure of the primary and secondary switch crosspoints of FIG 1F a circuit is completed for causing the operation in FIG 1I of the off-normal relay ON to initiate seizure operations in the register-outpulser circuit and to cause the release in the register trunk and link circuit of FIG 1F of several of the control relays which are no longer needed to be operated. The circuit for causing the operation of relay ON of FIG 1I extends from ground on conductor TC in FIG. 1F, over cable PR, the right hand primary crosspoint, cable RR, conductor TC, the secondary right hand crosspoint, cable SR, conductor TC extending into FIG. 1I, over break contact **2** of relay RL, break contact **8** of relay DCK, break contact **9** of relay SLT, break contact **7** of relay DCK, to negative battery through the lower primary winding of relay ON, which thereupon operates and locks in an obvious circuit through its upper secondary winding, over its own make contact **12**, to ground on conductor TC. The operation of relay ON completes an obvious circuit in FIG 1I over its make contact **10** to cause the operation of the register-outpulser make-busy relay MB, the operation of which causes the release in FIG. 1F of relays RT, RP and SCK, the release of relay RP in turn causing the release in FIG. 1F of the secondary select magnet SSM.

The operation of relay ON in FIG. 1I causes the operation in FIG. 1I of relays SLT1 and the operation in FIG. 1F of the trunk-busy relay TB, the operation of these relays causing the release of various control relays in the register trunk and link circuit of FIG. 1F and causing the splitting in FIG. 1F of the tip-ring circuit extending between the line finder and the first selector. Relay SLT1 in FIG. 1I operates in a circuit extending from ground, through its winding, through resistance SLT1, back contact **10** of relay REC, to negative battery over make contact **8** of relay ON. Relay SLT1, in operating, completes an obvious circuit in FIG. 1I over its make contact **2** to cause the operation of relay SLT through its upper primary winding, relay SLT thereupon locking in a circuit extending from ground through its lower secondary winding over break contact **8** of relay MR, make contact **1** of relay SLT to negative battery through the SLT resistance. Upon the operation of relay SLT, ground is extended from FIG. 1I, over break contact **5** of relay DCK and make contact **6** of relay SLT to the sleeve conductor S extending into FIG. 1F, thence over the secondary left and primary left crosspoints to the sleeve conductor S extending into the line finder of FIG. 1E to hold the preceding circuits of FIG. 1E in their operated condition. This ground on the sleeve conductor S in FIG. 1F also maintains the locking circuit for the trunk preference relay TP of FIG. 1F. Relay SLT, in operating, also completes a holding circuit for the hold magnets of the crossbar switches of FIG. 1F extending from ground in FIG. 1I, through the DCK resistance, make contact **9** of relay SLT, break contact **8** of relay DCK, break contact **2** of relay RL, conductor TC extending into FIG. 1I, thence over the right hand crosspoints of the secondary and primary switches, conductor TC, and over make contact **2** of hold magnet PHMR to the winding of the hold magnet PHMR, which in turn holds operated the hold magnet PHML. The grounded conductor TC also holds operated the hold magnet SHMR which in turn maintains the operating circuit for hold magnet SHML. The action in FIG. 1I of the effect of the hold magnet circuits being connected to the base of transistor Q1 will be discussed below. Also, upon the operation of relay SLT, ground is extended from FIG. 1I, over make contact **4** of relay SLT, break contact **4** of relay DCK, and make contact **3** of relay ON to the S**1** conductor extending into FIG. 1F and thence over the left hand secondary and primary crosspoints, to conductor S**1**, over break contact **4** of relay TB, to a battery through the winding of relay TB, thereby causing this relay to operate. Relay TB, in operating, completes a locking circuit for relay TP of FIG. 1F extending from battery, over make contact **6** of relay TB, make contact **5** of relay TP, through the winding of relay TP and over make contact **8** of relay TP to the resistance holding ground on conductor TC. Also, relay TB, in operating, completes a locking circuit for itself extending from its winding, through make contact **3** of relay TP, and make contact **3** of relay TB to ground on the sleeve conductor S. Ground on conductor S1 extending into FIG. 1F from FIG. 1I is further extended over make contact **4** of relay TB to the selector sleeve conductor FS extending into FIG. 1G to act as a sleeve holding ground to insure the presence of such a holding ground until such time as the first selector can apply ground to the sleeve conductor itself. Relay TB, in operating, causes the release in FIG. 1F of the HG relay and causes the release of relays GC, S and BC, the release of relay S in turn causing the release of relay SK and of the primary select magnet PSM (the holding circuit for magnet PSM controlled by relay S not being shown).

The operation of relay TB in FIG. 1F splits the tip, ring and sleeve conductors between the line finder of FIG. 1E and the first selector of FIG. 1G, terminates the tip and ring leads from the line finder in the windings of relay L**1** of FIG. 1H, and provides a holding circuit over the tip and ring conductors FT and FR from the first selector by virtue of circuitry in FIG. 1H. At this point in the description, all of the relays in FIG. 1F are released except relays TB, TP and the hold magnets PHMR, PHML, SHMR and SHML, leaving the line finder and first selector split with various conductors extending between the register trunk and link of FIG. 1F and the register-controller circuit of FIGS. 1I and 1H. In the register circuit of FIG. 1I, relays ON, MB, SLT1 and SLT are operated. The circuit for maintaining operated the A**1** relay of the first selector in FIG. 1G extends from ground in FIG. 1G, through the left hand winding of relay A**1**, over a break contact of relay D**1**, the tip conductor FT extending into FIG. 1F, over the left hand primary and secondary crosspoints, conductor FT extending into FIG. 1H, thence through break contact **9** of relay REC, the upper winding of relay CB, break contact **3** of the relay REC, tip conductor T extending into FIG. 1F, thence over the left hand secondary and primary crosspoints to the tip conductor T extending back to the line finder and line circuit of FIG. 1E, over the subscriber's loop, back over the ring lead R into FIG. 1F, over the left hand secondary and primary crosspoints, conductor R into FIG. 1H, thence over break contact **11** of relay REC, break contact **8** of relay TMF, thence over the conductor FR back into FIG. 1F, over the left hand secondary and primary crosspoints, conductor FR extending into FIG. 1G, over a break contact of the D**1** relay, to negative battery through the right hand winding of relay A**1**. Relay CB of FIG. 1H operates in this holding path for the first selector relay A**1** as an indication that the loop is completed from the line finder to the first selector through the tip-ring circuit of FIG. 1H.

Upon the operation previously described of relays ON, SLT1 and SLT of FIG. 1I, of relay TB of FIG. 1F, and of relay CB of FIG. 1H, a series of relay operations take place to complete the dial tone connection to the calling subscriber S of FIG. 1E. With reference to the input digit steering circuit of FIG. 1P, upon the operation of the off-normal relay ON of FIG. 1I a circuit is completed for causing the operation of the first input digit steering relay IS1 of FIG. 1P to prepare the circuit for steering the first incoming dial pulse digit to the A digit register of FIG. 1Q. This circuit extends from ground in FIG. 1P, over make contact **5** of relay ON, break contact **7** of relay REC, break contact **6** of relay IS1, to negative battery through the winding of relay IS1, which thereupon operates and completes a locking circuit for itself over its own make contact **6** and the series of No. **5** break contacts of relays IS2 through IS8, thence over break contact **5** of relay PKC to off-normal ground at make contact **5** of relay ON. Returning to FIG. 1I, upon the operation of relay SLT, relay ON1 operates in a circuit extending from ground, over make contact **11** of relay ON, make contact **2** of relay SLT, to negative battery through the winding of relay ON1, which provides a locking circuit for itself in an obvious manner over its own make contact **18**. Relay ON2 of FIG. 1I operates in an obvious circuit over make contact **6** of relay ON1 to in turn cause the operation in FIG. 1I of relay RA1 in a circuit extending from ground over make contact **12** of relay ON2, break contact **6** of relay RA2, to negative battery through the winding of relay RA1. The called digit outsteering circuit of FIG. 1W is placed in a starting position upon the operation of relay ON1 of FIG. 1I by causing the operation in FIG. 1W of the first outdigit steering relay OS1 in a circuit extending from ground in FIG. IV, over make contact **4** of relay ON1, over conductor X into FIG. 1W, thence over break contact **8** of relay REC, break contact **6** of relay OS1, to negative battery through the winding of relay OS1, which thereupon operates and completes a locking circuit for itself extending from the left hand side of its winding, over its own make contact **6**, through the series of No. **5** break contacts of relays OS2 through OS7, break contact **5** of relay ST, break contact **5** of relay ST1, break contact **8** of relay RCA, to ground over make contact **18** of the off-normal relay ON2. Upon the operation of the of-normal relay ON1 of FIG. 1I, a circuit is completed for operating relay L1 of FIG. 1H, this circuit extending from ground in FIG. 1H, through diode T, through the left hand secondary winding of relay L1, through the upper left winding of the repeat coil, over make contact **1** of relay ON1, through resistance PD3, over break contact **1** of relay REC, through the lower left winding of the repeat coil, through the right hand tertiary winding of the L1 relay, to negative battery through diode R. Relay L1, in operating, causes the operation in FIG. 1I of relays LA and L2, this circuit extending from ground in FIG. 1I, over make contact **24** of relay ON1, thence over make contact **3** of relay L1, through the upper winding of relay LA to negative battery through the LA resistance, and from make contact **24** of relay ON1, through make contact **4** of relay L1, to negative battery through the winding of relay L2. Relays LA and L2 operate in the previously described circuits. Upon the operation of relay CB of FIG. 1H and of relay ON1 of FIG. 1I, relay TR1 of FIG. 1I is operated in a circuit extending from ground in FIG. 1I, over make contact **22** of relay ON1, make contact **3** of relay CB, break contact **1** of relay REC, to negative battery through the winding of relay TR1. Relay TR1, in operating, completes a circuit in FIG. 1I from ground, over make contact **6** of relay L2, and make contact **9** of relay TR1, to the sleeve conductor S extending back into FIG. 1F to maintain ground on this sleeve conductor at such time as relay DCK (FIG. 1I) operates, to be described immediately below. Also, in FIG. 1I is will be noted that the operation of relay TR1 completes a circuit from ground, over its make contact **8** such that when relay DCK operates, this ground will be applied through make contact **8** of relay DCK to the TC conductor into FIG. 1F to hold operated the hold magnets of the trunk and register crossbar switches previously described. In the meantime upon the operation of relay ON1 of FIG. 1I, a circuit is completed for causing the operation of relay MR in FIG. 1I extending from battery in FIG. 1I, through make contact **2** of relay ON1, through resistance FR2, make contact **19** of relay ON1, through the winding of relay MR, through the upper primary winding of relay CCA, through break contact **4** of relay MR, conductor IC extending into FIG. 1F, thence over the right secondary and primary crosspoints, conductor IC, to punching IC cross connected to punching ICB (indicating that no party test is required), and to negative resistance battery. Relay MR, in operating, provides a locking circuit for itself in FIG. 1I over its make contact **4** through the upper winding of relay CCA.

In connection with resistance DCK in FIG. 1I, it will be noted that this resistance is carrying a current for supplying the windings of the relays and hold magnets which are being held from the potential on conductor TC in FIG. 1I, which circuit extending from ground in FIG. 1I, through resistance DCK, make contact **9** of relay SLT, break contact **8** of relay DCK, break contact **2** of relay RL, to conductor TC which in FIG. 1I supplies current for the upper winding of relay ON and which in FIG. 1F supplies holding current for hold magnets SHMR and PHMR and for the relay TP. This combination of relay and hold magnet windings, being held by current supplied through the DCK resistance, represents a condition calling for a specified amount of current to flow through the DCK resistance thereby to establish at the base of transistor Q1 a specified potential negative with respect to ground. However, if the TC conductor is short circuited to ground anywhere, such as a false ground or ground from another register-outpulser due to an inadvertent double connection (either of these situations representing a trouble condition), these added effects will prevent the base of transistor Q1 from acquiring a negative potential. Transistor Q1 is normally in the off condition and requires a specified negative voltage condition on its base to cause it to fire. The previously described legitimate condition (no false ground on the TC lead) representing the higher of negative voltage on the base Q1 is the one which will cause this transistor to fire and when it does so it will complete a circuit for operating relay DCK, which is included in the collector circuit of transistor Q1 extending to negative battery over make contact **1** of relay ON. Relay DCK, in operating, causes ground to be applied in FIG. 1I through make contact **11** of relay ON and make contact **12** of relay DCK to lock operated relay DCK and to ground the collector of transistor Q1. Also, relay DCK, in operating as previously described, applies solid ground to conductor TC which in turn is fed back to the base of transistor Q1, all of these conditions causing the transistor Q1 to shut off, leaving relay DCK locked operated under control of relay ON.

Upon the operation of relay ON1 of FIG. 1I, the pulse generator of FIG. 1M is placed in starting condition so that it will be ready when the time comes to develop pulses for outpulsing purposes. The normal condition (circuit deenergized) of the relays in FIG. 1M is that relays PG1 and PG2 are released. Upon the operation of relay ON1, a circuit is completed for operating relay PG1 extending from ground in FIG. 1M, over make contact **10** of relay ON1, break contact **7** of relay RL, break contact **5** of relay W, break contact **7** of relay IC, break contact **6** of relay RK, to negative battery through the windings of relay PG1. Upon the operation of relay PG1, circuits are completed for causing current to flow from left to right through both windings of relay PG2. Ground is supplied to the junction of resistance PG2 and condenser PG over make contact **4** of relay PG1; and, negative battery is supplied to the right hand side of the windings of relay **PG2** through resistance PG7 and break contact **6** of relay TMFA. Under these circumstances charging current will flow through condenser PG attempting to charge it up to the negative battery potential and current will flow through the upper winding of relay **PG2** through resistances PG2 and PG3 and break contact **5** of relay TMFA. Normally, current flowing from left to right in the upper winding of relay **PG2** will cause this relay to release; but, current flowing from left to right in the lower winding of relay **PG2** causes it to operate until such time as condenser PG has become charged up, thereby causing the current through the lower winding of relay **PG2** to drop to a point where the current in the upper winding can take control. This time element under the present circumstances, as primarily controlled by the value of resistance PG7, is about 35 milliseconds. Thus, at the end of about 35 milliseconds relay **PG2** will release under the control of the steady current through its upper winding. If relay **PG1** is still operated, as it is in the present circumstances, relay **PG2** will remain released. The pulse generator of FIG. 1M will remain in this condition with relay **PG1** operated and relay **PG2** released until outpulsing control starts, as will be described subsequently.

Returning now to the discussion of the tip-ring control circuit of FIG. 1I, the circuitry is in such condition as will recognize and take action upon the grounding of conductor **S1** from the first selector of FIG. 1G. When the first selector of FIG. 1G grounds its sleeve conductor FS, as an indication that it is ready to receive pulsing control, this ground will extend from conductor FS in FIG. 1G, back into FIG. 1F, over make contact **4** of relay TB, to the **S1** conductor extending over the left primary and secondary crosspoints, conductor **S1** into FIG. 1I, thence over make contact **3** of relay ON, make contact **4** of relay DCK, through the SLT diode, to the left hand side of the winding of relay **SLT1**, thereby shunting down this relay and causing it to start to release, relay **SLT1** being a slow release relay will take a substantial amount of time to complete its release. Upon the release of relay **SLT1**, the primary winding of relay SLT in FIG. 1I is deenergized and since the secondary winding of relay SLT is short circuited by make contact **8** of the operated relay MR, relay SLT will release after a slow release time interval. Upon the release of relay SLT, a circuit is completed for causing the operation in FIG. 1I of relay REC extending from ground, over make contact **22** of relay **ON1**, break contact **3** of relay SLT, make contact **4** of relay **TR1**, make contact **10** of relay DCK, to negative battery through the winding of relay REC, which operates and completes a locking circuit over conductor Y into FIG. 1W, thence over make contact **8** of relay REC, conductor X into FIG. 1V, to ground over make contact **4** of off normal relay **ON1**, relay **TR1** in FIG. 1I remaining locked operated in a circuit extending from the right hand side of its winding, through its make contact **6**, diode TR1, to the locking ground on conductor Y. Upon the operation of relay REC of FIG. 1I, circuits are completed in FIG. 1H for terminating relay **L1** in the tip-ring loop from the calling end of the connection, for releasing relay CB, and for terminating the first selector circuit in the series connection of relays RV and LT of FIG. 1H. In FIG. 1H the tip conductor T from the calling end of the connection extends over make contact **3** of relay REC, through the upper left winding of the repeat coil, and to ground through the left winding of relay **L1** and diode T; and, the ring conductor R extends over make contact **1** of relay REC, through the lower left winding of the repeat coil, and to negative battery through the right winding of relay **L1** and diode R. The upper winding of relay CB in FIG. 1H is deenergized by the opening of break contact **3** of relay REC and the lower winding of relay CB will be deenergized as will be described immediately below, thereby allowing relay CB to become released. The tip and ring leads FT and FR extending to the first selector circuit of FIG. 1G complete a loop circuit in FIG. 1H as follows: from conductor FT, over the parallel connection of break contact **4** of relay RK and make contact **1** of relay **PG1**, thence over make contact **7** of relay **L1**, break contact **6** of relay RCA, break contact **6** of relay TMF, make contact **9** of relay REC, resistance **FT1**, resistance **RV1**, the winding of relay RV (with the resistance **RV2** in shunt thereof), through the winding of relay LT, make contact **3** of relay **ON2**, resistance **FR1**, make contact **11** of relay REC, break contact **8** of relay TMF, to conductor FR. The impedance of this latter described circuit is arranged such that the potential at the joining point of the windings of relays LT and RV is essentially half of the battery potential on the winding of relay **A1** in the first selector circuit. Also, relay RV is a polar relay which will not operate unless its upper winding conductor is more positive than its lower winding conductor, which is the reverse of the instant case. Relay LT will operate in this circuit, however. With respect to the lower winding of relay CB, the resistances **BT2** and **BT3** are substantially equal thereby placing approximately half the battery potential on the left hand side of the lower winding of relay CB, it being noted that the right hand side of lower winding of relay CB is also substantially at half battery potential, thereby substantially deenergizing both windings of relay CB to allow it to release as has above been mentioned.

At the time that relay REC of FIG. 1I operated to place the relay **L1** of FIG. 1H in the fundamental tip and ring loop back to the calling party, it wiill be noted in FIG. 1H that at this point dial tone is supplied to the calling party in a circuit extending from the source of dial tone in FIG. 1H, through condenser **C6**, break contact **4** or relay DP, make contact **2** of relay **TR1**, through resistance DT1, and through the right hand windings of the repeat coil, thereby causing dial tone to be returned to the calling party S of FIG. 1E by induction through the repeat coil of FIG. 1H, as an indication to the calling subscriber that he may begin dialing the digits of the address code.

To summarize the situation of the circuits at the point when dial tone is supplied to the calling party S of FIG. 1E, it will be recalled at this point that the fundamental tip and ring circuit from the line finder of FIG. 1E extends into the register trunk and link circuit of FIG. 1F where it is split from the first selector of FIG. 1G by the operated conditions of relays TP and TB of FIG. 1F, and that the calling loop is extended over the crossbar switches of FIG. 1F into the tip-ring circuit of FIG. 1H terminating in the windings of relay **L1**. Also, the fundamental tip and ring loop from the first selector of FIG. 1G extends back into FIG. 1F and over the crossbar switch structure and is terminated in the series circuit including relays RV and LT of the tip-ring circuit of FIG. 1H. In the register trunk and link circuit of FIG. 1F, the hold magnets PHMR, PHML, SHMR and SHML are being held by the grounded conductor TC from the register circuit. In FIG. 1H, relays **L1** and LT are operated and the other relays are released. in FIG. 1I, the operated relays are ON, DCK, **ON1**, **ON2**, MB, MR, **RA1**, REC, **TR1**, **L2** and LA, the other relays being released at this time. In the pulse generator circuit of FIG. 1M relay **PG1** is operated and the other relays are released. Although the detailed circuits have not been shown, it will be understood in the pulse counting circuits of FIGS. 1K and 1L that these circuits have been normalized; i.e. reset into a condition from which to start pulse counting operation. In the input digit steering circuit of FIG. 1P the first indigit steering relay **IS1** is operated and locked under control of the off-normal relay ON. In the called digit outsteering circuit of FIG. 1W the first called digit outsteering relay **OS1** is operated and locked in a circuit under control of the off-normal relay ON2.

*Registering address code digits*

As is well known in the art, when the calling subscriber S of FIG. 1E manipulates the rotary dial on the usual dial pulse transmitter telephone, the tip-ring loop extending therefrom and terminating in the windings of relay L1 of FIG. 1H is successively opened and closed for each pulse of the digit dialed. In the circuitry under consideration these operations and releases of relay L1 of FIG. 1H will control the relay circuitry of FIG. 1I so as to cause the input pulse counting circuit of FIG. 1K to count the number of pulses in each of the successive digits. Also, the input digit steering circuit of FIG. 1P is controlled by the successive dialed digits to cause the pulse count output from FIG. 1K to be steered into the successive input digit registers of FIG. 1Q. While this input digit registration is taking place the operation and release of relay L1 of FIG. 1H opens and closes the fundamental tip-ring loop from FIG. 1H into the successive selector circuits of FIG. 1G, thereby causing the first, second and third, et cetera selectors to respond to the successively dialed digits, as also is well known. The present circuitry repeats the dialed digits to the successive selectors of FIG. 1G at the same time as these same digits are being registered in the input digit registers of FIG. 1Q. As will be explained hereinafter, at such time as the first three digits have been registered in the input digit registers of FIG. 1Q, a translator and decoder circuit will be consulted for routing instructions, whereupon the selectors of FIG. 1G will be released so that the outpulsing circuitry can reset these selectors in accordance with the decoding switching digits.

In the upper right-hand portion of FIG. 1H it will be noted that the fundamental tip and ring circuit extending into FIG. 1F, and thence into the selectors of FIG. 1G, includes in series therewith make contact **7** of the relay L1 and make contact **1** of relay PG1. The relay PG1, as has been explained hereinbefore, remains operated in the pulse generator of FIG. 1M until such time as outpulsing begins. Therefore, each time relay L1 of FIG. 1H releases and reoperates in response to a dialed pulse from the calling subscriber of FIG. 1E, the fundamental tip and ring circuit extending from FIG. 1H into the selectors of FIG. 1G will be opened and reclosed in response to that pulse, thereby causing the selectors of FIG. 1G to respond to the repeated dial pulses. As will be noted from the description to follow, at such time as the first three dialed digits have been registered in the input digit registers of FIG. 1Q and at such time as a translator-decoder has been seized for determining the switching digits for these dialed digits, relay SDO (among others of FIG. 1J) will be operated such that make contact **4** thereof in the upper right-hand portion of FIG. 1H will bridge make contact **7** of relay L1 so as to maintain closed the fundamental tip and ring circuit extending to the selectors of FIG. 1G. This prevents any further dialed digits from being repeated to these selectors. The details of this operation will be described below.

Upon the first release of relay L1 of FIG. 1H, at the start of the first pulse of the first digit, relay RA of FIG. 1I is operated to prepare relays for detecting the interdigital pause between dialed digits, the input digit steering circuit of FIG. 1P is conditioned preparatory to registering the first dialed digit and for steering the second dialed digit, and relay DP of FIG. 1I is operated to cut off the dial tone signal. When relay L1 releases, a circuit is completed for operating relay RA of FIG. 1I extending from battery, through the upper winding of relay RA, thence over make contact **2** of relay L2 (whose slow-release characteristic maintains itself operated over the short release times of relay L1 responsive to dialed pulses), thence over break contact **3** of relay L1, to off-normal ground. Relay RA, in operating, short-circuits its own secondary winding over its make contact **12**, thereby to cause relay RA to have a slow-release characteristic. Relay RA, in operating, completes an obvious circuit in FIG. 1I over its make contact **6** for operating relay RA2, the operation of which cause the release of relay RA1. In FIG. 1P, upon the operation of relays RA and RA2 a circuit is completed for causing the operation of the input digit steering control relay STR in a circuit extending from ground in FIG. 1P, over make contact **5** of the off-normal relay ON, thence over make contact **7** of relay REC, and over the parallel make contacts **2** and **10** of respective relays RA and RA2, to battery through the winding of relay STR, the operation of which extends the off-normal ground over make contact **3** of relay STR, break contact **7** of relay PKC, make contact **9** of relay IS1, break contact **6** of relay IS2, to negative battery through the winding of relay IS2. Relay IS2 operates and locks over its own make contact **6** to off-normal ground through the series of No. **5** break contacts on the remaining steering relays, as hereinbefore described. It will be noted in FIG. 1Q that the operation of relay IS2 does not alter the steering condition established by the operation of relay IS1 and that the operation of the second steering relay IS2 is merely a preparatory circuit operation which has no particular significance at the moment. Also in FIG. 1I, upon the operation of relay RA a circuit is completed for operating relay DP extending from ground in FIG. 1I, over make contact **10** of relay RA, break contact **2** of relay DP, to negative battery through the winding of relay DP, which thereupon operates and locks over its own make contact **2** to off-normal ground. The operation of relay DP opens at its break contact **4** in FIG. 1H the circuit supplying dial tone to the calling subscriber.

Each time relay L1 of FIG. 1H is released relay LA of FIG. 1I will become released and each reoperation of relay L1 at the end of each pulse of the digit will cause the reoperation of relay LA of FIG. 1I. Relays L1 of FIG. 1H and LA of FIG. 1I continue to release and reoperate responsive to each pulse of the first dialed digit. During this pulsing operation the input pulse counting circuit of FIG. 1K will count the pulses in the digit responsive to opens and closures of the three leads marked A. At the end of the first dialed digit, relays L1 and LA will reoperate as usual and will remain reoperated during the interdigital time when the subscriber is preparing to cause the dialing of the second digit. Upon the continued operation of relay L1, the energizing circuit through the upper winding of relay RA will be opened, allowing relay RA to release after approximately 100 milliseconds (ms.), which amounts to the slow-release time of relay RA. The eventual release of relay RA causes the release of relay RA2 and the reoperation in FIG. 1I of relay RA1. In FIG. 1K it will be noted that upon the release of relay RA2 and before the complete release of relay RA1 circuits are completed whereby over the conductors designated B in FIG. 1K a pulse count may be derived from the pulse counting circuit by the grounding in the pulse counting circuit of two-out-of-five of the five conductors extending therefrom over the break contacts **1**, **3**, **5**, **6** and **7** of relay RA1. These two grounded conductors extend from FIG. 1K into FIG. 1Q and thence over two make contacts of the steering relay IS1 into the A digit register of FIG. 1Q. It will be noted in FIG. 1R that two of these five register relays operate and lock over their own make contacts to the locking conductor L extending to ground over make contact **14** of relay ON1. It will be recalled that the first dialed digit in the assumed example was the digit 2: this will be represented by the operation in FIG. 1Q of the digit relays A0 and A2 representing the digit 2 in the well-known two-out-of-five coding. Thereafter, upon the operation of relay RA1, the output from the pulse counting circuit of FIG. 1K will be opened and the pulse counting circuit will be recycled preparatory to counting the number of pulses in the second dialed digit. In the meantime, in FIG. 1P, upon the release of relays RA and RA2, the steering control relay STR becomes released, thereby causing the release of the first input digit steering relay IS1, which it will be noted had been locked under control of make contact 3 of relay STR at the time that relay IS2 was operated. This leaves the input steering chain of FIG. 1P in the condition whereby the only relay operated is relay IS2, thereby conditioning the input digit registration circuit of FIG. 1Q to accept into the second or B digit register the pulse count of the second dialed digit.

To summarize the situation, in response to the first dialed digit, the first selector of FIG. 1G is elevated to the second level in response to the two pulses of this digit, following which the first selector will hunt along the second level for an idle second selector circuit in order to extend the fundamental tip and ring circuit to the second selector so that the latter may be responsive to the second dialed digit, as is well known in the art. Also, the first dialed digit has been registered in the A digit register of FIG. 1Q and the input digit steering chain of FIG. 1P has been controlled so that the second dialed digit will be registered in the B digit register of FIG. 1Q.

At the beginning of the dialing of the second digit, a 4 in the example, relay L1 of FIG. 1H will become released (and relay LA of FIG. 1I will follow the operations and releases of relay L1 as before), the release of relay L1 causing the reoperation of relays RA and RA2 of FIG. 1I, and the reoperation of relay RA2 causing the release again of relay RA1 of FIG. 1I. Also, the reoperation of relays RA and RA2 will cause the reoperation in FIG. 1P of relay STR, thereby completing a circuit for operating the third input steering digit relay IS3 in a circuit extending from off-normal ground in FIG. 1P, over make contact 3 of relay STR, break contact 7 of relay PKC, break contact 9 of relay IS1, make contact 9 of relay IS2, break contact 6 of relay IS3, to negative battery through the winding of relay IS3, which thereupon operates and locks over its own make contact 6 to off-normal ground over the series of No. 5 break contacts of the remaining steering relays. Relay IS2 remains operated under control of make contact 5 of relay IS3, break contact 7 of relay PKC, and make contact 3 of relay STR.

Throughout the dialing of the second digit relays L1 of FIG. 1H and LA of FIG. 1I will follow the dial pulsing as before and at the end of the dialing of this digit relays L1 and LA will remain operated as an indication that this is the end of the second dialed pulse digit. During the pulsing time, the input pulse counting circuit of FIG. 1K will count the number of pulses in the second digit and the second selector of FIG. 1G will be stepped to its fourth vertical level responsive to the second digit of four pulses and will thereupon initiate a hunting operation to seize an idle third selector.

At the end of the last pulse of the second digit relays L1 and LA will reoperate and will remain reoperated as an indication that this is the end of the digit. The reoperation of relay L1 causes the release of relays RA and RA2, whereupon the pulse count of the second digit is transmitted from the pulse counting circuit of FIG. 1K into FIG. 1Q, thence over break contacts of relay IS1 and make contacts of relay IS2 to register the second digit in the B digit register by the operation of relays B0 and B4 indicating the digit 4 on a two-out-of-five basis. Relay STR of FIG. 1P will become released, thereby releasing the steering relay IS2 to prepare the steering of the third digit into the C digit register of FIG. 1Q. At the beginning of the first pulse of the third digit, evidenced by the release of relay L1, relays RA, RA2 and STR will become reoperated, thereby causing the release of relay RA1 and the operation of the fourth steering relay IS4 of FIG. 1P in a circuit extending from battery through the winding of relay IS4, over its break contact 6, make contact 9 of relay IS3, break contacts 9 of relays IS2 and IS1, break contact 7 of relay PKC, to off-normal ground over make contact 3 of relay STR. Relay IS4 locks over its own make contact 6 to off-normal ground over the series of No. 5 break contacts of the remaining steering relays IS5 through IS8, et cetera. Relay IS3 of FIG. 1P remains locked in a circuit extending over its own make contact 6, make contact 5 of relay IS4, to off-normal ground over break contact 7 of relay PKC and make contact 3 of relay STR.

During the dialing of the third digit, as has been described above with respect to the first and second dialed digits, the third selector of FIG. 1G will be stepped vertically to its third level in accordance with the assumed third digit of 3, whereupon the third selector will hunt across the third level for an idle outgoing trunk such as the outgoing trunk No. 3 of FIG. 1G. During this interval of time the input pulse counting circuit of FIG. 1K will count the number of pulses in the third digit and at the end of the third digit, upon the continued reoperation of relays L1 and LA, relays RA and RA2 of FIG. 1I are again released, thereby to cause the reoperation of FIG. 1I of relay RA1 subsequent to the removal from FIG. 1K of the pulse count and the registration thereof in the C digit register of FIG. 1Q, as indicated by the operation therein of relays C1 and C2 to register the digit 3 on a two-out-of-five basis. This process of the dialing of successive digits of the assumed code 243–0123 will continue as above described, whereupon the input digit steering circuit of FIG. 1P will continue to advance so that the input pulse counting circuit of FIG. 1K can cause the registration in successive registers of FIG. 1Q of the successive digits as as they are received. In this regard, the D digit register of FIG. 1Q will have its relays D4 and D7 operated in accordance with the digit 0 its E register will have relays E0 and E1 operated in accordance with the fifth digit of 1, its F digit register will have its relays F0 and F2 operated in accordance with the sixth digit of 2, and its G register will have its relays G1 and G2 operated in accordance with the seventh or the last digit 3.

It will be recalled from previous discussion that at such time as the first three digits have been registered in the input digit register circuit of FIG. 1Q a translator and decoder will be seized for the decoding of these three digits, whereupon relay SD0 of FIG. 1J will become operated to stop further repeating of dial pulse digits to the selectors of FIG. 1G. Also, as will be seen below, as an incident to the translator-decoder seizure, a circuit operation will take place for causing the first, second and third selectors of FIG. 1G to be returned to their normal condition preparatory to being reset in accordance with the three digit switching code to be derived as a result of the decoder operation. It will be understood, however, that while this decoding operation is taking place the calling subscriber S of FIG. 1E will continue to dial all of the seven digits and these will continue to be counted in FIG. 1K and steered by the circuit of FIG. 1P into the successive registers of FIG. 1Q. The circuit operations which take place during the decoder-translator seizure will be discussed immediately below under a separate heading.

*Registering switching code digits and KP pulse*

When relay L1 of FIG. 1H reoperates at the end of the last pulse of the third digit, relay RA of FIG. 1I reoperates as an indication of the interdigital time and the operation of relay RA, with the fourth steering relay IS4 of FIG. 1P operated, completes a circuit for causing the operation in the translator-decoder control circuit of FIG. 1J of the recycle relay RCY. The latter circuit extends from ground in FIG. 1J, over make contact 17 of relay ON1, thence through a circuit (not shown) which indicates that the A digit is not a 0 or a 1, and thence over make contact 12 over relay IS4, break contact 5 of relay RA, break contact 6 of relay TDR, break contact 1 of relay TDSA, thence to negative battery through the upper winding of relay RCY, which thereupon operates and completes a circuit over its own make contact **1** through its lower secondary winding to cause the relay RCY to have a slow-releasing characteristic. Relay RCY, in operating, completes a circuit in FIG. 1J for causing the operation of the translator-decoder start relay TDST to initiate a bid for a translator-decoder circuit. Relay TDST operates in a circuit extending from off-normal ground in FIG. 1J, over make contact **2** of relay RCY, break contact **6** of relay TDST, break contact **1** of relay TDR, to negative battery through the winding of relay TDST, which thereupon operates and completes a circuit over its own make contact bypassing make contact **2** of relay RCY, the latter relay becoming de-energized upon the subsequent operation of relay TDSA so as to release at a time interval measured by the slow-release characteristic of its short-circuited secondary winding. Relay TDST, in operating, completes an obvious circuit in FIG. 1J over its make contact **5** to cause the operation of the auxiliary relay TDSA, which in turn completes a circuit over its own make contact **7** through its secondary winding to provide for itself a slow-releasing characteristic. The operation of relays TDST and TDSA initiates a number of circuit operations to be described presently, whereby a translator-decoder is seized and the first three register digits are decoded, and whereby the arbitrary switching code resulting from this translation is registered in the switching digit registration circuit of FIG. 1S.

Upon the operation of the translator-decoder start relay TDST of FIG. 1J, circuits are completed in the lower left-hand portion of FIG. 1J for extending resistance battery over three separate leads and ground over two other leads into the translator and decoder connector circuit shown as a box in FIG. 1AC. Ground is extended over make contacts **3** and **1** of relay TDST to respective conductors TM and LDB; and, battery is extended through respective resistances STB, STA and ST, over respective break contacts **7**, **5** and **9** of relay RT3, thence over respective make contacts **12**, **11** and **9** of relay TDST, to respective conductors STB, STA and ST. These five conductors extend from FIG. 1J into FIG. 1AC and thence into the translator and decoder connector circuit, the details of which have not been shown. The immediately foregoing circuit action initiates connector operations for selecting a translator and decoder and for interconnecting it with the register-outpulser circuitry in FIGS. 1H through 1N, 1P through 1Z and 1AA and 1AB. The translator-decoder circuit (also shown in FIG. 1AC as a box), upon being seized, initiates action to seize the trunk class connector of FIG. 1AC, which thereupon returns a ground signal to the translator and decoder. This ground is extended through the translator and decoder connector and out over conductor CI into FIG. 1I, thence over break contact **3** of relay RT3, conductor CI into FIG. 1F, thence over the lower and upper right-hand crosspoints of the crossbar switch, cable PR, conductor CI, to the punching C1, which is shown cross-connected to punching CL**0** (indicating that the class of service to which this particular trunk is entitled is class 0), thence over conductor CL**0** back into FIG. 1AC, through the trunk class connector circuit and over conductor CL**0** into the translator and decoder where this class indication is used to assist in decoding the first three dial pulse digits in order to derive the switching code therefrom.

Upon the interconnection between the box circuits shown in FIG. 1AC and the register-outpulser, the first three digits previously registered in the input digit registration circuit of FIG. 1Q are transferred to the translator-decoder. In FIG. 1Q the A digit of 2 is indicated by the grounding (see FIG. 1R) of the conductors **0** and **2** extending into cable AI, the B digit of 4 is indicated by the ground of conductors **0** and **4** extending into cable BI and the C digit of 3 is indicated by the grounding of conductors **1** and **2** extending into cable CI. These three cables are combined and extend over cable CLDI into the connector circuit of FIG. 1AC and thence into the translator and decoder where these three digits, in combination with the class indication from the trunk class connector, are used to derive the arbitrary switching digits which will be used to reset the selector train of FIG. 1G. It will be recalled from previous description that it has been assumed that the three register digits 2, 4, 3 will be decoded in the translator-decoder into the switching instructions represented by the three digits 2, 3, 8 followed by a KP signal. These indications are transmitted from the translator-decoder of FIG. 1AC through the translator and decoder connector and out over cable SWI extending into FIG. 1S where relays AR**0** and AR**2** are operated to indicate the first digit 2, relays BR**1** and BR**2** are operated to indicate the B digit of 3, the C relays CR**1** and CR**7** are operated to indicate the third digit of 8, and the relays DR**2** and DR**10** are operated to indicate the registration in this D register of the so-called KP pulse.

In the meantime, as has been assumed hereinbefore, the translator-decoder circuitry of FIG. 1AC will transmit indications back through the translator and decoder connector into the translator-decoder control circuit of FIG. 1J to indicate to the register-outpulser at least four additional items of information: (1) the complete address to be received will consist of seven digits; (2) delete three of the dialed digits when outpulsing beyond; (3) stop outpulsing exit digits after the first two until address code registration is complete; and, (4) expect a "STOP-GO" condition upon trunk seizure. The seven digit call indication is effected by the extension of ground potential from the translator-decoder of FIG. 1AC, through the translator and decoder connector, over conductor **7DG** into FIG. 1J, to cause the operation of relay **7DG**, which thereupon locks over its own make contact **5** to ground over make contact **15** of the off-normal relay ON**1**. The delete-three information is likewise transmitted by ground in FIG. 1AC, over conductor DL**3** into FIG. 1J to cause the operation of relay DL**3**, which thereupon locks over its own make contact **12** to off-normal ground over break contact **6** of relay RCY. The information regarding the stopping of outpulsing exit digits after the first two, as will be explained in more detail below, is embodied in the registration in the D register of FIG. 1S of the KP pulse indication, and particularly is embodied in the registration therein of the operation of relay DR**10**. The stop-go indication is transmitted from the translator-decoder of FIG. 1AC, through the translator and decoder connector as a ground applied to conductor SG, extending therefrom into FIG. 1J to cause the operation of relay STG**0**, which thereupon locks over its own make contact **12** to off-normal ground under control of the released relay RCY. In FIG. 1J the operation of relay STG**0** completes an obvious circuit over its make contact **11** to cause the operation of relay SD**0** (indicating that this is a sender outgoing class of call), which relay thereupon locks over its own make contact **2** to ground over make contact **20** of relay ON**2**. Upon the operation of relay SD**0**, a circuit is completed in FIG. 1J for causing the operation of relay RCA**1** extending from ground in FIG. 1J, over make contact **24** of relay ON**2**, make contact **9** of relay SD**0**, break contact **8** of relay TDR, make contact **8** of relay TDST, parallel break contacts **7** and **5** of respective relays SLT and RCS, thence to battery through the upper winding of relay RCA**1** which, upon operating, causes its make contact **12** to shunt its secondary winding, thereby providing it with a slow-releasing characteristic. The operation of relay RCA**1** completes an obvious circuit in the upper right-hand portion of FIG. 1J for operating the slow-release relay RCA. In the meantime, the translator-decoder will have ascertained that the switching instructions have properly been transmitted to the register-outpulser and will thereupon apply ground to conductor RL in FIG. 1AC, extending into FIG. 1J to cause the operation of the the translator-decoder release relay TDR, which thereupon locks over its make contact **3** to ground over make contact **20** of relay ON**2**. The operation of relay TDR causes the release in FIG. 1J of the translator-decoder start relay TDST, the release of which in turn initiates the slow-release of relay TDSA; and, the eventual release of these two relays will completely release the circuitry of FIG. 1AC from its connection with the register-outpulser circuit.

The operation of relay RCA of FIG. 1J initiates a series of operations leading up to the generating of the exit digits for controlling the selector train of FIG. 1G. With reference to FIG. 1H, it will be noted that upon the operation of relay RCA it opens its back contact **6**, which is in series with the fundamental tip-ring loop to the selector circuits of FIG. 1G, the opening of this loop eventually causing the release of all three of the first, second and third selectors which previously were set by repeated dial pulsing from the calling subscriber S of FIG. 1E. As has been explained hereinbefore, the action of the translator-decoder from seizure to release is sufficiently fast such that the third selector of FIG. 1G will not have had an opportunity to have hunted for and seized an idle outgoing trunk circuit. Furthermore, with regard to FIG. 1W, the previously operated and locked outsteering relay OS**1** is released upon the operation of relay RCA since it will be noticed that in the lower right-hand corner of FIG. 1W back contact **8** of relay RCA opens the locking circuit for relay OS**1**. It will be noted that when the selectors of FIG. 1G are returned to normal, ground on the sleeve conductor FS extending therefrom is removed, thus removing ground from conductor S**1** of FIG. 1F extending over the upper and lower left crosspoints of the crossbar switch extending into FIG. 1I, thereby removing from the left-hand side of the winding of relay SLT**1** the shunting ground. Relay SLT**1** thereupon reoperates in a circuit extending from ground in FIG. 1I, through its winding, through resistance SLT**1** and to battery over make contact **12** of relay RCA; and, the reoperation of relay SLT**1** causes the reoperation in FIG. 1I of relay SLT. In FIG. 1J, upon the operation of relay RCA and upon the operation of the translator-decoder release relay TDR, a circuit is completed for operating relay RCS extending from ground, over make contact **24** of relay ON**2**, make contact **9** of relay SD**0**, make contact **8** of relay TDR, make contact **1** of relay RCA, to negative battery through the upper winding of relay RCS, which thereupon operates and shunts its secondary winding over its own make contact **12** to provide itself with a slow-releasing characteristic. Also, in FIG. 1J make contact **8** of the operated relay SLT is arranged in shunt of make contact **1** of relay RCA. Upon the operation of relay RCS, a circuit is completed for causing the operation in FIG. 1V of the first arbitrary switching digit outsteering relay ARS in a circuit extending from ground in FIG. 1V, over make contact **15** of relay ON**2**, make contact **6** of relay RCS, to negative battery through the winding of relay ARS. The operation of relay ARS in FIG. 1V, following the release (above described) in FIG. 1W of the outsteering relay OS**1**, arranges the outsteering circuit, as will be described presently, whereby the first arbitrary exit digit now registered in the A register of FIG. 1S will be the first digit to be outpulsed.

Upon the operation (above described) of relay RCS of FIG. 1J, the winding of relay RCA**1** will become deenergized and eventually (after approximately 100 ms.) relay RCA**1** of FIG. 1J will release to in turn cause the release to in turn cause the release some 150 ms. thereafter of the slow-release relay RCA of FIG. 1J. The release of relay RCA recloses the fundamental tip-ring loop in FIG. 1H toward the first selector of FIG. 1G, thereby seizing the first selector which in turn will apply ground to its sleeve conductor extending back into FIG. 1F and thence over conductor S**1** previously described extending into FIG. 1I for shunting down the relay SLT**1**, as has been described previously, the release of relay SLT**1** in turn causing the release a measured time thereafter of the relay SLT in FIG. 1I, the release of which in turn initiates the release of the slow-release relay RCS of FIG. 1J.

In the meantime, upon the operation in FIG. 1V of the first arbitrary digit outsteering relay ARS, circuits are completed in FIG. 1X for reading out the first exit digit from the A digit register into the reading relays RR**0** through RR**10** of FIG. 1X. It will be recalled that the digit registered in the A digit register of FIG. 1S is the digit 2 and that this is represented in FIG. 1X and FIG. 1Y by the operation of relays AR**0** and AR**2**, thereby to cause the grounding out of the A digit register shown in FIG. 1X of conductors **0** and **2** extending over cable AR**0** and over make contacts of the steering relay ARS to battery through the windings of the reading relays RR**0** and RR**2**, thereby causing the operation of these two reading relays. With relay RCA**1** released in FIG. 1J (as previously described), upon the operation in FIG. 1X of two of the read-out relays a circuit is completed in FIG. 1N for operating the read-out check relay RK, the latter circuit extending from ground in FIG. 1N, over make contact **16** of relay ON**2**, break contact **8** of relay RCA**1**, thence over make contact **10** of the operated read-out relay RR**0**, thence over break contact **11** of relay RR**1**, make contact **11** of relay RR**2**, break contacts **12** of relays RR**4** and RR**7**, break contact **2** of relay RR**10**, make contact **5** of relay SD**0**, make contact **9** of relay TDR, make contact **11** of relay DP, to negative battery through the winding of relay RK, which thereupon operates as an indication of a proper operation of the reading relays of FIG. 1X. Upon the operation of relay RK, with relays RCA and RCS of FIG. 1J released (as previously described), the circuitry of the pulse generator of FIG. 1M, which had previously been left in the condition with relay PG**1** operated and relay PG**2** released, is now placed in a condition whereby relay PG**1** is released because of the opening of all of its locking circuits. The release of relay PG**1** in FIG. 1M will initiate the generation of dial pulses for controlling the first selector of FIG. 1G in accordance with the first arbitrary exit digit of 2 (presently recorded in the read-out relays of FIG. 1X) under the control of the output pulse counting circuit of FIG. 1L, the description of this operation being the subject matter of the next main subsection of this description.

It will be recalled that during the previously described detailed circuit operations which take place as an incident to the translator-decoder functioning and leading up to the circuit description whereby the pulse generator of FIG. 1M is about to be controlled for directing the selector train of FIG. 1G in accordance with the arbitrary exit digits, the calling subscriber S of FIG. 1E is continuing to dial into the machine the successive digits of the assumed address code 243–0123 and that these input digits are being counted by the input pulse counting circuit of FIG. 1K and are being successively registered in the input digit register of FIG. 1Q under control of the continuously advancing input digit steering circuitry of FIG. 1P.

*Controlling initial selectors*

It will be noted with reference to FIG. 1H, particularly the upper right-hand portion thereof, that the tip conductor FT, extending between FIG. 1H and the link circuit of FIG. 1F and thence to the selectors of FIG. 1G, has included in series therewith make contact **1** of relay PG**1**: make contacts of relays TMF, W and IC are open because these relays are released; and, break contact **4** of relay RK is open because this relay is operated. Subsequent action of the pulse generator of FIG. 1M will cause relay PG**1** to successively release and reoperate a number of times depending upon the number of pulses in the exit digit which is then controlling the selectors. This action of relay PG**1** will cause dial pulsing of the fundamental tip and ring loop to the selectors to cause these selectors to be reset in accordance with the successive exit digits. In the presently assumed example this pulsing of the selector train will take place in accordance with the first and second arbitrary exit digits now registered in the A and B registers of FIGS. 1S and 1X; whereupon this action will stop until such time as the input digit steering chain of FIG. 1P indicates that the total number of seven digits has been received. Following this, the outpulsing control of the selectors will continue such as will be described in detail in subsequent sections.

It will be recalled, upon the operation in FIG. 1N of the read-out check relay RK, with relays RCA and RCS released in FIG. 1J, that the pulse generator of FIG. 1M is allowed to start its pulsing operation. This pulsing operation is initiated by the release in FIG. 1M of relay PG1 with relay PG2 previously in the released condition. Upon the release of relay PG1, a circuit is completed for discharging condenser PG through the lower primary winding of relay PG2, thereby causing a discharge current to flow from right to left through the lower primary winding, this circuit extending from ground in FIG. 1M, over make contact **10** of relay ON1, break contact **7** of relay RL, break contact **4** of relay PG1, through the lower winding of relay PG2, through condenser PG, to negative resistance battery. This discharge current flowing from right to left in the lower winding of relay PG2 maintains relay PG2 in a released condition even though the upper or secondary winding of relay PG2 also carries a current flowing from right to left therethrough. When condenser PG has become discharged to a certain level, such as to cause the discharge current to have become considerably reduced, the current flowing in the upper secondary winding takes control and causes the operation of relay PG2. When relay PG2 operates, relay PG1 reoperates in an obvious circuit under control of make contact **3** of relay PG2. When relay PG1 reoperates, circuits are completed for causing condenser PG to carry charging current from left to right through the lower primary winding thereof in a circuit extending from ground at break contact **7** of relay RL, through make contact **4** of relay PG1, through condenser PG, the lower winding of relay PG2, and thence to negative battery through break contact **6** of relay TMFA and resistance PG7. This left-to-right charging current through the lower winding of relay PG2 maintains this relay operated even though the upper secondary winding is carrying current from left to right and having a tendency to release relay PG2. After condenser PG charges sufficiently, the current will have dropped to a point where the current through the upper secondary winding will take control causing relay PG2 to become released. The release of relay PG2 causes the release of relay PG1; and, this oscillating condition of relays PG1 and PG2 continues to repeat itself until some other circuit operation takes place (as will be described below) to provide a locking circuit for relay PG1, thereby to cause relay PG1 to remain in an operated condition regardless of the released or operated condition of relay PG2. Therefore, throughout the ensuing description, unless otherwise specified, it will be assumed that relays PG1 and PG2 continue to oscillate in the above fashion. The time during which relay PG1 is released is referred to as an open loop period of pulsing because (see FIG. 1H) when relay PG1 is released the fundamental tip-ring loop to the selectors of FIG. 1G is opened. The time during which relay PG1 is operated is similarly referred to as a closed loop period. Referring to FIG. 1M, for dial pulsing (such as to control the selectors of FIG. 1G) relays TMFA of FIG. 1X and TMF2 of FIG. 1M are both released and the pulsing rate of relay PG1 is adjusted to be approximately ten pulses per second (p.p.s.) with a 35 millisecond (ms.) closed loop period and a 65 ms. open loop period; for transmitting the so-called KP pulse, relay TMFA will be operated, thereby changing the pulsing rate of relay PG1 to 5 p.p.s. with a 100 ms. closed period and a 100 ms. open period; and, for MF outpulsing, relays TMFA and TMF2 will both be operated, thereby adjusting the pulsing rate of relay PG1 to approximately 7 p.p.s. with a 75 ms. closed loop period and a 75 ms. open loop period.

During the outpulsing of the dial pulse digits for controlling the selectors of FIG. 1G it is necessary for the circuitry to manufacture an interdigital time and this control is exercised primarily by the output pulse counting circuit of FIG. 1L and the outpulsing control circuitry of FIG. 1N. During dial pulsing the pulse counting circuit of FIG. 1L counts the number of pulses (releases and reoperations of relay PG1 of FIG. 1M), this pulse count is compared in a matching circuit to the digit presently represented by the operated condition of the read-out relays of FIG. 1X, and when these two are equal IC in FIG. 1L is operated to stop the outpulsing (see FIG. 1H where make contact **1** of relay 1C shunts make contact **1** of relay PG1) and to start an interdigital timing period during which the switching digit outsteering circuitry of FIG. 1V advances, the pulse counting circuitry of FIG. 1L is recycled, the read-out relays of FIG. 1X are released and reoperated in accordance with the second or B digit, and this next digit is outpulsed. When the so-called KP pulse or an MF pulse is to be transmitted, FIG. 1L does not function, the pulsing of the dual frequency pulses being controlled by relay PG1 alone.

Returning to the specific circuit situation again, the pulse generator of FIG. 1M will have been started, causing the above-described oscillating condition of relays PG1 and PG2, and the pulses counting circuit of FIG. 1L will count the pulses generated by relay PG1 by virtue of the circuitry shown in skeletonized form whereby ground extends over make contact **3** of relay ON1, break contact **10** of relay TMFA, break contact **5** of relay RCA, the parallel combination of make contact **2** of relay PG1 and break contact **4** of relay IC, into the pulse counting circuit, and whereby another counting circuit extends from ground on conductor Z from FIG. 1W, through break contact **7** of relay RCA, break contact **11** of relay TMFA, the parallel combination of make contact **3** of relay PG1 and break contact **2** of relay IC, and thence under the control of make contact **1** of relay P1 and transfer contacts **5** of relay PG1 into the pulse counting circuit. When the pulse counting circuit of FIG. 1L has counted two pulses, the matching circuit of FIG. 1L will indicate that this matches the initial exit digit of 2 registered on the read-out relays of FIG. 1X. This will cause the operation of relay IC in FIG. 1L in a circuit extending from the matching circuit, through make contact **6** of relay PG1, to negative battery through the winding of relay IC. Upon the next release of relay PG1, relay IC will remain locked operated in a circuit extending from its winding, through break contact **6** of relay PG1, make contact **2** of relay IC, to ground on conductors Z. Also, upon the aforementioned release of relay PG1 the pulse counting circuit of FIG. 1L will be recycled to its starting condition. With reference to FIG. 1N, upon the operation of relay IC a circuit is completed for causing the operation of relay W extending from ground in FIG. 1N, over make contact **16** of relay ON2, break contact **8** of relay RCA1, make contact **6** of relay IC, break contact **8** of relay TMF, break contact **6** of relay Z, to battery through the winding of relay W. With reference to FIG. 1V, upon the operation of relay W a circuit is completed for causing the operation of the second switching digit outsteering relay BRS extending from ground in FIG. 1V, over make contact **4** of relay ON1, make contact **4** of relay W, break contact **9** of relay RCA, break contact **8** of relay RCS, make contact **11** of relay ARS, break contact **8** of relay BRS, to battery through the winding of steering relay BRS. Relay BRS thereupon operates and locks under control of its own make contact **8** and break contacts **6** of the succeeding steering relays, to ground on conductor AS4 extending thereto from FIG.

1W. Relay ARS in FIG. 1V remains operated in a circuit extending from the left-hand side of its winding, over break contact **6** of relay RCS, make contact **8** of relay ARS, make contact **6** of relay BRS, break contacts **8** and **9** of respective relays RCS and RCA, to off-normal ground through make contact **4** of relay W. It will be noted in FIG. 1X that since relay ARS is still operated, the operated condition of steering relay BRS will not affect the condition at this particular instant of the operated read-out relays RR**0** and RR**2** under control of the A digit register. Prior to this particular circuit operation, the first digit of 2 will have been outpulsed into the first selector of FIG. 1G, thereby having driven the first selector to its second level where it proceeds to hunt for and seize an idle second selector during the interdigital timing which is presently underway.

Eventually relays PG**2** and PG**1** of FIG. 1M become reoperateed, at which time relay IC of FIG. 1L is released to in turn cause the operation in FIG. 1N of relay Z. The circuit for operating relay Z extends from ground in FIG. 1N, over make contact **16** of relay ON**2**, break contact **8** of relay RCA**1**, thence over break contact **6** of relay IC, break contact **7** of relay TMFA, make contact **10** of relay W, break contact **12** of relay Z, to battery through the winding of relay Z, which thereupon locks over its own make contact **12** and make contact **12** of relay W to off-normal ground. In FIG. 1L, the operation of relay Z completes a circuit from ground on conductor Z extending thereto from FIG. 1W, over make contact **4** of relay Z to an output pulse counting circuit (not shown in detail) which will complete the ground circuit therethrough to make cantact **6** of relay PG**1** when the pulse counting circuit of FIG. 1L has reached a pulse count of 4, this representing the end of the interdigital timing interval. Eventually relay PG**1** of FIG. 1M will have released and reoperated four times thereby causing the pulse counting circuit of FIG. 1L to arrive at a pulse count of 4. Upon the reoperation of relay PG**1** subsequent to having produced four dial pulses, a circuit is completed for again causing the operation of relay IC in FIG. 1L, this time under control of the output pulse count-of-four-circuitry of FIG. 1L. Upon the reoperation of relay IC, relay W of FIG. 1N is released, thereby causing the release in FIG. 1V of the first or A digit steering relay ARS. Upon the release of steering relay ARS the read-out relays of FIG. 1X will become released as far as the A digit registration is concerned and will immediately reoperate into a new pattern according to the digit registered in the B register of FIG. 1X, which represents the digit 3 and which will be manifested by the operation of read-out relays RR**1** and RR**2**. The release and reoperation of the read-out relays of FIG. 1X will cause the release in FIG. 1N of relay RK followed immediately by the reoperation of relay RK as an indication of a read-out check. Relays PG**1** and PG**2** continue to oscillate and upon the next release of relay PG**1** the pulse counting circuit of FIG. 1L will be recycled to normal and relay IC of FIG. 1L will remain locked under control of the released relay PG**1**. Eventually relays PG**2** and PG**1** again reoperate and upon this subsequent operation of relay PG**1** relay IC of FIG. 1L is released, to in turn cause the release in FIG. 1N of relay Z, thereby returning the interdigital timing circuitry to its normal condition. The reoperation of relay PG**1** also causes the release of relay PG**2** which in turn allows relay PG**1** to become released as soon as the read-out check relay RK is reoperated. This circuit operation has reset the entire outpulsing mechanism preparatory to outpulsing the first pulse of the second exit digit, it being noted at this point that relays IC and W are both released and that relay RK is operated so that make contact **1** of relay PG**1** in FIG. 1H may now again be used to transmit dial pulses to the selector circuitry of FIG. 1G, it being understood that by this time the first selector of FIG. 1G has hunted for and has seized a second selector which is now in the circuit ready to be controlled by the second exit digit.

The above procedure is repeated with respect to the second or B digit of FIG. 1X, namely a 3, whereby the second selector of FIG. 1G is stepped to its third level where it will hunt for and seize an idle third selector preparatory to accepting the third or trunk seizure digit registered in the C digit register of FIG. 1X. At the end of the third release of relay PG**1** of FIG. 1M, representing the pulsing to the second selector of FIG. 1G of the second digit of 3 pulses, relays PG**2** and PG**1** will reoperate as previously described thereby causing the operation in FIG. 1L of relay IC, to in turn cause the operation in FIG. 1N of relay W, to in turn cause the operation in FIG. 1V of the third or C digit steering relay CRS. This latter circuit extends from ground in FIG. 1V, over make contact **4** of relay ON**1**, make contact **4** of relay W, break contacts **9**, **8** and **11** of respective relays RCA, RCS and ARS, make contact **11** of relay BRS, break contact **8** of relay CRS, to battery through the winding of relay CRS, which thereupon locks over its own make contact **8** and the series of break contacts No. **6** of the succeeding steering relays to ground on conductor AS**4** extending thereto from FIG. 1W. Relay BRS remains locked in a circuit over its own make contact **8**, make contact **6** of relay CRS, to off-normal ground at break contact **8** of relay RCS. Again, relays PG**2** and PG**1** will both become released and again both become reoperated. However, upon the reoperation of relay PG**1** of FIG. 1M a circuit is now completed for causing relay PG**1** to become locked in the operated condition, this circuit extending from ground in FIG. 1X, over make contact **4** of relay ON**2**, break contact **1** of relay DPC, over conductor **10**G, through a make contact of the D digit register which contains the registration of 2 and 10, out over conductor D**10**, make contact **9** of relay CRS, break contact **2** of relay DPC, conductor PKC to FIG. 1M, break contact **11** of relay PKC, make contact **11** of relay PG**1**, to battery through the winding of relay PG**1**. However, upon the reoperation and locking of relay PG**1**, relay IC of FIG. 1L is released, thereby causing the operation in FIG. 1N of relay Z. In the meantime relay PG**2** of FIG. 1M will become released; however, at this point the pulse generator of FIG. 1M is clamped in the condition with relay PG**2** released and relay PG**1** operated until such time as relay PKC of the input digit steering circuit of FIG. 1P operates to indicate that all seven of the address code digits as dialed by the calling subscriber have actually been received and registered.

At this point it will be noted that the first selector of FIG. 1G has been raised to its second level in accordance with the first arbitrary exit digit 2, the second selector of FIG. 1G has been elevated to its third level in accordance with the second arbitrary exit digit 3, and that at this point the outpulsing into the selectors of FIG. 1G has been stopped by the locking of relay PG**1** of FIG. 1M until such time as all of the address code digits have been received. This prevents the setting of the third selector of FIG. 1G in accordance with the C digit of FIG. 1X; that is, it prevents the trunk seizure selector from actually seizing the trunk until such time as all of the input digits have been registered. This latter stopping condition, it will be recognized, is controlled by the steering relays of FIG. 1V sensing the KP pulse registered in the D digit register of FIG. 1X by virtue of recognizing the special registration of 10 therein.

*Controlling trunk seizure selector*

Summarizing the present situation at the moment, the pulse generator of FIG. 1M is locked in the condition with relay PG**1** operated and relay PG**2** released, thereby preventing any further pulsing in FIG. 1H of the fundamental tip and ring circuit extending to the selectors of FIG. 1G. The first selector of FIG. 1G is connected over its second level (in accordance with the first exit digit of 2) with a second selector which in turn is set on its third level (in according with the second exit digit of 3) and has seized a third selector preparatory to causing the third or trunk seizure digit of 8 to control this third selector. In FIG. 1V both of the steering relays BRS and CRS are operated and locked. In FIG. 1X the read-out relays RR1 and RR2 remain operated under control of the operated steering relay BRS and the registration of the digit 3 in the B register. The locking circuit for relay PG1 extends from ground in FIG. 1X, over conductor PKC into FIG. 1M, under control of the registration in the fourth or D digit register of FIG. 1X of the KP pulse represented by the operation of the relays DR2 and DR10, the latter 10 signal being the signal which has caused the stopping of the pulse generator of FIG. 1M one digit ahead of the third or C exit digit. In FIG. 1L relay IC is released and in FIG. 1N both of the relays W and Z are operated. The circuitry is now in such a condition that when the input digit steering circuit of FIG. 1P recognizes the registration of the seventh or last digit of the dialed address code 243–0123, relay PKC in FIG. 1P will become operated to permit the pulse generator of FIG. 1M to control the third selector of FIG. 1G.

Let it be assumed now that the input digit steering circuit of FIG. 1P has been successively advanced to a point where all seven of the address code digits 243–0123 have been registered in the successive registers of FIG. 1Q and that input digit steering relay IS8 of FIG. 1P has been operated preparatory to accepting the eighth (which will never come) input digit, if any. Upon the operation of relay IS8, a circuit is completed in FIG. 1P for causing the operation of relay PKC extending from ground in FIG. 1P, over make contact **20** of relay ON1, make contact **10** of relay 7DG (indicating that this call should consist of only seven digits), thence through a circuit (not shown) indicating that the A digit is neither a zero nor a one, thence over make contact **11** of relay IS8, break contact **4** of relay RA2, break contact **6** of relay PKC, to battery through the winding of relay PKC, which operates and locks over its own make contact **6** to off-normal ground. The operation of relay PKC causes the release in FIG. 1P of all other operated relays, including the steering relays IS7 and IS8. The operation of relay PKC, as has been explained hereinbefore, is an indication that all of the expected address code digits 243–0123 have been received and registered. Upon the operation of relay PKC of FIG. 1P, the locking circuit in FIG. 1M of relay PG1 is opened at break contact **11** of relay PKC, thereby allowing relay PG1 to become released to initiate the previously described interdigital timing operation which results in the reoperation of relay IC (FIG. 1L) upon the subsequent operation of relay PG1 as it begins again to oscillate with relay PG2. Without repeating previously described circuit detail, it will be understood that the subseqent oscillation of relays PG1 and PG2 of FIG. 1M causes the B digit steering relay BRS of FIG. 1V to become released, thereby allowing the read-out relays of FIG. 1X to become reoperated in accordance with the third or C digit of 8 (relays RR1 and RR7 of FIG. 1X operated) and causing the relay PG1 to open and close the fundamental tip-ring loop of FIG. 1H to elevate the third selector of FIG. 1G to its eighth level where it will proceed to hunt for and select an outgoing trunk, such as trunk No. 3 of FIG. 1G.

At the end of the pulsing of the third exit digit of 8, the D digit or fourth switching digit steering relay of FIG. 1V, namely relay DRS, will become operated and the circuitry of FIGS. 1L, 1N and 1M will proceed with the previously described interdigital timing interval eventually resulting in the release of the third or C digit steering relay CRS of FIG. 1V, to in turn cause the release of the read-out relays of FIG. 1X and to cause their reoperation to register the KP pulse (2 and 10) in the D digit position of FIG. 1X, namely with the read-out relays RR2 and RR10 operated. This causes the operation in FIG. 1N of the read-out check relay RK in a circuit extending from ground in FIG. 1N, over make contact **16** of relay ON2, break contact **8** of relay RCA1, break contacts **10** of relays RR0 and RR1, make contact **10** of relay RR2, break contacts **11** of relays RR4 and RR7, make contact **12** of relay RR10, to the previously described operating circuit for relay RK. Eventually, after the interdigital timing interval, relays PG1 and PG2 will have returned to their operated conditions, relay IC of FIG. 1L will have become released and relays Z and W of FIG. 1N will also have become released. In FIG. 1X relay RR10 became operated under the control of relays TMF and TMFA as follows: relay TMF is operated over the RR10 lead from the D digit register under control of the D digit steering relay DRS and under control of break contact **8** of relay DPC and break contact **5** of relay TMF; relay TMF, in operating, locked over its own make contact **5** to off-normal ground under control of break contact **4** of relay RCY and completed an obvious circuit for causing the operation of relay TMFA, which in turn allows relay RR10 to become operated on the ground from conductor RR10 extending thereto from the D digit register over make contact **4** of relay TMFA.

The operation of relays TMF and TMFA of FIG. 1X stops further dial pulse sending over the tip-ring loop to the selectors of FIG. 1G, includes in this loop circuit means for transmitting further pulsing on a multifrequency tone basis, immobilizes the output pulse counting circuitry of FIG. 1L, and changes the pulsing rate of the pulse generator of FIG. 1M. In FIG. 1H it will be noted that the fundamental tip-ring loop looking toward the selectors of FIG. 1G and comprising the conductors FT and FR in the upper right-hand corner of FIG. 1H may now be traced as follows: from conductor FT over make contact **9** of relay TMF, make contact **4** of relay SDO, break contact **6** of relay RCA, make contact **1** of relay TMF, through the upper left winding of transformer T, make contact **6** of relay TMF, make contact **9** of relay REC, resistance FT1, resistance RV1, through the windings of relays RV and LT (which remains operated), make contact **3** of relay ON2, resistance FR1, make contact **11** of relay REC, make contact **8** of relay TMF, lower left winding of transformer T, to the ring conductor FR leading to the first selectors of FIG. 1G. Thus, the operation of relay TMF of FIG. 1X has maintained closed the direct current loop to the first selectors and has interposed therein the secondary winding of the transformer T of FIG. 1H. The primary winding of transformer T in FIG. 1H extends over make contacts **3** and **2** of relay TMF, through resistances MF1 and MF2, break contacts **7** and **8** relay PG1, and thence through a network of contacts of the read-out relays of FIG. 1X to the multifrequency tone supply shown as a box in FIG. 1H. Thus, the operation of relay TMF has also placed further outpulsing on a multifrequency basis under control of the pulsing relay PG1 of the pulse generator of FIG. 1M. In FIG. 1L, relay TMFA, in operating, has opened its break contacts **10** and **11** thereby to immobilize any further action of the output pulse counting circuit of FIG. 1L. In FIG. 1M, the operation of relay TMFA, by virtue of its transfer contacts **6** and **5**, has altered the impedance in the timing circuit of the relay PG2 whereby, as has been mentioned hereinbefore, the pulsing rate of the pulsing generator is now set at approximately 5 p.p.s. Also, in FIG. 1M it will be noted that upon the operation of relay TMF a circuit is completed for locking operated relay PG1, this circuit extending from ground in FIG. 1M, over break contact **5** of relay SG1, make contact **4** of relay TMF, make contact **11** of relay PG1 and to battery through the winding of relay PG1. This circuitry will maintain relay PG1 operated (thereby preventing further oscillation of the pulse generator of FIG. 1M) until such time as relay SG1 (shown in FIG. 1J) is operated. The operation of relay SG1, as will be explained hereinafter, will represent a trunk signaling condition whereby it is permissible to transmit the KP signal presently recorded in the read-out relays of FIG. 1X. The circuitry is now set in the condition necessary for ascertaining what signaling condition exists in the outgoing trunk of FIG. 1G.

*Stop-go trunk condition*

It will be recalled from previous description that in FIG. 1J relay STGO was operated from the translator-decoder as a signal to indicate that when an outgoing trunk is seized a "STOP-GO" condition should be expected as a signaling condition on that trunk. With reference to FIG. 1H and to previous description it will be recalled that relay RV is in series with the direct current loop to the selectors of FIG. 1G. It will also be noted that the selectors have presented to the tip and ring leads FT and FR in FIG. 1H a condition whereby ground potential is on the tip lead FT and battery potential is on the ring lead FR, which resulted in current flowing through the winding of relay RV (from plus to minus) in the downward direction in FIG. 1H, relay RV being a polarized relay and responsive only to current flowing in the opposite direction. Therefore, relay RV has not been operated throughout the initial control of the selectors of FIG. 1G. Relay RV is so polarized as to detect a reversal of the normal ground and battery condition on respective conductors FT and FR and to operate in response to such a reversal as an indication of a stop signal. Although the details thereof have not been shown with respect to the outgoing trunk No. **3** of FIG. 1G, it will be understood that at such time as this trunk circuit is seized it returns a reverse battery signal over the tip and ring leads such as to cause the operation in FIG. 1H of relay RV. In the lower right-hand portion of FIG. 1J it will be noted that upon the operation of relay RV a circuit is completed for causing the operation of relay SG extending from ground in FIG. 1J, over make contact **19** of relay ON2, break contact **10** of relay RCA, make contact **1** of relay RV, make contact **10** of relay STGO, break contact **2** of relay SG1, to battery through the upper primary winding of relay SG. Relay SG operates, completes a locking circuit over its own make contact **2** independently of make contact **1** of relay RV and, over its own make contact **12**, completes a circuit through its lower secondary winding to insure that relay SG will have a slow-releasing characteristic. It will also be noted in FIG. 1J that after the operation of relay SG, relay SG1 will operate upon the release of relay RV of FIG. 1H, the release of which will take place only at such time as the trunk No. **3** of FIG. 1G again reverses the battery and ground signal over the tip and ring leads so as to put ground on conductor FT and battery potential on ring lead FR in FIG. 1H.

At such time as the equipment which may be connected to the far end of trunk No. **3** of FIG. 1G is in a condition for receiving further signaling, the trunk circuit of FIG. 1G will cause the battery-ground condition on the tip and ring circuit to again become reversed, thereby to cause the release in FIG. 1H of relay RV as a start or go signal. Upon the release in FIG. 1H fo relay RV, a circuit is completed in FIG. 1J for causing the operation of relay SG1 extending from ground at break contact **10** of relay RCA, thence through break contact **3** of relay RV, make contact **8** of relay SG, to negative battery through the winding of relay SG1. Relay SG1 operates and locks over its own make contact **4** to off-normal ground over break contact **10** of relay RCA and, in operating, initiates the slow release of relay SG. In FIG. 1M the operation of relay SG1 removes the locking ground which has been maintaining relay PG1 in the operated condition, thereby permitting relay PG1 to release to initiate further outpulsing, as explained in the immediately succeeding section of this description.

*Outpulsing KP pulse and address code digits*

Upon the release of relay PG1 of FIG. 1M, incident to the release in FIG. 1H of relay RV indicating a go condition on trunk No. **3** of FIG. 1G, it will be noted in FIG. 1H that circuits are completed for transmitting a two-frequency tone pulse from the MF tone supply in FIG. 1H out over the tip and ring conductors FT and FR extending into the first selector circuitry of FIG. 1G and thence out over the tip and ring leads T and R of the outgoing trunk circuit to the remote office. It will be recalled in FIG. 1X that at the moment the so-called KP signal is recorded in the read-out relays by the operation of relays RR2 and RR10, this being the signal necessary to be transmitted to the remote office to prepare the multifrequency receiving equipment thereat to receive and register the subsequently transmitted multifrequency outpost digits. In FIG. 1H, with reading relays RR2 and RR10 of FIG. 1X operated and with relay PG1 of FIG. 1M released, circuits are completed for transmitting two separate frequency tones over the tip and ring circuit as follows: one circuit extends from the tone supply, over conductor **2** (a signal of 1100 cycles), thence over make contact **3** of relay RR2, break contact **3** of relay RR1, break contact **7** of relay PG1, through resistance MF1 and make contact **3** of relay TMF to the right-hand side of transformer T; and, the other circuit extends from the tone supply in FIG. 1H, over conductor **10** (1700 cycles), thence over make contact **1** of relay RR10, break contact **4** of relay RR1, break contact **4** of relay RR0, break contact **8** of relay PG1, resistance MF2 and through make contact **2** of relay TMF to the right-hand windings of transformer T. These two tones of frequencies of 1100 and 1700 cycles are combined in the right-hand side of transformer T and are induced in the secondary or left-hand side of transformer T and thence extend over previously described circuitry over the tip and ring conductors extending to the selectors and trunk circuit of FIG. 1G.

Upon the release of relay PG1 in FIG. 1M the outpulsing control circuit of FIG. 1N goes through a series of circuit operations whereby relay W is operated and subsequently released to initiate action for controlling the outpulsing of the next digit. Upon the release of relay PG1, a circuit is completed for operating relay W extending from ground in FIG. 1N, over make contact **16** of relay ON2, break contact **8** of relay RCA1, break contact **6** of relay IC, break contact **10** of relay PG1, make contact **8** of relay TMFA, break contact **6** of relay Z, to battery through the winding of relay W. Also, upon the operation of relay W a circuit is completed for causing the operation in FIG. 1W of the fourth called digit outsteering relay OS4. It will be recalled in FIG. 1J that relay DL3 had been operated from the translator-decoder as a signal to delete three digits when outpulsing the called number; and, this is the reason why in FIG. 1W the fourth steering relay OS4 is operated at this point instead of one of the preceding relays OS1, OS2 and OS3. The circuit for operating relay OS4 extends from ground in FIG. 1V, over make contact **4** of relay ON1, make contact **4** of relay W, break contacts **9** and **8** of relays RCA and RCS, break contacts **11** of relays ARS, BRS and CRS, thence over make contact **11** of relay DRS, conductor AS3 extending into FIG. 1W, and therein through a circuit (not shown) indicating that the A digit is neither a zero nor a one, thence over make contact **8** of relay DL3, break contact **6** of relay OS4, to negative battery through the winding of relay OS4. Relay OS4 operates and locks over its own make contact **6** and over break contacts **5** of the succeeding steering relays OS5, OS6 and OS7, thence through break contacts **5** of relays ST and ST1, to off-normal ground over break contact **8** of relay RSA and make contact **18** of relay ON2. The D digit steering relays DRS of FIG. IV remains locked in a circuit extending from the left-hand side of its winding over its make contact **8**, break contacts **6** of relays ERS and FRS, thence over conductor AS4 into FIG. 1W, over break contacts **5** of relays OS1, OS2 and OS3, thence over make contact **5** of relay OS4, conductor AS5 extending back into FIG. 1V, to ground controlled by make contact **4** of relay W.

In the meantime, relays PG2 and PG1 of FIG. 1M will have been reoperated in accordance with previous description. The reoperation of relay PG1 will cause the eventual release of relay PG2. Relay PG1, in reoperating, locks over its own make contact **11**, make contact **11** of relay OS4, break contact **7** of relay TDR, to off-normal ground over make contact **11** of relay W. Also, in FIG. 1N, upon the reoperation of relay PG1, relay W will become released, thereby opening the locking circuit of relay DRS of FIG. 1V. Upon the release of the steering relay DRS of FIG. 1V, the read-out relays of FIG. 1X will release and will reoperate according to the digit registered in the D digit register of FIG. 1AA as follows: the digit 0 registered in the D digit position of FIG. 1AA will cause the grounding out of this D digit register of conductors **4** and **7** through cable D**0**, over make contacts of relay OS4, break contacts of relays OS3, OS2 and OS1, conductors OP4 and OP7, cable OP into FIG. 1X, conductors OP4 and OP7, thence over break contacts of relays FRS, ERS, DRS, CRS, BRS, and ARS, to cause the operation of the read-out relays RR4 and RR7. The release and reoperation of the read-out relays of FIG. 1X cause the release and reoperation in FIG. 1N of the read-out check relay RK, this time in a circuit extending from ground in FIG. 1N, over make contact **16** of relay ON2, break contact **8** of relay RCA1, break contacts **10** of relays RRO, RR1, and RR2, make contact **10** of relay RR4, make contact **12** of relay RR7, break contact **12** of relay RR10, to the previously described circuit for operating relay RK, the operation of which will allow the relay PG1 in FIG. 1M to again become released after a suitable time delay, as has been mentioned hereinbefore.

In the meantime, in the upper right-hand portion of FIG. 1M, upon the previously described operation and release of relay W of FIG. 1N, cicuits are completed for causing the operation of relays TMF1 and TMF2 extending from ground in FIG. 1M, over make contact **1** of relay TMFA, make contact **7** of relay W, to battery through the winding of relay TMF1, which locks over its make contact **2**, conductor L into FIG. 1S, to off-normal ground over break contact **8** of relay RCY and make contact **7** of relay ON1: upon the subsequent release of relay W relay TMF2 in FIG. 1M operates in an obvious circuit over break contact **7** of relay W and make contact **1** of relay TMF1, relay TMF2 locking over its own make contact **2**. It will be recalled in FIG. **1M** that upon the operation of relay TMF2 the timing operation of the oscillating pulse generator is changed so that subsequent MF pulsing will be done at a 7 p.p.s. rate.

It will be seen in FIG. 1H that upon the next release of relay PG1 circuits are completed for transmitting over the tip and ring circuit to the selectors and to the outgoing trunk the two separate frequencies of 1300 cycles and 1500 cycles under control of the operated read-out relays RR4 and RR7 of FIG. 1X. The latter tones are supplied from the tone supply of FIG. 1H over conductor **4** (1300 cycles), over make contact **1** of relay RR4, break contacts **3** of relays RR2 and RR1, and thence over break contact **7** of relay PG1 to the transformer T, and from conductor **7** extending from the tone supply (1500 cycles), over make contact **2** of relay RR7, make contact **4** of relay RR4, break contacts **4** of relays RR2 and RR1, break contact **4** of relay RR0, and to the transformer T under control of break contact **8** of relay PG1.

In like manner, under the control of the oscillation of relays PG1 and PG2 of FIG. 1M, the additional steering relays of FIG. 1W, namely, relays OS5, OS6 and OS7 will be successively operated to in turn control the read-out relays of FIG. 1X for transmitting in FIG. 1H the additional three successive multifrequency tones representing the E, F and D digits of 1, 2 and 3 registered in the input digit registers of FIGS. 1Q and 1AA. Eventually, upon the release of relay PG1 of FIG. 1M whereby the G digit of FIG. 1AA is transmitted over the outgoing trunk circuit, relay W of FIG. 1N will become reoperated. This reoperation of relay W will cause the operation in FIG. 1W of relay ST in order to transmit over the outgoing trunk circuit an ST signal indicating to the remote equipment the end of multifrequency pulsing. This circuit extends from ground in FIG. 1V, over make contact **4** of relay ON1, make contact **4** of relay W, break contacts **9** and **8** of relays RCA and RCS, thence over break contact **11** of all of the arbitrary switching digit outsteering relays, thence over conductor AS1 into FIG. 1W, over break contact **12** of the first six called digit outsteering relays, thence over make contact **12** of relay OS7, make contact **2** of relay **7**DG, make contact **12** of relay TMFA, make contact **12** of relay **7**DG, make contact **3** of relay W, make contact **3** of relay TMFA, break contact **8** of relay ST, to battery through the winding of relay ST, which operates and locks over its own make contact **8** to off-normal ground under control of break contact **5** of relay ST**1**. Relay OS7 will remain locked operated under control of make contact **5** of relay ST, over conductor AS5 into FIG. 1V until such time as relay W releases upon the next operation of relay PG1 in FIG. 1M. As soon as relays PG1 and PG2 of FIG. 1M reoperate, relay W of FIG. 1N is released, thereby causing the release in FIG. 1W of relay OS7. It will be noted in FIG. 1AA that the release of relay OS7 with relay ST operated causes the read-out relays of FIG. 1X to become released and to become reoperated to indicate the ST pulse of 7 and 10. The latter circuit extends from ground **in FIG. 1AA, over** make contacts **7** and **10** of relay ST, thence over break contacts of all of the steering relays of FIG. 1AA, conductors OP7 and OP**10**, cable OP into FIG. 1X, conductors OP7 and OP**10**, thence over break contacts of the arbitrary exit digit steering relays, conductors RR7 and RR10, to battery through the windings of relays RR7 and RR10, which thereupon become operated to in turn cause the read-out check relay RK in FIG. 1N to become reoperated. Eventually relays PG2 and PG1 of FIG. 1M will become released. Upon the next release of relay PG1 the ST pulse is transmitted from the tone supply of FIG. 1H under control of the operated read-out relays RR7 and RR**10**, out over the tip and ring circuit to the remote equipment as an indication that the end of multifrequency pulsing has been reached.

*Release of register-outpulser*

Upon the release, above described, of relay PG1 of FIG. 1M to cause the transmission over the outgoing trunk circuit of the ST pulse composed of frequencies of 1500 cycles and 1700 cycles, circuit operations are initiated for causing the complete release of the register-outpulser circuitry of FIGS. 1H through 1N, 1P through 1Z, 1AA and 1AB. The release of relay PG1 causes the reoperation in FIG. 1N of relay W, which in turn causes the operation in FIG. 1W of relay ST1 in a circuit extending from ground in FIG. 1V, over make contact **4** of relay ON1, make contact **4** of relay W, through the break contacts in the top conductor of FIG. 1V, thence to conductor AS1 extending into FIG. 1W, through break contacts **12** of all of the released steering relays, thence over make contact **3** of relay ST and break contact **4** of relay ST1 to battery through the winding of relay ST1. Relay ST1 operates and locks to off-normal ground over its own make contact **4**, relay ST remaining operated under control of make contact **5** of relay ST1 until such time as relay W of FIG. 1N releases to remove ground from conductor AS5 extending into FIG. 1W from FIG. 1V. Eventually relays PG2 and PG1 of FIG. 1M will reoperate and the reoperation of relay PG1 will cause the release in FIG. 1N of relay W, the release of which in turn will cause the release in FIG. 1W of relay ST. The release of relay ST causes the release of the operated read-out relays RR7 and RR10 of FIG. 1X and the release of these read-out relays in turn causes the release in FIG. 1N of the read-out check relay RK. The release of relay RK, in turn, completes a locking circuit in FIG. 1M to clamp operated relay PG1 in a circuit extending from battery, through the winding of relay PG1, break contact **6** of relay RK, break contact **7** of relay IC, break contact **5** of relay W, break contact **7** of relay RL, to off-normal ground over make contact **10** of relay ON1, thereby leaving relay PG1 locked operated when relay PG2 eventually releases.

Upon the release in FIG. 1W of relay ST, with relay ST1 operated, a circuit is completed in FIG. 1W for operating the release relay RL extending from ground in FIG. 1W, over make contact **17** of relay ON2, break contact **12** of relay ST, make contact **2** of relay ST1, make contact **4** of relay TDR, to battery through the winding of relay RL, which thereupon operates. The operation of relay RL causes the release in FIG. 1I of the off-normal relay ON and removes in FIG. 1I ground from conductor TC extending into the register trunk and link circuit of FIG. 1F. The release of relay ON of FIG. 1I and the removal of ground from conductor TC in the link circuit of FIG. 1F causes all of the relays of the register-outpulser to be released, as well as all of the relays of the register link and trunk circuit of FIG. 1F, it being considered unnecessary here to describe all of the detailed releasing circuits involved. Upon the release of the register trunk and link circuit of FIG. 1F and upon the release of all of the operated relays in the register-controller, the latter will be returned to an idle status so that it may be seized for another register-outpulser operation; and, the register trunk and link of FIG. 1F cut the line finder of FIG. 1E straight through to the selectors of FIG. 1G under control of break contacts in FIG. 1F of relays TP. This leaves the outgoing trunk circuit No. 3 of FIG. 1G involved in the circuit to supervise the continuance of the conversation or the disconnection therefrom of the calling and called parties.

## DETAILED DESCRIPTION

Due to the arrangement of the detailed circuitry (see FIG. 1B) it is considered advisable to describe the functions of each of the separate eight large blocks of circuitry concluding with a description of the originating register-outpulsing controller circuitry in order to tie all of the functions of the other circuits together. With reference to FIG. 1A it will be noted that there are a plurality of circuits provided such as the selectors in the step-by-step switch train, outgoing trunks, register-controllers, TOUCH-TONE receivers and converters, translators, decoders, and foreign area translators. In this connection the detailed disclosure shows the detailed circuitry of only one such circuit in each instance; however, throughout the detailed circuitry connections are shown in those instances where the others of a plurality of circuits would be connected.

### *Register trunk and link (FIGS. 2 and 7)*

With reference to FIGS. 2 and 7, the description of the circuit operation which takes place within the register trunk and link circuit has been fully described previously in connection with the feature description and complete details of this circuitry are found in the above-mentioned Riddell-Throckmorton Patent 3,159,716. The register trunk and link circuit provides means for linking a line finder (such as the one shown in FIG. 2) with a first selector (such as the one shown in FIG. 3) such that the common control circuitry of this system may be interposed between the line finder and the first selector for controlled outpulsing and code conversion. The completion of circuit operations within the register trunk and link of FIGS. 2 and 7 culminates in the operation of four sets of crossbar switch crosspoints shown in FIG. 7, with the associated hold magnets PHML, PHMR, SHMR and SHML operated in order to maintain closed the crosspoints shown in FIG. 7; and, in FIG. 2 the trunk preference relay TP and the trunk busy relay TB will be operated, thereby completely splitting-off the tip, ring and sleeve conductors between the line finder of FIG. 2 and the first selector of FIG. 3. Under these circumstances the tip, ring and sleeve conductors T, R and S from the line finder of FIG. 2 extend over cable **2–7** into FIG. 7, thence over crosspoints **1**, **2** and **3** of the left trunk switch, thence over cable **7A**, over crosspoints **1**, **2** and **3** of the left register switch, to the tip, ring and sleeve conductors T, R and S extending into the register-outpulser circuit of FIG. 8. Also, the tip, ring and sleeve conductors FT, FR and FS extend from the first selector circuit of FIG. 3 into FIG. 2 where the sleeve conductor FS extends over make contact **4** of relay TB to conductor S1, and where the tip, ring and sleeve conductors FT, FR and S1 extend over cable **2–7** into FIG. 7, thence over crosspoints **4**, **5** and **6** of the left trunk switch, cable **7A**, crosspoints **4**, **5** and **6** of the left register switch extending into the register-outpulser of FIG. 8. Also, conductor TC of FIG. 2 extends over cable **2–7** into FIG. 7, thence over crosspoint No. **1** of the right-hand trunk switch, cable **7B**, and over crosspoint No. **1** of the right register switch, to conductor TC extending into the register-outpulser of FIG. 12. Two other control leads IC and CI are extended from the link circuit of FIG. 7, over crosspoints **2** and **4** of the right trunk switch, cable **7B**, crosspoints **2** and **4** of the right register switch, conductors IC and CI extending into the register-outpulser of FIG. 12. Conductor IC, which is cross-connected in FIG. 7 to a punching ICB, will provide the register-outpulser with information to the effect that a party test need not be made with respect to this particular trunk extending between the line finder and the first selector; conductor CI, which is cross-connected to punching CL9 in FIG. 7, will provide the register-outpulser with information concerning the class of this particular line finder-first selector trunk circuit, which information is useful in the code conversion process; and, conductor TC extending from the register-outpulser into FIGS. 7 and 2 will be grounded in the register-outpulser to hold the register trunk and link circuit of FIGS. 2 and 7 off-normal, this ground being removed by the register-outpulser at such time as the register trunk and link circuit is to be released, whereupon all of the operated relays and hold magnets of FIGS. 2 and 7 will become released, thereby providing straight cut-through between the line finder of FIG. 2 and the first selector of FIG. 3.

As will be described hereinafter, primarily in the description of the register-outpulser functions the tip, ring and sleeve leads T, R and S from the line finder of FIG. 2 comprise the means whereby signals from the calling subscriber S of FIG. 2 are fed into and received by the register-outpulser; and, the tip, ring and sleeve leads FT and FR and S1 extending in FIG. 2 toward the first selector of FIG. 3 comprise the means whereby the register-outpulser can control the outgoing switch train to release it, reset it, and to perform whatever other operation is necessary as a result of the code conversion operation to be performed as a result of receiving input digits from the calling subscriber S of FIG. 2.

### *Selectors (FIGS. 3–5)*

Each of the first, second and third selectors of FIGS. 3, 4 and 5 is of well-known construction and operation whereby, in response to a first digit, the first selector will hunt for and seize a second selector, which in turn will be responsive to a second digit to hunt for and seize a third selector, which in turn will be responsive to a third digit to hunt for and seize an outgoing trunk circuit, such as the one shown in FIG. 6. Since these selector circuits of FIGS. 3, 4 and 5 are all alike and since they are of well-known construction it is considered sufficient to provide a brief description of one of these selectors, such as the first selector of FIG. 3, to indicate how they are controlled in the light of subsequent outpulsing by the common control mechanism. When the selector of FIG. 3 is seized, that is, when the tip and ring leads FT and FR extending thereto find a closed loop circuit in the register-outpulser as an incident to the splitting operation previously described, relay A1 of FIG. 3 will be operated over this loop. Relay B1 operates under control of make contact **2** of relay A1 and, in operating, applies ground over its own make contact **1** to the sleeve lead FS extending rearward toward the register trunk and link circuit. When dial pulses are received over the fundamental tip and ring circuit relay A1 will release and reoperate in response to the dial pulses but relay B1 will remain operated due to the fact that it has a slow-release characteristic. Each time relay A1 releases, ground at its back contact **1** will be extended through make contact **2** of relay B1 to cause the operation in series with each other of relay C1 and the vertical stepping magnet VERT **1**. This causes the switch to step in a vertical direction to the level specified by the number of pulses being detected by the repeated releases and reoperations of relay A1. As soon as the switch steps off-normal in the vertical direction, relay E1 will operate over contact **2** of the vertical off-normal switch VON **1** to the sleeve ground under control of the operated relay C1. Relay C1 is slow-to-release and will hold over dial pulses until vertical stepping is completed. Relay E1 locks under control of break contact **1** of the rotary magnet ROT **1**, make contact **1** of relay E1 and break contact **1** of relay D1, and prepares over its make contact **2** a circuit for causing rotary hunting as soon as the selector has been stepped to the specified vertical level.

At the end of the digit, relay A1 will remain operated, thereby causing relay C1 to become released to in turn complete a circuit for operating the rotary stepping magnet ROT **1** to cause the switch to take one rotary step. As soon as the rotary stepping magnet opens its break contact **1**, relay E1 will release to in turn cause the release of the rotary magnet. In the upper right-hand corner of FIG. 3 the sleeve brush S is now in contact with one of the multiple bank terminals and if this terminal is grounded because of a busy condition, relay E1 will reoperate, thereby causing the rotary step magnet to step the brushes to the next terminal. This automatic stepping or hunting will continue until an idle or nongrounded sleeve terminal is found.

When an idle sleeve terminal is found relay D1 will operate in series with relay E1 as soon as the rotary magnet ROT **1** is released, relay D1 being permitted to operate since it will no longer be short circuited by the ground through the sleeve brush. Relay E1 will not operate in series with relay D1 due to the high resistance in the circuit. The operation of relay D1 disconnects the tip and ring leads from relay A1 and cuts them through to the tip and ring brushes toward the second selector of FIG. 4. Relay D1, in operating, also extends the sleeve lead through to the selector beyond, the latter eventually functioning to connect ground to the sleeve lead to hold operated relay D1 and the preceding circuits prior to the time that the holding ground from the operated relay B1 is removed by the slow-release of this relay. When all of the trunks in a rotary hunting group on the selector of FIG. 3, are busy, the switch brushes will pass off the bank terminals and operate the eleventh rotary step switch 11RS1. The operation of the eleventh rotary step switch contacts will prevent the operation of relay D1, thus causing this selector to remain held under control of relay A1. The eleventh rotary step contact springs also apply two types of busy tone signal to the tip conductor FT extending back toward the register trunk and link circuit of FIG. 2: one busy signal comprises the positive 24 volt potential (negative grounded) extending through the left-hand side of the transformer in the lower part of FIG. 3, thence over contact **3** of the eleventh rotary step switch 11RS1, through the right-hand winding of relay A1, over break contact **7** of relay D1, to the tip conductor FT; and, the other busy tone signal comprises the 400–600 cycle alternating-current signal (interrupted at a rate of 120 interruptions per minute) induced into the left-hand side of the winding of the transformer. These two busy signals, as will be explained in connection with the functioning of the register-outpulser, are utilized in the register-outpulser to detect an all-trunks-busy condition on any one of the selectors, the busy tone detector circuitry of the register-outpulser being arranged to detect either a direct-current busy signal or an alternating-current busy tone signal.



The selector may be released either before cut-through or after cut-through as follows: before cut-through, that is, with relay A1 operated and relay D1 released, if the rearward fundamental tip-ring loop is open, relay A1 will release, thereby causing the operation of the release magnet RLS1 to cause the selector to return to normal; and, after cut-through, with relay A1 released and relay D1 operated, the opening of the rearward fundamental tip and ring circuit will cause the succeeding selector (or trunk circuit as the case may be) to release the instant relay D1, thereby also causing the operation of the release magnet RLS1 of the selector.

As will be seen from subsequent description of the register-outpulser circuitry, the A1 relay of FIG. 3 will actually be pulsed by a pulse generator circuit in the register-outpulser in accordance with certain digital information resulting from the code conversion process. Likewise, each of the succeeding selectors of FIGS. 4 and 5 will in turn be controlled by an additional successive dial pulse digit generated in the register-outpulser circuit.

It will be noted in FIG. 3 that a permanent signal holding trunk has been indicated as a box in the lower right-hand corner, thereby indicating, in the event that the common control circuitry determines that this particular call should be routed to a permanent signal holding trunk, that a single digit may be generated within the register-outpulser for the purposes of causing the first selector to hunt for and seize such a permanent signal holding trunk. It will also be understood, as indicated in FIGS. 3, 4 and 5 that additional second and third selectors and additional outgoing trunks may be selected by this outgoing switch train in accordance with the digits transmitted thereto from the register-outpulser, all as is well known in the art.

*Outgoing trunks* (*FIG. 6*)

The outgoing trunk circuit of FIG. 6 is a well-known circuit and is shown here for exemplary purposes only. When this trunk is seized by a selector, such as the third selector of FIG. 5, the closure of the tip and ring leads T and R through to the windings of relay A will cause the operation of relay A, it being noted that the ground and battery supplied through the windings of relay A are supplied to the respective tip and ring leads T and R rearward toward the third selector, this representing the normal condition as has been met previously in connection with the selectors of FIGS. 3, 4 and 5. Relay A, in operating, closes a loop over the tip and ring leads T and R toward the remote central office, this circuit extending from the tip conductor T over make contact **4** of relay A, break contact **4** of relay C, through the C resistance, through the lower winding of relay D, break contact **1** of relay C, and over the ring lead R to the central office. In the central office a typical arrangement therein (of an incoming trunk for example) would find the tip conductor T terminated in ground potential and the ring lead R terminated in battery potential, probably through dual windings of a seizure relay comparable with relay A of the trunk circuit of FIG. 6. The closure of this loop through the lower winding of relay D over the tip and ring leads to the remote office effects seizure of the remote equipment such as an incoming trunk circuit. Relay A, in operating, causes the operation of relay B of FIG. 6 which in turn energizes the upper winding of relay D, the windings of relay D being so arranged that under the potential conditions existing relay D will not operate because these two windings are operating in opposition to each other: the upper winding is carrying current from left to right in FIG. 6 and the lower winding is carrying current from right to left. Relay B, in operating, applies ground rearward over the sleeve lead to hold the preceding circuits, as is well known in the art. Relay B, in operating, also prepares a circuit for causing the operation of relay C if and when relay A is released. The operation of relay B also completes an alternating-current circuit extending from the tip and ring leads T and R from the third selector of FIG. 5, through condensers T and R under control of make contact **4** of relay B and make contacts **4** and **1** of relay A to the tip and ring conductors T and R extending to the remote central office.

As a result of the incoming trunk seizure which takes place at the remote office, a common control circuit therein (such as an incoming register) will be seized for purposes of accepting and processing any digital information which is forwarded. The seizure in the remote office of such equipment as an incoming register will cause a battery ground reversal over the tip and ring leads back toward the outgoing trunk of FIG. 6, thereby placing a battery condition on the tip lead T and a ground condition on the ring lead R. This battery-ground reversal will reverse the current through the lower winding of relay D, thereby causing the two windings of relay D to act in addition to each other so as to cause the operation of relay D. Relay D, in operating, reverses at its make and break contacts **1**, **2**, **3** and **4** the leads extending rearward from the windings of relay A, thereby extending back toward the third selector of FIG. 5 a battery and ground reversal signal. This reversal signal, as will be explained in more detail in connection with the register-outpulser operations, will be the first of a STOP-GO signal sequence which ultimately will cause the register-outpulser to transmit pulses to the remote office only upon the subsequent receipt of a GO signal. Subsequently, when the incoming register at the remote office is ready to receive pulsing signals, another ground and battery reversal will be transmitted back to the trunk circuit of FIG. 6, thereby returning the signal to the condition whereunder ground will appear on the tip lead and battery will appear on the ring lead. This latter reversal, following the initial reversal above mentioned, is the second or GO signal in the STOP-GO sequence; and, the receipt of this GO signal will cause the register-outpulser to begin outpulsing whatever signals it is required to transmit. Of course, this latter reversal to the original normal ground and battery condition on the tip and ring leads will cause the release of relay D in FIG. 6.

If outpulsing is to be done on a dial pulsing basis, such as loop pulsing, the tip and ring leads T and R from the third selector will open and close to in turn pulse relay A. Relay B will hold over the open pulse periods of relay A (released) due to the slow-release characteristic of relay B. Upon the first release of relay A, relay C operates to remove the lower winding of relay D from the forward loop and places resistance ground and resistance battery on the respective contacts **1** and **4** of relay A. Relay C, being a slow-releasing relay, will hold over the closed pulse periods of relay A (operated). Resistance ground on the tip lead and resistance battery on the ring lead to the remote office will forward dial pulses as the A relay is operated and released. At the end of the pulsing of each digit, relay C releases and performs the following functions in order: (1) bridges resistance D across the forward tip and ring leads, (2) disconnects battery and ground from the forward tip and ring leads, (3) bridges the lower winding of relay D across the tip and ring leads in parallel with resistance D, and (4) opens the circuit through resistance D: this sequence of operations insures against falsely operating relay D momentarily at the end of the digit. The lower winding of relay D is maintained in the tip and ring loop to the remote office in order to detect a battery-ground reversal as an answer signal.

If multifrequency (mf.) digit outpulsing is to be used, relay A of FIG. 6 will remain operated, relay C of FIG. 6 will remain released, and the mf. pulses will be transmitted through condensers T and R in FIG. 6 out over the tip and ring loop to the remote office where they will be received by an mf. receiving equipment which in turn will decode and register the data transmitted by means of these mf. pulses. As will be explained in the subsequent discussion of the register-outpulser, this mf. digital outpulsing is preceded by a so-called KP pulse which is an initial mf. signal pulse adjusting the mf. receiving equipment at the remote office to receive subsequent digits; the digital information is transmitted by a series of mf. pulses; and, at the end of the mf. digit outpulsing a so-called pulse is transmitted as an mf. signal to the remote receiving equipment that the end of mf. pulsing has been reached. During the mf. pulsing transmission the D relay of FIG. 6 will be in a released condition but the lower winding thereof will be bridged across the tip and ring loop to the remote office in order to detect a battery ground reversal therefrom as an answer signal or as a stop pulsing signal.

*TOUCH-TONE converter and receiver (FIGS. 40–43)*

It will be recalled in connection with the previous feature description that rotary dial pulsing was used as an example of transmission of input digital information from the calling subscriber; however, as is well known in the art, the calling subscriber may be equipped with the TOUCH-TONE type of key transmitting device whereby each digital transmission is represented by a combination of two frequencies. The register-outpulser (FIGS. 8–39) of the instant disclosure is arranged to be responsive to either type of pulsing and is provided (FIGS. 40–43) with a receiver-converter arrangement for translating TOUCH-TONE pulses into two-out-of-five register relay operations in order to handle TOUCH-TONE traffic.

With regard to rotary dial pulsing (as has been described in some detail in connection with the foregoing feature description) it will be recalled that the line relay L1 of FIG. 9 was in the calling dialing loop and that the subscriber dial control circuit of FIG. 15 was responsive to repeated releases and operations of line relay L1 to count the dial pulses in each digit and to transmit this information back into the subscriber dial control circuit of FIG. 12 and thence to the input digit register of FIGS. 38 and 39 on a two-out-of-five basis over conductors S0 through S7. It will also be recalled that the in-digit steering circuit of FIG. 24 was controlled by the subscriber dial control circuit of FIG. 15 to successively operate the in-digit steering relays IS1 through IS8, et cetera, thereby to successively steer into FIGS. 38 and 39 the successively counted digits to successive ones of the digit registers of FIGS. 38 and 39.

If the calling subscriber utilizes TOUCH-TONE signaling, the line relay L1 of FIG. 9 in the register-outpulser will not respond to these alternating-current frequency pulses; however, it will be noted in FIG. 9 that the right-hand winding of transformer T will have induced therein such TOUCH-TONE pulses. These TOUCH-TONE pulses will be transmitted over the tip and ring leads T and R in FIG. 9 into the converter circuit of FIG. 41 and thence into the amplifier of the receiver of FIG. 40. In the in-digit steering circuit of the register-outpulser (FIG. 24) it will be recalled that the relay STR was controlled by contacts of relays RA2 and RA of the subscriber dial control circuit of FIG. 15 when the calling subscriber was utilizing dial pulsing; however, when TOUCH-TONE call signaling is employed it will be noted in FIG. 24 that relay STR cannot be controlled by relays RA2 and RA since both of these relays will be released under these circumstances. Conductor STR extending from FIG. 24 into the converter of FIG. 41 is utilized for controlling relay STR of FIG. 24 from the receiver converter circuitry of FIGS. 40 and 41 for purposes of successively advancing the in-digit steering chain of FIG. 24 in the register-outpulser. At the same time conductor STR1 extending into FIG. 41 from the in-digit steering circuit of FIG. 24 is utilized to provide a ground potential into the converter circuitry of FIG. 41 so as to provide two-out-of-five ground signals over leads S0 through S7 extending from FIG. 41 into the in-digit register circuitry of FIGS. 38 and 39, thereby to transfer to the register-outpulser a two-out-of-five register translation of the TOUCH-TONE digits.

When the register-outpulser of FIGS. 8 through 39 is seized and the off-normal relay ON (FIG. 8) thereof is operated, a circuit is completed for causing the operation in the converter of FIG. 41 of relay ST–0 extending from negative battery in FIG. 8, over make contact **1** of relay ON, conductor C into FIG. 9, thence over break contacts **1** of relays ROD and PKC, thence over conductor ST into FIG. 41, to ground through the winding of relay ST–0. The operation of relay ST–0 extends battery from FIG. 41 over its make contact **2** to conductor BAT extending into FIG. 40 to supply energizing battery to the receiver circuitry of FIG. 40. Over its make contact **1** in FIG. 41 relay ST–0 completes a circuit whereby conductor STR may be utilized to control the in-digit steering circuitry of FIG. 24 in the register-outpulser.

The various signals transmitted from a TOUCH-TONE transmitter are made up of pairs of alternating-current frequencies, one selcted from a so-called low group, and the other selected from a so-called high group, it being understood, although the details thereof have not been shown, that the actuation of a digital key on a TOUCH-TONE transmitter equipment causes the transmission therefrom of two frequencies representative of that particular digit. Four low group frequencies are as follows: LF1—697 cycles, LF2—770 cycles, LF3—825 cycles, and LF4—941 cycles; and, the three high group frequencies are HF1—1209 cycles, HF2—1336 cycles, and HF3—1477 cycles. The following table indicates the pairs of frequencies representative of the ten digital values and shows related corresponding relay operations, et cetera in FIGS. 40 and 41:

| Digits | Frequencies | | Relays | Relays | Output Leads |
|---|---|---|---|---|---|
| | Low | High | FIG. 40 | FIG. 41 | FIG. 41 |
| 1 | LF1 | - HG1 | L1–H1 | LF0–HF1 | S0–S1 |
| 2 | LF1 | - HG2 | L1–H2 | LF0–HF2 | S0–S2 |
| 3 | LF1 | - HG3 | L1–H3 | LF0–HF3 | S1–S2 |
| 4 | LF2 | - HG1 | L2–H1 | LF3–HF1 | S0–S4 |
| 5 | LF2 | - HG2 | L2–H2 | LF3–HF2 | S1–S4 |
| 6 | LF2 | - HG3 | L2–H3 | LF3–HF3 | S2–S4 |
| 7 | LF3 | - HG1 | L3–H1 | LF6–HF1 | S0–S7 |
| 8 | LF3 | - HG2 | L3–H2 | LF6–HF2 | S1–S7 |
| 9 | LF3 | - HG3 | L3–H3 | LF6–HF3 | S2–S7 |
| 10(0) | LF4 | - HG2 | L4–H2 | LF9–HF2 | S4–S7 |

When a TOUCH-TONE signal is received on the tip and ring leads T and R in FIG. 40 this signal is amplified in the amplifier and then the high and low frequencies are separated by the band elimination filters; and, additional separation takes place in the seven band pass filters designated BPF such that the single low frequency and the single high frequency are passed through amplifiers individual thereto and over break contacts of the check relay CK to operate one of the low relays **L1** through **L4** and one of the high relays **H1** through **H3** to battery on conductor BAT. With one of the relays L1 through L4 operated and one of the relays **H1** through H3 operated, a circuit is extended from ground in the lower left-hand corner of FIG. 40, through the contact network of these relays to the **T1** timer which, provided the relays remain operated for at least twenty milliseconds, will extend ground therethrough and through break contact **1** of relay CK to battery through the winding of relay CK. Relay CK will thereupon operate as an indication that a legitimate twenty millisecond signal has existed representing a TOUCH-TONE digit. Upon the operation of relay CK, it locks over its own make contact **1** to ground over break contact **5** of relay RLS and extends ground in the right-hand portion of FIG. 40 over its make contact **2** and through break contact **3** of relay RLS to timer T**2**, which will provide a ground output signal to the right-hand side of the winding of relay RLS forty-five milliseconds later. The ground from make contact **2** of relay CK also extends over break contact **2** of relay RLS to conductor STR and through make contacts of the low relay and the high relay which have been operated, thereby extending into FIG. 41 ground on conductor STR and ground on one of the conductors LG**1** through LG**4** and ground on one of the conductors HG**1** through HG**3** to cause the operation of one of the relays LF**0–0** through LF**9–0** and one of the relays HF**1–0** through HF**3–0** to negative battery over make contact **2** of relay ST–**0**. The ground on conductor STR in FIG. 41 is extended over make contact **1** of relay ST–**0** to conductor STR for controlling the input digit steering chain in FIG. 24 of the register-outpulser. Ground is returned from the register-outpulser (FIG. 24) on conductor STR1 in the lower right-hand corner of FIG. 41 and thence through the contact network of the operated low frequency and high frequency relays to apply ground to two of the five conductors **S0** through **S7** to transmit to the incoming digit register of FIGS. 38 and 39 in the register-outpulser the digital value of the TOUCH-TONE signal on a two-out-of-five-basis. The timer **T2** of FIG. 40 provides an interval of forty-five milliseconds to enable the previously mentioned registration, whereupon ground from timer **T2** causes the operation of relay RLS in FIG. 40, the operation of which causes the return to normal in FIGS. 40 and 41 of all of the operated relays (except relay ST–**0** of FIG. 41) therein, thereby reverting the status of the receiver-converter circuitry of FIGS. 40 and 41 to the condition necessary for detecting and decoding the next TOUCH-TONE signal representing the second "dialed" digit from the calling subscriber. In like manner it will be understood that each of the TOUCH-TONE digits transmitted by the calling subscriber will be successively received. decoded and registered in the input digit register of FIGS. 38 and 39 in the register-outpulser under control of the input digit steering chain of FIG. 24.

The release of relay ST–**0** in FIG. 41 will return the receiver-converter circuitry of FIGS. 40 and 41 to normal. The release of relay ST–**0** can be caused by any one of three conditions: the return of the register-outpulser of FIGS. 8 through 39 to normal, as evidenced by the release in FIG. 8 of the off-normal relay ON, will remove battery from the operating circuit of relay ST–**0**; the operation in FIG. 27 of the recorder tone relay ROD, indicating that the register-outpulser is requesting a repetition of the dialed information, will open its break contact **1** in FIG. 9, thereby removing battery from the operating circuit of relay ST–**0**; and, the operation in the in-digit steering circuit of FIG. 24 of relay PKC, indicating that all of the dialed digits have been received, will open its break contact **1** in FIG. 9, thereby to cause the release in FIG. 41 of relay ST–**0**.

*Translator-decoder connector* (*FIGS. 77–95*)

The translator and decoder connector circuitry of FIGS. 77 through 95 represents the circuit means whereby (see block diagram of FIG. 1A) any one of the 300 register-outpulsers may effect connection with any one of the nine translator-decoder pairs on a preference-lock-out basis. The register-outpulsers in the system are numbered from **0** to **299** and the translator-decoder pairs are numbered **0** to **8**. The 300 register-outpulsers are arranged in fifteen groups designated groups **0–14**, each group containing twenty registers. FIGS. 77 and 78 represent a translator preference and connector circuit designated "connector **0**" and serves a register-outpulser group **0** consisting of register-outpulsers numbered **0–19**; FIGS. 80 and 81 represent a translator preference and connector circuit designated "connector **1**" for serving a register-outpulser group **1** consisting of register-outpulsers **20–39**; and, FIGS. 83 and 84 show a translator preference and connector circuit designated "connector **14**" for serving register-outpulser group **14** consisting of register-outpulsers **280–299**. Vertically, FIGS. 77, 78, 80, 81, 83, and 84 involve a preference lock-out circuit among all fifteen connector circuits for each translator-decoder pair. For instance, in FIGS. 83 and 84 it will be noted that there are conductor cables extending to translators **0**, **1** and **8**. As will be indicated in more detail hereinafter, only one register-outpulser in a particular register-outpulser group can effect a connection with a particular tranlsation-decoder pair at any one time. The completing of such a connection locks out other register-outpulser groups from seizing that busy translator-decoder pair. Thus, the circuit of these six figures enables nine connections at any one instant of time between one register-outpulser of each of nine of the fifteen register-outpulser groups to a different translator-decoder pair at any one time.

With reference to FIGS. 79, 82, 85 and 88 a cabling layout is provided which shows how these connections can come about on the operation of the register preference connector circuitry of FIGS. 90 and 93 and the translator preference and connector circuitry of FIGS. 77, 78, 80, 81, 83 and 84. Each translator-decoder pair, such as pair **0**, has a set of connector relays for each register-outpulser group: in FIG. 77 translator-decoder connector relays **TA0–0**, **TB0–0**, **TC0–0** and **TD0–0** are for interconnecting translator-decoder pair **0** with register-outpulser **0** of register-outpulser group **0**; in FIG. 80 connector relays **TA0–1**, **TB0–1**, **TC0–1** and **TD0–1** are for connecting translator-decoder **0** with any register-outpulser of register-outpulser group **1** corresponding to connector **1** of FIGS. 80 and 81, and, in FIG. 83 connector relays **TA0–14**, **TB0–14**, **TC0–14** and **TD0–14** are used for making a connection between translator-decoder **0** and any of the register-outpulsers of the register-outpulser group **14**. Only one of these sets of connector relays may be operated at any one time, thereby to restrict only one connection to a particular translator-decoder at any one time. Each of the 300 register-outpulsers has a corresponding set of register connector relays as shown in FIGS. 90 and 93. For instance, register connector relays **RA0**, **RB0**, **RC0** and **RD0** in FIG. 90 are individual to the first register-outpulser **0** and in FIG. 93 register connector relays **RA299**, **RB299**, **RC299** and **RD299** are individual to the last register-outpulser **299**. In FIGS. 90 and 93 it will be seen that all of the register connector relays for the register-outpulsers of a particular register-outpulser group are arranged together in circuitry corresponding to the horizontal arrangement of the translator preference in the connector circuits of FIGS. 77, et seq. For instance, with respect to FIGS. 79, 82, 85 and 88, with relays **TA0–0**, **TB0–0**, **TC0–0** and **TD0–0** of FIG. 77 operated and with relays **RA0**, **RB0**, **RC0** and **RD0** of FIG. 90 operated, a connection is established between register-outpulser **0** and translator-decoder pair **0**. Under these circumstances, in FIG. 79 cable **790** extending from translator **0** passes through make contacts of translator connector relay **TA0–0**, thence through cable **791** and over cable **792**, thence through make contacts of the register connector relay **RA0** and over cable **793** to register **0**: In FIG. 82 cables **820** and **821** from translator **0** and decoder **0** combine into cable **822**, and thence extend over make contacts of translator connector relay **TB0–0**, cable **823**, cable **824**, make contacts of register connector relay **RB0** and cable **825** to register **0**: In FIG. 85 cable **850** extends from decoder **0** through make contacts of the translator connector relay **TC0–0**, cable **851**, and through make contacts of register connector relay **RC0** and over cable **852** to register **0**: In FIG. 88 cable **880** extends from decoder **0**, over make contacts of translator connector relay **TD0–0**, cable **881**, over make contacts of register connector relay **RD0** and over cable **882** to register **0**: other cabling connectors between other combinations of translator-decoder pairs and register-outpulsers will be apparent from the showing of this cabling layout of FIGS. 79, 82, 85 and 88.

With respect to the cabling diagram shown on FIGS. 91 and 94, other connections through the operated translator and register connector relays are shown for allowing a trouble ticketer (not shown) to derive the equipment location of the particular register-outpulser involved when trouble may occur. For instance, with translator-decoder **0** connected to a register-outpulser in register-outpulser group **0** (register-outpulsers **0–19**), such as register **0**, relays **TD0–0** and **RD0** in FIG. 91 will be operated. In the upper right hand portion of FIG. 91 is will be noted that with the cross connections shown between the punchings and with relay **RD0** operated, a frame tens indication extends from the right hand punchings **FT4** and **FT7** (a 0 on a 2-out-of-five coding basis) across to the frame tens punchings **FAT** and **FTB**, thereby to indicate to the trouble ticketer that the tens digit of the particular frame on which register-outpulser **0** is mounted is a zero; and, the frame units indication extends from the punchings **FU4** and **FU7** across to the frame units punchings **FUA** and **FUB**, thereby to indicate that the units digit of the frame number is also a 0. In addition, the register-outpulser number on this particular frame is indicated by the cross connections between punchings **RN4** and **RN7** and the corresponding punchings **RNA** and **RNB**, thereby designating register-outpulser **0** as the number **0** register-outpulser on frame **00**. It will be noted that each register-outpulser frame mounts three register-outpulsers and that the register-outpulser frame numbers **0**, **1**, **2** repeat themselves throughout 100 frames. As indicated in FIG. 94, the last register-outpulser **299** is indicated by the cross connections as being register-outpulser **2** on frame **99**. These frame and register-outpulser notations are used by the trouble ticketer circuit (not shown) to produce a trouble record which will identify a particular register-outpulser which was being used at the time the trouble arose.

The decoder seizure circuit of FIG. 95 provides means whereby, upon any seizure of one of the nine decoders the seized decoder can be told whether or not this is a first seizure or a second seizure. It will be noted in FIG. 95 that there are fifteen connector circuits indicated, namely connector circuits **0–14** each controlling two leads **1TR** and **2TR** to each of the nine decoder circuits **0–8**. As will be seen hereinafter in connection with a discussion of the connector control and timing circuits, if one of the connector circuits fails to seize a decoder within a prescribed amount of time the connector control relay **TR1**, such as relay **TR1–0** of FIG. 89 for connector **0**, will operate thereby to transfer the operating ground in FIG. 95 from the **1TR** to the **2TR** leads so as to indicate to a decoder, at such time as it may be seized, that the particular seizer represents the second of two attempts.

Of the remaining portion of the translator and decoder connector circuitry of FIGS. 77–95, FIG. 86 shows a connector timing circuit for each of the fifteen connectors, FIG. 87 shows a traffic control and timing circuit common to the entire translator and decoder connector circuitry, and FIGS. 89 and 92 show fifteen connector control circuits corresponding to the fifteen connectors, in turn corresponding to the fifteen register-outpulser groups. For instance, in FIG. 86 the timing circuit for connector **0** is used to time the proper functioning of connector **0** which is shown in FIGS. 77 and 78; whereas, in FIG. 86 connectors **1–14** are shown as boxes because they include the same circuitry as the detail showing of the timing circuit for connector **0** in FIG. 86. In FIGS. 89 and 92 it is indicated that each of the fifteen connectors has its own control circuit and all of these fifteen control circuits are in turn connected to the general translator control and timing circuit of FIG. 87, which acts as a general traffic and control mechanism for the entire translator and decoder connector circuitry.

As has been mentioned previously each register-outpulser in a group of twenty has an appearance in one connector only. A set of start relays (RS0 through RS299 of FIGS. 90 and 93) and multicontact connector relays (RA0, etc. through RA299, etc. of FIGS. 90 through 93) is associated with each register-outpulse. If the connector in which a particular register-outpulser appears is idle, any register-outpulser in the group bidding for a translator-decoder pair is served directly. Once a set of register-outpulser and translator-decorder cut through relays (TA0–0 through TD8–14 of FIGS. 77, 78, 80, 81, 83 and 84) operates, the particular connector is made busy to all other register-outpulsers in the same group. A subsequent request by a register-outpulser for the services of a translator-decoder pair must then wait until bids by more highly preferred register-outpulsers are served within the particular register-outpulser group.

Whenever a register-outpulser is requesting the services of a translator-decoder connector, such as the register-outpulser of FIGS. 8 through 39 which is register-outpulser 0, the register-outpulser will apply resistance battery to the two start leads STA and STB in FIG. 77. The one of these two start leads in FIG. 77 which is effective will depend generally upon the condition of the W–0 relay of FIG. 89, which, as will be indicated hereinafter, alternates in its operated and released condition on alternate uses of the connector so as to alternate the preference for connecting to certain translator-decoder pairs. One of these start leads STA and STB of FIG. 77 will cause the energization of one of the punchings TSA and TSB, which in turn will apply resistance battery to one of the nine translator punchings TS0 through TS8, depending upon which is the first or alternate choice translator-decoder pair for the particular register-outpulser group which is presently making a bid for a translator-decoder pair. If the first choice translator-decoder is serving another connector circuit, the start lead will be advanced to the next idle translator-decoder in the preference chain in the connector, such as the one of FIGS. 77 and 78. Operation of the translator-decoder multicontact connector relays, such as relays TA0–0 through TD0–0 of FIG. 77, causes cut-through of the register-outpulser leads for service by the particular translator-decoder as has been mentioned in connection with the cabling diagram of FIGS. 79, 82, 85, and 88. Subsequently, on a signal from the connected translator-decoder, the register-outpulser and the translator-decoder will simultaneously release the connector, which then prepares to serve a subsequent bid by another register-outpulser.

If a call is not cut through within a predetermined length of time, an alarm condition is set up by the operation in FIG. 86 of the time-out relay TRS–0 and this will also cause a transfer (in FIG. 77) of the start lead to the alternate choice translator-decoders. Failure of a translator-decoder to complete service within a prescribed amount of time also sets up an alarm condition. Means is also provided for switching to the alternate choice translator-decoder on a trouble release signal from the translator-decoder, which will be initiated by a ground signal on conductor TR in FIG. 89 to cause the operation of relay TR–0: A subsequent trouble release on the second trial will cause disconnection of the attached register-outpulser and translator-decoder.

The traffic control and timing circuit of FIG. 87 holds "busy" all connectors that may have terminated service until such time as other connectors, which may be waiting for service, have actually been used. Again, alarms are provided in case of trouble in traffic routing.

For purposes of illustration, let it be assumed that register-outpulser 0 of FIGS. 8–39 has initiated a bid for the services of a translator-decoder pair. This bid is represented by the application from register-outpulser 0 of resistance battery to conductor ST in FIG. 90 and to the leads STA and STB in FIG. 77. Upon the application of resistance battery to conductor ST in FIG. 90, extending thereto from register-outpulser 0 of FIG. 20, a circuit is completed for causing the operation of the start relay RS0 corresponding to register-outpulser 0, this circuit extending from resistance battery on conductor ST, through the winding of relay RS0, break contact 1 of relay CBY–0, thence through a chain of back contacts 9 of the remaining start relays RS1 through RS19 associated with connector 0, to ground. Relay RS0, in operating, locks to ground in an obvious circuit over its own make contact 9, and over its make contact 12 completes obvious circuits for causing the operation of the register-connector relays RA0 through RD0 associated with register-outpulser 0, thereby establishing part of the interconnection circuit shown in the cabling diagrams of FIGS. 79, 82, 85, and 88. The energization of the two translator start leads STA and STB of FIG. 77 extending thereto from register-outpulser 0 in FIG. 20 will energize one of the two translator punchings TSA and TSB, depending upon the condition in FIG. 89 of the W–0 and Z–0 relays, it being assumed that both of these relays are released under the present circumstances. Thus, punching TSA in FIG. 77 will be energized in a circuit extending from resistance battery on lead STA, break contact 4 of relay TFC–0, break contact 10 of relay W–0, break contact 10 of relay TRS–0, break contact 9 of relay TR–0, to punching TSA and across the interconnection from punching TSA to punching TS0, thereby indicating that translator-decoder 0 is first preference at this particular time for connection with the bidding register-outpulser. Assuming that translator-decoder 0 is not being used at the moment, and particularly with reference to FIG. 83, ground potential is extended from translator 0 to conductor GD1 in FIG. 83 and extends vertically through FIGS. 83, 80, and 77 over correspondingly numbered conductors GD1 under control of back contacts 9 of the translator start relays TS0–14 of FIG. 83, TS0–1 of FIG. 80, and TS0–0 of FIG. 77 in the corresponding connector circuits, thence over break contact 9 of relay TDS0 of the automatic test circuit and thence returning vertically over conductor CH1 through FIGS. 77, 80, and 83, and extending back to the translator 0 where this conductor extends through the winding of a channel relay to negative battery, this channel relay being normally operated and is shown as relay CH1 in FIG. 44 of the circuit for translator 0. Resistance battery on punching TS0 in FIG. 77 will extend over break contact 4 of relay CB0–0, through the winding of translator start relay TS0–0 and thence to ground in translator 0 on conductor GD1, thereby causing the operation in FIG. 77 of the translator start relay TS0–0 corresponding to register-outpulser connector 0 of FIG. 77 and to translator 0 of FIGS. 44 through 53. Relay TS0–0 of FIG. 77, in operating, provides its own locking ground over its own make contact 9 and at its break contact 9 opens the previously mentioned circuit for the channel relay of the translator, thereby causing this channel relay CH1 of the translator in FIG. 44 to become released. Extending vertically through FIGS. 77, 80, and 83 are two other pairs of check relay circuits designated GD2, CH2, and GD3, CH3 which are circuits whereby ground is normally extended from translator 0 over conductors GD2 and GD3 and through break contacts of the translator start relays TS0–0 of FIG. 77 through TS0–14 of FIG. 83 to in turn normally cause the operation in translator 0 of two additional check relays, namely relays CH2 and CH3 in the translator 0 of FIG. 44. Upon the operation in FIG. 77 of the translator 0 start relay TS0–0, circuits are completed for causing the operation of the four translator-decoder connector relays TA0–0 through TD0–0 of FIG. 77, these circuits extending from battery through the windings of these four relays and thence over make contacts 12 and 10 of relay TS0–0, thence over conductors CH2 and CH3 into the automatic test circuit, thence over respective break contacts 12 and 2 of relay TDS0, and thence to ground over conductors GD2 and GD3 extending from the translator 0 circuit of FIG. 44. The operation of these four connector relays, as has been explained in connection with the cabling diagram of FIGS. 79, 82, 85, and 88, completes the interconnections between the translator-decoder pair **0** and the register-outpulser **0**. Upon the operation of connector relay TB**0**–**0** in FIG. 77, ground is extended over make contact **03** of this relay to conductor CBR, extending into FIG. 80 and thence into FIG. 83 and thence to the translator **0** circuit of FIG. 44 to effect seizure of this idle translator circuit. Upon seizure of the translator circuit **0** of FIGS. 44 through 53, this translator applies ground to conductors CB**00**, CB**01**, etc., through CB**014** in FIG. 83 to cause the operation in all of the connector circuits of the corresponding connector-busy relays CB**0**–**0** of FIG. 77 through CB**0**–**14** of FIG. 83, thereby making the translator that has been seized busy to other connectors. For instance, ground extends over conductor CB**00** in FIG. 83 vertically through FIGS. 83, 80, and 77, thence through the winding of connector-busy relay CB**0**–**0** to negative battery, relay CB**0**–**0** thereupon operating and locking in a circuit extending from the left-hand side of its winding, through diode CB**0**–**0**, over make contact **1** of relay CB**0**–**0**, and make contact **6** of relay TS**0**–**0** to conductor LDB, which extends to ground potential in the register-outpulser circuit **0** of FIG. 20, thereby allowing the relay CB**0**–**0** of FIG. 77 to be locked operated under control of register-outpulser **0** such that it will not release until both register-outpulser **0** and translator-decoder pair **0** have disconnected. The other connector-busy relays, such as relay CB**0**–**1** of FIG. 80 and CB**0**–**14** of FIG. 83 will remain operated under control only of ground supplied from the seized translator **0** over conductors CB**01** through CB**014** of FIG. 83.

The connector **0** circuit of FIGS. 77 and 78 is made busy to other register-outpulsers in the same register-outpulser group when relay TB**0**–**0** of FIG. 77 operates. The operation of relay TB**0**–**0** causes a circuit to extend from ground in FIG. 82 over conductor GB, thence through a make contact of connector TB**0**–**0**, conductor GB through cable **823**, thence over conductor GB to the connector control circuit of FIG. 89 (corresponding to connector **0** of FIGS. 77 and 78), through the winding of relay TK–**0** to negative battery, thereby causing the operation of relay TK–**0** of FIG. 89. Upon the operation of relay TK–**0**, a circuit is completed for causing the operation in FIG. 89 of the connector-busy relay CBY–**0** extending from negative battery in FIG. 89, through the winding of relay CBY–**0**, over make contact **8** of relay TK–**0**, conductor GA extending into FIG. 82, thence over conductor GA through cable **824**, over a make contact of the operated register-outpulser connector relay RB**0**, cable **825**, conductor GA to ground. Relay CBY–**0** in FIG. 89 operates in the latter described circuit and locks over its own make contact **12** to the ground on conductor GB, previously described as controlled by the translator-decoder connector relay TB**0**–**0** of FIG. 77, such that this connector-busy relay CBY–**0** of FIG. 89 will remain operated until such time as the translator-decoder connector relays of FIG. 77 are released. In FIG. 90, upon the operation of relay CBY–**0**, the operating paths of all other register-outpulser start relays RS**1** through RS**19** are opened, the operated register-outpulser start relay RS**0** being maintained locked under control of make contact **1** of the register-outpulser connector relay RA**0** which is in parallel with break contact **1** of relay CBY–**0**. Thus, no other register-outpulser in connector **0** may be served until disconnection of the existing connection occurs. Relays TK–**0** and CBY–**0** in the connector control circuit for connector **0** in FIG. 89 will be released only at such time as both of relays TB**0**–**0** of FIG. 77 and RB**0** of FIG. 90 release upon complete disconnect.

It will be noted, in FIG. 90, that if two or more register-outpulsers, simultaneously bid for a translator-decoder pair, their start relays (such as relays RS**0** through RS**19** of FIG. 90) will start to operate. More than one of these register-outpulser start relays may operate fully and lock but the lowest numbered relay, in operating its associated multicontact connector relays RA**0** through RD**0**, will thereby remove ground from the multicontact relays associated with the other start relays. Furthermore, when relay CBY–**0** of FIG. 89 operates on cut-through, all other start relays of FIG. 90 in that particular connector that may have operated will become released. These other register-outpulsers must wait until relay CBY–**0** of FIG. 89 is released before they can again initiate a bid for connection with a translator-decoder pair.

As has been mentioned previously in connection with the translator preference and connector circuitry of FIGS. 77 and 78, the two start leads STA and STB from the register-outpulsers of group **0** are cross connected to the punchings TS**0** through TS**8** corresponding to the first choice translators for the particular start leads involved. If a preferred translator is busy serving another connector circuit, the operated connector busy relay (such as relay CB**0**–**0** of FIG. 77) associated with that particular translator (such as translator **0**) will advance the start lead to the next idle translator in the chain. For instance, if translator start punching TS**0** is energized with negative battery as a start condition, translator **0** of FIGS. 44 through 53 is the first choice translator for this start condition since if this translator is not busy its relay CB**0**–**0** will be released to allow the start battery on punching TS**0** to be applied to the left hand side of the winding of the translator start relay TS**0**–**0**. On the other hand, if this particular translator is busy (as indicated by the operation of its relay CB**0**–**0**), battery on start punching TS**0** will extend through make contact **4** of relay CB**0**–**0** and break contact **2** of relay TS**0**–**0** so as to cause the operation of the next translator start relay TS**1**–**0** as a second choice. Obviously this start chain will be continuously advanced through FIGS. 77 and 78 such that translator number **8** corresponding to start relay TS**8**–**0** of FIG. 78 will be the last choice translator for this particular start condition in connector **0** of FIGS 77 and 78. If more than one of the connectors of FIGS. 77, 78 and 80, 81 and 83, 84 tries to seize a translator simultaneously their translator start relays such as TS**0**–**0** of FIG. 77, TS**0**–**1** of FIG. 80, and TS**0**–**14** of FIG. 83 may fully operate; but, the higher numbered connector (FIGS. 83 and 84) has preference in that its start relay TS**0**–**14**, in operating, would thereby cause the release of the corresponding start relays of all lower numbered connectors such as relays TS**0**–**1** of FIG. 80 and TS**0**–**0** of FIG. 77, thereby to advance the start leads in these other connectors as above mentioned. The operation in the seized connector, such as the one of FIGS. 77 and 78, of the translator connector multicontact relay such as relay TA**0**–**0** of FIG. 77 closes a circuit from the left hand side of the winding of this start relay TS**0**–**0**, through make contact **00** of relay TA**0**–**0**, to the start lead on punching TSO. Once the translator, such as translator **0** of FIGS. 44 through 53, is seized it will apply battery to conductor HD**00** in FIG. 77, thereby to hold operated the corresponding start relay TS**0**–**0** so that the start lead may now be opened without affecting the TS**0**–**0** relay which thereupon is under control of its corresponding translator.

As mentioned above, if the preferred translator is busy, the corresponding busy relay CB**0**–**0** of FIG. 77, in being operated, will hold the start lead advanced. A call is then serviced by a less preferred translator. When the preferred translator releases, the start lead must be kept advanced to prevent the call from shifting back to the more preferred translator. This is accomplished by locking all operated busy relays (such as relay CB**0**–**0** of FIG. 77, relay CB**0**–**1** of FIG. 80, and relay CB**0**–**14** of FIG. 83) through contacts of any operated start relay such as relay TS**0**–**0** of FIG. 77, TS**0**–**1** of FIG. 80 and TS**0**–**14** of FIG. 83 to ground from the particular register-outpulser which is being used. The register-outpulser supplies this locking ground over a circuit illustrated by conductor LDB of FIG. 77. Thus, the start lead remains advanced during the time that a call is being served.

Also it will be noted that whenever a connector busy relay (such as relay CB0–0 of FIG. 77) is operated it cannot advance the start lead until the corresponding translator start relay such as relay TS0–0 of FIG. 77 releases. In this way battery from the translator start punching TS0 of FIG. 77, or from the translator holding conductor such as conductor HD00 of FIG. 77, is prevented from advancing to the succeeding translator start relays of the particular connector, such as start relays TS1–0 of FIG. 77 through relay TS8–0 of FIG. 78.

Also, means is provided for making a translator busy to a particular connector by operating the corresponding busy relay in that translator such as relays CBA and CB of FIG. 44 in translator **0**. The operation of these connector busy relays in a particular translator will cause the application of ground potential in FIG. 83 to conductors **CB00** and **CB01** through **BO014**, thereby, as previously mentioned above, to cause the operation in FIGS. 77, 80, and 83 of the connector busy relays **CB0–0** through **CB0–14** in all of the connectors. The corresponding diodes, such as diode CB0–0 of FIG. 77 through CB0–14 of FIG. 83, prevent ground from holding other connector busy relays operated; otherwise, all connector busy relays in any particular connector would eventually be locked, in turn putting the connector out of service. All connector busy relays in a connector are effectively in parallel: the diodes prevent the simultaneous release of two or more connector busy relays from being mutually dependent in regard to the release time.

With respect to the connector control circuits, such as the one shown in FIG. 89 corresponding to connector **0** of FIGS. 77 and 78, a bid for the services of a translator by any register-outpulser such as register-outpulser **0** of FIGS. 8 through 39, causes ground to be placed in FIG. 89 on conductor TM extending thereto from the register-outpulser so as to cause the operation in FIG. 89 of relay **TM–0** in an obvious circuit from ground on conductor TM, through back contact **6** of relay TK–0 and back contact **8** of relay TRS–0. Relay TM–0, in operating causes the operation of relay TM1–0 in an obvious circuit over make contact **12** of relay TM–0. The operation of relay **TM1–0** starts the operation of the connector timing circuit of FIG. 86 as will be explained in detail hereinbelow. Upon the operation of the translator connector multicontact relay TB0–0 of FIG. 77, as has been mentioned previously, relay TK–0 of FIG. 89 is operated, the operation of which causes the release in FIG. 89 of relays **TM–0** and **TM1–0** which in turn recycles the timing circuit of FIG. 86. Upon the seizure of the translator, such as translator **0** of FIGS. 44 through 53, ground potentials are supplied to conductors TFC and TFC1 of FIG. 89, thereby to cause the operation of relays **TFC–0** and **TFC1–0** which, upon operating, lock over their own make contacts **12** to ground under control of the operated relay **TK–0**. The operation of relays **TFC–0** and **TFC1–0**, by controlling their respective break contacts **4** and **10** in FIG. 77, open the translator start leads. The operation of these two relays TFC–0 and TFC1–0, as will be explained below, also causes the W–0 and Z–0 relays of FIG. 89 to advance a step, thereby to cause the start preference of FIG. 77 to be alternated between the two conductors STA and STB as has been mentioned hereinbefore.

The W–0 and Z–0 relay combination of FIG. 89 functions in the following manner. Assuming that these two relays are normally released, the W–0 relay will operate when relays **TFC–0** and **TFC1–0** are both operated. When these two relays release on disconnect the Z–0 relay operates and locks operated the W–0 relay, which in turn holds relays Z–0 operated. The next seizure of the connector causes relays TFC–0 and TFC1–0 to operate, thereby releasing relay W–0. On disconnect, the TFC–0 and **TFC1–0** relays release relay **Z–0**. Thus, the **W–0** relay alternates between its operated and released condition on successive seizures of the translator, thereby causing the start leads STA and STB of FIG. 77 to alternate which in turn causes each successive bid for a translator from a particular register-outpulser group to alternate its preference from the beginning to the end of the translator preference and connector circuit of FIG. 77.

When relay TM–0 of FIG. 89 operates on a bid by a register-outpulser, ground potential is extended in the upper right hand corner of FIG. 89 over respective make contacts **2** and **4** of relay **TM–0** and break contacts **9** of relays TFC–0 and TFC1–0 to respective conductors TCA and TCB extending into FIG. 87, and thence over break contacts **8** of relays **GCA1**, **GCA2**, **GCB1** and **GCB2**, through the windings of relays TCA and TCB, and to negative battery under control of break contacts **12** of relays ALA and ALB, thereby causing the operation of relays TCA and TCB of FIG. 87. Upon the operation of relays TCA and TCB of FIG. 87, ground is extended in the upper center part of FIG. 87 over make contacts **1** of these two relays and over break contacts **8** and **2** of relays ABA and ABB to conductor **IT0**, extending back into FIG. 89, over break contacts **8** of relays **TFC–0** and **TFC1–0**, and make contact **8** of relay **TM–0**, to battery through the winding of relay **IT–0**. The operation of relay **IT–0** of FIG. 89 will cause the TRS timer of FIG. 86 to start timing for translator cut-through. When relays TFC–0 and TFC1–0 of FIG. 89 operate, as an indication that the translator cut-through operation has taken place, relay **IT–0** of FIG. 89 will release, thereby to recycle the TRS timer of FIG. 86.

The release of the connector circuitry is initiated by a signal from the translator. Both the register-outpulser and the translator simultaneously release the connector. The translator removes battery from the associated start relay such as relay **TS0–0** of FIG. 77 which, in releasing, causes the release of the multicontact connector relays **TA0–0** through **TD0–0** of FIG. 77, thereby disassociating the translator-decoder pair from the register-outpulser. The register-outpulser in turn removes battery from the translator start leads, such as conductors STA and STB of FIG 77 and conductor ST of FIG. 90, thereby causing the release of the register-outpulser start relay **RS0** of FIG. 90 and in turn the release of the register multicontact connector relays **RA0** through **RD0** of FIG. 90, thereby to disassociate the register from the translator-decoder pair. Relays **RB0** of FIG. 90 and **TB0–0** of FIG. 77, in releasing, cause the release in FIG. 89 of relays **TK–0** and **CBY–0** to restore the timing circuit of FIG. 86 to normal, thereby to prepare the connector circuit for a subsequent call. If no other connectors are waiting for translators the traffic control circuit of FIG. 87 allows relays **TFC–0** and **TFC1–0** of the connector control circuit of FIG. 89 to release. The condition of relays **W–0** and **Z–0** of FIG. 89 is advanced one step and the alternate translator start lead is prepared for the next seizure in FIG. 77.

Any connector, such as the one of FIG. 77, whose timing relay, such as relay **TM–0** of FIG. 89, is operated causes relays TCA and TCB of the traffic control circuit of FIG. 87 to operate, as has been described above, to in turn apply ground to conductor **IT0** from FIG. 87 into FIG. 89, thereby to cause the operation in the connector control circuit of FIG. 89 of the corresponding relay **IT–0** which, as has been mentioned above, initiates the operation in FIG. 86 of the TRS timer. On cut-through, if no other connectors are waiting for service, the operation of relays **TFC–0** and **TFC1–0** of FIG. 89 releases the relays **IT–0** of FIG. 89 and relays TCA and TCB of FIG. 87, thereby to recycle the TRS timer of FIG. 86.

If other connectors are waiting for cut-through, relays TCA and TCB of FIG. 87 remain operated because the operating circuits for these relays over conductors TCA and TCB extending into FIGS. 89 and 92 are in parallel under control of the timing relays **TM–0** et cetera for the various connector control circuits of FIGS. 89 and 92. When the first connector cuts through and its TFC– and

TFC1– relays operate, such as relays TFC–0 and TFC1–0 of FIG. 89, contacts close to cause the operation of the group control relays GCA1, GCA2, GCB1, and GCB2 of FIG. 87 by extending grounds over conductors GCA and GCB from for instance make contacts 1 in FIG. 89 of relays TFC–0 and TFC1–0. These group control relays maintain ground on leads TFC– and TFC1– extending from FIG. 87 into the various connector control circuits of FIGS. 89 and 92 until all of the other connectors have been served. When all connectors have cut through and their timing relays, such as relay TM–0 of FIG. 89 have been released, ground is thereupon removed from relays TCA and TCB of FIG. 87 causing these relays to release to in turn release group control relays GCA1 through GCB2 of FIG. 87 which, in releasing, in turn lose control of the TFC– and TFC1– relays such as relays TFC–0 and TFC1–0 of FIG. 89. Once relays TCA and TCB of FIG. 87 release they cannot be reoperated until the group control relays GCA1 through GCB2 of FIG. 87 in turn release. Thus, all connectors waiting for service must be served before others that have just released are allowed to accept more calls.

The operation in any connector circuit of its timing relay, such as relay TM–0 of FIG. 89 for connector 0, causes the operation of one of the relays CWA and CWB of FIG. 87 depending upon the condition in FIG. 89 of the corresponding relay Z–0. This circuit extends from ground in FIG. 89, over make contact 10 of relay TM–0, to either conductor CWA or CWB under control of the corresponding released relays TFC–0 and TFC1–0, depending upon whether relay Z–0 is released or operated. The operation in FIG. 87 of one of the relays CWA and CWB is an indication that the particular connector is waiting for service through either the A or the B circuit. If a translator is available, relays ABA and ABB of FIG. 87 will be released since the operating circuit for these two relays extends from FIG. 87 over conductors ABA and ABB into FIG. 44 of the translator 0, thence through make contacts of the busy relay for that translator and in series in FIG. 53 through the busy relays of all other translators to ground, such that if any one of these translators is available this series circuit through all of the busy relays will be open and relays ABA and ABB of FIG. 87 will remain released. Under these circumstances, in FIG. 87 either timer ALA or timer ALB will begin timing. Time-out under these circumstances would be an indication that the connector could not be served in sufficient time, although at least one translator were available. If all translators are busy and connectors are waiting for service, relays ABA and ABB of FIG. 87 will be operated, thereby to restore the timers ALA and ALB of FIG. 87 to normal. Also under these circumstances in FIG. 87, ground will be removed from conductor IT0 in the event that both of the relays ABA and ABB are operated, thereby to release all of the IT– relays in all of the connector control circuits, such as relay IT–0 of FIG. 89, thereby in turn to restore all of the TRS timers of the connector timer circuits involved such as the one of FIG. 86. Thus, if all translators are busy, cut-through timing is performed only by the auxiliary RC timers, such as the one of FIG. 86, with their correspondingly longer timing intervals.

Each connector is provided with two timing circuits, such as the RC timer and the TRS timer of FIG. 86 for connector 0, and the common traffic control and timing circuit of FIG. 87 is supplied with two timers, namely the ALA timer and the ALB timer. It will be noted in FIGS. 86 and 87 that the TRS timer, the ALA timer and the ALB timer are shown as boxes and indicated as being the same circuitry as shown in FIG. 86, thereby indicating that the timing circuits within these boxes are the same in essence as the detailed timing circuit shown for the RC timer in FIG. 86. In FIG. 86, the TRS timer is provided to time cut-through to a translator circuit and the RC timer is used as a release timer. The basic operation of both circuits is the same except that their timing intervals differ in accordance with their differing functions. In FIG. 86, in connection with the RC timer, the values of resistance CR1 and capacitor C1 are so arranged as to cause the RC timer to have a time constant of approximately 750 milliseconds (ms.). The resistance CR2 associated with the TRS timer of FIG. 86 is so arranged as to cause the TRS timer to have a time constant of approximately 150 ms.; and, in FIG. 87 in connection with the ALA and ALB timers, the values of capacitors C1 and C2 and resistances CR3 and CR4 are so arranged that the ALA and ALB timers have a time constant of approximately 4–6 seconds each.

With respect to the detailed circuitry shown in connection with the RC timer of FIG. 86, the three transistors Q1, Q2, and Q3 are normally in a cut-off condition and relay RC–0 is normally released. Initially, capacitor C1 is supplied with negative battery potential (assume minus 48 volts DC for instance) supplied thereto through back contact 5 of relay TK–0 and back contact 6 of relay TM1–0 to the upper electrode of capacitor C1: the lower electrode of capacitor C1 is connected to the junction of resistances VD1 and VD2 which are approximately equal in value so that the potential on the lower electrode of capacitor C1 is approximately minus 24 volts DC. Thus, capacitor C1 is charged to a voltage of about 24 volts so that the emitters of transistors Q1 and Q2 are substantially at 24 volts DC positive with respect to the base of transistor Q1. Timing begins whenever the negative battery potential is removed from the upper electrode of capacitor C1, such as by the operation of either relay TK–0 or relay TM1–0 as indicated by the transfer contacts of these relays shown in FIG. 86. When this happens the negative battery potential is removed from the upper side of capacitor C1 causing the voltage on that side of the capacitor to decay exponentially toward ground potential by virtue of the discharge path through the resistance CR1. When the capacitor voltage on the upper electrode thereof becomes more positive than the emitter voltage of the transistor Q1, this transistor will conduct and the flow of collector current therein will cause transistors Q2 and Q3 to conduct, to in turn operate the timing relay RC–0 when transistor Q3 saturates. If relay RC–0 operates under these circumstances, it will lock over its own make contact 8 to ground through the back contact of a release key designated CAR and indicated as existing in the jack, key and lamp circuit. Although the circuitry has not been shown to accomplish the function, it will be understood that the operation of the timing relay RC–0 or TRS–0 of FIG. 86 or of the alarm relays ALA and ALB of FIG. 87 will of course initiate visual or audible alarms to alert the attendance of maintenance personnel of a trouble situation.

With respect to the TRS timer of FIG. 86 the operation of relay IT–0 of FIG. 89, as has been mentioned previously, will start the TRS timer. If cut-through does not occur within approximately 150 ms., time-out will cause the operation of relay TRS–0 which will thereupon lock over its own make contact 11 to ground control of the release key above mentioned. Under these circumstances in FIG. 89, a relay TM–0 will be released by the operation of relay TRS–0 but relay TM1–0 will remain operated under the control of the operated timing relay TRS–0. The operation of relay TM–0 will release relay IT–0 in FIG. 89. Relay TRS–0 of FIG. 86, in operating, will initiate audible and/or visual alarms in the jack, key and lamp circuit. It also transfers the translator start leads in FIG. 77 to call for the alternate translator. When the translator is seized the operation of relay TK–0 of FIG. 89, as has been described, causes the release in FIG. 89 of relay TM1–0 to cause the RC timer of FIG. 86 to come into play to time for a release. Intially, both the TRS and the RC timers will time for cut-through. If time-out occurs in the TRS timer and cut-through to the alternate translator does not occur within a sufficient length of time, the RC timer of FIG. 86 also times-out. Timing interval in this case is approximately 750 ms. Relay RC–0 of FIG. 86, in operating, will lock as previously described and will effect the necessary audible and visual alarms. Operation of the alarm release key CAR, in the jack, key and lamp circuit indicated in FIG. 86, will release either or both of the alarm relays RC–0 and TRS–0. If cut-through does not occur within the prescribed time, the operation of relay TK–0 of FIG. 89 will restore the RC timer. When relay TM1–0 releases, as previously described, the timer is recycled to time for disconnect. Again, if release does not occur within approximately 750 ms., the timer fires and the alarm is provided. In FIG. 87 traffic control timer ALA is associated with the A part of the circuit while timer ALB is associated with the B section of the circuit. Trouble in either circuit will cause the corresponding timer to fire and to provide the necessary alarms. The alarm is sent by the operation of relay ALA or ALB, which also provides the necessary audible and visual lamp indications. The alarms are restored by the operation of an alarm release key designated TAR and shown in the jack, key and lamp circuit indicated in FIG. 87.

Under certain conditions of trouble the seized translator circuit will send a trouble release signal to the connectors by grounding conductor TR in FIG. 89 extending from the connector circuitry in FIG. 79 and ultimately from the translator which has been seized. Relay TR–0 in FIG. 89 will be operated as a result of the grounding of conductor TR and relay TR–0 will lock over its own make contact **6** to conduct G extending into FIG. 79 and thence out over cable **792** and over a make contact of the register connector relay RAO to ground. The operation of relay TR–0 is effective in FIG. 77 to open the translator start leads by opening its break contacts **7** and **9** and in FIG. 79 is effective to open the circuit of lead HD1 extending between the translator and the register-outpulser by opening its back contact number **4**. In response to this action the translator will then remove battery from the associated translator start relay, such as relay TS0–0 of FIG. 77, which releases the translator and decoder cut-through relays TA0–0 through TD0–0 of FIG. 77. Again, the release of relay TB0–0 of FIG. 77 causes the release in FIG. 89 of the relays TFC–0 and TFC1–0. The release of relay TAO–0 of FIG. 77 opens the circuit which supplied ground conductor TR in FIG. 89, thereby removing a ground shunt on the left hand side of the winding of relay TR1–0 and permitting relay TR1–0 to become operated. The action of relays TFC–0 and TFC1–0 of FIG. 89 causes the W–0 and Z–0 relays of FIG. 89 to step ahead as previously described. In addition, the alternate start lead is closed in FIG. 77 and the alternate choice translator is called for. The lead HD1 of FIG. 79 is reclosed on cut-through by the operation of relay TR1–0 of FIG. 89 by virtue of the make contact **8** thereof as shown in FIG. 79. If the alternate translator also sends a trouble release signal on the second trial, this signal is transmitted directly to the register-outpulser and causes disconnect by virtue of the fact that conductor TR in FIG. 89, which will carry the trouble release ground signal from the translator, is connected over make contact **6** of relay TR1–0 to conductor TRL which extends through FIG. 79 to the attached register-outpulser. When the register-outpulser connector relays, such as relay RA0 of FIG. 90, release on disconnect the relays TR–0 and TR1–0 of FIG. 89 are released. Other trouble conditions may cause the translator to send a trouble release signal on the conductor TRL in FIG. 89 and this signal again is sent directly to the attached register-outpulser to cause immediate disconnect without a second trial.

It will be noted particularly in FIGS. 77, 78, and 83 that a number of leads are shown whereby an automatic test circuit (not shown) may be used to test the operation of this translator-decoder connector circuitry of FIG. 77 through 95.

*Trunk class connector (FIG. 96)*

This circuit provides means whereby any one of the decoder circuits, such as decoder **0** of FIGS. 54 through 74, may obtain the class of the register trunk of FIG. 2 for purposes of assisting in translating the called code for routing purposes. The trunk class is derived by a cross connection at the register trunk and link frame shown in FIG. 7. A maximum of ten trunk classes is available to a maximum of nine decoder circuits served by this trunk class connector.

When the decoder determines that a trunk class indication is required, it operates its associated preference relay, such as relay P0 in FIG. 96 for decoder **0** of FIGS. 54 through 74. The operation of the preference relay P0 in turn locks out all other decoders and operates the corresponding connector relay, such as relay PC0 of FIG. 96. Ground potential is then applied from the circuit of FIG. 96 in the class identification lead which in turn is passed through the decoder, the translator-decoder connector, and through the register-outpulser to the secondary switch in FIG. 7 on the register trunk and link frame. The operated secondary and primary switch crosspoints in the link circuit of FIG. 7 extend this ground potential to the associated class identification terminal on the primary switch. One of the ten class terminals (designated CL0 through CL9 in FIG. 7) is thereupon grounded through a cross connection and this ground potential is then passed through the operated connector relay of FIG. 96 back to the decoder circuit. In the decoder, a trunk class register relay (see relays CL0 through CL9 of FIG. 68 in the decoder) is operated and locked; and, the operation of this register relay releases the preference and connector circuit of FIG. 96 so that other decoders may be served by the same trunk class connector circuit of FIG. 96.

With reference to FIG. 68 of the decoder circuit numbered **0**, when the decoder determines that a trunk class mark is required, resistance battery is placed on conductor ST0 in FIG. 68 and is extended into the trunk class connector circuit of FIG. 96, through the winding of the preference relay P0, thence through back contacts **1** of the higher numbered preference relays P1 through P8 to ground, thereby causing the operation of the preference relay P0 corresponding to decoder **0**, provided that the higher numbered decoder preference relays P1 through P8 are in a released condition. Relay P0, in operating, locks to ground over its own make contact **1** and completes a circuit for causing the operation of its associated connector relay PC0 over make contact **2** of relay P0. If an intermediate decoder, such as decoder number **1** of FIG. 74, had previously operated its preference relay, such as relay P1 of FIG. 96, then no preference relay of a lower numbered decoder, such as preference relay P0 of FIG. 96, may be operated since the operating circuits for the lower numbered preference relays are cut off by the back contacts of the operated intermediately numbered preference relay. However, preference relays for higher numbered decoders, such as preference relay P8 of FIG. 96, can operate. It will be noted that the preference-lockout arrangement for the respective connectors, such as connectors PC0 and PC1 through PC8 of FIG. 96, is arranged in the opposite direction; that is, the connector for a higher numbered decoder can operate, upon the operation of its associated preference relay P1, only in the event that the preference relays for all lower numbered decoders, such as preference relay P0 for decoder **0**, are released. The operation of a decoder connector relay, such as decoder connector relay PC0 of FIG. 96, extends ground potential from FIG. 96, over make contact **12** of relay PC0, and through make contact **3** of the associated preference relay P0, to the class identification lead CI0 extending into FIG. 68 of decoder **0**. In the decoder this grounded conductor CI0 in FIG. 68 becomes conductor CI extending into decoder control circuit of

FIG. 54, and thence extends over a cable into FIG. 64 of the decoder, thence by a cable into the translator-decoder connector circuitry of FIG. 88, over a make contact of the connector relay **TD0–0**, cable **881**, through a make contact of the register-outpulser connector relay **RD0**, and over cable **882** into FIG. 33 of the register-outpulser, thence over conductor CI into the party test control circuit of FIG. 12 in the register-outpulser, thence over break contact number **3** of relay **RT3** and over conductor CI into the register trunk and link circuit of FIG. 7. There, it extends over closed cross point number **4** of the right-hand secondary crossbar switch, conductor CI, over cables **7B** to the primary trunk switch, conductor CI, over make contact **4** of the trunk crossbar switch, and thence over conductor CI to a cross connecting punching in FIG. 7, which is shown cross connected to punching **CL9**, whereupon ground potential is further extended over conductor **CL9**, back into the trunk class connector circuit of FIG. 96, over make contact **10** of relay **PC0**, thence over conductor **CL9** into FIG. 68 of the decoder circuit, to cause the operation in FIG. 68 of the decoder circuit of the trunk class register relay **CL9**. Relay **CL9**, in operating, locks over its own make contact in FIG. 68 of the decoder to ground under control of make contact **9** of relay **TLC** (which will have been operated in the decoder circuit).

In the decoder circuit (see FIG. 68), the operation of the register relay **CL9** opens a chain circuit which previously supplied resistance battery to conductor **ST0**, previously described as extending into FIG. 96 to cause the operation of the preference relay **P0**, whereupon relay **P0** and its associated connector relay **PC0** of FIG. 96 become released, thereby to advance the preference chain to the next higher numbered preference relay **P1**. If no higher numbered preference relay is operated, a lower numbered preference relay associated with a decoder which has its start lead, such as conductors **ST0** through **ST8** of FIG. 96, activated.

*Foreign area translator* (*FIGS. 75 and 76*)

The foreign area translator circuitry of FIGS. 75 and 76 indicates in detail in FIG. 75 one of the foreign area translator circuits, indicates in FIG. 76 the remaining four translators of translator group **0** and indicates in FIG. 76 the extent of nine such foreign aret translator groups. With reference to the block diagram of FIG. 1A it will be noted that each translator-decoder pair is served by a maximum of five foreign area translators. This circuit works in conjunction with the decoder and translator circuits to provide six-digit translation for ten-and eleven-digit type calls. The five foreign area translator circuits, such as foreign area translators **0** through **4** of group **0** in FIGS. 75 and 76, work in conjunction with translator-decoder pair **0** represented by the translator circuitry of FIGS. 44 through 53 and the decoder circuitry of FIGS. 54 through 74. These five foreign area translator circuits provide for translating office codes in five foreign areas adjacent to the particular translator area. When an area code has been dialed and which requires six-digit translation, the particular decoder involved will return to the register-outpulser a "come-again-six" signal, whereupon the register-outpulser will release the attached translator and decoder circuits. When the register-outpulser has received the sixth digit (in excess of any prefix digit) it bids again for the services of a translator-decoder pair and transmits the six digits to the translator, following which the attached decoder in turn will connect to the proper foreign area translator circuit. Having translated the area code into an adjacent area code point and having determined which foreign area translator is to be used, the translator circuit proceeds to pass the office code information to the foreign area translator for the fourth, fifth, and sixth digits (if no prefix has been dialed) or the fifth, sixth, and seventh digits (if a prefix digit has been dialed). This information is first checked in the translator and is then passed on to the foreign area translator by means of ground potentials on the various conductors in FIGS. 75 designated **HT2** through **HT9** for the hundreds digit and the various leads designated **T0** through **T369** to designate the tens digit and the leads **U0** through **U9** in the top of FIG. 75 designating the units digit. These grounded leads cause the proper translating relays to operate in the foreign area translator of FIG. 75 such that through a contact arrangement of these various translating relays one of the eight hundred code points **C200** through **C999** will be grounded. These various code points will be cross connected to one of the code points designated **FAR000** through **FAR029** in FIG. 75, and this information is transmitted to the decoder circuit into the cross connecting field of FIG 60 in the decoder where the translated indication is cross connected according to the desired routing of the call.

When an area code has been dialed and which requires the use of a foreign area translator circuit, the attached decoder circuit will apply battery to one of the five conductors in FIG. 56 designated **FAT0** through **FAT4** and extending into FIGS. 75 and 76 to cause the operation of one of the relays **FAT0** through **FAT 4** to in effect seize the appropriate one of the five foreign area translators serving that particular translator-decoder pair. Assuming that relay **FAT0** of FIG. 75 is operated as an indication that foreign area translator **0** is the one required, the hundreds digit of 2 through 9 extending into FIG. 75 from FIG. 48 of the translator circuitry will cause the operation of one of the relays **HT2** through **HT9** through a make contact of the operated relay **FAT0** depending upon the value of the hundreds digit. If the tens digit transmitted to FIG. 75 from FIG. 50 of the translator is a 0, conductor **T0** in FIG. 75 will be grounded, thereby causing the operation of one of the relays **TT20** through **TT90** through a make contact of the operated one of the relays **HT2** through **HT9**, whereupon the grounding of one of the units leads **U0** through **U9** from FIG. 49 of the translator into FIG. 75 will extend in the right hand portion of FIG. 75 over a make contact of the operated one of the relays **TT20** through **TT90**, thereby to ground one of the code points **C200** through **C909**. In the event that the tens digit is something other than 0, two of the multinumbered tens leads in FIG. 75 will be grounded from FIG. 50 of the translator, whereby if the tens digit is a 1 or a 2 or a 3, one of the relays **TT2R** through **TT9R** will be operated, if the digit is a 4 or a 5 or a 6, one of the relays **TT2S** through **TT9S** will be operated, and if the tens digit is a 7 or 8 or 9, one of the relays **TT2T** through **TT9T** will be operated: in addition, one of the three relays **T147, 258** and **369** will be operated depending upon the value of the tens digit. In the latter situation the grounding of one of the units conductors in the upper part of FIG. 75 will extend over a make contact of the appropriate one of the relays **T147**, **T258** and **T369** and thence through make contacts of the operated one of the **TT2–** through **TT9–** relays to ground one of the code points **C210** through **C999**.

When the decoder circuit has completed its functions of foreign area routing, it will remove battery from the **FAT0** lead in FIG. 75 to release relay **FAT0**, which in turn will cause the release of all of the operated translating relays in FIG. 75 to restore the foreign area translator circuit to normal.

*Translator* (*FIGS. 44–53*)

With reference to the block diagram of FIG. 1A, it will be noted that nine translator circuits are provided numbered **0** through **8** and, as has been mentioned previously, these nine translators are paired with nine decoders numbered **0** through **8**. The detailed circuitry of one such translator number **0** is shown in FIGS. 44 through 53 and is used to provide three-digit code translation to the decoder circuit associated with the translator. If codes in an adjacent foreign area are to be translated and decoded the translator circuit provides means for connecting the office code information to the proper register relays in the translator and for then forwarding the office code information to the appropriate foreign area translator associated with the translator-decoder pair, such as the foreign area translator number **0** show in FIGS. 75 and 76.

The translator circuit is seized by a register-outpulser through the translator and decoder connector circuit of FIGS. 77 through 95 after the register-outpulser has received three (if no prefix digit exists) or four (with a prefix 0 or 1) digits of the called number. The register-outpulser circuit passes a no-prefix, a prefix-0, or a prefix-1 indication to the attached decoder by way of the translator circuit. The decoder in turn passes a prefix or a no-prefix indication back to the translator. The register-outpulser also passes the three digits of the area, office or service code to the translator which thereupon registers and checks this information and proceeds to translate the three-digit code into one of a possible 810 outputs.

Each output is transmitted to the attached decoder circuit where it is made available for cross connection to ultimately operate a route relay in the decoder. The operated route relay in the decoder circuit then controls the information transmitted to the register-outpulser for completion of the call.

When all of the information transmitted to the decoder has been checked, a release signal is sent to the translator which in turn sends a release signal to the register-outpulser. The register-outpulser then releases the connection through the translator and decoder connector circuit, allowing the translator and decoder combination to return to normal so as to be available for another call.

With respect to the release circuit shown in FIG. 45, the leads TR, TRL, and RL extending to the translator connector and decoder connector of FIG. 79, and therethrough into the attached register-outpulser circuit of FIGS. 8 through 39, are used to guard against false grounds and crosses on these conductors. A false ground on any one of these leads will cause the operation in FIG. 45 of relay XL, which thereupon locks over its own make contact **10** and conductor AR into FIG. 52 and to ground under control of the AR key of the miscellaneous circuit. The upper winding of relay XL is shown connected to the decoder circuit of FIG. 54 so that this relay XL may be controlled from the decoder if necessary. In the right hand part of FIG. 45 relay COX will operate to cause a major alarm and to light a visual lamp signal whenever relay XL operates. The translator and the associated decoder circuit are arranged to be restored to service in the event that relays XL and COX are operated and locked as a trouble condition.

Transistor timers are used for timing the translator and decoder functions. In FIG. 52 are shown two timer circuits designated the WT timer and the OAT timer, both indicated as being of the same circuitry as that previously described in connection with FIG. 86 of the translator and decoder connector circuitry. The work timer WT starts timing upon seizure of the translator and times for approximately 250 ms. If the translator does not complete its functions during this time interval, the work timer WT times-out and the translator will then send a trouble release signal to the translator and decoder connector circuitry. The translator and decoder connector circuitry thereupon will withdraw the seizure signal to release the translator and will attempt to seize another translator for completion of the call. If the work timer WT times-out twice on one seizure, an alarm will be sounded and a trouble release signal will be passed to the attached register-outpulser circuit. The over-all timer OAT of FIG. 52 starts timing upon seizure of the translator and times for approximately 600 ms. If the translator does not complete its functions during this time interval, and if the work timer WT has not timed-out, the over-all timer OAT will time-out to provide visual and audible alarm signals and to provide a trouble release signal to the attached register-outpulser circuitry.

As has been mentioned above, the translator is used to translate a three-digit code into a code output which is passed to the associated decoder, which thereupon uses the code output to provide routing information to the attached register-outpulser. The register-outpulser requests a connection to a translator by means of the translator and decoder connector circuitry of FIGS. 77 through 95: this connector, by operating various multicontact relays, seizes the translator which in turn seizes the decoder; and, the translator and decoder connector cuts through the necessary leads for passing information between the register-outpulser and the translator-decoder combination.

As has been mentioned hereinbefore in connection with description of the detailed circuit operation of the translator and decoder connector circuitry of FIGS. 77 through 95, operation of the preference relay in that connector associated with translator **0** of FIGS. 44 through 53 will cause the release in FIG. 44 of the chain relays CH**1**, CH**2** and CH**3**. Relays CH**1**, CH**2** and CH**3** are used to check the contact chains through all translator preference relays for this particular translator in all of the connectors of the translator and decoder connector circuitry of FIGS. 77 through 95, as has been explained hereinbefore. Each connector has a preference relay for each translator-decoder combination and when the preference relays for a particular translator-decoder combination are all normal, the relays CH**1**, CH**2** and CH**3** should be operated. When a translator is seized, such as the translator **0** of FIGS. 44 through 53, its relays CH**1**, CH**2** and CH**3** will become released. The release of any one of these chain relays stops the operation of the work timer WT of FIG. 52, causes the operation in FIG. 52 of relay STM to start the over-all timer OAT of FIG. 52, and partially completes the operating path in FIG. 44 for the translator off-normal relay ON.

Also, as has been mentioned hereinbefore in connection with the detailed circuitry of the translator and decoder connector of FIGS. 77 through 95, when the connector multicontact relays operate, relay HD of FIG. 44 is caused to operate from battery supplied over conductor HD**1** from the translator and decoder connector circuitry of FIG. 79 and to off-normal ground potential supplied thereto over conductor HD**00** in FIG. 44 and which ultimately originates in the attached register-outpulser circuitry. The operation of relay HD of FIG. 44 places resistance holding battery on the HD**00** lead back to the translator-decoder connector to hold operated the preference relay therein. Also, in FIG. 44 upon the operation of relay HD, the traffic control leads TFC and TFC**1** will be grounded back toward the translator-decoder connector circuitry. Also, as has been previously described, conductor CBR in FIG. 44 extending thereto from FIG. 83 of the translator-decoder connector circuitry will become grounded, whereupon the off-normal relay ON of FIG. 44 is operated in a circuit extending from ground on conductor CBR in FIG. 44, over break contacts **10** of relays CH**1**, CH**2** and CH**3**, and make contact **4** of relay HD, to negative battery through the winding of the off-normal relay ON, which operates and locks in an obvious manner over its own make contact **11**. Relay ON, in operating, provides off-normal locking grounds for various circuits of the translator, applies ground in the upper right hand portion of FIG. 44 over its own make contact **12** to the off-normal lead extending into FIG. 55 of the associated decoder (thereby causing seizure of the decoder circuit), and causes the operation in FIG. 44 of relays CB and CBA in a circuit extending from ground through make contact **5** of relay ON and break contact **6** of relay MB and in parallel through the windings of relays CB and CBA and thence to negative battery over break contact **8** of relay FA. The operation of relays CB and CBA of FIG. 44 grounds the connector busy leads CB**00** and CB**01** through CB**014** extending from FIG. 44 into FIG. 83 of the translator-decoder circuitry to cause the operation in this latter circuit of all of the connector-busy relays associated with the seized translator in each of the connectors of the translator-decoder connector circuitry, thereby causing the seized translator to appear busy to all other calls.

Having been seized, the translator receives information from the attached register-outpulser over conductors cut through therebetween by means of the translator-decoder connector circuitry of FIGS. 77 through 95. If the register-outpulser does not have a prefix digit (0 or 1) registered as the A digit, this information is transmitted to the decoder which in turn will cause the grounding in FIG. 44 of conductor NPA, thereby to cause the operation in FIG. 44 of relay NPA. On the other hand, if the register-outpulser has a zero or a one prefix digit registered as the A digit, this information is transmitted to the decoder which in turn will thereupon cause the grounding in FIG. 44 of conductor PFA to cause the operation in FIG. 44 of relay PFA. In FIG. 46, it will be noted that if relay NPA of FIG. 44 is operated (indicating no prefix digit) the A digit leads **A0** through **A7** will be connected to the hundreds digit registers **H0** through H7, the B digit leads will be connected to the tens digit register **T0** through T7 and the C digit leads will be connected to the units digits registers **U0** through **U7**. On the other hand, if relay PFA of FIG. 44 is operated (indicating that there was a prefix digit of 0 or 1 in the A digit position of the register-outpulser), the B digit leads from the connector circuitry will be associated with the hundreds register of FIG. 46, the C digits leads with the tens digits register and the D digit leads with the units digits register. And, it will be noted that all of these registrations are in the usual two-out-of-five operated relay basis.

Having registered the three digits of the area, office or service code, the translator checks to be certain that only two out of the five register relays for any particular digit are operated. It will be noted with reference to FIGS. 48 and 49 that contacts of the hundreds, tens, and units relays include control over conductors TBL2, TBL3 and TBL1 extending into FIG. 45 to the left hand side of the winding of the trouble relay TBL. These contact arrangements are provided so that if more than two register relays are operated in any one of the three groups, a circuit will be completed from ground in FIG. 48 or FIG. 49, through make contacts of the operated registers, and over the conductor TBL– into FIG. 45 to cause the operation of the trouble relay TBL. Relay TBL, in operating, extends ground from the left hand side of FIG. 45 over its make contact **10**, to conductor TS extending into FIG. 70 of the associated decoder circuitry, where this circuit is completed back to conductor TR in FIG. 45 and thence to the winding of relay TR, which in turn operates and locks over its own make contact **12** to off-normal ground. The operation of relays TBL and TR in FIG. 45 will block the translation function and will cause a trouble release. If less than two register relays operate in any one of the hundreds, tens, and units registers of FIG. 46 the translator circuit will block by virtue of being unable to continue with its function, thereby causing a time-out in the timer circuitry of FIG. 52 to cause a trouble release. If the hundreds, tens, and units digits of the three-digit code to be translated are properly registered on a two-out-of-five basis in the hundreds, tens, and units registers of FIG. 46, then the grounds in FIGS. 48 and 49 will be extended through contacts of these relays so that one of the 810 code leads extending from FIG. 51 to the associated decoder circuit will be grounded. This grounded code lead will correspond to the area, office or service code represented by the first three digits of the called number (exclusive of any prefix which may have preceded these three digits).

The contact network in FIG. 48, associated with the hundreds digits relays **H0** through H7 of FIG. 46, will cause the operation of one of the relays **HT2** through **HT9** of FIG. 48 corresponding to the hundreds digit of the three-digit code. This circuit extends from ground in the upper left hand portion of FIG. 48, through the two-out-of-five contact checking network of relays **H0** through **H7**, thence over break contact **11** of the trouble relay TBL, and thence over make contacts of the two operated relays **H0** through **H7**, to one of the conductors **HT2** through **HT9**, thence over a make contact of the operated home area translator relay HAT (operated in FIG. 44 under control of the operated one of the two relays NPA and PFA), and thence to battery through the winding of the associated relay **HT2** through **HT9**. The operated tens digit registers **T0** through **T7** of FIG. 46 will cause the operation in FIG. 50 of one or more of the relays shown therein depending upon the value of the tens digit. This circuit extends from ground in the lower left hand part of FIG. 48, through the two-out-of-five contact checking network of relays **T0** through **T7**, over conductor TT in FIG. 50 where it will cause the operation of one of the three relays **T147**, **T258** and **T369** depending upon the tens digit of the three-digit code. In addition, the tens digit, in conjunction with the operated one of the relays **HT2** through **HT9** of FIG. 48, will determine which specific one of the TT–R, TT–S and TT–T relays is operated corresponding to the hundreds and tens digits of the three-digit code. The operated relay **HT2** through **HT9** of FIG. 48 will determine which one of the eight possible relays in the R, S, and T groups is required for a given code, while the tens digit will determine which particular suffix letter R, S, or T is required. The R suffix denotes tens digits 1, 2 and 3; the S suffix denotes tens digits 4, 5 and 6; and, the T suffix denotes tens digits 7, 8 and 9. If the tens digit were a zero, then one of the relays **TT20** through **TT90** of FIG. 50 is operated instead of one of the R, S or T relay groups.

The particular code lead of FIG. 51 corresponding to the three-digit code and which is activated is grounded under control of the units digit relays **U0** through U7 of FIG. 46. This circuit extends from ground in FIG. 49, over a two-out-of-five contact checking network on the units relays, thence through back contact **4** of relay PS, thence over make contacts of the two operated units relays to ground one of the conductors **U0** through U9 extending over cable **U0**–**U9** into FIG. 51, and thence over make contacts of the combination of operated relays of FIG. 50 to ground one of the 810 conductors extending from FIG. 51 to FIG. 67 in the associated decoder circuit.

If the hundreds and tens digits of the three digit code are respectively 11 then the contact translating networks on the hundreds and tens digit registers of FIG. 46 will cause the operation in FIG. 48 of relay **11X**. This circuit will extend from ground in the upper left-hand part of FIG. 48, through the two-out-of-five contact checking network of the hundreds digit relays, over break contact **11** of relay TBL, and thence through make contact **12** of relay **H0**, make contact **2** of relay **H1**, make contact **8** of relay **T0**, make contact **8** of relay **T1**, make contact **1** of relay HAT, to a negative battery through the winding of relay **11X**. With reference to FIG. **51**, it will be noted that the code leads **110** through **119** are activated under control of the units digit registers **U0** through **U7** of FIG. 46 and make contacts of the relay **11X**.

When one of the code leads of FIG. **51** is grounded into the FIG. 67 of the associated decoder circuit, a corresponding code point in the decoder is grounded to ultimately operate a route relay therein. The operated route relay in the decoder circuit controls the information that is transmitted to the register-outpulser for control of the routing of the call. This routing control information is passed from the decoder circuit through the translator-decoder connector of FIGS. 77 through 95 to the attached register-outpulser. When all of the transmitted information has been registered and locked in the attached register-outpulser circuit of FIGS. 8 through 39, check relays are operated in the decoder circuit which in turn will apply ground potential to conductor RL in FIG. 45 of the translator, thereby to cause the operation in FIG. 45 of the release relay RL, which locks over its own make contact **12** to off-normal ground. Relay RL, in operating, applies ground in FIG. 45 over its own make contact **8** to the release conductor RL extending through the translator-decoder connector circuitry of FIG. 79 to the attached register-outpulser to operate a release relay in the register-outpulser. The operated release relay in the register-outpulser causes the release of the register-outpulser portion of the translator-decoder connector of FIGS. 77 through 95 and releases relay HD in FIG. 44, which thereupon opens the battery holding lead over conductor HD**00** from FIG. 44 back into the translator-decoder connector circuitry to in turn cause the release in that connector circuit of the translator-decoder portion thereof. When the translator preference relays in all of the connectors of the translator-decoder connector circuitry of FIGS. 77 through 95 are released, then the three chain relays CH**1**, CH**2** and CH**3** of FIG. 44 will become reoperated. Also, the release of the translator connector relay portion of the translator-decoder connector circuitry will cause the release in FIG. 44 of the translator off-normal relay ON, which in turn causes the release of the off-normal relay in the associated decoder and of the release relay RL in FIG. 45 of the translator. Furthermore, in FIG. 44 relays CB and CBA become released and relay STM in FIG. 52 is released to thereby restore the translator to normal.

As has been mentioned above, the work timer WT of FIG. 52 starts timing upon release of any one of the chain relays CH**1**, CH**2** and CH**3** of FIG. 44 and times for an interval of approximately 250 ms. If the work timer WT times-out, as indicated by the operation of relay WT in FIG. 52, a circuit is completed in the lower right hand part of FIG. 52 to cause the operation of relay WTO extending from ground, through make contact **5** of relay WT, break contact **3** of relay WTL, to negative battery through the winding of relay WTO. The operation of relay WTO causes the work timer WT to become recycled and causes the operation of relay WTL under control of make contact **11** of relay WTO and make contact **1** of relay STM. When the work timer WT is recycled, relay WT released, allowing relays WTO and WTL to lock-operated in series with each other under control of the operated relay STM. The operation of relay WTL allows the WT timer to start timing again for a second interval of 250 ms. A second time-out of the work timer WT will cause the operation in FIG. 52 of relay TOR in a circuit extending from ground in FIG. 52 over make contact **5** of relay WT, make contact **3** of relay WTL, to negative battery through the winding of relay TOR which, upon operating, locks over its own make contact **5** under control of make contact **1** of relay STM. The operation of relay TOR, in addition to bringing in the usual visual or audible alarm conditions, will extend ground in FIG. 45 over its make contact **3** to the trouble release lead TRL extending into the translator-decoder connector circuitry to eventually cause the release of the translator circuit.

The over-all timer OAT of FIG. 52 operates in a manner similar to that of the work timer WT but is under the control of relay STM of FIG. 52. The over-all timer OAT starts timing upon the operation of relay STM and times for an interval of approximately 600 ms. As has been mentioned previously, relay STM operates upon the release of any one of the chain relays CH**1**, CH**2** and CH**3** of FIG. 44 and, in operating, is held operated under control of relays HD of FIG. 44, RL or TBL of FIG. 45, or of the off-normal relay in the associated decoder circuitry. If the associated translator or decoder does not complete all of its functions within the 600 ms. time interval, relay OAT of FIG. 52 will operate to in turn cause the operation in FIG. 52 of relay TOR to bring in the usual alarms and to cause a trouble release signal to be transmitted to the attached register-outpulser circuitry by virtue of conductor TRL of FIG. 45 extending to the translator-decoder circuitry.

When the office is provided with permanent signal holding trunks, and if the register-outpulser recognizes that a permanent signal condition exists on a calling line, the register-outpulser will bid for a translator through the translator-decoder connector circuitry of FIGS. 77 through 95; and, when the translator is seized, ground will be applied to the PS lead in FIG. 44 to cause the operation of relay PS identifying the call as a permanent signal call. Under these circumstances, with reference to FIG. 49 of the translator circuit, ground is supplied over make contact **10** of the translator off-normal relay ON and thence through back contacts **4** of all of the units register relays of FIG. 46, thence over make contact **4** of relay PS, and over make contact **5** of relay PS, to ground conductor PS extending into FIG. 67 of the decoder circuit to cause the operation therein of a suitable route relay to indicate routing for a permanent signal holding condition. The decoder will thereupon transmit information to the attached register-outpulser as to the proper routing for attaching this permanent signal calling line condition to a permanent signal holding trunk. When all of the transmitted information has been registered and locked in the attached register-outpulser circuit, the operation of all of the check relays in the decoder will cause the operation in FIG. 45 of the translator release relay RL, which in turn will result in the release of the associated translator and decoder circuits which are attached to the register-outpulser.

*Decoder (FIGS. 54–74)*

It will be noted with reference to the block diagram of FIG. 1A that nine decoder circuits are provided and are numbered **0** through **8**, to be paired with the corresponding translator circuits **0** through **8**. FIGS. 54 through 74 show the detailed circuitry of one such decoder No. **0**. The decoder circuit is used in conjunction with an associated translator circuit to provide routing and pulsing information to a register-outpulser such as the one of FIGS. 8 through 39. The associated translator provides three-digit code translation into one of 810 code point outputs which appear in the bottom part of FIG. 67. The energized code point of FIG. 67 is screened by means of the trunk class information obtained through the trunk class connector of FIG. 96 and is screened by the prefix (no prefix, prefix 1 or prefix 2) information supplied from the register-outpulser to control the operation of a route relay and a route supplementary relay in the decoder circuit. The contacts of these relays are cross-connected to control the transmission of routing and pulsing information back to the register-outpulser. If office codes in an adjacent foreign area are to be translated, the particular translator involved provides means for forwarding the office code information to the proper foreign area translator, such as the one disclosed in FIGS. 75 and 76. The routing output of the foreign area translator is then used to operate the route relays in the decoder circuit, the foreign area translator output appearing in FIG. 60 on such leads as those designated FAR**000** through FAR**029**, et cetera.

The decoder circuit and its associated translator are seized by the register-outpulser through the translator and decoder connector circuitry of FIGS. 77 through 95 after the register-outpulser has received three (no prefix) or four (prefix 1 or 0) digits of the called number. The translator circuit, in going off-normal, starts its various timing circuits to time various phases of the translator-decoder function and in turn causes the decoder to go off-normal.

When the translator and decoder connector circuitry of FIGS. 77 through 95 has closed through the leads between the register-outpulser, the translator and the decoder, the register-outpulser circuit passes an indication to the decoder as to whether or not there was any prefix digit ahead of the called number. The decoder in turn will pass this prefix indication back to the translator. The register-outpulser also passes the three digits of the area, office or service code to the translator on a two-out-of-five coding basis. The translator registers and checks this information and then proceeds to translate the three-digit code into one of the possible 810 code point outputs shown in FIG. 67.

When the decoder is seized it will operate its transmitting lead connector relays TLC– of FIG. 69 to transfer the transmission leads from the cross detecting relays XTL– of FIG. 69 to the transmitted information terminals such as are shown extending to the decoder in the lower portions of FIGS. 61, 62, 63 and 64. A start signal is then sent to the trunk class connector circuit to obtain trunk class information. When this trunk class is registered in the decoder circuit, the start signal is withdrawn from the trunk class connector.

Each code point output from the translator circuit is made available to the decoder circuit cross connections of FIGS. 60 and 67 for grouping and for operation of a route relay. Using the prefix information, the code output point from the translator, and the trunk class information the decoder operates a route relay such as one of the relays **R00** through **R79** of FIG. 71 to supply the following type of information to the attached register-outpulser: (a) the number of digits to expect in the called number, (b) an indication of whether or not the call is a reverting call and (c) information as to whether or not the particular call is to use controlled outpulsing by the register-outpulser. In the event that controlled outpulsing is required, the route relay will operate a route supplementary relay such as relays **RS00** through **RS19** of FIG. 71 to supply further information to the attached register-outpulser: (a) the type of outpulsing to be used, (b) availability of an alternate route, (c) whether or not any of the called digits is or are to be deleted with respect to outpulsing-beyond, (d) how many arbitrary exit digits are to be used and the value thereof, (f) the digit position in the exit digit registers of the KP pulse for multifrequency pulsing control, and (g) whether or not a "STOP-GO" signaling condition is to be expected upon trunk seizure.

After the decoder circuit has made a check to ascertain the availability of an outgoing trunk for the required routing, the decoder places resistance battery on the transmitting leads back into the attached register-outpulser circuit to cause the operation therein of the information register relays. Locking grounds returned over the transmitting leads from the locked register-outpulser information relays will cause the operation in the decoder of various check relays to indicate that all of the transmitted routing and pulsing information has been properly registered and locked in the attached register-outpulser. The decoder then passes a release signal to the associated translator circuit, which in turn sends a release signal to the attached register-outpulser, which in response thereto causes the release of the attached translator and decoder circuits.

The timing of the translator and decoder functions is accomplished by the timing circuits previously described and included in the circuitry of the translator shown in FIGS. 44 through 53. As will be recalled, if the translator and the decoder do not complete their functions during the time intervals involved, the timing circuits will pass trouble release signals to the translator and decoder connector circuitry, which thereupon will release the attached translator and decoder and allow the register-outpuser to attempt to seize another translator-decoder pair.

Upon receiving three (no prefix) or four (with a prefix of 0 or 1) digits of the called number, the register-outpulser will request connection to a translator and a decoder by way of the translator and decoder connector circuitry of FIGS. 77 through 95. The translator preference relay in that connector operates and in turn seizes a translator, such translator **0** of FIGS. 44–53, which in turn will seize the associated decoder circuits by causing the operation in FIG. 55 of the off-normal relay ON of decoder circuit **0**. Also, when the preference relay in the translator and decoder connector circuitry operates, ground is connected to lead **1TR** extending into FIG. 54 from the connector circuitry of FIG. 95 if this was a first trial seizure by the translator and decoder connector circuitry. If this was a second trial seizure, lead **2TR** in FIG. 54 is grounded to operate relay **2TR** in FIG. 54. A second trial is made by the translator and decoder circuitry is the event that the translator and decoder used for the first trial should encounter trouble. Eventually, the multicontact relays in the translator and decoder connector circuitry operate to cut-through the leads necessary for passing information between the register-outpulser and the attached translator-decoder combination.

The decoder is arranged to handle both service and test calls. On test calls requiring decoder usage, relay TST of FIG. 54 is operated by a ground signal over conductor TST in FIG. 54 extending thereto from FIG. 61 and thence thereto from the translator-decoder connector of FIG. 85. Relay TST in FIG. 54, in operating, transfers control of the release functions to the test circuit involved. On service calls, conductor SC in FIG. 54 is grounded by the attached register-outpulser circuitry so that in the event of trouble this grounded conductor is used in FIG. 54 to give a service call indication to a trouble ticketer (not shown).

The decoder is arranged to handle three different seizure indications. These seizure indications are used by the decoder in conjunction with the code point output of the translator (see FIG. 67) to provide the proper routing for adjacent foreign area codes, interchangeable office and area codes, and for codes with an alternate route under such circumstances as when the register-outpulser has received a level busy indication from one of the selectors in the outgoing switch train. On the original attempt to set up a call conductor **0S** in FIG. 54 is grounded to cause the operation in FIG. 54 of relay **0S**. Relay **1S** in FIG. 54 is operated by a grounded conductor **1S** from the register-outpulser whenever the latter circuit reseizes the decoder after an office code has been registered on a call to an adjacent foreign area or after the conflicting code timing in the register-outpulser has resolved the conflict between an interchangeable area and office code to give a seven- or ten-digit call indication. Relay **2S** in FIG. 54 is operated by the grounding of conductor **2S** from the attached register-outpulser whenever the latter circuit reseizes the decoder after having detected a level busy indication from one of the selectors in the outgoing switch train on a call that has been indicated to the register-outpulser as having an alternate route available. It will be noted in FIG. 54 that the leads **0S**, **1S** and **2S** are extended into the trouble ticketer (not shown) to indicate the class of service in the event of a trouble condition.

The register-outpulser translates the digit registered in the A-digit position and determines whether or not the first digit involved a prefix. If the first digit is a one, then conductor **AD1** in FIG. 54 is grounded to cause the operation of relay **PF1** in FIG. 54. If the first digit is a zero, then conductor **AD0** in FIG. 54 is grounded to cause the operation of relay **PF0**. And, if the first digit is something other than a one or a zero, then the conductor NP in FIG. 54 is grounded from the attached register-outpulser circuit to cause the operation in FIG. 54 of relay NP. Under the control of the operated one of these prefix indication relays of FIG. 54 the decoder will transmit a signal to the attached translator extending from ground in FIG. 55, over a one-and-one-only check circuit of the contacts of relays **0S**, **1S** and **2S**, and thence over a one-out-of-three check circuit over contacts of the relays NP, **PF0** and PF1, to conductor X extending from FIG. 55 into FIG. 54, thence through break contact 1 of relay FAT, and thence out over conductor NPA or PFA to the attached translator circuit to give a corresponding indication of no prefix or a prefix. In the attached translator the grounding of conductor NPA from FIG. 54 will cause the operation of a no prefix relay which is used to register in the hundreds, tens and units positions of the registers in the translator the respective first three dialed digits of the called number. On the other hand, if conductor PFA of FIG. 54 is grounded onto the attached translator circuit, indicating a prefix of zero or one, then the translator causes the respective hundreds, tens and units digits registers of the translator to be activated in accordance with the respective B, C and D digits of the called number, thereby disregarding the initial prefix which will have been in the A-digit position.

If the hundreds, tens and units digits of the three-digit code to be translated are properly registered in the hundreds, tens and units relays in the attached translator then contacts of these relays will cause the grounding of one of the 810 leads extending into FIG. 67 from FIG. 51 of the attached translator. This grounded code point in FIG. 67 will correspond to the area, office or service code represented by the first three digits of the called number, exclusive of any prefix if such a prefix has been dialed.

The operation in FIG. 55 of the off-normal relay ON of the decoder causes the operation in FIG. 69 of relay TLC under control of make contact **12** of relay ON. The operation of relay TLC in turn causes the operation in an obvious manner in FIG. 69 of the four connector relays **TLC1**, **TLC2**, **TLC3** and **TLC4**. It will be noted in FIGS. 61, 62, 63 and 64 that the operation of relays **TLC1** through **TLC4** completes connections between the route series relay contacts and the conductors extending back through the translator and decoder connector circuitry to the attached register-outpulser. Prior to the operation of these relays **TLC1** through **TLC4**, the various information leads extending back toward the translator and decoder connector circuitry of FIGS. 77 through 95 are extended over break contacts of relays **TLC1** through **TLC4** to the windings of the cross detecting relays **XLT1** through **XLT3** of FIG. 69, the purpose of which will be discussed below.

Upon the operation of the off-normal relay ON of FIG. 55 and relay TLC of FIG. 69, the decoder circuitry will initiate a bid for connection to the trunk class translator circuit of FIG. 96 by placing resistance battery on conductor STO in FIG. 68 in a circuit extending from negative battery in FIG. 68, through the resistance CL, over make contact **12** of relay TLC, break contact **8** of relay CN, break contact **6** of relay CLX, thence through break contacts **6** of all of the class relays **CL0** through **CL9**, and thence over make contact **5** of the off-normal relay ON to conductor STO extending into the trunk class connector circuit of FIG. 96. As has been mentioned hereinbefore in connection with the detailed description of the trunk class connector circuit of FIG. 96, one and only one class identification can be made at any one time and thus the trunk class connector has a preference and lock-out circuit to prefer one decoder and to lock-out all other decoders until the selected decoder withdraws its bid for service. The trunk class connector passes a ground through the selected decoder on conductor **CI0** extending into FIG. 68 from the trunk class connector of FIG. 96, thence over conductor CI into FIG. 54, and thence over cable A into FIG. 64, whereupon it extends over a cable into the translator-decoder connector circuitry of FIG. 88, where it eventually finds its way to the register-outpulser circuitry and into the register, trunk and link circuit of FIG. 7 to the CI punching, thence across a strapping to one of the punchings **CL0** through **CL9**, and thence over one of the conductors **CL0** through **CL9** back through the trunk class connector circuit into FIG. 68, to battery through the winding of one of the class relays **CL0** through **CL9**. One of the relays **CL0** through **CL9** of FIG. 68 operates and thereby opens the battery start lead in the upper part of FIG. 68 to the trunk class connector circuitry, allowing the latter circuit to release. A one-up-only check on the contacts of the relays **CL0** through **CL9** completes a path for causing the operation of one of the multicontact class screening relays **CS0** through **CS9** of FIG. 68. This latter circuit extends from battery in FIG. 68, through the resistance CL and contacts of relays TLC, CN and CLX, thence through a one-and-one-only operated network of the contacts of relays **CL0** through **CL9**, and thence through make contact **10** of the operated one of relays **CL0** through **CL9**, to one of the conductors **CL0** through **CL9** extending from FIG. 68 into FIG. 73, and therein over a cross connection between punchings **CL0** through **CL9** and **CS0** through **CS9**, over the activated conductor **CS0** through **CS9** back into FIG. 68 to cause the operation of one of the screening relays **CS0** through **CS9**.



If a coin indication is received from the register-outpulser circuitry, conductor CC in FIG. 54 will be grounded and will thereupon extend into FIG. 68 to cause the operation of relay CN which thereupon opens the start lead STO in FIG. 68 to the trunk class connector by opening its back contact **8**, since a class identification is not necessary on this kind of a call. Furthermore, the operation of relay CN applies battery over its make contact **8** in FIG. 68, thence over conductor CN into FIG. 73 where punching CN may be cross connected to any one of the class screening punchings **CS0** through **CS9** depending upon which one these is reserved for coin class, and thence over the class screening lead **CS0** through **CS9** back into FIG. 68 to cause the operation in FIG. 68 of that screening relay **CS0** through **CS9** which is an indication of a coin class.

With reference to FIG. 67, a route is not necessarily identified solely by the grounding of one of the 810 code points shown therein but may require a combination of code point and class of service. The trunks are assigned classes for control of the routing and the process of combining code point and class of service to identify a route is referred to as service treatment. This service treatment is accomplished by using the class of service screening relays **CS0** through **CS9** of FIG. 68 and their associated cross connections. For instance, in the lower left-hand part of FIG. 68 are shown a number of contacts of the screening relays **CS0** through **CS9** shown interconnecting two groups of leads extending to punching circuits in the cross connecting field of FIG. 60 whereby one of the grounded code points of FIG. 67 may be connected to one of the punchings **SC00** through **SC29** of FIG. 60, and thence will extend into FIG. 68, and over a make contact of one of the operated screening relays **CS0** through **CS59**, and thence back into FIG. 60 to ground one of the code points **S000** through **S954**, which in turn can be cross connected to one of the punchings **RC00** through **RC79** to control the operation of a route relay when the so-called service treatment is required.

In FIG. 60 it will be noted that the punchings designated **RC00** through **RC79** extend into FIG. 71, thence through the windings of the corresponding route relays **R00** through **R79**, back over conductors **R00** through **R79** into FIG. 60, and thence to a corresponding set of eighty punchings which in turn are cross connectable to the punchings **RB1** through **RB4** extending into FIG. 56 where the operating battery supply for these route relays is shown. Of course it will be appreciated with reference to FIGS. 60 and 67 that a grounded one of the 810 code output leads from the translator of FIG. 51 may be cross-connected directly to one of the punchings **RC00** through **RC79** of FIG. 60 without going through the class screening process above-described with respect to the relays **CS0** through **CS9** of FIG. 68 in the event that service treatment is not required for the proper routing of a given code.

As will be appreciated, one of the route relays **R00** through R79 of FIG. 71 will be operated from a grounded code point of FIG. 67 when sufficient information is available to establish a route. With relay TSTB of FIG. 58 operated in an obvious circuit under control of make contact **4** of relay ON, upon the operation of one of the route relays **R00** through **R79** of FIG. 71, relay TSTA in FIG. 65 is operated in series with one of the relays **RA1** through RA4 in an obvious manner under control of make contact **8** of relay TSTB, a make contact of the operated route relay **R00** through **R79**, a break contact of one of the relays **GS1** through **GS4** and make contact **1** of off-normal relay ON. The operation in FIG. 65 of relay TSTA initiates the release in FIG. 58 of relay TSTB. The operation of one of the route relays **R00** through **R79** of FIG. 71 also causes the operation in FIG. 71 of one of the route supplementary relays **RS00** through **RS19** of FIG. 71 or one of the relay combinations RVT, NAR or NS, ARA to provide arbitrary digit, digit deletion and type of outpulsing information to the register-outpulser. Also, the operated route relay activates transmission leads back toward the register-outpulser to indicate which digits of the called number are actually to be used for outpulsing beyond. In the right-hand portion of FIG. 71, it will be noted that a make contact of the operated route relay extends a ground over one of the conductors **LR00** through **LR79** into FIG. 73 where a cross connection between punchings will energize one of the punchings LH or RH extending back into FIG. 71 to cause the operation of one of the relays LH and RH. Under control of the operated route relay and the operated relay LH or RH, a circuit extends from the left-hand part of FIG. 71 to one of the conductors **RT00** through **RT79** and one of the conductors **P00** through **P39** extending into FIG. 73 and thence by cross connections to cause the energization of one of the punchings **RS00** through **RS19**, RVT, NS–A, NS–N, SDR–A, et cetera through DPC–N and thence back into FIG. 71 to control the various relays **RS00** through DPC.

In addition, the operated route relay initiates a test of the appropriate trunk route to determine if any trunks are available for handling this particular call. With reference to FIG. 58, if at least one trunk is idle in the appropriate group relay TKA will be operated in a circuit extending from the right-hand side of FIG. 58 on conductor **GB00** through **GB39** (each one of which will be grounded if a trunk in the particular group represented thereby is idle), thence into FIG. 73 and over a cross connection to the assigned one of the terminals **TKA00** through **TKA79**, thence into FIG. 58 and over a make contact of the operated route relay **R00** through **R79**, thence over a break contact of the ground supply relay **GS1** through GS4, thence over break contact **3** of relay TST, break contact **8** of relay TKA, over make contact **20** of relay RH or LH, thence over break contact **8** of relay **2S**, break contact **5** of relay RAV, make contact **10** of relay RB (see FIG. 56), and thence to negative battery through the winding of relay TKA. If no trunks are idle in the appropriate trunk group, route advance takes place to an alternate route. This is initiated by the operation in FIG. 58 of relay RAV under control of off-normal ground supplied to the winding of relay RAV over make contact **8** of relay TSTA, break contact **10** of relay TKA, and break contact **7** of relay TSTB. In the event that relay TKA of FIG. 58 operates to indicate the availability of a trunk in the appropriate trunk group, relay TKB of FIG. 58 operates in a circuit extending from battery in FIG. 58, through the winding of relay TKB, conductor **CK2** extending into FIG. 69, thence through a chain of No. **5** back contacts of all of the check relays in the decoder circuitry, thence over conductor **CK1** into FIG. 58, over make contact **10** of relay TKA and make contact **8** of relay TSTA to off-normal ground. Relay TKB, in operating, locks over its own make contact **24** to off-normal ground. As will be seen hereinafter, the operation of relay TKB of FIG. 58 will allow the operation in FIGS. 61, 62, 63 and 64 of the various check relays **ARK1** through DGK in the decoder as an indication that the digit and routing information transmitted to the register-outpulser had been properly registered. These check relays become operated by the locking ground returned to the decoder from the register relays in the register-outpulser circuit.

With reference to the punching sheet of FIG. 60, it will be noted that the route relay terminals **R00** through **R79** associated with the route relays of FIG. 71 are cross-connectable to one of four terminals **RB1** through **RB4** to provide prefix screening and to supply operating battery from FIG. 56 in order to operate the route relay. The R-terminal is cross-connected to terminal **RB1** in FIG. 60 for those route relays that do not require any prefix screening, such as vacant code route, alternate routes, intercept routes, permanent signal routes, operator routes and so forth. The R terminal is cross-connected to the **RB2** terminal for those route relays which are for routes to be intercepted if a prefix one has been dialed. The R-terminal is cross-connected to the **RB3** terminal for those route relays which are for routes to be intercepted if no prefix is dialed. The R-terminal is cross-connected to the **RB4** terminal for those route relays where no prefix indicates a seven-digit route and where a prefix one indicates an area code was dialed and where reroute to a route relay for the ten-digit route is required. The contact configuration shown for the route relay battery supply of FIG. 56 will indicate the manner of this prefix screening. For instance conductor **RB1** in FIG. 56 is connected directly to the winding of relay RB and is under control of none of the prefix screening relays NP, **PF1** and **PF0** of FIG. 54. It will also be noted in FIG. 56 that conductor **RB2**, if grounded from FIG. 60, will cause the operation of relay RB for no prefix or for a prefix zero and will cause the operation of the intercept relay INT only in the event that the prefix is a one. On the other hand, if conductor **RB3** in FIG. 56 is grounded from the corresponding terminal of FIG. 60, it will be appreciated that this particular route is to be intercepted only in the event that no prefix has been dialed. Lastly, it will be noted that conductor **RB4** will cause the operation of the reroute relay RR in the event that a prefix one has been dialed.

Four ground supplies are provided for the route relays represented by the ground supply relays **GS1** through **GS4** of FIG. 72. It will be noted in various of the circuits of the decoder such as in FIGS. 71 and 65 that front and back contacts of these relays **GS1** through **GS4** are used to control the ground supply to four separate groups of route relays. In general, the first and second ground supplies **GS1** and **GS2** are for direct or preferred routes, the third ground supply **GS3** is generally for alternate routes and the fourth ground supply **GS4** is for final routes such as tone or announcement trunks, intercept et cetera.

When alternate routes are provided the decoder will have this information and will route advance to the alternate route when the preferred route is busy. The decoder checks to determine whether an idle trunk is available in the preferred route before sending routing information to the register-outpulser. If all trunks are busy, the decoder route advances to the alternate route and sends this information to the register-outpulser. When all of the trunks in the trunk group associated with the operated route relay are busy, as has been mentioned hereinbefore, relay TKA of FIG. 58 does not operate. The operated route relay causes the operation, as has been mentioned, of relay TSTA in FIG. 65 in series with one of the relays **RA1** through RA4. Then, when relay TSTB of FIG. 58 releases, with relay TKA of FIG. 58 unoperated, a path is closed in FIG. 58 as has been described previously, to cause the operation of the route advance relay RAV. With one of the relays **RA1** through RA4 of FIG. 65 operated and with relay RAV of FIG. 58 operated, the ground supply relay **GS1** through **GS4** of FIG. 72 associated with the particular operated route relay will become operated to open the ground supply to all of the contacts of that particular operated route relay. The operation of the ground supply relay GS1 through GS4 of FIG. 72 allows the release in FIG. 65 of relay TSTA, thereby causing the reoperation in FIG. 58 of relay TSTB and the release of relay RAV, which in turn will cause the release in FIG. 65 of the operated relay RA1 through RA4. The release of relays RAV of FIG. 58 and RA1 through RA4 of FIG. 65, with the route relay and the ground supply relay GS1 through GS4 of FIG. 72 operated, causes the grounding in FIG. 65 of a particular terminal RA00 through RA79 in an obvious manner. In FIG. 60 the grounded terminal RA00 through RA79 will be cross-connected to one of the route relay punchings RC00 through RC79 to cause the operation of a route relay in a righer numbered ground supply in order to ascertain the alternate route. The routing information relating to this new operated route relay for the alternate route is then transmitted to the attached register-outpulser. The decoder will now have two route relays operated; but, the information from the route relay in the lower numbered ground supply is made ineffective because of the operation of the associated ground supply relay GS1 through GS4 of FIG. 72. Wherever the decoder route advances it operates the ground supply relay for the route relay to be advanced away from, thereby eliminating the transmission of the routing information for that particular busy route.

The route relay for a seven- or a ten-digit route requiring no controlled outpulsing will have its terminal RT00 through RT79 (see FIG. 73) cross-connected to punching NS–A in FIG. 73 if an alternate route is available and will be connected to punching NS–N in FIG. 73 if no alternate route is availble. When the trunk availability check is made (relays TKA and TKB of FIG. 58 are operated to indicate availability of a trunk), relay NS of FIG. 71 will be operated in series with one of the relays NAR (no alternate route available) and ARA (alternate route available). Upon the operation of relay N, ground is supplied in FIG. 64 over make contact **10** of relay NS, through diode K27, through the winding of relay PKC, to resistance battery over make contact **14** of relay TKB, thereby operating the PCK check relay which locks to ground over its own make contact **10**. If relay ARA of FIG. 71 is operated it completes a circuit for causing the operation of FIG. 64 of the check relay ARAK. This circuit extends from ground in the upper right-hand part of FIG. 64, through resistance GB, through diode K32, over make contact **10** of relay ARA, break contact **8** of relay AR, and thence over the conductor ARA, through the translator and decoder connector circuitry to cause the operation in the attached register-outpulser of a corresponding register relay, which thereupon will lock and will return locking ground over conductor ARA into FIG. 64 which will thereupon extend through diode K31 and the winding of relay ARAK to resistance battery under control of make contact **16** of relay TKB. Relay ARAK thereupon operates in this circuit and locks under control of its own make contact **10** to ground. If relay NAR of FIG. 71 is operated it will simulate the return of locking ground from the register-outpulser circuit by applying in FIG. 64 ground over its make contact **11** directly to the lower electrode of diode K31 to cause the operation of relay ARAK. Furthermore, in FIG. 64 the conductor DE00 through DE79, carrying a potential supplied at the upper winding of relay DGK (somewhere between ground and negative battery) under control of the operated route relay, extends into FIG. 66 where the energized terminal will be cross-connected to the 7DG or 10DG punching as the case may be. The energized lead 7DG or 10 DG is returned to FIG. 64, thence over make contact **10** or **11** of relay TLC4, conductor A or C into FIG. 69, and thence over conductor 7DG or 10DG back into FIG. 64 and to the attached register-outpulser circuit. The appropriate relay will thereupon be operated in the register-outpulser and will return locking ground over these conductors such as will cause the operation in FIG. 64 of the check relay DGK. With reference to FIG. 69 it will be noted, upon the operation of relays PCK, ARAK and DGK of FIG. 64 and relay NS of FIG. 71, that a circuit is completed for sending a release signal to the associated translator. This circuit extends from off-normal ground in FIG. 69, over break contact **5** of relay CAK, break contact **8** of relay LFA, make contacts **2** of relays ARAK, PCK and DGK, and thence over make contact **6** of relay NS and over break contact **2** of relay TST to the release conductor RL extending to the associated translator circuit.

The route relay for a seven-or a ten-digit route which does require controlled outpulsing will have its terminal RT00 through RT79 of FIG. 71 cross-connected (see FIG. 73) to one of the terminals RS00 through RS19 to cause the operation in FIG. 71 of one of the relays RS00 through RS19. In addition, the LR00 through LR79 conductor (see FIG. 71) of the associated route relay will be cross-connected (see FIG. 73) to an LH or an RH terminal to thereby cause the operation in FIG. 71 of relay LH or RH. The operation of the route supplementary relay RS00 through RS19 of FIG. 71 and one of the relays LH and RH causes the energization of one of the conductors P00 through P39 in the lower left-hand corner of FIG. 71 which in turn is cross-connected (see FIG. 73) to one of the terminals SDR–A through DPC–N to in turn cause the operation in FIG. 71 of one of the relays SDR, SG and DPC in series with one of the relays NAR and ARA to supply the following items of information: (1) the number of arbitrary digits to be used for outpulsing up to a maximum of six digits including the exit digits and the KP signal used to precede the multifrequency outpulsing beyond, (2) the number of digits to be deleted which can be either 0, 1, 2, 3, 6 or all digits, (3) the type of outpulsing which can be step-by-step type dial pulsing with no "STOP-GO" trunk signaling condition, or dial pulsing with "STOP-GO," or multifrequency outpulsing, and (4) whether or not an alternate route is available.

With respect to the actual transmission of up to six arbitrary digits of information from the decoder to the register-outpulser, as represented in FIGS. 61, 62 and 63 by the respective groups of conductors AR0 through AR7, BR0 through BR10, CR0 through CR10, DR0 through DR10, ER0 through ER7 and FR0 through FR7, it will be noted that the B, C and D digit positions include leads designated BR10, CR10 or DR10. In the event of the necessity of multifrequency outpulsing beyond, it will be required that one of these three digit positions include the so-called KP multifrequency pulse signal comprising the energization of conductors BR2 and BR10 or CR2 and CR10 or DR2 and DR10. On the other hand, in the event that dial pulsing outgoing is required, but that a "STOP-GO" operation is expected, all of these digit positions will necessarily contain on a two-out-of-five coding basis a digital indication which will not involve the use of the leads BR10, CR10 and DR10. However, in the event of a expected "STOP-GO" condition under these circumstances, a cross-connection can be made in FIG. 59 in order to energize the terminal BR10 or in FIG. 66 of CR10 or DR10 in addition to the usual two-out-of-five indication in order to indicate to the register-outpulser where the "STOP-GO" condition is expected. It will be noted in FIGS. 59 and 66, with respect to the cross-connections between the ARA- and AR0 through **7** terminals under control of the operation in FIG. 61 of the route relays, that the A digit arbitrary position for exit outpulsing will require in FIG. 59 two cross connections, one from the ARA00 through ARA39 and one from the ARB00 through ARB39 terminals to two separate ones of the terminals AR0 through AR7 to provide the exit digit information on a two-out-of-five basis. With respect to the B digit translation of FIG. 59, in addition to cross-connecting two strappings to designate the two-out-of-five dial pulse digit, one of these two strappings will be duplicated to energize the conductor **BR10** if a "STOP-GO" condition is expected on the use of the **B** exit digit. This same proposition applies in FIG. 66 with respect to the C and D digits whereby the terminal **CR10** or **DR10** can be cross-connected to give an additional indication over and above the usual two-out-of-five coding.

With the advent of interchangeable area and office codes, means are required in the decoder to differentiate between the area code and the office for routing control. Where it is required that the area code be prefixed by a prefix one and the office code not be prefixed, the decoder is arranged to differentiate between the two routings by means of prefix screening on the route battery supply circuitry of FIG. 56. If the presence or absence of a prefix cannot be used to determine whether the ten-digit routing or the seven-digit routing is required when an interchangeable area and office code is dialed, then the conflict must be resolved by the conflicting code timing circuitry in the attached register-outpulser circuit. When prefix screening is used for routing control, the energized code point in FIG. 67 is cross-connected into FIG. 60 to the RC-terminal for a route relay in ground supply **1**, such as one of the route relays **R00** through **R19** of FIG. 71. In FIG. 60 the R-terminal (terminals **R00** through **R19**) for this route relay is cross-connected to terminal **RB4** which extends into FIG. 56 to the route relay battery supply circuit. If no prefix is dialed relay NP of FIG. 54 will be operated whereby the energized conductor **RB4** in FIG. 56 will cause the operation of relay RB in the battery supply circuit. When the trunk available check is made, the operated route relay in ground supply **1** transmits the information for the seven-digit routing to the attached register-outpulser. If a prefix one is dialed the relay **PF1** of FIG. 54 will be operated, thereby connecting the energized conductor **RB4** in FIG. 56 through the upper winding of relay RR to negative battery, whereupon relay RR operates in series with the route relay. The operation of relay RR causes the operation in FIG. 72 in an obvious manner of the ground supply relay **GS1** which, upon operating, locks over its own make contact **8** to off-normal ground. Relay **GS1**, in operating, removes energizing potential from the various terminals of the cross connecting field in FIGS. 59, 60, 66, 67 and 73 whereby the operated route relay in ground supply **1** would have transmitted information to the attached register-outpulser. The operation of the ground supply relay **GS1** of FIG. 72 closes a circuit shown in FIG. 65 under control of make contacts **4** of route relays **R00** through **R14** to energize one of the terminals **RR00** through **RR19** of FIG. 67, which will be cross-connected into FIG. 60 to one of the RC-terminals for a route relay identifying the ten-digit routing, but to such a relay in ground supply **2** such as one of the terminals **RC20** through **RC39**. The R-terminal such as **R20** of FIG. 60 would of course be cross-connected to terminal **RB2** into FIG. 56 since this particular route relay would be assigned to ground supply **2**. The second route relay will operate and when the trunk available check is made, the information for the ten-digit route identified by the latter operated route relay will be transmitted to the attached register-outpulser circuit. As mentioned above, if the presence or absence of the prefix 1 cannot be used to differentiate between interchangeable ten and seven-digit code routings, the conflict must be resolved by the conflicting code timing circuit of the register-outpulser. If the same route is used for the seven-digit and for the ten-digit code, the route relay contacts are cross-connected to transmit the routing and pulsing information and the DE terminal shown on FIG. 66 would be cross-connected therein to terminal CCT, thereby to cause a registration in the attached register-outpulser circuit of this CCT condition. The CCT indication means that an interchangeable area and office code was dialed but that the decoder cannot resolve the situation; and, this CCT mark causes the register-outpulser to activate its conflicting code timing circuit. If an eighth digit (exclusive of any prefix) is received by the register-outpulser, the decoder will not be recalled since the routing and pulsing information would be valid for both the seven-digit and the ten-digit route. As mentioned above, if the ten-digit route requires a different route than the seven-digit code, the code point for the interchangeable area (such as one of the **810** punchings in FIG. 67) will be cross-connected to the RC-punching of FIG. 60 corresponding to a route relay in the first ground supply such as one of the route relays **R00** through **R19** of FIG. 71. The contacts of this route relay are cross-connected to transmit the routing and pulsing information for the seven-digit route and the DE-terminal in FIG. 66 for this route relay is cross-connected to terminal CCT extending into FIG. 64 and thence into the attached register-outpulser circuit. In FIG. 67, the RR-terminal for the route relay in ground supply **1** is cross connected into FIG. 60 to the RC-terminal of the route relay in ground supply **2** which would supply the necessary ten-digit route if needed. If the register-outpulser receives an eighth digit (exclusive of any prefix), the register-outpulser will reseize the decoder and will provide thereto a **1S** indication by causing the operation in FIG. 54 of relay **1S** in the decoder; and, in FIG. 69, upon seizing the decoder, the register-outpulser will cause the operation of relays **10D** and CC by virtue of the fact that these indications will have been recorded in the register-outpulser on the previous seizure of the decoder when the conflicting code could not be resolved. Now, when the route relay in ground supply **1** operates, the circuitry of FIG. 65 will cause the grounding of one of the RR-terminals associated with that ground supply because the ground supply relay **GS1** of FIG. 72 will have been operated at the time that relay RR of FIG. 56 operated, which in turn was operated upon decoder seizure with relays **1S**, CC and **10D** operated. In FIG. 67, the energized RR-terminal for the route relay of ground supply **1** will now cause the operation of the ten-digit route relay in ground supply **2**, whereupon the information for this route is transmitted into the register-outpulser and is thereafter used to control the establishment of the ten-digit route.



The route relay for a reverting route will have its RT-terminal of FIG. 73 cross-connected to terminal RVT, thereby to cause the operation in FIG. 71 of relays RVT and NAR. The RVT indication is passed to the register-outpulser and the locking ground is checked by relay PCK in FIG. 64. The DE-terminal of the operated route relay is cross-connected in FIG. 66 to terminal **4DG** or **5DG** to indicate to the register whether to expect four or five digits.

The code point for an adjacent foreign area for which a foreign area translator is provided in cross-connected in FIG. 67 to one of the punchings **FA0** through **FA4**, thereby to cause the operation in FIG. 56 of one of the relays **FA0** through **FA4** identifying the particular foreign area translator which needs to be consulted for additional routing instructions. In FIG. 56, upon the operation of one of the FA-relays, a circuit is completed from off-normal (lead ON) ground in FIG. 56, over a one-only operated circuit of the contacts of the FA-relays, thence through back contact **4** of relay LFA, through resistance **G9**, through diode **K34**, and over conductor **CA6** into FIG. 54, thence over cable A into FIG. 64, and to the attached register-outpulser by way of the translator and decoder connector circuitry of FIG. 88. This causes the operation in the attached register-outpulser of a **CA6** relay to indicate that the register-outpulser is to recall the decoder after it has received six digits exclusive of any prefix. The locking ground returned from the register-outpulser over the **CA6** conductor returns into

FIG. 56 and thence through diode K33 and the winding of relay CAK to operate the latter relay as a check that the register-outpulser has received the indication. in FIG. 69, upon the operation of relay CAK of FIG. 66 and upon the previous operation of relay OS of FIG. 54 incident to the original register-outpulser seizure of the decoder, a circuit is completed from ground over make contact **7** of relay ON, make contact **4** of relay CAK, make contact **6** of relay OS, break contact **7** of relay LFA, and break contact **2** of relay TST to the release conductor RL extending into the associated translator circuit, thereby to cause the eventual release of the decoder circuit. When the register-outpulser recalls the decoder after three more digits have been received, the leads CA**6** into FIG. 56 and 1S into FIG. 54 are grounded, thereby to cause the operation of relays CAK in FIG. 56 and 1S in FIG. 54. Relay LFA in FIG. 56 thereupon operates in a circuit extending from battery, through its winding, over break contact **6** of relay LFA, make contact **12** of relay 1S, make contact **2** of relay CAK, and thence over break contacts of all of the FA-relays to off-normal ground on conductor ON. Relay LFA, in operating, locks operated over its own make contact **6**, prepares a locking circuit over its make contact **12** in the upper left-hand part of FIG. 56 for the FA-relay when it operates, and prepares a circuit in the upper right-hand corner of FIG. 56 over its make contact **4** to cause the operation of relay FAT at such time as one of the relays FA**0** through FA4 of FIG. 56 becomes operated. When the code point in FIG. 67 is grounded, one of the relays FA**0** through FA4 of FIG. 56 operates and locks to in turn cause the operation in an obvious manner of relay FAT in FIG. 56. The operation of relay FAT in FIG. 56, by virtue of its transfer contacts **1** shown in FIG. 54, causes the deenergization of the conductor NPA or PFA extending into the attached translator, thereby to cause the release in the translator of the connector relays for the first three digits which have been registered in the associated translator. The register relays in the translator thereupon release and when the units digit register in the translator is released an indication is supplied to the decoder by the grounding of the conductor UDK in FIG. 55. Ground on conductor UDK in FIG. 55, causes the operation of the units down check relay UDK in an obvious manner and which, upon operating, locks over its own make contact **9** to off-normal ground. The operation of relay UDK completes a circuit in FIG. 54 from ground on conductor X, over make contact **1** of relay FAT and make contact **8** of relay UDK to one of the conductors PFB and NPB depending upon the prefix indication as determined by which one of the relays PF**0**, PF**1** and NP of FIG. 54 is operated. In the associated translator circuit, the energization of one of these conductors PFB and NPB in FIG. 54 causes the digit connector for the next three digits to operate, thereby to register in the hundreds, tens and units digit registers of the associated translator (see FIG. 46) of the fouth, fifth and sixth digits of the six-digit code. Also, upon the operation of relay UDK of FIG. 55, a circuit is completed in FIG. 56 from negative battery, through resistance B**9**, over make contact **12** of relay UDK, make contact **4** of relay FAT, and thence over the make contact of the operated one of the relays FA**0** through FA4 to energize one of the conductors FAT0 through FAT4 extending into the foreign area translator circuit to cause the seizure thereof. Thereupon, the code point for the office code in the foreign area is grounded to operate a route relay over one of the leads FAR**000** through FAR**429** in the cross-connecting field of FIG. 60. The operated route and route supplementary relays, which are operated by virtue of the cross-connection of one of these FAR-terminals of FIG. 60 to one of the RC-terminals, et cetera, results in the transmission back to the register-outpulser of the necessary routing instructions. When the locking grounds are returned to the decoder circuit from the register-outpulser the decoder releases.

When all of the information for a route has been transmitted to the register-outpulser, the locking grounds returned therefrom operate the various check relays of FIGS. 61, 62, 63 and 64, et cetera. If no information is transmitted over a family of leads a local decoder ground will operate the check relays, such as make contact **10** of relay NS in FIG. 64 regarding check relay PCK. The latter indication arises under those circumstances where calls do not require controlled outpulsing so that the make contact of relay NS will bypass the usual checking circuits. When all of the proper check relays are operated, as shown in FIG. 69 conductor RL extending to the associated translator circuit will be grounded to operate a release relay in the translator, the release thereof in turn operating a release relay in the register-outpulser circuit, which in turn causes the release of the connections between the register-outpulser and the translator-decoder pair through the translator and decoder connector of FIGS. 77 through 95. This, in turn, will cause the release of the associated translator part of the connector. When the back contact chains on the decoder and translator preference relays in the connector circuitry of FIGS. 77 through 95 are closed, then relay operations previously described take place in the translator to cause the release of the off-normal relay thereof. The release of the off-normal relay in the translator causes the release of the off-normal relay ON in FIG. 55 of the decoder and of the release relay in the translator. The translator and the decoder are thereupon returned to normal.

The decoder is equipped with trouble detecting devices which if operated can cause a trouble ticketer (not shown) to be seized for the purpose of printing a trouble ticket. These trouble detecting devices are of the following types: (a) cross check relays in the decoder and its associated translator circuit and (b) registration checks in the decoder and its associated translator circuit. Relays XTL**1**, XTL**2** and XTL**3** of FIG. 69 and relay CLX of FIG. 68 are typical cross check relays in the decoder. Relay XTL**1** checks for false grounds on the A, B and C arbitrary digit leads extending to the register-outpulser from FIGS. 61 and 62. The XTL**2** relay checks for false grounds on the D, E and F digit leads extending to the register-outpulser from FIGS. 62 and 63. Relay XTL**3** checks for false grounds on the miscellaneous information leads extending to the register-outpulser from FIG. 64. It will be noted that each one of the information leads, such as in FIG. 61, is connected in series with a break contact of the connector relay (such as relay TLC**1**) to conductor XTL**1** extending from FIG. 61 and into FIG. 62 and thence into FIG. 69 through break contact **3** of relay COX to battery through the winding of relay XTL**1**. In this way all of the leads are continuously checked for false grounds while the circuit is normal. Should any lead become grounded, the associated XTL-relay will become operated, to in turn cause the operation in FIG. 70 of relay TS in an obvious circuit under control of a make contact of one of the XTL-relays. The operation of relay TS in FIG. 70 will cause the seizure of a trouble ticketer (not shown). When the trouble ticketer registration is complete, relay COX of FIG. 69 will be operated by a signal from the associated translator over conductor COX in FIG. 69. Relay COX, in operating, locks over its own make contact **2** in FIG. 69 and over conductor AR into FIG. 57 to ground under control of the alarm release key AR in the miscellaneous circuit. The operation of relay COX opens the operate paths in FIG. 69 of all of the XTL-relays, which nevertheless are locked under control of their own make contacts **8** to the same alarm release key AR in FIG. 57. The operation of the alarm release key AR of FIG. 57 will of course cause the release of relays XTL– and COX of FIG. 69. Relay CLX of FIG. 68 in a like fashion continuously checks for possible cross conditions in the class indicating circuit comprising the contact arrangement of relays CL0 through CL9 of FIG. 68.

In the trouble ticketer seizure and control circuit of FIG. 70, relay TS, in operating, indicates that a trouble ticket should be printed. Operation of relay TS completes a circuit in the upper portion of FIG. 70 whereby negative battery is extended through a resistance over break contact **7** of relay TB, through break contact **9** of relay **TT1** or make contact **1** of relay TT, and thence through make contact **12** of relay TS to a conductor TS– leading to the trouble ticketer circuit to cause the seizure thereof. The operation of relay TS also completes a circuit in FIG. 70 for causing the operation of relay TT in a circuit extending from ground in FIG. 70, over break contact **8** of relay COX, make contact **6** of the operated XTL-relay, thence over make contact **6** of relay TS, over conductor TS into the associated translator where it will be returned therefrom over conductor TR into FIG. 70, and thence over break contact **4** of relay TB and break contact **11** of relay **TT1** to battery through the winding of relay TT. Relay TT, in operating, completes a circuit for causing the operation in FIG. 70 of relay TT1 under control of make contact **11** of relay TS, make contact **2** of relay TT and break contact **8** of relay **TT1**, the latter relay operating and locking over its own make contact **8** to ground under control of make contact **11** of relay TS. The operation of relay **TT1** starts the release of relay TT. If the trouble ticketer complete signal is not received before relay TT releases a major alarm will be sounded, the decoder is trouble released, and the start battery to the trouble ticketer may be withdrawn. The start battery on the TS– lead in FIG. 70 toward the trouble ticketer (not shown) causes the operation in the trouble ticketer of a decoder preference relay. When the trouble ticketer connector relays operate to interconnect leads between the decoder and the trouble ticketer, ground on conductor TCK in FIG. 70 from the trouble ticketer will cause the operation of relay TCK to indicate that the decoder has connected to the ticketer. When the trouble ticketer registration is complete, lead TB in FIG. 70 from the trouble ticketer is grounded to cause the operation of relay TB in FIG. 70. The trouble ticket is printed, during which time the trouble ticket remains busy to all other circuits. When relay TB of FIG. 70 operates, conductor TR extending from FIG. 70 towards the associated translator is grounded under control of make contact **4** of relay TB, thereby to cause a trouble release of the decoder and its associated translator circuit. In the event that the trouble ticketer should be busy when relay TS of FIG. 70 operates in an attempt to seize the trouble ticketer, relay TB will be operated immediately, thereby to cause the immediate grounding of conductor TR toward the associated translator to cause a trouble release. Also, a circuit is completed in FIG. 70 for causing the operation of relay DL extending from ground in FIG. 70, over make contact **9** of relay TS, break contact **8** of relay TCK, make contact **8** of relay TB, through the winding of relay DL, and thence to negative battery in the jack, key and lamp circuit. Relay DL locks over its own make contact **1** to ground and provides (not shown) an indication in the jack, key and lamp circuit that a display has been lost.

Test calls originated by an automatic test circuit or by a manual test circuit may be used to test the decoder. These calls are handled, with minor exceptions, by the decoder in the same manner as service calls. The test circuit gains access to the decoder through the translator and decoder connector circuitry of FIGS. 77 through 95 and through the associated register-outpulser of FIGS. 8 through 39. In this way the register-outpulser can prime the decoder with the required information. The information passed by the register-outpulser to the decoder is the same as for a service call except that conductor TST in FIG. 54 is grounded instead of conductor SC, thereby causing the operation in FIG. 54 of relay TST. The operation of relay TST merely modifies various circuits throughout the decoder for the particular test condition desired.



As an example of how the decoder cross-connections and circuit functions operate in light of the example used in describing the feature circuitry of FIGS. 1C through 1N, 1P through 1Z and 1AA through 1AC, it will be recalled that the called number dialed into the machine by the calling party was the seven-digit number 243–0123 and that no prefix digit was dialed. And, although in discussing the circuitry associated with the register trunk and link circuit of FIG. 1F it was assumed that the calling trunk had a class of CL**0**, it will be assumed as shown in FIG. 7 that a cross-connection exists between the CI punching and the CL**9** punching, thereby indicating that the particular trunk circuit handling this calling condition has a class of CL**9**. It will also be recalled, as a result of injecting this called number into the register-outpulser of FIGS. 8 through 39, that a decoder and translator combination will become attached and will return routing information to the register-outpulser. The outgoing switch train, which will have been put into motion by virtue of the first one or two or three digits of the called number (the 243 of the number 243–0123), will be released. Three arbitrary exit digits **238** will be required to be outpulsed on a dial-pulse basis to control the first, second and third selectors of the outgoing switch train in order to effect seizure of a proper trunk in accordance with the routing instructions. Upon trunk seizure, a "STOP-GO" signaling condition will be expected on the trunk. When a GO condition is received, the register-outpulser will switch to multifrequency (MF) signaling and will thereupon delete the first three digits of the called number and will outpulse the KP pulse followed by the four numericals **0123** and end up with the ST multifrequency signal. Since no prefix digit is involved, relay NP of FIG. 54 will be operated; and, since it will be assumed that this is the first seizure of the decoder for this particular job, relay OS of FIG. 54 will be operated. The operated relays OS and NP of FIG. 54 will cause the grounding in FIG. 54 of conductor NPA leading back to the associated translator circuit. The trunk class information CL**9** will be passed into FIG. 68 to cause the operation of relay CL**9** of FIG. 68, which in turn will be assumed to have its punching CL**9** of FIG. 73 cross-connected to class-of-service punching CS**0** of FIG. 73, thereby to cause the operation in FIG. 68 of the class screening relay CS**0**. The first three digits of the called number **243** will cause the energization in FIG. 67 of the corresponding punching designated **243** (not shown). Punching **243** of FIG. 67 will be cross-connected to service screening punching SC**00** of FIG. 60, thence over a make contact of relay CS**0** in FIG. 68 to conductor S**000** extending back into FIG. 60 to punching S**000**, which it will be assumed is cross-connected to punching RC**00**, thereby extending the ground into FIG. 71 and through the winding of route relay R**00**, back over conductor R**00** into FIG. 60 where it will be assumed that punching R**00** is cross-connected to punching RB1 designating ground supply No. **1**. The grounded punching RB1 in FIG. 60 extends this ground into FIG. 56 and thence to battery through the winding of relay RB, which will operate in series with the route relay R**00** of FIG. 71. In FIG. 58, the particular trunk group involved is tested by virtue of conductor GB**00** extending into FIG. 73 and therein over a cross-connection between punchings GB**00** and TKA**00**, thence over conductor TKA**00** into FIG. 58, over make contact **7** of route relay R**00**, back contact **4** of ground supply relay GS**1**, back contact **3** of relay TST, back contact **8** of relay TKA, break contact **3** of relay SLB, break contact **8** of relay **2S**, break contact **5** of relay RAV, make contact **10** of relay RB, to negative battery through the winding of relay TKA which, in operating, causes the operation in FIG. 58 of relay TKB. In the meantime, relays TSTA and RA1 of FIG. 65 will have become operated. In FIG. 71, conductor RT**00** will be grounded into FIG. 73 wherein punching RT**00** will be cross-connected to punching RS**00** extending back into FIG. 71 to cause the operation of the route series relay RS**00**. Also in FIG. 71, conductor LR**00** will be grounded into FIG. 73 wherein punching LR**00** will be cross-connected to punching LH, thereby to cause the operation in FIG. 71 of relay LH. Furthermore, conductor P**00** in FIG. 71 will become grounded into FIG. 73 where it will be assumed that punching P**00** is cross-connected to punching SG–A, which returns this ground into FIG. 71, through the upper winding of relay SG and to negative battery through the winding of relay ARA. Relays SG and ARA, in operating, will indicate that this call is a controlled-outpulsing call expecting a "STOP-GO" signaling condition on the seized trunk and a call with respect to which an alternate route is available.

The information to be transmitted from the decoder circuitry to the attached register-outpulser consists of (1) the arbitrary A, B and C exit digits 238 from FIGS. 61 and 62, (2) the KP pulse from the D digit position of FIG. 62, (3) no information from the E and F digit positions of FIG. 63, (4) a DL3 signal (delete three digits when outpulsing beyond) from FIG. 64, (5) an SG signal (controlled outpulsing with dial-pulse exit digits switching to MF signaling and except a "STOP-GO" condition on trunk seizure) from FIG. 64, (6) a 7DG signal (seven digits in the called number) from FIG. 64 and (7) an ARA signal (alternate route available) from FIG. 64. As has been mentioned hereinbefore, it will be noted in FIG. 69 that a circuit will be completed through the make contacts **2** of all of the check relays of FIGS. 61, 62, 63 and 64 when all of the information has been transmitted to the register-outpulser, thereby to apply ground potential in FIG. 69 to the release conductor RL extending into the associated translator. The A arbitrary digit of 2 is transmitted and checked by the check relays ARK**1** and ARK**2** of FIG. 61. In FIG. 61 it will be noted that a potentiometer arrangement exists from ground potential, through resistance G**1** and through make contacts **1** and **2** of relay PKB, thence through resistance B**1** to negative battery, thereby placing the upper terminal of the windings of relays ARK1 and ARK2 at a potential somewhere between negative battery and ground, such for instance as about −10 volts. In the bottom of FIG. 61, the conductors AR**0** through AR**7** extending toward the attached register-outpulser eventually complete paths in the register-outpulser through the windings of two relays to negative battery; and, the register-outpulser circuit is so arranged that upon the operation of two of these relays they will lock over their own make contacts to ground, thereby returning ground potential back to FIG. 61 over the respective conductors AR**0** through AR**7**. In FIG. 61, a circuit is completed for causing the operation in the attached register-outpulser of one of the two-out-of-five arbitrary digit registers extending from approximately −10 volts on the upper winding of relay ARK**1**, thence through diode K**2**, over make contact **1** of relay LH, thence over make contact **30** of relay RS**00**, conductor ARA**20** extending into FIG. 59 where punching ARA**20** will be cross-connected to punching AR**0**, thereby over conductor AR**0** back into FIG. 61, over make contact **1** of relay TLC**1**, to conductor AR**0** extending into the attached register-outpulser circuit. Another circuit extends from FIG. 61 from approximately −10 volt potential at the upper winding of relay ARK**2**, thence over diode K**4**, make contact **2** of relay LH, make contact **40** of relay RS**00**, conductor ARB**20** into FIG. 69 where punching ARB**20** will be cross-connected to punching AR**2**, thence over conductor AR**2** back into FIG. 61 and over make contact **3** of relay TLC**1** to conductor AR**2**. Conductors AR**0** and AR**2** of FIG. 61, being energized into the attached register-outpulser circuitry, extend therein through the windings of two corresponding relays to negative battery, thereby causing the operation of these two relays and the return into FIG. 61 over the conductors AR**0** and AR**2** of the locking ground potential from the register-outpulser. The return of these two locking grounds into FIG. 61 will cause the operation of the two arbitrary A-digit checking relays ARK**1** and ARK**2**, the circuit for relay ARK**1**, for instance, extending from ground on conductor AR**0** in FIG. 61, through make contact **1** of relay TLC**1**, conductor AR**0**, through the cross-connection of FIG. 59 to conductor ARA**20** into FIG. 61, through make contact **30** of relay RS**00**, make contact **1** of relay LH, thence through diode K**1**, and to minus 10 volts through the winding of relay ARK**1**. Relay ARK**1** operates and locks to ground over its own make contact **10**. Similarly, the check relay ARK**2** of FIG. 61 will become operated and locked. Likewise, the B arbitrary digit of 3 will be transmitted from FIG. 61 to the attached register-outpulser circuit under control of make contacts **3** and **4** of relay LH, make contacts **50** and **31** of relay RS**00** and the cross-connections in FIG. 59 where punchings BRA**20** and BRB**20** are cross-connected to respective punchings BR**1** and BR**2**. The B checking relays BRK**1** and BRK**2** of FIG. 61 operate on the locking grounds returned from the attached register-outpulser circuit. Similarly, the C arbitrary digit of 8 will be transmitted from conductors CR**1** and CR**7** of FIG. 62 extending to the attached register-outpulser circuit (punchings CRA**20** and CRB**20** of FIG. 66 being cross-connected to respective punchings CR**1** and CR**7**); and, the C-digit check relays CRK**1** and CRK**2** of FIG. 62 will operate on the locking grounds returned from the attached register-outpulser. The D arbitrary digit position will contain the KP pulse made up of the energized conductors DR**2** and DR**10** extending from FIG. 62 into the attached register-outpulser (punchings DRA**20** and DRB**20** of FIG. 66 being cross-connected to respective punchings DR**2** and DR**10**), the D-digit checking relays DRK**1** and DRK**2** of FIG. 62 operating on the locking grounds returned from the attached register-outpulser. No digital information is transmitted to the attached register-outpulser with respect to the E and F arbitrary digit positions, as indicated by the cross-connection in FIG. 66 of punchings ERA**20** and ERB**20** to punching NER and of punchings FRA**20** and FRB**20** to punching NFR. In FIG. 63 conductors NER and NFR, extending thereto from the cross-connections of FIG. 66, being grounded cause the operation of the E and F checking relays ERK**1**, ERK**2**, FRK**1** and FRK**2** of FIG. 63. In FIG. 64, conductor LD**3** extending toward the attached register-outpulser is energized under control of punching DD**20** of FIG. 66 being cross-connected to punching DL**3**, the locking ground returned from the register-outpulser causing the operation in FIG. 64 of the checking relay DLK. Similarly, the checking relay PCK of FIG. 64 is operated on the locking ground returned from the attached register-outpulser when the SG lead extending thereto from FIG. 64 is energized by make contact **10** of relay SG. The **7**DG signal, applied to the corresponding lead in FIG. 64 toward the attached register-outpulser (under control of cross-connection DE**00** in FIG. 66 being cross-connected to punching **7**DG), causes the operation in the associated register-outpulser of the seven-digit called number registration; and, the locking ground returned over this lead causes the operation in FIG. 64 of the check relay DGK. Lastly, the alternate route available signal applied to conductor ARA in FIG. 64 toward the attached register-outpulser causes the registration therein of this information; and, the locking ground returned over this lead causes the operation in FIG. 64 of the checking relay ARK**1**. The operation of all of these various check relays of FIGS. 61, 62, 63 and 64, indicating that all of the information has properly beeng transmitted to the attached register-outpulser, completes the check path in the upper part of FIG. 69 whereby ground potential is applied to the release conductor RL extending to the attached translator circuit. This release signal, as has been mentioned hereinbefore, causes the ultimate release of the attached translator and decoder circuits and enables the register-outpulser to proceed to control the outgoing switch train to complete the call.

### *Register-outpulser* (*FIGS. 8–39*)

It will be noted with reference to the block diagram of FIG. 1A that fifteen groups of register-outpulsers are provided, each group containing a maximum of twenty register-outpulsers. The detailed circuitry of only one such register-outpulser, namely register-outpulser No. **0**, is disclosed in FIGS. 8 through 39 since the circuitry of the remaining **299** register-outpulsers is the same. In FIG. 1A it is shown that the fifteen groups of register-outpulsers have access to nine translator-decoder pairs through the translator-decoder connector circuitry of FIGS. 77 through 95. Also, it will be noted that each register-outpulser has associated therewith a TOUCH-TONE receiver and converter for purposes of translating TOUCH-TONE incoming signals.

The description provided below of the details of operation of register-outpulser No. **0**, represented by the circuitry of FIGS. 8 through 39, is arranged in sections according to the following headings:

General Operation
Functional Parts
Dial Tone Connection
Register-Outpulser Preparations
Registering TOUCH-TONE Digits
Registering Dial Pulse Digits
Dial Pulse Generation
Initial Selector Setting
Translator-Decoder Usage
Recycle of Switch Train
Resetting Selectors
Outpulsing Beyond
Disconnect
Timing
Translator-Decoder Reseizure

#### GENERAL OPERATION

Whenever a call is placed from a calling line, such as is shown in FIG. 2, the register, trunk and link circuit of FIGS. 2 and 7 is the circuitry by means of which the register-outpulser is interposed between the line finder of FIG. 2 and the first selector of FIG. 3. The register-outpulser terminates the calling line so as to receive therefrom the called number, either by means of dial pulsing from the calling station or by means of TOUCH-TONE digits received therefrom. The register-outpulser terminates the stepping circuitry of the first selector of FIG. 3 in order to repeat to this first selector the digits as they are received from the calling equipment. If the called digits are received from the calling line by dial pulsing, these dial pulse digits are counted in the register-outpulser, registered therein, and are repeated by a pulse generating circuit into the fundamental tip and ring loop to the selectors of the switching train, as shown in FIGS. 3, 4 and 5. If the calling subscriber is transmitting TOUCH-TONE digits, then the register-outpulser will have these TOUCH-TONE digits decoded by its associated TOUCH-TONE receiver and converter circuitry and will register these successive decoded digits. Thereafter, the register-outpulser will again cause its pulse generating circuit to generate and repeat these called digits as dial pulse digits into the step-by-step selectors of FIGS. 3, 4 and 5.

After three digits (exclusive of any prefix) have been received by the register-outpulser, the services of a translator-decoder pair will provide to the register-outpulser the necessary information for controlling the continuation of the call. If the received digits are dial pulse digits the register-outpulser, if it is not needed for any controlled outpulsing, will be allowed to release during one of the interdigital pauses, thereby allowing the calling subscriber to continue to control the outgoing switch train as though the register-outpulser were not in the picture. If controlled outpulsing is needed, the decoder will inform the register-outpulser to this effect, whereupon the register-outpulser will release any of the selectors which have been set in accordance with the repeated digits. Thereafter, the register-outpulser will reset the switch train in accordance with the number and nature of arbitrary exit digits supplied thereto from the translator-decoder and will proceed to outpulse beyond any necessary information, ranging from all to none of the received digits, and on a dial pulse or multifrequency signaling basis. If the called number is received by means of TOUCH-TONE digit signaling, the register-outpulser must remain on the connection in order to convert these signals to dial pulse digits to control the outgoing switch train in any event. The register-outpulser may merely repeat the incoming digits in dial pulse fashion to the outgoing switch train and then release or the register-outpulser may recycle the switch train and then outpulse beyond anything from all to none of the incoming digits on either a dial pulse or a multifrequency basis.

Whenever the register-outpulser is caused to recycle the outgoing switch train, to reset the switch train and to outpulse beyond on the very rapid multifrequency signaling basis, it is most likely, particularly where the incoming digits are being transmitted on a dial pulse basis, that the switch train may become reset and the register-outpulser prepared to do MF outpulsing beyond even before all of the called digits have been received from the calling subscriber. In this circumstance, one of three choices is available: (1) the resetting of the outgoing switch train can be held up until all of the called digits are received; (2) the outgoing switch train may be completely set in accordance with the arbitrary exit digits and outpulsing may be started upon trunk seizure without waiting for all of the called digits to be received; or (3) the outgoing switch train may be partially set but trunk seizure may be held up contingent upon the reception of a complete set of called digits. Procedure (1) is undesirable in that the switch train must be completely set after the receipt of the full called address code digits, thereby representing a fair amount of delay before the outpulsing control can be made effective. On the other hand, procedure (2) is undesirable because if the register-outpulser seizes a trunk before the called number registration is complete, this may represent unnecessary usage and seizure of equipment (including common control gear at the remote point) in the event that the called number is never fully received (such as an abandoned call). Procedure (3) is the one employed in the present register-outpulser in that once the register-outpulser has received the exit digit information on a recycle condition, the switch train will be reset one selector short of actual trunk seizure, whereupon further control of the outgoing switch train will be held up contingent upon the receipt of a complete called number. The latter situation saves considerable time, particularly where more than one exit digit may be used to set the switch train in order to seize an outgoing trunk. Setting one or more initial selectors and then stopping until complete digit registration is effected obviously saves considerable time and allows the control of the trunk seizure selector and outpulsing beyond to take place immediately upon receipt of a complete called number.

#### FUNCTIONAL PARTS

The register link control circuits of FIGS. 8 and 11 works in conjunction with the register, trunk and link circuit of FIGS. 2 and 7 whereby the register-outpulser may be interposed between the line finder of FIG. 2 and the train of switching selectors of FIGS. 3, 4 and 5. The register link control circuit makes various checks of the circuit situation such as to check for double connections and false grounds on the fundamental leads to the line finder and to the first selector of FIG. 3.

In FIGS. 9, 10 and 13 is shown the tip and ring control circuit involving the fundamental pulsing circuitry to handle inpulsing and outpulsing. Also, the tip and ring control circuit is used to supply tone signals to the calling line, to detect busy tone from the switching train, to make tests of continuity in the forward direction, and to detect signals rearward from beyond without permitting such signals to extend back to the calling line. One example of the latter type of signaling is the so-called "STOP-GO" signaling condition which may be discovered on the outgoing trunk circuit of FIG. 6 when seized from the third selector. In FIG. 9 relay **L1** follows dial pulsing from the relay loop; whereas, if the calling subscriber is using TOUCH-TONE signaling, these alternating current frequency pulses are transmitted to the attached TOUCH-TONE converter over the tip and ring leads extending from FIG. 9 into the converter of FIG. 41.

FIGS. 14 and 17 and the upper part of FIG. 12 comprise the party test and control circuitry whereby the register-outpulser may ascertain, where necessary, whether a tip or a ring party, et cetera, is placing the call.

FIG. 15 and the lower part of FIG. 12 comprise the subscriber dial control circuit used primarily for counting the pulses of dial pulse digits incoming of the register-outpulser and for initiating the control of other circuits for causing these input digits to be registered.

The in-digit steering circuit of FIG. 24 provides the control relays for causing the called digits to be registered in successive ones of the digit registers of FIGS. 38 and 39.

FIGS. 20 and 21 show the translator-decoder control circuitry by means of which the register-outpulser secures the assistance of a translator-decoder pair in order to derive therefrom certain control information for completing the call.

FIG. 18 shows a number of register relays for receiving the translator-decoder information and for registering it in the register-outpulser. The information data registered on the relays of FIG. 18 is then used by the register-outpulser to control its further operation as a result of the translator-decoder seizure operation.

FIGS. 32 and 33 show the auxiliary digit registers into which arbitrary exit digit information, when needed, will be registered as a result of the translator-decoder seizure.

FIGS. 25 and 28 show the recycle control circuitry of the register-outpulser whereby the latter circuit will, upon appropriate instructions from the translator-decoder seizure, cause a release of any selectors which may have been set by the called digits and will cause these selectors to be reset in accordance with the arbitrary exit digit information registered in the auxiliary digit registers of FIGS. 32 and 33.

FIGS. 19 and 22 show the dial pulse generator and counting control circuitry whereby the register-outpulser can generate and transmit dial pulse digits to the step-by-step switch train when so instructed.

FIGS. 16, 35 and 36 show the outsteering control circuitry for the arbitary exit digit information and for the called address code digits. This circuitry extracts these digits from the proper registers and transmits them to and through the switch train under control of data supplied by the translator-decoder pair.

FIGS. 29, 30, 31 and 34 show the circuitry whereby data to be pulsed toward and/or through the outgoing switch train is generated and steered under control of the outpulsing steering circuitry previously mentioned.

FIGS. 23, 26 and 27 show the timing control circuitry for timing various of the operations of the register-outpulser. This circuitry exercises alarm control for indicating whenever the register-outpulser fails to perform one of its operations within a prescribed interval of time.

FIG. 37 indicates the fifteen groups of registers each containing a maximum of twenty register-outpulsers.

## DIAL TONE CONNECTION

Establishing a dial tone connection in the system of the present disclosure involves a number of steps including: (1) the seizure by the register, trunk and link circuit of FIGS. 2 and 7 of an idle register-outpulser, such as the one shown in FIGS. 8 through 39; (2) the performing by the register-outpulser of whatever party testing, if any, is required: (3) splitting the fundamental tip, ring and sleeve circuit between the line finder of FIG. 2 and the first selector of FIG. 3; (4) terminating the calling loop in the register-outpulser; (5) terminating the first selector stepping circuitry in the register-outpulser; (6) performing various tests on the established circuit, such as testing for double connections, loop continuity, and the like; and (7) supplying dial tone to the calling subscriber as a signal to begin transmitting the called digits.

Certain assumptions will be made at the outset with respect to the register-outpulser of FIGS. 8 through 39; namely, that this register-outpulser is not busy as represented by its relay MB of FIG. 11 being released, and that in FIG. 13, switch S is closed, thereby having operated relay BTDC to arrange this particular register-outpulser to detect direct current signaling from the selector train of FIGS. 3 through 5, such as a busy selector signal. In regard to the latter situation, if switch S of FIG. 13 were not closed, thereby causing relay BTDC to be released, the register-outpulser would be arranged to detect an alternating current signal as a busy selector signal. With relay MB of FIG. 11 released, it will be noted, in the left-hand part of FIG. 11, that ground is supplied to conductor RP extending toward FIG. 7 under control of break contacts **7** and **6** of respective relays MB and RT**1**, and that ground is extended from FIG. 11 into FIG. 7 over conductor RA under control of break contacts **5** of these same two relays. In FIG. 7, ground on conductor RA (extending thereto from FIG. 11) terminates in a punching which is shown cross-connected to punching TA, and thereafter extending to negative battery through the winding of relay RT which operates and in turn completes a circuit in the lower portion of FIG. 7 for operating relay RB in an obvious manner. The cross-connection in FIG. 11, between punchings RA and TA (causing relay RT to operate), is an indication that this particular register-outpulser is arranged to handle not only dial pulse calls but also TOUCH-TONE calls; whereas, if the cross-connection in FIG. 7 were made between punchings RA and DA (so as to cause the operation of relay RD instead of relay RT), this would be an indication that this particular register-outpulser is arranged to handle only dial pulse calls. With these preliminary circuit operations already effective, the register, trunk and link circuit of FIGS. 2 and 7 is in condition for seizing this idle-register outpulser, as will be described below.

While the line finder of FIG. **2** is hunting for the calling line, it grounds its sleeve conductor into the register, trunk and link circuit of FIGS. 2 and 7, thereby to cause the operation in FIG. 2 of relay TP. The circuit for operating relay TP extends from ground on the sleeve conductor S in FIG. 2, through break contact **8** of relay TB, through the winding of relay TP, over break contact **5** of relay TP, to negative battery over break contact **1** of relay HG. Relay TP locks over its own make contact **5**, to negative battery over break contact **6** of relay TB. In the meantime, the tip, ring, and sleeve conductors extending between the line finder of FIG. 2 and the first selector of FIG. 3 remain connected over back contacts **1**, **2**, and **3** of relay TB. The operation of relay TP of FIG. 2 completes an obvious circuit in the lower right-hand portion of FIG. 7 for causing the operation of relay HG, which in turn, upon operating, completes a circuit in FIG. 7 for causing the operation of relay S. The operating circuit for relay S extends from ground in FIG. 7, over make contact **4** of relay RB, break contact **5** of relay S, through the upper winding of relay S, over break contact **6** of relay S, break contact **1** of relay SHMR, make contact **2** of relay RT, break contact **5** of relay BC, make contact **2** of relay HG, punching RT, over the cross-connection to punching RP, through break contact **10** of relay TB, to negative battery over make contact **8** of relay TP. Relay S, in operating, locks in a circuit including the windings of relays GC and BC of FIG. 7, which in turn operate in this locking path, the locking path extending from ground in FIG. 7, through the winding of relay GC, over make contact **5** of relay S, through the upper winding of relay S, over make contact **6** of relay S, thence through the upper winding of relay BC, thence over make contact **2** of relay HG to the previously described circuit supplying negative battery thereto. Relays GC and BC operate in the holding path for relay S. Relay GC, in operating, causes the release of relay RB in the lower right-hand corner of FIG. **7**. Relay S, upon operating, completes an obvious circuit in the lower right-hand portion of FIG. 7 for causing the operation of relay SK, which upon operating, enables the operation of the register preference relay RP in a circuit extending from negative battery in FIG. 7, over make contact **6** of relay SK, break contact **3** of relay SCK, break contact **6** of relay RP, through the winding of relay RP, over conductor RP extending into FIG. **11** of the register-outpulser, and thence to ground over break contacts **6** and **7** of respective relays RT1 and MB. Relay RP, in operating, completes a locking circuit for itself over its own make contact **6** in FIG. 7 and thence over make contact **9** of relay SK to negative battery through the winding of relay SCK, which operates in this locking path.

Upon the operation previously described of relays SK, SCK, and RP in FIG. 7, a circuit is completed for causing the operation of the secondary switch select magnets SSML and SSMR in the lower left portion of FIG. 7 to prepare for closure the crosspoints on the secondary crossbar switch. This circuit extends from negative battery in FIG. 7, over make contact **6** of relay SK, make contact **3** of relay SCK, make contact **2** of relay RP, to ground through the windings of the secondary select magnets SSMR and SSML. The operation of these select magnets will prepare for closure a set of crosspoints on the secondary crossbar switch, depending upon which hold magnets are operated as is well known in the art. The operation of the right-hand secondary select magnet SSMR completes a circuit in the upper right-hand portion of FIG. 7 for causing the operation of the primary select magnet PSM, this circuit extending from negative battery, over make contact **1** of magnet SSMR, a make contact of relay S, through the winding of the primary select magnet PSM, to ground over break contact **1** of the secondary hold magnet SHMR. The operation of the primary select magnet circuit, as is well known in the art, will prepare for closure a set of crosspoints on the primary trunk switch, depending upon which one of the hold magnets is subsequently operated. In FIG. 2, upon the operation of the primary select magnet PSM a circuit is completed for causing the operation of the primary right-hand hold magnet PHMR, extending from ground in FIG. 2, over make contact **1** of magnet PSM, make contact **7** of relay TP, break contact **9** of relay TB, to negative battery through the winding of hold magnet PHMR, which thereupon then operates. Magnet PHMR, in operating in FIG. 2, extends its operating ground over its make contact **2** to conductor TC extending into the crosspoint structure of FIG. 7, and over its make contact **1** completes an obvious circuit in FIG. 2 for causing the operation of the left-hand primary hold magnet PHML. The operation of the right and left-hand primary hold magnets PHMR and PHML completes a pair of crosspoints on the primary trunk switch in the upper part of FIG. 7, as is well known in the art. Ground on conductor TC from FIG. 2 extending into FIG. 7 thereupon causes the operation of the right-hand secondary hold magnet SHMR which, in operating, in turn causes the operation of the left-hand secondary hold magnet SHML over make contact **2** of hold magnet SHMR. The circuit for causing the operation of secondary hold magnet SHMR extends from ground on conductor TC in FIG. 2, thence over cable **2–7** into FIG. 7, conductor TC over the No. **1** crosspoint contact of the right-hand primary crossbar switch, conductor TC over cable **7B**, thence to negative battery through the winding of secondary hold magnet SHMR. The closing of the four sets of crosspoints in FIG. 7 completes circuits between the conductors in cable **2–7** from FIG. 2 and the conductors extending from FIG. 7 into FIGS. 8 and 12 of the corresponding register-outpulser.



Upon the closure of the crosspoint connections of FIG. 7, ground on conductor TC is extended over the closed crosspoint No. **1** of the right-hand secondary crossbar switch to conductor TC, extending into FIG. 12 and thence into FIG. 8 where it extends over break contact **2** of relay RL, break contact **6** of relay **TA1**, break contact **8** of relay DCK, break contact **9** of relay SLT, break contact **7** of relay DCK, to negative battery through the lower winding of the register-outpulser off-normal relay ON, which thereupon operates and locks over its own make contact **12**, through its upper winding to ground on conductor TC supplied thereto from the register, trunk and link circuit of FIGS. 2 and 7. Relay ON, in operating in FIG. 8, causes the operation in FIG. 11, in an obvious fashion of the register make-busy relay MB, the operation of which, in turn, causes the release in FIG. 7 of relays RT and RP. The release in FIG. 7 of relay RP causes the release in FIG. 7 of relay SCK and of the secondary select magnets SSML and SSMR, leaving the secondary crossbar switch crosspoints of FIG. 7 closed under control of the operated hold magets SHMR and SHML. The release of the secondary select magnet SSMR in turn causes the release in FIG. 7 of the primary hold magnet PSM, thereby to cause the primary crosspoints of FIG. 7 to remain closed under control of the operated hold magnets PHMR and PHML. The operation of the off-normal relay ON of FIG. 8 also causes the operation, in FIG. 8, of relay SLT1 in a circuit extending from negative battery in FIG. 11, over make contact **8** of relay ON, break contact **10** of relay REC, conductor SL into FIG. 8, thence through resistance SLT1 and to ground through the winding of relay SLT1. Relay SLT1 of FIG. 8, in operating, completes a circuit in FIG. 11 over its make contact **2** for causing the operation of relay SLT through the upper winding of the latter relay. Relay SLT, in operating, completes a locking circuit for itself in FIG. 11 extending from ground, over break contact **4** of relay CC, through the lower winding of relay SLT, through break contact **8** of relay MR, thence over a parallel circuit consisting of break contacts **8** and **10** of respective relays FR and **PT5**, over make contact **1** of relay SLT, to negative battery through the SLT resistance. Upon the operation of relay SLT of FIG. 11, a circuit is completed in FIG. 8 for connecting the base of transistor Q1 to the TC lead, extending back to the hold magnets of the secondary crossbar switches of FIG. 7, this circuit extending in FIG. 8 from the base of transistor Q1, over make contact **9** of relay SLT, break contact **8** of relay DCK, break contact **6** of relay **TA1**, to the conductor TC over break contact **2** of relay RL. At this particular point the hold magnets SHMR and PHMR of FIGS. 7 and 2 are held from the DCK resistance-ground in FIG. 8 and the current through this resistance will depend upon the number of hold magnets operated therethrough. The voltage developed across the resistance DCK in FIG. 8 will be such as to cause transistor Q1 to become conducting, thereby to cause the operation in FIG. 8 of relay DCK in a circuit extending from negative battery, through make contact **1** of relay ON and through the winding of relay DCK to the collector circuit of transistor Q1, relay DCK thereupon locking over its own make contact **12**, conductor ON into FIG. 11 and to ground over make contact **11** of relay ON. The operation of relay DCK is an indication that no false ground exists on the TC lead, such as a short circuit to ground or a ground due to a double connection by another register-outpulser. Upon the operation of relay DCK in FIG. 8, conductor TC extending thereto from FIG. 7 (for holding the hold magnets operated) is extended in FIG. 8 over break contact **2** of relay RL, break contact **6** of relay TA1, make contact **8** of relay DCK and break contact **8** of relay TR1 to conductor S, extending back into FIG. 7 and through the closed crosspoints to the grounded sleeve conductor S extending in FIG. 2 from the line finder.

Upon the operation of relay SLT of FIG. 11, and before the operation in FIG. 8 of the check relay DCK, a circuit was completed for causing the operation of relay TB in FIG. 2, extending from negative battery in FIG. 2 through the winding of relay TB, break contact **4** of relay TB, conductor S1, cable **2–7** into FIG. 7, over the No. **6** left-hand primary crosspoint, conductor S1, cable **7A**, over the No. **6** left secondary crosspoint, conductor S1 into FIG. 8, over make contact **3** of relay ON, break contact **4** of relay DCK, to ground over make contact **4** of relay SLT. Relay TB, in operating, completes a locking circuit in FIG. 2 over make contact **3** of relay TP, make contact **3** of relay TB, to ground on the sleeve conductor from the line finder so that relay TB will remain operated upon the operation in FIG. 8 of the check relay DCK above described. Relay TB, in operating, completes a circuit in FIG. 2 over its own make contact **6** and make contact **5** of relay TP in order to provide a locking circuit for relay TP, over make contact **8** of relay TB to the conductor TC which is controlled by the register link control circuit of FIG. 8.

The operation of relay TB opens the tip, ring and sleeve conductors in FIG. 2 between the line finder and the first selector and allows the fundamental tip, ring and sleeve circuit to be maintained between the line finder and the first selector but through the agency of the attached register-outpulser circuitry. In this regard, in FIG. 8 upon the operation of relays ON and SLT, a circuit is completed for causing the operation of relay ON1, extending from negative battery in FIG. 8, through the winding of relay ON1, over make contact **2** of relay SLT, conductor ON into FIG. 11 and to ground over make contact **11** of relay ON, relay ON1 of FIG. 8 thereupon operating and locking over its own make contact **18** to off-normal ground on conductor ON. Upon the operation of relay ON1, a circuit is completed in FIG. 9 for causing the operation of relay L1, extending from ground in FIG. 9, through diode T, through the lower winding of relay L1 through the lower left winding of repeat coil T, make contact **21** of relay ON1, resistance PD3, break contact **1** of relay REC, through the upper left winding of repeat coil T, to negative battery through the upper winding of relay L1 and through diode R. The tip and ring leads from the line finder of FIG. 2 extend over conductors T and R, through cable **2–7** to FIG. 7, thence over the left-hand primary and secondary crosspoints to conductors T and R, extending into the register-outpulser of FIG. 8, thence into the tip and ring control circuit of FIG. 9. The ring conductor R in FIG. 9 extends over break contact **2** of relay PT2, break contact **11** of relay REC, conductor A into FIG. 10, and over break contact **8** of relay TMF to conductor FR extending back into FIG. 8. The tip conductor T in FIG. 9 extends over break contact **8** of relay PT2, break contact **3** of relay REC, conductor B into FIG. 10, through the lower winding of relay CB, break contact **6** of relay TMF, break contact **6** of relay RCA, make contact **6** of relay L1, break contact **4** of relay RK, break contact **5** of relay ROD, to the conductor FT extending back to FIG. 8. Conductors FR and FT of FIG. 8 extend into FIG. 7 and thence over the left-hand secondary and primary crosspoints to conductors FT and FR of FIG. 2, and thence to the first selector of FIG. 3. The latter described circuit maintains the tip and ring loop between the line finder and the first selector but maintains this circuit under control of the tip and ring control circuit of FIGS. 9 and 10 of the register-outpulser.

Eventually, the line finder of FIG. 2 will have found the calling line and will have gone to a cut-through condition, whereupon relay CB of FIG. 10, previously described above as included in series with the fundamental tip and ring loop between the line finder of FIG. 2 and the first selector of FIG. 3, will become operated provided the tip-ring loop is closed between the line finder and the first selector. It being assumed that such is the case, relay CB of FIG. 10 will become operated. In the meantime, upon the operation in FIG. 2 of relay TB, relay HG of FIG. 7 will be released to in turn cause the release in FIG. 7 of relays S, BC, GC, and SK. Upon the operation in FIG. 10 of relay CB (as an indication that the tip-ring loop between the line finder of FIG. 2 and the first selector of FIG. 3 is complete), a circuit is completed in FIG. 13 for causing the operation of relay TR1, extending from ground in FIG. 13, over make contact **22** of relay ON1, make contact **7** of relay CB, break contact **2** of relay REC, break contact **4** of relay PT2, to negative battery through the winding of relay TR1. Upon the operation of relay TR1 of FIG. 13, ground is applied in FIG. 8 to the TC lead over make contact **8** of relay TR1, make contact **8** of relay DCK, and break contacts **6** and **2** of respective relays TA1 and RL, thereby to hold operated in FIGS. 2 and 7 the four hold magnets of the crossbar switch structure previously described. In FIG. 13 it will be noted, upon the operation of relay TR1, that a circuit is partially prepared for the operation in FIG. 13 of relay REC at such time as relay SLT of FIG. 11 is released. The release of relay SLT will take place after the register-outpulser has satisfied itself that whatever party test is necessary has been completed, as will be described below.

Upon the operation, previously described of the off-normal relay ON1 in FIG. 8, circuits are completed in the register-outpulser to cause the register-outpulser to supervise the making of whatever calling party tests are required, if any. In this regard, it will be noted in FIG. 28 that upon the operation of the off-normal relay ON1 of FIG. 8 an obvious circuit is completed for causing the operation of relay ON2 of FIG. 28. In FIG. 7, it will be noted with respect to the right-hand primary trunk switch verticals that conductor IC is connected to a punching which in turn is cross-connectable to one of four punchings designated P, ground, CN and ICB. If the cross-connection is made to punching P, punching P in turn will be completed to negative battery through the winding of a relay in an associated trunk, this cross-connection indicating that the party test is to be made by a message rate trunk circuit: if the cross-connection is made to the grounded punching this will indicate a two-party flat rate circuit and under these circumstances party test will be made in the register-outpulser circuitry of FIGS. 14 and 17: if the punching is cross-connected to punching CN, indicating a coin class call, no party test will be made but the register-outpulser will recognize the class of this particular call: and; if the cross connection is made to punching ICB this will indicate that the call involves a trunk circuit which is neither coin nor two party, thereby making it unnecessary for any party test to be made. As will be seen from subsequent description, with reference to FIG. 11 it is noted that relay SLT is lock operated through its lower winding under control of relays CC, MR and FR of FIG. 12 and of relay PT5 of FIG. 14. These latter relays are involved in the party test supervisory circuitry of the register-outpulser under such circumstances that relay SLT will not be permitted to release until such time as suitable control is exercised over the relays involved in the locking circuit to indicate that either party test had been made or no party test is required. The control of the locking circuit of relay SLT is significant in that in FIG. 13 relay REC cannot operate until relay SLT releases, the operation of relay REC being required, as will be explained, in order to supply dial tone to the calling subscriber.

If party test is to be made by a message rate trunk, as indicated by the cross-connection in FIG. 7 of the IC punching to the P punching (extending to negative battery through the winding of a control relay in the associated trunk circuit), a circuit is completed for causing the operation in FIG. 12 of relays CCA and MR extending from negative battery in the associated trunk, through the winding of the control relay therein (not shown), from punching P in FIG. 7 to punching IC, thence over conductor IC, over contact No. **2** of the right-hand section of the primary trunk switch, conductor IC, cable 7B, conductor IC, contact No. **2** of the right-hand crosspoint of the secondary register switch, conductor IC into FIG. 12, thence over break contacts **4** and **6** of respective relays MR and FR, thence through the winding of relay CCA, over break contact **2** of relay CC, through the winding of relay MR, through diode FR, break contact **7** of relay FR and make contact **19** of relay ON1, to the potentiometer comprising resistances FR and make contact **2** of relay ON1 to negative battery. Relays MR and CCA operate in the latter described circuit, it being noted in FIG. 12 that the operation of relay MR opens its back contact **5**, thereby to prevent the operation of relay CC. In FIG. 11, the operation of relay MR will, by virtue of its transfer contacts **8**, open the locking circuit of relay SLT and close a short circuit across its lower winding, thereby to cause relay SLT to have a slow releasing characteristic at such time as relay SLT1 of FIG. 8 in turn releases, as will be described below. In FIG. 12, upon the operation of relay MR, its make contact **4** completes a locking circuit for the operated relays CCA and MR and its make contact **11** completes a circuit for allowing a "soak" condition to be applied to the control relay of the message rate trunk, the latter circuit extending from ground in FIG. 27, over make contact **19** of relay ON2, break contact **2** of relay RCS, conductor MR into FIG. 12, through a resistance and make contacts **11** and **5** of respective relays MR and SLT to conductor IC extending back through the register, trunk and link circuit of FIG. 7 to the control relay in the associated message rate trunk circuit. In this particular situation both of the relays CCA and MR of FIG. 12 are permitted to operate in series with the control relay of the message rate trunk because the impedance of the trunk relay in series with these relays CCA and MR is sufficiently low to permit the operation of both relays in series therewith.

If the associated trunk circuit involves neither a coin nor a two party condition, as in the assumed example where punching IC is connected to punching ICB in FIG. 7, the same situation prevails as above described with respect to the message rate trunk circuit except that resistance ICB in FIG. 7 is a low resistance (comparable to that of the message rate trunk control relay) so that both of the relays MR and CCA of FIG. 12 will operate in series therewith.

In the event that the trunk circuit involved is a coin trunk, as would be the situation if punching IC in FIG. 7 were cross-connected to punching CN, it will be noted that the relays CCA and MR of FIG. 12 will be in series with resistance CN of FIG. 7. The latter resistance is a fairly high resistance such that both of the relays CCA and MR cannot operate in series therewith, relay CCA being the only one permitted to operate in series with this high resistance. Under these circumstances, relay CCA of FIG. 12 will operate to in turn complete an obvious circuit in FIG. 12 over its make contact **7**, break contact **6** of relay CC, and break contact **5** of relay MR to cause the operation of relay CC, which in turn locks over its own make contact **6** to off-normal ground under control of make contact **23** of relay ON2, relay CCA being released upon the operation of relay CC. In FIG. 11, it will be noted that relay CC, in operating, opens its break contact **4** thereby to de-energize the lower locking winding of relay SLT such that this relay may be allowed to release upon the release in FIG. 8 of relay SLT1.



In all three of the above-described situations no party test is required to be made by the register-outpulser; and, in the case of the two party message rate trunk circuit (punching P of FIG. 7) the party test will be made by the trunk circuit itself. The situation which requires party test to be made by the register-outpulser circuitry is that situation involving a two party flat rate trunk as indicated by the connection in FIG. 7 of punching IC to the grounded punching. This situation reverses the polarity of the voltage applied in FIG. 12 to the party test control relays, such that relay FR will be operated from ground on conductor IC in FIG. 12, through break contacts **4** and **6** of respective relays MR and FR, thence through diode MR, through the winding of relay FR, and through make contact **19** of the off-normal relay ON1 to negative potential on the potentiometer. Relay FR, in operating, completes a locking circuit for itself in FIG. 12 over its make contact **6** and completes a shunt circuit over its own make contact **12** and diode FR to provide relay FR with a slow releasing characteristic upon the de-energization of its winding. In FIG. 11, the operation of relay FR opens its back contact **8**, which is in parallel with back contact **10** of relay PT5 of FIG. 14, the lower winding of relay SLT not being de-energized at this point until such time as relay PT5 of FIG. 14 operates. The operation of relay PT5 will indicate the completion of party test by the register-outpulser circuitry of FIGS. 14 and 17.

The operation above-described in FIG. 12 of relay FR initiates circuit operations in the party test circuitry of FIGS. 14 and 17 whereby the register-outpulser performs a test to determine the nature of the calling party (whether tip party or ring party). Relay FR, in operating, closes a circuit through the lower primary winding in FIG. 14 of relay PT, thereby establishing a biasing current through this winding to cause relay PT to close its back contacts and open its front contacts. This circuit extends from ground in FIG. 14, over make contact **11** of relay ON1, back contact **5** of relay ROA, make contact **2** of relay FR, resistance PT, back contact **7** of relay PT5, through the lower winding of relay PT, to negative 110 volt direct current power source through make contact **1** of relay ON1. Also, in FIG. 14 the operation of relay FR completes a circuit for energizing the lower secondary winding of relay PT1 (causing it to close its front contacts and open its back contacts) and to discharge whatever charge condition may exist on condensers C5A and C5B. The latter circuit extends from ground in FIG. 14, over make contact **12** of relay TR1, make contact **4** of relay FR, break contact **6** of relay PT5, break contacts **11** and **6** of respective relays PT2 and PT3, break contact **6** of relay RP, to negative battery through the lower secondary winding of relay PT1, it being noted that the upper primary winding of relay PT1 had previously been energized in a circuit including make contact **12** of relay TR1, break contact **5** of relay PT7, and negative battery supplied through resistance PT1. Of course, the ground applied to the right-hand end of resistance PT7 causes condensers C5A and C5B to become discharged. Relay PT1, in operating, causes the operation of relay PT2 in a circuit extending from ground at transfer contacts **7** of relay PT1, over break contact **11** of relay PT7, break contacts **8**, **6**, **2**, and **2** of respective relays ROD, RL, RP, and TP, to negative battery through the lower primary winding of relay PT2, which thereupon operates and completes a circuit through its upper secondary winding over its own make contact **6** to cause relay PT2 to have a slow-releasing characteristic. It will be noted in FIG. 9 that on the operation of relay PT2 of FIG. 14, the tip and ring conductors extending back toward the calling line are tied together in parallel over make contacts **8** and **9** of relay PT2 to conductor **26**, extending from FIG. 9 into FIG. 14 to enable a test to be made of whether the calling party is a tip party or a ring party. Also, the operation of relay PT2 opens the lower secondary winding of relay PT1, thereby allowing relay PT1 to initiate its slow release. Also in FIG. 9, make contact **12** of relay PT2 completes a circuit in parallel with break contact **1** of relay REC to maintain operated relay L1 of FIG. 9. In addition, in FIG. 10 the operation of relay PT2 closes a loop circuit to the tip and ring conductors FT and FR extending toward the first selector in order to prevent the selector from pulsing or releasing. This latter circuit extends in FIG. 10 from conductor FR, through break contact **8** of relay TMF, make contact **2** of relay PT2, resistance LB, break contact **6** of relay TMF, break contact **6** of relay RCA, make contact **6** of relay L1, break contact **4** of relay RK, to the tip conductor FT.

Returning now to the operation of the party test circuit of FIGS. 14 and 17, the tip and ring conductors extending back toward the calling line are extended in parallel over conductor **26** from FIG. 9 into FIG. 14. If the call is originated by a ring party, no ground condition will exist on conductor **26** of FIG. 14; however, if the call has been originated by a tip party then the station ground will appear on conductor **26** in FIG. 14. When the call is originated by a ring station, relay PT of FIG. 14 will remain normal. When relay PT1 releases, after approximately 60 milliseconds, a circuit will be completed for causing the operation in FIG. 14 of relay RP. The release time of relay PT1 in FIG. 14 is controlled by the charging time of capacitors C5A and C5B through resistance PT7. Upon the release of relay PT1, the circuit for operating relay RP will extend from ground in FIG. 14, over back contacts **11** and **5** of respective relays ON1 and ROA, and thence over make contact **3** of relay PT2, back contacts **11** and **7** of relays PT7 and PT1, break contacts **7**, **10**, and **2** of relays PT, PT3 and PT7, break contact **12** of relay RP, through the winding of relay RP, break contact **10** of relay TP, to negative battery through the PT resistance.

In the event that the call has been originated by a tip party, ground on conductor **26** in FIG. 14 will cause the energization of the upper secondary winding of relay PT thereby causing relay PT to operate, this circuit extending from ground on conductor **26** in FIG. 14, through break contact **7** of relay ROA, diode PT, through the upper winding of relay PT, and to negative battery potential through make contact **1** of relay ON1. The operation of relay PT causes the above-described circuit to be switched at transfer contact **7** of relay PT to cause the operation of relay TP by extending this ground over make contact **7** of relay PT, break contacts **8** and **7** of relays PT3 and PT7, thence over break contact **12** of relay TP, through the winding of relay TP, through break contact **10** of relay RP, to negative battery through the PT resistance.

When party identification has been made, as indicated by the operation of either relay RP (ring party) or relay TP (tip party) in FIG. 14, relay PT2 will be allowed to release after a period of about 35 milliseconds to provide a time interval during which line voltage stabilization may take place. During this interval, negative battery in FIG. 14 will be supplied through the PT resistance and over make contact **10** of the operated relay RP or TP, over make contact **1** of relay PT2, break contact **2** of relay PT5, back over the above-described circuit involving conductor **26** into FIG. 9, and thence in parallel to the tip and ring conductors extending back to the calling line. Eventually, the release of relay PT2 will transfer the calling tip and ring leads from the party test circuit of FIGS. 14 and 17 and will reclose these tip and ring leads in FIG. 9 as they existed prior to initiation of party test. Following the release of relay PT2, relay PT1 will reoperate to initiate a party test check circuit operation to determine whether one of the relays RP and TP actually did operate. The operation of relay PT3 will satisfy this



check circuit, the circuit for causing the operation of relay PT3 extending from ground in FIG. 14, over make contacts **12** and **4** of relays TR1 and FR, thence over break contact **6** of relay PT5, make contact **7** of relay PT1, break contacts **8** and **6** of relays ROD and RL, and thence over a break contact or a make contact **2** of relay RP and a make contact **2** or a break contact **7** of relay TP, thence through break contacts **4** and **7** of relays PT7 and PT2, to negative battery through the winding of relay PT3, which locks over its own make contact **12** to the previously described ground supply, independent of relay PT1. Upon the operation of relay PT3, the secondary winding of relay PT1 is de-energized, thereby causing the latter relay to release.

In order to be certain that relay PT has the ability to operate even under the circumstances where a ring party test is determined (which it will be recalled is effective under a released condition of relay PT), the ability of relay PT is checked on every call on which relay RP is operated. This check is made by connecting a simulated tip party line condition to the winding of relay PT extending in FIG. 14 from ground, through resistance PTG, inductor PT, make contact **11** of relay RP, break contact **4** of relay TP, resistance PT4, break contact **5** of relay PT5, make contacts **5** and **2** of relays PT2 and PT3, thence through diode PT, to negative battery through the upper secondary winding of relay PT. Relay PT, in operating under this simulated condition, completes a circuit for causing the operation in FIG. 14 of relay PT5, extending from ground at transfer contact **7** of relay PT, over make contact **7** of relay PT, make contacts **8** and **4** of relays PT3 and RP, to negative battery through the winding of relay PT5, which thereupon operates and locks over its own make contact **6** to ground under control of make contacts **4** and **12** of relays FR and TR1. The operation of relay PT5 opens the locking circuit of relay PT3, which is thereupon allowed to release. On tip party calls, non-operate test of relay PT is made by using relay PT4 when the relay TP is operated. This circuit extends from ground in FIG. 14, through the winding of relay PT4, break contact **7** of relay RP, resistance PT3, make contact **4** of relay TP, and thence over the previously described circuit through the upper secondary winding of relay PT, relay PT4 operating in this circuit while relay PT remains normal. The operation of relay PT4 completes a circuit for causing the operation of relay PT5, this circuit extending from ground at transfer contact **7** of relay PT in FIG. 14, over break contacts **7** of relay PT, make contact **10** of relay PT3, make contact **4** of relay PT4, break contact **4** of relay RP, to negative battery through the winding of relay PT5, which thereupon operates and locks in a circuit above-described.

Upon the operation of relay PT5 above-described, the operated relays PT3 and PT4, etc., will release to prepare for making a party retest which, as will be mentioned hereinafter, occurs on TOUCH-TONE calls (other than those with conflicting office and area codes) just prior to outpulsing of the last digit.

It will be noted in FIG. 11 that upon the operation of relay PT5 of FIG. 14 the lower locking winding of relay SLT is completely opened, thereby allowing this relay to release under control of relay SLT1 of FIG. 8. As has been mentioned above, it will also be noted in FIGS. 9 and 10 that upon the release in FIG. 14 of relay PT2, the tip and ring circuits extending from the tip and ring control circuitry of FIGS. 9 and 10 back toward the calling line and forward toward the first selector circuit have been re-established. It is noted in FIG. 10 that whenever the calling loop is "off-hook" (relay L2 of FIG. 15 operated) and the calling party has been ascertained to be a tip party (relay TP of FIG. 14 operated), ground is applied to the forward tip conductor FT in FIG. 10 through the 3600 ohm relay PTG under control of make contacts **4** and **11** of relays L2 and TP. This passes a 3600 ohm (inductive load) ground tip party indication forward as a party identification signal.

It will be recalled with reference to FIG. 8 that relay SLT1 has been operated in a circuit extending from battery in FIG. 11, over make contact **8** of relay ON, break contact **10** of relay REC, conductor SL extending into FIG. 8, and thence through resistance SLT1 to ground through the winding of relay SLT1. The left-hand side of the winding of relay SLT1 extends through diode SLT and make contacts **4** and **3** of relays DCK and ON, to conductor S1 extending into FIG. 7 and thence over the left-hand secondary and primary crossbar switch cross points, thence over cable 2–7 into FIG. 2, where conductor S1 extends over make contact **4** of relay TB to the first selector sleeve conductor FS. In FIG. 3 it will be noted that the sleeve conductor of the first selector will be extended to ground over make contact **1** of relay B1 as soon as relays A1 and B1 of the first selector have been operated, as an indication that this selector is in condition to receive pulsing. When the sleeve ground is returned from the first selector on conductor S1 in FIG. 8, this will shunt down relay SLT1 of FIG. 8 so that it will thereupon release as an indication that the first selector is in condition to receive control. In FIG. 11 it will be noted that relay SLT can release only when both of its upper and lower windings are de-energized, the upper winding being de-energized when relay SLT1 of FIG. 8 is released, and the lower winding being de-energized as previously described at such time as the register-outpulser has satisfied itself on the party check supervision situation. As soon as both of these situations prevail, relay SLT of FIG. 11 will release. When relay SLT releases, the base of the double connection check transistor Q1 of FIG. 8 is disconnected from the TC lead extending back to the register, trunk and link circuit, thereby allowing transistor Q1 of FIG. 8 to become de-energized, relay DCK remaining locked operated as previously described. In FIG. 12, upon the release of relay SLT, make contact **5** of relay SLT disconnects the circuit previously described for causing a soak condition to be applied to the control relay of a two-party message-rate trunk circuit. Also, in FIG. 11 make contact **1** of relay SLT opens to prevent the lower winding of relay SLT from becoming re-energized upon the return to normal of the party test control relays. Lastly, in FIG. 13, upon the release of relay SLT of FIG. 11, a circuit is completed for causing the operation of relay REC extending from ground in FIG. 13, over make contact **22** of relay ON1, break contact **3** of relay SLT, make contacts **4** and **10** of relay TR1 and DCK, to negative battery through the winding of relay REC. Relay REC operates and locks in a circuit extending from the left-hand side of its winding, over conductor B into FIG. 35, thence over make contact **8** of relay REC to off-normal ground over make contact **4** of relay ON1, the locking ground on conductor B in FIG. 13 also locking operated relay TR1 in FIG. 13 through diode TR1 and make contact **6** of relay TR1.

The operation in FIG. 13 of relay REC completes a number of circuit functions, the primary one of immediate consideration being the supplying to the calling subscriber of dial tone. The operated relay REC opens the operating circuit (in FIG. 11) for relay SLT1 of FIG. 8 to prevent it from reoperating. In the tip and ring control circuitry of FIGS. 9 and 10 the operation of relay REC splits the tip and ring loop between the line finder of FIG. 2 and the first selector of FIG. 3 and in doing so, terminates these two circuits separately in the register-outpulser. In FIG. 9 the tip and ring leads T and R extending thereto from the calling subscriber extend over respective break contacts **8** and **9** of relay PT2, respective make contacts **3** and **1** of relay REC, and through the respective lower and upper left windings of the repeat coil T to ground and battery through the lower and upper windings of relay L1, thereby to cause relay L1 to remain operated over the calling loop. In FIG. 10, the tip and ring leads FT and FR extending thereto from the first selector circuitry of FIG. 3 are included in a circuit traceable as follows: from conductor FR in FIG. 10, over break contact **8** of relay TMF, conductor A into FIG. 9, make contact **11** of relay REC, resistance FR1, make contact **3** of relay ON2, through the winding of relay LT (ready BTDC of FIG. 13 being operated provides through its make contacts **1** and **2** a resistance in shunt of relay LT to adjust the impedance of the circuit), over conductor BTDC into FIG. 10, thence through the winding of relay RV (with part of resistance RV in shunt thereof through make contact **3** of relay BTDC), make contact **5** of relay BTDC, resistance FT1, make contact **9** of relay REC, break contacts **6** of relays TMF and RCA, thence over make contact **6** of relay L1 and break contact **4** of relay RK, thence over break contact **5** of relay ROD to the tip conductor FT extending back to the first selector circuit. Relay CB in FIG. 10 will be released upon the operation of relay REC; and, relay CB will not reoperate on its upper winding unless +24 volts direct-current potential appears through diode BT as an indication of a busy selector. Relay LT in FIG. 9 will operate in the loop circuit to the first selector as an indication that this loop is completed: Relay RV in FIG. 10, included in the same loop to the first selector circuit will, on the other hand, remain released since relay RV is a polar relay and the voltage impressed across its winding under these present circumstances from the first selector is such as to cause relay RV to remain released. Relay RV is included in this loop in order to detect a polarity reversal from the switching train for purposes to be described hereinafter.

In FIG. 9, upon the operation of relay REC, dial tone signal is transmitted back toward the calling end of the connection in a circuit extending from the source of dial tone indicated as a box in FIG. 9, through condenser C6, through break contacts **4** and **3** of relays DP and MF1, make contact **2** of relay TR1, resistance DT1, break contact **4** of relay ROD, through the right-hand winding of repeat coil T to ground, the dial tone being induced by transformer action into the left-hand windings of repeat coil T and thence over make contacts **1** and **3** of relay REC, back over the previously traced path to the tip and ring leads extending back toward the calling end of the connection. At this point, the calling subscriber, upon receiving the dial tone, will presumably initiate the manipulation of its dial pulse dial or its TOUCH-TONE key set in order to transmit the digits of the called number; however, a number of circuit operations will have taken place in the register-outpulser of FIGS. 8 through 39 prior to this time, as will be described in the next section.

## REGISTER-OUTPULSER PREPARATIONS

Upon the operation of the off-normal relays ON and ON1 of FIG. 8 and of the off-normal relay ON2 of FIG. 28, a number of circuit operations take place within the register-outpulser to prepare the circuit for use. These circuit operations will take place prior to the completion of the dial tone connection above described as indicated by the operation of relay REC in FIG. 13.

A circuit is completed for placing the TOUCH-TONE converter of FIG. 41 in operative condition, extending from negative battery in FIG. 8 over make contact **1** of relay ON, conductor C extending into FIG. 9, and thence over break contacts **1** of relays ROD and PKC, to the start conductor ST extending from FIG. 9 into the TOUCH-TONE converter circuit of FIG. 41. As a result of this start signal, the converter, as has been described hereinbefore, is placed in condition for detecting TOUCH-TONE signals that may be received from FIG. 9 over the tip and ring conductors T and R extending from FIG. 9 into FIG. 41 in order to convert these signals into digital information which may thereupon be registered in the digit registers of FIGS. 38 and 39.

In FIG. 13, upon the operation of off-normal relay ON2, battery and ground potentials are supplied to the tone detector shown therein to enable this tone detector to be in an operative condition for detecting possible busy tones returned from the selector switch train of FIGS. 3, 4, and 5, under circumstances where this signal may be an alternating current signal, as has been mentioned hereinbefore. However, under the present circumstances, it will be recalled that in FIG. 13 relay BTDC is operated such that in FIG. 10 break contact **8** of relay BTDC is opened to remove the alternating current tone detector of FIG. 13 from the circuit. As will be recalled from previous discussion, in the event that the tone detector of FIG. 13 is used to detect alternating current busy tones from the selector switch train, switch S of FIG. 13 will be opened and relay BTDC will be released.

In the subscriber dial control circuit of FIG. 15, upon the operation of relay ON2 an obvious circuit is completed in the lower left-hand corner of FIG. 15 to cause the operation of relay RA1. Also, circuits are completed in FIG. 15 upon the operation of relay ON1 with relay L1 of FIG. 9 operated for causing the operation of relays LA and L2. The circuit for operating relay LA extends from ground in FIG. 15, over make contact **24** of relay ON1, over make contact **3** of relay L1, to battery through the upper winding of relay LA. The circuit for causing the operation of relay L2 in FIG. 15 extends from the same operating ground, over make contact **4** of relay L1, to battery through the winding of relay L2. These relay operations place the subscriber dial control circuitry of FIGS. 12 and 15 in condition for counting dial pulses which may be transmitted thereto from the calling subscriber.

In FIG. 24, the in-digit steering chain is placed in operative condition upon the operation of relay ON, by a circuit extending from ground in FIG. 24, over make contact **5** of relay ON, break contact **7** or relay REC (prior to the operation thereof), over break contact **6** of relay IS1 to negative battery through the winding of relay **IS1**. Relay **IS1**, in operating, locks in a circuit extending from the left-hand side of its winding, over its own make contact **6**, and thence through a chain of break contacts **No. 5** of relays **IS2** through **IS11** and of relay **PKC**, thence to off-normal ground, thereby locking operated relay **IS1** independently of the condition of relay REC (which, as will be seen from previous discussion, subsequently operates to provide dial tone). It will be noted in FIG. 38 that with the in-digit steering relay **IS1** of FIG. 24 operated, circuits are completed either from the TOUCH-TONE converter of FIG. 41 or from the subscriber dial control circuit of FIG. 12 for causing the first digit transmitted from the calling subscriber to be registered in the A digit register of FIG. 38.

The timing control circuitry of FIGS. 23 and 26 is placed in operation upon the operation of the off-normal relay ON of FIG. 8 and particularly the start timing relay STT of FIG. 26 is operated in a circuit extending from ground in FIG. 23, over make contact **4** of relay ON, conductor ON extending into FIG. 26, thence over break contacts **4**, **12**, **4**, and **10** of respective relays REC, ROD, TDSA, and RCY, and thence to negative battery through the winding of relay STT. The details of the timing circuitry of the register-outpulser will be discussed in detail in a section hereinafter. Let it suffice at the moment to point out that the operation of relay STT places the timing control circuit in operation; however, it will be noted that relay STT will release upon the subsequent operation of relay REC (which provides dial tone as above described). It will be assumed for present discussion that no time-out occurs in the timing section of the register-outpulser based on the further assumption that all circuit operations take place within the allotted time intervals. The matter of time-outs will be discussed in detail hereinafter.

In FIG. 13 of the tip and ring control circuitry, upon the operation in FIG. 9 of relay LT (indicating a closed loop to the first selector circuit), relay LTA of FIG. 13 will operate in a circuit extending from negative battery, through its winding, conductor LTA extending into FIG. 27, and thence to off-normal ground over make contact **4** of relay LT. Relay LTA of FIG. 13 operates in this circuit and completes a path through its lower winding and over its own make contact **2** to provide relay LTA with a slow-releasing characteristic.

In FIG. 35, upon the operation of the off-normal relay **ON2**, a circuit is completed for causing the operation of the first out-steering relay **OS1** of FIG. 35 to prepare the register-outpulser for outpulsing the first bit of digital information (see FIG. 31) contained in the A digit register of FIG. 38. This circuit extends from ground in FIG. 35, over make contact **4** of relay **ON1**, break contact **8** of relay REC, break contact **6** of relay **OS1**, to negative battery through the winding of relay **OS1**. Relay **OS1**, in operating, completes a locking circuit for itself over its own make contact **6**, thence through a chain of No. 5 back contacts of relays **OS2** through **OS8**, conductor C extending into FIG. 36, thence through another chain of No. 5 back contacts of relays **OS9** through **OS11** and of relays ST and ST1, thence over break contact **8** of relay RCA to off-normal ground over make contact **18** of relay **ON2.** It will be noted that the locking circuit for relay **OS1** in FIG. 35 thereby becomes independent of the condition of relay REC (which will become operated to supply the dial tone as above described).

The final circuit for discussion at the moment, which becomes prepared upon the operation of the off-normal relays in the register-outpulser, is the dial pulse generator and counting control circuitry of FIGS. 19 and 22. When relay ON1 becomes operated, a circuit is completed in FIG. 22 for operating relay PG1, this circuit extending from ground in FIG. 22, over make contact **10** of relay ON1, break contact **7** of relay RL, conductor L extending into FIG. 19, thence over break contacts **5**, **7**, and **6** of relays W, IC, and RK, thence over conductor PG bask into FIG. 22, to negative battery through the winding of relay PG1. At the same time the ground on conductor L in FIG. 19 is extended over make contact **4** of relay PG1, through the capacitors PGA through PGF, through the lower winding of relay PG2, and to negative battery through break contact **6** of relay TMFA and through resistance PG6–8. Also, this same ground extends through resistance PG2–5 and break contact **5** of relay TMFA, through the upper winding of relay **PG2** to the same battery supply. Capacitors PGA through PGF acquire charging current through the lower winding of relay PG2 at the same time that a seady current is flowing in the upper winding of relay **PG2**. The large charging current through the lower primary winding of relay PG2 causes relay **PG2** to operate thereby to complete a circuit over its make contact **3** in FIG. 22 to hold operated relay **PG1.** After about 35 to 40 milliseconds time the charging current through the lower winding of relay PG2 will drop to a level where the steady current through the upper secondary winding will become controlling to cause the release of relay **PG2**. The circuitry involving relay **PG1** of FIG. 22 and relay PG2 of FIG. 19 stays in this condition, with relay PG1 operated and relay PG2 released, until such time as relay RK of FIG. 34 becomes operated to cause the release in FIG. 22 of relay PG1. This operation will be described later with regard to the use of the read out relays **RR0** through **RR10** in the lower left-hand portion of FIG. 29. At such time as these read out relays are used to determine what digit is to be outpulsed, they will be operated on a two-out-of-five basis: this two-out-of-five operation of these read out relays will be used in the out-steering and outpulsing control circuit of FIG. 34 to cause the operation of relay RK as an indication that a read out check has taken place. When this read out check takes place, as indicated by the operation in FIG. 34 of relay RK, back contact No. 6 thereof in FIG. 19 will open to allow relay PG1 to release. This release of relay PG1, as will be described in detail hereinafter, will initiate the operation of the pulse generator circuitry of

FIGS. 19 and 22 in order to develop the proper number of dial pulses for controlling the outgoing switch train.

REGISTERING TOUCH-TONE DIGITS

Transmission of called digits from the calling line of FIG. 2 on a TOUCH-TONE signal basis causes a pulse of two frequencies to be transmitted through the register, trunk and link circuit of FIGS. 2 and 7 and into FIG. 9 over the tip and ring leads T and R. This TOUCH-TONE signal will appear in the left-hand windings of repeat coil T in FIG. 9 and will be thence induced into the right-hand winding of the same repeat coil, thereby to be transmitted over the tip and ring leads T and R from FIG. 9 into the attached TOUCH-TONE converter circuitry of FIG. 41. The successively received TOUCH-TONE digits will be translated by the TOUCH-TONE converter and receiver circuitry and will be transmitted therefrom into FIGS. 38 and 39 so as to be registered in successive ones of the digit registers under control of the continuously advancing indigit steering circuit of FIG. 24.

It will be recalled, from previous description of the TOUCH-TONE receiver and converter circuitry of FIGS. 40 through 43, that when the receiver and converter have detected a legitimate TOUCH-TONE digital pulse, ground will be applied in FIG. 24 to conductor STR, extending through diode STR to negative battery through the winding of relay STR. The operated relay STR completes a circuit in FIG. 24 for operating relay MF1 extending from ground, over make contact **5** of relay ON, make contact **3** of relay STR, break contact **7** of relay PKC, make contact **10** of relay RA1, break contacts **8** and **5** of relays RA and MF1, to negative battery through the winding of relay MF1, which thereupon operates and locks over its own make contact **5**, conductor MF1 into FIG. 15, and thence to off-normal ground over make contact **24** of relay ON1. It will be noted in FIG. 9 that upon the operation of relay MF1, dial tone is removed from the secondary winding of repeat coil T by the opening of break contact **3** of relay MF1. The operation of relay STR in FIG. 24 completes a circuit for causing the operation of the second digit steering relay IS2 extending from off-normal ground, over make contact **3** of relay STR, break contact **7** of relay PKC, make contact **9** of relay IS1, break contact **6** of relay IS2, to negative battery through the winding of relay IS2. Relay IS2, in operating, locks over its own make contact **6**, through the chain of No. 5 break contacts of relays IS3 through IS11 and break contact **5** of relay PKC, to off-normal ground, the locking circuit for relay IS1 extending over make contact **5** of relay IS2 to the grounded conductor previously traced under control of make contact **3** of relay STR. It will be noted, with reference to FIG. 38, that even though both of the steering relays IS1 and IS2 are operated the input conductors S0 through S7 are routed only to the A digit register under control of the first operated one of these two steering relays.

In FIG. 24, upon the operation of relay STR, ground from the make contact **3** thereof and through break contact **7** of relay PKC is also applied to conductor STR1 extending to the TOUCH-TONE converter circuitry of FIG. 41 to provide a ground supply by means of which relays in the converter circuitry may transmit into FIG. 38 over conductors S0 through S7 on a two-out-of-five basis the equivalent digital registration represented by the decoded TOUCH-TONE digit. The converter circuit is arranged to cause the transmission of this two-out-of-five signal into FIG. 38 for a minimum time of 45 milliseconds, at the end of which time ground will be removed in FIG. 24 from conductor STR, thereby allowing relay STR in FIG. 24 to become released at the end of this 45 millisecond interval. In FIG. 38, the first TOUCH-TONE digit, converted on conductors S0 through S7 to a two-out-of-five registration basis, is transmitted through make contacts of the steering relay IS1 to battery through the windings of two of the relays A0 through A7, which thereupon operate and lock to off normal ground over their own make contacts **8** to thereby register in the A digit position of FIG. 38 the first received TOUCH-TONE digit.



Upon the release in FIG. 24 of relay STR at the end of the registration time above mentioned for the first TOUCH-TONE digit, the locking circuit for relay IS1 is opened, thereby allowing this steering relay to release and leaving relay IS2 operated ready to place the second received digit in the B digit register of FIG. 38. Also, relay STR, in releasing, removes ground from conductor STR1 in FIG. 24 extending toward the converter circuit. The process of receiving successive TOUCH-TONE digits and the successive control of the registration thereof by the in-digit steering circuit of FIG. 24 will be described further below after a description of what takes place as a result of the registration of the very first TOUCH-TONE digit in the A digit register of FIG. 38.

With reference to FIGS. 29, 30, and 31, as soon as two of the five A digit registers of FIG. 38 have been operated, circuits are completed for causing the operation in FIG. 29 of two-out-of-five of the read out relays RR0 through RR7. These circuits extend from off normal ground in FIG. 31, over make contacts **12** of the two operated relays, over make contacts of the operated out steering relay OS1 (see FIG. 35), thence over two of the conductors OP0 through OP7, cable OP into FIG. 30, conductors OP0 through OP7, thence through break contacts of steering relays FRS, ERS, and DRS, cable RR into FIG. 29, thence over break contacts of the steering relays CRS, BRS, and ARS, to battery through the windings of two of the read out relays RR0 through RR7. The operation of two of the read out relays RR0 through RR7 of FIG. 29 prepares the register-outpulser circuitry for outpulsing this digit. With reference to FIG. 34, the check relay RK will be operated if a proper two-out-of-five registration has taken place in the read out relays RR0 through RR7 of FIG. 29. At the moment it will be assumed that the particular call involved is not a zero operator call (relay Z0 of FIG. 26 is released), that relays DPC and SD0 of FIG. 18 are released since the register-outpulser has not sought the assistance as yet of a translator-decoder pair, that read out relay RR10 of FIG. 29 is released since it is not used for the usual two-out-of-five coding, that relay PS of FIG. 27 is released since it will be assumed that this call is not one involving a permanent signal condition, that relay TDR of FIG. 20 is released since this also is a translator-decoder control relay, and that relay DP of FIG. 15 is released since this is a TOUCH-TONE call and not a dial pulse call. Under these circumstances, a circuit is completed in FIG. 34 for causing the operation of the read out check relay RK extending from ground in FIG. 34, over make contact **16** of relay ON2, break contact **8** of relay RCA1, through a two-out-of-five contact checking network of relays RR0 through RR7, thence through break contact **2** of relay RR10, make contact **8** of relay MF1, break contact **11** of relay DP, to battery through the winding of relay RK.

As previously indicated, the operation of relay RK is an indication that a proper digital registration has been detected by the read out relays of FIG. 29 and therefore may be outpulsed where necessary. It will be recalled in the previous discussion of preparing certain of the circuits of the register-outpulser that the dial pulse generator and counting control circuit of FIGS. 19 and 22 has been in the condition with relay PG1 of FIG. 22 operated and relay PG2 of FIG. 19 released. When relay RK of FIG. 34 operates, it will be noted in FIG. 19 that break contact **6** of relay PK is opened, thereby opening the circuit to the winding of relay PG1 of FIG. 22 and allowing it to release. As will be explained in more detail later, the release of relay PG1 of FIG. 22 will cause the dial pulse generator and counting control circuit of FIGS. 19 and 22 to generate a number of pulses corresponding to the registration of the digit contained in the read out relays of FIG. 29 and will cause the transmission of this digit on a dial pulse basis over the fundamental tip ring loop to the first selector of FIG. 3.

Returning now to a continuation of the description of the in-digit registration function, relay STR of FIG. 24 will again be operated when the TOUCH-TONE converter has detected the second transmitted digit of the called number. This, in turn, will cause the operation in FIG. 24 of the third steering relay IS3 under control of make contact **9** of relay IS2. Relay IS3 will lock over its own make contact **6** to the previously described off normal ground, relay IS2 will now be locked under control of make contact **5** of relay IS3 and the operated relay STR, and ground will be applied to conductor STR1 extending toward the TOUCH-tone converter to cause the latter circuit to transmit into FIG. 38 on a two-out-of-five basis the second digit, which will thereupon be steered through break contacts of steering relay IS1 and make contacts of steering relay IS2 to become registered in the B register of FIGURE 38.

As will be made clear in subsequent description of the actual outpulsing control, when the first digit contained in the read out relays of FIG. 29 has been outpulsed, the out-digit steering circuitry of FIGS. 35 and 36 will be advanced so that relay OS1 is released and the next out-steering relay OS2 is operated. In the process of advancing the outsteering chain of FIGS. 35 and 36, the read out relays of FIG. 29 will be released when the A digit registration is removed by the release of the steering relay OS1 (see FIG. 31) and will become reoperated in accordance with the B digit registration upon the operation of the second outsteering relay OS2. This release and reoperation of the read out relays of FIG. 29 causes the release in FIG. 34 of relay RK thereby, in turn, to lock operated relay PG1 of FIG. 22 during an interdigital time measured by the circuitry of FIGS. 19 and 22, followed by the reoperation in FIG. 24 of relay RK as an indication that the second digit is ready to be read out, at which time the pulsing circuitry of FIGS. 19 and 22 is allowed to generate and transmit dial pulses in accordance with the second, or B digit, registered in FIG. 31.

In the meantime, the insteering of called digits into the registers of FIGS. 38 and 39 under control of the in-digit steering circuit of FIG. 24 continues until such times as relay PKC of FIG. 24 is operated as an indication that a complete called number has been received. Before this time (the operation of relay PKC of FIG. 24), the register-outpulser, as will be explained in more detail below, will have consulted a translator-decoder pair for switching instructions and these switching instructions will have been transmitted back to certain register relays in the register-outpulser including those of FIG. 18. Among the information transmitted to the register-outpulser during its connection with a translator-decoder pair will be the operation in FIG. 18 of one of the relays 3DG, 4DG, 5DG, 7DG, and **10**DG as an indication that the called number will contain, respectively, 3, 4, 5, 7, or 10 digits. Also, it will be noted in FIG. 21 that relay AD**01** will be operated if the digit registered in the A digit register of FIG. 38 is a ZERO (relays A4 and A7 of FIG. 38 operated) or a ONE (relays A0 and A1 of FIG. 38 operated). In either of the latter cases, the circuit for causing the operation of relay AD01 in FIG. 21 extends from off-normal ground therein, over contact **17** of relay ON1, through break contact **7** of relay PS, and (a) if the A digit is a ZERO over make contact **11** or relay A7, break contact **11** of relay A2, make contact **11** of relay A4, through break contacts **12** and **5** of relays IS5 and AD01, to negative battery through the winding of relay AD01, or (b) if the A digit is a ONE over break contact **11** of relay A7, break contact **10** of relay A4, make contact **7** of relay A0, break contact **9** of relay A2, and through break contacts **12** and **5** of relays IS5 and AD**01** to negative battery through the winding of relay AD**01**. In either of these instances (an A digit of ZERO or ONE), relay AD01 will operate and will lock in an obvious manner over its own make contact **5**. On the other hand, if the A digit is anything other than ZERO or ONE, relay AD**01** of FIG. 21 will remain released.

It will be recalled with reference to the in-digit steering circuit of FIG. 24 that the second, or B digit, will be registered in FIG. 38 upon the release of steering relay IS1, the third digit will be registered upon the release of relay IS2, et cetera. In FIG. 24, a number of circuits are arranged for controlling the relay PKC. One such circuit is completed on a three digit call (relay **3**DG of FIG. 18 operated), upon the operation of steering relay IS**4** which, in turn, occurs upon the release of steering relay IS**2** during the registration of the third, or C digit. This latter circuit extends from off-normal ground in FIG. 24, through make contact **11** of relay **3**DG and make contact **11** of relay IS4, thence through break contact **4** of relay RA2 and break contact **6** of relay PKC to negative battery through the winding of relay PKC, which thereupon operates and locks over its own make contact **6** to off-normal ground. Likewise, it will be obvious that on a four digit call (relay **4**DG of FIG. 18 operated), a circuit will be completed for operating relay PKC upon the operation of steering relay IS**5**. Similarly, with relay **5**DG of FIG. 18 operated, relay PKC will operate upon the operation in FIG. 24 of the steering relay IS**6**. With respect to a seven digit call (relay **7**DG of FIG. 18 operated), relay PKC will be operated upon the operation of steering relay IS**8**, provided the A digit is not ZERO or ONE (relay AD**01** of FIG. 21 released). On the other hand, if the A digit is a ZERO or a ONE, then relay PKC of FIG. 24 will not be operated until the operation of steering relay IS**9**. On a ten digit call (relay **10**DG of FIG. 18 operated), relay PKC will be operated when the eleventh steering relay IS**11** is operated provided that the A digit is not a ZERO or a ONE, this action taking place as before upon the release of steering relay IS**9**. On the other hand, if the A digit is a ZERO or a ONE, then relay PKC will operate only after steering relay IS**10** is released, that is, during the registration of the eleventh digit in the L digit register of FIG. 39.

When relay PKC of FIG. 24 operates as an indication that called digit registration is complete, the steering chain of FIG. 24 is stopped from advancing because the operation of relay PKC at its transfer contacts **7** in FIG. 24 removes control of the steering chain from the transfer contacts No. **3** of relay STR. This, in turn, will cause the last operated steering relay to become released, leaving relay PKC operated and locked to off-normal ground, leaving relay STR released, and preventing any further ground signals to be sent to the TOUCH-TONE converter over conductor STR1.

### REGISTERING DIAL PULSE DIGITS

When a call from a dial pulse customer is to be served by the register-outpulser, relay L1 of FIG. 9 will respond to the dial pulses, releasing when the tip and ring leads are opened and reoperating when these leads are closed. The subscriber dial control circuitry of FIGS. 12 and 15 is arranged to count the pulses of these successive digits and to cause these digits to be transmitted to FIG. 38 thereby to be steered into successive ones of the digit registers of FIGS. 38 and 39. The outsteering and outpulsing control circuit of FIG. 34 will not be effective to cause the operation of the readout check relay RK under these circumstances because, as will be described below, relay DP of FIG. 15 will be operated as an indication that this is a dial pulse call, whereupon, in FIG. 34 no circuit is completed for causing the operation of relay RK since relay TDR has its make contact **9** opened because no translator-decoder pair has been consulted as yet. Therefore, in FIGS. 19 and 22 relay PG1 of FIG. 22 will remain operated and relay PG2 of FIG. 19 will remain released, at least during the initial digital registrations in the register of FIGS. 38 and 39. In other words, the dial pulse generator and counting control circuitry of FIGS. 19 and 22 will not generate and transmit to the switching train dial pulse digits in accordance with those registered in FIGS. 38 and 39.

In lieu of this pulse generation, previously described in connection with the TOUCH-TONE call, the operations and releases in FIG. 9 of relay L1 responsive to the calling subscriber's dial pulses will control the circuitry of FIG. 10, particularly through the agency of make contact **6** of relay L1, to repeat the dial pulses to the outgoing switch train of FIGS. 3, 4 and 5. In this connection it will be recalled that the tip and ring loop from the calling end of the connection extends into FIG. 9 over conductors T and R from FIG. 8, thence over break contacts **8** and **9** of relay PT2, make contacts **3** and **1** of relay REC, and thence to ground and negative battery through the respective lower and upper windings of relay L1 which is operated in the calling loop and which will release and reoperate responsive to dial pulses therein. It will also be recalled that the tip and ring loop from the first selector of FIG. 3 extends down into FIG. 10 and to conductors FT and FR, the loop being completed from conductor FT in FIG. 10 through a network of contacts in the lower central part of FIG. 10, involving make and break contacts of various relays, to conductor FR1 thence over break contact **6** of relays RCA and TMF, thence over make contact **9** of relay REC, through resistance FT1, over make contact **5** of relay BTDC, thence through the winding of relay RV (which remains released), thence over conductor BTDC into FIG. 9, through the winding of relay LT (operated to indicate a closed loop to the selector), thence over make contact **3** of relay ON2, through resistance FR1, make contact **11** of relay REC, to conductor A extending back into FIG. 10, and through break contact **8** of relay TMF to the ring conductor FR. In regard to the latter circuit closing the loop to the first selector, the pulsing control for dial pulse purposes is rendered effective in this loop in the contact chain in the lower central part of FIG. 10 between the conductors FR1 and FT. Under the assumed circumstances where dial pulses are beginning to be counted from the calling party and the successive digits are about to be registered in the digit registers of FIGS. 38 and 39, with reference to this contact network in FIG. 10 relay SD0 will be released, relay PKC will be released, relays IC and W will be released, relay TMF will be released, relay RK will be released and relay PG1 will be operated. Thus, make contact **6** of relay L1 is the only contact completing the loop circuit between conductors FR1 and FT with the assistance of break contact **4** of relay RK and make contact **1** of relay PG1. Since, as above described, relay RK of FIG. 34 will not be operated, and since the dial pulse generator and counting control circuitry of FIGS. 19 and 22 will not be brought into play (relay PG1 of FIG. 22 remaining operated), it will be apparent immediately that make contact **6** of relay L1 in FIG. 10 will open and close the loop to the first selector to repeat the dial pulses detected by relay L1 from the calling loop in FIG. 9.

Upon the first release of relay L1 in FIG. 9 responsive to the first open loop pulse from the calling party make contact **6** of relay L1 in FIG. 10 will open thereby to repeat this first open pulse period to the first selector of FIG. 3 causing the first selector to step vertically one step. The first release of relay L1 will also complete a circuit in FIG. 15 causing relay RA to operate in a circuit extending from ground, over make contact **24** of relay ON1, to break contact **2** of relay L1, and make contact **8** of relay L2 (which remains operated due to its slow-release characteristic during pulses of a digit when relay L1 is released), thence to negative battery through the winding of relay RA. Relay RA operates and completes a circuit over its own make contact **12** to cause itself to have a slow-releasing characteristic to hold over operations of relay L1 between open loop pulses of each digit. Relay RA, in operating, completes a circuit for causing the operation in FIG. 15 of relay DP extending from ground in FIG. 15, over break contact **9** of relay ROA, make contact **10** of relay RA, break contact **2** of relay DP, to negative battery through the winding of relay DP, which thereupon operates and locks to off-normal ground over its own make contact **2**. Relay DP, in operating, removes dial tone in FIG. 9 from the calling end of the connection at its transfer contacts **4**, and in FIG. 34 at its transfer contacts **11** prevents the operation of the read-out check relay RK until relay TDR becomes operative (which will occur only after the translator-decoder usage which occurs sometime subsequent to the instant situation). Upon the operation of relay DP of FIG. 15, a circuit is completed for causing the operation in FIG. 17 of the party retest relay PR, this circuit extending from ground in FIG. 35 over make contact **4** of relay ON1, conductor **30** extending into FIG. 17, thence over make contact **2** over relay PT5, break contact **6** of relay PT7, make contact **10** of relay DP, through the winding of relay PR to negative battery through resistance PR, relay PR operating in this circuit and locking to off-normal ground over its make contact **8**. The operation of relay PR prepares the party retest circuitry of FIGS. 14 and 17 to verify the original party test situation at the end of inpulsing of the first digit, as will be described hereinafter.

Upon the operation in FIG. 15 of relay RA, as an indication of the first open period dial pulse from the calling line, relay RA2 is operated in an obvious manner over make contact **6** of relay RA, the operation of relay RA2 thereupon causing the release in FIG. 15 of relay RA1. With relay RA1 released and relay LA of FIG. 15 released, a circuit is completed in FIG. 15 for causing the operation of the first inpulse counting relay IP1 extending from ground in FIG. 15, over make contact **2** of relay ON2, break contact **9** of relay RA1, break contact **6** of relay LA, break contact **12** of relay IP2, to negative battery through the winding of relay IP1, which thereupon operates and locks to off-normal ground over its own make contact **8** and make contact **2** of relay RA2. In the meantime, in the in-digit steering circuit of FIG. 24, upon the operation of relay RA of FIG. 15 (during the first open loop period release of the line relay L1 of FIG. 9), a circuit is completed for causing the operation of relay STR extending from off-normal ground in FIG. 24, make contact **7** of relay REC, make contact **2** of relay RA to negative battery through the winding of relay STR. It will be noted that make contact **10** of relay RA2 is in parallel with make contact **2** of relay RA so that relay STR of FIG. 24 remains operated until both of these relays are released. Upon the operation of relay STR in FIG. 24, a circuit is completed for operating the second in-digit steering relay IS2 extending from off-normal ground in FIG. 24, over make contact **3** of relay STR, break contact **7** of relay PKC, make contact **9** of relay IS1, break contact **6** of relay IS2, to negative battery through the winding of relay IS2, which thereupon operates and locks over its own make contact **6** to off-normal ground through the chain of No. 5 break contacts through the remaining steering relays, relay IS1 remaining locked over make contact **5** of relay IS2 to the off-normal ground controlled by make contact **3** of relay STR.

Each time relay L1 of FIG. 9 releases and reoperates in response to each dial pulse from the calling line, relay LA of FIG. 15 will release and will reoperate. Relays L1 of FIG. 9 and LA of FIG. 15 will therefore release and reoperate responsive to each dial pulse from the calling line until such time as relay L1 remains operated at the end of the first digit, whereupon relay RA of FIG. 15 (whose slow release characteristic allows it to remain operated over the closed loop periods when relay L1 is operated) will release to indicate the interdigital pause. The releases and reoperations of relay LA of FIG. 15 will control the impulse counting circuit comprising relays IP1 through IP5 of FIG. 15 to count the number of pulses in each digit. When relay LA of FIG. 15 reoperates at the end of the first pulse of the first digit, relay IP2 in FIG. 15 operates in a circuit extending from off-normal ground, over make contact 8 of relay RA2, make contact **10** of relay LA, make contact **11** of relay IP1, break contact 6 of relay IP2, to negative battery through the winding of relay IP2. Relay IP2 thereupon operates and locks over its own make contact **6**, make contact **8** of relay IP1, to off-normal ground over make contact 2 of relay RA2, relay IP1 remaining locked operated in a circuit extending from the left side of its winding, over make contact **12** of relay IP2, make contacts **11** and **10** of relays IP1 and LA, to off-normal ground over make contact **8** of relay RA2. Upon the release of relay LA of FIG. 15 responsive to the next release of relay L1 of FIG. 9 during the second open dial pulse period from the calling line, the locking circuit for relay IP1 in FIG. 15 is opened at make contact **10** of relay LA, thereupon allowing relay IP1 to release, relay IP2 remaining operated under control of break contact **6** of relay LA. Upon the release of relay IP1, a circuit is completed for operating relay IP3 from off-normal ground, over make contact **2** of relay RA2, make contact **4** of relay IP2, break contact **4** of relay IP1, break contacts **6** of relays IP5 and IP4, to negative battery through the winding of relay IP3, which thereupon operates and locks over its own make contact **11**, break contact **8** of relay IP1, and over make contact **2** of relay RA2 to off-normal ground. Upon the next operation of relay LA (at the end of the second pulse), relay IP2 is released by the opening of break contact **6** of relay LA. Upon the next release of relay LA, a circuit is completed for reoperating relay IP1 under control of break contact **6** of relay LA, relay IP1 locking as previously described over its own make contact **8**. Upon the next reoperation of relay LA, relay IP2 is reoperated in a circuit previously described and locked over its own make contact **6** to off-normal ground under control of make contact **8** of relay IP1, relay IP1 remaining locked under control of make contact **12** of relay IP2 as previously described. Upon the reoperation of relay IP2, a circuit is completed for causing the operation of relay IP4 in a circuit extending from off-normal ground, over make contact **2** of relay RA2, make contact **4** of relay IP2, make contact **4** of relay IP1, make contact **1** of relay IP3, break contack **7** of relay IP5, to negative battery through the winding of relay IP4, relay IP4 operating and locking over its own make contact **11** and break contact **8** of relay IP5, to off-normal ground over make contact **2** of relay RA2. Upon the release of relay LA during the fourth pulse, relay IP1 will release, allowing relay IP2 to release upon the next reoperation of relay LA at the end of the fourth pulse, and permitting relay IP1 to become reoperated upon the next release of relay LA during the fifth pulse. Upon this reoperation of relay IP1, relay IP3 is released, whereby upon the next reoperation of relay LA at the end of the fifth pulse, a circuit is completed for causing the reoperation of relay IP2. During the sixth pulse, upon the release of relay LA, relay IP1 is again released, so that upon the reoperation of relay LA at the end of the sixth pulse, relay IP2 is released, to in turn permit the operation of relay IP5 in a circuit extending from off-normal ground in FIG. 15, over make contact **2** of relay RA2, over break contacts **4**, **10** and **4** of relays IP2, IP1 and IP3, over make contact **1** of relay IP4, to negative battery through the winding of relay IP5, which thereupon operates and locks to off-normal ground over its own make contact **8** and make contact **2** of relay RA2. By a similar circuit operation, at the end of a seventh pulse, relays IP1, IP2, IP4 and IP5 will be operated; at the end of an eighth pulse, relays IP3, IP4 and IP5 will be operated; at the end of a ninth pulse, relays IP1, IP2, IP3 and IP5 will be operated; and, at the end of a tenth pulse relays IP3 and IP5 will be operated. The pulse count situation for the subscriber dial control circuit of FIG. 15 is summarized in the following table:



| Digit pulses: | Operated relays |
|---|---|
| 1 | IP1, IP2 |
| 2 | IP3 |
| 3 | IP1, IP2, IP3, IP4 |
| 4 | IP3, IP4 |
| 5 | IP1, IP2, IP4 |
| 6 | IP4, IP5 |
| 7 | IP1, IP2, IP4, IP5 |
| 8 | IP3, IP4, IP5 |
| 9 | IP1, IP2, IP3, IP5 |
| 10 | IP3, IP5 |

At the end of a digit, relay L1 of FIG. 9 will remain operated due to the closed calling loop, whereupon relay LA of FIG. 15 will remain operated and relay RA of FIG. 15 will release after an interval of time measured by its slow-release characteristic, the release of relay RA being an indication of the interdigital pause. Upon the release in FIG. 15 of relay RA, relay RA2 will become released to complete circuits for transmitting on a two-out-of-five basis the pulse count existing in the relays IP– of FIG. 15 into the A digit register of FIG. 38. This circuit extends from off-normal ground in FIG. 15, over make contact **2** of relay ON2, and over break contacts **2** and **8** of relay RA2 to the contact configuration network of the IP– relays in FIGS. 12 and 15 to energize in FIG. 12 two-out-of-five of the conductors S0 through S7 extending into FIG. 38 and thence over make contacts of the in-digit steering relay IS1 to operate two of the five A digit relays A0 through A7, which thereupon lock over their own make contacts to off-normal ground. The release in FIG. 15 of relays RA and RA2 causes the release in FIG. 24 of relay STR, which allows the release of the first steering relay IS1, leaving relay IS2 locked in the circuit previously described. In the meantime, the reoperation in FIG. 15 of relay RA1 causes the release of all of the in-digit counting relays IP1 through IP5 as may be operated, thereby to remove from the five conductors S0 through S7 in FIG. 12 the energizing grounds extending into the digit register of FIG. 38, thereby preventing the double registration of this digit in the B digit register of FIG. 38 when the input steering relay IS1 of FIG. 24 releases. The in-digit steering circuit of FIG. 24 and the pulse counting circuitry of FIG. 15 are now in condition for counting the second dialed digit. As soon as relay L1 of FIG. 9 releases in response to the first pulse of the second digit, relay RA of FIG. 15 will reoperate, thereby to reoperate relay STR in FIG. 24 to in turn cause the operation of relay IS3 in FIG. 24 under control of make contact **9** of relay IS2 and break contact **9** of relay IS1 to prepare the register circuit of FIG. 38 for accepting the third digit at such time as the second steering relay IS2 releases.

As was mentioned hereinbefore, it will be noted in FIG. 10, particularly with respect to make contact **6** of relay L1 shown thereon, that the pulsing loop to the first selector of FIG. 3 between conductors FR1 and FT in FIG. 10 is opened and closed responsive to each pulse of each digit, thereby to repeat to the selector switch train each of the dial pulse digits recognized by relay L1 of FIG. 9.

During the first interdigital timing interval a circuit is completed in the party test circuit of FIGS. 14 and 17 for making a party retest in order to verify the original party test made at the beginning of the call. Upon the release in FIG. 15 of relay RA at the first interdigital interval, a circuit is completed in FIG. 17 for causing the operation of relay PT7 from ground, over break contact **7** of relay

RA, make contact **6** of relay DP, and break contact **8** of relay PT7, relay PT7 operating in this circuit and locking over its own make contact **8** to off-normal ground on conductor **30** and extending this off-normal ground over make contacts **2** and **6** of relays PT5 and PT7 and make contact **6** of relay PR to conductor **33** extending into FIG. 22 and thence over make contact **11** of relay PG1 to maintain relay PG1 operated during this test interval. Upon the operation in FIG. 17 of relay PT7, relay PT1 of FIG. 14 is reoperated over its lower secondary winding in a circuit extending from negative battery, through the lower winding of relay PT1, over either of the transfer contacts No. **6** of relay RP, thence through break contacts **6** and **11** of relay PT3 and PT2, make contact **2** of relay PR, make contact **5** of relay DP, make contact **1** of relay PT7, to off-normal ground over make contacts **4** and **12** of relays FR and TR1. Relay PT1, in operating, extends its operating ground over make contact **7** of relay PT1, thence over break contacts **8** and **6** of relay ROD and RL, thence over the transfer contacts of relays RP and TP, make contact **4** of relay PT7, to negative battery through the lower winding of relay PT2, which thereupon operates. The operation of relay PT2, as has been described hereinbefore, connects the upper secondary winding of relay PT of FIG. 14 in parallel to the tip and ring conductors of FIG. 9 back to the calling subscriber's line circuit. It will be recalled under these circumstances that in the event that the calling party is a tip party ground will be present in the tip-ring loop, thereby to cause the operation in FIG. 14 of relay PT; whereas, if the calling party is a ring party relay PT of FIG. 14 will remain released. Eventually, after approximately 60 milliseconds delay, relay PT1 will become released as previously described. Thereupon a circuit is completed in FIG. 14 to apply ground potential to the upper winding of relay PR in FIG. 17 to shunt down and thereby cause the release of relay PR in the event that the party retest matches the previous party test. This circuit extends from ground in FIG. 14 over make contact **11** of relay ON1, break contact **5** of relay ROA, make contact **3** of relay PT2, make contact **4** of relay PR, through break contact **7** of relay PT1 to the transfer contacts **7** of relay PT.

In the circuit of FIG. 14, ground appearing at transfer contact **7** of relay PT will be extended to conductor PR1 leading into FIG. 17 thereby to shunt down relay PR only in the event that the present party retest matches the party test that had previously been made. If the previous party test had indicated a tip party, then relay TP of FIG. 14 will be operated and relay RP will be released; whereas, if the previous test indicated a ring party then relay RP of FIG. 14 will be operated and relay TP will be released. In the present party retest, if the party retest detects a tip party then relay PT of FIG. 14 will operate; whereas, if the present party retest indicates a ring party then relay PT will remain released. Under these circumstances it will be obvious by inspecting the contact configuration in FIG. 14 between transfer contacts **7** of relay PT and conductor PR1 that relay PR of FIG. 17 will be shunted down only in the event that the retest corresponds with the original party test. For instance, if the present indication is that the calling party is a tip party (relay PT of FIG. 14 operated), then a circuit will be completed from transfer contact **7** of relay PT, through make contact **7** thereof, through break contact **3** of relay PT3, make contact **7** of relay PT7, and break contact **8** of relay RP to conductor PR1 extending into FIG. 17 to cause the release therein of relay PR. The release of relay PR in FIG. 17 will cause the release in FIG. 14 of relay PT2 and the release of relay PT (if operated), the release of relay PT2 causing the tip and ring conductors in FIG. 9 to be returned to their original through-transmission condition to the winding of relay L1. In FIG. 14, in the event that the party retest does not match the original party test the ground at transfer contact **7** of relay PT will be exended through diode RO and to conductor RO into the timing control circuit of FIG. 27 for a purpose to be described hereinafter.



It may be noted at this point in passing that on calls involving incoming TOUCH-TONE signaling, party retest will be made just prior to outpulsing of the last digit except in situations involving conflicting office and area codes. In these circumstances the register-outpulser is prepared for making party retest after the fifth digit (exclusive of any exit digits) has been outpulsed as indicated by the operation to be described more in detail hereinafter of the outsteering relay OS6 of FIG. 35. The party retest relay PR of FIG. 17 will be operated at this time in a circuit extending from off normal ground in FIG. 35, over make contact **4** of relay ON1, conductor **30** extending into FIG. 17, thence over make contact **2** of relay PT5, break contact **6** of relay PT7, make contact **9** of relay OS6, through the winding of relay PR to negative battery through resistance PR, relay PR operating in this circuit and locking to off normal ground on conductor **30** over its own make contact **8**. As will appear more clearly hereinafter, under these circumstances in FIG. 18 one of the two information relays 7DG and 10DG will be operated from the translator-decoder as an indication to the register-outpulser that this call will involve 7 or 10 digits. For instance, on a seven digit call (relay 7DG of FIG. 18 operated) a circuit is completed for operating relay PT7 of FIG. 17 after the outpulsing of the digit in the sixth position (the F digit in FIG. 31) and before the outpulsing of the seventh or last digit. Ground will extend in FIG. 36, over break contact **3** of relay W (released during the interdigital time between digit transmissions), thence over make contact **12** of relay 7DG, break contact **2** of relay CCT, break contact **7** of relay ADO1 (released under the assumption that the A digit is not a zero or a one), thence over make contact **2** of relay 7DG, make contact **12** of relay OS7, conductor A into FIG. 35, thence through the chain of No. **12** back contacts of all of the preceding outsteering relays OS6 through OS1, conductor AS1 extending into FIG. 16, thence over back contacts **11** of the steering relays FRS through ARS, thence over back contacts **8** and **9** of relays RCS and RCA, conductor AS2 extending into FIG. 35, over back contact **4** of relay W, through diode PR, conductor PR extending into FIG. 17, thence over make contact **4** of relay 7DG, and break contacts **6** and **8** of relays DP and PT7, to negative battery through the winding of relay PT7. Relay PT7 operates and locks over its own make contact **8** to off-normal ground on conductor **30** extending thereto from FIG. 35. The locking ground on conductor **30** in FIG. 17 is extended over make contacts **2**, **6**, and **6** of relays PT5, PT7 and PR to conductor **33** extending into FIG. 22, thence over make contact **11** of relay PG1 to cause relay PG1 to become locked operated during the party retest. The locking of relay PG1 of FIG. 22 causes the dial pulse generator and counting control circuitry of FIGS. 19 and 22 to stop developing dial pulse transmission, if this were the case.

Party retest on information calls is controlled by relay IPR of FIG. 21. Such calls will be of the type 1+411 and 1+*NPA*+411 (NPA is a national area code). If the digit registered in the A position of FIG. 38 is a 1 and the digit registered in the B position is a 4, relay IPR of FIG. 21 will operate in a circuit extending from off-normal ground in FIG. 21, over make contact **17** of relay ON1, break contact **7** of relay PS, break contacts **11** and **10** of relays A7 and A4, thence over make contact **7** of relay A0, break contact **2** of relay A2, make contact **6** of relay A0, break contact **2** of relay B1, and make contacts **3** of relays B0 and B4 to negative battery over make contact **1** of relay FR and through the winding of relay IPR. In FIG. 17, make contact **9** of relay IPR will allow relay PT7 to operate to cause party retest after the register-outpulser has outpulsed four digits under circumstances where the translator-decoder has operated relay **4DG** of FIG. 18 indicating that this is a four digit call. Under these circumstances the circuit for operating relay **PT7** of FIG. 17 extends from ground in FIG. 36, over break contact **3** of relay W, conductor B extending into FIG. 35, thence over make contacts **11** and **4** of relays IPR and **4DG**, make contact **12** of relay **OS5**, thence over break contacts **12** of all of the preceding outsteering relays, and over a circuit previously described including conductors **AS1** and **AS2** of FIG. 35 to conductor PR extending from FIG. 35 into FIG. 17, thence to cause the operation of relay **PT7** under control of make contact **9** of relay IPR. On a call of an information nature, such as $1+NPA+411$, the E digit in FIG. 31 will be 4, the F digit will be 1, and the G digit will be 1, thereby causing the operation in FIG. 38 of all of the relays **ED0**, **ED4**, **FD0**, **FD1**, **GD0**, and **GD1**. Thus, in FIG. 21, relay IPR is operated in a circuit extending from its winding through make contact **1** of relay FR, make contact **9** of relay **GD1**, make contact **6** of relay **A0**, back contact **9** of relay **A2**, make contact **7** of relay **A0** to the previously described off-normal ground under control of break contacts **10**, **11** and **7** of relays A4, A7 and PS.

### DIAL PULSE GENERATION

The dial pulse generator and counting control circuitry of FIGS. 19 and 22 is utilized to generate dial pulse digits for controlling the outgoing switch train of FIGS. 3, 4 and 5 under control of the arbitrary exit digit registers of FIGS. 32 and 33 and of the called digit registers of FIGS. 38 and 39, in turn controlled by the exit digit steering circuitry of FIG. 16 and by the called digit steering circuitry of FIGS. 35 and 36. As has been mentioned previously, any incoming dial pulse digits from the calling line and which are to be used to control the selectors of FIGS. 3, 4 and 5 are repeated by virtue of make contact **6** of relay **L1** in FIG. 10. Whenever the dial pulse generator and counting control circuitry of FIGS. 19 and 22 is used for controlling the selectors of FIGS. 3, 4 and 5, make contact No. **1** of relay **PG1** in FIG. 10 is used to control pulsing of the loop to the selector circuitry. It will be recalled, in connection with previous discussion of incoming TOUCH-TONE called digits that relay L1 of FIG. 9 remains operated over the calling loop and that under these circumstances the outsteering and outpulsing control circuit of FIG. 34 will detect the registration in the readout relays RRO through RR7 of FIG. 29 of each digit as it is registered in the called digit registers of FIGS. 38 and 39, thereby to cause the operation in FIG. 34 of the readout check relay RK. In FIG. 10 it will be noted that whenever this check relay RK is operated, it opens its back contact **4**, thereby allowing make contact **1** of relay **PG1** to be utilized to control the pulsing loop to the first selector. It will also be recalled that upon the operation of readout check relay RK of FIG. 34, break contact **6** in FIG. 19 opens the locking circuit for relay **PG1**, which previously had been locked in a circuit extending through break contact **6** of relay RK, break contact **7** of relay IC and break contact **5** of relay W to off-normal ground from FIG. 22 on conductor L. There are a number of circuit situations which may occur from time to time and which will cause relay **PG1** of FIG. 22 to be locked in the operated condition, thereby to stop the oscillation of relays **PG1** and **PG2** to prevent further generation of dial pulse digits. These locking circuits for clamping the pulse generator of FIGS. 19 and 22 will be mentioned from time to time as the circuitry is pertinent to the discussion. At the moment the basic operation of this pulse generating circuitry will be described generally.

Whenever the locking circuit for relay **PG1** of FIG. 22 is opened, relay **PG1** will be allowed to release. Relay **PG1**, in releasing, completes a circuit for discharging condensers PGA through PGF of FIG. 19 through the lower primary winding of relay **PG2**, thereby causing a discharge current to flow from right to left through the lower primary winding. This latter circuit extends from ground in FIG. 22, over make contact **10** of relay **ON1**, break contact **7** of relay RL, conductor L extending into FIG. 19, break contact **4** of relay **PG1**, through the lower winding of relay **PG2**, through condensers PGA through PGF to negative resistance battery. This discharge current flowing from right to left in the lower winding of relay **PG2** maintains relay **PG2** in a released condition even though the upper or secondary winding of relay **PG2** also carries a current flowing from right to left therethrough. When condensers PGA through PGF have become discharged to a certain level, such as to cause the discharge current to have become considerably reduced, the current flowing in the upper secondary winding of relay **PG2** takes control and causes relay **PG2** to operate. When relay **PG2** operates relay **PG1** reoperates in an obvious circuit in FIG. 22 under control of make contact **3** of relay **PG2**. When relay **PG1** operates, circuits are completed for causing condensers PGA through PGF of FIG. 19 to again carry charging current from left to right through the lower primary winding of relay **PG2** in a circuit extending from ground on conductor L in FIG. 19, through make contact **4** of relay **PG1**, through condensers PGA through PGF, the lower winding of relay **PG2**, and thence to negative battery through break contact **6** of relay TMFA and through resistance **PG6–8**. This left-to-right charging current through the lower winding of relay **PG2** maintains this relay operated even though the upper secondary winding is carrying current from left to right tending to cause relay **PG2** to release. After condensers PGA through PGF have charged sufficiently the current will have dropped to a point where the current through the upper secondary winding will again take control, causing relay **PG2** to become released. This release of relay **PG2** causes the release of relay **PG1**; and, this oscillating condition of relays **PG1** and **PG2** continues to repeat itself until some other circuit operation takes place to provide a locking circuit for clamping relay **PG1** in the operated condition, thereby to cause relay **PG1** to remain in an operated condition regardless of the released or operated condition of relay **PG2**. The time during which relay **PG1** is released is referred to as an open loop period of pulsing because (see make contact **1** of relay **PG1** in FIG. 10) when relay **PG1** is released the fundamental tip-ring loop to the selectors of FIGS. 3, 4 and 5 is opened. The time during which relay **PG1** is operated is similarly referred to as a closed loop period. As will be more apparent from description to be provided hereinafter, whenever the dial pulse generator and counting control circuit of FIGS. 19 and 22 is to be used for developing dial pulsing (such as to control the selectors of FIGS. 3, 4 and 5), relays TMFA of FIG. 29 and **TMF2** of FIG. 33 will both be released, thereby adjusting the resistances in the circuit of FIG. 19 such that the pulsing rate of relay **PG1** of FIG. 22 will be adjusted to approximately ten pulses per second (p.p.s.) with a 35 millisecond (ms.) closed loop period and a 65 ms. open loop period. For transmitting the so-called KP pulse ahead of multifrequency pulse transmission, relay TMFA of FIG. 29 will be operated, thereby changing the pulsing rate of relay **PG1** to 5 p.p.s. with a 100 ms. closed period and a 100 ms. open period; and, for MF outpulsing, relays TMFA of FIG. 29 and **TMF2** of FIG. 33 will both be operated, thereby adjusting the pulsing rate of relay **PG1** to approximately 7 p.p.s. with a 75 ms. closed loop period and a 75 ms. open loop period.

During the outpulsing of dial pulse digits for controlling the selectors of FIGS. 3, 4 and 5, it is necessary for the circuitry to manufacture an interdigital time. This interdigital time control is exercised by the output pulse counting relays P1 through P5 of FIGS, 19 and 22 and by the control thereof over relay IC in FIG.

22, as additionally controlled by the readout relays RRO through RR7 of FIG. 29. During dial pulsing the pulse counting circuit comprising relays P1 through P5 of FIGS. 22 and 19 counts the number of pulses (releases and reoperations of relay PG1 of FIG. 22) and the pulse count on these relays is compared in the matching circuit in the lower right-hand part of FIG. 22 to the digit presently represented by the operated condition of the readout relays RRO through RR7 of FIG. 29. When these two are equal, relay IC in FIG. 22 is operated to stop the outpulsing (see FIG. 10 where make contact **1** of relay IC is arranged in shunt of make contact **1** of relay PG1) and to start an interdigital timing period during which the switching digit outsteering circuitry of FIGS. 35 and 36 advances, the pulse counting circuitry of FIGS. 19 and 22 is recycled, the readout relays RRO through RR7 of FIG. 29 are released and reoperated in accordance with the next digit, and this next digit is outpulsed. When the so-called KP pulse (preceding multifrequency pulse transmission) or an actual multifrequency pulse is to be transmitted, the pulse counting and comparing circuitry of FIGS. 19 and 22 is not utilized (see break contact **10** of relay TMFA in FIG. 19), the pulsing of the dual frequency pulse transmission being controlled by relay PG1 alone. It is considered unnecessary to describe in detail the circuit operation of the pulse counting relays P1 through P5 of FIGS. 22 and 19 since the operation of these relays is the same as the previously described description of the subscriber dial control circuit of FIG. 15 with respect to the input pulse counting relays IP1 through IP5. These relays P1 through P5 of FIGS. 22 and 19 count the successive releases of relay PG1 such that when relay PG1 reoperates at the end of one pulse only relays P1 and P2 are operated, at the end of two pulses relay P3 alone is operated, at the end of three pulses only relays P1, P2, P3 and P4 are operated, at the end of pulse **4** only relays P3 and P4 are operated, at the end of five pulses only relays P1, P2 and P4 are operated, at the end of six pulses only relays P4 and P5 are operated, at the end of seven pulses only relays P1, P2, P4 and P5 are operated, at the end of eight pulses only relays P3, P4 and P5 are operated, at the end of nine pulses only relays P1, P2, P3 and P5 are operated, and at the end of ten pulses only relays P3 and P5 are operated. Each time relay PG1 reoperates at the end of a particular pulse the winding of relay IC in FIG. 22 is connected over make contact **6** of relay PG1 to a matching network of contacts of the counting relays P1 through P5 and of the readout relays RRO through RR7 of FIG. 29 in order that relay IC will operate whenever the output pulse count matches the digital value then contained in the readout relays of FIG. 29. For instance, if the readout relays of FIG. 29 contain the digit 3, as evidenced by the operation of relays RR1 and RR2, when the output pulse counting relays P1 through P5 have counted three pulses (only relays P1, P2, P3 and P4 operated), a circuit is completed through the contact matching network in FIG. 22 as an indication that the output pulse count matches the digit presently in the readout relays of FIG. 29.

This circuit under the assumed example will extend from negative battery in FIG. 22, through the winding of relay IC, over make contact **6** of relay PG1, make contacts **2** of relays P1 and P3, break contact **12** of relay P5, make contacts **6** of relays RR1 and RR2, and thence through break contact **4** of relay Z, to ground on conductor D extending thereto from FIG. 35. Upon the next release of relay PG1, relay IC locks in a circuit extending over break contact **6** of relay PG1, make contact **2** of relay IC, and thence to ground on conductor D through break contacts **11** and **7** of relays TMFA and RCA. Also, it will be noted that upon the release of relay PG1 with relay IC operated, all of the operated ones of the counting relays P1 through P5 are released to their normal condition. Upon the operation of relay IC of FIG. 22 a circuit is completed in FIG. 34 for causing the operation of relay W extending from ground, over make contact **16** of Relay ON2, break contact **8** of relay RCA1, make contact **6** of relay IC, break contact **8** of relay TMFA, break contact **6** of relay Z, to negative battery through the winding of relay W. It will be noted in FIG. 35 that upon the operation of relay W of FIG. 34 a circuit is completed for causing the operation of the second out-digit steering relay OS2 of FIG. 35. This circuit extends from ground in FIG. 35, over make contact **4** of relay ON1, through make contact **4** of relay W, thence over conductor AS2 into FIG. 16 and returning from FIG. 16 into FIG. 35 on conductor AS1, over make contact **12** of relay OS1, through break contact **6** of relay OS2, to negative battery through the winding of relay OS2. Relay OS2 operates and locks over its own make contact **6** to the previously described locking circuit on conductor C extending from FIG. 35 into FIG. 36, relay OS1 remaining locked under control of make contact **5** of relay OS2, conductor AS5 extending into FIG. 16, and thence returning therefrom on conductor AS2 into FIG. 35 to off-normal ground. The first steering relay OS1 in FIG. 35, in remaining operated, prevents the operation of the second steering relay OS2 from affecting the condition at this particular instant of the operated readout relays RRO through RR7 of FIG. 29. Prior to this particular circuit operation, the first digit will have been outpulsed into the first selector of FIG. 3, thereby having driven the first selector to its second level where it proceeds to hunt for and seize an idle second selector during the interdigital timing which is presently underway.

Eventually relays PG1 of FIG. 22 and PG2 of FIG. 19 will become reoperated at which time relay IC of FIG. 22 is released, to in turn cause the operation in FIG. 34 of relay Z. Relay Z operates in a circuit extending from ground in FIG. 34 previously traced, over break contact **6** of relay IC, break contact **7** of relay TMFA, make contact **10** of relay W, break contact **12** of relay Z to battery through the winding of relay Z, which thereupon locks over its own make contact **12** and make contact **12** of relay W to off-normal ground. In FIG. 22, the operation of relay Z completes a circuit from ground on conductor D extending into FIG. 22 from FIG. 35, and thence over make contact **4** of relay Z to a contact network which will complete the ground circuit therethrough to make contact **6** of relay PG1 when the pulse counting circuit of FIGS. 19 and 22 has reached a pulse count of 4 (relays P3 and P4 of FIG. 19 operated), this representing the end of the interdigital timing interval. This circuit is completed in FIG. 22 from make contact **4** of relay Z, through make contact **10** of relay P4, break contact **10** of relay P5, make contact **10** of relay P3, and break contact **2** of relay P1. Eventually, relay PG1 of FIG. 22 will have released and reoperated four times, thereby completing the previously described count-of-four circuit in the contact network of FIG. 22. Upon the reoperation of relay PG1, subsequent to having produced four dial pulses, a circuit is again completed for causing the operation of relay IC of FIG. 22 under control of this above-mentioned count-of-four circuitry in FIG. 22. Upon the reoperation of relay IC, relay W of FIG. 34 is released, thereby causing the release in FIG. 35 of the first out-digit steering steering relay OS1. Upon the release of the steering relay OS1 of FIG. 35 the readout relays of FIG. 29 will become released as far as the first digit is concerned and will immediately reoperate in a new pattern according to the digit registered in the second digit register corresponding to out-digit steering relay OS2 of FIG. 35. The release and reoperation of the readout relays of FIG. 29 will cause the release in FIG. 34 of the readout check relay RK, followed immediately by the reoperation of this check relay RK as an indication that the next digit has properly been registered in the readout relays of FIG. 29. Relays PG1 and PG2 of FIGS. 22 and 19 continue to oscillate and upon the next release of relay PG1 the pulse counting circuit of FIGS. 19 and 22 will be recycled to normal and relay IC of FIG. 22 will remain locked operated under control of the released relay PG1. Eventually relays PG2 and PG1 again reoperate and upon this subsequent operation of relay PG1, relay IC of FIG. 22 is released to in turn cause the release in FIG. 34 of relay Z, thereby returning the interdigital timing circuitry to its normal condition. The reoperation of relay PG1 also causes the release of relay PG2 which in turn allows relay PG1 to become released as soon as the readout check relay RK is reoperated. This circuit operation has reset the entire outpulsing mechanism preparatory to outpulsing the first pulse of the second exit digit, it being noted at this point that relays IC of FIG. 22 and W of FIG. 34 are both released and that relay RK of FIG. 34 is operated so that make contact **1** of relay PG1 in FIG. 10 may now again be used to transmit dial pulses to the selector circuitry of FIGS. 3, 4 and 5. It will be understood that by this time the first selector of FIG. 3 has hunted for and has seized a second selector which is now in the circuit ready to be controlled by the second exit digit.

The above procedure is repeated with respect to subsequent digits under control of the outsteering circuitry of FIGS. 35 and 36, thereby to successively adjust successive ones of the step-by-step selectors in the outgoing switch train of FIGS. 3, 4 and 5.

As will be seen from subsequent description, the control of the dial pulse generator and counting control circuitry of FIGS. 19 and 22 is controlled by the outsteering chain of FIGS. 35 and 36 in accordance with the called digits contained in the registers of FIGS. 38 and 39 until such time as the register-outpulser will have consulted a translator-decoder pair for routing instructions. At this point it may be necessary, in accordance with instructions from the translator-decoder pair, for the switch train previously adjusted to be released and to be reset in accordance with some specified number and nature of arbitrary exit digits. Under these circumstances, relay PG1 of FIG. 22 will become locked operated by control circuitry to be mentioned hereinafter, to thereby prevent any further transmission of dial pulsing to the outgoing switch train. Also the arbitrary exit digits to be used for resetting the switching train will be registered in the auxiliary digit registers of FIGS. 32 and 33, the outgoing steering chain of FIGS. 35 and 36 will be recycled, and the arbitrary outdigit steering circuitry of FIG. 16 will be brought into play to cause the pulse generator and counting circuitry of FIGS. 19 and 22 to be controlled in accordance with the arbitrary exit digits and to cause this transmission to be followed by the outpulsing beyond of any necessary digits that must be transmitted.

## INITIAL SELECTOR SETTING

It will be recalled from previous description that when the calling subscriber is using dial pulse signaling the pulses dialed by the subscribed are repeated into the switch train of FIGS. 3, 4 and 5 under control of relay L1 of FIG. 9 which follows the dial pulses. It will also be recalled that when the calling subscriber is using TOUCH-TONE dialing the TOUCH-TONE digits are deciphered by the TOUCH-TONE receiver and converter and are registered in the digit registers of FIGS. 38 and 39 to in turn control the dial pulse generator circuitry of FIGS. 19 and 22 to repeat these TOUCH-TONE digits as dial pulse digits to the switch train of FIGS. 3, 4 and 5. The dialing loop to the first selector of FIG. 3 extends from the two windings of relay A1 of FIG. 3, over break contacts **7** and **5** of relay D1, thence to conductors FT and FR extending into and through the register, trunk and link circuit of FIGS. 2 and 7, and thence into the tip and ring control circuit shown in FIG. 10 of the register-outpulser. The loop circuit continues from FIG. 10 on conductor FR, over break contact **8** of relay TMF, conductor A into FIG. 9, thence over make contact **11** of relay REC, through resistance FR1, make contact **3** of relay ON2, through the winding of relay LT (which operates as an indication that the loop is closed to the first selector circuit), thence over conductor BTDC into FIG. 10, thence through the winding of relay RV (which does not operate unless and until a battery-ground reversal signal appears in the outgoing trunk circuit), thence over make contact **5** of relay BTDC, through resistance FT1, make contact **9** of relay REC, thence over break contacts **6** of relays TMF and RCA to conductor FR1, thence through a contact network of some eight relays (to be explained below) to conductor FT.



The contact network in the lower center part of FIG. 10 interconnecting conductors FR1 and FT involves make and break contacts of some eight relays, whereby the loop to the first selector of FIG. 3 may be opened and closed under certain circuit conditions as will be described below. At the beginning of the call, relay SDO of FIG. 18 will be released because this relay is not operated (if at all) until the register-outpulser consults a translator-decoder pair for switching instructions: thus, make contact **4** of relay SDO in FIG. 10 will be open. Relay PKC of FIG. 24 will be released because this relay is not operated until the complete called number has been received and registered: thus, in FIG. 10 make contact **2** of relay PKC will be open. Also, relay TMF of FIG. 29 will be released since among the called digits there will be no ten-signal involved in the registration of the readout relays RR0 through RR10 of FIG. 29: thus, in FIG. 10 make contact **9** of relay TMF will be open.

On diol pulse calls relay RK of FIG. 34 will be released because this relay is a check relay for indicating the proper operation of the readout relays RR0 through RR10 of FIG. 29 which are not involved in repeating dial pulse digits to the selector train: thus, in FIG. 10 break contact **4** of relay RK will be closed. Furthermore, relay PG1 of FIG. 22 will be operated and locked as previously described, thereby causing make contact **1** thereof in FIG. 10 to be closed. Relays W of FIG. 34 and IC of FIG. 22 will both be released since these relays are not involved in repeating dial pulse digits: therefore, make contacts **1** of these relays in FIG. 10 will both be open. As will be recalled from previous description, relay L1 of FIG. 9 follows the calling subscriber's dial pulses; and, it will be noted in FIG. 10 that make contact **6** of FIG. 1L will cause these dial-pulse open and closed loops to be repeated on the fundamental tip and ring loop involving conductors FT and FR into the first selector of FIG. 3.

On TOUCH-TONE calls relay L1 of FIG. 9 will remain operated, thereby causing its make contact **6** in FIG. 10 to remain closed. Relay RK of FIG. 34 will operate to check the proper registration in the readout relays RR0 through RR7 of FIG. 29 of each TOUCH-TONE digit. Each such digit is decoded and registered in the registers of FIGS. 38 and 39: thus, break contact **4** of relay RK in FIG. 10 will open and close upon the operations and releases of this relay RK. Relays PG1 of FIG. 22 and PG2 of FIG. 19 will oscillate, as has been described previously; the counting relays P1 through P5 of FIGS. 22 and 19 will count the number of cycles of operation and release of relay PG1 of FIG. 22; relay IC of FIG. 22 will operate to indicate the pulse count as matching the registration in the readout relays RR0 through RR7 of FIG. 29; relays W and Z of FIG. 34 are controlled by relays IC and PG1 of FIG. 22 to count the interdigital time. Relay PG1 of FIG. 22, in operating and releasing, will open and close its make contact **1** in FIG. 10 to cause the transmission of dial pulsing to the first selector of FIG. 3. Relays IC of FIG. 22 and W of FIG. 34 become operated during the interdigital timing interval, thereby to close their make contacts **1** in FIG. 10 to prevent any transmission of dial pulsing to the first selector during the interdigital timing interval.

With respect to the first selector of FIG. 3, when the fundamental tip-ring loop (conductor FT and FR) is closed, an obvious circuit is completed for causing the operation in FIG. 3 of relay **A1**. Relay **A1**, in operating, completes an obvious circuit over its make contact **2** for causing the operation of the slow-release relay **B1**. Relay **B1**, in operating, applies ground over its make contact **1** to the sleeve conductor FS extending rearward to hold the switch train of FIG. 2. Relay **A1** will release and reoperate in response to each open loop dial pulse effective on the fundamental tip and ring circuit involving conductors FT and FR. Relay **B1**, due to its slow-releasing characteristic, will remain operated over the short open loop periods when relay **A1** is released; but, relay **B1** will release during the interdigital pause when relay **A1** remains operated for a longer interval of time. Upon the first release of relay **A1**, with relay **B1** remaining operated, a circuit is completed for causing the operation in FIG. 3 of relay **C1** in series with the vertical stepping magnet **VERT1**. This circuit extends from ground in FIG. 3, over break contact **1** of relay **D1**, break contact **1** of relay **A1**, make contact **2** of relay **B1**, through the winding of relay **C1** and to negative battery through the winding of magnet **VERT1**. Relay **C1** is a slow-release relay which will remain operated over the pulsing which in turn will cause magnet **VERT1** to operate and release in accordance with each dial pulse, thereby to step the first selector vertically a number of steps corresponding to the number of pulses in the digit. As soon as the first selector begins to move vertically, the vertical off-normal switch **VON1** of FIG. 3 is closed, thereby completing a circuit for causing the operation of relay **E1** in FIG. 3 extending from negative battery, through the winding of relay **E1**, over make contact **2** of switch **VON1**, thence over make contact **1** of relay **C1**, to ground over make contact **1** of relay **B1**, relay **E1** locking in a circuit extending over break contact **1** of the rotary stepping magnet **ROT1**, over make contact **1** of relay **E1** and to ground over break contact **1** of relay **D1**.

At the end of the digit, when relay **A1** remains operated, relay **C1** will become released, thereby causing the operation of the rotary stepping magnet **ROT1** in a circuit extending from negative battery, through the winding of magnet **ROT1**, over make contact **2** of relay **E1**, break contact **2** of relay **C1**, to ground on the sleeve conductor FS. The operation of magnet **ROT1** will cause the first selector to take one step in the rotary direction on the particular vertical level to which it has been stepped in accordance with the first digit. The operation of magnet **ROT1** causes the release of relay **E1**, the release of which in turn will cause the release of magnet **ROT1**. Each time magnet **ROT1** releases a circuit is completed for causing the reoperation of relay **E1** if the particular second selector represented by that step position is busy. This circuit extends from negative battery, through the winding of relay **E1**, over make contact **2** of switch **VON1**, break contact **1** of magnet **ROT1** and over break contact **2** of relay **D1** to the sleeve conductor S extending to the second selector. If this second selector is busy (grounded sleeve conductor), relay **E1** will reoperate thereby causing the reoperation of the magnet **ROT1** to continue the self-interrupting operation. Each reoperation of relay **E1** also completes a circuit over its make contact **1** for shunting the winding of relay **D1** to ground, thereby preventing relay **D1** from operating. When the first selector of FIG. 3 steps onto a terminal representing an idle second selector, relay **E1** will not operate because the sleeve conductor S of this idle second selector will not be at ground potential. Under these circumstances a circuit is completed for causing the operation in FIG. 3 of relay **D1** in series with relay **E1**, this circuit extending from negative battery in FIG. 3, through the winding of relay **E1**, over make contact **2** of the switch **VON1**, break contact **1** of magnet **ROT1**, through the winding of relay **D1**, over break contact **1** of the eleventh rotary stepped switch **11RS1**, and thence to ground on the sleeve conductor FS extending rearward of the switch train. Relay **D1** will operate in this circuit but relay **E1** will not operate in series therewith due to the high resistance in this circuit. Upon the operation of relay **D1** of FIG. 3, the sleeve conductor FS from FIG. 2 is extended over make contact **3** of relay **D1** to the sleeve conductor S of the second selector circuit of FIG. 4. Also, the operation of relay **D1** cuts through the fundamental tip and ring leads FT and FR over its make contacts **6** and **4** to the tip and ring leads T and R extending to the second selector of FIG. 4. In FIG. 4 the cut-through of the fundamental tip and ring leads will in turn cause the operation of relays **A2** and **B2** to prepare the second selector of FIG. 4 for receiving the pulses of the second digit.

In the event that all of the trunks to second selectors from FIG. 3 are busy, the self-interrupting rotary stepping circuit will continue to step in a rotary direction until such time as the eleventh rotary switch **11RS1** of FIG. 3 becomes operated. This prevents the operation of relay **D1** by opening the circuit of its winding and thus maintains a circuit for holding operated relay **A1** to hold the first selector. Upon the operation of the switch **11RS1**, two different types of busy signals are transmitted back over the tip lead FT toward the register-outpulser. One of these signals is the **24** volt positive direct-current potential connected to the left-hand side of the transformer in the lower part of FIG. 3, extending over make contact **3** of switch **11RS1**, through the right-hand winding of relay **A1**, and over break contact **7** of relay **D1** to the tip lead FT. The other signal is an alternating-current signal provided by the 400 to 600 cycle busy tone interrupted at a rate of 120 interruptions per minute, induced through the transformer in FIG. 3 and thence out over the tip conductor FT back toward the register-outpulser. As will be recalled from previous description, particularly in connection with the tip and ring control circuitry of FIGS. 10 and 13 of the register-outpulser, that with switch S of FIG. 13 closed, the register-outpulser will be arranged (operation of relay **BTDC**) to detect direct-current busy signals from the selector; whereas, with switch S of FIG. 13 open, the register-outpulser is arranged (tone detector of FIG. 13) to detect the alternating-current busy tone signal from the selectors.

The selectors of the outgoing switch train of FIGS. 3, 4 and 5 may be released before cut-through or after cut-through. Before cut-through, relay **A1** of the first selector of FIG. 3 will be operated and relay **D1** thereof will be released. Under these circumstances if the fundamental tip and ring loop involving conductors FT and FR extending back toward FIG. 2 is opened, relay **A1** will become released, thereby completing a circuit for operating the release magnet **RLS1** of FIG. 3, this circuit extending from negative battery in FIG. 3, through the winding of magnet **RLS1**, over make contact **1** of switch **VON1**, break contact **3** of relay **B1**, break contact **1** of relay **A1**, to ground over break contact **1** of relay **D1**. The operation of the release magnet **RLS1** will cause the first selector circuit of FIG. 3 to return to normal. After cut-through, relay **A1** of FIG. **3** will be released and relay **D1** will be operated. Under these circumstances if the fundamental tip and ring loop rearward is opened, relay **D1** will be released when the forward portion of the switch train (FIGS. 4, 5 and 6 et cetera) releases. This release of relay **D1** will in turn complete the above-described circuit for causing the operation of the release magnet **RLS1**.

At the end of the third dialed digit, a third selector (see FIG. 5) will have been stepped vertically to the specified trunk hunting level and will then have caused its stepping circuitry to initiate a change-over from vertical to rotary stepping. While this selector action is taking place, and usually before rotary trunk hunting can become effective, circuit action takes place as will be described below to seize a translator-decoder pair for securing switching instructions corresponding to the first three dialed digits. This operation takes place very quickly so that actual seizure by the third selector of FIG. 5 of an outgoing trunk, such as is shown in FIG. 6, will not be effected. The register-outpulser will transmit the first three dialed digits to the translator-decoder, to which is also supplied additional information as will be mentioned, whereupon the translator-decoder will transmit back to the register-outpulser the necessary switching instructions. The translator-decoder connection will be released as soon as the necessary switching instructions are properly registered in the attached register-outpulser. The holding time of these connecting circuits can be expected not to exceed perhaps 100 milliseconds, which is hardly enough time for the third selector to start rotary trunk hunting, let alone to actually cause a seizure of one. Thus, the register-outpulser will receive the signal to release the switch train for recycling purposes (if necessary) before any selection beyond can take place incident to the repeating of dialed digits into the selector train. As will be seen below, when recycling is necessary due to code conversion, the register-outpulser will receive a signal from the translator-decoder pair to release the selectors, whereupon the register-outpulser will release the entire switch train of FIGS. 3, 4 and 5 and will reset this switch train in accordance with arbitrary exit digits supplied thereto from the translator-decoder pair as the proper switching instructions for the instant call.

TRANSLATOR-DECODER USAGE

When the register-outpulser has received enough called digits to necessitate the seizure of a translator-decoder pair for purposes of providing instructions in accordance with the called digits, the translator-decoder seizure action will be initiated by the operation in FIG. 21 of relay RCY. In accordance with description previously set forth, it will be understood that the first four called digits will be registered in the A, B, C and D registers of FIG. 38 on the well-known two-out-of-five registration coding. Also, the in-digit steering circuitry of FIG. 24 will have advanced to steer the successively received called digits into the successive registers of FIGS. 38 and 39. If the A digit is not a zero or a one, a circuit is completed for operating relay RCY of FIG. 21 upon the operation of steering relay IS4 of FIG. 24, which occurs after three digits have been registered. On the other hand, if the A digit is a one or a zero, a circuit will be completed in FIG. 21 for causing the operation of relay RCY upon the operation in FIG. 24 of steering relay IS5 with steering relay IS4 released, this circuit condition representing the fact that four digits have been registered in the registers of FIG. 38. Under either circumstance, ground extends in FIG. 21 over make contact **17** of relay ON1 and break contact **7** of relay PS to transfer contacts **11** of the register relay A7. If the A digit is anything from 2 to 9, it will be obvious by inspection of the contact network of the A registers relays in FIG. 21 that ground on transfer contact **11** of relay A7 will be extended to the corresponding punching A2 through A9 and thence to punching NP. If the A digit is a zero, ground at transfer contacts **11** of relay A7 in FIG. 21 will be extended over make contact **11** of relay A7, break contact **11** of relay A2 and make contact **11** of relay A4 to transfer contacts **12** of relay IS5. Also, if the A digit is a one, then ground at transfer contacts **11** of relay A7 will be extended over break contact **11** of relay A7, break contact **10** of relay A4, make contact **7** of relay A0, and over break contact **9** of relay A2 to transfer contacts **12** of relay IS5. Ground on punching NP in FIG. 21 will be extended over make contact **12** of relay IS4 and through break contacts **5**, **6** and **1** of relays RA, TDR and TDSA to negative battery through the lower winding of relay RCY, which thereupon operates and completes a circuit through its upper winding to provide itself with a slow-releasing characteristic. On the other hand, if ground appears at transfer contact **12** of relay IS5, this ground will be extended to make contact **12** of relay IS5 (at the end of the fourth digit), thence through diode ADO and break contact **12** of relay IS4 to the above-described circuit for causing the operation of relay RCY. In FIG. 21, punchings A2 through A9 have been shown all cross-connected to punching NP since it has been decided for exemplary purposes to illustrate the operation of the register-outpulser under conditions where the A digit of 2 to 9 is not used for any translation purposes. If any one of these punchings were connected to punching PFA, then relay PFA of FIG. 21 would be operated to in turn cause the register-outpulser to open the switch train and call for a translator-decoder after the registration of three digits. On the other hand, if punching PFB were involved, then relay PFB of FIG. 21 would be operated to cause the register-outpulser to be released after the registration of the A digit is repeated to the switch train on a non-common-control dial-pulse call.

Another circumstance which will cause the operation of relay RCY in FIG. 21 is the well-known permanent signal condition where no digits are received by the register-outpulser within a specified interval of time. With reference to FIG. 23, as will be explained in more detail in subsequent description of the timing control circuitry of FIGS. 23 and 26, relay LTO will become operated if the indigit steering circuit of FIG. 24 does not advance (no digits are received) within the allotted time determined by the LTO timer circuit of FIG. 23. If relay LTO of FIG. 23 operates to indicate a permanent signal condition, a circuit will be completed for causing the operation in FIG. 27 of the permanent signal relay PS. Under these circumstances, it will be recalled that relay L1 of FIG. 9 will be operated over the calling loop circuit in which case a circuit extends from ground in FIG. 15 over make contact **24** of relay ON1, make contact **4** of relay L1, conductor A extending into FIG. 27, thence over break contact **10** of relay TA1, break contacts, **8**, **4** and **12** of relays STO, MF1 and DP, through make contact **8** of relay LTO, break contact **5** of relay PS, to battery through the winding of relay PS, which thereupon operates and locks to its operating ground over its own make contact **5**. Upon the operation of relay PS of FIG. 27 a circuit extends from ground in FIG. 26, over make contact **1** of relay PS, conductor TS extending into FIG. 21, and thence through break contacts **6** and **1** of relays TDR and TDSA, to negative battery through the winding of relay RCY, which thereupon operates as previously described.

Two other circumstances will cause the operation of relay RCY in FIG. 21, namely, the operation of either of the recycle control relays **1S** and **2S** of FIG. 25, as will be apparent in FIG. 21 since make contacts **9** and **2** of these relays **1S** and **2S** will extend off normal ground to the operating circuit for relay RCY. Neither of the relays **1S** and **2S** is operated on the original seizure of a translator-decoder pair by a register-outpulser. Therefore, the original translator-decoder seizure by a register-outpulser will be in accordance with the previous circumstances discussed immediately above. On the other hand, the operation of either one of these relays **1S** and **2S** of FIG. 25 will cause the immediate operation of relay RCY in FIG. 21, thereby to cause the immediate reseizure of a translator-decoder pair, as will be described presently. As will be understood in more detail from subsequent description, after a seizure of a translator-decoder pair and after all of the necessary switching instructions have been transmitted to the register-outpulser, the translator-decoder release relay TDR of FIG. 20 will be operated and will lock operated as an indication that the seizure of the translator-decoder has been completed. It will be noted in FIG. 25 that upon the operation of relay TDR (indicating that a seizure of the translator-decoder has taken place) off-normal ground is extended over make contact **5** of relay ON1, through make contact **10** of relay TDR and through break contacts **6** and **4** of relays RCA1 and RCA to transfer contacts **9** of relay CA6. Relay 1S of FIG. 25 will become operated to cause reseizure of the translator-decoder on a foreign area call or on a call involving conflicting code timing. The ground at transfer contact **9** of relay CA6 will be extended through make contact **9** of relay CA6 (operated on a foreign area call) to the transfer contacts **10** of relay AD01: if the A digit is not a zero or a one this ground will extend through break contact **10** of relay AD01, break contact **8** of relay IS6 and make contact **10** of relay IS7 to the transfer point of contacts **10** of relay IS7 after the registration of the sixth digit: ground at transfer contacts **10** of relay AD01 will extend through make contact **10** thereof if the A digit is a zero or a one and thence through make contact **8** of relay IS8 and break contact **10** of relay IS7 after the registration of the seventh digit: this ground extends from the transfer contacts **10** of relay IS7 through break contact **4** of relay ISA to battery through the winding of relay 1S, which thereupon operates and locks in series with relay 1SA (which operates) in a circuit extending from negative battery through the winding of relay IS, through make contact **10** of relay IS, through the winding of relay ISA, to off-normal ground over make contact **22** of relay ON2. Relay 2S will become operated, thereby to cause immediately reseizure of the translator-decoder pair, under circumstances where a busy signal has been received from the selector train on a call with respect to which an alternate route is available. A busy selector will be indicated by the operation in FIG. 13 of relay BTA1 (where DC selector busy signaling is used) or of relay BTA2 (where the tone detector of FIG. 13 is used to detect alternating-current busy selector signaling). As has been mentioned previously in connection with the first selector of FIG. 3, in the event that this selector is busy, the eleventh rotary stepswitch 11RS1 will operate to apply to the tip conductor FT extending rearward into the switch train two signals comprising the 24 volt direct-current potential and the 400 to 600 cycle interrupted signal. These signals will appear on conductor FT in FIG. 10 and will be extended through the pulsing contact network to conductor FR1, thence through break contact **6** of relay RCA to transfer contacts **1** of relay TMF: for alternating-current busy tone signaling (relay BTDC of FIG. 13 released), the A-C signal will extend in FIG. 10 over break contact **1** of relay TMF, break contact **8** of relay BTDC, conductor BT4 into FIG. 13, thence through one or more of the paths through the contact network associated with the tone detector and thereby to the input terminal **2** of the tone detector, whereupon the tone detector will cause the operation of relay BTA2 which will lock over its own make contact **5** to off-normal ground under control of the released relays TDSA AND TDRA: If direct-current busy selector signaling is used (relay BTDC of FIG. 13 operated), the 24 volt direct-current potential will extend from transfer contacts **1** of relay TMF in FIG. 10 through break contact **6** of relay TMF, make contact **9** of relay REC, resistance FT1, make contact **5** of relay BTDC, thence through the winding of relay RV over make contact **4** of relay BTDC, through diode BT and resistance BT1, through make contact **14** of relay ON2, over make contact **7** of relay BTDC, to the right-hand side of the upper winding of relay CB, thence through the winding of relay CB and over make contact **6** of relay BTDC to the potentiometer arrangement of resistances BT2 and BT3, whereupon relay CB of FIG. 10 will operate, to in turn complete an obvious circuit in FIG. 13 for causing the operation of relay BTA1. In FIG. 25, upon the operation of either of the busy relays BTA1 and BTA2 of FIG. 13, and with relay ARA of FIG. 18 operated as an indication (on the previous translator-decoder seizure) that an alternate route is available, a circuit is completed for causing the operation of relay 2S from ground at transfer contact **9** of relay CA6, through break contact **9** of relay CA6, through break contacts **7** and **8** of relays RCS and CCT, thence through make contact **9** of relay ARA, and through make contact **3** of the operated one of relays BTA1 and BTA2, through break contact **4** of relay **2S** and to negative battery through the winding fo relay **2S**. Relay 2S, in operating, locks in an obvious manner over its own make contact **4**. It will therefore be appreciated, with reference to FIG. 21 upon the operation of either of the relays **1S** and **2S** of FIG. 25, that relay RCY of FIG. 21 will be operated under control of make contacts **9** and **2** of these two relays to off-normal ground.

In addition to the operation in FIG. 21 of relay RCY upon the registration in FIGS. 38 and 39 of three digits (exclusive of a prefix of zero or one), relay **3DR** in FIG. 25 is caused to be operated. The circuit for operating relay 3DR extends from ground in FIG. 22, over make contact **10** of relay ON1, thence through break contact **6** of relay ADO1 (if the A digit is not a zero or a one) to conductor B or through make contact **6** of relay ADO1 (if the A digit is a zero or a one), to conductor A extending into FIG. 25, and through make contact **8** of steering relay IS4 or of steering relay IS5, and through make contact **8** of relay DP to negative battery through the winding of relay 3DR, which operates and locks to off-normal ground over its own make contact **1**. Relay RCY of FIG. 21, in operating, opens locking circuits in FIGS. 18, 29, 30, 32 and 33 for a number of relays to insure that these relays are released: in FIGS. 29 and 30 the locking circuits for any of the relays SBR through SFR are opened, thereby insuring that these relays will be released; in FIG. 18 the locking circuit for a number of the information registers is opened, thereby to cause these relays to release; and, in FIGS. 32 and 33 the locking circuit for the arbitrary exit digits AR– through FR– and for the relays TMF1 and TMF2 are opened to insure that these relays become released. Relay RCY of FIG. 21, in operating, causes the operation on FIG. 21 of the translator-decoder seizure-start relay TDST. This circuit extends from off-normal ground in FIG. 21, over make contact **17** of relay ON1, thence over make contact **2** of relay RCY, and break contacts **6**, **1** and **2** of relays TDST, TDR and TDTR, to negative battery through the winding of relay TDST. Relay TDST, in operating, locks to off-normal ground over its own make contact **6** and completes an obvious circuit in the lower right-hand corner of FIG. 21 to cause the operation of relay TDSA, which in turn completes a circuit through its upper winding to provide itself with a slow-releasing characteristic. The operation of relay TDSA causes the release in FIG. 21 of relay RCY, which thereupon completes once again the locking circuits for those registers mentioned above. Upon the release of relay RCY of FIG. 21, with the relay TDST of FIG. 21 operated, a circuit is completed in the timing control circuitry of FIG. 26 to cause the timing control circuit to start a timing interval within which the translator-decoder seizure and operation must take place. This circuit extends from off-normal ground in FIG. 23, over make contact **4** of relay ON, over conductor ON into FIG. 26, thence over make contact **4** of relay REC, through break contact **2** of relay TDR, make contact **2** of relay TDST, break contact **12** of relay ROD, make contact **10** of relay TDST, break contact **10** of relay RCY, to battery through the winding of relay STT.

Upon the operation, above described, of relay TDST of FIG. 21, with reference to FIG. 20 ground potential is supplied to the translator-decoder connector circuitry of FIGS. 77 through 95 over leads TM and LDB and resistance battery is supplied to the translator-decoder connector circuitry over conductors ST, STA and STB. As has been described hereinbefore in connection with the translator-decoder connector circuitry, the result of these battery and ground potentials being supplied to the connector circuit from FIG. 20 causes the register-outpulser to be connected to a translator-decoder pair by means of the cables indicated in FIGS. 32, 33, 38 and 39 which, as it will be noted, also include conductors extending to and from FIGS. 12, 18, 20 and 21.

In FIG. 12 conductor CI extending from FIG. 33 carries ground potential from the trunk class connector of FIG. 96 through the translator-decoder connector of FIGS. 77 through 95 into FIG. 7 and back through the trunk class connector of FIG. 96 into the decoder circuit of FIGS. 54 through 74 in order to register in the decoder the class of the trunk circuit used in the code conversion process.

With reference to FIG. 18, a number of information leads are shown in the bottom of FIG. 18 extending between the register-outpulser and the attached translator-decoder circuitry. Conductors **3DG** through **10DG** are the means whereby the decoder circuit registers in the register-outpulser the number of called digits to expect: these relays, upon operating, lock over their own make contacts to local off-normal ground in FIG. 18. Conductor ARA extends from the decoder thereby to cause the registration in FIG. 18 of an indication that an alternate route is available. Relay ARA locks in a circuit including its own make contact **12** and contacts of relays **MF1** and SDO or **IS6**. Relay DPC of FIG. 18 is operated from the decoder to indicate a sender class, dial-pulse call with stop-go signaling. Relay SDO is operated from the decoder to indicate a sender class dial-pulse call without stop-go signaling. Relay STGO is operated from the decoder to indicate a sender class call where dial pulse digits are used for exit purposes and where a switch has to be made to multifrequency pulsing for pulsing beyond. Relays DAD through DL1 are operated from the decoder to indicate to the register-outpulser that one or more of the called digits are to be deleted when outpulsing beyond. The three relays DPC, STGO and DAD through DL1 lock over their own make contacts to a local off-normal ground in FIG. 18. Conductor BSY or NB is grounded into the decoder circuit from FIG. 18 in order to indicate to the decoder whether the selector train is busy or is not busy. Conductor NCC in the upper right part of FIG. 18 or conductor CC in the lower right portion thereof is energized from the register-outpulser into the decoder to indicate that the class of the call is either a non-coin call or is a coin call. Relay RVT is operated from the decoder to indicate that this is a reverting call. Relay SDO is operated from the decoder to indicate a sender class call with no stop-go condition. Relay CA6 is operated from the decoder to indicate the existence of a conflicting code, necessitating that the register-outpulser reseize the decoder after the receipt of six digits. The three relays RVT, SDO and CA6 also lock locally over their own make contacts. Conductors OS, **1S** and **2S** are means whereby the register-outpulser indicates to the decoder circuitry the class of the seizure: conductor OS indicates an original seizure; conductor **1S** indicates a reseizure on a foreign area call or on a conflicting code timing situation; and, relay **2S** indicates the reseizure of the decoder after a selector busy condition on a call which previously had been indicated as having associated therewith an alternate route.

In FIG. 20 four leads RL, TRL, HD1 and PS are shown extending between the register-outpulser and the translator-decoder pair. Conductor RL will be energized from the associated translator circuit to cause the operation of the translator-decoder release relay TDR of FIG. 20 at such time as this release condition becomes effective. Relay TDTR will be energized from the associated translator under trouble release conditions. Both of these relays TDR and TDTR lock over their own make contacts to off-normal ground in FIG. 21. Conductor HD1 carries off-normal ground through make contact **5** of relay TDSA in FIG. 21, thereby extending the off-normal register-outpulser ground forward to the associated translator. Conductor PS is the means whereby a permanent signal indication is transmitted to the associated translator.

In FIG. 21 a number of leads are shown extending between the register-outpulser and the associated translator-decoder pair. Conductor SC provides an indication to the decoder of the fact that this particular call is a service call. Conductor TST provides information to the decoder that this call is a test call. Conductor CCT is the means whereby the decoder may indicate to the register-outpulser (by the operation of relay CCT in FIG. 21) that this call should be given conflicting code timing: relay CCT, in operating, will lock over its own make contact **12** to off-normal ground in FIG. 21. Conductors ADO and AD1 provide respective indications to the decoder circuitry that the A digit is a zero or a one. Conductor NP provides an indication to the decoder circuit that no A digit prefix control is effective on this call. Conductor RCY is the means whereby the decoder circuit may cause the operation in FIG. 21 of relay RCY under trouble conditions. Conductor ZO is the means whereby the register-outpulser may indicate to the attached decoder that the instant call is a zero-operator call.

In FIGS. 32 and 33 conductors ARO of FIG. 32 through FR7 of FIG. 33 are the transmitting leads whereby the associated decoder may transmit up to six arbitrary exit digit information items to the register-outpulser. These registers when operated will lock to local off-normal ground in FIG. 32.

FIGS. 38 and 39, and particularly conductors AO of FIG. 38 through G7 of FIG. 39, show the transmitting leads whereby information in any of the first seven registers of the called digit register may be transmitted from the register-outpulser to the associated translator-decoder pair to be used in the code conversion process.

The associated translator-decoder circuitry involves a number of check relays (previously described in connection with these circuits) which will operate as an indication that all of the transmitted information has been properly registered in the register-outpulser. Upon the proper operation of these check relays, the translator will apply ground to conductor RL in FIG. 20, thereby to cause the operation of relay TDR, which locks over its own make contact **3**, on conductor TDR extending into FIG. 21, thence to off-normal ground under control of contacts of relays **1S**, **1SA**, **2S** and ARA. In FIG. 26, upon the operation of relay TDR of FIG. 20, relay STT is released to stop the timing circuitry and relay TDRA is operated in a circuit extending from negative battery, through the winding of relay TDRA, through make contact **2** of relay TDR, and thence to off-normal ground on conductor ON through make contact **4** of relay REC. Also, upon the operation of relay TDR of FIG. 20, the translator-decoder seizure start relay TDST of FIG. 21 is released, which in turn causes the slow-release of relay TDSA (FIG. 21) and also causes the disconnection of the translator-decoder pair from the register-outpulser by releasing the entire translator-decoder connector circuitry of FIGS. 77 through 95 and the trunk class connector of FIG. 96.

RECYCLE OF SWITCH TRAIN

Recycling of the outgoing switch train of FIGS. 3, 4 and 5 takes place upon the operation in FIG. 28 of relay RCA. The operation of relay RCA will open its back contact **6** in FIG. 10 thereby to open the loop circuit to the first selector of FIG. 3, thereby to ultimately cause the release of any of the selectors which have been set. Relay RCA of FIG. 28 is operable in an obvious manner by the operation of either relay RCA1 of FIG. 28 or relay ROD of FIG. 27. Relay ROD is operable in order to provide reorder tone to the calling subscriber under certain conditions which are described in detail later under the section of the description relating to disconnect procedures. Relay RCA1 of FIG. 28 is operated under normal circumstances for recycling the switch train. The switch train may be recycled by the operation of relay RCA1 of FIG. 28 either before translator-decoder usage (relay TDR of FIG. 20 released) or as a result of translator-decoder usage where controlled outpulsing is required (relay SDO of FIG. 18 operated).

Prior to translator-decoder usage (relay TDR of FIG. 20 released), a circuit is completed in FIG. 28 from ground, over make contact **24** of relay ON2, break contact **9** of relay SDO, through break contact **12** of relay TDR, and through a parallel arrangement of contacts in the lower central part of FIG. 28 to negative battery through the upper winding of relay RCA1. If the A digit is a 1, then relays AO and A1 of FIG. 38 will be operated, thereby completing in FIG. 28 the above-mentioned circuit over make contacts **9** of these two relays and thence over a parallel circuit involving break contacts **5** and **7** of relays RCS and SLT to the winding of relay RCA1. Under these circumstances relay RCA1 will operate to in turn cause the operation in FIG. 28 of relay RCA to cause the outgoing switch train to be released. Relay RCA1, in operating, also completes an obvious circuit through its lower winding over its own make contact **2** to provide itself with a slow-releasing characteristic. Under these circumstances, as has been explained previously in connection with the translator-decoder control circuit of FIG. 21, relay RCY of FIG. 21 will be operated (to call in a translator-decoder pair for usage) after four digits have been registered. Again, with reference to FIG. 28, if the A digit registered in the A digit register of FIG. 38 is a zero and if the call is a noncoin class call (relay CC of FIG. 12 released) and if no further digits are received, relay ZO of FIG. 26 will be operated to indicate that this call is a zero operator call. Under these circumstances in FIG. 28 the circuit is completed in the lower center part of the figure through make contact **12** of relay ZO and break contact **12** of relay CC to cause the operation of relay RCA1. Also as has been previously described in connection with the translator-decoder circuit of FIG. 21, if any one of the punchings A2 through A9 were connected to punching PFA, thereby to cause the operation of relay PFA in FIG. 21, this would complete the circuit over make contact **1** of relay PFA in FIG. 28 to cause the operation of relay RCA1. As has been mentioned before, under these circumstances the outgoing switch train will be released and the translator-decoder pair will be seized after the registration of three digits (under control of make contact **2** of relay PFA in FIG. 21).

During the seizure of a translator-decoder pair for code conversion purposes and before relay TDR in FIG. 20 is operated from the decoder as a release signal, a circuit is completed in FIG. 28 for causing the operation of relay RCA1 if relay SDO of FIG. 18 has been operated from the decoder as an indication that outpulsing is required. This circuit extends in FIG. 28 from ground, over make contact **24** of relay ON2, over make contact **9** of relay SDO, to the transfer contacts No. **8** of relay CA6. If relay CA6 of FIG. 18 has been operated from the decoder as an indication that the translator should be reseized after six digits, the circuit of FIG. 28 will be completed through make contact **8** of relay CA6, break contact **3** of relay **1** SA (released in FIG. 25 indicating that this is not a decoder reseizure due to the necessity of a six-digit translation), thence over make contact **12** of relay TDSA, to transfer contacts **8** of relay TDR. On the other hand, if relay CA6 of FIG. 18 is not operated from the decoder (indicating that this call does not require six digits for translation), the circuit will be completed in FIG. 28 through break contact **8** of relay CA6 directly to transfer contacts **8** of relay TDR. This ground potential is continued in FIG. 28 over break contact **8** of relay TDR, make contact **8** of relay TDST, and thence to battery through the upper winding of relay RCA1 under control of the parallel break contacts **7** and **5** of relays SLT and RCS.

Relay RCA1 of FIG. 28, in operating, locks to off-normal ground under control of break contact **8** of relay PS and of its own make contact **4**. And, as has been mentioned above, the operation of relay RCA1 causes the operation in FIG. 28 of relay RCA, break contact **6** of which in FIG 10 opens the loop to the first selector thereby to cause the release of any of the operated selectors of FIGS. 3, 4 and 5. This operation has thereby caused the recycling of the outgoing switch train preparatory to further switching instructions. These switching instructions will be mentioned immediately below in connection with the descrption portion relating to the resetting of the selectors.

## RESETTING SELECTORS

When relay RCA of FIG. 28 is operated to recycle the switch train, as above-described, negative battery is extended in FIG. 8, over make contact **12** of relay RCA, to the left-hand side of resistance SLT1, the right-hand side of which extends through diode SLT, and to the selector sleeve conductor S1 through make contacts **4** and **3** of respective relays DCK and ON. When the selector switch train returns to normal as a result of the recycle condition, ground will be removed from the sleeve conductor thereof extending to conductor S1 in FIG. 8. This will allow relay SLT1 to operate in FIG. 8, to in turn cause the operation in FIG. 11 of relay SLT. Since, as described hereinbefore, the lower winding of relay SLT in FIG. 11 will be opened as a result of the previous party test control circuit operations of FIG. 12 et cetera, relay SLT will remain operated as long as relay SLT1 of FIG. 8 remains operated. Relay SLT1 of FIG. 8 will remain operated until such time as ground is once again returned on conductor S1 in FIG 8 from the selector train as an indication that the selector train has been seized. When this happens, relay SLT1 of FIG. 8 will release, to in turn cause the release in FIG. 11 of relay SLT. In the meantime, it will be noted in FIG. 28 that relay RCS can be operated only after translator-decoder usage (relay TDR of FIG. 20 operated) and even then only if the decoder has indicated (the operation in FIG. 18 of relay SDO) that the call is a sender class call. Also, during this time, relay RCA1 of FIG. 28 remains operated under control of break contact **5** of relay RCS, to in turn maintain operated relay RCA, which holds open (break contact **6**) the loop circuit in FIG. 10 toward the first selector. At such time as translator-decoder usage has been completed, relay RCS of FIG. 28 will become operated under control of the parallel make contacts **1** and **8** of relays RCA and SLT, to in turn complete a circuit through its own lower winding and over its own make contact **12** to provide itself with a slow-releasing characteristic. The operation of relay RCS will in turn permit the release of relay RCA1, which in turn permits relay RCA to release. The release of relay RCA allows relay RCS of FIG. 28 to release at such time as relay SLT of FIG. 11 is released, which in turn will be an indication that the selector train has been seized.

The operation of relay RCS of FIG. 28 clamps the pulse generator circuitry of FIGS. 19 and 22 by completing a ground circuit through its make contact **10** in FIG. 22 to prevent the pulse generator from generating any further dial pulses. Also, in FIG. 16 the operation of relay RCS completes an obvious circuit over its make contact **6** for causing the operation of the first arbitrary exit digit steering relay ARS. As has been mentioned hereinbefore with respect to FIG. 36, the operation of relay RCA of FIG. 28 opened the locking circuitry of the digit steering relays of FIGS. 35 and 36, causing any of these operated relays to release. Also, in FIG. 16 break contacts **8** and **9** of respective relays RCS and RCA open the chain circuit through FIGS. 16, 35 and 36 for preventing any further advance of the outsteering relays of FIGS. 35 and 36. Eventually, as above mentioned, relays RCA, RCS and RCA1 of FIG. 28 will all become released after a number of timing intervals determined by their slow-releasing characteristics, whereupon the pulse generator circuitry of FIGS. 19 and 22 will be unlocked to allow relays PG1 of FIG. 22 and PG2 of FIG. 19 to again oscillate and to develop pulses. In FIG. 16, upon the release of relays RCS and RCA, the outsteering advancing chain interconnecting conductors AS1, AS2 and AS3 in FIGS. 16 and 35 is again completed. In FIGS. 19 and 22, upon the release of relay RCA (see back contacts **5** and **7** of relay RCA), the counting relays P1 through P5 are re-energized to allow further counting of output pulsing. In FIG. 36, upon the release of relay RCA, off-normal ground is again applied over its break contact **8** to the locking chain for the outsteering relays of FIGS. 16, 35 and 36.

Incident to the above-mentioned translator-decoder usage and the accompanying recycling of the outgoing switch train, the auxiliary digit registers of FIGS. 32 and 33 will have been supplied with information from the decoder as to the number and nature of exit digits required for trunk seizure. It is noted in FIGS. 32 and 33 that there may be up to six arbitrary exit digits to be used for outpulsing purposes. The A, E and F digit positions will contain only decimal digit information on the usual two-out-of-five registration basis. The B, C and D digit positions include a sixth relay, namely, relays BR10, CR10, and DR10. These exit digit positions therefore can be used to contain the multifrequency KP pulse (relays **2** and **10** operated) or these digit positions may contain one of the usual two-out-of-five digital registrations plus the operation of the BR10, CR10 or DR10 relay to indicate that the digital registration has a special character. During the outpulsing procedure, as will be seen from discussion below, the registration of BR10, CR10 or DR10 will be a signal to the pulse generating circuit of FIGS. 19 and 22 to stop pulsing.

Also, during the translator-decoder usage others of the information relays previously mentioned, and particularly those of FIG. 18 will be operated to provide the register-outpulser with information necessary to handle the proper outpulsing. For instance, in FIG. 18 one of the relays DL1 through DAD may be operated to indicate whether or not the outpulser is to delete one or more of the called digits when outpulsing beyond. The latter "delete digit" type of information, as will be seen by inspecting the circuitry of FIGS. 35 and 36, is used to skip outpulsing steering relays in order to delete the digital registrations represented thereby.

It will be recalled from previous description, in connection particularly with the outsteering and outpulsing control circuitry of FIG. 34, that relay RK of FIG. 34 is a check relay which operates upon a proper registration in the readout relays RR0 through RR10 of FIG. 29, to in turn unclamp the dial pulse generator of FIGS. 19 and 22 (see break contact **6** of relay RK in FIG. 19) in order to allow the pulse generator to transmit dial pulse digits to the outgoing switch train. When relay RCA1 of FIG. 28 operates, as above described, to initiate recycle of the outgoing switch train, it will be noted in FIG. 34 that at break contact **8** of relay RCA1 the entire circuitry of FIG. 34 is returned to normal. Subsequently, upon the release of relay RCA1 of FIG. 28 at the end of the recycling operation, the circuitry of FIG. 34 is again arranged so that relay RK can again detect digital registrations in the readout relays of FIG. 29 for controlling the outgoing switch train.

After the recycle operation is over with, as indicated by the release in FIG. 28 of relays RCA, RCS and RCA1, the first arbitrary exit digit steering relay ARS of FIG. 16 is operated and locked in a circuit extending from negative battery in FIG. 16 through the winding of relay ARS, over break contact **6** of relay RCS, make contact **8** of relay ARS, thence through the chain of break contacts **6** of relays BRS through FRS, conductor AS4 extending into FIG. 35, thence through the chain of No. **5** break contacts of relays OS1 through OS8, conductor C extending into FIG. 36, through the chain of No. **5** break contacts of steering relays OS9 through OS11 and of relays ST and ST1, to off-normal ground over break contact **8** of relay RCA. With relay ARS of FIG. 16 operated, a circuit is completed in FIG. 29 for causing the operation of two-out-of-five of the readout relays RR0 through RR7 in accordance with the digit registered in the A digit position of the arbitrary registers of FIGS. 32 and 33. These circuits extend in an obvious manner from ground in FIG. 29, over make contacts of the two operated relays AR0 through AR7, thence over make contacts of the steering relay ARS, to negative battery through the winding of two of the five readout relays RR0 through RR7.



With two-out-of-five of the readout relays of FIG. 29 operated in accordance with the first arbitrary exit digit registered in the A digit register of FIG. 32, the outsteering and outpulsing control circuit of FIG. 34 is once again brought into condition for allowing the pulse generator and counting of FIGS. 19 and 22 to develop dial pulses and to transmit them to the switch train. The transmission to the outgoing switch train of FIGS. 3, 4 and 5 of the arbitrary exit digits registered in FIGS. 32 and 33 depends upon a number of factors, the ones of primary consideration being: the operation in FIG. 18 of one of the relays DPC, STGO and SDO to indicate the general class of the call; the operation, if any, in FIG. 18 of one of the delete digit relays DL1 through DAD; the operation in FIG. 18 of one of the relays 3DG through 10DG (indicating the number of called digits to expect); the operation of relay DP of FIG. 15 (indicating a dial pulse calling subscriber) or of relay MF1 of FIG. 24 (indicating a TOUCH-TONE calling subscriber); the completion of the recycle operation as indicated by the released condition in FIG. 28 of relays RCA1, RCA and RCS; and, the completion of the decoder usage operation as indicated by the operation in FIG. 20 of the translator-decoder release relay TDR.

It will be recalled that the operation of relay SDO in FIG. 18 from the decoder circuit indicates a sender-class call without stop-go signaling but with controlled outpulsing. Upon the seizure of the translator-decoder pair, the operation of relay SDO operates relays RCA1 and RCA of FIG. 28. The operated RCA relay opens the fundamental loop to drop the switch train. When ground has been removed from the sleeve lead of the outgoing switch train, relay SLT1 of FIG. 8 operates, followed by the operation in FIG. 11 of relay SLT. The decoder transmits and registers in the arbitrary digit registers of FIGS. 32 and 33 the necessary exit digits of which there may be any number from 1 to 6.

The operation of relay STGO of FIG. 18 from the decoder indicates a sender-class call on which the register-outpulser will dial-outpulse the necessary arbitrary exit digits and will then switch to multifrequency outpulsing for the remainder of the digits. Under these circumstances trunk seizure will be delayed until such time as the called number has been completely registered. The operation of relay STGO of FIG. 18 will operate relay SDO in an obvious manner over make contact **11** in FIG. 18 of relay STGO. In addition, the operated relay STGO prepares a circuit over its make contact **10** in FIG. 26 for allowing relay SG of FIG. 26 to operate under the stop-go signaling condition, as will be explained subsequently in connection with outpulsing beyond.

In FIG. 18 the operation of relay DPC from the decoder circuitry indicates a dial pulse call with stop-go signaling operation. Relay DPC, in operating, completes an obvious circuit over its make contact **6** in FIG. 18 for causing the operation of relay STGO, which in turn, as above mentioned, causes the operation of relay SD0 of FIG. 18. The circuit operation with respect to outpulsing is the same as above described under circumstances where relay SD0 alone is operated, except that a stop-go signaling condition is expected when the register is connected to the distant end upon seizure of an outgoing trunk circuit.

Returning now to the description of the outpulsing of arbitrary exit digits, in FIG. 34, it will be noted that a circuit extends from negative battery, through the winding of relay RK, to the transfer contacts **11** of relay DP: from this point, if the call is a dial pulse calling subscriber class, the circuit will extend over make contact **11** of relay DP, and make contact **9** of relay TDR (when the decoder release takes place), and thence through make contact **5** of relay SD**0** (sender-class call), disregarding the permanent signal condition regarding relay PS of FIG. 27, to the transfer contacts **2** of reading relay RR**10** of FIG. 29. On the other hand, if the call has been placed from a TOUCH-TONE calling subscriber, the circuit will extend in FIG. 34 from the right-hand side of the winding of relay RK, through break contact **11** of relay DP, and thence through make contact **8** of relay MF**1** (indicating a TOUCH-TONE call), thence to the transfer contacts **2** of reading relay RR**10**. The ground feed for controlling the circuitry of FIG. 34, extending over make contact **16** of relay ON**2**, was opened and reclosed by the operation and subsequent release of relay RCA**1** of FIG. 28 incident to the recycle operation previously described.

Under the conditions (relay SD**0** of FIG. 18 operated alone) where a sender-class call is indicated without any stop-go signaling, the decoder circuit will cause the registration in FIGS. 32 and 33 of the necessary number of arbitrary exit digits on the usual straightforward two-out-of-five signaling basis; that is, there will be no relay BR**10**, CR**10** or DR**10** operated in FIGS. 32 and 33. Under these circumstances the proper number of exit digits will be generated on a dial pulse basis by the dial pulse generator circuit of FIGS. 19 and 22 under control of the outsteering and outpulsing control circuit of FIG. 34. In FIG. 34, with relay SD**0** of FIG. 18 operated and with relay DPC of FIG. 18 released, the contact network of the readout relays will be recognized as comprising the usual two-out-of-five check path extending through break contact **2** of relay RR**10** to the previously described circuit for energizing the winding of relay RK. When a proper operation of two-out-of-five of the readout relays of FIG. 29 takes place in accordance with the first or A arbitrary digit of FIG. 32, relay RK of FIG. 34 will operate. The operation of relay RK will unlock the pulse generator of FIGS. 19 and 22 (see break contact **6** of relay RK in FIG. 19), thereby to allow the dial pulse generator and counting control circuit of FIGS. 19 and 22 to generate a number of pulses corresponding to the pulse count contained in the readout relays RR**0** through RR**7** of FIG. 29. This digit is transmitted to the first selector of FIG. 3 as previously described; and, when the proper number of pulses has been transmitted to the first selector, relay IC of FIG. 22 will operate to indicate the end of the digit. Upon the operation of relay IC of FIG. 22, the pulse counting and generating circuit of FIGS. 19 and 22, as has been described hereinbefore, generates the interdigital timing interval consisting of four oscillations of relay PG**1** of FIG. 22. During this first digital operation the W and Z relays of FIG. 34, as previously described, are controlled by make contact **6** of relay IC and break contact **8** of relay TMFA. In the meantime, in FIGS. 29 and 30 circuits are completed for causing the operation of those relays SBR, SCR, SDR, SER and SFR corresponding to the B, C, D, E and F arbitrary digit registers of FIGS. 32 and 33 in accordance with whether or not an arbitrary digit is actually registered therein. It will be noted in FIGS. 29 and 30 that relay SBR, for instance, will be operated in an obvious manner if a digit is registered in the B position, relay SBR thereupon locking over its own make contact **8** to off-normal ground in FIG. 30 on conductor ON**1**. At the end of the first arbitrary digital transmission to the first selector, above described, a circuit is completed for operating the next arbitrary outdigit steering relay of FIG. 16, depending upon the status of the above-mentioned relays SBR through SFR of FIGS. 29 and 30. This circuit extends from off-normal ground in FIG. 35, through make contact **4** of relay W, conductor AS**2** extending into FIG. 16, thence over break contacts **9** and **8** of relays RCA and RCS, thence over make contact **11** of the operated steering relay ARS, to transfer contacts **12** of relay SBR. It will be obvious by inspection in FIG. 16 that relay BRS or CRS et cetera through FRS will be operated depending upon which is the next one of these registers which contains a proper exit digit. Assuming that relay SBR of FIG. 29 is operated, indicating that there is an exit digit in the B position, the above-described circuit in FIG. 16 will be extended over make contact **12** of relay SBR, break contact **8** of relay BRS, to negative battery through the winding of relay BRS, which thereupon operates and locks over its own make contact **8** to the previously-described locking ground on conductor AS**4** extending into FIG. 35. Relay ARS of FIG. 16 will remain locked over break contact **6** of relay RCS, make contact **8** of relay ARS, and make contact **6** of relay BRS to the operating ground extending over break contact **8** of relay RCS until such time as relay W of FIG. 34 is released at the end of the interdigital time to remove this operating ground, whereupon relay ARS will release. Upon the release of relay ARS of FIG. 16, with relay BRS operated, it will be obvious by inspection in FIGS. 29 and 30 that the readout relays RR**0** through RR**7** are released and are reoperated in accordance with the second or B exit digit. In FIG. 34, upon the release of the reading relays and of their reoperation in accordance with the second or B exit digit, relay RK will release (to clamp the pulse generator of FIGS. 19 and 22) and will subsequently reoperate (to allow the pulse generator of FIGS. 19 and 22 to again continue to oscillate) in accordance with the second or B arbitrary exit digit. This process will continue with the steering circuit of FIG. 16 continuing to advance to operate the next arbitrary outsteering relay until such time as the last one of these arbitrary exit digits is used. This represents the situation where an outgoing trunk circuit is seized, whereupon the next circuit operation will cause the advancing ground of FIG. 16 to be extended through make contact **11** of the last operated arbitrary digit steering relay of FIG. 16 and back contacts of the remaining released relays SBR through SFR of FIGS. 29 and 30 to conductor AS**3** extending into FIG. 35, where it will cause the operation of one of the steering relays OS**1**, OS**2**, OS**3**, OS**4**, OS**5**, OS**7** or OS**8**, depending upon the status in FIG. 18 of the delete relays DAD through DL**1** and depending upon the status in FIG. 21 of relay AD**01**. The description of what takes place in this regard is found in the next section dealing with outpulsing beyond.

If relay STGO of FIG. 18 is operated from the decoder indicating that the call is a sender-class call on which the register-outpulser will dial-outpulse the arbitrary exit digits and will then switch to multifrequency outpulsing beyond, relays STGO and SD**0** of FIG. 18 will be operated. Also, the proper ones of the **10**DG through **3**DG and DAD through DL**1** relays of FIG. 18 will be operated to indicate the number of digits to expect in the called number and the delete digit information concerned with outpulsing beyond. As has been mentioned previously, this situation differs from the dial pulse outgoing type of call without stop-go operation in that the operation of relay STGO prepares a circuit in FIG. 26 to detect a stop-go signaling condition on the outgoing trunk circuit when seized. One side of this circuit extends from ground in FIG. 27, over make contact **19** of relay ON**2**, break contact **10** of relay RCA, conductor A into FIG. 26, and thence to make contact **1** of relay RV of FIG. 10: the other side of this circuit extends from negative battery in FIG. 26, through the lower winding of relay SG, through break contact **2** of relay SG**1**, and make contact **10** of relay STGO to make contact **1** of relay RV. It will be recalled with respect to relay RV of FIG. 10, that this relay is in series with the fundamental tip-ring loop extending toward the outgoing switch train but will not be operated unless a battery-ground reversal is returned from the outgoing trunk circuit upon seizure. When this situation occurs, as will be described below in the section concerning outpulsing beyond, relay RV will operate, thereby to cause the operation in FIG. 26 of relay SG to initiate a stop-go timing interval. In the meantime, the decoder circuit will have registered in the exit digit registers of FIGS. 32 and 33 the necessary number of exit digits to cause trunk seizure and will have registered in FIGS. 32 and 33 in the next exit digit register following the trunk seizure digit the so called KP pulse (signals **2** and **10**) which is utilized for transmitting beyond to enable a multifrequency receiver at the distant end preparatory to accepting the subsequently outpulsed multifrequency digits. In this regard, if trunk seizure is to take place under the action of a single exit digit registered in the A digit register of FIG. 32 then the KP pulse comprising signals **2** and **10** will be registered in the B register of FIG. 32 by the operation of relays BR2 and BR**10**. Under these circumstances, a circuit is completed immediately for preventing the pulse generator of FIGS. 19 and 22 from developing any exit digit outpulsing at all, this circuit extending from off-normal ground in FIG. 30, through make contact **4** of relay ON2, break contact **1** of relay DPC, conductor ON into FIG. 29, thence over the make contact of relay BR**10**, conductor B extending into FIG. 30, through break contact **9** of the steering relays BRS and CRS of FIG. 16, thence through break contact **2** of relay DPC, conductor PKC into FIG. 19, thence extending into FIG. 22, over break contact **11** of relay PKC and through make contact **11** of relay PG**1** to lock operated relay PG**1**. This prevents the pulsing generator of FIGS. 19 and 22 from oscillating, thereby to prevent the transmission to the first selector of FIG. 3 of the first arbitrary exit digit. As has been described hereinbefore, only when all of the exit digits have been registered, as indicated by the operation in FIG. 24 of relay PKC, will this clamping circuit just described be removed thereby to allow the release of relay PG1 of FIG. 22 (see break contact **11** in FIG. 22 of relay PKC). If, for instance, three arbitrary exit digits are necessary for trunk seizure, then the registers A, B, and C of FIG. 32 will contain the usual two-out-of-five decimal digit registration and the D digit register of FIG. 33 will contain the KP signal comprising the operation of relays DR2 and DR**10**. Under these circumstances, as is evident by inspection of FIGS. 29 and 30, the first two (the A and B) exit digits will be transmitted to the switch train; but, as soon as the C digit steering relay CRS of FIG. 16 is operated with the second digit steering relay BRS of FIG. 16 released, the above described circuit for clamping the pulse generator of FIGS. 19 and 22 will extend from ground in FIG. 30 on conductor ON, over the make contact of relay DR**10**, through make contact **9** of relay CRS, and break contact **2** of relay DPC, and over conductor PKC into FIGS. 19 and 22 to clamp the pulse generator. Therefore, the first two of the exit digits will be used to set the first two selectors but the third exit digit will not be used to cause trunk seizure until such time as complete called number registration takes place as indicated by the operation in FIG. 24 of relay PKC.

In FIG. 18 if the decoder causes the operation of relay DPC indicating that this call is a dial pulse outgoing call involving a stop-go signaling condition, the operation of relay DPC will cause the operation of relay STGO of FIG. 18, which in turn will cause the operation of relay SD**0**. The circuit now functions as previously described except that a stop-go signaling condition is expected when the register is connected to the distant end (upon trunk seizure). Under these circumstances, the decoder will cause the operation in FIGS. 32 and 33 of a number of arbitrary exit digit registers corresponding to the number of digits required to be pulsed to the selector train to cause trunk seizure. The last digit thereof, such for instance as in the C digit register if three digits are required to seize a trunk, will contain not only the usual two-out-of-five decimal digit registration but will also include the operation of its ten signal relay (such as relay CR**10** of FIG. 32). It will be apparent by inspection of the operating circuit for relay RK in FIG. 34, with relay DPC of FIG. 18 operated, as soon as reading relay RR**10** of FIG. 29 operates when the out-steering advancing chain reaches the register containing the ten signal (such as relay CR**10** of FIG. 32), the operating circuit for relay RK of FIG. 34 is opened. And, as has been mentioned hereinbefore, the released condition of relay RK (see break contact **6** of relay RK in FIG. 19) prevents the pulse generator circuit of FIGS. 19 and 22 from continuing to oscillate. This means that the selector train will be advanced to the point where an outgoing trunk is seized but stop-go signaling is expected on this trunk circuit and continued outpulsing will not take place until such time as the go signal is received after a stop signal.

OUTPULSING BEYOND

It will be recalled from previous description, particularly concerning the resetting of the selector train, that three classes of calls may be involved during outpulsing functions. One class of call is indicated by the operation in FIG. 18 from the decoder circuit of relay SD**0** which indicates a sender class call without stop-go signaling but with controlled outpulsing. Another class of call involves the operation in FIG. 18 from the decoder of relay STGO, indicating a sender class call on which the register-outpulser will use dial pulse exit digits to control the selector train and will then switch to multifrequency outpulsing beyond for the remainder of the outpulsed digits: in this instance the operation of relay STGO of FIG. 18 will cause the operation of relay SD**0**. The third situation involves that in which relay DPC of FIG. 18 is operated from the decoder to indicate a dial pulse call with stop-go signaling: under these circumstances the operation of relay DPC also causes the operation of relays STGO and SD**0** of FIG. 18. The so-called "stop-go" signaling situation involved in the latter two types of calls is a situation whereunder when an outgoing trunk circuit is seized, it is expected that this trunk circuit will contain reverse battery signaling on it, thereby to cause the operation in FIG. 10 of relay RV which is in series with the loop circuit to the selectors. The operation of relay RV, as will be noted in FIG. 26, completes the circuit for operating relay SG. Relay SG, in operating, starts a timing interval during which the circuitry waits for an additional reversal from beyond as an indication that it is proper to continue outpulsing. The stop-go signaling situation will be described below after description of the class of call involving the operation in FIG. 18 of only relay SD**0** as a basis for further description of the more complex situations.

It will be recalled from previous description of the circuit operation involved in resetting the selector train, that the outsteering and outpulsing control circuit of FIG. 34 detects the successive registrations in the readout relays of FIG. 29 of successive ones of the arbitrary exit digits of FIGS. 32 and 33 required for reaching an outgoing trunk circuit. The latter operation is under the control of the arbitrary outdigit steering circuit of FIG. 16, which in turn is successively advanced from steering relay to steering relay under control of the W and Z relays of FIG. 34, in turn controlled by relay PG**1** of the pulse generator circuit of FIG. 22. When the arbitrary outdigit steering circuit of FIG. 16 has advanced to a point represented by the outpulsing of the last exit digit (that is, the trunk seizure digit), the remaining relays SBR through SFR of FIGS. 29 and 30 will be released since there will be no more arbitrary exit digits in the registers of FIGS. 32 and 33. Under these circumstances, at the end of the digit when relay W of FIG. 34 operates, ground on conductor AS2 into FIG. 16 from FIG.

35 extends over back contacts **9** and **8** of relays RCA and RCS, thence over break contacts **11** of the steering relays ARS, BRS, et cetera, released when the previous digits were outpulsed, thence over make contact **11** of the last steering relay involved in exit digit pulsing, thence over back contacts of the remaining relays such as SDR, SER and SFR, thence over conductor AS3 into FIG. 35 to cause the operation of one of the called digit outsteering relays OS1, OS2, OS3, OS4, OS5, OS7 or OS8, depending upon whether the A digit is a zero or a one and depending upon whether any of the delete digit relays DAD through DL1 of FIG. 18 are operated or not.

If all of the called digits are to be deleted when outpulsing beyond, relay DAD of FIG. 18 will be operated, whereupon a circuit will be completed between FIGS. 35 and 36 for grounding the release lead RLS extending from FIG. 36 into FIG. 25 to thereby cause the operation in FIG. 25 of the release relay RL. If the A digit registered in the A register of FIG. 38 is not a zero or a one, then relay AD01 of FIG. 21 will be released, as has been described previously. Under these circumstances ground on conductor AS3 in FIG. 35 will be extended over break contact **9** of relay AD01, break contacts **10**, **2**, **8** and **3** of relays DL1, DL2, DL3 and DL6, conductor E into FIG. 36, thence over make contact **2** of relay DAD, make contact **3** of relay W, break contact **3** of relay TMFA and make contact **4** of relay TDR to conductor RLS extending to FIG. 25. If, on the other hand, relay AD01 of FIG. 21 is operated as an indication that the A digit is a zero or a one, then ground on conductor AS3 in FIG. 35 will be extended over make contact **9** of relay AD01, thence over break contacts **11**, **3** and **10** of relays DL1, DL2 and DL3, thence over conductor F into FIG. 36, over break contact **2** of relay DL6, make contact **3** of relay DAD to the previously-described circuit for causing the operation of the release relay RL of FIG. 25. In FIG. 35, it will be noted, in the event that relay DL1 of FIG. 18 is operated as an indication that one digit is to be deleted on outpulsing, that the previously-described circuit involving ground on conductor AS3 will extend over a break or a make contact of relay AD01, and thence over make contact **10** or **11** of relay DL1, and over break contact **6** of relay OS2 or relay OS3, to cause the operation of relay OS2 or OS3, depending upon whether the A digit is a zero or a one or is some other digit. Assuming that the A digit is not a zero or a one, relay OS2 will be operated and will lock over its own make contact **6** through the chain of No. **5** break contacts of the succeeding outsteering relays into FIG. 36 and to off-normal ground previously described. Eventually, at the end of the interdigital timing interval, as determined by the relay 1C of FIG. 22 and relays W and Z of FIG. 34, ground will be removed from conductor AS2 extending into FIG. 16 from FIG. 35 and will thereupon be removed from conductor AS5 in FIG. 16 to cause the release in FIG. 16 of the last operated arbitrary digit outsteering relay. Under these circumstances it will be observed in FIG. 31, with relay OS2 of FIG. 35 operated and with all of the preceding steering relays of FIGS. 29, 30 and 31 released, that the digit registered in the B register of FIG. 38 will be extended from FIG. 31, over make contact of relay OS2, and to the left through FIGS. 30 and 29 to cause the operation of two-out-of-five of the readout relays RR0 through RR7 of FIG. 29. This in turn will cause the check circuit of FIG. 34 to operate, thereby to allow the pulse generator of FIGS. 19 and 20 to develop the corresponding number of pulses, which in turn causes relay PG1 of FIG. 22 to transmit these digits toward the outgoing switch train through the selectors and the trunk thereof and to the connection beyond. In the meantime, upon the next operation of relay W of FIG. 34, ground is extended over conductor AS2 from FIG. 35 to FIG. 16 and returning therefrom over conductor AS1 into FIG. 35, through back contact **12** of relay OS1, make contact



**12** of relay OS2, break contact **6** of relay OS3, to negative battery through the winding of outsteering relay OS3. Relay OS3 operates and locks to off-normal ground over its own make contact **6**, relay OS2 remaining locked over its own make contact **6** and make contact **5** of relay OS3 to ground on conductor AS5 supplied to FIG. 35 from FIG. 16 during the interval when relay W of FIG. **34** is operated. At the end of the outpulsing of the B digit, steering relay OS2 of FIG. 35 will be released, thereby allowing steering relay OS3 of FIG. 35 to extract the digit in the C position of FIG. 31, to in turn cause it to be transmitted out over the trunk circuit. This operation continues until such time as the steering circuit of FIGS. 35 and 36 has caused the outpulsing of the last digit, as indicated by the operation in FIG. 18 of one of the relays 3DG through 7DG and under control of the status of the A digit relay AD01 of FIG. 21. For instance, if the called number consisted of seven digits, relay 7DG of FIG. 18 would be operated and assuming that relay AD01 of FIG. 21 is released indicating that the A digit is not a zero or a one, then with relay OS7 of FIG. 35 operated and relay OS6 of FIG. 35 released during the outpulsing of the seventh or last digit, ground will be extended from conductor A in FIG. 36 over make contact **12** of relay OS7, make contact **2** of relay 7DG, break contact **7** of relay AD01, break contact **2** of relay CCT, and through make contact **12** of relay 7DG to the previously-described circuit over make contact **3** of relay W for causing the operation in FIG. 25 of the register-outpulser release relay RL.

As was mentioned previously, when relay DPC of FIG. 18 is operated, indicating a dial pulse call expecting a stop-go signaling condition on the outgoing trunk circuit, relays STGO and SD0 of FIG. 18 will also be operated. Also, under these circumstances the one of the exit digit registers of FIGS. 32 and 33 which will contain the last (or trunk seizure) exit digit will also include the operation of the relay BR10, CR10 or DR10. This "ten signal," as has been described previously, will cause the operation in FIG. 29 of the readout relay RR10 when this particular digit is being outpulsed to the switching train for trunk seizure. Also, as has been mentioned hereinbefore, in FIG. 34 the operation of relay RR10, with relay DPC operated, prevents the operation of the check relay RK which in turn immobilizes the pulse generating and counting circuitry of FIGS. 19 and 22, thereby to prevent any further outpulsing until the stop-go signaling condition is dealt with.

In FIGS. 26 and 27, as as also been described, upon the operation of relay STGO of FIG. 18, a circuit is completed from off-normal ground in FIG. 27, over make contact **19** of relay ON2, break contact **10** of relay RCA, conductor A into FIG. 26, to make contact **1** of relay RV: negative battery extends from FIG. 26, through the lower winding of relay SG, through break contact **2** of relay SG1, and over make contact **10** of relay STGO to make contact **1** of relay RV. Relay RV in FIG. 10, as previously described, is in the loop circuit to the selector switching train and will be operated upon a battery-ground reversal from beyond as a stop signal. When relay RV of FIG. 10 operates, the circuit is completed in FIG. 26 for causing the operation of relay SG which, in operating, locks over its own make contact **2** independently of make contact **1** of relay RV. Eventually, when the additional battery ground reversal is returned from the equipment beyond as a go signal, relay RV of FIG. 10 will release, whereupon ground in FIG. 26 on conductor A is extended over break contact **3** of relay RV, make contact **8** of relay SG, to battery through the winding of relay SG1, which thereupon operates and locks over its own make contact **4** to off-normal ground on conductor A. The operation of relay SG1 will cause relay SG to release after an interval of time measured by the slow-release characteristic of its upper winding as controlled by its own make contact **12**.

With relay DPC of FIG. 18 operated and with relay SG1 of FIG. 26 operated, ground is removed from conductor ON in FIGS. 29 and 30, thereby to cause the release in FIG. 29 of relay RR10. The release of relay RR10 permits the outsteering and outpulsing control circuit of FIG. 34 to operate relay RK to once again allow the pulse generator and counting circuitry of FIGS. 19 and 22 to continue to generate and to transmit over the outgoing trunk circuit the remaining digits under control of the outsteering circuitry of FIGS. 35 and 36. and 36.

The remaining situation to be described in connection with outpulsing beyond is the circumstance where relay STGO of FIG. 18 is operated from the decoder to indicate a sender class call on which the register-outpulser will use dial pulsing to control the outgoing switch train and will then switch to multifrequency outpulsing for the remainder of the digits. Under these circumstances, as has been mentioned previously, relay SD0 of FIG. 18 is also operated. Also, it will be recalled that a number of exit digits will be required to be registered from the decoder into the register-outpulser of FIGS. 32 and 33 depending upon the number of dial pulse digits required to seize a trunk circuit. The next one of the arbitrary digit registers of FIGS. 32 and 33 will have registered therein the so-called KP signal (signals 2 and 10) which must be transmitted to the connection beyond on a multifrequency basis to energize the multifrequency receiving equipment thereat. Subsequently, those of the called digits registered in FIGS. 38 and 39 as are required to be outpulsed will be transmitted on a multifrequency basis. At the conclusion of the transmission of these digits, a multifrequency stop signal ST (signals 7 and 10) will be transmitted beyond as an indication to the equipment on the receiving end that multifrequency transmission has ceased. With reference to FIGS. 16, 29 and 30, when the arbitrary exit digit steering relay of FIG. 16 operates to prepare for transmission, a circuit is completed for determining whether the next subsequent arbitrary digit contains the ten signal. This circuit extends from ground in FIG. 30, over make contact **4** of relay ON2, over break contact **1** of relay DPC, to conductor ON in FIGS. 29 and 30, thence over a make contact of the BR10, CR10 or DR10 relay, thence over conductors C and B in FIGS. 29 and 30 to the transfer contacts **9** of relays BRS and CRS, thence over break contact **2** of relay DPC, conductor PKC into FIG. 19, thence into FIG. 22, over break contact **11** of relay PKC, and through make contact **11** of relay PG1, to cause relay PG1 to remain locked operated. This clamps the pulse generator of FIGS. 19 and 22 so that no further outpulsing can take place until further circuit operations come about. Under these circumstances, as distinguished from the ones described above, the arbitrary exit digit outpulsing has been stopped one digit prior to trunk seizure so as to partially set the switch train so as not to seize a trunk circuit until such time as called digit registration is complete, as indicated by the operation in FIG. 24 of relay PKC. When relay PKC of FIG. 24 operates, the above-described locking circuit for relay PG1 of FIG. 22 is opened, thereby allowing relay PG1 to release to initiate once again the operations and releases of relays PG1 of FIG. 22 and PG2 of FIG. 19. The outpulsing control circuit of FIG. 34 will thereupon cause the pulse generator and counting circuitry of FIGS. 19 and 22 to outpulse the last or trunk seizure digit which is the last exit digit contained in the auxiliary digit registers of FIGS. 32 and 33, thereby to cause trunk seizure. Since relay STGO of FIG. 18 is operated, the stop-go signaling condition is expected, as has been described above, and when relay RV of FIG. 10 operates to detect this stop condition, relay SG of FIG. 26 will become operated as has been described. Upon the advance of the arbitrary outdigit steering circuit of FIG. 16 to a position preparatory to reading out the so-called KP pulse (signals 2 and 10), reading relay RR2 of FIG. 29 will be operated and conductor RR10 from the arbitrary digit register will cause the operation of relay TMF of FIG. 29 in a circuit extending from conductor RR10, through break contact **8** of relay DPC, break contact **5** of relay TMF, to negative battery through the winding of relay TMF. Relay TMF, in operating, causes the operation of relay TMFA over make contact **12** of relay TMF and both of these relays lock over make contact **5** of relay TMF to off-normal ground on conductor ON1. Upon the operation of relay TMFA the ground on conductor RR10 in FIG. 29 will extend over break contact **8** of relay DPC and through make contact **4** of relay TMFA to battery through the winding of relay RR10, thereby causing the operation of relay RR10. Upon the operation in FIG. 29 of relay TMFA, break contacts **10** and **11** thereof in FIGS. 19 and 22 immobilize the pulse counting and interdigital timing circuitry (relays IC and P1 through P5) since they are no longer needed. Also, in FIG. 22 ground extends over break contact **5** of relay SG1 and make contact **4** of relay TMF to clamp the pulse generator by locking relay PG1 of FIG. 22 until such time as relay SG1 of FIG. 26 is operated, as will be described presently. In FIG. 19, with relay TMFA of FIG. 29 released, and with relay TMF2 of FIG. 33 released, the oscillating condition of relays PG1 and PG2 for purposes of transmitting dial pulses is arranged at a pulsing speed of approximately 10 pulses per second (p.p.s.) each with a 35 millisecond closed interval and a 65 millisecond (ms.) open interval. Upon the operation of relay TMFA of FIG. 29, the timing interval of this relay PG2 is changed so that relay PG1 of FIG. 22 operates and releases at a rate of 5 p.p.s., representing a 100 millisecond open interval and a 100 millisecond closed interval. Subsequently, as will be mentioned in connection with multifrequency outpulsing of the called digits, when relay TMF2 of FIG. 33 operates, the timing interval is further changed so that the pulsing rate is approximately 7 p.p.s., representing open and closed pulsing intervals of approximately 75 milliseconds each. Furthermore, in FIG. 10 it will be noted, upon the operation of relay TMF of FIG. 29, that make contact **9** of relay TMF is arranged in shunt of make contact **1** of relay PG1 of FIG. 22, thereby preventing the operations and releases of relay PG1 from transmitting any further dial pulse loop changes toward the circuits beyond. It will also be noted in FIG. 10, upon the operation of relay TMF of FIG. 29, that each release of relay PG1 will supply a multifrequency tone signal from the tone supply in FIG. 10 through the transformer TMF toward the fundamental tip and ring circuit comprising conductors FT and FR extending from FIG. 10 toward the outgoing selectors. This latter circuit extends from the tone supply in FIG. 10 through various resistances and over make and break contacts of various ones of the readout relays RR0 through RR10 of FIG. 29, thence over break contacts **8** and **7** of relay PG1, through resistances MF2 and MF1, over make contacts **2** and **3** of relay TMF to the right-hand side of the winding of transformer TMF, thence through the secondary winding thereof to the fundamental tip and ring leads FT and FR extending toward the outgoing switch train. Therefore, each time relay PG1 of FIG. 22 is released and reoperated one tone spurt is supplied out over the outgoing trunk circuit.

As soon as the outgoing trunk circuit is seized, relay RV of FIG. 10 will become operated due to the reverse battery-ground stop signal present on this trunk circuit. This will cause the operation, as above described, in FIG. 26 of relay SG. When the equipment beyond causes the outgoing trunk circuit to again supply a reverse-battery condition toward FIG. 10, relay RV will release as an indication of a go signal. This will cause the operation in FIG. 26 of relay SG1, as previously indicated, thereby removing the locking condition in FIG. 22 from the winding of relay PG1 which is allowed to release. The release of relay PG1 as above indicated, will transmit from FIG. 10 a multifrequency tone signal represented by the signals 2 and 10 (frequencies 1100 and 1700 cycles per second) representing the so-called KP signal which is thereupon transmitted to the equipment beyond to prepare the circuitry thereat for receiving multifrequency pulsing. In FIG. 34 relays W and V are advanced under the control of the operated relay TMFA of FIG. 29 and of the operating and releasing relay PG1 of FIG. 22, thereby to cause the outsteering circuitry of FIGS. 16, 35 and 36 to advance from digit to digit. The successive digits are read by the reading relays of FIG. 29 which in turn control the RK relay of FIG. 34, which in turn allows relays PG1 and PG2 of FIGS. 22 and 19 to continue to oscillate. Each one of the successive digits to be outpulsed is selected by the contacts in FIG. 10 of the readout relays of FIG. 29 and is transmitted over the outgoing trunk circuit as a multifrequency pulse. At the end of outpulsing of all the required digits, all of the outsteering relays OS1 through OS11 of FIGS. 35 and 36 will have become released, thereby to cause the operation in FIG. 36 of relay ST in a circuit extending from transfer contact 3 of relay W in FIG. 36, through make contact **3** of relay W, make contact 3 of relay TMFA, and through break contact **8** of relay ST, to negative battery through the winding of relay ST. Relay ST, in operating, locks over its own make contact **8** to off-normal ground over break contact **5** of relay ST1. Upon the subsequent release of the last steering relay in the circuit of FIGS. 35 and 36, ground will extend through break contact **12** of relay OS11, over make contact **3** of relay ST, through break contact **4** of relay ST1, to negative battery through the winding of relay ST1. Relay ST1, in operating, locks over its own make contact **4** to off-normal ground in FIG. 36 and causes the ultimate release of relay ST of FIG. 36. During the time when relay ST of FIG. 36 is operated a circuit is completed for causing the transmission on a multifrequency basis of the so-called ST signal as an indication to the equipment beyond that the end of multifrequency pulsing has taken place. This circuit extends from ground in FIG. 31 over make contacts **7** and **10** of relay ST, thence through back contacts of all of the outsteering relays, over conductors OP7 and OP10 extending into FIG. 30, thence through back contacts of the arbitrary digit outsteering relays in FIGS. 30 and 29 to cause the operation in FIG. 29 of relays RR7 and RR10. This causes the outpulsing control circuit of FIG. 34 to in turn allow relay PG1 of FIG. 22 to transmit from FIG. 10 the ST pulse on a multifrequency basis. Eventually, when the relay ST of FIG. 36 releases, ground is extended from FIG. 36 over make contact **17** of relay ON2, break contact **12** of relay ST, make contact **2** of relay ST1, and make contact 4 of relay TDR, to conductor RLS extending into FIG. 25 to cause the operation therein of the register-outpulser release relay RL.

### DISCONNECT

Disconnect of the register-outpulser can take place under a number of circumstances, any one of which ultimately results in the release of the register-outpulser off-normal relays ON and ON1 of FIG. 8 and ON2 of FIG. 28 and the removal of holding ground from the TC lead extending from FIG. 8 back toward the register, trunk and link circuit of FIGS. 2 and 7 to cause the release thereof. Some specific register-outpulser disconnect situations will be described briefly in the following paragraphs.

If a call is abandoned before loop closure to the selector switching train, relays CB of FIG. 10 and TR1 of FIG. 13 do not become operated. When relay DCK of FIG. 8 operates, as an indication that the register, trunk and link circuit of FIGS. 2 and 7 has been connected properly, with relay TR1 of FIG. 13 released, relay ON of FIG. 8 is released to in turn cause the successive releases of relays ON1 of FIG. 8 and ON2 of FIG. 28. The release of these off-normal relays will eventually cause the release of all operated relays in the register-outpulser. In addition, with relay DCK of FIG. 8 operated, under circumstances where relay TR1 of FIG. 13 has not operated, in FIG. 8 ground is removed from conductor TC extending back toward the register, trunk and link circuit to cause the release of that link circuit.

If a call is abandoned after loop closure to the selector train but before dial tone is supplied to the calling subscriber, relays CB of FIG. 10 and TR1 of FIG. 13 will be operated. When the call is abandoned relay CB of FIG. 10 will become released. Then, upon the operation in FIG. 8 of relay DCK, with relay CB of FIG. 10 released, relay TR1 of FIG. 13 is released to in turn remove ground from conductor TC extending from FIG. 8 toward the register, trunk and link circuit and to cause the release of the above-mentioned register-outpulser off-normal relays.

A regular release of the register-outpulser will be caused by the operation in FIG. 25 of the release relay RL under control of the outdigit steering chain of FIGS. 35 and 36. For instance, in FIG. 36 it will be noted, if the outpulsing has involved multifrequency outpulsing, that relay TMFA of FIG. 29 will be operated and relay ST1 of FIG. 36 will be operated. The operation of relay ST1 will have started the release in FIG. 36 of relay ST. When relay ST releases, a circuit is completed from ground in FIG. 36, over make contact **17** of relay ON2, break contact **12** of relay ST, make contact **2** of relay ST1, and over make contact 4 of relay TDR to conductor RLS extending into FIG. 25 to cause the operation therein of relay RL, this circuit extending in FIG. 25 over break contact **2** of relay ROD, break contact **8** of relay TA1, and break contact **1** of relay RT3 to the winding of release relay RL. Relay RL, in operating, opens its break contact **2** in FIG. 8, thereby to cause the release of the above-mentioned off-normal relays and of the register, trunk and link circuit of FIGS. 2 and 7. If relay TMFA of FIG. 29 is released, indicating that the outpulsing did not involve multifrequency signaling, then the operation of relay RL of FIG. 25 will be controlled over make contact **3** of relay W in FIG. 36 and through break contact **3** of relay TMFA to the above-described circuit to conductor RLS. It will be recalled that relay W of FIG. 34 is operated at the end of each outpulsed digit when relay IC of FIG. 22 operates as an indication of the end of the proper number of pulses. Also, relay Z of FIG. 34 operates when relay IC of FIG. 22 is released after the advancing of the outstanding circuitry, the recycling of the readout relays of FIG. 29 and the recycling of the pulse counting circuitry of FIGS. 19 and 22. Also, relay W of FIG. 34 will become released when relay IC of FIG. 22 reoperates at the end of a count of four pulses, representing the manufactured interdigital time. Lastly, relay Z of FIG. 34 is released when relay IC of FIG. 22 is released after the recycling of the counting circuitry preparatory to developing the necessary pulses represented by the next digit to be outpulsed. Therefore, each time that relay W of FIG. 34 operates it completes the circuit in FIG. 36 through its make contact **3** to energize the release lead RLS extending into FIG. 25 provided that the conditions are proper in FIGS. 35 and 36 for extending ground potential to make contact **3** of relay W. Some of these release conditions have been mentioned above in connection with the detailed description of certain functions of the register-outpulser. One example, for instance, would be on a call involving ten digits (as indicated by the operation in FIG. 18 of relay **10**DG) when relay OS10 of FIG. 36 is operated with relay OS9 released preparatory to outpulsing the tenth called digit (in the K register of FIGS. 31 and 39). If the A digit is not a zero or a one, relay AD01 of FIG. 21 will be released, whereupon ground will extend from FIG. 35, over make contact **4** of relay ON1, through make contact **4** of relay W, conductor AS2 into FIG. 16, over break contacts **9** and **8** of relays RCA and RCS, thence through back contacts **11** of all of the arbitrary outdigit steering relays, conductor AS1 extending into FIG. 35, thence over break contacts **12** of outsteering relays OS1 through OS6, conductor A into FIG. 36, thence over break contacts **12** of outsteering relays OS7, OS8 and OS9, thence over make contact **12** of relay OS10 and break contact **12** of relay AD01 to the above-described circuit involving make contact **3** of relay W. On the other hand, if the A digit is a zero or a one (relay AD01 of FIG. 21 operated) the above-described circuit will extend over make contact **12** of relay AD01 in FIG. 36 to cause the operation of outsteering relay OS11. When relay OS11 operates, with relay OS10 released, it will be obvious that the operating ground will extend from conductor A in FIG. 36 over break contacts **12** of the outsteering relays OS7 through OS10 and thence over make contact **12** of relay OS11 to the above-described circuit to release conductor RLS.

If a call is abandoned after dial tone has been supplied to the calling subscriber, relay L1 of FIG. 9 will become released to in turn cause the release in FIG. 15 of relay LA and the operation in FIG. 15 of relay RA. Also relay L2 of FIG. 15 will release after an interval of time determined by its slow-release characteristic. A circuit will thereupon be completed for causing the operation in FIG. 27 of the wink-line-finder relay WLF extending from off-normal ground on conductor ON in FIG. 26, over make contact **4** of relay REC, thence over conductor B into FIG. 27, thence over break contact **9** of relay L2, and break contact **11** of relay TDSA, to battery through the winding of relay WLF. In FIG. 25 it will be noted that upon the operation of relay WLF of FIG. 27 a circuit is completed for operating the release relay RL extending from ground in FIG. 25, over make contact **12** of relay WLF, break contact **8** of relay TA1 and break contact **1** of relay RT3.

Under a situation where a TOUCH-TONE calling subscriber or a dial pulse calling subscriber effects a partial dial situation (does not dial a complete number) the register-outpulser will be released by the operation in FIG. 27 of relay WLF. Relay DP of FIG. 15 or relay MF1 of FIG. 24 will be operated, depending upon whether the call is a dial pulse calling subscriber or a TOUCH-TONE calling subscriber. Relay REC of FIG. 13 will be operated, as will relay L1 of FIG. 9. Relay STR of FIG. 24 will be operated and released under control of relays RA and RA2 of FIG. 15 for a dial pulse call or under the control of conductor STR extending into FIG. 24 from the TOUCH-TONE converter if the calling subscriber is a TOUCH-TONE calling subscriber. Relay PKC of FIG. 24 is released since a complete called number has not been registered yet. Each time relay STR of FIG. 24 is released between digital registrations, ground will be extended from FIG. 24 over make contact **5** of relay ON, break contact **3** of relay STR, break contact **9** of relay PKC, and break contact **9** of relay ROD to conductor ON extending into FIG. 23 to start the long time-out LTO (about 18 seconds timing). If no more digits are received by the time relay LTO of FIG. 23 operates, circuits are completed for initiating the release of the register-outpulser. Relay PK of FIG. 27 will operate in a circuit extending from negative battery, through its winding, over break contact **4** of relay PK, break contact **8** of relay PKC, make contact **6** of relay LTO, and thence over make contact **12** of relay DP and break contact **4** of relay MF1, or over make contact **4** of relay MF1, and over break contact **8** of relay STO, break contact **10** of relay TA1, conductor A into FIG. 15 and thence to off-normal ground over make contact **4** of relay L1. In the meantime, in FIG. 27, upon the operation of the long time-out relay LTO of FIG. 23, a circuit is completed for operating the reorder relay ROD of FIG. 27 extending from ground on conductor B in FIG. 27, over make contact **4** of relay LTO, through diode ROD, break contact **10** of relay PS and break contact **4** of relay RL to negative battery through the winding of relay ROD. Relay ROD, in operating, causes the release in FIG. 23 of relay LTO (by removing ground in FIG. 24 from conductor ON extending into FIG. 23). Also, it will be noted in FIG. 10 that any operation of relay ROD opens the loop to the switch train (back contact **5** of relay ROD), thereby releasing any operated selectors. The release of relay LTO of FIG. 23 with relay ROD of FIG. 27 operated causes relay ROA of FIG. 27 to be operated in a circuit extending from battery, through its winding, over break contact **2** of relay PS, make contact **7** of relay ROD and break contact **4** of relay LTO to ground on conductor B. The operation of relay ROA (see FIG. 24) restores ground to conductor ON extending from FIG. 24 into FIG. 23 to again start the 18-second timing interval of the LTO timer. At this time ground extends in FIG. 15 over break contact **3** of relay RL to conductor PK extending into FIG. 27, thence over make contact **1** of relay PK, break contact **12** of relay RT1, make contact **1** of relay ROA, to conductor A extending into FIG. 9 to energize the no-such-number-tone signaling box shown therein, whereupon this tone signal is supplied through a resistance NT, make contact **3** of relay PK, through capacitor RO and make contact **4** of relay ROD to the right-hand side of transformer T, whereupon the no-such-number-tone signal is transmitted back to the calling subscriber. At the end of 18 seconds, during which time the no-such-number-tone signal is transmitted to this calling subscriber, relay LTO of FIG. 23 will operate to in turn cause the operation in FIG. 27 of the wink-line-finder relay WLF. This circuit extends from ground on conductor B in FIG. 27, over make contact **4** of relay LTO, make contact **4** of relay ROA and break contact **11** of relay TDSA to the winding of relay WLF. In FIG. 25, the operation of relay WLF, as previously described, will cause the operation of the register-outpulser release relay RL.

A disconnect of the register-outpulser may take place under control of the three punchings designated PS, 1DG and 2DG in the outpulsing steering circuitry of FIG. 35. If the routing instruction for a permanent signal trunk circuit is one digit (terminated on the first selector) or two digits (terminated on a second selector), the punching PS of FIG. 35 will be cross-connected to the punching 1DG or 2DG, depending upon whether the permanent signal routing involves one digit or two digits. After the outpulsing of the first arbitrary exit digit contained in the AR register of FIG. 32 and as controlled by the first arbitrary digit steering relay ARS of FIG. 16, ground on conductor AS3 in FIG. 35 will extend through break contact **9** of relay AD01, and thence through the break contact chain of relays DL1, DL2, DL3 and DL6, conductor E into FIG. 36, over break contact **2** of relay DAD and back into FIG. 35 over conductor G to cause the operation of the first outsteering relay OS1 if no digits are to be deleted on outpulsing: If one digit is to be deleted upon outpulsing, relay DL1 of FIG. 18 will be operated, whereupon the above-described ground in FIG. 35 will extend over make contact **10** of relay DL1 to cause the operation of relay OS2 in the outpulsing chain. If relay OS1 of FIG. 35 is operated, ground extending into FIG. 35 on conductor AS1 will extend over make contact **12** of relay OS1 to punching 1DG: if relay OS2 of FIG. 35 is operated with relay OS1 released, this ground will extend over make contact **12** of relay OS2 to energize punching 2DG in FIG. 35. If one of these punchings is cross-connected to punching PS in FIG. 35, ground will extend to punching PS in FIG. 35 and thence over make contact **6** of relay PS (operated in FIG. 27 to indicate a permanent signal condition), thence over conductor RLS into FIG. 36 and from there into FIG. 25 to cause the operation of the release relay RL.

Disconnect of the register-outpulser may take place under circumstances where three digits are required to seize a permanent signal holding trunk. Under these circumstances the steering relays ARS, BRS and CRS of FIG. 16 will have been properly controlled to have caused three arbitrary exit digits to be employed for connecting the calling line to a permanent signal holding trunk on the third selector. At this time, ground will extend into FIG. 35 on conductor AS3 and thence through break contact **9** of relay **AD01**, over break contacts of relays DL1, DL2, DL3 and DL6, conductor E extending into FIG. 36, thence over make contact **2** of relay DAD (operated from the decoder to indicate no outpulsing of any called digits), thence over make contact **3** of relay **W** to the previously-described circuit for causing the operation in FIG. 25 of the release relay RL.

Release of the register-outpulser may take place on a trouble time-out before dial tone is received. Under these circumstances relay TA1 of FIG. 23 will become operated to indicate this situation. A circuit is then completed for causing the operation in FIG. 27 of relay WLF extending from ground in FIG. 13, over make contact **22** of relay ON1, make contact **7** of relay CB, break contact **2** of relay REC, make contact **2** of relay TA1, conductor WLF extending into FIG. 27, thence over break contact **11** of relay TDSA to the winding of relay WLF. It will be noted with reference to FIG. 8 that upon the operation of relay WLF, ground will be removed at its break contact **9** from the circuit for holding operated the off-normal relay ON and for supplying ground on the TC conductor to the register, trunk and link circuit. Therefore the off-normal relays of the register-outpulser will be released and the register, trunk and link circuit of FIGS. 2 and 7 will become released.

A register-outpulser release situation also occurs or can occur on a trouble time-out after TOUCH-TONE keying or dial pulse dialing has been completed. This will be indicated by the operation in FIG. 23 of relay TA1. Under these circumstances the recorder relay ROD of FIG. 27 will be operated in a circuit extending from ground on conductor A in FIG. 15 extending into FIG. 27, thence over make contact **10** of relay TA1, break contact **4** of relay RL, to battery through the winding of relay ROD. Upon the operation of relay ROD, recorder tone is supplied from the designated box in FIG. 9 through resistance **R0**, break contact **3** of relay PK, through condenser **R0**, and make contact **4** of relay ROD back toward the calling subscriber. Relay ROD of FIG. 27, in operating, causes the operation of relay ROA in a circuit previously described under control of make contact **7** of relay ROD and break contact **4** of relay LTO. The operation of relay ROA starts the LTO timer of FIG. 23 to time an interval of 18 seconds, this circuit extending in FIG. 24 from off-normal ground over make contact **5** of relay ON, break contact **3** of relay STR, make contact **9** of relay PKC (dialing complete), thence over make contacts **9** and **2** of relays ROD and ROA, to conductor ON extending into FIG. 23 to initiate the timing operation. At the end of the 18 seconds, relay LTO of FIG. 23 will become operated to in turn cause the operation in FIG. 27 of relay WLF as has been described hereinbefore. The operation of relay WLF (see FIG. 9) will cause the release of the off-normal relays of the register-outpulser and will cause the release of the register, trunk and link circuit of FIGS. 2 and 7.

Release of the register-outpulser may also take place due to a time-out during the above-mentioned stop-go signaling condition. With relay RV of FIG. 10 operated as an indication of a stop pulsing signal, relay SG of FIG. 26 will be operated as previously described. The operation of relay SG of FIG. 26 causes the start in FIG. 23 of a 10 second timing interval, at the end of which relay STO or relay TA1 of FIG. 23 will be operated unless the timing interval is canceled before then. It will be recalled from previous description that if relay RV of FIG. 10 is released as a start signal, then relay SG1 of FIG. 26 will become operated to in turn cause the release in FIG. 26 of relay SG. This situation will recycle the STO timer of FIG. 23. However, in the event that the start signal is not received within the 10 second interval, relay STO or TA1 will operate as a time-out signal. Relay STO operates if all digits have not been received (back contact **3** of relay PKC in FIG. 23); and relay TA1 will operate if the time-out occurs after all digits are received (front contact **3** of relay PKC in FIG. 23). The operation of relay STO of FIG. 23 will cause the operation in FIG. 27 of relay ROD in a circuit extending from ground on conductor ON in FIG. 26, over make contact **4** of relay REC, make contact **1** of relay STO, break contact **3** of relay ZO, thence over break contact **3** of relay CCT, conductor **R0** into FIG. 27, through break contact **4** of relay RL and to battery through the winding of relay ROD. The operation, on the other hand, of relay TA1 in FIG. 23 operates relay ROD of FIG. 27 from ground on conductor A in FIG. 27 over make contact **10** of relay TA1. As has been mentioned previously, the operation of relay ROD of FIG. 27 supplies reorder tone from FIG. 9 back toward the calling subscriber, recycles the LTO timer of FIG. 23, and causes the operation in FIG. 27 of relay ROA, thereby to restart the LTO timer of FIG. 23. Eighteen seconds later relay LTO of FIG. 23 will operate, to in turn cause the operation in FIG. 27 of relay WLF, thereby to cause the release (see break contact **9** of relay WLF in FIG. 8) of the off-normal relays of the register-outpulser and to cause the release of the register, trunk and link circuit of FIGS. 2 and 7.

Release of the register-outpulser may also take place if a proper stop-go signal has been received but if a second stop signal is received. The first stop signal will operate relay RV of FIG. 10 as has been previously described, which in turn will cause the operation in FIG. 26 of relay SG. When relay RV of FIG. 10 releases as a start or go signal, relay SG1 of FIG. 26 will be operated, as has been described. Thereupon, if relay RV of FIG. 10 reoperates as a second stop signal, a circuit is completed for causing the operation in FIG. 23 of the time-out relay TA1. This latter circuit extends from ground in FIG. 27, over make contact **19** of relay ON2, break contact **10** of relay RCA, conductor A into FIG. 26, thence over make contact **2** of relay RV, make contact **3** of relay SG1, make contact **12** of relay TDRA, make contact **11** of relay SDO, make contact **5** of relay TDR, to conductor TA1 extending into FIG. 23 to cause the operation of relay TA1 therein. Relay TA1 of FIG. 23, in operating, causes the operation in FIG. 27 of relay ROD in a circuit previously described from ground on conductor A extending into FIG. 27 from FIG. 15. Relay ROD causes the operation in FIG. 27 of relay ROA to start the timing of the LTO timer of FIG. 23. After an 18 second interval of time, relay LTO of FIG. 23 operates, to in turn cause the operation in FIG. 27 of relay WLF. As above described, relay WLF of FIG. 27, in operating, releases the register-outpulser and releases the register, trunk and link circuit of FIGS. 2 and 7.

The register-outpulser will become released upon a failure of the previously described party retest condition. Under these circumstances, as will be recalled from previous description, ground is applied in FIG. 14 to conductor **R0** extending into FIG. 27, thence over break contact **4** of relay RL to cause the operation of relay ROD. This operation of relay ROD supplies reorder tone from FIG. 9 toward the calling subscriber, recycles the **LT0** timer of FIG. 23, and operates relayl ROA of FIG. 27. At the end of 18 seconds of timing relay LTO of FIG. 23 operates, to in turn cause the operation in FIG. 27 of relay WLF, the operation of which, as above mentioned, causes the release of the register-outpulser and of the register, trunk and link circuit of FIGS. 2 and 7.

There are a number of other circuit circumstances under which the register-outpulser may be released; however, it is believed that the above examples will be sufficient to illustrate the versatility of the machine. Other release situations will be obvious to those skilled in the art by a knowledge of the circuitry employed.

TIMING

The timing of register-outpulser functions is controlled by the two timer circuits shown in FIG. 23. The circuit details inside the boxes of these timers is the same as has been described previously in connection with FIG. 86 of the translator-decoder connector circuitry of FIGS. 77 through 95. These two timers furnish various timing intervals for various functions. The STO timer provides a normal interval of approximately 3 seconds timing when the junction of resistors CT1 and CT2 is grounded; whereas, when the junction between resistors CT1 and CT2 is not grounded the STO timer provides a timing interval of approximately 10 seconds. The LTO timer provides a normal timing interval of approximately 18 seconds when the junction between resistors CT3 and CT4 is not grounded; whereas, when this junction is grounded the timing interval of the LTO timer is reduced to approximately 10 seconds. These two timers are basically resistance-capacitor timing networks which control three-stage transistor amplifiers as shown in FIG. 86. The amplifier outputs are connected to relays such as relays LTO, STO and TA1 in FIG. 23, one of which is operated whenever the associated timing circuit times out.

In the case of the STO timer, capacitor CT is in parallel with a capacitor located inside the box and connected between terminals **1** and **2**. These capacitors are normally (relay STT of FIG. 26 released) charged to approximately −46 volts D.C. (the negative battery potential being approximately −48 volts D.C.) at terminal **1** of the timer circuit by virtue of the circuit from negative battery to terminal **1** over break contact **2** of relay STT. When the register-outpulser is seized, as indicated by the operation of its off-normal relay ON of FIG. 8, a circuit is completed for causing the operation of relay STT in FIG. 26. This circuit extends from off-normal ground on conductor ON in FIG. 26, over break contact **4** of relay REC, thence through break contacts **12**, **4** and **10** of respective relays ROD, TDSA and RCY, to negative battery through the winding of relay STT. In FIG. 23, upon the operation of relay STT, negative battery is removed from terminal **1** of the timer circuit and is extended over make contact **2** of relay STT to terminal **2**, thereby causing terminal **1** of the timer to instantaneously assume a value of approximately −94 volts direct current. At this time the junction between resistors CT1 and CT2 is grounded in an obvious manner over make contact **11** of relay ON2 and break contacts **4**, **6**, **11** and **9** of respective relays RR10, SG, TMF and TDSA. Under these circumstances resistance CT1 starts discharging the timing capacitors toward ground potential. When terminal **1** of the timer reaches approximately −46 volts the internal circuitry of the timer causes the transistors therein to function and to operate relay TA1 of FIG. 23 over break contact **12** of relay REC (this being the situation prior to the providing of dial tone). If relay REC of FIG. 13 is operated (after dial tone), the circuit would extend over make contact **12** of relay REC in FIG. 23, thence over break contacts **4**, **3** and **10** of relays SG, PKC and TDSA to cause the operation of relay STO instead of relay TA1. The release at any time of relay STT of FIG. 26 causes the rapid recharging of the timing capacitors to the −46 volt condition on terminal **1**, thereby recycling the timer. The operation of relay TDSA of FIG. 21 (at the time that the register-outpulser bids for a translator-decoder) opens break contact **9** of relay TDSA in FIG. 23, thereby to add resistance CT2 to resistance CT1 in the discharge path, thereby to increase the time element from approximately 3 seconds to approximately 10 seconds. It will also be noted that the operation of relay TDSA will cause a transfer (see transfer contacts **10** of relay TDSA in FIG. 23) of the STO timer control from relay STO to relay TA1.

The LTO timer of FIG. 23 uses the same basic circuitry as the STO timer but does not have the voltage doubling action on the timing capacitors. Capacitor CT1–3 is in parallel with the capacitor of the timing circuitry connected between terminals **1** and **2**. Before the register-outpulser is seized the top electrode of capacitor CT1–3, and thereby terminal **1** of the timer circuitry, will be held at approximately battery potential (−48 volts); and terminals **3** and **2** of the timer circuitry will be at approximately ground potential, with terminal **7** being supplied by the −48 volt battery. When the register-outpulser is seized (relay ON of FIG. 8 operated), a circuit extends from ground in FIG. 24, over make contact **5** of relay ON, break contact **3** of relay STR, break contacts **9** of relays PKC and ROD, thence over conductor ON into FIG. 23 to the left-hand electrode of diode DA. Also in FIG. 23 negative battery is supplied over make contact **2** of relay ON, through break contact **11** of relay RT1, and thence to ground through resistances CT5 which are approximately equal, thereby establishing at the junction of these two resistances approximately half of the negative battery potential or about −24 volts. The top electrode of capacitor CT1–3, and thereby terminal **1** of the circuit, is clamped by diode DB so as not to become more positive than −48 volts. With terminal **1** of the circuit at −48 volts, the timer starts to discharge toward ground through the resistances CT3 and CT4 and the equivalent source resistance on the −24 volt voltage divider comprising resistances CT5. The circuit starts to conduct when terminal **1** thereof reaches approximately −22 volts. As current flows into the equivalent source resistance of the voltage divider at terminal **3** of the circuit, that point becomes more positive than −24 volts and eventually relay LTO of FIG. 23 is operated. If at any time the all registers busy relay ARB of FIG. 27 is operated from the associated register, trunk and link circuit of FIG. 7, contact **11** thereof in FIG. 23 shorts out resistance CT3, thereby reducing the time element of the LTO timer from 18 seconds to approximately 10 seconds.

When the register-outpulser is seized, as has been mentioned above, the operation of its off-normal relay ON of FIG. 8 operates relay STT of FIG. 26 to start the operation of the STO timer of FIG. 23 on a 3 second timing interval. At the same time, the LTO timer of FIG. 23 is started on its 18 second work timing. After the register-outpulser has made loop continuity check, double-connection check, and party test if required, the register-outpulser operates its REC relay of FIG. 13 to return dial tone to the calling customer. The operation of relay REC, as will be apparent by noting break contact **4** thereof in FIG. 26, causes relay STT of FIG. 26 to become released, thereby to recycle the STO timer. A time-out will occur if the above checks have not been made in three seconds, thereby to cause the operation in FIG. 23 of relay TA1. As has been described previously, this operation of relay TA1 will cause the return to the calling subscriber of reorder tone for approximately 18 seconds and opens the fundamental tip-ring loop to release the switch train (if relay CTR of FIG. 11 is released indicating that timed release of the register-outpulser has not been canceled). At the end of the reorder tone period, relay LTO of FIG. 23 will operate to cause the release of the register, trunk and link circuit of FIGS. 2 and 7, of the line finder of FIG. 2 and eventually of the register-outpulser.

If a zero is received as the first dialed digit, relay ZO of FIG. 26 will operate, as has been described. With relays STT of FIG. 26 and REC and FIG. 13 operated, the STO timer will time-out in three seconds, to cause the operation of relay STO of FIG. 23. If another digit is received before time-out, then the operation of the in-digit steering relay IS3 of FIG. 24 will cause the release in FIG. 26 of relay ZO, thereby to release relay STT to recycle the timing circuit.

Receipt by the register-outpulser of three or four digits, as has been explained hereinbefore, causes the operation in FIG. 21 of relay RCY to initiate seizure of a translator-decoder pair. The operation of relay RCY causes the operation in FIG. 21, as been described, of relays TDST and TDSA. It is the operation of the latter two relays which causes seizure of the translator-decoder pair. The operation of relay TDSA releases relay RCY; and, relay STT of FIG. 26 is operated during this process to start the STO timer on a 10 second timing interval (in FIG. 23 break contact **9** of relay TDSA is opened). The release of relays TDST and TDSA (indicating a proper translator-decoder seizure) releases relay STT of FIG. 26 to recycle the timer. If a time-out occurs, relay TA1 of FIG. 23 will operate to indicate an equipment trouble.

If relay CCT of FIG. 21 has been operated from the translator-decoder circuitry to indicate that the register-outpulser should initiate a conflicting code timing interval, the operation of in-digit steering relay IS8 of FIG. 24 with relays IS7 and IS9 of FIG. 24 released and with relay AD01 of FIG. 21 released, will complete a circuit in FIG. 26 for causing the operation of relay STT; whereas, if relay AD01 of FIG. 21 is operated, then the operation of relay IS9 of FIG. 24 will cause the operation in FIG. 26 of relay STT. This circuit extends from off-normal ground on conductor ON in FIG. 26, over make contact **4** of relay REC, through make contact **10** of relay CCT and thence over (1) make contact **8** of relay AD01, break contacts **10** of relays GD1 and IS10, make contact **12** of relay IS9 and break contact **10** of relay IS8 or (2) break contact **8** of relay AD01, break contacts **10** and **8** of relays IS9 and IS7 and thence over make contact **10** of relay IS8, thence over break contact **6** of ZO to the operating circuit for relay STT. If a time-out occurs, relay STO of FIG. 23 will be operated, whereupon a circuit is completed for causing the operation of relay 7DG of FIG. 18 to indicate a seven-digit call, this circuit extending from off-normal ground on conductor ON in FIG. 26, over make contact **4** of relay REC, make contact **1** of relay STO, break contact **3** of relay ZO, make contact **3** of relay CCT, break contacts **11** and **12** of relays GD1 and IS, to conductor 7DG extending into FIG. 18 and thence to negative battery through the winding of relay 7DG. On the other hand, if a time-out does not occur (that is, other digits are received before time-out), eventually the operation of the insteering relay IS9 or IS10 of FIG. 24 will complete a circuit for causing the operation in FIG. 18 of the relay 10DG, indicating that a ten-digit number is involved. This latter circuit extends from ground at transfer contacts **8** of relay AD01 in FIG. 26, thence one way or the other and eventually through make contact **10** of relay IS9 or IS10, to conductor 10DG extending into FIG. 18 to negative battery through the winding of relay 10DG.

Permanent signal timing is accomplished by the LTO timer of FIG. 23. This 18 second timer is in effect from seizure of the register-outpulser to reception of the first digit. The operation of relay STR in FIG. 24 recycles the timer (see transfer contacts **3** of relay STR in FIG. 24). If a time-out occurs before receipt of any digits, relay LTO of FIG. 23 operates to complete a circuit for causing the operation in FIG. 27 of the permanent signal relay PS. This latter circuit extends from ground in FIG. 15 over make contact **24** of relay ON1, over make contact **4** of relay L1, conductor A into FIG. 27, thence over break contact **10** of relay TA1, over break contacts **8**, **4** and **12** of relays STO, MF1 and DP, thence over make contact **8** of relay LTO and break contact **5** of relay PS to negative battery through the winding of relay PS.

Once at least one digit has been received, then the operation of either relay DP of FIG. 15 or MF1 of FIG. 24 will change the register-outpulser timing from permanent signal timing to partial key timing. This means that if a time-out occurs, the partial key relay PK of FIG. 27 will be operated instead of the permanent signal relay PS. With the receipt of the first digit rely STR of FIG. 24 operates and cancels the long timing. When relay STR releases long timing is recycled. If another digit is not received in the 18 second interval, time-out will occur and relays LTO and PK will operate. The circuit for operating relay PK of FIG. 27 extends over break contact **8** of relay STO in FIG. 27 and thence over make or break contacts of the relays MF1 and DP, thence over make contact **6** of relay LTO and break contacts **8** and **4** of relays PKC and PK to negative battery through the winding of relay PK.

After the register-outpulser has determined that all digits have been received, as has been described previously, relay PKC of FIG. 24 will operate and lock. The operations and releases of the interdigital relay IC of FIG. 22 during outpulsing, as has been mentioned previously, then controls the timing and recycling of timing for all outpulsing digits and for the interdigital time of all of these outpulsed digits. This control is exercised by break contact **3** in FIG. 26 of relay IC. Under these circumstances if a time-out occurs, relay TA1 of FIG. 23 will be operated.

When a register-outpulser is seized it makes a check of the condition of its lead HSR– extending from FIG. 11 into the jack, key and lamp circuit to prepare for holding if a time-out occurs. With the register-outpulser release relay RL of FIG. 25 released, ground is extended through break contact **9** thereof in FIG. 11, and thence through the windings of relay CTR, over break contact **1** of relay TA1 and make contact **23** of relay ON1, to conductor HSR0 extending into the jack, key and lamp circuit. When the jack, key and lamp circuit is set to hold a stuck register-outpulser, make contact **1** of the RH0 key will be closed, whereupon battery is extended over conductor HSR0 to cause the operation of relay CTR to cancel any timed-release of the register-outpulser. The operation of relay TA1 (following a time-out) under these circumstances will complete an obvious locking circuit in FIG. 11 for relay CTR. Also, in FIG. 25, relay TA1, in operating, puts the operation of the register-outpulser release relay RL under control of a jack in the jack, key and lamp circuit, thereby preventing the release of the register-outpulser except under control of the jack panel. In FIG. 8 it will be noted that the operated relays TA1 and CTR maintain ground over their make contacts **4** and **6** on the TC lead back toward the register, link and trunk circuit to hold this circuit. It will be noted in FIG. 8 that if the HT0 key in the jack, key and lamp circuit is operated, ground will be extended over make contacts **3**, **9**, **4** and **3** of relays CTR, TA1, DCK and ON to the sleeve conductor S1 extending toward the outgoing switch train to prevent its release. As will be apparent by inspection of FIG. 25, a held register-outpulser is released by the insertion of a make-busy plug in the RL jack in FIG. 25, whereby to cause the operation of the release relay RL which, upon operating, opens the holding circuit for relay CTR of FIG. 11 to thereby release and disconnect the holding ground for the off-normal relay ON of FIG. 8. This allows the register-outpulser to return to normal.

When a stop-go signaling condition is met upon seizure of an outgoing trunk circuit, a timing interval is started in the STO timer of FIG. 23 to time for a start signal. This circuit extends from ground in FIG. 27, over make contact **19** of relay ON2, break contact **10** of relay RCA, conductor A into FIG. 26, thence over break contact **4** of relay SG1 (released until a start condition exists), thence over make contact **10** of relay SG (operated upon the previously received stop condition), thence through break contact **6** of relay ZO, to the previously mentioned operating circuit for relay STT which, in operating, initiates the timing of the STO timer of FIG. 23. If a start or go condition is received before the operation in FIG. 23 of relay STO (all digits not received-relay PKC released) or relay TA1 (relay PKC operated) as a result of this stop-go timing, relay SG1 of FIG. 26 will be operated, thereby to cause the release in FIG. 26 of relay STT to recycle the timer.

Other specific timing cycles are initiated by other circuit operations but these are not considered sufficiently of interest at the moment to warrant detailed description. It will be apparent to those skilled in the art by an inspection of the circuits how these timing operations come about.

### TRANSLATOR-DECODER RESEIZURE

As has been mentioned hereinbefore, whenever a register-outpulser effects seizure of a translator-decoder pair, one of the three leads in FIG. 18 designated OS, 1S and 2S is grounded to indicate to the translator-decoder the information as follows: if lead OS is grounded, this indicates an original seizure (relays 1S and 2S of FIG. 25 released); lead 1S in FIG. 18 indicates reseizure on a foreign area call or on a call invoving conflicting code timing (relay 1S of FIG. 25 operated and relay 2S of FIG. 25 released); and, conductor 2S of FIG. 18 indicates a reseizure on a call for which an alternate route is available where a busy selector train is encountered (relay 2S of FIG. 25 operated). The circuit for grounding one of the conductors OS, 1S and 2S in FIG. 18 extends from ground in FIG. 21, over make contact **20** of relay ON2, thence over conductor A extending into FIG. 18, and through the appropriate one of the transfer contacts **1** and **11** of respective relays 2S and 1S.

If conflicting code timing is in effect, the decoder will have provided the register-outpulser with the necessary route for a seven-digit call and will have operated the conflicting code timing relay CCT in FIG. 21 and the decoder release relay TDR of FIG. 20. Under these circumstances, the operation of the conflicting code timing relay CCT of FIG. 21 will cause the register-outpulser timing control circuitry of FIGS. 23 and 26 to initiate a timing interval during which the register-outpulser wll ascertain whether or not the call involves seven digits or ten digits. If a time-out occurs, relay 7DG of FIG. 18 will be operated from the timing control circuit of FIG. 26 to indicate that the call involves seven digits; whereas, if further digits are received without a time-out, then the 10DG relay of FIG. 18 will be operated from the timing control circuit of FIG. 26 to indicate that the call involves ten digits. If the call is ascertained to be a seven-digit call, the register-outpulser will already have been supplied with the necessary seven-digit route and reseizure of a translator-decoder pair is unnecessary to ascertain the required route. Under these circumstances however, if the alternate route available relay ARA of FIG. 18 has been operated from the translator-decoder, indicating that an lternaet route is available, then a translator-decoder reseizure will be necessry if a busy outgoing switch train is encountered. The circuit for causing this reseizure is the circuit for operating relay 2S of FIG. 25, extending from ground in FIG. 25, over make contact **5** of relay ON1, make contact **10** of relay TDR, break contacts **6**, **4**, **9** and **7** of relays RCA1, RCA, CA 6 and RSC, thence over make contact **8** of relay CCT, make contact **3** of relay 7DG, make contact **9** of relay ARA, thence over make contact **3** of either relay BTA1 or relay BTA2 to negative battery through the winding of relay 2S under control of break contact **4** of relay 2S. Relay 2S, in operating, locks the off-normal ground in an obvious manner over its own make contact **4**. The locking circuit for relay TDR of FIG. 20 extends from the winding thereof in FIG. 20, over make contact **3** of relay TDR, conductor TDR into FIG. 21, thence to off-normal ground under control of make and break contacts of various ones of relays 1S, 2S, 1SA and ARA. Upon the operation of relay 2S of FIG. 25, relay TDR of FIG. 20 will be released, thereby completing a circuit in FIG. 21 for causing the operation of relay RCY under control of make contact **2** of relay 2S. As will be appreciated from previous description, the operation of relay RCY in FIG. 21 causes a translator-decoder reseizure. Since under these circumstances conductor 2S of FIG. 18 will be grounded toward the translator-decoder, the reseizure will be indicated to the decoder as one asking for an alternate route, it being noted in FIG. 18 that upon the operation of relay RCY the original locking circuit for relay ARA of FIG. 18 is opened so that relay ARA is released upon the second seizure of the translator-decoder. If relay ARA of FIG. 18 had not been operated on the original seizure, thereby indicating that an alternate route was not available, then it will be noted in FIG. 25 that the previously-described circuit for causing the operation of relay 2S is broken at transfer contacts **9** of relay ARA and the ground supplied thereto is extended over break contact **9** of relay ARA to previously-mentioned circuits for directly controlling the register-outpulser release relay RL of FIG. 25 or for leaving relay RL under control of the outpulsing chain of FIGS. 35 and 36. If a time-out does not occur under the conflicting code timing situation (more digits received), relay 10DG of FIG. 18 will be operated, whereupon a reseizure of the translator-decoder is necessary to ascertain the ten-digit route. Under these circumstances the previously-described circuit in FIG. 25 extends over make contact **8** of relay CCT, thence over make contact **5** of relay 10DG and break contact **4** of relay 1SA, to negative battery through the winding of relay 1S, which thereupon operates The operation of relay 1S of FIG. 25 opens the locking circuit in FIG. 21 for relay TDR of FIG. 20, thereby causing relay TDR to release, to in turn allow relay RCY of FIG. 21 to reoperate under control of make contact **9** of relay 1S to cause a translator-decoder reseizure. When relay TDR of FIG. 20 releases, relay 1SA of FIG. 25 is allowed to operate in series with relay 1S. When relay TDR of FIG. 20 reoperates at the end of the translator-decoder seizure, it locks in the circuit of FIG. 21 controlled by make contact **6** of relay 1SA and break contact **2** of relay 2S. If relay ARA of FIG. 18 is operated as a result of the second translator-decoder reseizure, then circuits are arranged in FIG. 25 so that relay 2S may be operated to cause another translator-decoder seizure in the event of a busy outgoing switch train (relay BTA1 or BTA2 of FIG. 13 operated). On the other hand, if no alternate route is available (relay ARA of FIG. 18 released), then the circuit of FIG. 25 will extend over break contact **9** of relay ARA to the register-outpulser release circuitry.

If the translator-decoder usage resulted in no conflicting code timing (relay CCT of FIG. 21 released) and no foreign area translator call (relay CA6 of FIG. 18 released), then when relay TDR of FIG. 20 operates at the end of translator-decoder reseizure, the circuitry of FIG. 25 is arranged so that relay 2S is the only one which can operate provided that an alternate route is available (relay ARA of FIG. 18 operated). If no alternate route is available, then the circuitry of FIG. 25 is arranged to enable control of the register-outpulser release relay RL of FIG. 25.

If the translator-decoder has indicated (relay CA6 of FIG. 18 operated) that this is a foreign area call, the register-outpulser is arranged to reseize the translator-decoder after the receipt of six digits. This reseizure is caused by the operation in FIG. 25 of relay 1S in a circuit extending over make contact **9** of relay CA6 to transfer contacts **10** of relay ADO1 of FIG. 21. If the A digit is not a zero or a one, then this circuit will extend in FIG. 25 over break contact **10** of relay ADO1, thence through break contact **8** of relay IS 6 and make contact **10** of relay IS7 at the end of receiving six digits, thence to the previously-described circuit for causing the operation of relay 1S in FIG. 25. If the A digit was a zero or a one, then the circuit would extend in FIG. 25 over make contact **10** of relay ADO1, thence through make contact **8** of relay IS8 and break contact **10** of relay IS7 after the receipt of the seventh digit, to the circuit for operating relay 1S of FIG. 25.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

**1.** In a switching system wherein a plurality of serially related switching stages is provided, wherein a variable number of initial stages is settable to select and establish a tandem connection through to a line-seizure stage, wherein said line-seizure stage is settable to seize a line terminating therein, wherein a received plural digit address code is used to derive a plural digit switching code comprising a last switching digit and a variable number of initial switching digits, wherein the number of initial swtching digits in a derived switching code is used initially to set a corresponding number of initial stages in tandem, and wherein the last switching digit in said derived switching code is used subsequently to set said line-seizure stage:

(A) first registering means for registering a received series of digits constituting a complete said plural digit address code;

(B) second registering means for registering said plural digit switching code;

(C) translating means controlled by said first registering means upon registration therein of a predetermined number of address digits

(1) for deriving said switching code from said predetermined number of registered address digits;

(2) and for causing said derived switching code to be registered in said second registering means;

(D) and switching stage control means controlled by said first and second registering means

(1) for setting a number of initial stages according to the number of registered initial switching digits and independently of complete address code registration

(2) and for preventing the setting of said line-seizure stage according to said registered last switching digit until address code registration is complete.

**2**. The invention defined in claim **1**

(A) wherein said control means includes means for setting respective stages by sending thereto signals representing respective registered switching digits;

(B) wherein said control means includes means for allowing the sending of any registered initial switching digit independently of complete address code registration;

(C) and, wherein said control means includes means for preventing the sending of said registered last switching digit until address code registration is complete.

**3**. The invention defined in claim **2** wherein said preventing means includes controllable circuit means for stopping the sending of said last switching digit when address code registration is incomplete and for permitting the sending of said last switching digit when address code registration becomes complete.

**4**. The invention defined in claim **3**

(A) wherein means is provided controlled by said first registering means for indicating whether or not address code registration is complete;

(B) and, wherein said circuit means is controlled by said indicating means.

**5**. The invention defined in claim **4**

(A) wherein said sending means includes a signal generator selectively controllable by said second registering means for generating signals corresponding to registered switching digits;

(B) wherein said allowing means selectively controls the generation by said generator of a signal corresponding to a registered initial switching digit;

(C) and, wherein said circuit means selectively controls the generation by said generator of a signal corresponding to said registered last switching digit.

**6**. The invention defined in claim **5**

(A) wherein said second registering means includes a fixed plurality of registers arranged in an order representing the order in which digits registered therein are to control said signal generator;

(B) wherein said translating means causes

(1) said variable number of initial switching digits to be registered in a corresponding initial number of registers in said order

(2) and said last switching digit to be registered in that register immediately following in said order the register into which the last of said initial switching digits is registered;

(C) and, wherein said sending means includes sequencing means for causing said signal generator to be controlled by said registers successively in sequence according to said order.

**7**. The invention defined in claim **6**

(A) wherein said sequencing means comprises means for ascertaining when said signal generator is to be next controlled in said order by said last switching digit register;

(B) and, wherein said circuit means is controlled by said ascertaining means.

**8**. The invention defined in claim **7**

(A wherein at least one data digit is to be transmitted over said seized line;

(B) wherein said translating means is also controlled by said first registering means upon registration therein of said predetermined number of address digits

(1) for deriving said data digit from said predetermined number of address digits

(2) and for causing said derived data digit to be registered in the register immediately following in said order the register into which said last switching digit is registered;

(C) wherein said translating means causes said data digit to be registered in a manner to distinctively mark the registration thereof as such;

(D) and, wherein said ascertaining means includes means to detect said marked data digit registration after said signal generator has been controlled by the last of said registered initial switching digits and before said signal generator is controlled by said registered last switching digit.

**9**. The invention refined in claim **8**

(A) wherein each register capable of registering said data digit includes an operable mark relay;

(B) wherein said translating means causes the operation of a mark relay in only that register wherein said data digit is registered;

(C) and, wherein said detecting means detects the operated condition of said mark relay.

**10**. The invention defined in claim **9**

(A) wherein each register includes five register relays;

(B) wherein a switching digit is registered by the coded operation of two-out-of-five of said register relays;

(C) and, wherein said data digit is register by the coded operation of said mark relay and at least one-out-of-five of said register relays.

**11**. In a step-by-step telephone switching system wherein is provided a plurality of serially related step-by-step impulse controlled switches, wherein a variable number of switches is selectively settable to select and establish a tandem connection through a trunk seizure switch, wherein said trunk seizure switch is selectively settable to seize a trunk terminating therein and which represents a suitable telephone route for a called number, wherein a received series of caller number digits is used to derive a plural digit switching code comprising a last switching digit and a variable number of initial switching digits, wherein the number of initial switching digits in a derived switching code is used initially to set a corresponding number of initial switches in tandem, wherein the last switching digit in said derived switching code is used subsequently to set said trunk seizure switch, and wherein at least one data digit is to be transmitted over said seized trunk:

(A) a register-sender exclusive of said switches, common thereto, and capable of associating itself with a first switch for controlling said first switch and subsequent switches in said tandem connection;

(B) said register-sender including

(1) a called number register for registering said series of successively received called number digits constituting a complete called number,

(2) a switching code register for registering said data digit and said plural digit switching code,

(3) and switch control means controlled by said number register and said code register

(a) for setting a number of initial switches according to the number of registered initial switching digits and independently of complete called number registration

(b) and for preventing the setting of said trunk seizure switch according to said registered last switching digit until called number registration is complete;

(C) and, a translator associable with said register-sender upon registration in the latter of a predetermined number less than all of registered called number digits

(1) for translating said predetermined number of called digits into said data digit and said plural digit switching code

(2) and for causing said data and switching code digits to be registered in said code register of said register-sender.

12. The invention defined in claim 11

(A) wherein said control mens includes means for setting respective switches by sending thereto signals representing respective registered switching digits;

(B) wherein said control means includes means for allowing the sending of any registered initial switching digit independently of complete called number registration;

(C) and, wherein said control means includes means for preventing the sending of said registered last switching digit until called number registration is complete.

13. The invention defined in claim 12 wherein said preventing means includes controllable circuit means for stopping the sending of said last switching digit when called number registration is incomplete and for permitting the sending of said last switching digit when called number registration becomes complete.

14. The invention defined in claim 13

(A) wherein means is provided controlled by said called number register for indicating whether or not called number registration is complete;

(B) and, wherein said circuit means is controlled by said indicating means.

15. The invention defined in claim 14

(A) wherein said sending means includes a step-by-step impulse digit signal generator selectively controllable by said code register for generating signals corresponding to registered switching digits;

(B) wherein said allowing means selectively controls the generation by said generator of a signal corresponding to a registered initial switching digit;

(C) and, wherein said circuit means selectively controls the generation by said generator of a signal corresponding to said registered last switching digit.

16. The invention defined in claim 15

(A) wherein said code register includes a fixed plurality of digit registers arranged in an order representing the order in which digits registered therein are to control said signal generator;

(B) wherein said translator means causes

(1) said variable number of initial switching digits to be register in a corresponding initial number of digit registers in said order

(2) and said last switching digit to be registered in that digit register immediately following in said order that the digit register into which the last of said initial switching digits is registered;

(C) and, wherein said sending means includes sequencing means for causing said signal generator to be controlled by said digit registers successively in sequence according to said order.

17. The invention defined in claim 16

(A) wherein said sequencing means comprises means for ascertaining when said signal generator is to be next controlled in said order by said last switching digit register;

(B) and, wherein said circuit means is controlled by said ascertaining means.

18. The invention defined in claim 17

(A) wherein said translating means causes said derived data digit to be registered in the digit register immediately following in said order the digit register into which said last switching digit is registered;

(B) wherein said translating means causes said data digit to be registered in a manner to distinctively mark the registration thereof as such;

(C) and, wherein said ascertaining means includes means to detect said marked data digit registration after said signal generator has been controlled by the last of said registered initial switching digits and before said signal generator is controlled by said registered last switching digit.

19. The invention defined in claim 18

(A) wherein each digit register capable of registering said data digit includes an operable mark relay;

(B) wherein said translating means causes the operation of a mark relay in only that digit register wherein said data digit is registered;

(C) and, wherein said detecting means detects the operated condition of said mark relay.

20. The invention defined in claim 19

(A) wherein each digit register includes five register relays;

(B) wherein a switching digit is registered by the coded operation of two-out-of-five of said register relays;

(C) and, wherein said data digit is registered by the coded operation of said mark relay and at least one-out-of-five of said register relays.

21. In a step-by-step telephone switching system wherein is provided a plurality of serially related step-by-step impulse controlled switches, wherein a variable number of initial switches is selectively settable to select and establish a tandem connection through to a trunk seizure switch, wherein said trunk seizure switch is selectively settable to seize a trunk terminating therein and which represents a suitable telephone route for a called number, wherein a received series of called number digits is used to derive a plural digit switching code comprising a last switching digit and a variable number of initial switching digits, wherein the number of initial switching digits in a derved switching code is used initially to set a corresponding number of initial switches in tandem, wherein the last switching digit in said derived switching code is used subsequently to set said trunk seizure switch, and wherein at least one data digit is to be sent over said seized trunk:

(A) first registering means for registering said called digits;

(B) indicating means controlled by said first registering means for indicating when called digit registration is complete;

(C) second registering means for registering said data digit and said switching digits;

(D) a translator controlled by said first registering means upon registration therein of a predetermined number less than all of said called digits

(1) for deriving said data digit and said switching digits from said predetermined number of called digits

(2) and for causing said data digit and said switch-

ing digits to be registered in said second registering means;

(E) and, a sender controlled by said indicating means and by said second registering means

(1) to set a number of initial switches according to the number of registered initial switching digits and independently of complete called digit registration,

(2) to set said trunk seizure switch according to said registered last switching digit only when called digit registration is complete,

(3) and to send said data digit over said seized trunk.

**22.** The invention defined in claim **21**

(A) wherein said second registering means includes a fixed plurality of registers arranged in an order representing the order in which digits registered therein are to control said sender;

(B) wherein said translator causes

(1) said variable number of initial switching digits to be registered in a corresponding initial number of registers in said order,

(2) said last switching digit to be registered in that register immediately following in said order the register into which the last of said initial switching digits is registered,

(3) and said data digit to be registered in that register immediately following in said order the register into which said last switching digit is registered;

(C) and, wherein said sender includes a sequence circuit for causing said sender to be controlled by said registers successively in sequence according to said order.

**23.** The invention defined in claim **22**

(A) wherein said translator causes said data digit to be registered in a manner to distinctly mark the registration thereof as such;

(B) and, wherein said sender includes means controlled by said sequence circuit for ascertaining the position in said order of said registered last switching digit by ascertaining the position in said order of said marked data digit registration.

**24.** The invention defined in claim **23**

(A) wherein said sender comprise a step-by-step impulse generator connectable to and controllable by a switching digit register to generate a series of impulses corresponding to the switching digit registration;

(B) wherein said sequence circuit comprises a steering connector

(1) for successively connecting said generator to successive registers one at a time in sequence according to said order;

(2) and for establishing an interval of testing time subsequent to connection of said generator to any register and prior to connection of said generator to the immediately succeeding register in said order;

(C) and, wherein said ascertaining means comprises detector circuitry controlled by said steering connector and by said data digit register to detect said marked data digit registration during that said testing interval prior to connection of said generator to the register having registered therein the said last switching digit.

**25.** The invention defined in claim **24**

(A) wherein said detector circuitry comprises a normally ineffective generator stopping circuit rendered effective upon said detection of said marked data digit registration;

(B) wherein said called digit complete registration indicating means comprises a start relay under the control of said first registering means to be released when called digit registration is incomplete and to be operated when called digit registration is complete;

(C) wherein said generator is controlled by any initial switching digit register independently of the condition of said start relay;

(D) and, wherein said generator stopping circuit whenever rendered effective prevents said generator from being controlled by said last switching digit register unless said start relay is operated.

**26.** In a switching system, a plurality of switching stages, means for registering a plurality of digits comprising a variable number of switching digits, a signaling digit, and a plurality of data digits, control means for serially setting a variable number of switching stages in accordance with said registered switching digits, and means for preventing the setting of the last of said number of switching stages in response to the last of said switching digits until registration of all said data digits has been completed, said preventing means including means for detecting the registration of said signaling digit.

**27.** The invention defined in claim **26** wherein the registration of said signaling digit includes a registration index not utilized in the registration of any data digit, said preventing means including means for detecting the presence of said registration index.


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KATHLEEN H. CLAFFY, *Primary Examiner.*

LAURENCE A. WRIGHT, *Assistant Examiner.*