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Technical Note 282

KEYPUNCH CONTROLS FOR STRING-PUNCHING OF STATISTICAL DATA

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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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NATIONAL BUREAU OF STANDARDS

Technical Note 282

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KEYPUNCH CONTROLS FOR STRING-PUNCHING OF STATISTICAL DATA

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This note describes controls for a keypunch machine used to key statistical data with "string-punching techniques". Since the data are punched into cards that do not contain fixed field sizes, an identification code is punched for each data entry. To avoid a split field (part on one card and the remainder on another), the keypunch machine is programmed to provide a justification zone in which an answer identification code or a "delete" code can not be keyed. The cards are automatically serialized for each questionnaire and an arrangement is provided to punch an end-of-questionnaire code in the last card for the questionnaire.

Other disclosures on various subjects may be found in NBS Technical Notes 237, 253 and 263.

KEYPUNCH CONTROLS FOR STRING-PUNCHING OF STATISTICAL DATA

Martin J. Brennan

Introduction

A Census of Agriculture is conducted every five years and is a complete inventory of farm land and its uses, of crops, livestock and products, of poultry and products, and of produce on hand and/or sold during the year. A twenty percent sample is used to obtain additional information about the persons living on the farm, the farm facilities, equipment and expenditures. The total number of farms in the United States is estimated between 3,000,000 and 3,500,000.

To encompass the entire range of agricultural activities, the farm questionnaire contains 355 questions, many of which are in several parts. Since the great majority of farms do not include all activities, for a given farm, many questions may have no answer. No answers are usually indicated by a check in a "none" box for a series of related questions.

In the past a number of different card types were designed for the various sections of the questionnaire and many of the cards punched had a large number of X-skipped fields. An operator punched only one section of the questionnaire represented by a particular card type. The set of questionnaires was then moved to another operator to punch another section. The questionnaires would ultimately be handled by ten or more operators before all the information for a given group of farms could be recorded on punched cards. Obviously, this was very time consuming and required extensive controls.

In contrast, when "string-punching" techniques are used, the answers in each questionnaire are punched by a single operator. The questionnaire is divided into segments and the segments are further divided into items. Each item contains one or more data fields in which answers are recorded. The operator uses keypunch machine 85 (Fig. 1), under control of program card 86, to key identification data into the first information card 87 for a questionnaire. The cards are then punched only when an answer is indicated on the questionnaire, or to indicate that a segment has been considered by the operator. Since there are no fixed field sizes, this necessitates the punching of identification codes for each answer.

Upon recognizing an error, the operator does not destroy the error card. A "delete" code is punched and repunching is started in the next column. The repunching is always of the entire questionnaire, the segment, or the item, depending upon where the error is indicated.

Serializer unit 88 is controlled by program card 86 and in turn controls the punch unit in machine 85 to automatically serialize the cards for a questionnaire, and the end of questionnaire control unit 89 is operated by machine 85 to control the punch unit to identify the last card in the series. This permits the operator to ascertain the number of cards for a questionnaire and to keep the cards in correct order.

To avoid a split field (part on one card and the remainder on another), card 86 is programmed to control justification unit 90, which prevents the keying of any part of an answer identification code or a "delete" code in a justification zone. Should this be attempted the keyboard on machine 85 will lock without the character being punched, and the card will move to the area for automatic serialization. After serialization, the card will eject, a new card will be fed in, the identification information data for the questionnaire will be duplicated and the keyboard will be unlocked.

This method of punching is possible since the cards are read on magnetic tape by an arrangement that is not shown, and processed on a computer. Without the use of the computer, it is not possible to derive meaningful data from the "string-punched" cards.

Terminology and Notation

When Figs. 5 to 9 are arranged as shown in Fig. 4, numbers ranging from 0 to 10 appear in the left-hand margin and letters A and B appear along the top of Fig. 4 and the bottom of Fig. 9. This forms a coordinate system which may be used to locate the contacts of the relays in the figures. For example, relay coil 7P is associated with rectangle 7, Fig. 5, which represents relay 7 and is divided into sections marked 2B, 1B, 8A, 8A, representing contacts 7-1 to 7-4 or contacts 1 to 4 of the relay, respectively. The notation in each section designates the location of the associated contact in the figures. Thus, to use the notation 2B to locate contacts 7-1, find the area between numbers 2 and 3 in the left-hand margin of Fig. 6 and proceed to the B or right-hand portion of this figure.

Every relay and relay coil is represented by a number in a rectangle. When a rectangle has a P nearby, it represents the pick coil of a relay, the number of which appears in the rectangle. A pick coil is energized quickly and is used for operations that are not to be maintained for a long period of time. When a rectangle has an H nearby, it represents a coil used in a hold circuit for the relay whose number appears in the rectangle.

By way of illustration, the arrangement disclosed herein controls an IBM Card Punch Machine 024, which is one type of keypunch machine. The structure shown in Figs. 5 to 9, enclosed in a dotted rectangle and marked "85", is therefore located in the IBM machine. When a lead is broken and a number is found nearby, the number corresponds to a component found in the IBM machine.

While the present arrangement controls an IBM Card Punch Machine 024, it will be understood that by virtue of the principles underlying this disclosure that the arrangement could be modified to control other keypunch machines, paper tape perforators, or data recorders. It will also be understood that the IBM machine is not necessarily the best keypunch machine for the purposes described herein.

With reference to Fig. 2, the armature of contacts 93 is resting on the "normal" contact and, when actuated, engages or is transferred to the "transferred" contact. When the armature engages the transferred contact, the contacts are designated as "transferred contacts 93" and when the armature engages the normal contact, the contacts are designated as "normal contacts 93."

With reference to Fig. 3, the positive terminal of battery 95 is connected to the "pick" of relay 94, while the negative terminal is connected to the "common" of the relay.

When a resistor in Figs. 5 to 9 is connected between the pick of a relay or relay coil and positive potential source 96, such as resistor 97 (Fig. 5), the resistor functions as a current limiting resistor. Likewise, 91 and 92 (Fig. 9) are current limiting resistors. When a resistor and capacitor are connected in series across a relay or relay coil, such as 98 and 99 (Fig. 5), the latter components form an arc suppressor circuit. Finally, the various diodes in the figures prevent sneak circuits.

Questionnaire Composition

The questionnaire is divided into segments identified by alphabetic codes. Each segment code is punched even when there is no answer for any question in the segment.

The segments are divided into items, and the items are further divided into data fields. Each item is designated by an item code, which comprises three characters, the first being a numeric "V" or "12" punch. (A "V" punch is a perforation in the second row above the "0" row on information card 87, Fig. 10.) If there is an answer entered into any of the answer positions associated with a given item code, the latter code is punched first, followed by the answer or group of answers. Each answer is recorded in a data field, preceded by a numeric "X" or "11" punch. (An "X" punch is a perforation in the first row above the "0" row in the information card.) If there are several answer positions for an item and one or more is blank, an "X" is punched for each blank

field except where all remaining fields for the item are blank.

Start of Operation

At the start of operation, an information card 87 is registered in keypunch machine 85 and the auto-dup switch 100 (Fig. 5) is open. The operator closes the "string-punching" switch 102 (Fig. 8) to complete a circuit through relay coil 10H to positive potential source 96, and the latter coil is energized. In "string-punching" techniques the skip key, that controls the manual skip, is not used. Hence, when relay coil 10H is energized, contacts 10-3 open, breaking splice 45PP to relay 45 in the keypunch machine. This disables relay 45, which during normal operation, will cause the machine to escape one column when the skip key is struck. Again, when relay 10H is energized, contacts 10-4 close to apply negative potential source 104 to display tubes 105 and 106, placing the tubes in operation.

The operator depresses key 111 (Fig. 8) to reset counter 110. After the key is depressed, relay coil 1H is energized and contacts 1-2 close. A circuit is then completed to P-cam 2 that maintains relay coil 1H energized until machine 85 performs the next punch clutch cycle. Contacts 1-1 close and a circuit is completed through interrupter contacts 113, arm 117 of bank 1 and units relay coil 109 to advance the stepping switch of the counter until arm 117 comes to rest on contact 1. Likewise, contacts 1-4 close and a circuit is completed through interrupter contacts 115 and tens relay 119 until arm 120 comes to rest on contact 0 of tens bank 1. In this way counter 110 is reset to 01.

When the operator starts to punch the identifying data in card 87, the first keyed digit starts a punch clutch cycle during which the contacts controlled by P-cam 2 open and release relay coil 1H.

Recording Information

The punching of information in card 87 is under the control of program card 86, which contains a standard program in rows 12, 11, 0 and 1 and an alternate program in rows 4 to 7. Rows 4 and 12 are punched in the omitted portions of cards 86 and 87 in Fig. 10. Row 2 in the program card defines the justification zone, row 3 defines the areas for recording "delete" and end of questionnaire codes, and rows 8 and 9 the area for recording the card count.

Keypunch machine 85 is in standard program at the start of the recording process, and the operator keys identification data into the first information card 87. This will include the state and county in which the data was collected. The counties are mapped out into Enumeration Assignments (EAs), and most of the EAs contain smaller areas known as Enumeration Districts (EDs). The operator punches the EA number, the ED number and then the type and number of the questionnaire. (If an EA contains only one ED, the operator keys "1" for the ED number.) This data is shown recorded in the card illustrated in Fig. 10, where the "A1" printed over column 10 designates the classification of the questionnaire being punched.

After keying the identification data, the operator closes the auto-dup switch 100 (Fig. 5) and turning to the segment A of the questionnaire, uses "string-punching" techniques to record data on the card. First, an "A" is keyed in column 13, card 87 (represented by a perforation in rows 12 and 1). The first item in this segment has one question: "How many acres do you rent from others?" The answer is "620". Thus the operator keys rows 12, 1 and 1 to represent the first item code V11; row 11 ("X") in column 17 to represent a data field; and rows 6, 2, 0 in columns 18, 19 and 20, respectively, to represent the answer.

The second item in segment A has one question: "How many acres do you rent from others?" Since the answer is "none", the second item code is not punched. The third item contains four answer positions, and the answers in the first, third and fourth positions are 42, 68 and 124, respectively. After punching V13 in columns 21 to 23 to represent the code for the third item, the operator keys "X" and 42, the answer for field one. He then keys: "X" for field two, "X" and the answer 68 for field three, and finally, "X" and 124 for field four. If fields one and two had contained answers, but fields three and four were blank, after keying field two the operator would proceed to the next item containing an answer in segment A. This is item V56 whose code is recorded in columns 35 to 37.

Card Serialization

Using the "string-punching" techniques just described, the operator continues to key data into information card 87. As he approaches the end of the card, assume that the answer to be punched into the last data field ends in column 78.

Since this is the first questionnaire card, arms 120 and 117 of units and tens bank 1 in counter 110 (Fig. 7) are on their 0 and 1 contacts, respectively; and arms 122 and 121 of units and tens bank 2 are also on their 0 and 1 contacts, respectively. Relay 50 (not shown) in keypunch machine 85 controls the operation of contacts 50-2 (Fig. 7) whose armature is connected through contacts 4-1 to the pin sense contacts common to effect automatic duplication of information from one card to the following card.

After the operator punches the data into column 78, the keypunch machine advances to column 79 where star wheels 0, 2, and 8 sense the perforations in rows 0, 2 and 8, respectively, of program card 86. When star wheel 2 senses the perforation in row 2, relay coil 4P is energized. Contacts 4-1 are then transferred to bypass the auto-dup operation in the keypunch machine. Contacts 4-5 are also transferred. When star wheel 8 senses the perforation in row 8, relay coil 6P is activated so that contacts 6-2 are closed. Finally, when star wheel 0 senses the perforation in row 0 a circuit is completed through transferred contacts 4-5 and closed contacts 6-2 and 2-3 to the auto-dup circuit in the keypunch machine, which is then placed in auto-dup operation. During this operation, relay 50 (not shown) in the machine is picked up and contacts 50-2 close.

After star wheel 8 senses the perforation in row 8, column 79 in the program card, relay coil 6P is energized and contacts 6-1 are transferred. P-cam 5 generates a pulse during each punch clutch cycle which is applied through closed contacts 50-2, transferred contacts 4-1, normal contacts 5-1, transferred contact 6-1 and through arm 121 to the zero punch magnet. Row 0 in column 79 in information card 87 is then punched.

When the zero punch magnet is energized, another punch clutch cycle is effected and keypunch machine 85 advances to column 80. In this column, star wheel 0, 2, and 9 sense the perforations in rows 0, 2 and 9, respectively; relay coil 4P remains energized and relay coil 5P is activated. Contacts 4-5 remain transferred and contacts 5-2 close to complete a circuit from the star wheel common through star wheel 0 to the auto-dup circuit, maintaining the machine in "auto-dup" operation.

In column 80, as noted above, the star wheels 2 and 9 sense the perforations in rows 2 and 9, respectively, in program card 86, maintaining relay coil 4P energized and picking up relay coil 5P. Contacts 4-1 are therefore maintained in the transferred position and contacts 5-1 are transferred, so that the next pulse generated by P-cam 5 is directed through closed contacts 5-2, transferred contacts 4-1 and 5-1 and through arm 122 to activate the one magnet. Row 1 in column 80 in the information card 87 is then punched. In this manner, 01 is recorded in the information card.

After column 80 has been punched, keypunch machine 85 automatically ejects card 87 and causes a new card to be registered. Since relay 10H is energized, contacts 10-5 are closed and while the new card is being registered, a pulse, generated by card feed cam CF-4 (Fig. 7), is applied through closed contacts 10-5, 1-3 and 2-1 to activate relay coil 109 of the stepping switch related to counter 110. When the pulse terminates, the switch is advanced and arm 117 moves to contact 2. The counter now reads 02.

Since the stepping switch includes units and tens bank 2 (Fig. 7), arm 122 advances to contact 2, and since the switch also includes units and tens bank 4 (Fig. 9), the units and tens registered in counter 110 are displayed on tubes 106 and 105, respectively. This provides the operator with a visual indication of the count as well as an indication that keypunch machine 85 is operating properly.

When a questionnaire requires a large number of cards, some may be punched in one and the remainder in another period of operation. The operator will then note the count of the punched cards appearing on display tubes 105 and 106 at the end of the first period and before the start of the next period will set counter 110 at the noted count. This is accomplished by means of units and tens advance keys 123 and 124, for each time one of these keys is depressed an obvious circuit is completed to advance counter 110 by either a unit or a ten.

When arm 117 advances from contact 9 to contact 10 on unit bank 1 (Fig. 7), relay coil 109 is energized by a circuit that extends through units interrupter contacts 113. Arm 117 is then advanced to contact 0 where it comes to rest. As arm 117 moves from contact 9 to 10, units carry switch 135 is closed by a mechanical arrangement on the stepping switch and remains closed until 117 moves from contact 10 to 0. When switch 135 is closed, 0 volts is applied to tens relay coil 119, energizing the coil, and when the switch opens, arm 120 is advanced from contact 0 to 1. Arms 117 and 120 are then on contacts 0 and 1 of units and tens bank 1, respectively, while arms 138 and 139 are on contacts 0 and 1 of units and tens banks 4, respectively. A count of 10 is then registered in counter 110 and displayed on tubes 105 and 106.

Justification

As information is keyed into card 87, the keypunch machine 85 advances until at column 72 the machine enters the justification zone which extends through column 78 and is defined by the perforations in row 2 of program card 86. In this zone the operator may complete the punching of any information that has been started but will not be allowed to start a new segment, item or data field. Should the operator depress the X, V or alpha shift keys, the keyboard will lock without the character being punched and the machine will skip to column 79 for automatic serialization.

Assume that the data for the last item recorded in a card 87 ends in column 71 and the card is registered in column 72. Star wheel 2 will sense the perforation in column 72, row 2 of program card 86, and since contacts 10-6 are closed, a circuit is completed that picks up relay coil 4P. Contacts 4-2, 4-3, and 4-4 are then transferred. If the operator should strike the V or the X key to start an item or data field entry, 0 potential will be applied through either contacts 4-2 or 4-4 and closed contacts 3-3 to terminal 45PP in keypunch machine 85. This will place the machine in the auto-skip operation which is maintained by the field definition punched in row 12 of program card 86. Thus, an auto-skip operation, started in column 72, will continue through column 77, placing the machine in column 78. In a similar manner 0 volts is normally applied to capacitor 145 which is charged, and when the alpha shift key is struck the capacitor is discharged through contacts 4-3, 3-3 to terminal 45PP to effect an auto-skip to column 78.

When the X, V or alpha shift key is depressed, relay coil 45 in the keypunch machine is energized and contacts 45-6 close. This picks up relay coil 3P and contacts 3-3 open to allow the field definition in row 12, program card 87 to control keypunch machine 85 in the auto-skip operation. Contacts 3-1 close, completing a holding circuit through contacts 2AL-C. The latter contacts are controlled by relay 2 in the keypunch machine and remains energized until card 87 is ejected.

In column 78, star wheel 3 senses a perforation in row 3, picking up relay coil 7P. Contacts 7-2 close. Star wheel 0 senses the perforation in row 0 to complete a circuit through closed switch 100 and closed contacts 7-2, 3-2, 2-3 to the auto-dup circuit. This initiates a dummy punch clutch cycle. At the same time, star wheel 2 reads the perforation in row 2 to pick up relay coil 4P and transfer contacts 4-1. P-cam 5 then generates a pulse that is applied through closed contacts 50-2, transferred contacts 4-1, normal contacts 5-1, 6-1, 8-5, and 9-5 to energize relay coil 11P. Contacts 11-2 close so that the pulse generated by P-cam 2 activates relay coil 11H. Contacts 11-1 close and 0 potential is applied to 49-4C in keypunch machine 85, which causes the machine to space one column. As the machine is spaced, a punch clutch cycle is initiated that opens the circuit through which the pulse generated by P-cam 2 is applied to relay coil 11H. The latter coil then drops out. During the latter punch clutch cycle, P-cam 5 closes and initiates the operations effecting read-out of counter 110, as described above under "Serialization".

After card 87 has been serialized, it is ejected and a new card is registered in the keypunch machine. Star wheel 0 then senses the perforation in column 1, row 0 in program card 86 to complete a circuit through closed switch 100, normal contacts 4-5 to the auto-dup circuit. This will start an auto-dup operation that is maintained through column 12 by the perforations in row 12 in the program card. In this way, the identification data in the first information card 87 is reproduced in the second.

Punching the Last Card of a Questionnaire

Assume that the last data entry for a questionnaire is made in column 24 of the card registered in keypunch machine 85. The operator then depresses the space bar (Fig. 6) which functions as the end-of-questionnaire key.

When the space bar is depressed, since contacts 10-2 are transferred relay coil 8H is activated and contacts 8-1 close. Since terminal 1/2A (Fig. 6) is connected to terminal 1/3B in the keypunch machine, 0 volts is applied through closed contacts 148, 8-1 and normal contacts 7-1 to 45PP, which energizes relay coil 45 in the machine. This places the machine in an auto-skip operation. Contacts 45-6 close to pick up relay coil 3P. Contacts 3-3 open to allow the field definition in row 12, program card 86 to control the keypunch machine in auto-skip until information card 87 is positioned at column 78. (The drawings for the IBM Card Punch Machine 024 do not identify contacts 148 with a number.)

When relay coil 8H is energized, contacts 8-2 are closed and a holding circuit for the coil is completed through contacts 8-2 and normally closed contacts 1-6.

In column 78, star wheels 2 and 3 sense the perforations in rows 2 and 3 of program card 86, energizing relay coils 4 and 7. Normally, when the space bar is depressed, the keyboard on keypunch machine 85 would be restored and locked by a circuit connected through contacts 1AU and 48-4 (Fig. 9) and a circuit connected through contacts 50-3T and 45-2. These circuits, when activated, will also cause the keypunch machine to escape one column. However, since the escapement in column 78 is to be controlled via the circuits described below, when relay coil 7P is energized contacts 7-3 and 7-4 open and the keypunch machine can not space over column 78 until the end-of-questionnaire code is punched in this column.

Contacts 7-1 make and 0 volts is applied through closed contacts 8-1 and 7-1 to energize relay coil 3P, which closes contacts 3-2 and opens contacts 3-3. At the same time, contacts 7-2 close and star wheel 0 senses the perforation in row 0 of program card 86 so that 0 volts is applied through closed switch 100 and closed contacts 7-2, 3-2 and 2-3 to the auto-dup circuit. This places the machine in auto-dup operation, providing a punch clutch cycle. Since relay 50 (not shown) in keypunch machine 85 is energized, contacts 50-2 are closed and the pulse, generated by P-cam 5 during the latter clutch cycle, is applied through contacts 50-2, transferred contacts 4-1, normal contacts 5-1 and 6-1, and transferred contacts 8-5 to terminals 8, 3 and 12. These terminals are connected in circuits in keypunch machine 85 that are responsive to 0 volts to punch rows 8, 3 and 12 in column 78. Consequently, a "period," which is the end-of-questionnaire code, is punched in column 78 of the information card 87.

Card 87 is now advanced to column 79, and as previously described, is serialized and ejected. An auto-feed operation is then initiated in the keypunch machine to register the next information card in the punch station. During this operation, cam CF-3 (Fig. 8) generates a pulse that is sent through closed contacts 8-4 to pick up relay coil 1H. Contacts 16 open to break the holding circuit on relay coil 8H. Meanwhile, before contacts 8-6 open, cam CF-3 (Fig. 6) applies a pulse through the latter contacts to relay coil 8H, establishing a holding circuit for the duration of the pulse generated by CF-3. In this way coil 8H is held energized for a short period after coil 1H drops out and contacts 1-6 open.

When relay coil 8H is energized, contacts 8-3 make, and a circuit is completed to the grid of electron tube V2. The tube conducts and electromagnet coil 147 is energized to lock the keyboard on keypunch machine 85 until the termination of the pulse generated by cam CF-3. (The number for coil 147 does not appear in the circuit diagram for the IBM Card Punch Machine 024.)

When relay coil 1H is energized, contacts 1-5 close to pick up relay coil 36P. This places keypunch machine 85 in alternate program and control of the machine shifts to star wheels 4 to 7. Contacts 36-1 close to complete a circuit to terminal 2-PH in the machine and thereby establish a holding circuit for relay coil 36P.

Again, when relay coil 1H is energized, contacts 1-1 and 1-4 close and counter 110 is reset, as described above in connection with reset key 111 under "Start of Operation". The units and tens bank 3 are connected in the manner shown in Fig. 5 to insure that counter 110 is rest to 01 before the keypunch machine performs the auto-dup operation described immediately below.

After relay coil 36P is energized and a new card is registered in the keypunch machine, star wheel 6 senses the perforation in column 1, row 6. If the counter 110 is reset to 01, a circuit is completed through the units and tens bank 3 in the stepping switch related to 110, transferred contacts 36-3 and contacts 4-5 to the auto-dup circuit. The keypunch machine is then placed in auto-dup operation under control of the perforations in row 4, columns 2 to 8 in program card 86. Thus, the auto-dup operation will be maintained through column 8 of the new card and the identification information punched in the first eight columns of the last card for the previous questionnaire is recorded in the first eight columns of the first card for the new questionnaire.

In many instances, the code in column 9 in the last card can be duplicated in the new card. If this is the case, the operator depresses the manual-dup key (not shown) to provide a one column duplication. If the data to be recorded is not the same as in column 9 of the last card, the operator keys the new information. He then punches a new questionnaire number in columns 10 to 12. This brings the keypunch machine to column 13 where the operator starts recording information using the "string-punching" techniques described above.

After the new card has been completely punched, the holding circuit in the keypunch machine for relay coil 36P is broken and the coil drops out. The machine is then in standard program, under control of rows 12, 11, 0 and 1 in program card 86.

When an information card 87, punched with an end-of-questionnaire code, is in the pin sense station, diode 150 (Fig. 9) prevents a sneak circuit that would be established to punch magnet 3 in the keypunch machine if a delete-farm code, described below, is keyed.

Self-Detected Error

Delete Item. If an error of omission or of punching is made in a data field, the R or "delete" key (not shown) on the keyboard of machine 85 is depressed. An "R" will be punched in the current column. Starting in the next available column, the entire item starting with the item code is repunched.

If an error is made in any digit of the current item code other than the "V" punch, it may be corrected by depressing the R key and proceeding to punch that item code again. If something other than "V" is punched for the first digit of the item code, the R key is depressed and the previous item is repunched in its entirety. If this error occurs in the first item of a segment, the "R" must be followed by the segment letter.

Delete Segment. The entire segment must be "deleted" and repunched when an error in an item code, or in a data field for an item is not detected until after the first character of the succeeding item code has been correctly punched. The same R key, which is used for deleting an item, is also used for deleting a segment. An entire segment must also be deleted and repunched if one or more items were skipped and the error is realized after starting to punch succeeding items.

It is noted that the "R" punch will delete data fields and item or segment codes back to and including the last preceding item or segment code. The actual area deleted is determined by the codes punched immediately after the "R" code. An item code immediately following the delete code will cause the computer to remove all information back to and including that item code. A segment code immediately following the delete code will cause the computer to remove all information back to and including that segment code. The "R" punch must, therefore, be followed immediately by the "V" or the segment code which was punched in error, and punching should resume from that point.

Delete Questionnaire. If an error of omission or of punching is detected in a previous segment, or when it is realized that the wrong questionnaire number has been punched for the current questionnaire, the skip key (Fig. 6) is depressed. The keypunch machine 85 will then perform the same operations as when the end of questionnaire is reached and the space bar (Fig. 6) is depressed with the exception that the operation is under control of relay coil 9H, through transferred contacts 10-1, instead of relay coil 8H. Thus, at column 78 the pulse generated by P-cam 5 is transmitted through a circuit that includes closed contacts 50-2, and transferred contacts 4-1 and 9-5 to the terminals marked X and 8. An "X" and an 8 are then punched in column 78, which represents a "Q".

The presence of the "Q" in column 78 indicates that all cards punched for this questionnaire are to be disregarded or deleted. The questionnaire is repunched as if it were a new one and the repunched cards are placed in the file directly behind the deleted ones.

Card Release

When recording data in a series of cards related to a questionnaire, the operator may wish to release a card registered in keypunch machine 85 without altering the card count. He may accomplish this by depressing the release key (Fig. 8).

More specifically, when the release key is depressed, the information card 87 registered in the keypunch machine is automatically released and a new information card is registered. A circuit is established through the release key that applies 0 volts to relay coil 2P which is then energized. Contacts 2-2 close, and since contacts 4-6 and switch 102 are closed, relay coil 2H is activated. As the keypunch machine enters column 72, star wheel 2 senses the perforation in row 2 of program card 86, and relay coil 4P is picked up. Contacts 4-6 then open and relay coil 2H drops out. However, relay coil 2P remains energized by the circuit through the release key. As the keypunch machine leaves column 80, relay coil 4P drops out and contacts 4-6 close, establishing a circuit that energizes relay coil 2H. The latter coil will remain energized until column 72 of the new information card when relay coil 4P is again picked up and contacts 4-6 open to release relay coil 2H.

When either relay coil 2P or 2H is energized, contacts 2-3 are opened to prevent the completion of a circuit from star wheel 0 to the auto-dup circuit as program card 86 is spaced through columns 79 and 80. Hence relay 50 in keypunch machine 85, which is closed during an auto-dup operation, remains inactivated and contacts 50-2 remain open. Consequently, counter 110 is not read out as information card 87 is spaced through columns 79 and 80. Contacts 2-1 open so that a pulse, generated by card feed cam CF-4, can not be fed through closed contacts 10-5 and 1-3 to units relay coil 109, and the counter is not advanced.

Again, when either relay coil 2P or 2H is activated, contacts 2-4 close. If at this time, the keypunch machine is in alternate program, relay coil 36P is energized and a holding circuit for the latter coil is set up through contacts 36-12 and 2-4. This will maintain the machine in alternate program for the information card 87 that follows the one being released.

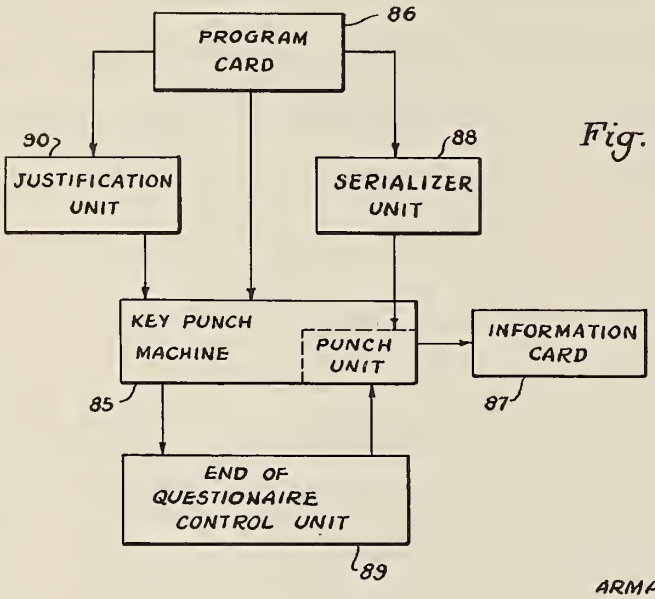

Fig. 1

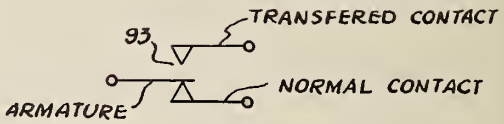

Fig. 2

Fig. 5
Fig. 6
Fig. 7
Fig. 8
Fig. 9

Fig. 4

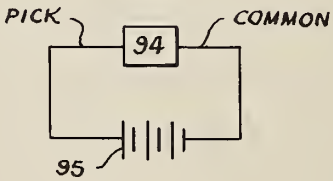

Fig. 3

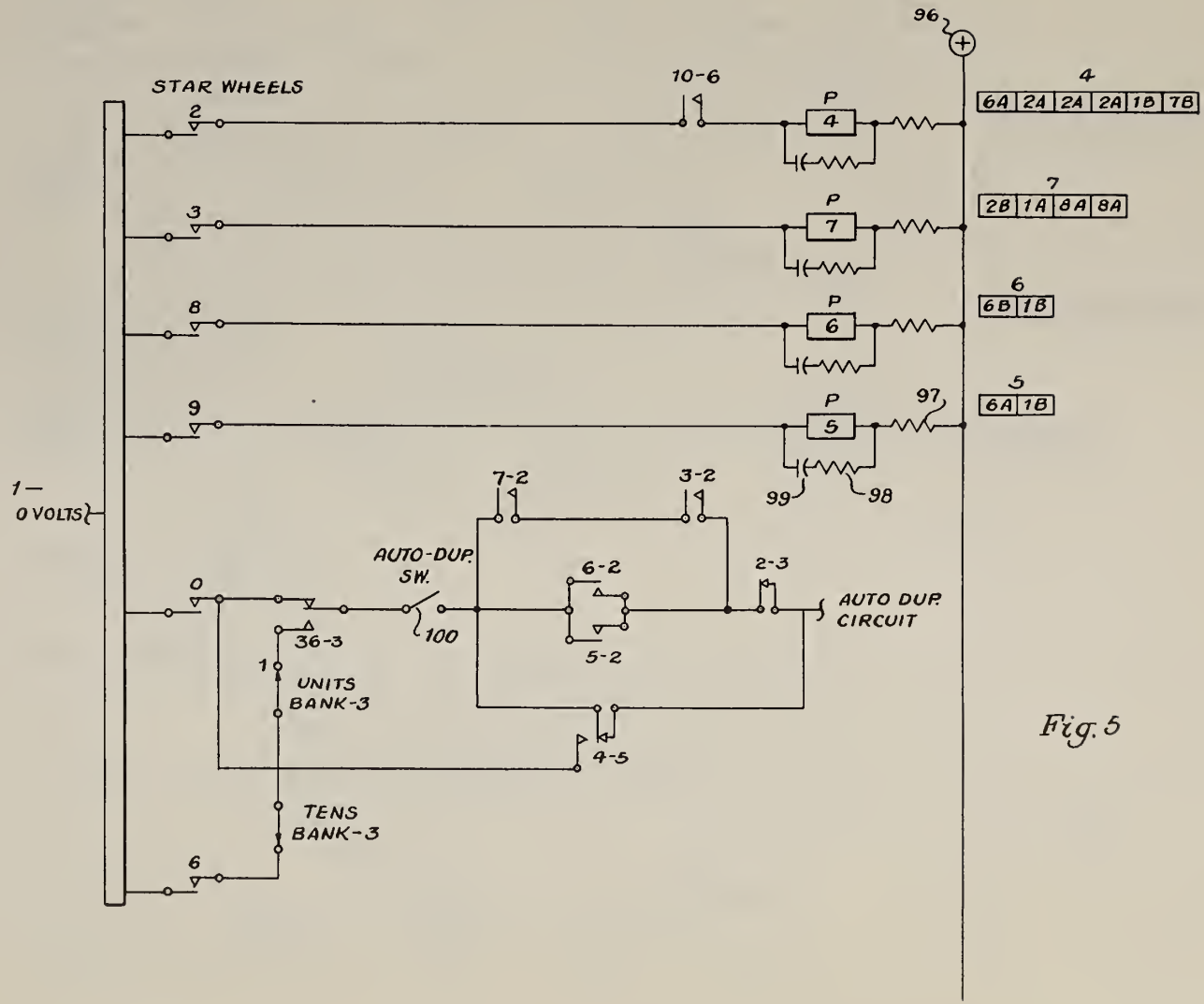
0—
A
1
B
96
STAR WHEELS
2
3
8
9
10-6
P
4
7
6
5
97
99
98
4
6A 2A 2A 2A 1B 7B
7
2B 1A 8A 8A
6
6B 1B
5
6A 1B
1—
0 VOLTS
7-2
3-2
AUTO-DUP. SW.
6-2
2-3
AUTO DUP. CIRCUIT
0
36-3
100
1
UNITS BANK-3
5-2
4-5
TENS BANK-3
6

Fig. 5

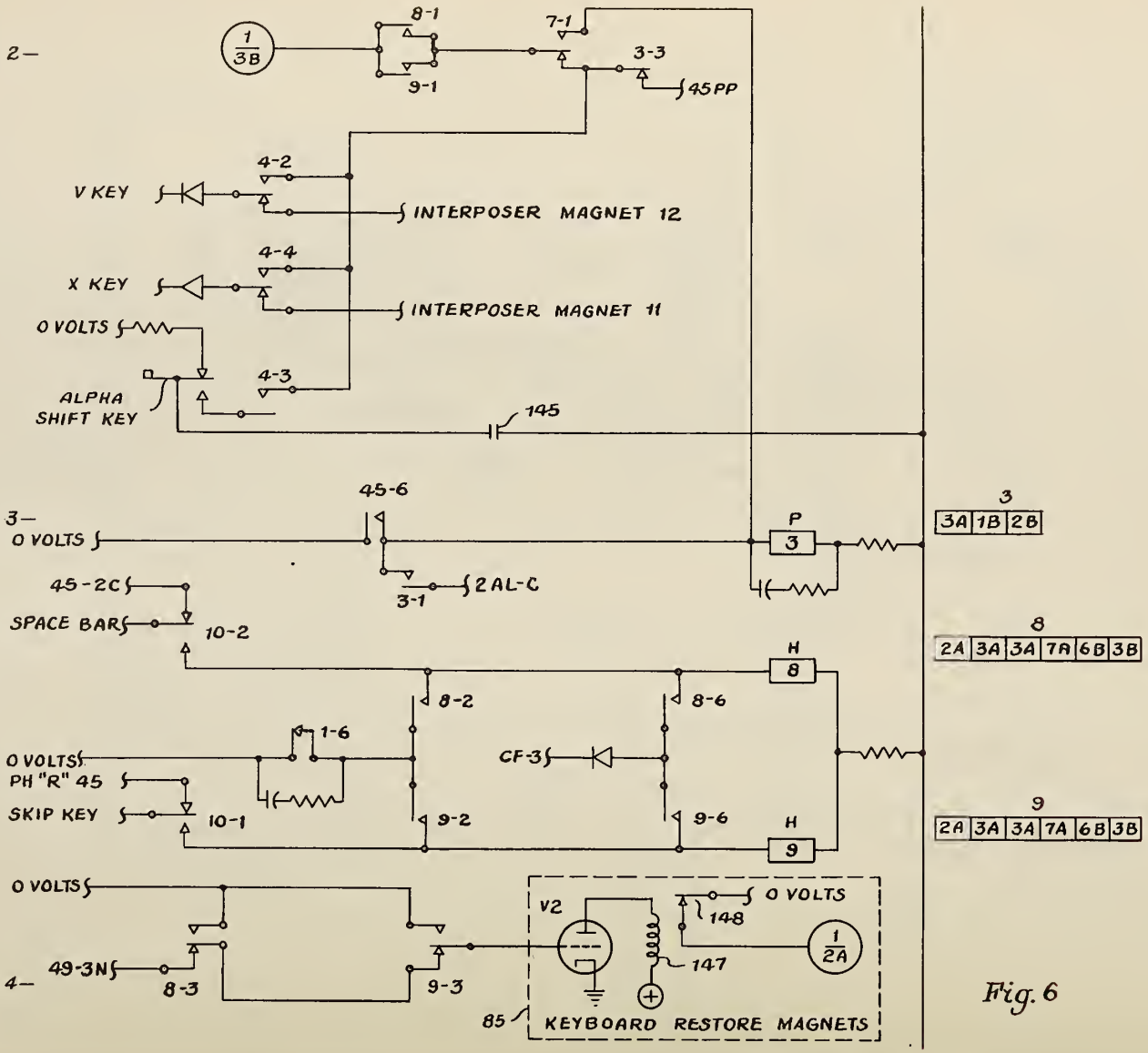
2—
1/3B
8-1
9-1
7-1
3-3
45PP
4-2
V KEY
INTERPOSER MAGNET 12
4-4
X KEY
INTERPOSER MAGNET 11
0 VOLTS
4-3
ALPHA SHIFT KEY
145
3—
0 VOLTS
45-6
3-1
2AL-C
P
3
3
3A 1B 2B
45-2C
SPACE BAR
10-2
8
2A 3A 3A 7A 6B 3B
H
8
8-2
8-6
1-6
0 VOLTS
PH "R" 45
SKIP KEY
10-1
CF-3
9-2
9-6
H
9
9
2A 3A 3A 7A 6B 3B
0 VOLTS
4—
49-3N
8-3
9-3
V2
0 VOLTS
148
147
1/2A
85
KEYBOARD RESTORE MAGNETS

Fig. 6

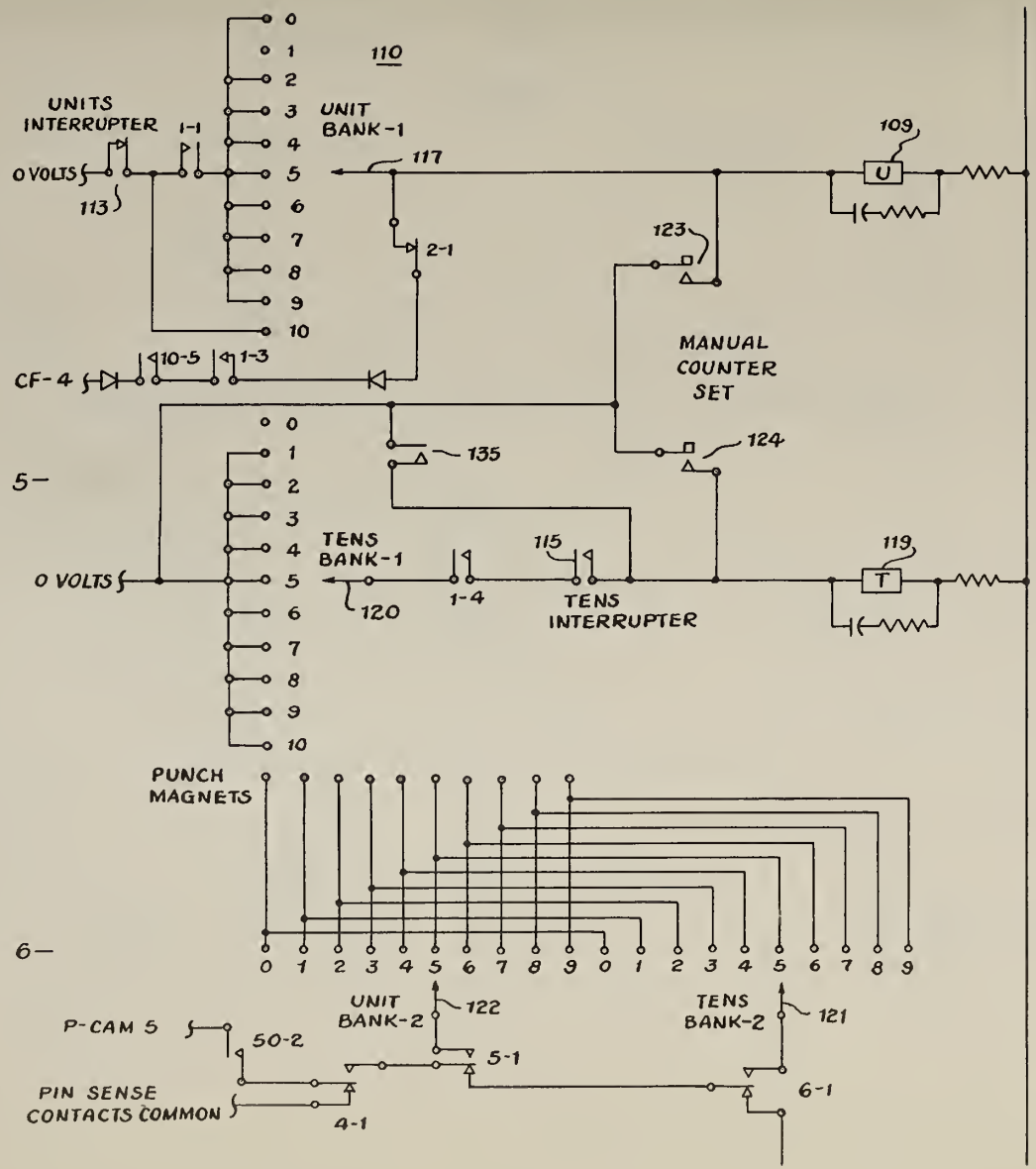
110
UNITS INTERRUPTER
1-1
UNIT BANK-1
117
109
U
0 VOLTS
113
2-1
123
MANUAL COUNTER SET
CF-4
10-5
1-3
135
124
5—
TENS BANK-1
115
119
T
0 VOLTS
120
1-4
TENS INTERRUPTER
PUNCH MAGNETS
6—
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9
UNIT BANK-2
122
TENS BANK-2
121
P-CAM 5
50-2
5-1
6-1
PIN SENSE CONTACTS COMMON
4-1

Fig. 7

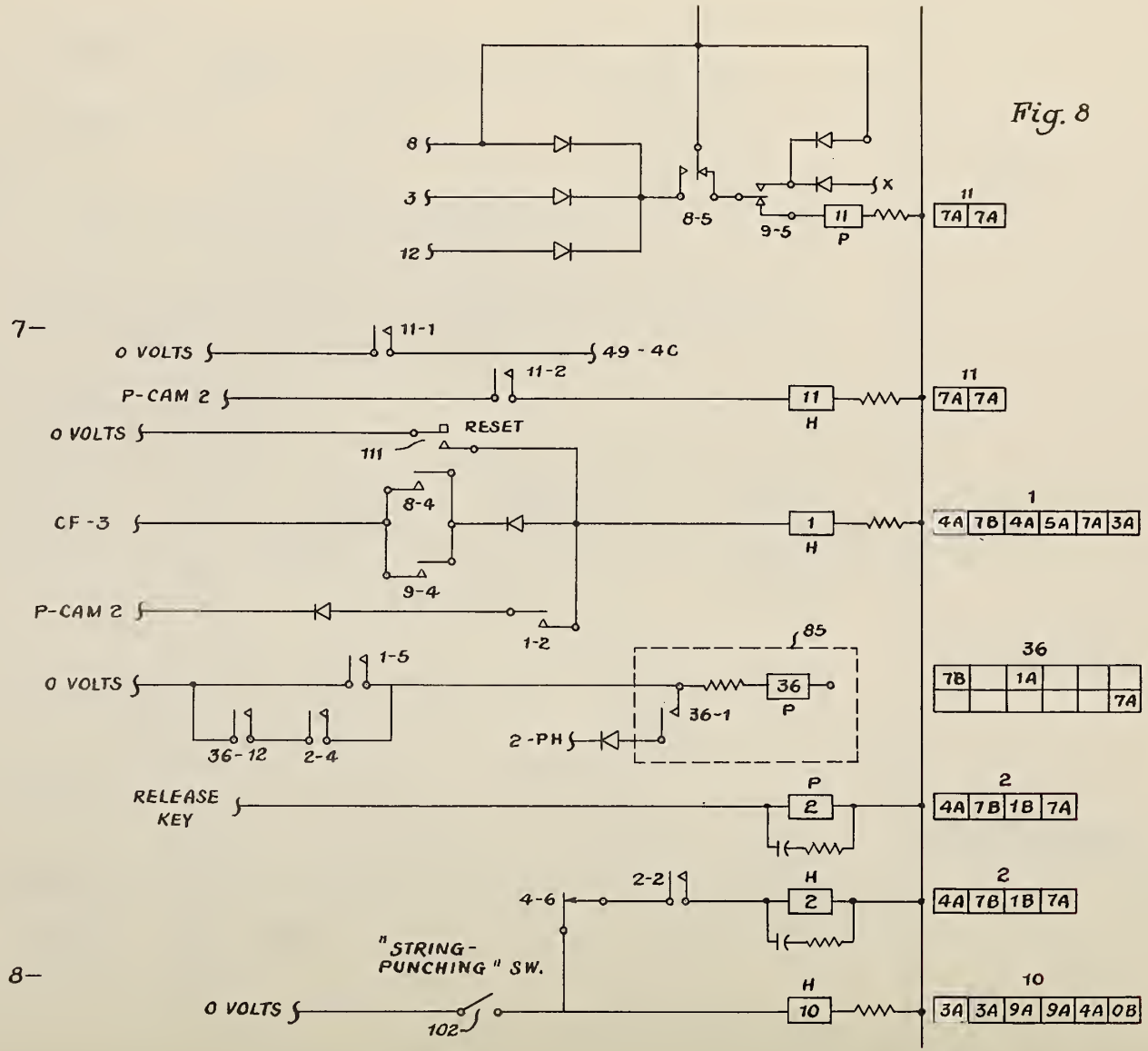
8
3
12
8-5
X
9-5
11
P
11
7A 7A
7—
0 VOLTS
11-1
49 - 4C
P-CAM 2
11-2
11
H
11
7A 7A
0 VOLTS
RESET
111
CF -3
8-4
9-4
1
H
1
4A 7B 4A 5A 7A 3A
P-CAM 2
1-2
85
0 VOLTS
1-5
36
P
36-1
2-PH
36-12
2-4
36
7B 1A 7A
RELEASE KEY
P
2
2
4A 7B 1B 7A
4-6
2-2
H
2
2
4A 7B 1B 7A
"STRING-PUNCHING" SW.
8—
0 VOLTS
102
H
10
10
3A 3A 9A 9A 4A 0B

Fig. 8

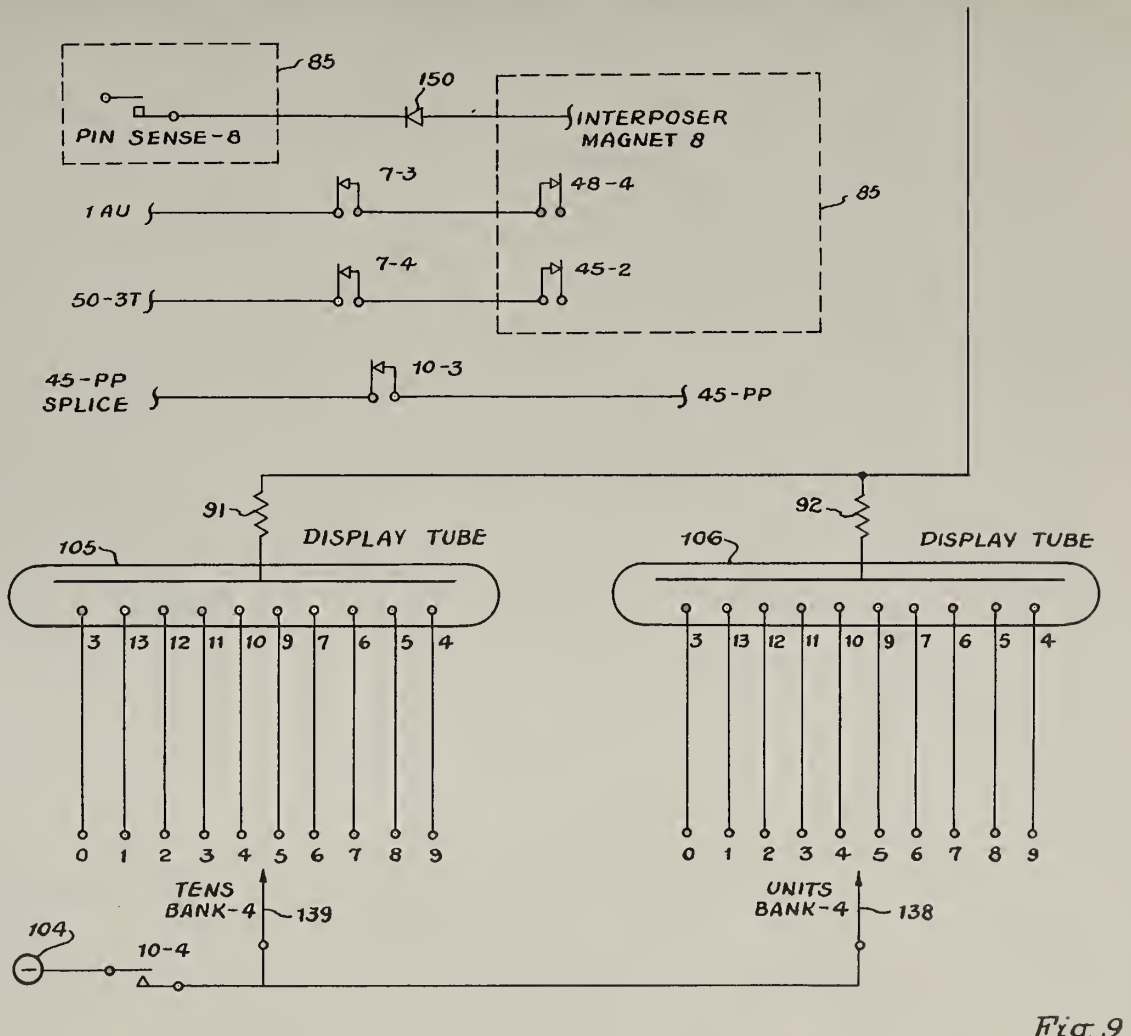
85
150
PIN SENSE-8
INTERPOSER MAGNET 8
7-3
48-4
1AU
85
7-4
45-2
50-3T
9—
10-3
45-PP SPLICE
45-PP
91
DISPLAY TUBE
92
DISPLAY TUBE
105
106
3 13 12 11 10 9 7 6 5 4
0 1 2 3 4 5 6 7 8 9
TENS BANK-4
139
UNITS BANK-4
138
104
10-4
10—

Fig. 9

A I B

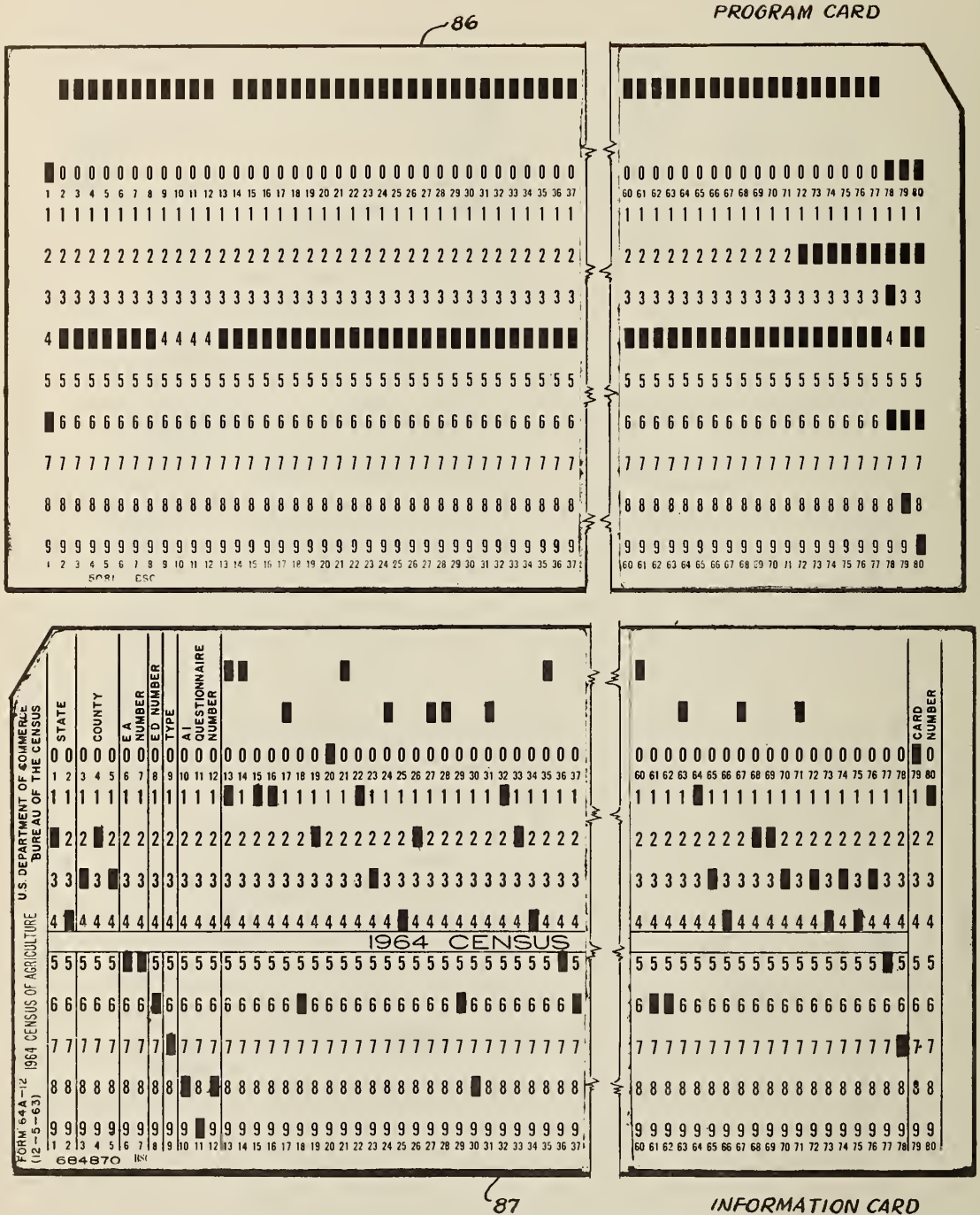
86
PROGRAM CARD
U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
1964 CENSUS OF AGRICULTURE
FORM 64A-12
(12-5-63)
STATE
COUNTY
E A NUMBER
E D NUMBER
TYPE
AI QUESTIONNAIRE NUMBER
CARD NUMBER
1964 CENSUS
87
INFORMATION CARD

Fig. 10

U.S. DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20230

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE