SECTION 4

PRETRANSLATION

PRETRANSLATION

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FIGURES

1 - Typical Cross Connections for a Three Digit Home Area
2 - Typical Cross Connections for a Three Digit Home Area where the Home Office is Arranged for XOX and XlX Codes

A. GENERAL

1.01 This section is one of a group which describes the detailed circuit operation of various types of calls handled by the No. 5 Crossbar System with wire spring relays.

1.02 This section describes the operation of the pretranslator circuit. Pretranslation is a process of examining the dialed digits of a central office code with the intent to determine how many digits in all may be dialed. A telephone subscriber can dial different numbers of digits. For instance, if he dials a service code (211, 411, etc,) he dials three digits. If he dials the intraoffice code in a 2-5 numbering plan area, he dials seven digits. He may dial seven or eight digits for a manual office number. Individual lines have seven digits and party lines have eight digits. Customers who can dial toll calls directly, may dial ten or eleven digits. They dial ten digits for machine office telephones and manual office direct line (XOXABC1234). They dial eleven digits when calling party line phones in manual offices (XOXABC1234J).

1.03 If an originating register could know just how many digits a subscriber intended to dial, then it would know when the last digit was received. After this last digit was stored, the originating register could start for a completing marker. It wouldn't have to wait to see if the subscriber was going to dial more digits.

1.04 Of course, it isn't possible for the originating register to determine exactly how many digits the subscriber will dial every time. Yet there are certain categories that central office codes fall into which may help us solve the problem. If we can determine from certain central office codes just how many more digits to expect, we can save originating register holding time.

1.05 We can recognize certain codes such as 211, 411, 611, etc, as three-digit codes. If the originating register is told to summon a marker immediately after it receives one of these codes, we cut down on holding time. Cutting down on holding time is important because it helps to reduce the number of originating register circuits we need in our office.

1.06 If a subscriber dials the intraoffice code in a 2-5 numbering plan area, then we can have the pretranslator circuit tell the originating register that the seventh digit is the last digit. The register can start for a completing marker as soon as this G digit is stored. We can treat calls for dial central offices like this. Codes for manual offices present a different situation. The originating register can't know if the subscriber is going to dial a number for an individual or party line. So, the register must wait for the extra digit (party letter). For manual office codes, the pretranslator tells the register to start an extra digit timer at the end of the G or seventh digit. This gives the subscriber enough time to dial a party letter digit.

1.07 Where the numbering arrangement of the local area is not complex, the originating register does the pretranslating functions. The process of pretranslating codes in the originating register is discussed in CD-26040. Where it is complex, it is more economical to concentrate these functions in common pretranslator circuits. Pretranslators are also required for foreign area customer dialing (FACD) to distinguish between local or home area calls and foreign area calls. Pretranslators are reached by the originating registers through pretranslator connectors.

1.08 One pretranslator is able to handle the traffic in most offices; however, an additional pretranslator is always provided for maintenance purposes. Two pretranslators may serve two marker groups when office codes receive the same translation in both groups. The holding time of pretranslators is short - about 160 milliseconds.

1.09 The originating register summons a pretranslator after either the second digit (2-4 numbering plan) or the third digit (2-5 numbering plan) is received. It seizes the pretranslator connector and then the connector seizes an idle pretranslator. The connector closes two groups of leads from the originating register to the pretranslator. The first group of leads transmits the digits representing the central office code from the registration relays in the originating register to the code register relays of the pretranslator. These are the receiving leads, because it is through them that the pretranslator receives the code which it is to translate. The pretranslator then translates the code into one of several possible indications. The second set of leads, called the transmitting leads, is used to return this indication or "start index" to the originating register. For any particular code, the pretranslator sends one indication.

1.10 This section describes the operation of both the pretranslator and pretranslator connector circuits as they perform these functions. It describes the arrangement of the pretranslators in numbering areas using three-digit office codes and foreign area directing codes.

B. ESTABLISHING THE CONNECTION TO A PRETRANSLATOR

1. General

1.01 An originating register has access to either pretranslator through the pretranslator connector circuit. One pretranslator connector is provided for each pretranslator. Each pretranslator connector has access to both pretranslators. The arrangement of pretranslators, connectors, and originating registers is shown on the block diagram of OS 713-1, Sheet 1.

1.02 Each connector can serve a maximum of 60 originating registers which are divided into three subgroups with a maximum of 20 registers per subgroup. This arrangement reduces the number connected to a common multiple and reduces the service hazard which may be caused by an open or cross in this multiple. An originating register connects to the subgroup multiple through its associated PRA- relay. A subgroup connects to the common connector through the GA- and GB- relays. The connector circuit has access to the pretranslator through the PA- and PB- relays. All registers on the same register frame are assigned to the same connector subgroup to simplify the

wiring of the PRS- (register preference) and PRA- (register connector) relays. These relays are located on the same register frames as their originating registers. All other connector circuit equipment is located on the pretranslator frame.

2. Pretranslator Start

2.01 The originating register can start for the pretranslator after the second or third digit (OS 711-1). It depends upon the office code and whether straightforward call completion is involved. In two-digit office code areas also having two-digit straightforward codes, the pretranslation is started after the second digit. In all other cases, pretranslation is made after the third digit. The 11 prefix is not included in the digit count because it is not included in the registration but is counted on a separate prefix counter.

2.02 In a three-digit (2-5 numbering plan) central office area, the originating register starts for the pretranslator after the third digit is stored. After the C digit is registered, relay DS- (D digit steering) operates. Relay DS- operates relay PST- (pretranslator start) which locks and starts selection of a pretranslator by seizing the connector. This is done by connecting the battery to a start lead. This battery operates the associated PRS- relay (OS 712-1) through the register preference chain.

3. Register and Subgroup Preference

3.01 Two relay chain circuits are provided in each connector to evenly distribute pretranslator service to all registers which request it. These are the register preference chains and the subgroup preference chain (OS 712-1). Each register preference chain consists of all the PRS- relays for the registers in a subgroup (maximum of twenty PRS- relays). This chain determines the preference when two registers in the same subgroup want a pretranslator. Three of these chains are provided per connector - one for each subgroup. The subgroup preference chain is three GS- (group selection) relays, one for each register subgroup. This chain determines the preference when two originating registers in two subgroups of a connector want pretranslator service at the same time. Each of these chains is described in the following paragraphs.

3.02 The operating ground for the PRS- relays is closed through a chain of normal contacts of these relays. It starts at the last register. The chain uses parallel contacts of the PRS- relays and bridged leads to prevent a single open lead or contact from denying some registers access to the connector.

3.03 When an originating register connects battery to its ST- lead it operates its associated PRS- relay through normal contacts of all succeeding (higher numbered) PRS- relays. Once operated, the PRS- locks through its own contacts to ground. If no other PRS- relays are operated at the time, the operated PRS- relay closes two parallel paths (with bridged leads) to operate its PRA- relay in series with the GS- relay in the subgroup. These leads are carried through a normal contact chain of all preceding PRS- relays in the subgroup. The PRS- contacts of the first register are closest to the functional ground. This ground is supplied through the normals of the BR- and GR- relays in the connector. This gives the lowest numbered originating

register preference for operating its associated PRA- relay if two or more registers operate their PST- relays. Other calls are served in turn when ground is made available to them by the release of the preceding PRS- relays.

3.04 There are two chain grounds at work in this PRS- relay circuit. The first one is the operating ground for the PRS- relays. In this circuit the higher numbered PRS- is preferred. In fact, even after a certain PRS- relay is operated, a higher numbered PRS- can operate to this ground. However, once operated and locked, the lower numbered PRS- relay has preference for operating its associated PRA- relay. This is so because it is nearer to the functional ground - a chain circuit which runs opposite to the operating ground. A PRS- relay can operate over a path through its own normal contacts to the locking ground of a lower numbered PRS- relay which is operated even though a higher numbered PRS- relay is operated and waiting. For instance, if PRS0 is operated and being served by the connector, a demand from the register two can operate PRS2 - If in the meantime register one demands pretranslator service, it can operate its PRS1 through its own normals and operated contacts of PRS0. The number twelve contacts of the PRS- relays, those in the operating chain, are continuity transfer contacts (make before break). The higher numbered PRS- relay waits its turn for the functional ground. When the last operated PRS- relay releases, ground is restored to the lead through which the PRS- relays operate. The relays for preceding registers which have waiting calls operate. The preference chain again determines the order in which they are served.

3.05 The GS- relays are arranged in a chain circuit so that only one demand from a subgroup can be served when other subgroups in the connector are waiting for service. Relay GS0 may be operated independently of both the GS1 and the GS2 relays. Relay GS1, however, can operate only when GS0 is normal. When operated, it locks, so that subsequent operation of GS0 will not release it. Similarly, relay GS2 can operate only when GS0 and GS1 are normal, and once operated, it locks independently of these relays.

3.06 Contacts of the GS- (group start) relays are wired in a chain circuit. The ground originates at normals of the GK- relay contacts (OS 712-1, Sheet 2 upper left hand corner) and is connected to the contacts of GS2 first, GS1, and then GS0 relays. This is the functional ground circuit for the subgroups. This arrangement gives preference to the higher numbered subgroup GS- relay which is operated.

4. Register and Subgroup Connector Relay Operation

4.01 The PRA-relay closes the receiving and transmitting leads from the register to the associated subgroup connector relays. On OS 712-1, Sheet 1, it also extends start battery through resistors STA and STB over leads STA and STB to the pretranslator connector. Start leads A and B are used alternately for selecting a pretranslator. Resistors STA and STB protect the register battery supply and prevent a trouble ground on one start lead from affecting the other.

4.02 Relay GC- operates its GA- and GB- (subgroup connector) relays. GA- and GB- relays close the receiving and transmitting leads through to the pretranslator connector relays and operate the GCA- relay for the subgroup. Relay GCA- operates the GK and GK1 (subgroup check) relays that are common to the three subgroups in the connector. These relays remove ground from the operating circuit of the GC- relays so that no other subgroup can operate its GC- relays.

4.03 Here we have another example of a double chain circuit. For the operating ground, relay GS0 is preferred, GS1 next preferred and GS2 is last. In the functional ground circuit, relay GC2 is closest to the ground through the GK and GK1 relays. GC1 is next and GC0 is last in the chain.

5. Connection to the Pretranslator

5.01 Two relay chain circuits are used in the pretranslator connector to select the preferred pretranslator. These are the CB- (connector busy) relay chain and the PS- (pretransistor start) relay chain. Each of these chains consists of one CB- and PS- relay for each pretranslator in the group. The following paragraphs describe these chains.

5.02 When a pretranslator is busy on a call, it operates its CB- relay in the connector not being served. For example, on OS 712-1 when pretranslator zero is busy serving pretranslator connector zero, it operates the CB0 relay in connector one. The operation of any GC- relay in connector one locks the CB0 relay operated. This prevents a call from reverting to a more preferred pretranslator if one should become idle. The circuit is arranged so that one CB- relay must be normal to complete the path for locking the other if it is operated. This prevents a request for a pretranslator from blocking itself if both pretranslators are momentarily busy.

5.03 The operation of relay GC- (subgroup connector) extends the start battery from the originating register on leads STA and STB through the W and Z relay combination and normal contacts of relay TRS-to either the STA or STB punching. Relay Z is released for one call and operated for the next. It alternately closes leads STA and STB on successive calls. This permits each connector to alternate its pretranslator preference, which distributes the usage evenly. There is a detailed description of the W and Z walking circuit operation in the section of the text - Dial Tone Call.

5.04 In connector zero on OS 712-1, Sheet 2, STA is cross connected to PS0 and STB to PS1. This arrangement makes pretranslator zero the first choice pretranslator for start lead A and makes pretranslator one first choice for start lead B.

5.05 When battery is closed through one of the start leads, it operates relay PS-, which corresponds to the preferred pretranslator available, through normal contacts of its associated CB- relay in the connector. The operating ground for relay PS- is furnished either directly from pretranslator punching PSG or through contacts of the PS- relay chain circuit. If both pretranslators are busy, the call is delayed momentarily until one becomes idle.

5.06 The PS- relays for the same pretranslator are wired in a chain through the connectors. If two connectors call for the same pretranslator at about the same time, both of the PS- relays may operate and lock. The one nearer the PSG ground has the preference and can seize the pretranslator. On OS 712-1, Sheet 2, PSO (pretranslator start relay -0) in connector one is closest to the operating ground. For pretranslator number one, the operating ground is nearer to PS1 in connector zero.

5.07 Let's assume that the first originating register in connector zero, subgroup zero (extreme left of Sheet 1, OS 712-1) is demanding service. Let's assume also that the Z relay in pretranslator connector zero is operated. This opens start lead A and closes start lead B. Now we can trace a path for operating a pretranslator start (PS-) relay in the pretranslator connector zero.

5.08 The path is from battery in the originating register through operated PST (pretranslator start) and normal PRL (pretranslator release) relays in the originating register to the start leads in the subgroup connector. We continue through the STB resistor, operated PRA, operated GCO over lead four to Sheet 2. On Sheet 2 we continue through operated Z contacts, normal TRS to the STB-PS1 cross connection, through normal CB1, the winding of PS1 and down the sheet to the PSK1 to PSG cross connection and ground in pretranslator one. This operates the PS1 relay for pretranslator number one in connector number zero. PS1 releases the normally operated PC- and PS- relays in the pretranslator. These relays guard chain circuits through the connectors. They start the pretranslator timer when they release.

5.09 Relay PS1 operates PC1 through normal contacts of the PS1 relay in connector one to ground in the pretranslator. While PS1 relay in connector zero was closer to the operating ground, it is less preferred for the functional ground which operates the PC1 relay in connector zero. PC1 operates PA1, PB1, and PK in the connector. The PA1 and PB1 relays close leads from the connector to the pretranslator. Now we have a complete circuit for the transmitting and receiving leads from the originating register to the pretranslator. PA1 and PB1 operate PCA1. Relay PCA1 operates the MB relay in the pretranslator which in turn operates the CB1 relay in connector number one. Ground through operated MB in the pretranslator over CB2 lead to the primary winding of CB1 relay in connector one to battery through the resistor. The MB relay also extends ground over the CB1 lead to the winding of CB1 relay in connector zero. However, the other side of the primary winding of this relay is also grounded through operated contacts of PC1 relay and this prevents CB1 from operating. The secondary winding is open at its own contacts and the primary winding is short-circuited by the grounds connected on each side. The circuit is designed this way so that CB1 relay in connector zero can't operate; if it were allowed to operate it would open the operating path of PS1 relay and we would knock our own demand out of the connector. The CB1 relay in connector one is operated so that a subsequent demand for pretranslator one coming in from connector number one can't override our own demand.

5.10 There is a feature built into the pretranslator connector which prevents a demand, which has been shifted to the lesser preferred PS- relay, from reverting to the higher preferred PS- once the demand is in the connector. Assume on this call we have a demand coming over start lead A in connector zero and that pretranslator zero is busy with a demand in connector one. We would find CB0 relay in connector zero operated by the battery

on its primary winding to the ground on operated MB relay in pretranslator zero. This would shift our start lead battery away from PSO, through operated contacts of CBO relay to the winding of PS1 relay. Pretranslator one would be seized. However, suppose that pretranslator zero finishes with its demand while our register is engaged with pretranslator number one. If we don't keep CBO relay operated, our demand will revert to pretranslator zero during our call. This would mean releasing pretranslator one and seizing pretranslator zero. This is not desirable.

5.11 To prevent this, CBO is held up. There is a path from battery at the secondary winding of CBO, through its own operated contacts, over to the normals of CB1 and back on the LCB lead to the operated GC- relay on Sheet 2 (lead 15) to ground. This holds up CBO relay in connector zero while our demand is being served. To lock up, a CB- relay must go through normals of another CB- relay. This feature prevents both CB- relays from becoming locked operated. At the end of this call, the GC- relay releases and in turn releases the CBO relay. Now the connector is restored to normal.

C. PRETRANSLATOR OPERATION

1. General

1.01 The connector has completed its job of selecting a pretranslator and establishing the connection between it and the originating register which is requesting pretranslation. The pretranslator assumes control of the connector. The central office code digits are now sent to the pretranslator. Grounds from contacts of the A, B, and C digit register relays are extended through the operated PRA- relay for the originating register, through the operated GA- and GB- relays of the subgroup and through the PA- and PB- relays of the connector. The translation index - 11 or LT - also passes through to the pretranslator. On OS 713-1, Sheet 1, we can see how these grounds operate storage relays in the pretranslator. The pretranslator examines the digits of the office code, translates them into a marker start indication, and sends this signal back to the originating register. The pretranslator checks the transmitting leads for continuity from the pretranslator through the connector to the originating register.

2. Pretranslator Seizure

2.01 When PC- and PS- relays in the pretranslator released, they started the pretranslator circuit functions. The connector relays PRA-, GA-, GB-, PA-, and PB- have connected many leads from our register to the pretranslator.

3. Receiving Leads

3.01 As the subscriber dialed the A, B, and C digits of the central office code, they were stored in the originating register on digit register relays. Now we have paths from the grounds on the contacts of these register relays through the connector relays to the AC-, BC-, and CC- relays in the pretranslator. Two out of five AC-, BC-, and CC- relays are operated and they correspond to the digits in the originating register. If a trouble record were taken, the punches would have the same designation as the operated originating register relays.

3.02 Foreign Area Directing Code Calls: If calls using 11 directing codes require a different number of digits than the local area office codes, we use the LT- relay (local translator) and 11X relay (11 translator). When a subscriber dials an 11 prefix code, the 11C relay in the originating register is operated. This is described in Section three of this text - Dialing the Called Number. The operated 11C relay in the originating register transfers ground from the LT to the 11 lead. This is shown on OS 713-1, Sheet 1. The ground on the 11 lead operates 11X relay in the pretranslator. If the subscriber doesn't dial an 11 prefix before dialing the ABC digits of the central office code, then the LT lead is grounded. This ground operates LT- relay in the pretranslator. The 11X relay in the pretranslator sets up the pretranslation of 11 foreign area codes. When pretranslation of 11 codes is not required, relays LT- and 11X are omitted because all calls receive local translation. The pretranslator is used with 11-prefix call only in offices where 11 is used as a foreign area directing code.

4. Indications to the Originating Register

4.01 Pretranslation is the conversion of an input code to an output code. The input code is a two-out-of-five code representing the central office code dialed. The output code is one of the indications which is returned to the originating register. The input is applied by passing the office code on a two-out-of-five basis from the register to the pretranslator. Before describing the pretranslation, we will look at the output signals.

4.02 Eight signals to the register can be used for assigned central office codes. Two other signals can be used where the register calls a marker after it receives two or three digits. Indications are given to the register when ground is connected to transmitting punchings BS or CM- as follows:

(a) Punching BSS represents the basic setting. BSS is used for the number of digits which originating registers receive on most calls. Usually the number of digits received on intraoffice calls is associated with the basic setting (BSS punching). For instance, in a central office area where we have a 2-5 numbering system, the register gets seven digits on intraoffice calls. We would probably assign the BSS punching to these codes and to other connecting offices which have the same number structure. This punching is also used for foreign area codes which require the same total number of digits (not counting the 11 prefix as digits).

(b) Punching BSP is used for central office codes which have the same number of digits as the basic setting, but require stations delay because of party letters or numbers over 9999.

(c) Punchings CMSA, CMSB, and CMSC are used for additional settings when the office code digits plus telephone numericals add up to a different number from the digits of the basic setting. They may represent any number of digits without stations delay.

(d) Punchings CMPA, CMPB, and CMPC represent the same number of digits as the corresponding CMS- punchings, but signal the register for stations delay.

(e) Punching CMS3 is used to signal the register to call a marker, without returning coin, after two digits are dialed in two-digit offices having AB straightforward codes, or after three digits are dialed in all other offices.

(f) Punching CMP3 is also used to signal the register to call a marker after two or three digits, except that the register is instructed to return the coin on coin lines before doing so.

5. Translation

General

5.01 The following paragraphs describe the arrangement and operation of the translator relays and the cross connections which make them effective. Before we do this we should consider the number of central office codes which must be translated. First we shall exclude those ABC codes which are not used for central office codes. The originating register will go for a completing marker if the first digit is zero. The register won't accept a one in the A digit. It does recognize two ones (11) as a prefix to the A digit. The B digits zero and one are reserved for use with foreign area customer dialing (FACD) area directing codes. The C digit zero is not usually used for office codes, but when it is, it is more economical to provide a supplementary group of relays (C zero translator relays) to translate it.

5.02 From this analyzation we can see that the digits we must consider are:

A digits 2 to 9 = 8 digits
B digits 2 to 9 = 8 digits
C digits 1 to 9 = 9 digits

This permits a maximum of 64 combinations of A and B digits (8 x 8) and 576 combinations of A, B, and C digits (8 x 8 x 9).

Translation of Three-Digit Office Codes

5.03 The 576 codes which must be pretranslated are divided into 192 groups of three consecutive codes each. This arrangement permits the three consecutive codes to be translated as a group through a single cross connection. However, we can still change the translation of one code of a group without changing the other two codes of the same group. Each of the 192 groups is associated with three punchings similarly numbered but designated R, S, and T. The numerical prefix of each punching designation corresponds to the A and B digits of the office code: --R punchings represent codes with C digits 1, 2, and 3; --S punchings represent codes with C digits 4, 5, and 6; and --T punchings represent codes with C digits 7, 8, and 9. For example, punching 22R represents codes 221, 222, and 223; 59S represents codes 594, 595, and 596; while 99T represents codes 997, 998, 999.

5.04 In a seven-digit area without foreign area directing codes, the home area office codes require only three signals to the register. The signals are:

(a) Office codes of three digits followed by four numerical digits - Pretranslator signals register to call marker after seven digits.

(b) Office codes of three digits followed by either five numerical digits or four numerical digits and possibly a party letter - Pretranslator signals register to provide stations delay after seven digits.

(c) Vacant codes - Pretranslator signals register to call marker after three digits.

5.05 The three indications (a), (b), and (c) above are designated W1, W2, and W3 respectively. If we take any three consecutive central office codes, we can see that each of these can receive one of the three treatments W1, W2, or W3. If we start setting down on paper the various permutations of this arrangement as has been done in Table A, we see that there are twenty-seven different arrangements. These twenty-seven different arrangements are represented by punchings P0 to P26.

TABLE A

P	U	V	W	P	U	V	W	P	U	V	W
0	W1	W1	W1	9	W2	W1	W1	18	W3	W1	W1
1	W1	W1	W2	10	W2	W1	W2	19	W3	W1	W2
2	W1	W1	W3	11	W2	W1	W3	20	W3	W1	W3
3	W1	W2	W1	12	W2	W2	W1	21	W3	W2	W1
4	W1	W2	W2	13	W2	W2	W2	22	W3	W2	W2
5	W1	W2	W3	14	W2	W2	W3	23	W3	W2	W3
6	W1	W3	W1	15	W2	W3	W1	24	W3	W3	W1
7	W1	W3	W2	16	W2	W3	W2	25	W3	W3	W2
8	W1	W3	W3	17	W2	W3	W3	26	W3	W3	W3

5.06 The three consecutive codes in any one group are represented by U, V, and W where U represents the lowest-numbered code of the group and W the highest. Thus U represents the C digits 1, 4, or 7, V the C digits 2, 5, or 8, and W the C digits 3, 6, or 9. The pattern numbers in the table correspond to the P- punchings. For instance, if punching 22R is cross connected to P0, codes 221, 222, and 223 all receive the W1 treatment. If punching 595 is cross connected to punching P5, codes 594, 595, and 596 receive the W1, W2, and W3 treatments, respectively. Since punchings W1, W2, and W3 are permanently cross-connected in these offices to BSS, BSP, and CMS3 or CMP3, respectively, the cross connections between punchings P- and punchings --R, --S, and --T are the only variables in the pretranslator.

5.07 An additional group of eight relays (BA2 through BA9) is provided to help translate digits A and B of the code. Each of these relays is wired in series with its corresponding B- relay. Thus both relays B- and BA- are operated in series when the corresponding B digit is registered.

5.08 Two groups of relays are provided to translate the C digit. The first group, relays CR, CS, and CT (C digit primary translator relays), completes the conversion of the code received into a ground on an --R, --S, or --T subgroup punching. The second group, relays CU, CV, and CW and their auxiliaries CUA, CVA, and CWA, make up the C digit secondary translator. These relays convert ground on a P- punching to a particular start indication W1, W2, or W3 for each code. The only exceptions to this are punchings P0, P13, and P26. It is not necessary to translate the C digit when these patterns are used because they provide the same treatment for the three codes of each group.

5.09 The operation of one or more of relays BC2, BC4, BC7, CC2, CC4, and CC7 operates relay CR, CS, or CT through contacts of the operated CC- relays and windings of CU and CUA; CV and CVA, or CW and CWA to 62-ohm resistance battery.

5.10 So far in this discussion we have assumed that all codes with a zero in the C digit are vacant. When this is true, a zero in the C digit doesn't operate any of the C digit translator relays. Instead, it grounds either punching VCR or lead CMS3.

5.11 C Zero Codes Assigned for Use: If any codes with zero in the C position are assigned, relays CZ2 through CZ9 (C zero translator) and CZC (C zero connector) are provided. One of relays CZ2 through CZ9 is operated in series with the corresponding B- and BA- relays after the B digit is registered. Registration of a zero C digit operates relay CZC, which closes ground from two operated AC- relays through the operated CZ- relay to a single code punching of the 220 through 990 group. Each of these punchings is an individual code point for the code it represents and is cross-connected to punchings BS and CM- as required. Fig. 1 shows typical cross connections for a three-digit home area.

X11 Code Translation

5.12 X11 codes may be used as service codes or as manual straightforward codes. Registration of a one in the B digit grounds code point X1. A one in the C digit grounds punching X11 in offices which translate three-digit office codes. The A digit is not translated in either case, because it does not change the indication given for this type of code. The appropriate X1 or X11 punching is cross-connected to punching CMP3 or CMS3 as required, see Figs 1 and 2.

11 Foreign Area Directing Code Translation

5.13 The operation of relay 11X indicates an 11-prefix call. Translation of this call is provided only when the foreign area office code represents a different number of digits than the home area office code. However, only the A digit of the 11 call is translated. Operation of the A-digit register relays closes ground through contacts of the 11X relay to the 11X2 to 11X9 punchings. Each of these punchings which is used is cross-connected to punching BS- or CM- as required. Punching 11X0 is treated as a vacant code punching.

XOX and X1X Code Translation

5.14 The foreign area customer dialing (FACD) program involves direct customer dialing on a nationwide basis and uses XOX and X1X codes as national area codes. The XOX and X1X codes are used only in areas where the home office codes consist of three digits. The pretranslator can distinguish XOX and X1X foreign area codes from local area codes. The C-zero translator relays are provided to do this. On OS 713, Sheet 2 we see that the CZO to CZ9 relays are in series with the B-digit translator relays. They are in fact auxiliaries to B-digit translator relays. If the pretranslator receives an XOX or X1X code, either CZO or CZ1 relay will operate. For local area codes (which never have a zero or one in the B digit) one of the relays CZ2 to CZ9 is operated. These relays are used to separate toll directing codes from local central office codes. Punchings W1 and W2 are cross-connected to punchings WA and WB, respectively. This provides two paths for local codes and two paths for foreign area directing codes. Punching W3 is cross-connected directly to CMP3 or CMS3 for three-digit code indication. For home area office codes, punchings WA and WB are connected by the operation of relays CZ2 through CZ9 to punchings W4 and W6, which are cross-connected to punchings BSS and BSP for a seven- and eight-digit indication, respectively. For XOX and X1X codes, punchings WA and WB are connected by the operation of relay CZO or CZ1 to punchings W5 and W7, which are cross-connected to either punching CMSA or CMPA for ten- or eleven-digit indication, respectively. Punchings CMSB and CMPB, or CMSC and CMPC may also be used for other indications if they are needed.

5.15 Each --K, --S, --T punching represents three XOX or X1X codes having A digits 2 through 9, B digits 0 or 1, and C digits 1 through 9 (X11 codes being excluded). These punchings are cross-connected to punchings P0 through P26 in a manner similar to three-digit home area office codes. On calls involving X11 codes, ground is connected to punching X11 and is not connected to the corresponding punchings X1R. When the pretranslator receives an X11 code (211, 411, etc,) it connects ground to the X11 punching. Ground is not present on the corresponding --H punching because the CR-relay is not operated. For example, suppose a subscriber dials 211, the AC 0 and 2, BC 0 and 1, and CC 0 and 1 relays are operated; the CR-relay is not operated and so the 21R punching is not grounded. The 21R punching represents codes 211, 212, and 213. Therefore, these punchings may be cross-connected to any P-punching that satisfies the conditions required for the second and third codes of the group without regard to the first (X11) code. For example, if code 212 requires 10 digits and code 213 requires 11 digits, punching 21R may be cross-connected to any one of punchings P1, P10, or P19. The X11 punching is grounded through the CC0 and 1, BC0 and 1, and LT-relay contacts. The X11 punching is cross-connected to either CMS3 or CMP 3 punchings. This will signal the originating register to call the marker after three digits.

5.16 Punchings 200, 300, etc, and 210, 310, etc, are individual code points for the corresponding XOX and X1X codes. They are cross-connected directly to punchings CM-.

5.17 Punchings which represent vacant codes are cross-connected to CMS3 or CMP3. CMS3 signals the register to call a marker after three digits. CMP3 signals the register to return a coin and then call the marker after three digits.

6. Closure of the Transmitting Leads

6.01 When one of the punchings on Sheet 3 of OS 713-1 is grounded through a cross connection, one of the five transmitting relays CMA, B, C, 3, or BS is operated. Whichever one operates depends on the cross connection. It will operate in series with either the PW (primary winding) or SW (secondary winding) relay. This arrangement uses seven relays for ten indications. The XR-relay provides a cross detection circuit. It will operate if two or more of the ten punchings are grounded. The resistance of one path doesn't allow enough current to flow to operate it. If it does operate, it opens its own biasing circuit which insures that it will stay up if the trouble should disappear.

6.02 Here is a table which shows how grounds on the ten transmitting punchings on the left side of OS 713-1, Sheet 3, cause pretranslator relays to operate and leads from the pretranslator to the originating register to be closed:

Punching Grounded	Relays Operated	Leads Closed
BSS	BS, SW, SW1	NONE
BSP	BS, PW, PW1	SD
CMS3	CM3, SW, SW1	CM3
CMP3	CM3, PW, PW1	CM3, SD
CMSA	CMA, SW, SW1	CMA
CMPA	CMA, PW, PW1	CMA, SD
CMSB	CMB, SW, SW1	CMB
CMPB	CMB, PW, PW1	CMB, SD
CMSC	CMC, SW, SW1	CMC
CMPC	CMC, PW, PW1	CMC, SD

The operation of one of the CM- relays closes ground to the similarly designated lead through the pretranslator connector circuit to operate the corresponding CM- relay in the originating register. The operation of relay PW1 grounds lead SD through the connector to operate register relay SD-(stations delay).

7. Typical Example of Pretranslation

7.01 Let's suppose a subscriber is dialing a telephone which is in his own office. This is an intraoffice call. In a 2-5 numbering plan area, he dials seven digits. Our originating register would have option C on OS 711-1, Sheet 2. This option lets the register start for the pretranslator at the end of the third digit. This digit is the end of the central office code. For instance if the central office code is 595, the originating register has received and stored digits 595 on the A, B, and C digit registers. Now the register operates its PST relay and we place our demand in the pretranslator connector. This demand is answered just as we discussed in Part B of this section.

7.02 When the originating register is connected to the pretranslator, the A, B, and C digits, 595, are sent to the AC1 and AC4, BC2 and BC7, CC1 and CC4 relays on OS 713-1, Sheet 1. The LT- (local translation) relay in the pretranslator would be operated from ground in the originating register.

7.03 On OS 713-1, Sheet 2 we can see contacts of the BC2, 4, and 7, and CC2, 4, and 7 relays in the upper left-hand corner. BC2, BC7, and CC4 relays would be operated on this call. Now we have a path from ground through operated contacts of these relays and LT- contacts to operated BC2 and BC7 relay contacts through windings of B9, BA9, and CZ9 in series. The BC2 and BC7 are operated from the nine in 595 code.

7.04 In lower left-hand corner we have contacts of BC-, CC-, and LT- relays which supply ground to winding of CR-, CS-, and CT- relays. These C digit auxiliary relays split the C digit into three groups. CR represents C digits one, two, and three. CS represents C digits four, five, and six. CT represents C digits seven, eight, and nine. Because our C digit (595 code) is a five, we should find a path through winding of the CS-to contacts of CC1 and CC4 relays. We notice that this path is in series with two relays CVA and CV. All three relays CV, CVA, and CS- operate.

7.05 The CR-, CS-, and CT- relays split the C digits one to nine into three groups. The CU and CUA, CV and CVA, CW and CWA relays also split the C digits one to nine into three groups, but in a different way. We can set up a little table which shows how these relays act as coordinates for pinpointing the C digit.

TABLE B

	CU CUA	CV CVA	CW CWA
CR	1	2	3
CS	4	5	6
CT	7	8	9

We can see that any combination of one relay of CR-, CS-, and CT- combined with one of the pairs of CU(A), CV(A), CW(A) gives us an exact definition of the C digit.

7.06 This arrangement is used to simplify pretranslator cross connections. If we represented all the codes which could be dialed on individual punchings, we would have a large cross-connection field. In the pretranslator, this C digit translation arrangement cuts the cross-connection field by a third.

7.07 To continue with our call, in the middle of Sheet 2, OS 713-1 we have contacts of AC1 and AC4 relays which are operated because our A digit is five. We have a circuit from the ground through AC- relay contacts, option C, operated CS-and operated B9 relay to the 59S punching. This punching stands for the central office codes 594, 595, and 596. Punching 59S is cross-connected to one of the P0-P26 punchings which give the correct indications for the three codes.

7.08 We have already said that our code - 595 - is a seven-digit code. If we know what the two associated codes, 594 and 596, require we can pick the proper P- punching for our cross connection. Lets assume that code 594 is vacant and code 596 is a manual central office. Now we know that the P- punching we choose must indicate a three-digit marker start for the first code, seven-digit start for the second, and stations delay (seven or eight-digit) for the third.

7.09 Table A on Page 11 shows the various marker start signals which the P0 to P26 punchings represent. The symbols W1, W2, and W3 stand for seven digits, eight digits and three digits in that order. What we want is three digits (W3) for 594, seven digits (W1) for 595, and eight digits (W2) for 596 in that order. There is one punching which gives us this indication - P19. So we cross-connect 59S to P19.

7.10 Following through our circuit path, the grounded is now present on the P19 punching. We can continue through operated CVA contacts to the W1 punching.

7.11 In central offices without foreign area customer dialing, W1 punching is cross-connected to BSS on Sheet 3. In offices with this service, W1 is cross-connected to WA punching on Sheet 2. The C2-9 relays are provided when XOX and X1X toll codes are translated. If we had this feature, the CZ5 relay would be operated for our call, moving the ground to the W4 punching. This is cross-connected to the BSS punching on Sheet 3. In either case, the BS and SW relays are operated. This is called the basic setting of the pretranslator operation. When the pretranslator has its BSS punching grounded, it doens't send a marker start signal to the originating register. It just sends a pretranslator release (PRL relay) signal which the originating register recognizes as a seven-digit marker start indication. For all other marker start indications, the pretranslator sends the originating register a signal by operating one of the CMA, B, C, 3, or SD- relays in the originating register. On our call, only the PRL operates. It releases DMS (delay marker start). The DMS relay is in the circuit so that the originating register will wait for the signal from the pretranslator. On most calls the signal is received soon enough so that the originating register doesn't have to wait for it after the customer finishes dialing. On our call for instance, the originating register would have the marker start signal before the subscriber finishes dialing the D digit.

7.12 The subscriber now dials the four digits of the telephone number. When the seventh digit is received and stored, we have digits in the A to G digit register relays. At the end of the last pulse of the G digit, the L operates and remains operated. The slow release RA- relay releases operating RA1 and the G two-out-of-five register relays. RA1 operates the HS steering relay. Now we have a path from the MST relay winding on OS 713-1, Sheet 3 through normals of CR, 2P (the dialing subscriber does not have two-party class of service) through normals of DMS, SD, DMS, operated PST, normal CMA, CMB, CMC, CM3 to the CM1 punching. This punching is cross-connected to the G punching which is grounded by operated HS. This operates the MST relay.

D. PRETRANSLATOR AND PRETRANSLATOR CONNECTOR RELEASE

1. General

1.01 After passing its translation to the originating register, the pretranslator checks the continuity of the transmitting leads used on the call. It does this before it releases. It also supplies holding grounds and a holding battery to the connector to maintain the connection to the originating register, and checks the hold circuit. It then operates the PRL-(register release) relay (OS 713-1).

1.02 Relay PRL-locks any of the originating register translation relays that are operated over transmitting leads (OS 713-1). This makes sure the start index is not removed before it can be used by the originating register. The pretranslator checks that the required transfer relays are locked. If they are, or if none of the transfer relays are required (basic setting indication), the pretranslator removes the connector holding circuits, which release the connector. Release of the connector relays releases the operated pretranslator relays.

2. Continuity Check of the Transmitting Leads

2.01 The CCM-(continuity CM) and CSD-(continuity SD) relays (OS 713-1) are provided to check the continuity of leads CM- and SD- if either or both leads are used to transmit the start index to the register. These relays operate in series with the operated translation relays in the originating register. The operation of each of these relays indicates a continuous operating circuit on the transmitting lead used.

3. Control of the Pretranslator Connection

3.01 The operation of relay PW1 or SW1 operates and locks the HD (hold) relay (OS 713-1). Relay HD closes battery through lamp HD and the winding of relay HDK (hold check) to lead HD to the connector (OS 712-1). This supplies a holding battery for the operates PS- and PRS-relays. It also prevents the release of PS- and PRS-when originating register relay PRL-is operated, and permits the pretranslator to check the locking of the required register transfer relays.

3.02 The operation of relay HD also grounds leads G1 and G2, which hold pretranslator connector relays PRA-, PRB-, and GS-. This also denies the use of these leads to any originating register requesting a pretranslator connector. The arrangement allows the pretranslator to hold the connection until its functions are completed.

3.03 Relay HD also grounds lead GR, operating the connector GR- (ground removal) relay (OS 713-1) which is associated with the pretranslator in use. Relay GR- removes the operating ground from relays PRA-, PRB-, and GS- (OS 712-1). When the connection is released later in the call, the release of relay GR- delays the reclosure of these grounds which prevents overlap between successive calls.

3.04 The operation of relay GR- also grounds lead PCK (OS 713-1) to the pretranslator, operating relay PCK (pretranslator control check). This indicates that all of the control relays in the connector are operated.

4. Operation of the Originating Register Circuit Release Relay

4.01 The operation of relay HDK grounds lead PRL to the connector when the continuity check of the transmitting leads is satisfactory (CCM and CSD operated). This operates register relay PRL. Lead PRL is wired through parallel contacts of relays CCM and BS and then through parallel contacts of CSD and SW1. This is done because relay BS is always operated if none of the CM- leads are used and because relay SW1 is operated if lead SD is not used.

4.02 The operation of register relay PRL opens the pretranslator connector start lead (OS 712-1) and provides a locking ground for register relays CM- and SD- (OS 713-1). The opening of the start lead has no effect because relays PRS and PS- are held by battery supplied over lead HD.

4.03 Relay PRL is double-wound (OS 713-1): lead PRL connecting to the primary winding, and lead RLK to the secondary. When operated, it locks through both windings and returns ground to the pretranslator on both leads. The RLK ground operates pretranslator relay RLK (release check). Relay RLK locks to ground through both the PRL and RLK leads from the connector.

5. Lock Check

5.01 Two check circuits are provided to check the application of the locking ground to either relay CM- or SD-, or both. Each of these check circuits has two operating methods, depending on the start indication provided.

5.02 The operation of relay LCM (lock CM-) indicates that either the operated CM- register relay is locked or that the operation of a CM- relay is not required (OS 713-1). Similarly, the operation of relay LSD (lock SD-) indicates that either the operated SD- register relay is locked or that its operation is not required by the start indication of the call.

5.03 For any translation, either relay BS or CM- and the SW1 or the SD relay operate. If the BS or SW1 relays operate, the CM- or SD- lock tests are not required. The operation of relay RLK then directly operates relays LCM or LSD.

5.04 However, if neither BS nor SW1 operate, the operation of RLK operates relay KTR (check transfer). This transfers the pretranslator end of leads CM- and SD from relays CCM and CSD, used in the continuity check, to relays LCM and LSD for the lock check. This releases CCM and CSD. If the locking ground is present on either or both of these leads, relays LCM and/or LSD operate.

5.05 When operated, both LCM and LSD lock to ground through relay RLK. An additional locking ground is supplied for relay LCM through the operated PW1 or SW1 relay to prevent false momentary operation of relay HD during release.

6. Pretranslator Connector Release

6.01 Pretranslator relay HD holds relays PRA-, PRB-, and GS- by ground on leads G1 and G2 and relays PRS- and PS- by battery on lead HD. The operation of relays LCM and LSD opens the operating and holding circuit of HD (OS 713-1). This releases HDK (OS 712-1) in the pretranslator and removes battery from lead HD, thereby releasing PRS- and PS-. Relay HD also removes ground from leads G1, G2, and GR, releasing relays PRA-, PRB-, GS-, and GR-. These leads are opened simultaneously to prevent false start which might otherwise occur if lead HD were opened first.

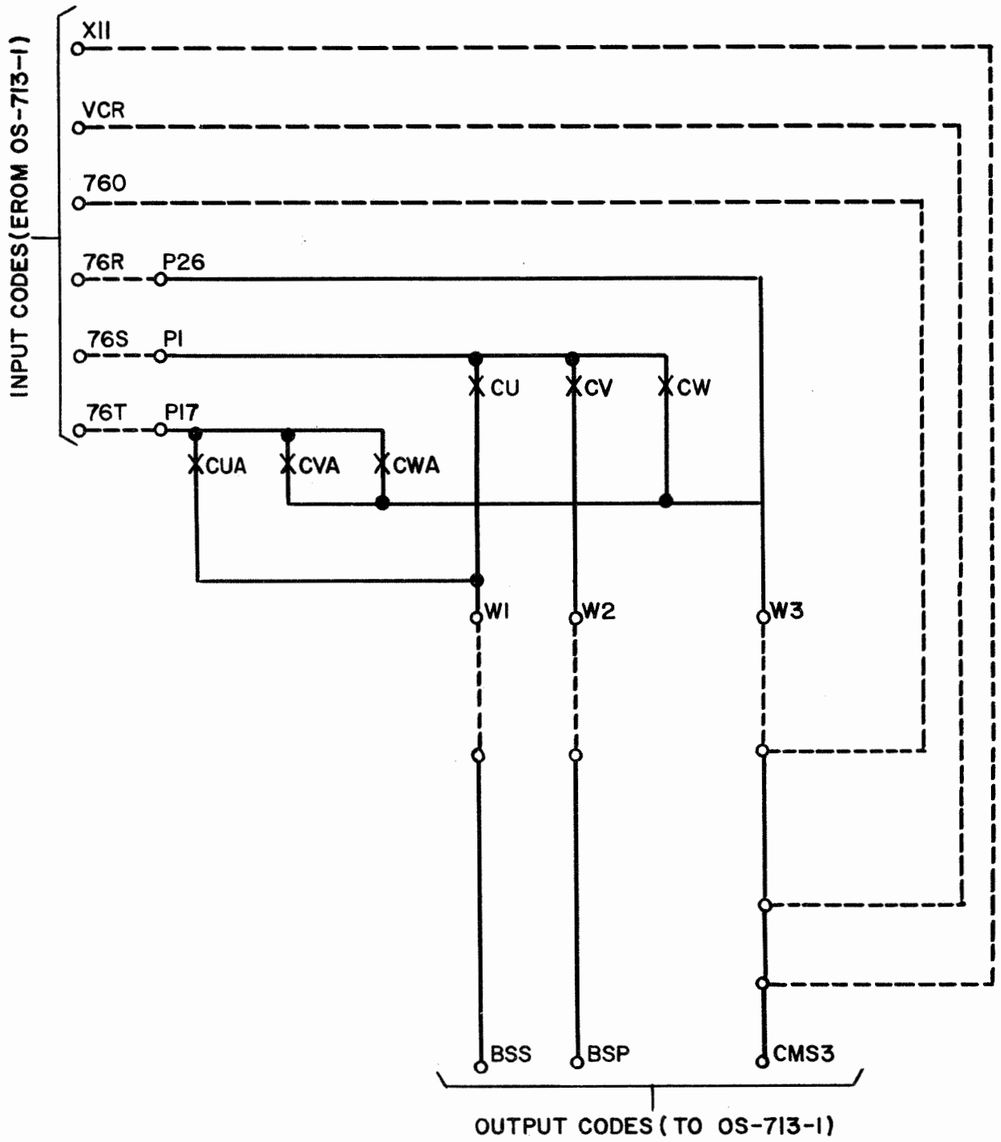
6.02 The release of PRA- and PRB- opens the receiving leads, which releases any of the relays AC-, BC-, CC-, LT-, and 11X that are operated (OS 713-1). This releases operated translator relays. The release of relays AC- causes the release of BS or CM-, PW or SW, and PW1 or SW1 relays (OS 713-1). The release of PW1 or SW1 releases LCM.

6.03 The release of relay PS- closes chain circuits PSK and PCK to reoperate pretranslator relays PS- and PC-. It also releases connector relay PC- which allows relay CB- in the connector being served to operate, and releases connector relays PA- and PB-. Relay PC- releasing, causes relay Z to either operate or release, depending upon its condition (OS 712-1). The release of relays PA- and PB- releases PCA-, thereby releasing relays PK, PCK, and MB. The release of MB releases all CB- relays. Release of relay GS- causes relays GC-, GA-, GB-, GCA, GK, GK1, and GR- to release.

E. CONTROL FUNCTIONS

1. General

1.01 The several other features of the pretranslator, timing, trouble recorder start, second trial, etc, are discussed in detail in the circuit description - CD-25568-01.

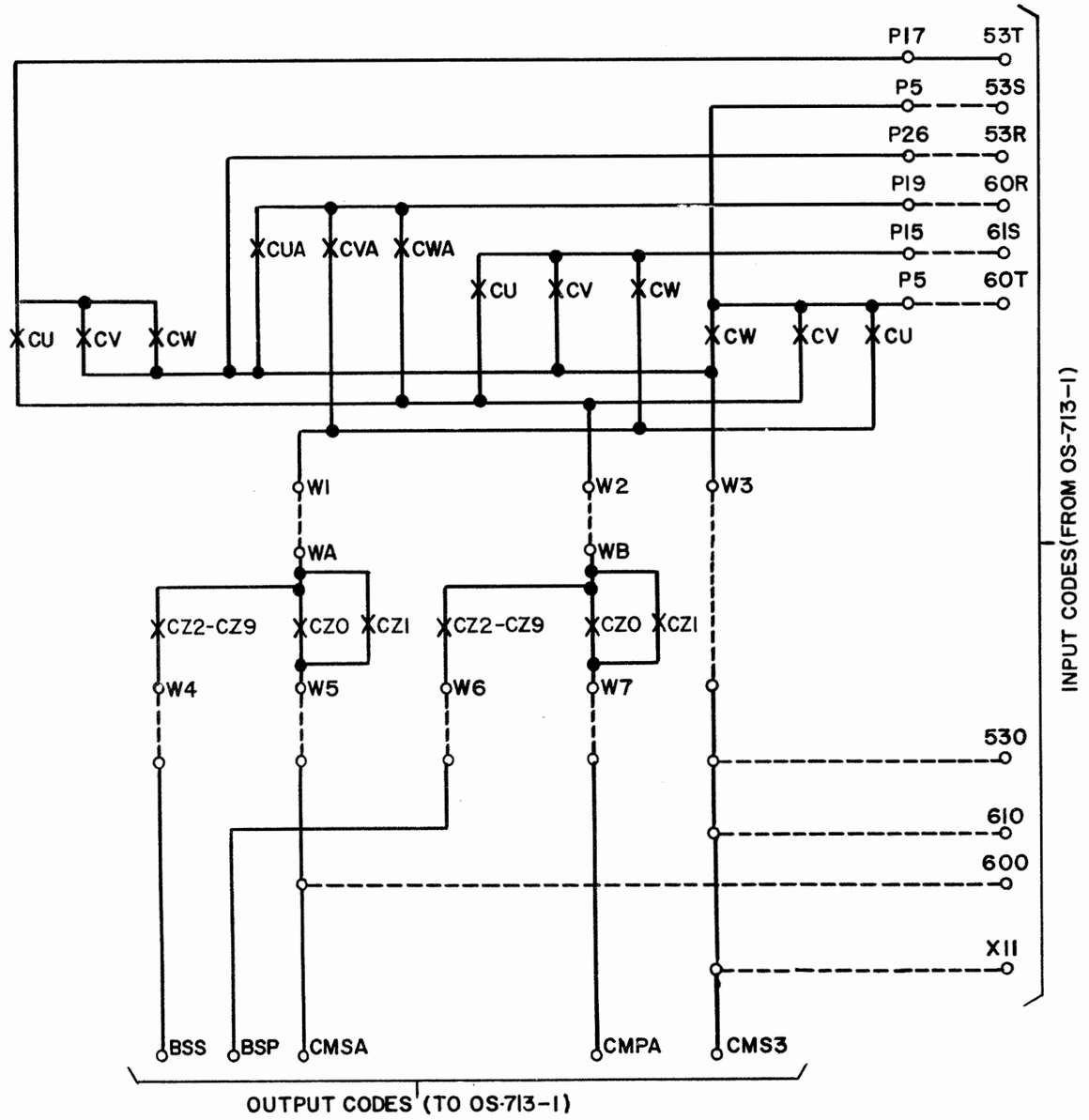


OUTPUT CODES	
PUNCHING	REGISTER TO CALL IN MARKER AFTER
BSS	7 DIGITS
BSP	7 DIGITS AND STATIONS DELAY
CMS3	3 DIGITS (NO COIN RETURN)

INPUT CODE CROSS CONNECTIONS

CODE	PUNCHING	ABC DIGITS	REGISTER TO CALL IN MARKER AFTER	CROSS CONNECT PUNCHING
760	530	760	3 DIGITS	760 TO CMS3 (NO COIN RETURN)
761	53R	761		76R TO P26 W3 TO CMS3 (NO COIN RETURN)
762		762		
763		763		
764	53S	764	7 DIGITS	76S TO PI
765		765	7 DIGITS AND STATIONS DELAY	WI TO BSS, W2 TO BSS
766		766	3 DIGITS	W2 TO CMS3 (NO COIN RETURN)
767	53T	767	7 DIGITS AND STATIONS DELAY	76T TO PI7 W2 TO BSP
768		768	3 DIGITS	W3 TO CMS3 (NO COIN RETURN)
769		769		
XII	XII	XII		XII TO CMS3 (NO COIN RETURN)
VCR	VCR	---		VCR TO CMS3 (NO COIN RETURN)

FIG. I — TYPICAL CROSS CONNECTIONS FOR A 3 DIGIT HOME AREA



OUTPUT CODES	
PUNCHING	REGISTER TO CALL IN MARKER AFTER
BSS	7 DIGITS
BSP	7 DIGITS AND STATIONS DELAY
CMSA	10 DIGITS
CMPA	10 DIGITS AND STATIONS DELAY
CMP3	3 DIGITS (COIN RETURN)
CMS3	3 DIGITS (NO COIN RETURN)

INPUT CODE CROSS CONNECTIONS				
CODE	PUNCHING	ABC DIGITS	REGISTER TO CALL IN MARKER AFTER	CROSS CONNECT PUNCHING
530	530	530	3 DIGITS	530 TO CMS3 (NO COIN RETURN)
531	53R	531		53R TO P26 W3 TO CMS3 (NO COIN RETURN)
532		532		
533		533		
534	53S	534	7 DIGITS	53S TO P5 W1 TO WA, W4 TO BSP, W2 TO WB, W6 TO BSP, W3 TO CMS3 (NO COIN RETURN)
535		535	7 DIGITS AND STATIONS DELAY	
536		536	3 DIGITS	
537	53T	537	7 DIGITS AND STATIONS DELAY	53T TO P17 W2 TO WB, W6 TO BSP W3 TO CMS3 (NO COIN RETURN)
538		538	3 DIGITS	
539		539		
600	600	600	10 DIGITS	600 TO CMSA
601	60R	601	3 DIGITS	60R TO P19 W3 TO CMS3 (NO COIN RETURN) W1 TO WA, W5 TO CMSA W2 TO WB, W7 TO CMPA
602		602	10 DIGITS	
603		603	10 DIGITS AND STATIONS DELAY	
607	60T	607	10 DIGITS	60T TO P5 W1 TO WA, W5 TO CMSA W2 TO WB, W7 TO CMPA W3 TO CMS3 (NO COIN RETURN)
608		608	10 DIGITS AND STATIONS DELAY	
609		609	3 DIGITS	
610	610	610		W3 TO CMS3 (NO COIN RETURN)
614	61S	614	10 DIGITS AND STATIONS DELAY	61S TO P15 W2 TO WB, W7 TO CMPA W3 TO CMS3 (NO COIN RETURN) W1 TO WA, W5 TO CMSA
615		615	3 DIGITS	
616		616	10 DIGITS	
X11	X11	X11	3 DIGITS	X11 TO CMS3 (NO COIN RETURN)

FIG. 2 – TYPICAL CROSS-CONNECTIONS FOR A 3 DIGIT HOME AREA WHERE THE HOME OFFICE IS ARRANGED FOR XOX AND XIX CODES

FIG. 2