Pretranslation in No. 5 crossbar

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An originating register in the No. 5 crossbar system does not seize a marker until it has recorded all the digits dialed by the subscriber, and it must therefore have some indication of the number of digits the subscriber will dial. In areas where the same number of digits is always dialed, the register is arranged to seize a marker as soon as this number of digits has been received.

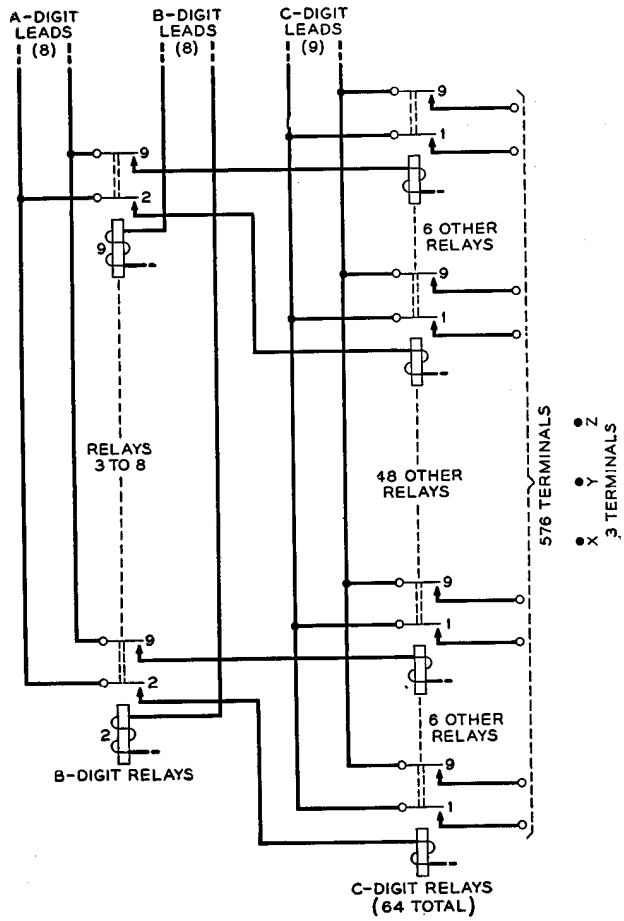

Fig. 1—The type of circuit usually employed in the past for translation as applied to the 576 codes which are treated in a novel manner by the pretranslator.

In many areas, however, the number of digits to be dialed varies for different called offices, and the register must have some way of determining from the office code how many digits to expect. This process is called pretranslation.

Where the numbering arrangement is simple, the register may be arranged to do the necessary pretranslation itself. In the Vineland, New Jersey, office, for example, only three-digit office codes with a four-digit line number are used except for lines in a manual office, for which the code 9 without numericals is dialed. To reach a DSA or toll operator, a 0 or a three-digit code is dialed. All registers are arranged to recognize an initial 0 for an operator and to call in a marker at once, and they can readily be arranged to do all the pretranslation where the conditions are as simple as at Vineland.

In more involved situations, however, it is more economical to concentrate the pretranslating functions in common pretranslator circuits, which are accessible to the originating registers through pretranslator connectors. In the Freeport-Baldwin office on Long Island, for example, a three-digit office code and four numericals are used to reach stations in a number of dial offices, whereas an additional digit is required for party lines in several nearby manual offices. It is not practicable to identify the particular lines of an office that require party letters or a fifth numerical digit, and thus when the office code indicates such an office, the register must allow a "station delay" interval of about four seconds after receiving the seventh digit to allow time for an eighth digit to be dialed.

The average holding time of the originating register is about 13.5 seconds without station delay and 17.5 seconds with it. To provide this delay on all calls, and thereby eliminate the need for pretranslation, would increase the completion time of calls to offices which do not require the delay by about

30 per cent, and more registers would be needed. In general the cost of the additional registers would be greater than the cost of pretranslation. The pretranslator developed for this purpose is designed to translate both two and three-digit office codes, foreign-area directing codes in the series 112 to 119 followed by an office code and a number, and service codes such as 211 and 411 that do not require additional digits. It is seized through a pretranslator connector as soon as three digits have been received by the register, and the three digits have been transmitted to it.

Separate small relay circuits are available when required for translating foreign-area office codes beginning with 11, and for dealing with 0 as the final digit of the code. The register itself acts directly when the first digit is 0. The greater part of the pretranslator circuit, however, is employed for translating codes having any number from 2 to 9, inclusive, for the first and second digits—or the A and B digits as they are referred to—and any number from 1 to 9, inclusive, for the third or C digit. The 576 (8 x 8 x 9) codes of this type are translated into one or another of three indications. These may be referred to as X, Y, and Z. An X indication tells the register to seize a marker after seven digits have been received. A Y indication tells it to allow a station delay interval after

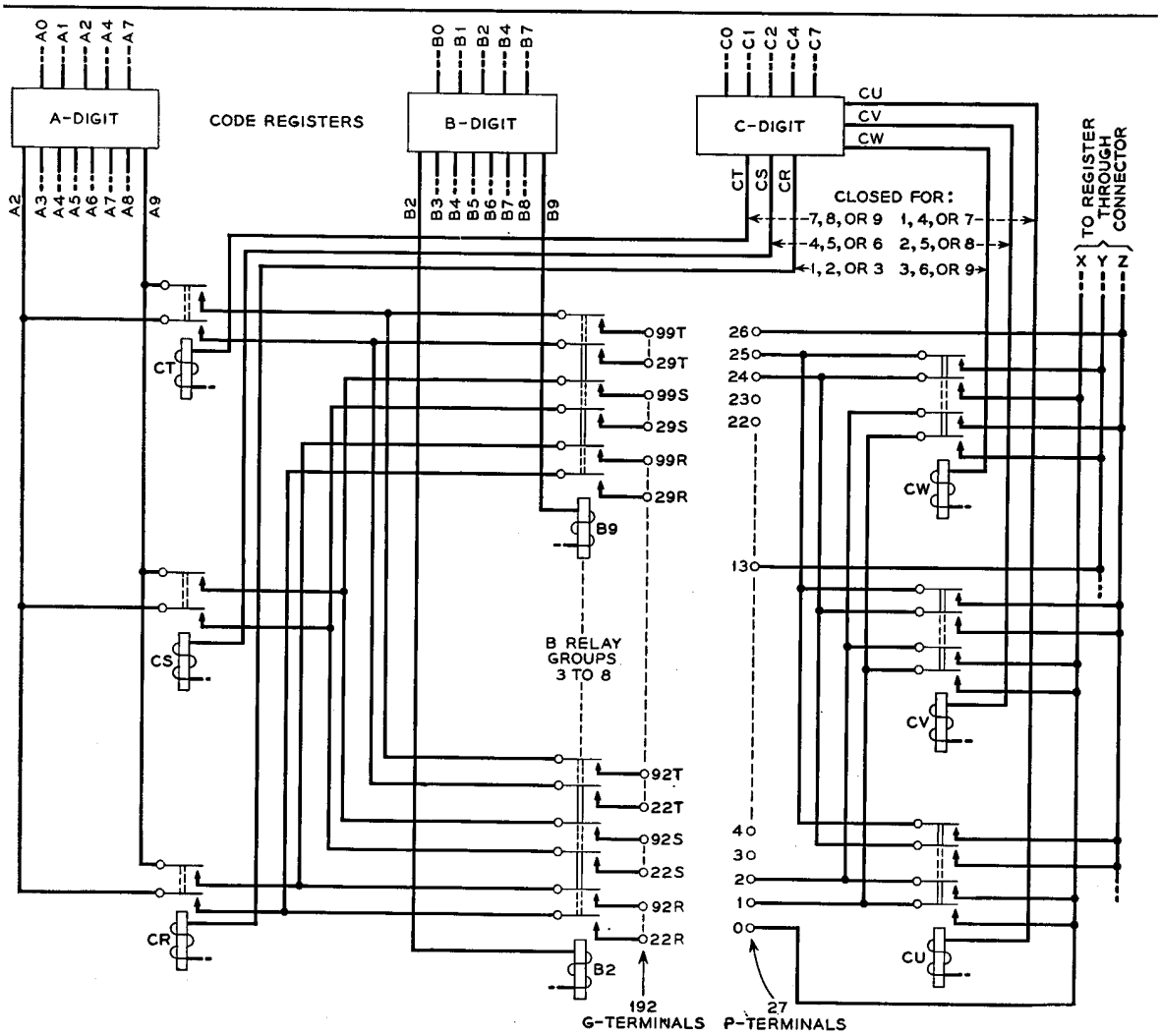

Fig. 2—Simplified schematic of circuit employed for translating in the pretranslator.

the seventh digit to give time for an eighth digit to be dialed, while a Z indication, which is given when the office code is one not assigned, tells the register to seize a marker after three digits have been received.

Although translation is now commonplace in telephone systems, the method for translating the 576 codes to one of three indications employed by the No. 5 crossbar pretranslator is novel. It permits the translation to be made with much less equipment than would have been required with the more usual method of translation.

Had the usual method of translation been followed, the circuit would have been of the general type indicated in Figure 1. Each of the three digits of the code are transmitted to the pretranslator by the register as ground on two out of five leads. For translation by the method of Figure 1, these indications are converted to ground on one lead of each of three sets—one set for the first, or A digit, one for the second, or B digit, and one for the third, or C digit. At the left of Figure 1 are eight B-digit relays, which are operated by the eight B-digit leads. The eight A-digit leads are multiplied to the armature springs of these B-digit relays. There are thus 64 leads leaving the front contacts of the B-digit relays, and each of these is connected to the winding of a relay closing nine contacts. The nine C-digit leads are multiplied to the nine armature springs of each of these latter relays. There are thus 576 (9 x 64) front contacts on the C-digit relays, and they are connected to a bank of 576 cross-connecting terminals – one for each code. Adjacent to these terminals would be three others as shown—or three banks of multiplied terminals—for the three possible indications to be returned to the register. Jumpers would be run between the bank of 576 and the bank of three terminals to associate each of the 576 codes with its proper X, Y or Z indication.

TABLE I—THE TWENTY-SEVEN POSSIBLE COMBINATIONS OF THREE THINGS—X, Y, AND Z—TAKEN THREE AT A TIME.

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

With this arrangement there are in all 640 relay contacts and 579 cross-connecting terminals. With the circuit actually used, however, only 288 relay contacts and 219 cross-connecting terminals are required. This great reduction in the amount of equipment was brought about by using the translator circuit indicated in Figure 2.

With this circuit, three codes are translated as a group with one jumper, and thus only one-third as many jumpers need be run as for the arrangement in Figure 1. In spite of this, there is complete flexibility since the translation of one code of a group of three may be changed without affecting the other two codes of the group. Since there are 576 codes in all, there are 192 groups of three codes, and each of the terminals in the column marked G in Figure 2 represents a group of three consecutive codes. The translating jumper wires from these G terminals are not run to the X, Y, and Z terminals but rather to a bank of twenty-seven P terminals, each of which represents one of the twenty-seven patterns in which three codes may be translated into any of three indications.

The three consecutive codes in any one group may be represented by U, V, and W, where U represents the lowest numbered code of the group and W the highest. The three columns to the right of column P in Table I represent the twenty-seven possible translation patterns for three codes into three indications. In pattern No. 0, for example, all three codes of the group are translated to an X indication. In pattern No. 5, the U code is translated to X, the V code to Y, and the W code to Z. The column labeled P in Table I represents the number of the P terminal that corresponds to each pattern. If for a particular group of codes the U code requires translation to X, the V code to Y, and the W code to Z, the G terminal for that group would be jumpered to P5. If it were desired to change the V code of this group to a Z translation without affecting the U and W codes, the jumper would be moved from P5 to P8, which represents pattern X, Z, Z as

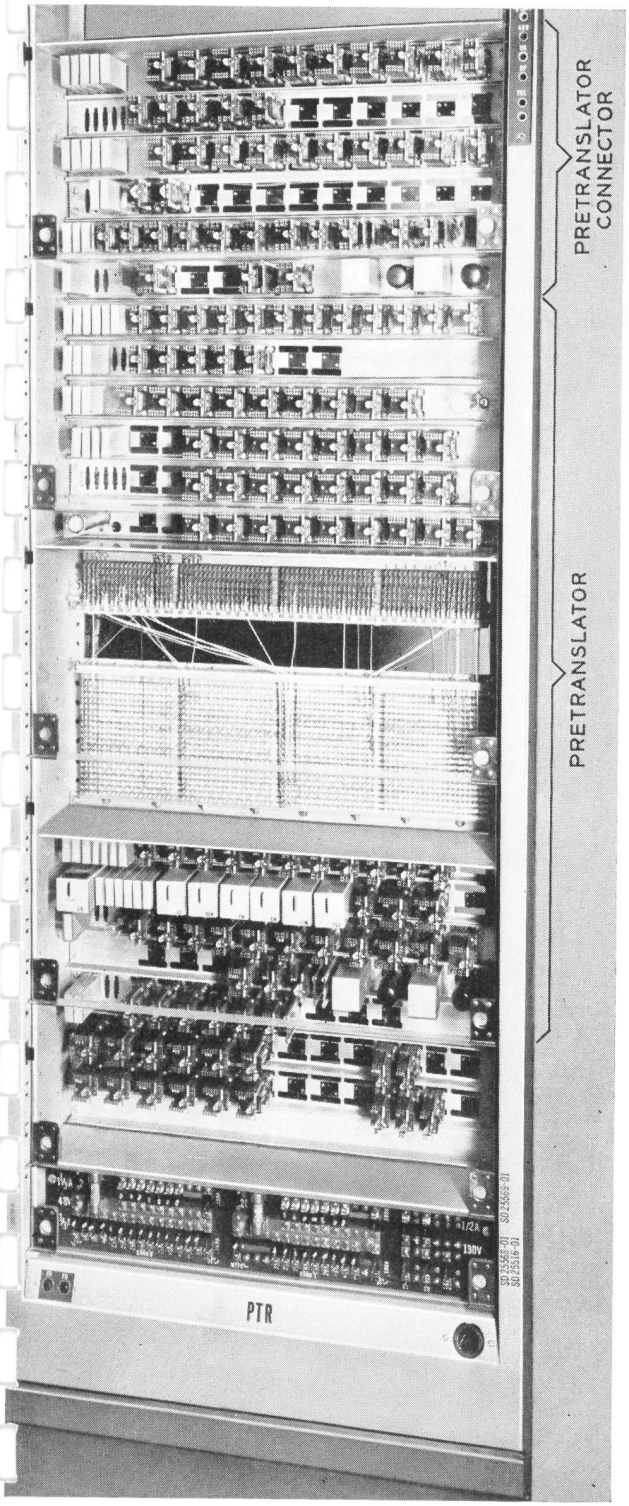

Fig. 3—Lower part of a pretranslator frame. The whole frame is arranged for two pretranslators and two pretranslator connectors.

may be seen in the table. These translating jumpers between the G and P terminals are the only variables between the input to the pretranslator and the X, Y, and Z leads, by which the translated information is returned to the register.

To convert the code recorded in the pretranslator to ground on only one of the G terminals, eight B-digit relays are used as in the circuit of Figure 1, but the A-digit leads, instead of being connected directly to their armature springs as in that circuit, are multiplied to the armature springs of a CR, a CS, and a CT relay. The twenty-four leads from the front contacts of these three relays are multiplied to the armature springs of the eight B-digit relays. Since a single U-type relay will not operate twenty-four contacts, two B relays are operated in series by each B-digit lead.

Relays CR, CS, and CT are operated from the circuit that records the C digit of the code. If the C digit is a 1, 2, or 3, relay CR is operated; if it is 4, 5, or 6, CS is operated; while if it is 7, 8, or 9, CT is operated. For each possible combination of the A and B digits in a code, there are thus three code groups: an R group when the C digit is 1, 2, or 3; an S group when it is 4, 5, or 6; and a T group when it is 7, 8, or 9. This group letter is included in the designations of the G terminals, which run from 22R to 99T. The G terminals to which the contacts of the B2 relays are connected, for example, will be the twenty-four numbered from 22R to 92R, 22S to 92S, and 22T to 92T—all those, in other words, that have a 2 as the B digit.

To distribute the twenty-seven P terminals to one or another of the X, Y, and Z leads, the three relays, marked CU, CV, and CW, are employed. Here also two relays operated in series are used for each designation, since one would not handle the number of springs that are required.

Whether a P terminal should be connected to X, Y, or Z depends on whether the particular code being translated is the first, second, or third of the code group. Since this fact is determined by the C digit, the operation of relays CU, CV, and CW is made to depend on whether the code is the first, second, or third of its group. Thus CU is operated whenever the C digit is 1, 4, or 7, CV when it is 2, 5, or 8, and CW when it is 3,

6, or 9. It will be noticed in Table I that for P0 all three codes of the group are translated as X; that for P13 they are all translated as Y; and for P26, they are all translated as Z. These three terminals thus do not need to be carried through the CU, CV, and CW relays since the code is given the same translation whether it is the first, second, or third of the group. These three terminals are thus connected directly to the X, Y, and Z leads. Each of the remaining twenty-four P terminals is connected to one armature spring on each of the CU, CV, and CW relays, and the front contacts of these relays are connected to the X, Y, and Z leads as indicated in Table I.

Terminals P1 to P8, inclusive, are connected to the first eight armature springs of each of the three relays; P9 to P17, inclusive, but excluding P13, are connected to the next eight armature springs of each relay; and P18 to P25, inclusive, are connected to the last eight armature springs of each relay. The front contacts of the CU relay are then connected to the X, Y, and Z leads in accordance with the U column of Table I. Similarly the front contacts of CV are connected according to the V column of Table I, and the front contacts of CW according to the W column.

Suppose, for example, that in code group 32S the first code, 324, requires translation as an X, the second code, 325, requires translation as a Y, and the third code, 326, as a Z. The G terminal 32S would thus be jumpered to P5, which gives this distribution as may been seen in Table I. If code 326 were now transmitted to the pretranslator, ground would appear on the No. 3 A-digit lead and the No. 2 B-digit lead. The No. 2 B relay would operate because of the ground on the No. 2 B-digit lead, and the CS and CW relays would operate because the C digit was 6. The ground on the No. 3 A-digit lead would thus be extended through contacts of CS and B2 to G terminal 32S, thence over the jumper to P5, and thence through a contact on CW to the Z lead.

Two of these pretranslator circuits and two pretranslator connectors are mounted on a single frame. The lower part of such a frame, with one pretranslator and one connector, is shown in Figure 3. Both circuits are protected by time alarms as are other common control circuits, and are arranged for the second trial feature. The pretranslator has access to the trouble recorder so that records of failures may be made. A number of additional safeguards have been provided in the design of these circuits to minimize the likelihood of trouble.

The pretranslator circuit operates in about 0.160 second, and is rated at 15,000 calls per hour—probably the highest usage of any telephone circuit. One pretranslator can carry the traffic in most offices, and two are sufficient for a marker group in any case. One additional circuit is provided for maintenance, however, and thus there will always be at least two pretranslators in an office. There are always as many connectors as there are pretranslators.