

Systems Reference Library

FARGO for IBM 1401

FARGO (*Fourteen-O-One Automatic Report Generating Operation*) is a report generator that requires no expert knowledge of programming techniques. This manual explains the writing of report specifications and the preparation of FARGO control cards to produce the desired results. Reports can be prepared on blank paper or preprinted report forms.

The method requires a minimum of 4,000 positions of core storage and is applicable to card input files only.

For a list of associated publications and abstracts, see the *IBM 1401 and 1460 Bibliography*, A24-1495.

Fourth Edition

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Significant changes or additions to the specifications contained in this publication will be reported in subsequent revisions or Technical Newsletters.

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FARGO, Fourteen-O-One Automatic Report Generating Operation, is a report generator that requires no expert knowledge of programming techniques. It is easy to learn and apply. Developed for the IBM 1401 Data Processing System, FARGO may be quickly adapted to many types of listed reports or group-printed reports now prepared with unit-record equipment on blank paper or on preprinted forms.

In addition to providing the program for processing the input detail-data cards, FARGO provides for printing one title line, including page number, on each page of the report. It also provides for printing two lines of field headings used to designate the various columns of the report. The printing of this information, normally required when preparing reports on blank paper, is controlled by the carriage tape. One advantage of FARGO is that any number of different reports may be prepared in a continuous mode, provided the reports are prepared on blank paper and that the carriage-tape specifications are standardized for all the reports.

Requirements of the report, such as title and field headings, detail and/or total printing, carriage spacing, skipping, ejecting, etc., are first laid out on an IBM 1403 Printer Spacing Chart. The report specifications are then recorded on specially-designed FARGO con-

trol card coding-sheets (Phases 1, 2, 3 and 4). Control cards for each of the four phases are then punched on standard 5081-type cards. These are inserted behind their respective FARGO condensed-program decks, and all precede the detail data cards to be processed. The file is then loaded into the 1402 file feed. The operation is started by pressing the load key. The 1401 loads each phase of the FARGO program, and generates the program steps from the control cards that follow each phase.

In approximately 20 seconds, report printing is started. It continues without interruption until the report is finished. This procedure is graphically illustrated in Figure 1. If several reports are to be run consecutively, a separator card containing a lozenge (□, 12-4-8) punch in card column one is placed behind the last detail data card for each report. This branches the generated program into the last card routine, ejects to the first printing line of the next form, and immediately begins reading-in the next program deck.

FARGO is designed primarily for IBM 1401 card systems having a minimum of 4,000 positions of core storage, and parallels the 407 approach to report preparation. It is a *load-and-go* system with no intermediate operations such as *symbolic assembly*.

General Description

Following is a list of operations that can be performed under FARGO control.

Print one full line (132 positions) of *Report Heading* on the first line of each page of the report (carriage-tape channel-1, including page numbers).

Skip to carriage-tape channel-2 and print a maximum of two full lines of columnar- or field-headings on each page of the report.

Skip to the body line of the report (carriage-tape channel-3).

List or group-print the body of the report.

Control on a maximum of four fields anywhere in the detailed data cards regardless of length.

Group-indicate a maximum of four fields on the first line of each minor control group.

Distinguish a maximum of 10 different types of detail cards and print results in the appropriate columns of the report. Each code used to identify a given type of card may be punched in the same column of the detail card, or a separate column may be used to identify each type up to a maximum of 10. If more than one card-column must be tested to identify a given type of card (multiple column type), a *patching* routine is generally required. Special provisions have been made within the FARGO program for accomplishing this type of patching. (See *Patching*.) However, two columns may be tested without patching if, as is frequently the case, a type of card is identified by a digit (1-9) in one column and a zone (usually an X) in another column. Example: 3 in column 6, X in column 80. (See Figure 25.)

Add, subtract, multiply, and divide detail data or totals.

Accumulate and print totals (with or without summary punching) for each control level, plus final totals at the end of the report. Minor totals are *rolled* into intermediate totals, intermediate totals into major, etc.

Space before or after printing, or skip to predetermined total-lines (carriage-tape channels 4 to 9).

Crossfoot detail data or totals, print the results on desired total levels, and print progressive totals wherever desired.

Print totals horizontally or vertically for each total level on as many lines as desired.

Print multiple lines from one card (MLP).

Print reports on preprinted forms, including inverted forms with MLP printing. In such cases, specifications for report and field headings are not required.

Card count by types of cards and print card count totals on desired total levels.

Overflow or eject from form to form.

Print any number of different types of reports consecutively, provided that reports are prepared on continuous blank paper and that the carriage-tape specifications are standardized for all the reports.

Report Specifications

In developing report specifications, the first step is to lay out the report on an IBM 1403 Printer Spacing Chart (step 1 in Figure 1). This establishes the positions at which the various data will be printed and indicates the spacing or skipping between lines of printing. This step is always required for new reports but may not be necessary for existing reports, that is, reports that have been prepared previously with the 407. In such cases, the same spacing chart used in laying out the report for the 407 can be used with the FARGO system. If minor modifications are made in the conversion of the report from the 407 to the 1401 because of the greater printing capacity, a new layout using the 1403 printer spacing chart is necessary. Once the report layout is completed and the operations to be performed are clearly indicated, the next step (step 2 in Figure 1) is to record the specifications on FARGO coding sheets.

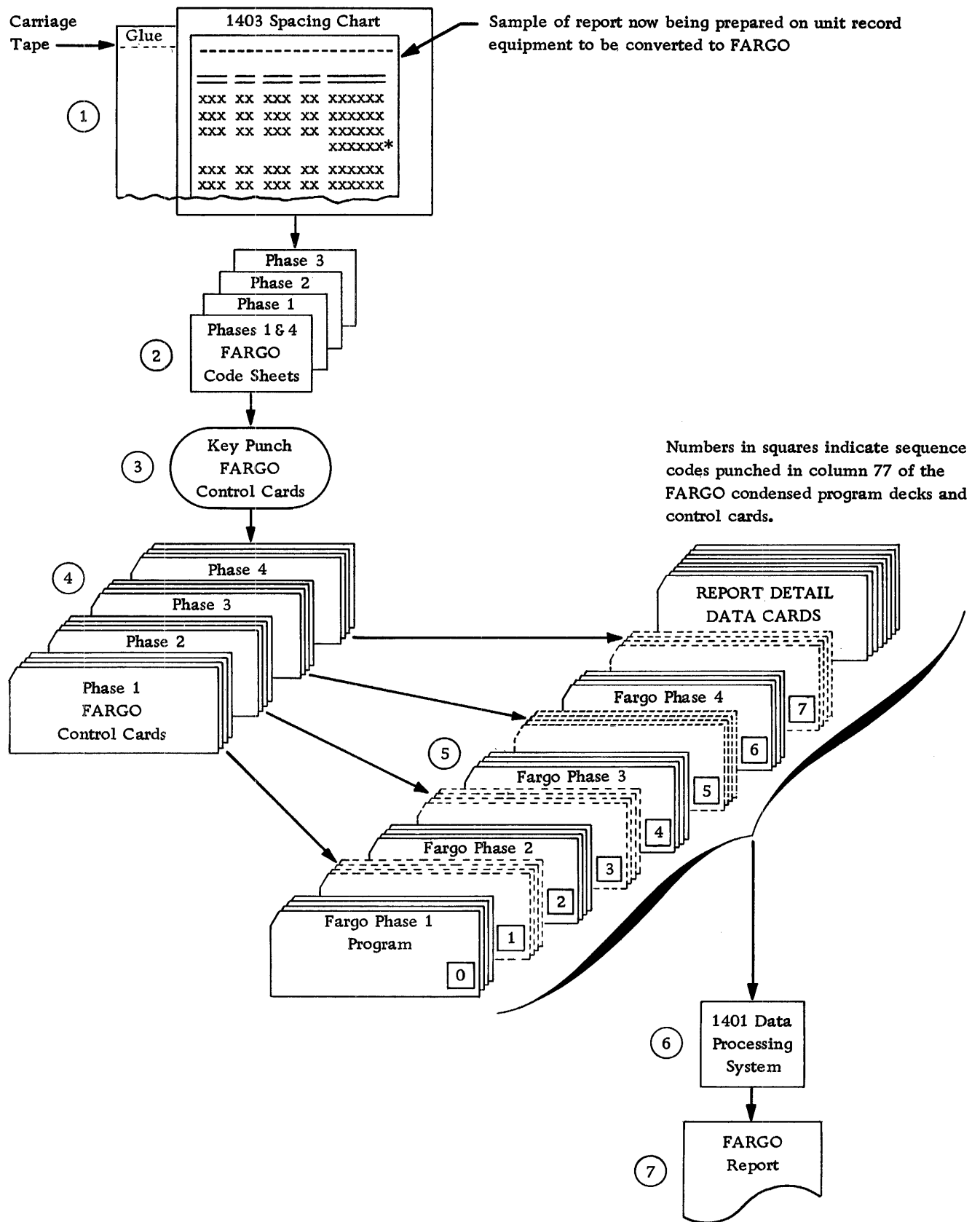


Figure 1. FARGO—Basic Steps

Coding Sheets

Coding sheets (Figure 2) are designed to facilitate the recording of specifications in the FARGO language, following a few simple rules. The statements used to supply the information are based on the logic of the 407. Thus, any person with sufficient knowledge to develop IBM 407 specifications for a given report can learn and apply the FARGO language with very little training.

The areas on the coding sheets labeled *Report*, *Programmed By*, *Page Nos.*, and *Date* are for the convenience of the programmer, but are not punched in the FARGO control cards. If the programmer assigns a number to the program for identification purposes, the number is entered in the area labeled *Program Identification*, 73-76. This number is later punched in each FARGO control card.

Each line of the coding sheets is identified by a pre-printed sequence number in columns 77-80. These sequence numbers should be punched in the control cards. When the control cards for the four phases are properly inserted behind their respective FARGO condensed-program decks, the sequence numbers must be in ascending order as shown here.

Phase	Cards	No. of Cards	Sequence Numbers
1	Condensed Program Deck	50	0001-0050
1	Control Cards	variable	1000-1xxx
2	Condensed Program Deck	32	2000-2031
2	Control Cards	variable	3010-3xxx
3	Condensed Program Deck	33	4000-4032
3	Control Cards	variable	5010-5xxx
4	Condensed Program Deck	12	6000-6011
4	Control Cards	variable	7001-70xx

The coding sheets for the four phases are described in the order in which they are normally filled out.

FORM NO. x24-6556

Phase 4 — Report-Heading Control Cards (two cards maximum).

Field-Headings Control Cards (four cards maximum).

Phase 1 — Master-Report Control Card (one card maximum).

Control-Break Control Cards (four cards maximum).

FORM NO. x24-6557

Phase 1 — Constants Control Cards (50 cards maximum).

FORM NO. x24-6559

Phase 3 — Detail Control Cards (variable)

FORM NO. x24-6558

Phase 2 — Total Control Cards (variable)

Phase 4 (Form No. X24-6556)

Report-Heading Control Cards

Two report-heading control cards (sequence numbers 7001 and 7002) provide a maximum of 132 positions of report-heading information that may be printed at the top of each page of the report (carriage-tape channel-1). Report-heading specifications are entered in columns 1-68 as follows:

Card Columns	Control Data
1	H - Report-Heading Control Card.
2	1 - First card. 2 - Second card.
3-68	Enter report-heading information (66 characters maximum for each card). Card 1 prints in positions 1-66, Card 2 prints in positions 67-132.

RULE: If a report heading is required, two cards always must be punched, and H1 control card must precede H2 control card. Depending on the length of the report heading and the print positions selected, either H1 or H2 control card may be blank in columns 3-68. The report heading may include the word PAGE anywhere on the line if page numbering is specified.

If a report heading is not required (preprinted forms), these two control cards are omitted.

Field-Headings Control Cards

Four field-headings control cards (sequence numbers 7011-7014) provide two full 132 positions for field-heading information that may be printed on each page of the report following the report heading (carriage-tape channel-2). Field-headings specifications are entered in columns 1-68 as follows:

Card Columns	Control Data
1	F - Field-Heading Control Card.
2	1 - First Card. 2 - Second Card. 3 - Third Card. 4 - Fourth Card.
3-68	Enter field-heading information (66 characters maximum for each card). Cards 1 and 2 print first line of field headings: Card 1 - print positions 1-66. Card 2 - print positions 67-132. Cards 3 and 4 print second line of field headings: Card 3 - print positions 1-66. Card 4 - print positions 67-132.

RULE: If field headings are required, these four cards must enter the machine in ascending sequence. If not required (preprinted forms), they are omitted.

RULE: Whether or not report and/or field headings are specified, a blank card punched with the # (3-8) symbol in column 1 *must* be the last card in the combined program deck. In other words, it always *precedes* the first detail data card. This signals the end of FARGO program loading and the beginning of detail card processing.

Figure 2. FARGO Coding Sheets

Phase 1 (Form No. X24-6556)

Master-Report Control Card

This card (sequence number 1000), always punched *M* in column 1, specifies:

1. type of report (list or group-print).
2. page overflow, if desired.
3. page numbering, if desired.
4. positions selected to print the page number anywhere on the report-heading line.
5. data to be group-indicated on the first line of each minor control group of a *listed report only*.

The control data is entered in the various columns of the coding sheet as shown here.

Card Columns	Control Data
1	M - Master-Report Control Card.
2	L - List; Blank - Group Print.
3	O (alpha) - Page overflow to carriage-tape channel-1. Blank - No page overflow.
4	P - Page numbering if desired. Blank - No page numbering.
5-7 (from) 8-10 (to)	IBM 1403 print positions selected for printing page number on report-heading line. (<i>From</i> indicates the left-hand or high-order print position while <i>to</i> indicates the right-hand or units print position.)
11	First field to be group indicated. M - Move Z - Move and suppress zeros.
12-14 (from) 15-17 (to)	Location of data in detail card to be group-indicated. (<i>From</i> indicates the left-hand or high-order card column, while <i>to</i> indicates the right-hand or units card column.)
18-20 (from) 21-23 (to)	IBM 1403 print positions selected for printing first group-indicated field.
24-36	Second field to be group-indicated. Same format as Field 1.
37-49	Third field to be group-indicated. Same format as Field 1.
50-62	Fourth field to be group-indicated. Same format as Field 1.

RULE: The master-report control card is always punched, even though it might be blank except for the *M* in column 1 and the sequence number (1000) in columns 77-80.

Control-Break Control Cards

These cards (sequence numbers 1001-1004) always punched *B* in column 1, specify the four control levels and define the card columns in which the control fields are punched in the detail cards. For a simple listed report with no controls, these cards are omitted. When controls are required, the specifications are recorded in columns 1-8 as follows.

Card Columns	Code	Control Data
1	B	Control-break control card.
2	1	First-level control (minor).
	2	Second-level control (intermediate).
	3	Third-level control (major).
	4	Fourth-level control.
3-5 (from) 6-8 (to)		Location of control field.

Split-Control Fields

Normally, information in a given level control, identified by a single card-field heading, is punched in consecutive columns of the card. In some cases, the information may be punched in more than one card field but still in consecutive columns of the card. The various card fields involved may be treated as one-level control merely by specifying the level desired (1, 2, 3, or 4), and the high-order position of the left-most field (*from*) and the low-order position of the right-most field (*to*).

When a given level control (for example, *minor*) is split, that is, represented by two card fields that are not adjacent, one field is specified as *minor* (code 1) and the other field as *intermediate* (code 2). Because an intermediate control-break forces a minor total-level, all the total operations are specified in T1 (minor level) control cards in Phase 2. A single T2 (intermediate level) control card, coded SPS in columns 52-54, follows. However, no total operations are specified on the intermediate level. For each *extra B-control card* required in Phase 1, one total level is sacrificed in Phase 2.

Phase 1 (Form No. X24-6557)

Constants Control Cards

These cards, punched *C* or *S* in column 1, define the length of each constant word, the label used in the program when referring to the constant, and the characters that compose the constant word, with or without a word mark. Constant areas of core storage used to accumulate totals must be given a label. A maximum of 50 constants control cards may be used. Any combination of characters except *PGE* may be used as a label. The reason *PGE* cannot be used is that a 4-position constant area is reserved by the program to permit addressing the page number counter. If page numbering is not required, the counter may be used for other purposes in the program, in which case the counter must be referred to by the *PGE* label.

Because the number of constants control cards may vary from report to report, complete sequence numbers are not preprinted on the form. Only the hundreds position (column 78) need be entered, using 0 for the first 9 lines, then 1's, 2's, etc., as required to establish sequence. If more than one sheet is needed, skip the first line (sequence no. 1010) on all overflow sheets and continue numbering with the second line (1x20). The same numbering scheme applies to sequence numbers for *Total* and *Detail Control Cards* recorded on other forms.

Specifications for constants are recorded in columns 1-72 as follows.

Card Columns	Control Data
1	<i>C</i> - Constant with a word mark. <i>S</i> - Special constant without a word mark.
2-3	Number of positions in the constant word, including blanks.
4-6	Label assigned to identify the constant word when referring to it in the program.
7-72	Composition of the constant word (66 characters maximum). Blank positions are considered characters.

Phase 3 (Form No. X24-6559)

Detail Control Cards

These cards, always punched *D* in column 1, specify the various operations to be performed for each type of detail card as follows.

1. Recognize type of card upon which operations specified in the same card are to be performed.
2. Move digits or zones from a single column of the detail card.
3. Transfer constant words to print/punch areas.
4. Transfer data from detail card to print/punch areas.
5. Perform arithmetic operations on detail-card data.
6. Print multiple lines from a single card.
7. After printing a detail line, skip to a carriage-tape channel, or space 1, 2, or 3 lines.

Detail-control-card specifications are recorded in columns 1 to 72 as follows.

Card Columns	Control Data
1	<i>D</i> - Detail Control Card.
2-6	If only one type of detail card, leave columns 2-6 blank. If more than one type (maximum 10), enter information in columns 2-6 as specified in the following rule.

RULE: For operations that are to be performed on all detail cards regardless of type, leave column 2 blank and enter *ALL* in columns 3-5. On the last *ALL* control card, also enter an asterisk (*) (11-4-8) in column 2. *ALL* control cards *must precede* all other control cards punched *D* in column 1.

For operations that are to be performed on specific types of detail cards, enter in column 2 the type code, in columns 3-5 the column in the detail card that contains the type code, and in column 6 *C* for a character test or *Z* for a zone test. The *C* and *Z* codes in column 6 control the method to be used for determining the type of card indicated in column 2.

Applications of this rule are illustrated in the following examples.

For detail cards where no operation is to be performed, columns 1-6 of the detail control card must always be punched.

Applications of this rule are illustrated in the following examples.

Control Card Columns		Result	Card Columns	Control Data
1	2 345 6			
D	ALL)	Operations specified in these control cards are performed on all cards regardless of type.	15-17 (from)	Enter the detail card column that contains the digit or zone to be moved.
D	ALL)		18-20 (to)	Enter the card column to which the digit or zone is to be moved.
D	ALL)			
D *	ALL)			
D -	080 C	Character test. Operations specified in this control card are performed on cards containing only an X (11-punch) in column 80.		Control-card columns 14 through 20 are used primarily to move <i>credit X-punches</i> from some position of the data card to the units position of an amount field that is to be accumulated or edited. If the position from which the X was moved must be cleared, another control card may be used to move a blank zone into the position from which the X was moved.
D -	080 Z	Zone test. Operations specified in this control card are performed on cards containing an X in column 80. This includes characters in the 11-zone (J to R).		
D &	080 C	Character test. Operations specified in this control card are performed on cards containing only a 12-punch in column 80.	21	
D &	080 Z	Zone test. Operations specified in this control card are performed on cards containing a 12-punch in column 80. This includes characters in the 12-zone (A to I).		
D 6	080 C	Character test. Operations specified in this control card are performed on cards containing a 6-punch in column 80.	22-24	Enter the label assigned to the constant to be transferred to the print or punch areas.
D 6	080 Z	No-Zone test. Operations specified in this control card are performed on cards containing no-zone punches (0, 11, 12) in column 80. For this type of test, any digit from 1 through 9 can be used in column 2 of the control card.	25-27 (from) 28-30 (to)	Print positions selected to print the constant data.
D Z	080 C	Character test. Operations specified in this control card are performed on cards containing the letter Z (0-9) in column 80.	31-33 (from) 34-36 (to)	Summary-card columns selected to punch the constant data.
D Z	080 Z	Zero-Zone test. Operations specified in this control card are performed on cards containing a zero-zone punch. This includes special character (/) and letters S to Z. For this type of test, any of the characters mentioned can be used in column 2 of the control card.	37	E - Edit detail data. M - Move detail data. Z - Move and suppress zeros from detail data. D - Move digit. Y - Move zone.
D	080 C	Blank-column test. Operations specified in this control card are performed on cards that are blank in column 80.	38-40 (***)from 41-43 (to)	Location of field to be transferred. ***NOTE: To conserve on 1401 core storage, subsequent references to the same field in the same card types may be made by inserting asterisks in columns 38-40. This also applies to columns 57-59.
D	080 Z	No-Zone test. Operations specified in this control card are performed on cards containing no-zone punches (0, 11, 12) in column 80. This test can be used to differentiate between an X80 or NX80 condition.	44-46 (from) 47-49 (to)	Print positions selected to print detail data.
			50-52 (from) 53-55 (to)	Summary-card columns selected to punch detail data.
			56	A - Add. S - Subtract. @ - Multiply (4-8 punch). % - Divide (0-4-8 punch). ? - Zero and Add (12-0 punch). ! - Zero and Subtract (11-0 punch). D - Move digit. Y - Move zone. M - Move. Z - Move and suppress zeros.
Card Columns	Control Data		57-59 (***)from 60-62 (to)	Location of field upon which operations coded in column 56 are to be performed.
7-13	Special 4- or 7-position instructions coded in actual IBM 1401 machine language, to be executed for specific types of cards, can be inserted in these columns. Instructions can also be used to branch to patching subroutines written in actual machine language. The specific patch point in the program must be determined by the programmer. Instructions for inserting patching subroutines are given under <i>Patching</i> .		63-65	Label assigned to constant upon which operations coded in column 56 are to be performed.
14	D - Move digit. Y - Move zone.		66-68	Label of core-storage positions to be used as accumulator, multiplier-product, or quotient-dividend-remainder.

*Card
Columns*

Control Data

- 69 P - Print. Primarily used for MLP printing. A control card is required for each MLP line to be printed from the same type of card. Coding in column 69 is required for all MLP lines except the last. Printing the last line of an MLP card is automatic. All lines printed from an MLP card are single-spaced.
- 70-71 SP - Space after printing a detail line.
SK - Skip after printing a detail line.
- 72 1-3 - Single-, double-, or triple-space after printing.
4-9 - Skip to corresponding carriage tape channels.
In a listed report, skipping or spacing indicated in columns 70-72 takes place after printing of the detail line for the particular type of card specified in column 2.
In a group-printed report, skipping or spacing indicated in columns 70-72 causes no carriage operation. In such cases, skipping and spacing is controlled with T (Total) control cards entered in Phase 2.

RULE: When several control cards are entered for the same type of detail card, a skip or space instruction must be entered in the *last control card of each type*.

RULE: For printing and punching the same detail data, two separate control cards are required: one to move data to print positions, the other to move data to punch positions. This rule must be observed when entering data in control card columns 22-36 and 38-55.

Phase 2 (Form No. X24-6558)

Total Control Cards

These cards, always punched *T* in column 1, specify the various operations to be performed for each *class of total* or each *total within the same class*. Operations include:

1. Skip to a carriage tape channel, space before and/or after total printing, or eject from form to form.
2. Add one total-level accumulator to a higher-level accumulator. Subtract one total-level accumulator from a higher-level accumulator. Multiply or divide one total by another on the same level.
3. Crossfoot totals on any total level desired.
4. Load or move constant data to the printer output area.
5. Move, move and suppress zeros, or edit accumulated totals to the print or punch areas.
6. Move digits or zones from a single storage position. For example, remove or add a sign to the units position of a total.
7. Clear accumulators.
8. Print constants on total levels to identify totals.
9. Print totals on total lines.

10. Print multiple lines of information read from a single card in Phase 3.

11. Punch summary cards.

Several totals within the same class, designated by field headings, may be printed horizontally on the same line, each under its appropriate column of the report. Or, they may be identified by constants and printed vertically on separate lines in the same column of the report. Examples:

Horizontal Method

Gross Earnings	Withholding Tax	F.I.C.A.	Other Deductions	Net Pay
150.00	27.00	5.44	10.00	107.56

Vertical Method

Gross Earnings	150.00
Less WHTax	27.00
F.I.C.A.	5.44
Other	10.00
Net Pay	107.56*

Similarly, different classes of totals may be printed horizontally under designated report columns or vertically in the same report column.

Total-control-card specifications are recorded in columns 1 to 56 as follows.

*Card
Columns*

Control Data

- 1 T - Total control card.
- 2 1 - Minor-total level.
2 - Intermediate-total level.
3 - Major-total level.
4 - Fourth-total level.
5 - Fifth- (final) total level. (Occurs on last card runoff with Sense Switch A turned ON.)
- 3-4 SP - Space before total printing.
SK - Skip before total printing.
- 5 Enter 1-3 to space number of times designated.
Enter 4-9 to skip to corresponding carriage tape channels.
NOTE: Because normal single spacing is automatic, leave columns 3-5 blank if normal spacing is desired.
- 6 A - Add.
S - Subtract.
@ - Multiply (4-8 punch).
% - Divide (0-4-8 punch).
M - Move.
- 7-9 (from) Label of accumulator read out of.
- 10-12 (to) Label of accumulator read into.
- 13 L - Load edit control word.
M - Move constant data.
Z - Move and suppress zeros.
- 14-16 Label assigned to constant being moved or loaded.
- 17-19 (from) Print positions selected to print constant data.
20-22 (to)
- 23 E - Edit total or constant data.
M - Move total or constant data.
Z - Move and suppress zeros from total or constant.

<i>Card Columns</i>	<i>Control Data</i>
24-26	Label assigned to accumulator or constant.
27-29 (from) 30-32 (to)	Print positions selected to print total or constant data addressed by the label coded in columns 24-26 of the same control card.
33-35 (from) 36-38 (to)	Summary-card columns selected to punch total or constant data addressed by the label coded in columns 24-26 of the same control card.
<p>RULE: For printing and punching from the same accumulator, two separate control cards are required. One moves data to print positions, and the other moves data to punch positions.</p>	
39	<p>D - Move digit (only) portion of a character from one card column to another in punch area.</p> <p>Y - Move zone (only).</p>
40-42	Summary-card column from which digit or zone is to be moved.
43-45	Summary-card column to which digit or zone is to be moved.
46	S - Clear accumulator by subtracting it from itself.
47-49	Label assigned to accumulator to be cleared.
<p>NOTE: When both printing and punching from the same accumulator, clear accumulator on the second control card, after information has been transferred to the print and punch areas.</p>	
50	P - Print total line. All totals within the same level may be printed on one line or on separate lines.
51	P - Punch total summary card. All totals within the same level may be punched in one card or in separate summary cards.
52-53	<p>SP - Space after total printing.</p> <p>SK - Skip after total printing.</p>

<i>Card Columns</i>	<i>Control Data</i>
54	<p>Enter S to single space.</p> <p>Enter 1-3 to obtain additional spaces beyond the normal single space (1 for double space, 2 for triple space, 3 for quadruple space).</p> <p>Enter 1-9 to skip to corresponding carriage tape channels.</p>
<p>NOTE: When skipping to carriage-tape channel-1 after total printing, report and field headings do not print.</p>	
<p>RULE: When several totals within the same level are printed on separate lines, the last T (Total) control card for each total level must contain a Skip, Space, or Eject instruction. If normal single spacing is desired, the last control card must be coded SPS in columns 52-54.</p>	
55	E - Eject form to carriage-tape channel-1 after total printing. Report and field headings will print on the next page following the eject.
56	* - The last T control card specified in Phase 2 (Form No. X24-6558) must contain an asterisk (*) punch in column 56.
<p>RULE: When four control levels are specified in the problem, final-total operations are specified on level 5. When less than four control levels are specified, final-total operations are specified on the next higher level. Examples:</p> <p>No controls, final-total operations are specified on level 1.</p> <p>Minor control only (level 1), final-total operations are specified on level 2.</p> <p>Minor and intermediate controls (levels 1 and 2, respectively), final-total operations are specified on level 3.</p> <p>Minor, intermediate and major controls (levels 1, 2 and 3, respectively), final-total operations are specified on level 4.</p> <p>For all the conditions mentioned in these examples, the last final-total control card must contain an asterisk (*) punch in column 56.</p> <p>If Final Totals are not required, a last-card-runout total-card for level 1, 2, 3, 4 or 5 must contain an asterisk in column 56.</p> <p>The level is always one higher than the number of control levels specified in the problem.</p>	

Automatic-Carriage-Control Operation

Page overflow is controlled by the letter O in column 3 of the master-report control card — Phase 1. Ejecting from form to form (carriage-tape channels 12 to 1), and skipping to carriage-tape channels 2 and 3, occur automatically as shown in Figure 3, depending on the presence or absence of report- and field-headings control cards — Phase 4.

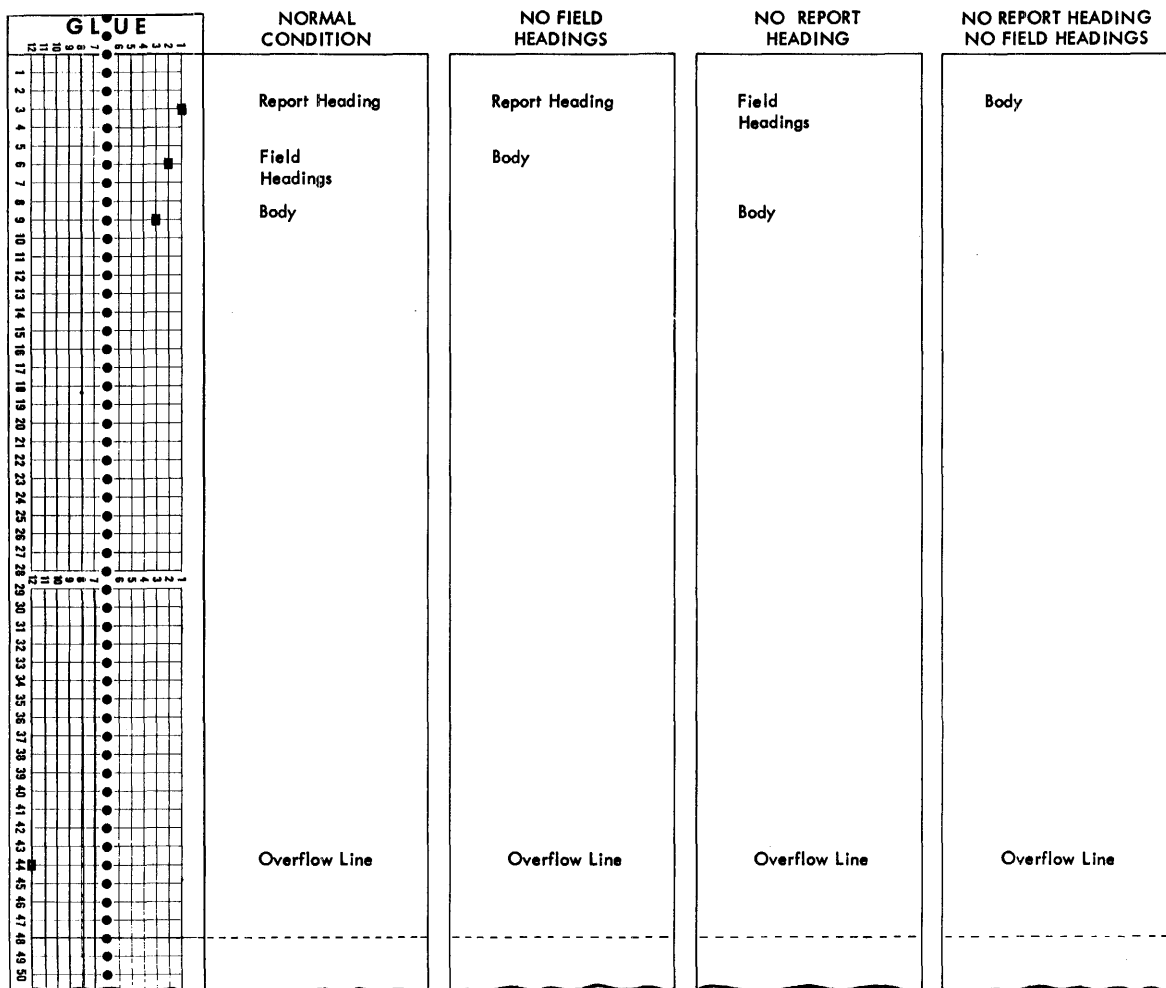


Figure 3. Automatic-Carriage-Control Operation

Operating Instructions

To prepare reports with FARGO, proceed as follows:

1. Ready the IBM 1403 Printer.
 - a. Insert into the carriage the paper or form on which the report is to be printed. Make the necessary vertical and horizontal adjustments to properly position the form.
 - b. Insert the carriage tape punched as follows.

Normal Condition

- Channel 1 - Report-heading line.
- Channel 2 - First field-heading line.
- Channel 3 - First body line.
- Channels 4-9, if required. Skip-stops for pre-determined line printing.
- Channel 12 - Overflow line.

NOTE: For conditions other than normal, channels 2 and/or 3 may not be required. (See Figure 3.)

- c. Set feed-clutch knob to *neutral* position.
 - d. Press carriage-restore key.
 - e. Turn feed-clutch knob back to *drive* position.
 - f. Press check-reset key on the 1403 printer.
2. Ready the 1401 Console.
 - a. Set mode switch to *run* position.
 - b. Set I/O check-stop switch to the ON (up) position.
 - c. Set sense switch A to the ON (up) position.
 - d. Press check-reset key on the 1401 console.
 - e. Press the start-reset key on the 1401 console.
 3. Ready the 1402 read-punch unit.
 - a. Set reader switch to ON.
 - b. Press the non-process runout read key to clear the read feed.
 - c. Place FARGO program and detail cards in the 1402 read unit in the sequence illustrated in Figures 1 or 6.
 - d. If summary punching, set punch switch to the ON position.
 1. Press the non-process runout punch key to clear the punch feed.
 2. Place cards to be summary punched in the punch hopper.
 - e. Press check-reset key on the 1402 read-punch unit.
 - f. Press load key on the 1402 read-punch unit.
- If the control cards punched from the FARGO coding sheets contain no errors, the program is loaded in approximately 20 seconds. Processing of detail data cards is started immediately thereafter. When the last card has left the hopper and the machine stops, press the start key on the 1402. If specified in the program, final totals print automatically on the runout.

Program Halts

Program halts may occur not only during the loading of the FARGO program deck (Phases 1 to 4) but also during processing of the detail cards. Halts occurring during Phases 1 to 4 indicate that the control cards punched from the coding sheets are not in the proper sequence as shown in Figure 1. Or, if they are in the proper sequence, invalid codes are punched in column 1 of the control cards. Valid codes are *M*, *B*, *C*, *S*, *T*, *D*, *H*, *F*, or *#*. Codes other than these are invalid.

Following is a list of program halts, reason for halt, and procedure for restarting. When the halt occurs, the last card in the read stacker (NR) has an invalid code in column 1.

Storage Address Displayed	Phase	Reason for Halt
2639	1	Card has other than <i>M</i> .
2947	1	Card has other than <i>B</i> , <i>C</i> , or <i>S</i> .
2363	2	Card has other than <i>T</i> .
2379	3	Card has other than <i>D</i> .
3090	4	Card has other than <i>H</i> , <i>F</i> , or <i>#</i> .

To restart from any of these halts, proceed as follows.

1. Remove cards from read hopper.
 2. Press non-process runout read key.
 3. Remove the last three cards from the read stacker (NR). The first of these three cards is the control card in error.
 4. Correct the error.
 5. Replace the three cards in front of the cards taken from the read hopper.
 6. Place the card file in the read hopper.
 7. Press check reset key on the 1402.
- CAUTION: Do not press the start reset key on the 1401 console.
8. Press start key on the 1402 read unit.

During processing of detail cards, if the machine stops with the red Stop Light ON (1401 Console) and storage address 0157 displayed, a constants label has been referred to in one of the *T* or *D* control cards for which there is no corresponding constants control card. This may be due to misspelling the 3-character label abbreviation on the *T* or *D* control card. Or, it may be that constants control card was inadvertently omitted in the constants coding sheet. To restart, proceed as follows.

1. Remove all cards from read hopper and file feed.
2. Press non-process runout read key on the 1402.
3. Locate erroneous control card, make corrections, and restart from the beginning.

If the machine stops with the red Stop Light on and storage address 3547 displayed, the last card in the stacker is a type of card for which no entry was made on the Phase 3 code sheet.

During processing of detail cards, the program may hang up at an unknown address with the following lights ON:

PROCESS
CHECK RESET
A- OR I-ADDRESS REGISTER.

The A-Address Register Light means that an edit control word entered in the constants coding sheet is too small for the data being edited. The I-Address Register Light means that a 1401 operation code represented by an invalid character is detected in storage.

To locate the edit control word that is too small for the data being edited, execute a STORAGE PRINT-OUT as follows.

1. Set mode switch to STORAGE PRINT-OUT.
2. Press I-address register key and note address location displayed.
3. Turn hundreds and thousands manual-address switches to digits corresponding to the hundreds and thousands positions displayed.
4. Press start key on the 1401 console.
5. Examine the storage print-out and find the I-address displayed in Step 2.
6. Go back from there to the first load (L) instruction. The A-operand of this instruction contains the storage address of the edit control word that is too small.
7. Locate constants control card, make corrections, and restart from the beginning.

To locate and correct an invalid character used as an operation code execute a STORAGE SCAN as follows.

1. Set mode switch to STORAGE SCAN.
2. Set manual-address switches to 0000.
3. Hold down the start key.
4. Machine stops when an invalid character is detected in storage. The storage position in error is shown in the storage-address display unit. The B-register displays the contents of the storage position in which the error is detected.

5. Locate the control card in which the invalid character is punched and remove it from the program deck.
6. Correct the error by punching a new control card and inserting it in the program deck.
7. To restart, a complete card runout and start reset is necessary.

Patching

The term *patching* as used in connection with FARGO, means *linking a special subroutine or library program to the main FARGO program*. The linkage is accomplished by branching from a specific patch point in Phase 3 (detail control cards) or Phase 2 (total control cards) to the patch subroutine, then branching back to the main FARGO program, after the subroutine is executed.

With a 4k machine, at least 956 storage positions are available for storing patch subroutines. In some cases, depending upon the complexity of the report involved, more storage positions may be available. These subroutines must be entered into the machine in actual 1401 machine language. Therefore, a knowledge of 1401 programming or symbolic programming (SPS) is a prerequisite.

The specific patch point(s) for linking subroutines is determined by the programmer as he normally writes the FARGO instructions. These patch points are first recorded on Phase 3 and Phase 2 coding sheets as 4- or 7-position no-op instructions. They are changed later to unconditional branch instructions after the exact locations of the patch subroutines are determined.

Phase 3 — Detail No-Op Control Cards

At each point in Phase 3 where branching to subroutines is required, make an entry on the coding sheet in columns 1, 2-6, and 7-10 as shown in Figure 4.

DETAIL CONTROL CARDS — PHASE 3																																							
D	Type of Detail Card			Special 4 or 7 position 1401 Instruction (actual)							Column Split		E = Edit L = Load Edit Control Word M = Move Constant Data Z = Move and Suppress Zeros D = Move Digit Y = Move Zone										E = Edit DETAIL CARD DATA M = Move Z = Move and Suppress Zeros D = Move Digit Y = Move Zone																
													D = Move Digit Y = Move Zone		Label		Print Positions		Punch Positions		Data Card Columns		Print Positions		Punch Positions														
	C = Char. Z = Zone	C	O	P	A	B	From	To	From	From	To	From	To	From	To	From	To	From	To	From	To																		
	Code	Card Cols.	Z	C	O	P	A	B	From	To	From	From	To	From	To	From	To	From	To	From	To																		
1	2	3	5	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	27	28	30	31	33	34	36	37	38	40	41	43	44	46	47	49	50	52	53	5	
D	X	X	X	X	X	N	O	O	O																														
D																																							

Figure 4

Phase 2 – Total No-Op Control Cards

The *T* in column 1 is preprinted on the form and indicates that branching to the patch subroutine is to occur during the *total* portion of the program. Any digit from 1 to 5 entered in column 2 specifies the program level during which the patch subroutine is to be executed. The entry N788788 in columns 39-45 is the no-op instruction. This must be changed later by an instruction in the patch subroutine to an unconditional branch instruction (Bxxxxbbb), with xxx indicating the actual machine address of the patch subroutine and bbb indicating blanks.

The FARGO program, including the no-op control cards that cause no machine operation, is completely tested with a representative deck of detail data cards and approved before the subroutines are inserted into the program deck. This is necessary because any change in the FARGO control cards after the subroutines are inserted affects the storage locations of the

After the FARGO-generated portion of the report is satisfactorily tested, execute a STORAGE PRINT-OUT and examine it to determine:

1. the end of the FARGO-generated program.
2. storage location of patch points (no-op detail and total control cards).

The end of the generated program is determined by locating the report-heading information that is loaded into storage immediately after the last instruction from the detail control cards. If report-heading information is not specified in Phase 4, the end of the generated program is the last BE66 instruction. This instruction appears following the last generated instruction for each type of detail card specified in Phase 3. Therefore, the end of the generated program is either the last position of the report-heading information (including blanks), or the last BE66 instruction. The area available for storing the patch subroutines extends from this point (storage location 2358 or lower, depending upon the complexity of the report involved) to 3313. Thus, with a 4k machine, 956 storage positions or more are available for patch subroutines. Obviously, with machines of greater capacity, an additional amount of storage is available, starting with location 4000.

The storage location of each patch point is determined by visually scanning the storage print-out and finding the no-op instructions. Detail no-op instructions are identified by N000. Total no-op instructions are identified by N888888. N888888 was recorded on the coding sheet as N788788 but changed by the FARGO program to N888888.

[illegible]

Figure 5

Converting No-Op Instructions

The control card containing the detail no-op instruction (N000) may be removed from the FARGO deck and replaced with a control card containing an unconditional branch instruction Bxxx. Or, it may remain in the deck in which case the no-op instruction must be converted to an unconditional branch instruction Bxxx by an instruction in the patch subroutine.

The control card containing the total no-op instruction (N788788) always remains in the FARGO deck. The no-op instruction, therefore, must be converted to an unconditional branch instruction Bxxxbbb by an instruction in the patch subroutine.

Coding the Patch Subroutines

As previously stated, a patch subroutine must be entered in storage in actual 1401 machine language. It may be written in symbolic language and assembled with an assembly processor as described in *IBM 1401 Symbolic Programming Systems, Form C24-1480*.

To branch back to the main FARGO routine after the subroutine is executed, the last instruction in each patch subroutine must be an unconditional branch instruction. For example, if a detail (Phase 3) no-op instruction (N000 converted to Bxxx) is in locations 1445-1448 as noted in the storage print-out, the last instruction in the subroutine used at this point must branch back to 1449. If a total (Phase 2) no-op instruction (N888888 converted to Bxxxbbb) is in locations 1201-1207 as noted in the storage print-out, the last instruction in the subroutine used at this point must branch back to location 1208.

If coded in SPS, the program is assembled after testing the FARGO portion of the job so that the origin address of the subroutine can be determined from the storage print-out. When the object program deck is created by the SPS assembly processor, the first two cards contain instructions to clear storage. *These two cards must be removed from the deck.* The rest of the object program deck (one instruction per card) can then be loaded directly behind Phase-4 control cards. Or it can first be condensed into multiple instructions per card with a condensing program as described in *IBM 1401 Symbolic Programming Systems, Form C24-1480*.

An example of a patch subroutine coded in actual machine language is shown in Figure 23-G. Another example of FARGO patching and linkage using SPS is shown in Figure 24.

NOTE:

If the 1401 does not have a Multiply-Divide optional feature, the Multiply-Divide Subroutines discussed in the 1401 Reference Manual can be patched into the FARGO program.

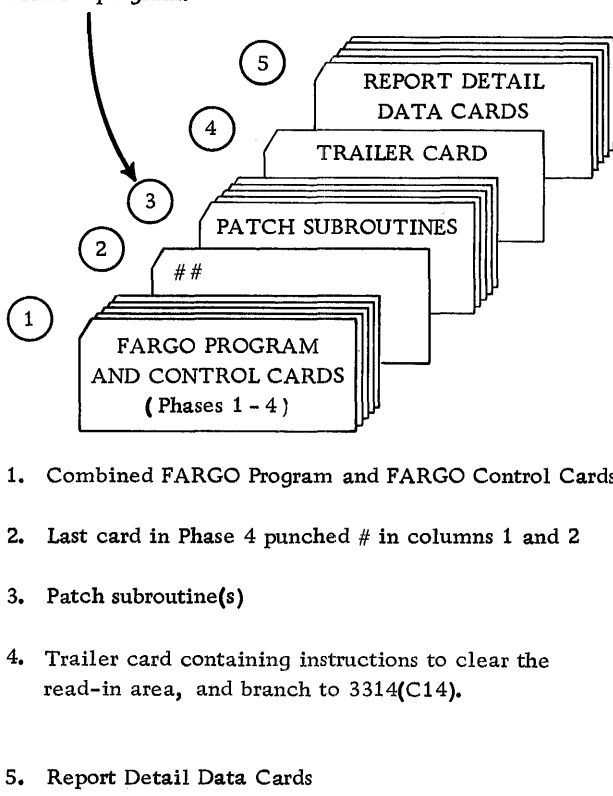


Figure 6. FARGO with Patch Subroutine

Loading the Patch Subroutines

All patch subroutines are loaded immediately after the Phase-4 control cards. Normally, the last Phase-4 control card is punched # in column 1 of a blank card. To signal the FARGO program that patch-subroutine instruction cards are to be read into the system after Phase 4 is completed, this same card must also have a # punched in column 2. This causes the program to clear the read-in area (locations 1-80), set a word mark in location 001, read the next card, and then branch to location 001.

After the last patch subroutine is loaded, a clear-and-branch trailer card must follow to clear the read-in area, and branch to location C14 (3314), this being the starting location of the permanent FARGO program. The report detail cards immediately follow the trailer card.

The cards are run through the machine in the sequence illustrated in Figure 6.

Multiply-Divide Optional Feature

If the multiply-divide optional feature is installed in the 1401, direct multiplication and division can be specified with FARGO detail and/or total (Phases 3 and 2) control cards. Before the proper entries can be made in these coding sheets, however, several factors must be considered.

Multiplication

Whenever FARGO report specifications involve a multiplying operation, the first thing that must be decided is the size of the product to be developed. As explained in the IBM 1401 Data Processing System Reference Manual, A24-1403, this is done by adding 1 to the sum of the number of digits in the multiplier and the multiplicand. Assuming a 3-digit multiplier and a 4-digit multiplicand, the size of the product can then be readily determined by the following formula:

3 (multiplier) plus 4 (multiplicand) plus 1 = 8 (size of product).

The multiplier may be fixed; that is, not punched in the detail cards but set up as a constant with an identifying label in Phase 1 for later reference in

Phases 3 or 2. Or, it may be variable; that is, punched in each detail card or some specific type of card within a control group.

A fixed multiplier (example: 125) may be set up as a constant in one of several ways as shown in Figure 7.

A variable multiplier may be punched in known columns of all or specific types of detail cards.

Multiplicands are always variable and may be punched in known columns of all or specific types of detail cards. Or, they may be developed as a total in an accumulator and identified with an appropriate label. Although any 1-, 2-, or 3-character label may be used to identify an accumulator, many users of FARGO prefer to use labels corresponding to 407 counters; for example, 2A, 2B, etc., 4A, 4B, etc.

Experience has shown that this method of labeling accumulators often simplifies the conversion of report specifications from the 407 to the 1401.

Having determined the size of the product, set up a work area in storage for developing and retrieving the product. This is done by making two successive entries on the constants control cards coding-sheet (Phase 1) as shown in Figure 8.

CONSTANTS CONTROL CARDS — PHASE 1																																									
C or S	No. Pos.		Label	Column 1 C = Constant with a word mark; S = Constant without a word mark Columns 2-3 = Size of Constant Word Columns 4-6 = Label to identify Constant Word Columns 7-72 = Field for punching Constant Word (66 characters maximum)																																					
				1	2	3	4	6	7	10	15	20	25	30	35	40	45	50																							
C	0	3	125	1	2	5																																			
			or																																						
C	0	3	FIX	1	2	5																																			
			or																																						
C	0	3	XXX	1	2	5	(xxx standing for any three characters chosen by the programmer)																																		

Figure 7

CONSTANTS CONTROL CARDS – PHASE 1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
C or S	No. Pos.		Label	Column 1 C = Constant with a word mark; S = Constant without a word mark Columns 2-3 = Size of Constant Word Columns 4-6 = Label to identify Constant Word Columns 7-72 = Field for punching Constant Word (66 characters maximum)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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Figure 8

The second entry, S (constant without a word mark), sets up the five low-order (right-hand) positions of the product work area, thus establishing an 8-position product work area somewhere in storage.

Multiplying with a fixed multiplier (125) can be specified for *all or any specific type of detail card* by making the entries in columns 56-68 as shown in Figure 9.

The first or second entry ? (whichever one is used) zeros (resets) and adds the constant 125 in the three high-order (left-hand) positions of the product area.

Entry @ multiplies the 4-digit multiplicand punched in columns 31-34 of the detail card by the fixed multiplier (125). When the multiplying operation is completed, the product is in the seven low-order positions of the product area, thus destroying the multiplier. The

Following the multiply operation @, another entry moves the product either to print positions and/or to an accumulator identified by a constant label. If the product is to be punctuated, an edit control word is first loaded into the desired print positions. The product is then moved to the same print positions with an *E* (edit) instruction.

Multiplying with a variable multiplier can be specified for *all or any specific type of detail card* by making the entries in columns 56-68 as shown in Figure 10.

Entry ? zeros (resets) and adds the variable 3-digit multiplier punched in columns 21-23 of the detail card into the three high-order (MPR) positions of the product area.

Entry @ multiplies the 4-digit multiplicand punched in columns 31-34 of the detail card by the variable 3-digit multiplier punched in columns 21-23 of the same card. The product is developed in the same manner as previously described.

Figure 9

Figure 10

Multiplying in Phase 2

Multiplying in Phase 2 (total control cards) always involves three labels. One label identifies a fixed- or group-multiplier. A second label identifies an accumulated multiplicand, while a third label identifies the product.

In establishing the size of the product, the same rule applies. However, because the multiplicand factor is an accumulated total, the maximum number of digits *expected* in the multiplicand must be predetermined before setting up a product work area.

Having determined the size of the product, make the appropriate C and S entries on the constants control cards coding-sheet (Phase 1) to set up the product work area.

During the Phase-3 (detail) portion of the program, a fixed multiplier set up with a constant control card, or a group multiplier punched in a specific detail card within the control group, is moved to the MPR portion of the product work area. The detail multiplicands are accumulated in a storage area labeled, for example, MCD. *On any given total level* in Phase 2, multiplication is specified by making the entry in columns 6-12 as shown in Figure 11.

Entry @ multiplies the accumulated multiplicand labeled MCD (or any other label chosen by the programmer) by the fixed- or group-multiplier moved to the MPR portion of the product work area during Phase 3. The product is developed in the product work

area labeled PDT (or any other label chosen by the programmer). For example, in a payroll application, the multiplier might be labeled RTE (rate), the multiplicand HRS (hours), and the product GES (gross earnings). In another application, the multiplier might be labeled UNP (unit price), the multiplicand QTY (quantity), and the product AMT (amount).

Division

Whenever FARGO report specifications involve a dividing operation, a work area for accommodating the dividend and developing the quotient and dividend/remainder must be set up in storage with constants control cards in Phase 1. The size of this work area must be equal to the sum of the number of digits in the divisor and dividend, plus 1. Assuming a 3-digit divisor and a 4-digit dividend, the size of the work area can be readily determined by the following formula:

3 (divisor) plus 4 (dividend) plus 1 = 8-position work area.

Having determined the size of the work area, set up the area in sections to permit addressing specific locations of the quotient, dividend, and dividend/remainder. These sections must be set up in proper sequence, which may vary, depending on the size of the dividend and the divisor. For the example used, the following analysis of the problem illustrates how this sequence is established.

TOTAL CONTROL CARDS — PHASE 2																																																							
T	Total Levels 1-5					A = Add S = Subtract @ = Multiply % = Divide M = Move					L = Load Edit Control Word M = Move Constant Data Z = Move and Suppress Zeros										E = Edit M = Move Z = Move and Suppress Zeros										Summary Punch Column Split					Clear Accum.																			
	Be-fore Print					Label					Label					Print Positions					Label					Print Positions					Punch Positions					D = Move Digit Y = Move Zone					S														
	S	P	K			From					To					From					From					To					From					From					To					From					To				
	S	K				6	7	9	10	12	13	14	16	17	19	20	22	23	24	26	27	29	30	32	33	35	36	38	39	40	42	43	45	46	47	49																			
	1	2	3	4	5	6	7	9	10	12	13	14	16	17	19	20	22	23	24	26	27	29	30	32	33	35	36	38	39	40	42	43	45	46	47	49																			
T	X					@	M	C	D	P	D	T																																											
T																																																							

Figure 11

PROBLEM ANALYSIS

8-position area required for example used.

Counting from the low-order position of the work area, draw a line to the left of the length of the divisor plus 1.
3 (divisor) plus 1 = 4.

Quot.
 |x|x|x|x| | | | | To the left of this line, a 4-digit quotient is developed.
 | | | | | The units position is the address of the quotient upon completion of the divide operation.

Dividend
 | | | | |x|x|x|x| The 4-digit dividend with a plus sign in the units position is placed in the low-order positions of the work area with a ZERO and ADD instruction (?).
 | | | | | The high-order position of the dividend must be addressed when executing the DIVIDE instruction.

Quot. Div/Rem
 |x|x|x|x|0|x|x|x| The units position of the work area is the address of the dividend/remainder upon completion of the divide operation. With a 3-digit divisor, the dividend/remainder is always less than the divisor. Therefore, the position immediately to the right of the quotient is always zero.

To set up the three sections of the work area in the sequence established by the foregoing analysis, make three entries in the constants control card coding-sheet as shown in Figure 12.

Entry C (constant with a word mark) sets up the 4-digit quotient section of the work area.

The first entry S (constant without a word mark) sets up the high-order position of the dividend. This position is addressed when executing the DIVIDE instruction.

The second entry S sets up the remaining low-order positions of the work area, thus establishing the 8-position work area required for the example used.

In some problems, the analysis will show that the quotient area and the dividend area overlap; that is, the high-order position of the dividend extends further to the left than the low-order position of the quotient. Example: 5-digit dividend, 2-digit divisor.

Quot. D/R
 |x|x|x|x|x|0|x|x|
 Dividend
 | | |x|x|x|x|x|

In such cases, the work area is set up in four sections as shown in Figure 13.

Other variations are presented later in this manual under *Half-Adjustments of Products and Quotients*.

CONSTANTS CONTROL CARDS — PHASE 1																
C or S	No. Pos.	Label		Column 1 C = Constant with a word mark; S = Constant without a word mark Columns 2-3 = Size of Constant Word Columns 4-6 = Label to identify Constant Word Columns 7-72 = Field for punching Constant Word (66 characters maximum)												
1	2	3	4	6	7	10	15	20	25	30	35	40	45	50		
C	04	QNT	0	0	0	(NOTE: Blanks instead of zeros could be used in columns 7-10 if desired)										
S	01	DIV	0													
S	03	D/R	0	0	0											

Figure 12

CONSTANTS CONTROL CARDS — PHASE 1														
C o r d s	No. Pos.	Label					Column 1 C = Constant with a word mark; S = Constant without a word mark Columns 2-3 = Size of Constant Word Columns 4-6 = Label to identify Constant Word Columns 7-72 = Field for punching Constant Word (66 characters maximum)							
1	2	3	4	6	7	10	15	20	25	30	35	40	45	50
C	03	000	0000				This label is never referred to in the program.							
S	01	DIV	0				This label addresses the high-order position of the dividend when executing the divide instruction.							
S	01	QNT	0				This label addresses the low-order position of the quotient.							
S	03	D/R	0000				This label addresses the low-order position of the dividend and the remainder.							

Figure 13

Dividing in Phase 3 with a Fixed Divisor

Assuming that the fixed divisor (3 digits) is set up in storage with a label **FIX**, and the 4-digit dividend is punched in detail card columns 21-24, the divide instructions are recorded in detail control cards Phase-3 coding-sheet as shown in Figure 14.

Entry ? zeros (resets) and adds the dividend punched in columns 21-24 in the four low-order positions of the work area placing a plus sign in the units position, if the dividend is positive.

Entry % addresses the high-order position of the dividend, divides it by the fixed divisor, and develops a 4-digit quotient in the high-order positions of the work area labeled QNT.

Following the divide operation, another entry moves the quotient to print positions and/or to accumulator identified by a constant label. If the quotient is to be punctuated, an edit control word is first loaded into the desired print positions; the quotient is then moved to the same print positions with an *E* (edit) instruction.

Dividing in Phase 3 with a Variable Divisor

Dividing with a variable divisor can be specified for all or any specific type of detail card. Assuming that the 4-digit dividend and the 3-digit divisor are punched in columns 21-24 and 25-27, respectively, the

entries are made in columns 56-68 as shown in Figure 15.

Entry 9 zeros (resets) and adds the dividend punched in columns 21-24 in the four low-order positions of the work area placing a plus sign in the units position, if the dividend is positive.

Entry % addresses the high-order position of the dividend, divides it by the divisor punched in columns 25-27, and develops a 4-digit quotient in the high-order positions of the work area labeled QNT placing a sign in the units position of the quotient.

Dividing in Phase 2

Dividing in Phase 2 (total control cards) involves an accumulated factor that may be either the dividend or the divisor. Once the sizes of these factors are known, appropriate *C* and *S* entries, as previously described, are made on the constants control cards coding-sheet (Phase 1) to set up the work area.

Assume that the accumulated factor developed in Phase 3 (detail portion of the program) under the label AMT (amount) is to be used as the dividend. The divisor is either a fixed- or a group-divisor, properly identified with any label chosen by the programmer. *On any given total level in Phase 2*, division is specified

[illegible]

Figure 14

[illegible]

Figure 15

Assume that the accumulated factor developed in Phase 3 under the label QTY (quantity) is to be used

Entry % addresses the high-order position of the dividend (DIV), divides it by the accumulated quantity (QTY), and develops the quotient in the high-order positions of the work area labeled QNT.

Figure 16Figure 17

Products and/or quotients may be half-adjusted (rounded) by adding 5 to the position in the product or quotient immediately to the right of the wanted result. If the position to which the 5 is added stood at 5, 6, 7, 8, or 9, a carry occurs to the units position of the wanted result, thus rounding the product or quotient by adding the carry-over 1. If the position stood at 0, 1, 2, 3, or 4, the carry does not occur and the product or quotient is not adjusted. This procedure is often used to round out results to the nearest cent.

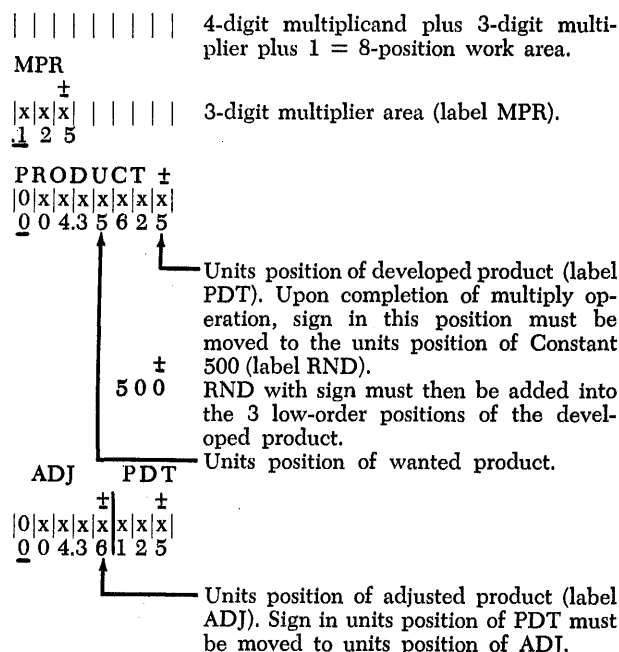
Product Adjustment

Assume a 4-digit multiplicand (with two decimals) and a 3-digit multiplier (all decimals).

EXAMPLE

	34.85	<i>Rule for placing the decimal point in the product:</i>
	$\times .125$	The sum of the number of decimal positions in the multiplicand and the multiplier equals the number of decimal positions in the product.
Product	<u>4.35625</u>	
$\frac{1}{2}$ adjust	500	
	4.36125	
Rounded Product	4.36	Dropped decimals

PROBLEM ANALYSIS



Characters &CR in the edit control word are not required if the products are always positive. The zero (0) to the left of the decimal point suppresses all insignificant zeros to the left of the decimal point, and the & causes a space between the units position of negative amounts and CR symbols. Examples of edit printing:

.09
4.36
15.08
.07 CR
8.39 CR
29.06 CR

To make proper entries on the coding sheets for this example, base the specifications on the following assumptions.

1. Multiplication is to be accomplished for all detail data cards (Phase 3).
2. Multiplier is punched in columns 21-23, with an X punch in column 23 if negative.
3. Multiplicand is punched in columns 31-34, with an X punch in column 34 if negative.
4. Adjusted product (positive or negative) is to be edited and printed in print positions 101-109, with no sign if positive, and CR symbols if negative.

To accomplish item 4, make the following entries in addition to those required to perform the basic multiplication.

1. Move the plus or minus sign from the units position of the developed product to the units position of the constant RND 500.
2. Add RND with sign to the low-order positions of the developed product (PDT).
3. Move the sign from the units position of PDT to the units position of the adjusted product (ADJ).
4. Load edit control word (ECWbb0.bb&CR) to print positions 101-109.
5. Edit and print ADJ in print positions 101-109.

Seven entries are required in various columns of detail control cards (Phase 3) coding-sheet as shown in Figure 19.

Quotient Adjustment

Assume a 6-digit dividend (with two decimals) and a 3-digit divisor (with no decimals).

EXAMPLE

0034.856 ← Extended quotient adjusted to 34.86 by adding 5 to the units position.

125)4357.120

375

607

500

1071

1000

712 (end of actual dividend)

625

870 (dividend extended)

750

120 (end of division)

Rule for placing the decimal point in the quotient:
Number of decimals in the dividend minus the number of decimals in the divisor equals the number of decimals in the quotient.

PROBLEM ANALYSIS

| | | | | | | | | 7-digit extended dividend plus 3-digit divisor plus 1 = 11-position work area.

Quotient | | | | | | | | | Line to the left of the number of digits in the divisor plus 1 locates the extended quotient including sign in the units position.

Dividend ±

| | | | | | | | |

4 3 5 7.1 2 0

← Units position of extended dividend (label EXD). Supplied by moving constant 0 or blank to EXD.

Units position of actual dividend (label ACD). To signal end of division, *sign* in this position resulting from a ZERO AND ADD instruction *must be removed* and transferred to the units position of extended dividend before executing the divide instruction.

High-order position of actual dividend (label DIV). This position is addressed when executing the divide operation.

±

| | | | | | | | |

0 0 3 4.8 5 6 0 1 2 0

Units position of extended quotient (label EXQ). Upon completion of the divide operation, sign in this position must be moved to Constant 5 (RND).

RND with sign must then be added to units position of extended quotient.

Adj. Quot.

±

| | | | | | | | |

0 0 3 4.8 6 1 0 1 2 0

Units position of adjusted quotient (label ADQ). Sign in units position of EXQ must be moved to units position of ADQ.

High-order position of ADQ.

To set up the various sections of the work area in the proper sequence and to set up other required constants as analyzed in the foregoing, make entries in the constants control cards coding-sheet as shown in Figure 20.

To make the proper entries on the coding sheets for this example, base the specifications on the following assumptions.

1. Division is to be accomplished for all detail data cards (Phase 3).
2. Dividend is punched in columns 31-36, with X punch in column 36 if negative.
3. Divisor is punched in columns 37-39, with X punch in column 39 if negative.
4. Adjusted quotient (positive or negative) is to be edited and printed in print positions 101-111 with no sign if positive and CR symbols if negative.

To develop adjusted quotient as specified, make entries in the various columns of the detail control cards (Phase 3) coding-sheet as shown in Figure 21.

FARGO General Program Operation and 1401 Core-Storage Organization

The following table describes in summary the sequence of events occurring during the loading of the combined FARGO program decks and the control cards punched from the coding sheets.

Code in

Column 77 Program Operation and Core-Storage Organization

- 0 FARGO Phase 1 program is loaded temporarily into locations 2618-3313.
FARGO program is loaded permanently into locations 3314-3699 during Phase 1.
- 1 Phase-1 control cards coded *M*, *B*, *C*, and *S* modify the permanent FARGO program, load up to 50 constants into storage beginning with location 333, and set up a table in locations 3700-3999 indicating the location of each constant.
- 2 FARGO Phase-2 program is loaded temporarily into locations 2306-3313, canceling out the temporary FARGO Phase-1 program.
- 3 Phase-2 control cards coded *T* generate total instructions and load them into locations immediately following the constant area.
- 4 FARGO Phase-3 program is temporarily loaded into locations 2301-3313, canceling out the temporary FARGO Phase-2 program.
- 5 Phase-3 control cards coded *D* generate detail instructions and load them into locations immediately following the total instructions. The last instruction generated in Phase 3 will be BE66.
- 6 FARGO Phase-4 program is loaded into locations 3023-3313, canceling out a portion of the temporary FARGO Phase-3 program.
- 7 Phase-4 control cards coded *H* load the report-heading information into locations immediately following the last BE66 instruction generated in Phase 3. The constant table in locations 3700-3999 set up during Phase 1 is cleared and the Phase 4 control cards coded *F* load the field-headings information into this area.
Location 2358 (or less) up to location 3313 is available for storing patch subroutines.

FARGO Report Examples

Register of Earnings and Deductions

This report will be listed on blank paper. Specifications include the following operations:

1. Report and Field Headings with overflow and page numbering.
2. Minor and Intermediate Controls.
3. Group-indication of control fields.
4. Addition and Subtraction (two types of detail data cards).
5. Three minor totals, three intermediate totals and three final totals. All amounts listed and total-printed will be edited.

Report format and completed FARGO coding sheets are shown in Figures 22-A to 22-E. An example of the finished report is shown in Figure 22-F.

Remittance Statement and Voucher Check

Statement and voucher check will be prepared on preprinted inverted forms. Statement portion of form provides for listing of debit and credit accounts payable items (4 types of detail data cards punched 1-4 in column 7), total printing of date, vendor number, and an edited statement total with floating \$.

Voucher check provides for date, vendor number, check number, and edited check amount with floating \$ on one line. This is followed by a space and 3-line printing of name, address, and city read into storage from a card punched — (11-punch) in column 7. A fourth line address, when required, is read into storage from a trailer address card punched & (12-punch) in column 7. *Name and address cards precede detail data cards.*

Specifications include punching of a summary card for both valid and void (overflow) checks. The summary cards, including those punched for void checks, will be used to prepare check registers and for check reconciliation.

Valid checks are printed and summary punched with FARGO instructions. Void checks are printed and summary punched with instructions from a patching subroutine.

Format of Remittance Statement and Voucher Check and completed FARGO coding sheets are shown in Figures 23-A to 23-G. Patch subroutine card format is shown in Figure 23-H. Examples of statements and checks are shown in Figure 23-J.

Figure 22-A. Specifications for Register of Earnings and Deductions Report

IBM

LINE DESCRIPTION

FIELD HEADINGS/WORD MARKS

INTERNATIONAL BUSINESS MACHINES CORPORATION
IBM 407, 408, 409, 1403 AND 1404 PRINTER SPACING CHART
 6 Lines Per Inch

Form X24-6436
 Printed in U.S.A.

Printing span:
 ← IBM 1403, Model 1
 ← IBM 407, 408, 409
 ← IBM 1403 & 1404, Model 2

CARD TYPES
 Earnings Card (NoX-74)
 Deduction Card (X-74)

REPORT SPECIFICATIONS

List-Overflow-Page Numbering
 Report Heading — 3-digit page number

Field Headings
 Intermediate Control Dept; Minor Control Serial
 First Card Minor — Group Indicate Dept. and Serial
 Earnings (NoX-74) list in Earnings and Net Pay columns
 Deductions (X-74) list in Deductions and Net Pay columns
 Level 1 — Employee Totals (Earnings, Deductions and Net Pay) 5 digit each
 Double space after Employee Totals

Level 2 — Department Totals (Earnings, Deductions and Net Pay) 6 digits each
 Triple space after Department Totals

Level 3 — Final Totals (Earnings and Net Pay) 7 digits each; (Deduction) 6 digits

DUAL-SPEED CARTRIDGE (IBM 1403, 1404)
 Punch only one channel per line. Holes in the same channel should be punched at least 8 lines apart.

MEASUREMENTS	FORM WIDTHS	COMMONLY USED FORM DEPTHS
Horizontal spacing 1/10"	Min. 3 1/2"	3 1/2", 3 1/2", 3 1/2", 5 1/2", 6"
Vertical spacing 1/6"	Max. 18 3/4"	7", 7 1/2", 8 1/2", 11"

NOTE: This chart is subject to inaccuracies from variations in humidity. Dimensions of form should be calculated from measurements shown and not scaled from this chart.

620515MSP

IBM

REPORT *Printed at Examiners and Productions* IBM 1401 DATA PROCESSING SYSTEM

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PROGRAMMED BY E. Johnson

[illegible][illegible][illegible]

CONTROL BREAK CONTROL CARDS — PHASE 1									
B	Level	Control Field Card Cols.							Sequence Number
		From	To						
1	2	3	5	6	8				7778
B	1	0117	0210			First Level Control (minor)			1 0 0
B	2	0114	0116			Second Level Control (intermediate)			1 0 0
B	3					Third Level Control (major)			1 0 0
B	4					Fourth Level Control			1 0 0

IBMREPORT [®] Register of Earnings and Deductions

INTERNATIONAL BUSINESS MACHINES CORPORATION

IBM 1401 DATA PROCESSING SYSTEM

FARGO REPORT SPECIFICATIONS • Phase 1

PROGRAM IDENTIFICATION

1	2	4	8
73	74	75	76

PROGRAMMED BY F. Johnson

DATE 12/15/61 Page 2 of 4

CONSTANTS CONTROL CARDS — PHASE 1

[illegible]

Figure 22-1D

IBM

REPORT

Register of Earnings and Deductions

IBM 1401 DATA PROCESSING SYSTEM

FARGO REPORT SPECIFICATIONS • Phase 3

PROGRAMMED BY

F. Johnson

INTERNATIONAL BUSINESS MACHINES CORPORATION

PROGRAM IDENTIFICATION

FORM X24-6559
Printed in U.S.A.112419
73747576DATE 12/15/61 Page 3 of 4

DETAIL CONTROL CARDS — PHASE 3

Type of Detail Card		Special 4 or 7 position 1401 Instruction (actual)		Column Split		E = Edit L = Load Edit Control Word M = Move Constant Data Z = Move and Suppress Zeros D = Move Digit Y = Move Zone		DETAIL CARD DATA		A = Add; S = Subtract @ = Multiply; % = Divide ? = Zero Add; ! = Zero Subtract D = Move Digit; Y = Move Zone M = Move Z = Move and Suppress Zeros		After Print		Sequence Number			
C = Char. Z = Zone	Code	C	O	P	A	B	D = Move Digit Y = Move Zone	Label	Print Positions	Punch Positions	Data Card Columns	Print Positions	Punch Positions	Data Card Columns	Label	Print (MLP)	S P K
							From To	From To	From To	From To	From To	From To	From To	From To	From To		
D	0174Z							L EICW	0125 0135		E 0176	01810 0125 0135		A ***	01810	E I A I	5 0 1 0
D	0174Z							L EICW	0146 0156		E ***	01810 0146 0156		A ***	01810	W P I	5 0 2 0
D	-0174Z							L EICW	0135 0145		E 0176	01810 0135 0145		A ***	01810	D I E I	5 0 3 0
D	-0174Z						Y 0174 01810	L EICW	0146 0156		E ***	01810 0146 0156		A ***	01810	W P I	5 0 4 0
D																	5 5 0
D																	5 6 0
D																	5 7 0
D																	5 8 0
D																	5 9 0
D																	5 0 0
D																	5 1 0
D																	5 2 0
D																	5 3 0
D																	5 4 0
D																	5 5 0
D																	5 6 0
D																	5 7 0
D																	5 8 0
D																	5 9 0
D																	5 0 0
D																	5 1 0

DATE 12/15/61 Page 4 of 4

REPORT Register of Earnings and Deductions IBM 1401 DATA PROCESSING SYSTEM
FARGO REPORT SPECIFICATIONS • Phase

PROGRAMMED BY G. Johnson

[illegible]

REGISTER OF EARNINGS AND DEDUCTIONS - PAGE 1				
EMPLOYEE NO. DEPT. SERIAL	EARNINGS AFTER TAXES	DEDUCTIONS	NET PAY	
1 00120	125.75		125.75	
		3.75	3.75CR	
		1.10	1.10CR	
		4.00	4.00CR	
EMP.TOTALS	125.75	8.85	116.90	
1 00121	85.00		85.00	
		4.75	4.75CR	
EMP.TOTALS	85.00	4.75	80.25	
1 00122	108.92		108.92	
		1.25	1.25CR	
		3.00	3.00CR	
		.80	.80CR	
		.07	.07CR	
EMP.TOTALS	108.92	5.12	103.80	
DEPT.TOTALS	319.67	18.72	300.95	
11 23815	185.00		185.00	
EMP.TOTALS	185.00	.00	185.00	
11 23816	160.00		160.00	
		25.00	25.00CR	
		3.95	3.95CR	
EMP.TOTALS	160.00	28.95	131.05	
11 23905	115.00		115.00	
		5.63	5.63CR	
		10.00	10.00CR	
EMP.TOTALS	115.00	15.63	99.37	
REGISTER OF EARNINGS AND DEDUCTIONS - PAGE 2				
EMPLOYEE NO. DEPT. SERIAL	EARNINGS AFTER TAXES	DEDUCTIONS	NET PAY	
11 23919		5.00	5.00CR	
EMP.TOTALS	.00	5.00	5.00CR	
DEPT.TOTALS	460.00	49.58	410.42	
124 01060	192.50		192.50	
		16.50	16.50CR	
		22.15	22.15CR	
		3.10	3.10CR	
EMP.TOTALS	192.50	41.75	150.75	
124 01070	225.00		225.00	
		25.00	25.00CR	
EMP.TOTALS	225.00	25.00	200.00	
124 01080	155.45		155.45	
		22.00	22.00CR	
		10.00	10.00CR	
EMP.TOTALS	155.45	32.00	123.45	
DEPT.TOTALS	572.95	98.75	474.20	
FINAL TOTALS	11,355.80	1,004.25	10,351.55	

Figure 22-F. Register of Earnings and Deductions Report

INTERNATIONAL BUSINESS MACHINES CORPORATION

IBM 407, 408, 409, 1403 AND 1404 PRINTER SPACING CHART

4 Lines Per Inch

Form 324-6436
Printed in U.S.A.

CARD TYPES

FIELD HEADINGS/WORD MARKS

Printing on: IBM 1403, Model 1

NAME AND ADDRESS CARD
- (11 punch) in column 7

TRAILER ADDRESS CARD
6 (12 punch) in column 7

DETAIL DATA CARD
Blank in col. 6; 1-2 in col. 7
- (11) in col. 6; 3-4 in col. 7

SUMMARY CARD

Vendor	(FIRST LINE) Name	(SECOND LINE) Name or Address	(THIRD LINE) City or Address
Vendor	(FOURTH LINE) City		
Vendor	Mo/Da Refer.	Amount	
Date	Vendor Check#	Amount	

GLUE

407, 408, 409, 1403, 1404

0	1	2	3	4	5	6
General Manufacturing Company - Endicott, N. Y.						
<input type="radio"/> We enclose check in full payment of items listed <input type="radio"/> CODES: 1. Invoices 2. Claims 3. Discounts 4. Allowances <input type="radio"/> DETACH CHECK BEFORE DEPOSITING	Invoice Mo.	Our Ref. Day	Invoice or Claim Number	Discount or Allowance	S C	AMOUNT
	XX	XX	XXXX	XX,XXX.XX	1	XX,XXX.XX
	XX	XX	XXXX	XX,XXX.XX	3	XX,XXX.XX-
	XX	XX	XXXX	XX,XXX.XX	2	XX,XXX.XX
	XX	XX	XXXX	XX,XXX.XX	4	XX,XXX.XX-
	XX/XX/XX		XXXXXX	TOTAL PAID → \$XX,XXX.XX		
	Date		Vendor			

GENERAL MANUFACTURING COMPANY
Endicott, N. Y.

GENERAL BANK AND TRUST CO.
ENDICOTT, N. Y.

PAY TO THE ORDER OF

1452
320

Date	Vendor	Check No.	Amount
XX/XX/XX	XXXXXX	XXXXXX	\$XX,XXX.XX

XXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXX

GENERAL MANUFACTURING COMPANY
Treasurer

0	1	2	3	4	5	6
General Manufacturing Company - Endicott, N. Y.						
<input type="radio"/> We enclose check in full	Invoice Mo.	Our Ref. Day	Invoice or Claim Number	Discount or Allowance	S C	AMOUNT
	XX	XX	XXXX	XX,XXX.XX	1	XX,XXX.XX
	XX	XX	XXXX	XX,XXX.XX	3	XX,XXX.XX-
	XX	XX	XXXX	XX,XXX.XX	2	XX,XXX.XX
	XX	XX	XXXX	XX,XXX.XX	4	XX,XXX.XX-

REPORT SPECIFICATIONS

MASTER REPORT CONTROL CARD - List

CONTROL BREAK CONTROL CARD - Minor Control on Vendor (columns 1-5)

DETAIL CONTROL CARDS

All - Move Vendor (columns 1-5) to VEN

All - Branch to patch subroutine to test for overflow (see Figure 23-C)

Code

- Move Name, Address and City to NME, ADD and CTY; space 1 (see NOTE)

6 Move Trailer Address to TRL; space 1

1 Edit Inv. Date (IDA); Move 6 Zero Suppress Reference; Move Code; Edit

2 Amount (ECI); add Amount to TOT; space 1

3 Move Zone (-) in column 6 to column 37; Edit Inv. Date, etc. same as

4 for codes 1 and 2

Overflow - Execute patch subroutine

TOTAL CONTROL CARDS

Before print skip to carriage tape channel 5

Move Statement and Check Date (SCD) to print area

Move 6 Zero Suppress Vendor (VEN) to print area

Edit (EC2) TOT and print

Before print skip to carriage tape channel 6

Add "1" (ONE) to Check No. (CKN)

Move Statement and Check Date (SCD) to print area

Move 6 Zero Suppress Vendor (VEN) to print area

Move 6 Zero Suppress Check No. (CKN) to print area

Edit (EC2) TOT and print

Move Statement and Check Date (SCD) to punch area

Move Vendor (VEN) to punch area

Move Check No. (CKN) to punch area

Move TOT to punch area; remove sign from units position of TOT

Clear TOT and punch

Space 1 before print

Move Name (NME) to print area and print

Move Address (ADD) to print area and print

Move City (CTY) to print area and print

Move Trailer Address (TRL) to print area and print

Move CLR to TRL to clear Trailer Address and skip to carriage tape channel 1

NOTE: Although the first printing line is indicated on Line 4 of the carriage tape, printing of the first detail data card for each vendor occurs on Line 5 if only one address card or on Line 6 if two address cards. This is because the last control card of each type of card to be processed requires a space code (rule). On overflow forms printing starts on Line 4.

Vertical spacing 1/6"

Max. 18 3/4"

NOTE: This chart is subject to inaccuracies from variations in humidity. Dimensions of form should be calculated from measurements shown and not scaled from this chart.

IBM

REPORTS

REPORT Permitance Statement and Voucher Check

INTERNATIONAL BUSINESS MACHINES CORPORATION

IBM 1401 DATA PROCESSING SYSTEM

FARGO REPORT SPECIFICATIONS • Phases 4 and 1

PROGRAM IDENTIFICATION

DATE 12/10/61 Page 1 of 6

H	Card	Two Cards (one line) Card 1=Print Positions 1-66; Card 2=Print Positions 67-132																																																																				Sequence Number
1	2	3	5	10	15	20	25	30	35	40	45	50	55	60	65	68		77	78	80																																																		
H	1																	7	0	0																																																		
H	2																	7	0	0																																																		

F		Card		Four Cards (two lines) Card 1 = Print Positions 1-66; Card 2 = Print Positions 67-132 Card 3 = Print Positions 1-66; Card 4 = Print Positions 67-132																																																																Sequence Number		
1	2	3	5	10	15	20	25	30	35	40	45	50	55	60	65	68		77	78	80																																																		
F	1																																																																					
F	2																																																																					
F	3																																																																					
F	4																																																																					
#	NOTE: BLANK CARD PUNCHED # IN COLUMNS 1, MUST FOLLOW LAST CONTROL CARD IN PHASE 4 to load patch subroutine																	70	15																																																			

NOTE: BLANK CARD PUNCHED # IN COLUMNS 1, MUST FOLLOW LAST CONTROL CARD IN PHASE 4 *to load patch subroutine*

[illegible]

B	Level	Control Field Card Cols.				Sequence Number					
		From		To							
1	2	3	5	6	8						
B 1		9	9	1	9	0	5	First Level Control (minor)	77	78	80
B 2								Second Level Control (intermediate)	1	0	0
B 3								Third Level Control (major)	1	0	0
B 4								Fourth Level Control	1	0	0

REPORT ^① Remittance Statement and Voucher Check

IBM 1401 DATA PROCESSING SYSTEM

FARGO REPORT SPECIFICATIONS • Phase 1

PROGRAM IDENTIFICATION

1	2	4	8
73	74	75	76

PROGRAMMED BY G. Johnson

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[illegible]

IBMREPORT Permittance Statement and Voucher Check

IBM 1401 DATA PROCESSING SYSTEM

PROGRAM IDENTIFICATION

PROGRAMMED BY G. Johnson

FARGO REPORT SPECIFICATIONS • Phase 3

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DETAIL CONTROL CARDS — PHASE 3

[illegible]

IBMREPORT ⁸ *Permittance Statement and Voucher Check*

INTERNATIONAL BUSINESS MACHINES CORPORATION

IBM 1401 DATA PROCESSING SYSTEM

FARGO REPORT SPECIFICATIONS • Phase 3

PROGRAM IDENTIFICATION

1	2	4	8
73	74	75	76

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PROGRAMMED BY G. Johnson

DETAIL CONTROL CARDS — PHASE 3

[illegible]

REPORT Permitance Statement and Voucher Check

IBM 1401 DATA PROCESSING SYSTEM

PROGRAM IDENTIFICATION

PROGRAMMED BY G. Johnson

FARGO REPORT SPECIFICATIONS • Phase 2

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[illegible]

IBM 1401 PROGRAM CHART

Program: Patch Subroutine for Remittance Statement and Voucher Check PAGE 6 of 6

Programmer: F. Johnson

Date: 12/10/61

Step No.	Inst. Address	Instruction						Remarks	Effective No. of Characters		
		O	A/I	B					Inst.	Data	Total
		P	d		d		d				
1	(2201) K01	B	K	1	0	@		If on channel 12, branch to K10	5		5
2	K06	B	7	3	1			If not on channel 12, branch back to next instruction in Phase 3	4		9
3	K10	C	0	0	5	3	3	7	7		16
4	K17	B	5	0	0	1		If unequal, branch back to the first instruction in Phase 2	5		21
5	K22	F	6					If equal, skip to carriage tape channel 6	2		23
6	K24	A	K	9	9	3	8	8	7		30
7	K31	L	3	7	1	1	0	8	7		37
8	K38	M	3	7	6	1	1	3	7		44
9	K45	M	3	8	8	1	1	8	7		51
10	K52	M	L	0	6	1	2	5	7		58
11	K59	4						Punch summary card for voided check	1		59
12	K60	L	3	7	1	2	2	7	7		66
13	K67	Z	3	7	6	2	3	3	7		73
14	K74	Z	3	8	8	2	3	9	7		80
15	K81	M	L	0	6	2	5	7	7		87
16	K88	2						Print voided check	1		88
17	K89	/	2	9	9			Clear print area	4		92
18	K93	F	1					Skip to carriage tape channel 1	2		94
19	K95	B	7	3	1			Branch back to Location 731. This is the address of the first instruction in Phase 3 that follows BK01	4		98
20	K99	1						Constant "1" to increase Check Number for voided checks		1	99
21	(2306) L06	V	-	0	-	1	-	D		7	106
									98	8	106

NOTE: The following addresses of the various instructions in the patch subroutine were determined from the storage printout after testing the main FARGO program:

Address

K01 = Starting location (2201) of patch subroutine

337 = Location of low-order position of Vendor Number for compare purposes

371 = Statement and Check Date (label SCD)

376 = Vendor Number (label VEN)

388 = Check Number (label CKN)

500 = Location of first instruction in Phase 2 after control break

731 = Location of instruction in Phase 3 immediately following BK01

Figure 23-G. Patch Subroutine Instructions

PATCH SUBROUTINE CARD FORMAT

Card Columns----->	1234	567	11 8901	11111111 23456789	6666666 0123456	6667777 7890123	7777 4567	778 890
<u>Leader Cards</u>								
#1	<u>1</u> 008	012	<u>1</u> 001	-	-	-	-	-
#2	<u>1</u> 060	067	<u>1</u> 001	-	-	-	-	-
#3	<u>1</u> 074	078	<u>1</u> 060	-	-	-	-	-
<u>Instruction Cards</u>								
Step 1	L019	K01	1060	BK10@	A007080	M080007	B001	007
Step 2	L019	K06	1060	E731				
Step 3	L019	K10	1060	C005337				
Step 4	L019	K17	1060	B500/				
Step 5	L019	K22	1060	F6				
Step 6	L019	K24	1060	AK99388				
Step 7	L019	K31	1060	L371108				
Step 8	L019	K38	1060	M376113				
Step 9	L019	K45	1060	M388118				
Step 10	L019	K52	1060	ML06125				
Step 11	L019	K59	1060	4				
Step 12	L019	K60	1060	L371227				
Step 13	L019	K67	1060	Z376233				
Step 14	L019	K74	1060	Z388239				
Step 15	L019	K81	1060	ML06257				
Step 16	L019	K88	1060	2				
Step 17	L019	K89	1060	7299				
Step 18	L019	K93	1060	F1				
Step 19	L019	K95	1060	E731	A007080	M080007	B001	007
<u>Constants Cards</u>								
Step 20	L001	K99	1060	1	A004080	M080004	B001	011
Step 21	L007	L06	1060	V-0-I-D	A004080	M080004	B001	011
<u>Clear & Branch Card</u>	-	-	-	-	/C14080	-	-	-

NOTES: Card columns 1-4, 8-11, and 60-80 are prepunched as recommended in the IBM 1401 Reference Manual, Form A24-1403, under PROGRAM LOADING ROUTINE.

Underscored positions indicate position of word marks set by leader cards 1, 2 and 3.

Card columns 5-7 and 12-18 are key punched from the IBM 1401 Program Chart (Figure 23-G).

After loading the patch subroutine the clear and branch card clears read-in area 1-80 and branches to location C14 (3314). This is the address of the first instruction in the permanent FARGO program.

Figure 23-H. Patch Subroutine Card Format

General Manufacturing Company — Endicott, N. Y.												
	Invoice		Our Ref. Number	Invoice or Claim Amount	Discount or Allowance	Code	AMOUNT					
	Mo.	Day										
We enclose check in full payment of items listed CODES: 1. Invoices 2. Claims 3. Discounts 4. Allowances	11	15	3456	550.75		1	550.75					
	11	15	3456		11.02	3	11.02-					
	11	18	3490	11.02		2	11.02					
	11	20	3510		11.02	4	11.02-					
	11	30	4127	39,460.27		1	39,460.27					
	12	06	4273	1,000.00		1	1,000.00					
	12	06	4273		20.00	3	20.00-					
	12	08	4280		10.00	4	10.00-					
	DETACH CHECK BEFORE DEPOSITING <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>Date</td> <td>Vendor</td> </tr> <tr> <td></td> <td></td> </tr> </table>							Date	Vendor			TOTAL PAID →
	Date	Vendor										

GENERAL MANUFACTURING COMPANY Endicott, N. Y.									
GENERAL BANK AND TRUST CO. ENDICOTT, N. Y.	<u>1452</u> 320								
PAY TO THE ORDER OF	<table border="1" style="width: 100%;"> <tr> <td>Date</td> <td>Vendor</td> <td>Check No.</td> <td>Amount</td> </tr> <tr> <td>12/15/61</td> <td>815</td> <td>19876</td> <td>V-0-I-D</td> </tr> </table>	Date	Vendor	Check No.	Amount	12/15/61	815	19876	V-0-I-D
Date	Vendor	Check No.	Amount						
12/15/61	815	19876	V-0-I-D						
GENERAL MANUFACTURING COMPANY _____ Treasurer									

General Manufacturing Company — Endicott, N. Y.											
	Invoice		Our Ref. Number	Invoice or Claim Amount	Discount or Allowance	Code	AMOUNT				
	Mo.	Day									
We enclose check in full payment of items listed CODES: 1. Invoices 2. Claims 3. Discounts 4. Allowances	12	09	4285	9,030.86		1	9,030.86				
	12	11	5117	500.00		1	500.00				
	12	12	5328		150.86	4	150.86-				
	12	13	5416	123.45		1	123.45				
	12	13	5417	876.55		1	876.55				
	DETACH CHECK BEFORE DEPOSITING <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>Date</td> <td>Vendor</td> </tr> <tr> <td>12/15/61</td> <td>815</td> </tr> </table>							Date	Vendor	12/15/61	815
Date	Vendor										
12/15/61	815										

GENERAL MANUFACTURING COMPANY Endicott, N. Y.									
GENERAL BANK AND TRUST CO. ENDICOTT, N. Y.	<u>1452</u> 320								
PAY TO THE ORDER OF	<table border="1" style="width: 100%;"> <tr> <td>Date</td> <td>Vendor</td> <td>Check No.</td> <td>Amount</td> </tr> <tr> <td>12/15/61</td> <td>815</td> <td>19877</td> <td>\$51,350.00</td> </tr> </table>	Date	Vendor	Check No.	Amount	12/15/61	815	19877	\$51,350.00
Date	Vendor	Check No.	Amount						
12/15/61	815	19877	\$51,350.00						
INTERNATIONAL BUSINESS MACHINES CORPORATION NORTH ST. ENDICOTT, NEW YORK GENERAL MANUFACTURING COMPANY _____ Treasurer									

Figure 23-J. Remittance Statement and Voucher Check

General Manufacturing Company — Endicott, N. Y.							
	Invoice		Our Ref. Number	Invoice or Claim Amount	Discount or Allowance	Code	AMOUNT
	Mo.	Day					
We enclose check in full payment of items listed	11	06	3219	347.09		1	347.09
CODES: 1. Invoices 2. Claims 3. Discounts 4. Allowances							
DETACH CHECK BEFORE DEPOSITING		12/15/61		1875	TOTAL PAID → \$347.09		
		Date		Vendor			

GENERAL MANUFACTURING COMPANY
Endicott, N. Y.

GENERAL BANK AND TRUST CO. ENDICOTT, N. Y. 1452
320

PAY TO THE ORDER OF	Date	Vendor	Check No.	Amount
	12/15/61	1875	19878	\$347.09

SUTCAN, INC.
2710 HELEN ST.
ENDICOTT, NEW YORK

GENERAL MANUFACTURING COMPANY

Treasurer

General Manufacturing Company — Endicott, N. Y.							
	Invoice		Our Ref. Number	Invoice or Claim Amount	Discount or Allowance	Code	AMOUNT
	Mo.	Day					
We enclose check in full payment of items listed	11	14	3428	750.33		1	750.33
	11	14	3428		37.52	3	37.52-
CODES: 1. Invoices 2. Claims 3. Discounts 4. Allowances							
DETACH CHECK BEFORE DEPOSITING		12/15/61		21264	TOTAL PAID → \$712.81		
		Date		Vendor			

GENERAL MANUFACTURING COMPANY
Endicott, N. Y.

GENERAL BANK AND TRUST CO. ENDICOTT, N. Y. 1452
320

PAY TO THE ORDER OF	Date	Vendor	Check No.	Amount
	12/15/61	21264	19879	\$712.81

DANIELS & MCCATHY, INC.
502 N. ARLINGTON DRIVE
GREENCASTLE, INDIANA

GENERAL MANUFACTURING COMPANY

Treasurer

General Manufacturing Company — Endicott, N. Y.							
	Invoice		Our Ref. Number	Invoice or Claim Amount	Discount or Allowance	Code	AMOUNT
	Mo.	Day					
We enclose check in full							

Figure 23-J. (2)

Figure 24. Example of FARGO Patching and Linkage Using SPS.

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION
IBM 1401 SYMBOLIC PROGRAMMING SYSTEM
 CODING SHEET

FORM X24-1152
 PRINTED IN U.S.A.

Program _____

Page No. 1 of 2

Programmed by _____

Date _____

Identification 76 80

LINE 3	COUNT 5 6 7 8	LABEL 13	OPERATION 14 16 17	(A) OPERAND				(B) OPERAND				d 39	COMMENTS 40	55
				ADDRESS 23	± 23	CHAR. ADJ. 27	IND. 27	ADDRESS 28	± 34	CHAR. ADJ. 38	IND. 38			
010			CTL	33										
020		*EXAMPLE		OF		FARGO		PATCHING		AND			LINKAGE USING SPS	
030		*												
040			ORG	1445									D PATCH POINT	
050			B	DPATCH									LINK TO DPATCH	
060			ORG	1201									T PATCH POINT	
070			B	TPATCH									LINK TO TPATCH	
080	03		DC	*									THREE BLANKS	
090			ORG	2400									BEGIN PATCH AREA	
100		DPATCH											INSTRUCTIONS FOR	
110													DETAIL PATCH	
120													SUBROUTINE	
130														
140			B	1449									BR BACK TO FARGO	
150		TPATCH											INSTRUCTIONS FOR	
160													TOTAL PATCH	
170													SUBROUTINE	
180														
190			B	1208									BR BACK TO FARGO	
200			END	3314									CLEAR AND BRANCH	

NOTES: Entry 040 -- ORG 1445 specifies the location of N000 (detail No-Op) in the FARGO generated program.
 Entry 050 -- B DPATCH will be converted during assembly to an actual machine language instruction (in this case BM00) and loaded over N000 in 1445-1448.
 Entry 060 -- ORG 1201 specifies the location of N888888 (total No-Op) in the FARGO generated program.
 Entry 070 -- B TPATCH will be converted during assembly to an actual machine language instruction and loaded over N888 followed by three blanks (entry 080).
 Entry 090 -- In this example, the patch area begins in location 2400 converted to M00 during assembly. The last instruction in each subroutine must branch back to the proper point (B1449 and B1208) in the FARGO generated program.
 Entry 200 -- The END card must branch back to 3314 to the first card read instruction of FARGO.

REPORT

PROGRAM IDENTIFICATION

73	74	75	7
----	----	----	---

PROGRAMMED BY _____

DATE _____ Page _____ of _____

[illegible]

Figure 25. Example Method of Identifying Types of Cards when a Digit Is Punched in One Column and an X (11 Punch) in Another.

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Form C24-1464-3

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