

Series F

Burroughs
SERIES F 2000
COMPUTER

INSTRUCTION BOOK



Subject To Change Without Notice

APPLICATION
AND
OPERATION

LOGICAL
DESCRIPTION

MECHANISMS
AND
ADJUSTMENTS

FUTURE USE

FEATURES

SERVICING
PROCEDURES

ELECTRICAL
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INDEX

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CONTENTS

Application and Operation

An introduction to the equipment including general applications and a description of external features.

Logic Description

Technical details of equipment functions with block diagrams, illustrations, etc.

Mechanisms and Adjustments

Mechanisms grouped by section functions and treated by means of a detailed illustration. Description of purpose, construction and operation of mechanisms with tests, adjustments and reasons.

Circuits

Reserved for electronic circuits.

Features

A detailed description of optional features.

Servicing Procedures

Preventive maintenance, test routines, section removal, and installation instructions.

Electrical Reference Information

Charts, diagrams, and illustrations required for maintenance and troubleshooting.

Correction Index

Items of urgent information of a technical nature released to the Field.

✓ Changes or additions since last issue.

Burroughs
SERIES F2000
COMPUTER

INSTRUCTION BOOK

Section I



APPLICATION AND OPERATION

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APPLICATION AND OPERATION

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Burroughs Series F 2000 Computer

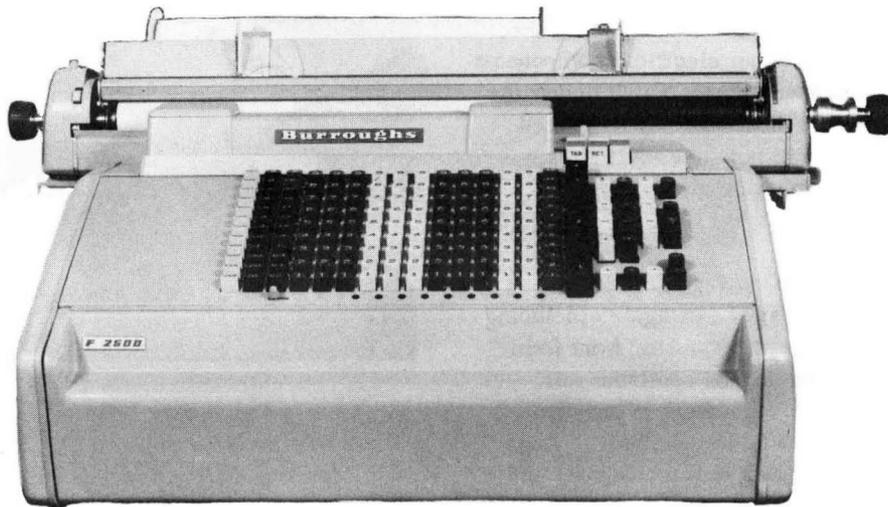


Fig. I-1

The Series F2000 Computer is designed for the accounting machine application which requires multiplication. With the addition of an electro-mechanical "package" to the Basic Series "F" Burroughs accounting machine we now have a compact computer accounting machine wherein the flexibility of the basic Sensimatic and its simplicity of operation is retained. In addition, .1" tabulation as used on the Series F1000 is incorporated into the F2000 for even more flexibility. These features together with speed of multiplication provide a fast Computer to solve all of the multiplication encountered in Tax Billing, Loan Scheduling, Interest Billing, Payroll, and similar accounting applications.

The Computer is designated Series F2000. The various styles within this series are designated by the last three digits of the style number and refer to the style features of the basic Sensimatic machine. Style F2503, for example, includes the functional mechanism of Style F503 with, of course, the additional function of computing.

Features which are standard on the F2000 Computer include:

1. Carriage return by minus sign of CF "A", carriage controlled.
2. Automatic count - column 3 carriage controlled.
3. Crossfooter non-clear lock.

GENERAL DESCRIPTION

There are two major components of the F2000 Computer: the Basic Sensimatic machine and the computing section. Although both components operate from the same source of power, each unit operates individually. The computing mechanism is located at the rear of the machine, and extensions of the base and case provide housing for the additional mechanisms. Changes in the add racks include extensions to permit transferring results from the electro-mechanical computing mechanism to the basic portion of the machine. The power supply and other electrical components are mounted to the stand proper which makes the stand an integral part of the machine. Forced air cooling is used to remove the extra heat developed by the computing mechanisms.

CARRIAGE FEATURES

The 22" front feed carriage has all the features of the Series F1000 carriage -- including .1" carriage tabulation mechanism, front form guides, rear form chutes, and continuous roll journal. The latest advancement in program panels is also incorporated in the F2000. This new side insertion program unit includes 41 additional lanes of which 13 are used for controlling the computing process. Seven of the additional lanes provide control in conjunction with an auxiliary sensing unit which is mounted behind and driven by the main sensing unit. The other six lanes are electrical lanes which provide information to the machine as a result of pins in the panel actuating switches located in these lanes. The remaining lanes are for future expansion.

PANEL LOCK

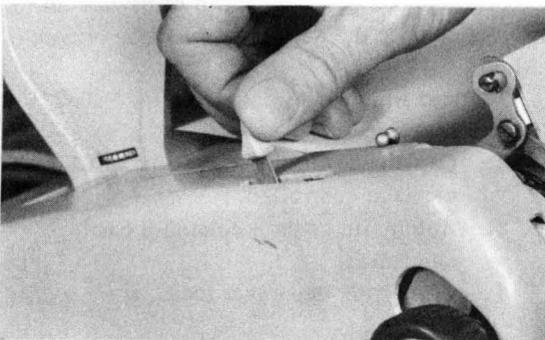


Fig. I-2

Removal of this panel is accomplished by moving the locking lever to the rear, grasping the panel end plate and pulling away from the carriage.

PANEL REMOVAL

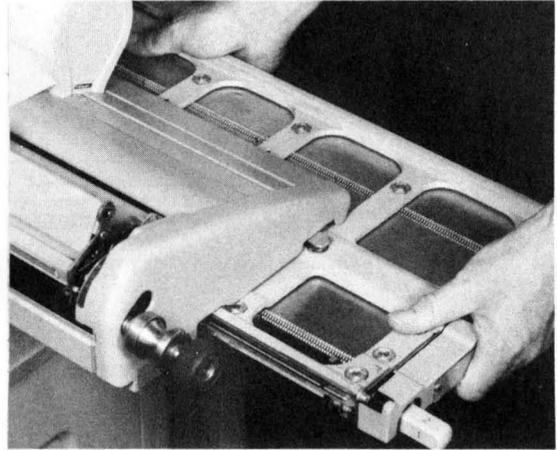


Fig. I-3

After one-half of the panel is clear of the carriage, grasp also the center rear panel rail to aid in holding the panel when it is clear of the machine.

PANEL REPLACEMENT

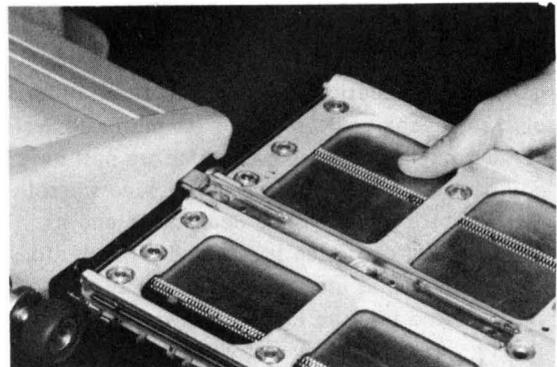


Fig. I-4

Replace the panel by lining up guide channels while holding panel parallel to floor. Push panel towards left end of carriage until latched.

OPERAND STORAGE UNIT A, Fig. I-5

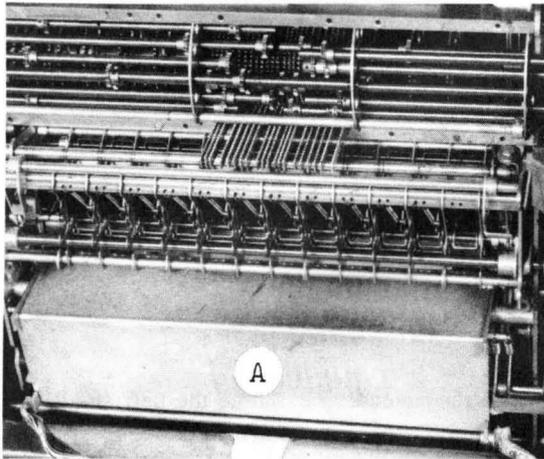


Fig. I-5

The Operand Storage Unit, designated as "D" section of the machine, is located between the "C" register section and the Product Accumulator. Its function is to store the two different factors for multiplication, i. e., the Multiplicand and the Multiplier, as programmed in the carriage control panel. The dual construction of the "D" section permits two amounts to be stored at the same time. The factors stored in the "D" section may be received from the keyboard, mechanical accumulator storage, or from the Product Accumulator.

While being introduced into the "D" section, the Multiplicand and/or Multiplier may be printed, non-added, added or subtracted in "A", "B" or "C" sections in accordance with the layout. An amount stored in the "D" section will remain there until a Sensimatic operation in a position programmed to enter another MP or MC. At the beginning of this MP or MC cycle the affected portion of the "D" section is restored to zero, clearing out any stored up figures. If no amounts are being indexed the "D" section "wheels" remain at zero.

PRODUCT ACCUMULATOR B, Fig. I-6

The Product Accumulator is located between the "D" section and the components unit and serves as a storage unit in which to accumulate partial products. This electro-mechanical unit

contains twenty accumulating pinions. The left twelve pinions can be meshed with the add rack extensions to read out the product of multiplication. The eight pinions on the right provide a means of obtaining greater accuracy in the accumulation of fractional amounts. These eight pinions can not be meshed with add rack extensions or read out in any other manner. For this reason, a means is provided for clearing these pinions without meshing with add rack extensions. Amounts may be accumulated in the Product Accumulator only from the process of multiplication. The Product Accumulator will not receive amounts from the keyboard, a crossfooter or a register.

The final product is transferred to the add racks on the first Sensimatic machine cycle following the multiplication routine and in the same carriage position in which multiplication has taken place. This machine cycle, which may be initiated by a repeat of machine operation or by the use of a motor bar, is called a "Product Cycle." The use of a result key will cause a malfunction. (Only the smaller amount in each column will print.) On the Product Cycle the amount in the Product Accumulator may be transferred to a crossfooter and/or register; either added, subtracted or non-added as programmed in the Control Unit. The product may also be introduced into the "D" section (Operand Storage Unit) as a Multiplicand and/or Multiplier at the same time.

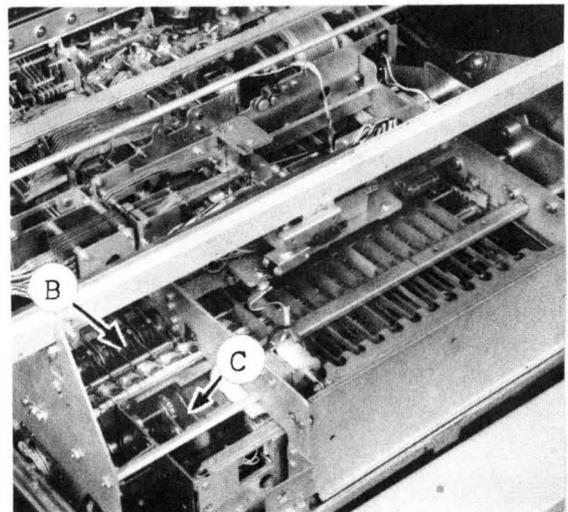


Fig. I-6

COMPONENTS UNIT C, Fig. I-6

This electro-mechanical section performs all of the actual multiplication. It produces two components for each multiplier digit which are referred to as the right and left hand components. These components are channeled into the Product Accumulator where they accumulate into a grand total or product. The columns of the Product Accumulator which receive these components are selected by the Components Unit which is in turn directed by the Program Unit.

METHOD OF MULTIPLICATION

Multiplication as accomplished by the F2000 Computer utilizes what is referred to as a Right and Left Hand Component method. To begin with, the basic multiplication tables are broken into right hand components and left hand components of each possible multiplying combination. For example, in the case of 9×9 , the product is 81. The figure 1 to the right is the right hand component of 9×9 . The figure 8 to the left is the left hand component of 9×9 . It will be noted that in all the multiplication tables, (of 1 through 9) the largest products have only two numbers in them. (The largest product being 81; the result of 9×9).

Taking an example from the multiplication table of 7, $3 \times 7 = 21$; the right hand component of 3×7 is 1, the left hand component of 3×7 is 2. In the case where we have smaller figures such as 3×3 , the left hand component would be 0. For a compound example, 3×64109 , the right hand component would be 82307 and the left hand component would be 11002.

Following is an example of a simple multiplication performed manually:

$$\begin{array}{r} 42345 \\ \times 3 \\ \hline 127035 \end{array}$$

This could be written as follows:

$$\begin{array}{r} 42345 \\ \times 3 \\ \hline 127035 \end{array}$$

In the preceding example the Left and Right components are:

Left hand components Right hand components

$$\begin{array}{r} 1 \\ 1 \\ 0 \\ 0 \\ 1 \end{array} \quad \begin{array}{r} 5 \\ 2 \\ 9 \\ 6 \\ 2 \end{array}$$

This problem could be written another way:

$$\begin{array}{r} 42345 \\ \times 3 \\ \hline 26925 \text{ Right Hand Component} \\ 10011 \text{ Left Hand Component} \\ \hline 127035 \end{array}$$

The Computer performs this problem in a similar manner as follows:

- 42345 Entered in Multiplicand Storage (MC)
- 3 Entered in Multiplier Storage (MP)
- 26925 On the first multiplication cycle the right hand components are added in the Product Accumulator
- 10011 On the second multiplication cycle the left hand components are added in the Product Accumulator
- 127035 On the Sensimatic Cycle following the answer is cleared from the Product Accumulator & transferred as programmed in the Sensimatic Control Unit.

Multiplication tables are contained in 18 "function" tables, one for the right hand components of each number 1 through 9 and one for the left hand components of each number 1 through 9. These function tables are electrical circuits printed on two disks -- one for all right hand components and the other for all left hand components.

In the multiplication process, a figure read from the Multiplier Storage Unit (part of "D" section) turns the two disks to the function tables for that figure. Electrical impulses are sent through the tables (first the right and then the left hand) to the Multiplicand Storage Unit (part of "D" section). Figures stored there permit the transferring, through switch connections, of these electrical right and left hand components to the Product Accumulator.

A digit of the multiplier thus finds the right hand components of the entire multiplicand in one multiplying cycle and the left hand components in the next multiplying cycle. Each digit of the multiplier, in turn, finds first the right hand components and then the left hand components of the multiplicand. The left hand components are "stepped over" one column to the left of the right hand components in adding in the Product Accumulator. The multiplication starts with the first significant digit on the right and proceeds from right to left.

SPEED OF MULTIPLICATION

Multiplication is automatic and is controlled through pins used in lanes of the Control Unit. A digit of the multiplier, other than zero, requires two product accumulator cycles. On the first cycle the right hand components are routed electro-mechanically through the components unit to the Product Accumulator and, on the second cycle, the left hand components. The cycling of the multiplying mechanism is controlled independently of, and not concurrently with, the usual Sensimatic cycle. The product accumulator cycles at the rate of 300 revolutions per minute. This speed determines the basic multiplying speed.

Two cycles are required for each digit of value in the Multiplier. Each digit requires .4 of a second (or 400 milli-seconds) except zero, which requires no significant time. This multiplying time is not affected by the number of digits in the Multiplicand. To obtain maximum speed, the Multiplier should contain the factor with the least number of digits other than zeros.

To round off the answer and clear the unwanted fractional amounts requires an additional .4 of a second. A Sensimatic cycle is needed to complete the operation and requires .55 seconds. The multiplication of a seven digit number by a three digit number containing one zero would require approximately 1.75 seconds including round off, clear, transfer and print.

EXAMPLE

PROBLEM

6253754 - In Multiplicand

 x709 - In Multiplier

OPERATION

TIME

Multiplication (2 digits x .4)	.8 Sec.
Round off & clear	.4 Sec.
Transfer & Print	<u>.55 Sec.</u>
Total Time	1.75 Sec.

.0095 SEC

SEQUENCE OF MULTIPLICATION

- A. The Multiplicand (or Multiplier) is introduced into the Operands Storage Unit.
- B. The Multiplier (or Multiplicand) is introduced into the Operands Storage Unit.
- C. Decimal Shift occurs as programmed.
- D. The product is accumulated in the Product Accumulator.
- E. Round-off and clear occurs as programmed.
- F. The Product Accumulator is cleared on the first machine cycle following the multiplication (M) routine and in the same carriage position.

Example:

\$20.50 x 4.15 computed to dollars and cents
 2 Decimal places
 +2 Decimal places
-2 Decimal places
 2 Decimal Shift

Decimal shift of 2 would be programmed.

Since 2, 5, 7, and 8 are the only shifts available, if the answer when using the rule is not 2, 5, 7 or 8, the number of decimal places in the multiplier and/or multiplicand must be increased or decreased to arrive at one of the available shifts.

Example:

\$50.25 x .0125 computed to dollars and cents.
 2 Decimal places
 +4 Decimal places
-2 Decimal places
 4 Decimal Shift

Since there is no decimal shift of 4, a zero is added to .0125 making it .01250.

\$50.25 x .01250 computed to dollars and cents.
 2 Decimal places
 +5 Decimal places
-2 Decimal places
 5 Decimal Shift

A decimal shift of 5 would be programmed and the answer would be printed properly pointed off.

ROUND-OFF AND CLEAR

When performing multiplication involving decimals it is usually desirable to "round-off" the answer to a unit of significant value and drop the digits of no significant value. This is called round-off and clear.

"Round-off" is accomplished by automatically adding 5 in column 0, 1, 2 or 3 in the pro-

duct accumulator as programmed in the Sensi-matic Control Unit.

"Clear" is accomplished by eliminating the digit in the column receiving the round-off pulse and all columns to the right of it.

Example 1: round-off and clear, column "O"(RCO).

\$20.53 x 4.15 computed to dollars and cents.

\$20.53 (MC)
x4.15 (MP)

85.1995 (Partial Product)

.005 (Round-off)

85.2045000000 (Partial Product)

85.20xxxxxxx (Clear)

85.20 (Printed Product)

Example 2: round-off and clear column "2"(RC2)

\$.00109 x 2,000.00 computed to dollars.

\$.00109 (MC)
x2,000.00 (MP)

2.1800000000 (Partial Product)

.5 (Round-off)

2.6800000000 (Partial Product)

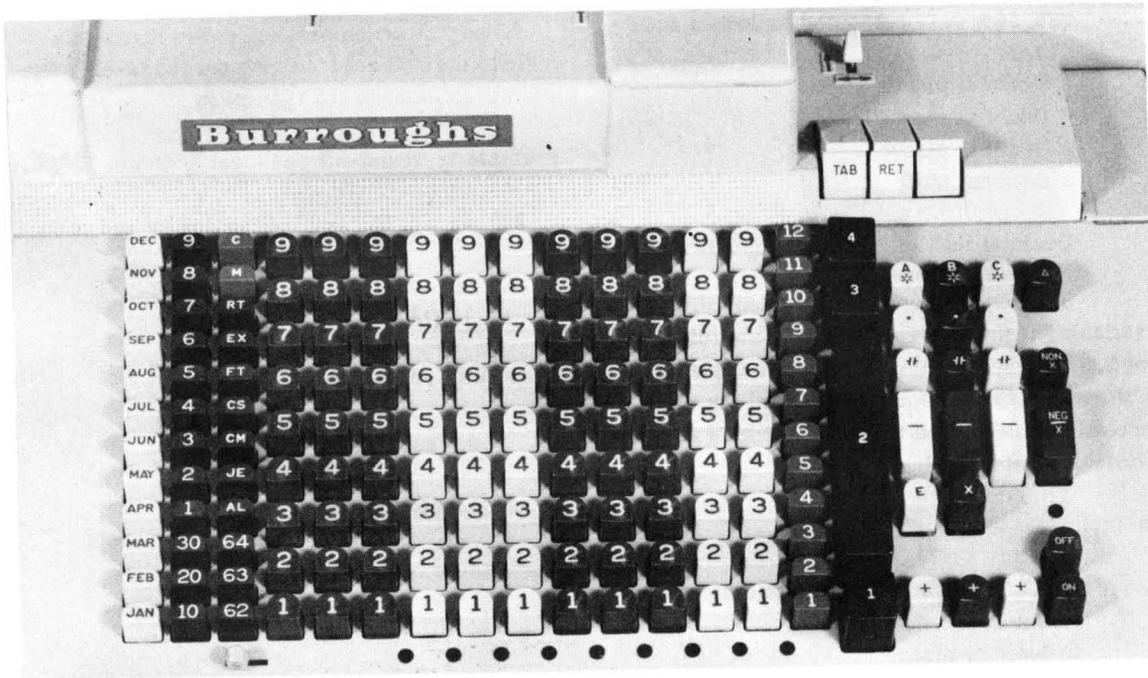
2.xxxxxxxxx (clear)

\$2.00 (Printed Product)

Where the product is not carried to the nearest whole unit, no round-off is required. However, pins are still required in the program unit to obtain a clear of the unwanted fractional amounts. (NRC, with column designation)

In some applications it is necessary to retain the fractional amounts in the first eight columns of the Product Accumulator and add them to the next multiplication. This may be accomplished also by programming and is called pro-rating (PR).

KEYBOARD



DECIMAL INDICATOR LAMPS

These lamps are floating decimal points. When an amount is to be indexed on the keyboard a Decimal Indicator Lamp will inform the operator in which columns the amount should be entered. Whole numbers will normally be indexed to the left of an illuminated lamp, and cents and other fractions to the right. A row of Decimal Indicator Lamp Windows are provided below the "1" keys. The nine indicators are located between columns, starting between columns "0" and "1" and ending between columns "8" and "9". Only three of the lamps may be programmed for illumination. The standard positions for the three lamps are located between columns 2/3, 5/6 and 8/9.

One Decimal Indicator Lamp will be illuminated when the carriage is stationary except when the Sensimatic Control Lever is moved to the rearward position for normalizing the carriage. If no pin is active in lane 64 or 65 the lamp on the right will be illuminated. If an electrical pin is active in lane 64 the center lamp will be illuminated. An active pin in lane 65 will illuminate the lamp on the left side of the keyboard.

"C" AND "M" KEYS

The "C" and "M" keys are located in the 12th keyboard column, in positions 11 and 12. They are normally used on applications where it is desired to change a programmed Unit Price multiplication to a Price Per Hundred (C) or a Price Per Thousand (M).

The "C" key always shifts the product seven (7) places - regardless of the programmed shift. The "M" key always shifts the product eight (8) places - regardless of the programmed shift. To have the Unit Price multiplications correctly pointed off - whenever the "C" or "M" keys might be used - a Decimal Shift of 5 (S5) must be programmed.

The "C" or "M" key must be depressed in the position prior to multiplication. A "Repeat Keyboard" must be programmed in this position to hold either key ("C" or "M") into the multiplication position.

In addition to shifting the product the "C" or "M" key will cause a "C" or "M" to be printed in column 12.

DELTA CLEAR

The Delta Clear (or 20 place clear) operation is used to clear the product accumulator of incorrect or fractional amounts following a power failure or after pro-rating. The operation can be indexed manually by depression of the Delta Key (marked " Δ "), located in keyboard position D8, with the carriage control disabling lever rearward. It can also be programmed into the control unit (lane 66) for automatic clearing after pro-rating.

Indexing of a Delta Clear operation causes the multiplier section to cycle and clear itself and the sensimatic to cycle, at the same time, to print the clear symbol (.00 Δ) only. Any amount thus cleared cannot be added to or subtracted from the mechanical accumulating sections.

Depression of the Delta Key with the carriage control disabling lever forward, operates the machine the same as Bar 2 and the product accumulator will not be cleared.

POWER ON KEY

This key, marked "ON", is located in position D1. It turns on the power to the computer. It must be held down momentarily when starting machine. If not held down for a sufficient length of time the key will restore. An electrical power failure of sufficient length to give an erroneous answer, will shut off the machine and this key will restore.

POWER OFF KEY

This key, marked "OFF", is located in position D2. It turns off the power to the computer.

NEGATIVE MULTIPLY

This key, marked "NEG X", is located in position D4-5. When depressed, provides a manual control of multiplication so that the next product may be automatically subtracted from the crossfooter and printed in red. This does not alter the carriage controlled functions of register "B" or "C". The "NEG X" key will not cycle the machine.

NEGATIVE MULTIPLICATION LAMP

This lamp located below the "NEG X" key will glow red when a negative multiplication has been called for by carriage control or by manual indexing of the "NEG X" key. It will remain illuminated until the entire multiplication cycle has been completed or the condition is cancelled by use of the Sensimatic Control Lever or the Non-Multiply Key with a machine cycle.

NON-MULTIPLY KEY

This key, marked NON X, is located in position 6. When depressed, disables basic Sensimatic functions of Repeat of Keyboard, Repeat and MBR. Does not operate the machine. Its two functions are:

1. Disable Multiplication Routine
The Non-Multiply Key is used in the Pre-multiply position when it is desired to disable the multiplication routine. It disables the Pre-multiply function. When used it permits normal listing or posting instead of multiplication in the next operating position.
2. Disable Negative Multiply
If a Negative Multiply is set up, the Non-Multiply Key and a machine cycle in any carriage position (not programmed for multiplication) will cancel it. If a Negative Multiply is set up and the Non-multiply Key is used in the next Pre-multiply position, both the Pre-multiply and the Negative Multiply functions will be disabled.

CARRIAGE CONTROL DISABLING LEVER

In addition to its basic functions the Carriage Control Lever is used to normalize certain Computer functions as follows:

- A. Delta Clear
Before using the " Δ " key the Carriage Control Lever must be positioned rearward. After using the " Δ " key, it is again positioned in its forward position.

- B. Motor Bar Used in Error
If a motor bar is used in a pre-multiply position which moves the carriage to a position that is not programmed for multiplication, or disable pre-multiply, the machine is inoperable. The Carriage Control Lever must be used to normalize the locks set up by the pre-multiply.
- C. Negative Multiply
After the use of either the carriage controlled or the manual negative multiply, the negative multiply function may be disabled by the Carriage Control Lever. This must be accomplished prior to multiplication. The lever need be positioned rearward only momentarily.
- D. Decimal Indicator Lamps
The decimal indicator lamps may only be illuminated when the Carriage Control Lever is in the forward position.

MACHINE INTERLOCKS

To eliminate the possibility of operational errors during a multiplication routine the following machine interlocks are active for protection.

MACHINE BLOCK

This interlock prevents a machine cycle until the multiplication routine is completed.

For example, if in a Multiply (M) position, with a preceding Pre-multiply (PM) control and a Repeat, the machine will always multiply first. After multiplication the machine will then cycle.

COLUMN SELECTOR KEYS

After the start of the multiplication routine, the Column Selector Keys are locked against depression. For example, in a Multiplication (M) position, with a preceding Pre-multiply (PM) control and a Repeat, the Column Selector Keys are both locked immediately before the start of the multiplication routine. After the product cycle, the Column Selector Keys are free and may be used.

CARRIAGE CONTROL DISABLING LEVER

After the start of the multiplication routine, this lever is locked in its forward position until the product cycle is completed.

KEYBOARD INTERLOCKS

- A. The three upper keys in the keyboard column "D", marked " Δ ", "NON X" and "NEG X", are interlocked to prevent depression of two or more of these keys simultaneously.
- B. The "A", "B" and "C" total and sub-total keys and the " Δ " key are interlocked to prevent simultaneous depression.

TYPICAL BILLING OPERATION

INVOICE							
Burroughs 							
DEMONSTRATING FORM							
						No. 8375	APR 15-
SOLD		. Ace Manufacturing Co.		SHIP		. 8888	
TO		. 3579 Any St.		TO		.	
		. Anywhere, U. S. A.					
QUANTITY ORDERED	DESCRIPTION	PRICE	QUANTITY SHIPPED	GROSS	MULT. FACTOR	NET	TOTAL
Line 1	ITEM	12.74	15	191.10	850	162.44+	
Line 2	ITEM	10.47C	1425			149.20+	
Line 3	PRICE INCREASE 2% NET				020	6.23+	311.64*
Line 4	GRATIS CARTONS FREIGHT CHARGES		1000			6.65+	
Line 5	REFUND ON PREVIOUS FREIGHT CHARGES	1.03M	3000			3.09-	321.43*

Fig. I-7

Schedule 4

First Line of Billing - Showing - 15% Discount on the Gross Amount Shipped

Stop 7

List on the keyboard the price of the item, \$12.74. (Note: The decimal indicator lamp indicates where to list the amounts on the keyboard, dollars to the left and cents to the right of the light.) Depression of motor bar 2 will cause the machine to operate, print the amount, store it in the multiplicand (MC) storage unit and tab to position 8.

Stop 8

List on the keyboard the quantity shipped, 15. The decimal indicator lamp is now lit between keyboard columns 5/6. The amount will be listed to the left of the light, (whole numbers to the

left and fractional amounts to the right of the light). Depression of motor bar 1 will cause the machine to operate, print the amount, store it in the multiplier (MP) storage unit and tab to position 9.

Stop 9

Here the machine will multiply, operate and print the gross amount, store it in the multiplicand (MC) storage unit and tab to position 10.

Stop 10

Note: To take a 15% discount on this line of billing, subtract 15% from 100%. The 85% will be the multiplying factor. By multiply the gross amount times the factor, .85, the net amount is obtained.

List on the keyboard the multiplying factor, .85. (Note the decimal light between columns 5/6. Since this is a fractional amount, it will be listed to the right of the light.) Depression of motor bar 2 will cause the machine to operate, print the multiplying factor, store it in the multiplier (MP) storage unit and tab to position 11.

Stop 11

The machine will multiply (M), print the net amount, add it to the CF "A" and return to position 7 for the second line of billing.

Second Line of Billing Showing Price Per 100 with No Discount

Stop 7

List on the keyboard the price of the item, \$10.47 (Note decimal light). Depression of motor bar 2 will cause the machine to operate and print the amount, store it in the multiplicand (MC) storage unit and tab to position 8.

Stop 8

List on the keyboard the quantity shipped, 1,425 (Note decimal light between columns 5/6). Because the price listed in position 7 was price per 100, the "C" key in column 12 will now be depressed. This will instruct the machine to multiply by the price per 100 rather than the per unit price which is scheduled for this position. Depression of motor bar 4 will cause the machine to operate, print the quantity, store it in the multiplier (MP) storage unit, and skip to position 11.

Stop 11

Here the machine will multiply, print the net amount, add it to CF "A", and skip to position 13.

Stop 13

Motor bar 2 will operate the machine and return to position 12.

Stop 12

Repeat of motor bar 2 will operate the machine, subtotal CF "A", print the amount, store it in the multiplicand (MC) storage unit, space and return to position 10.

Third Line of Billing - a 2% Price Increase on the Net Bill

Stop 10

List on the keyboard the multiplying factor of .02 (Note decimal light). Depression of motor bar 2 will cause the machine to operate, print the factor, store it in the multiplier (MP) storage unit and tab to position 11.

Stop 11

Here the machine will multiply (M), print the amount, add it to CF "A", and return to position 7.

Fourth Line of Billing - the use of the Non-Multiply Key

Stop 7

This line of billing shows a gratis shipment of 1,000 empty cartons to the customer, but billing him for the freight cost. No price will be listed in this case. Depression of motor bar 2 will operate the machine and tab the carriage to position 8.

Stop 8

List on the keyboard the quantity shipped, 1000 (Note decimal light). This being a gratis shipment with no multiplication needed, the non-multiply key in column "D" is depressed. Depression of motor bar 2 will cause the machine to operate, print the amount, store it in the multiplier (MP) storage unit and skip to position 11.

PROGRAMMING INFORMATION

<u>LANE NO.</u>	<u>PIN NO.</u>	<u>LAYOUT SYMBOL</u>	<u>DESCRIPTION</u>
1-25			Basic Series F
26-30			For Typewriter Use
31			Unassigned
32	3	\$	Non-add, non-extend, non-clear of Col. 1&2
33	2	MC	Multiplicand
34	2	MP	Multiplier
35-40			Unassigned
41	7	PM	Pre-multiply
	5	NPM	Negative Pre-multiply
	3	NM	Negative Multiply
	1	SPM	Selective Pre-multiply
42	0	RC	Round-off and Clear
	7	NRC	No Round-Off, Clear
	5	PR	No Round-Off, No Clear
43	0	0	Location of RC or NRC, Column 0
	7	1	Location of RC or NRC, Column 1
	5	2	Location of RC or NRC, Column 2
	3	3	Location of RC or NRC, Column 3
44	0	S8	Decimal Shift 8 places
	7	S7	Decimal Shift 7 places
	5	S5	Decimal Shift 5 places
	3	S2	Decimal Shift 2 places
45-60			Unassigned
61	X	CFNC	Non-Clear Lock
62	X	DPM	Disable Pre-Multiply
63	X	M	Multiply
64&65	0	.2	Dec. Light Col. 2/3
64	X	.5	Dec. Light Col. 5/6
65	X	.8	Dec. Light Col. 8/9
66	X	△	Clear Product Accum.

Machines with rear insertion panels do not use lanes 61-66 but use instead lanes 46-51. Therefore, subtract 15 from each lane 61-66 in the previous material to find the corresponding lane in the rear insertion panel machines.

Burroughs
SERIES F2000
COMPUTER

INSTRUCTION BOOK

Section II



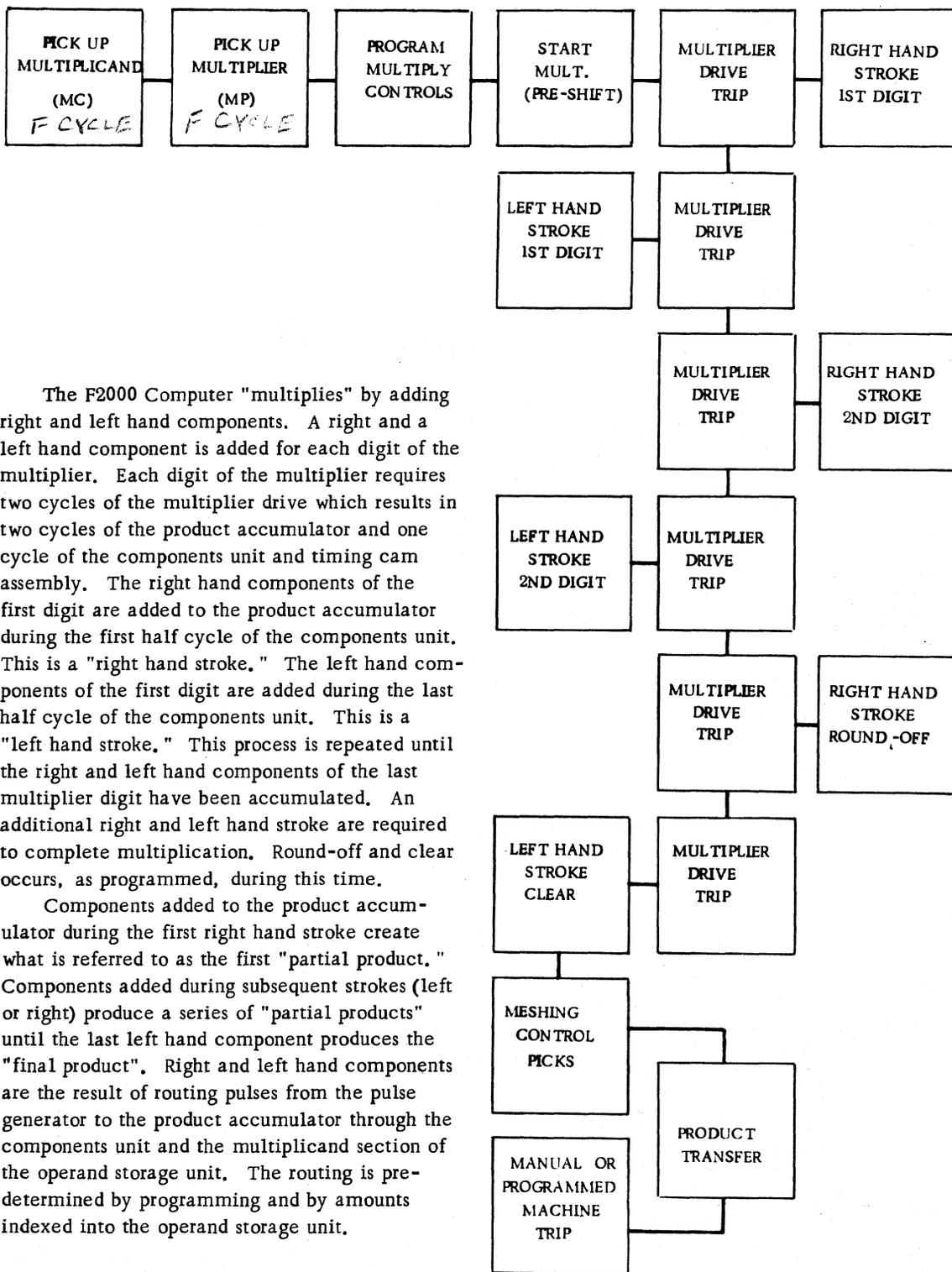
LOGICAL DESCRIPTION

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LOGICAL DESCRIPTION

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BASIC PROCESS OF MULTIPLICATION



The F2000 Computer "multiplies" by adding right and left hand components. A right and a left hand component is added for each digit of the multiplier. Each digit of the multiplier requires two cycles of the multiplier drive which results in two cycles of the product accumulator and one cycle of the components unit and timing cam assembly. The right hand components of the first digit are added to the product accumulator during the first half cycle of the components unit. This is a "right hand stroke." The left hand components of the first digit are added during the last half cycle of the components unit. This is a "left hand stroke." This process is repeated until the right and left hand components of the last multiplier digit have been accumulated. An additional right and left hand stroke are required to complete multiplication. Round-off and clear occurs, as programmed, during this time.

Components added to the product accumulator during the first right hand stroke create what is referred to as the first "partial product." Components added during subsequent strokes (left or right) produce a series of "partial products" until the last left hand component produces the "final product". Right and left hand components are the result of routing pulses from the pulse generator to the product accumulator through the components unit and the multiplicand section of the operand storage unit. The routing is pre-determined by programming and by amounts indexed into the operand storage unit.

Fig. II-1

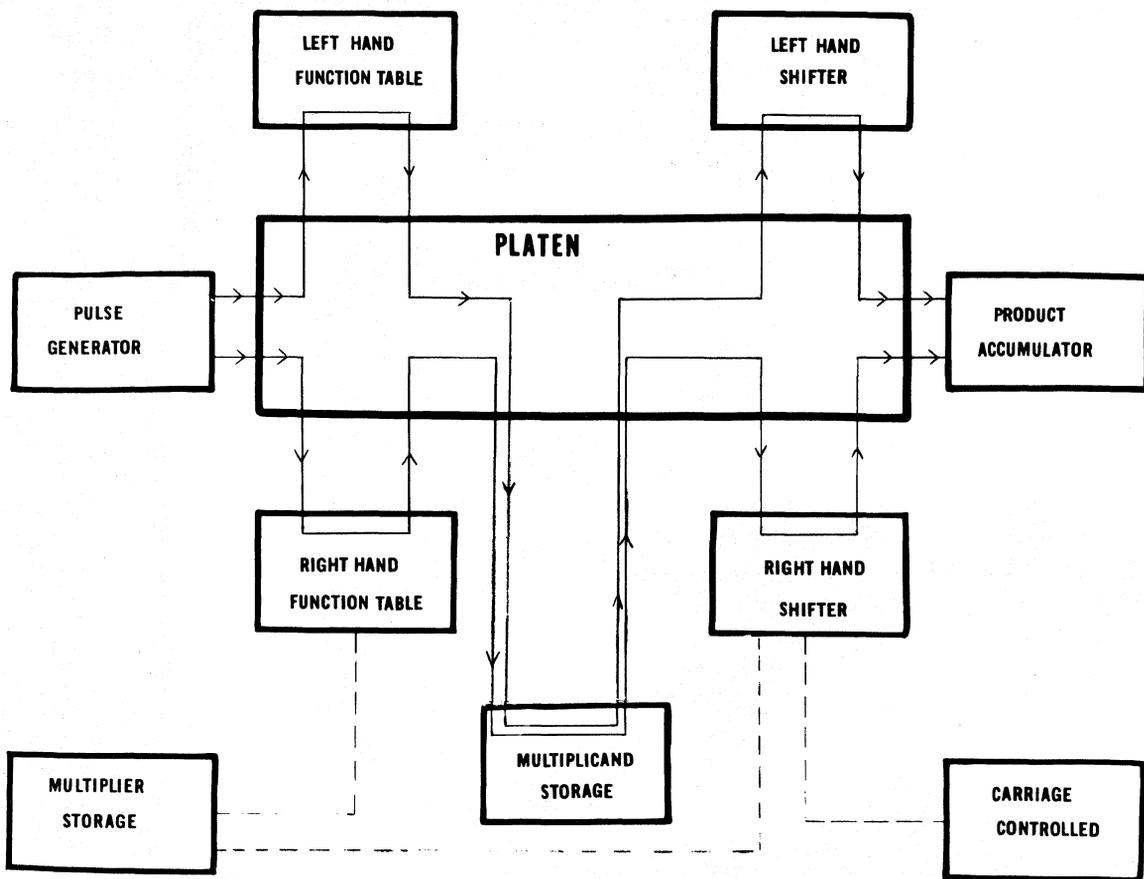


Fig. II-2

Pulses from the pulse generator are applied to the components unit during each cycle of the multiplier drive. The components unit function table disks, the positioning of which is determined by the multiplier digit being used, routes the proper pulse to the proper buss line of the multiplicand section of the operand storage unit. Amounts previously stored there have completed circuits from these buss lines to the shifter disks of the components unit. The shifter disks connect the twelve outputs of the multiplicand storage section to their proper columns in the product accumulator. In some style machines there are only eleven columns in the operand storage unit.

BASIC TIMING OF THE PULSE ROUTE

At the start of multiplication, when multiplier drive trip solenoid L230 is energized, the drive cycles once, the product accumulator cycles once, the components unit camshaft cycles 180° and the timing cam switch assembly cycles 180° . The pulse route circuits are completed at 14° of the components unit cycles. S209 supplies the basic nine pulse to the pulse generator beginning at 15° of the components unit cycle. The pulse generator cam and the product accumulator pinion shaft begin their forward rotation to accumulate the right hand components at approximately

30° of the components unit cycle. As the multiplier drive trip solenoid is again energized, the drive cycles once, the product accumulator cycles once, the components unit camshaft cycles 180° (to home) and the timing cam switch assembly cycles 180° (to home). The pulse route circuits are again completed at 194° of the component cycle. S209 supplies the basic nine pulse to the pulse generator beginning at 195° of the components unit cycle. The pulse generator cam and product accumulator pinion shaft begin their forward rotation to accumulate the left hand components at approximately 210° of the components unit cycle. Interlock circuits are provided to ensure that the right or left hand disks (function table and shifter) are fully positioned prior to tripping the multiplier drive for a right or left hand stroke respectively.

The pulse route originates with timing cam switch S209. This switch, when transferred, applies B+ to the pulse generator. The resulting pulses are routed through function table disks, multiplicand storage section and shifter disks to the product accumulator pinion solenoids. Energizing these solenoids at the proper time during the product accumulator cycle allows a partial rotation of the pinion corresponding to the length of the pulse applied to the solenoid.

The pulse generator consists of eight sets of circuit-breaking contacts which receive B+ from timing cam switch S209 (Gate pulse generator). The length of pulses one through eight is determined by opening these eight sets of contacts. Timing cam switch S209 determines the length of the nine pulse.

THE PULSE ROUTE

Note: The following pulse route description considers .03 as the multiplier, 1, 234, 567.89 as the multiplicand and a shift of 2.

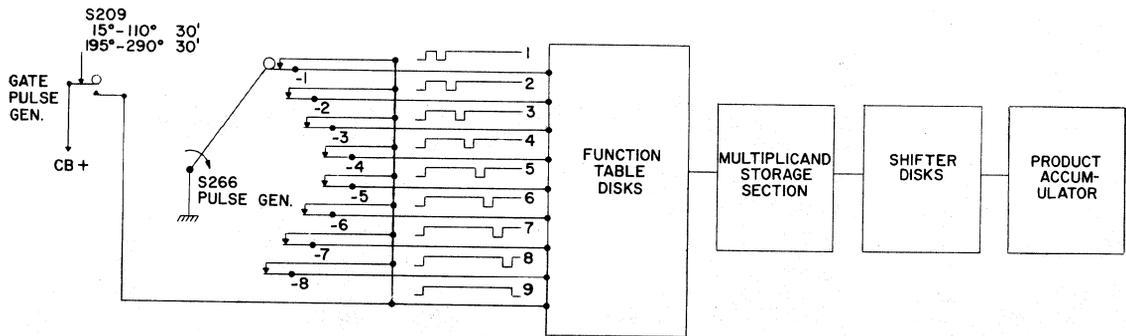


Fig. II-3

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For Form 3747

MENTAL OR MANUAL PROCESS

F2000 COMPUTER MULTIPLYING PROCESS

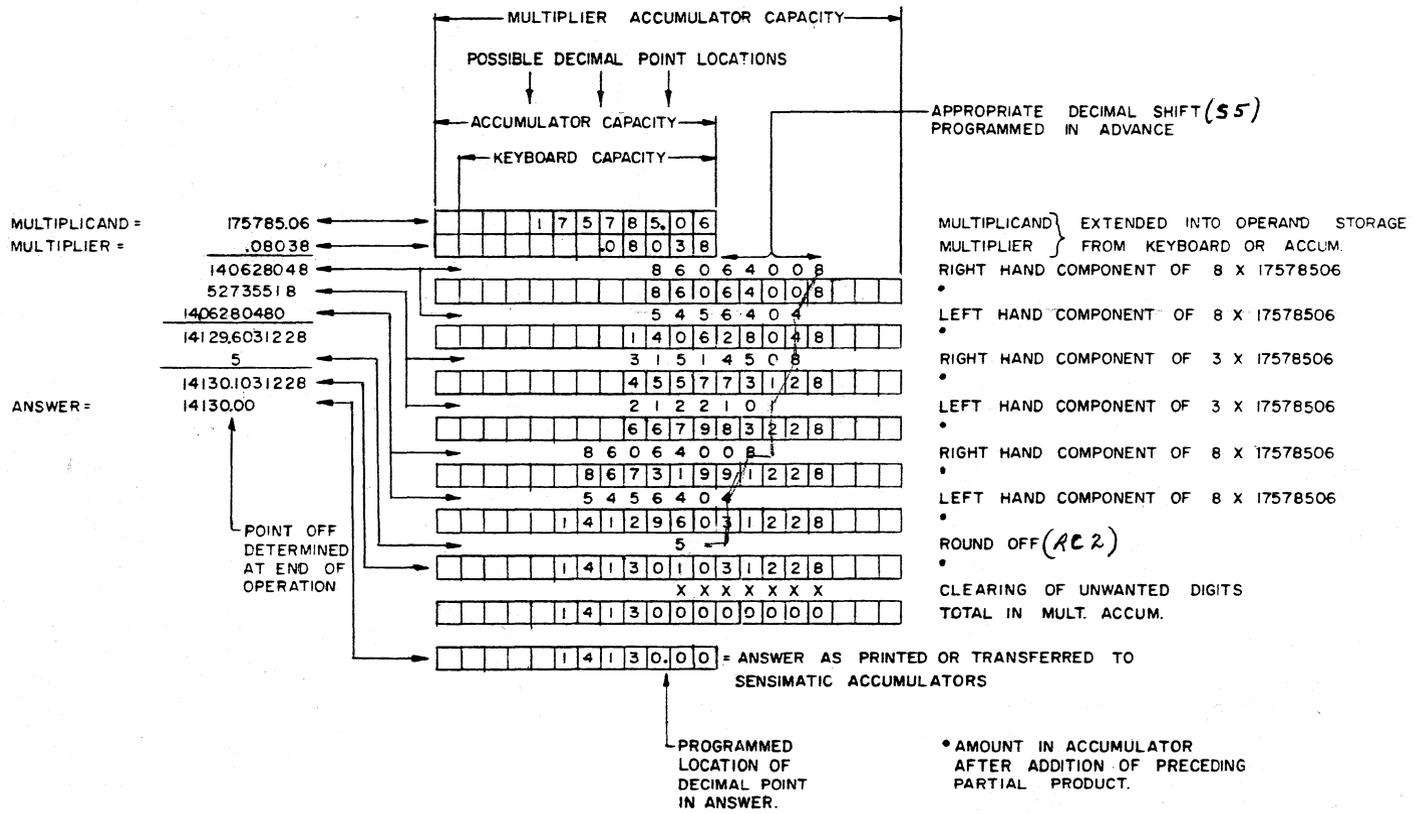


Fig. 1

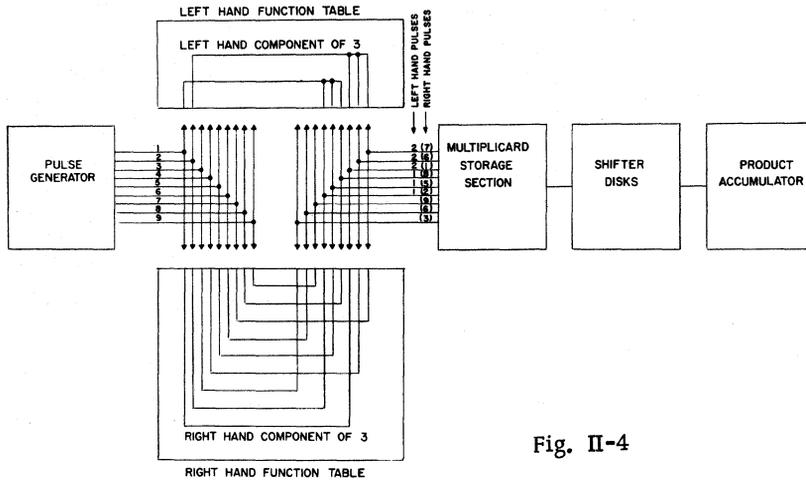


Fig. II-4

The nine different length pulses thus generated enter the components unit platen. During the first half cycle (180°) of the components unit the platen is moved rearward to sense the right hand function table and shifter disks simultaneously. During the remaining half cycle the platen is moved forward to sense the left hand function table and shifter disks simultaneously. The pulses from the pulse generator are connected to nine sensing pins on the platen. As these pins contact the right or left function table disk they are connected by the disks to nine output platen pins which are wired to the nine buss lines of the multiplicand storage section. The position (1 through 9) of the function table disks, representing the multiplier digit being used, determines which input pulse will be applied to which output pin (buss line of the multiplicand storage section).

Prior to multiplication an amount representing the multiplicand must be indexed into the operand storage unit. Indexing of this amount positions the wiping gear contacts of the operand storage unit (multiplicand section) to connect the output line of each column to the buss line representing the digit indexed into that column. In this manner pulses applied to the nine buss lines of the multiplicand section of the operand storage unit are routed to the twelve output lines of the multiplicand section which in turn are wired to twelve pins on the components unit platen. As the platen senses the right or left hand disks, the shifter disk connects these twelve pins to twelve columns of the product accumulator as a group. For example if the output of column one of the multiplicand is routed to column 7 of the product accumulator, the output of column two would be routed to pro-

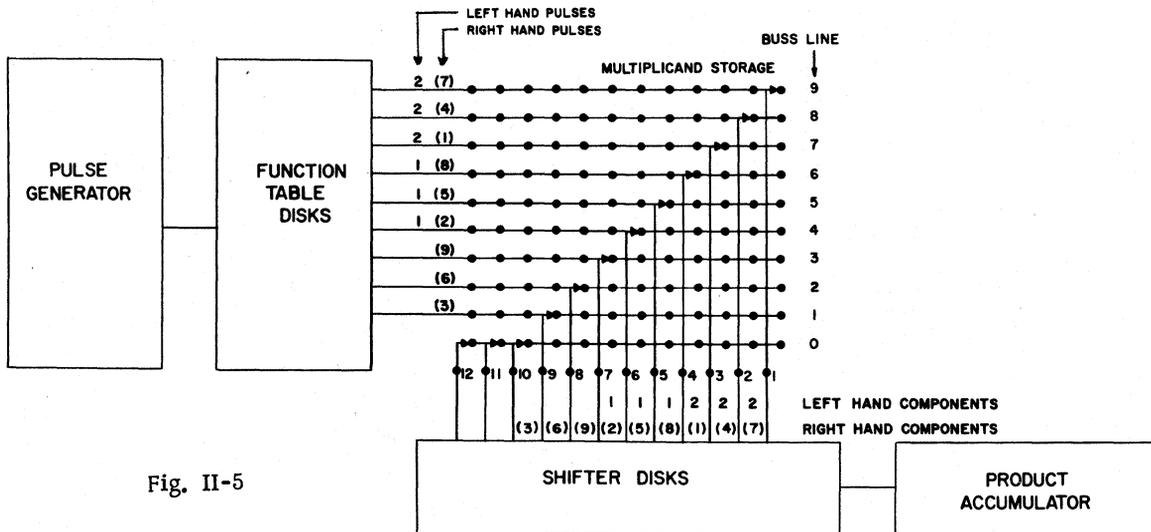


Fig. II-5

Speed of Multiplication

The cycling of the electro mechanical multiplying mechanism is controlled independently of, and not concurrently with, the usual machine cycle. The Product Accumulator cycles at the rate of 300 revolutions per minute. This speed, because of the time sharing of other multiplying operations, determines the basic multiplying speed.

Two cycles are required for each figure of value in the multiplier; one for the right hand component and one for the left. Each digit requires four tenths of a second, except zero which requires no significant time. This multiplying time is not affected by the number digits of the multiplicand. To obtain maximum speed the multiplier should contain the factor with the least number of digits other than zeros.

Round-off and clear requires an additional four tenths of a second. A machine cycle is needed for the product cycle and requires about one half second. The multiplication of a ten-digit number by a five-digit number containing one zero would require approximately 2.55 seconds including round-off, clear, transfer and print as follows:

Multiplication (4 digits x .4)	1.6 seconds
Round-off and Clear	.4 seconds
Transfer and Print	<u>.55</u> seconds
	2.55 seconds

duct accumulator, column 8, etc., with the output of column 12 being routed to product accumulator column 18. The position number of the right hand shifter indicates the product accumulator column to which the output of column one of the multiplicand is routed. For example with the right hand shifter in position 7, the output of column one of the multiplicand section will be routed to product accumulator column 7 when the platen senses the right hand disks. The left hand shifter is wired one column to the left of the right hand shifter; therefore, in left hand shifter position 7 the output of column one of the multiplicand storage would be routed to column 8 of the product accumulator as the platen senses the left hand disks.

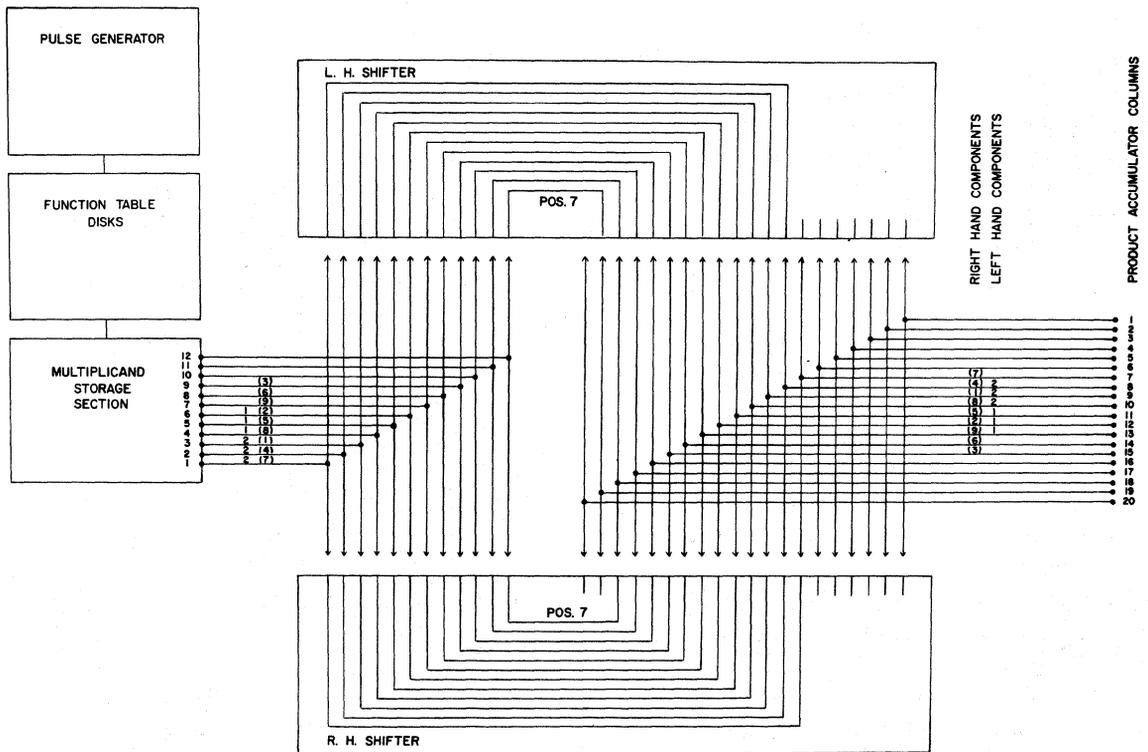


Fig. II-6

ROUND-OFF AND CLEAR

The final product, produced by the accumulation of the right and left hand components of all the digits of the multiplier, can be rounded-off and/or cleared to the nearest penny, dime, dollar or ten dollars through programming. There are three round-off and clear options (lane 42) and four column location options (lane 43). For simplicity, round-off and clear keyboard column 1 (RC1) and no round-off and clear keyboard column 2 (NRC2), will be considered.

With RC1 programmed, round-off is accomplished by routing the five pulse from the pulse generator to the product accumulator pinion solenoid in column 9 during the last right hand stroke. The nine pulses from the pulse generator are applied to the platen as on other strokes; however, with the right hand shifter in position 21 these normal circuits are not completed to the product accumulator. The five pulse is connected to two platen pins, one of which is located on the function table side and the other on the shifter disk side. This latter pin is connected through the right hand shifter (in position 21) and another platen pin to pad D of S261 (lane 42). Pad D of S261 is connected by its wiper to the A pad. The A pad of S261 is wired to the E pad of S262 (lane 43). With RC1 programmed the wiper of S262 completes the round-off pulse route to pad C which is wired to product accumulator column 9.

The "clear" function is accomplished by pulsing the product accumulator total bail solenoid and applying nine pulses to those Product Accumulator columns that are to be cleared (the rounded-off column and all those to the right of it). With the left hand shifter in position 21 and the platen sensing the left hand disks, pad F of S261 is connected to product accumulator columns 1 through 7 and back to pads D and C of S261. The nine pulse from S209-NO is wired to pad E of S261.

With RC1 programmed, the wiper of S261 will connect pads E and F completing the clear pulse route to product accumulator columns 1 through 7. Pad D of S261 will supply the nine pulse to pad A, which is wired to pad E of S262. The wiper of S262, positioned for RC1 will route the nine pulse to pad C and column 9 of the product accumulator. Pad C of S261 is wired to pad D of S263. The wiper for S263, positioned with S262 from lane 43, completes the pulse route to

pad C of S263 which is wired to column 8 of the product accumulator. In this manner columns 1 through 9 receive the clear pulse.

With NRC2 programmed, the wipers of S261 would be positioned to bridge the E and F pads, and the A and C pads. The round-off pulse which is applied to the D pad of S261 would therefore be lost and no round-off would occur during the last right hand stroke. During the last left hand stroke the nine pulse would be routed to the D and C pads of S261 and to the first seven columns of the product accumulator as previously described. The nine pulse to pad D of S261 would produce no result. The nine pulse to pad C of S261 which is wired to pad D of S263, is routed by the wiper of S261 to pad A of S261. Pad A of S261 is wired to pad E of S262. With NRC2 programmed, the wiper of S263 connects pads C and B to pad D, routing the nine pulse to columns 8 and 9 of the product accumulator. The wiper of S262 would be positioned to connect pads B and E, thereby routing the nine pulse to column 10 of the product accumulator. In this manner columns 1 through 10 receive the clear pulse. If no round-off, no clear is programmed (Prorate) the five pulse would be lost on pad D of S261 and the nine pulse would be lost on the E pad of S261, due to the position of the wipers for S261.

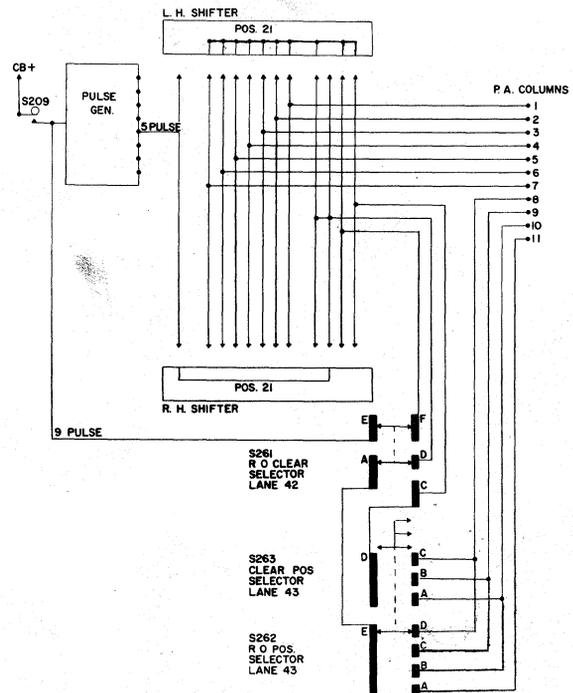


Fig. II-7

MULTIPLICATION CONTROL LOGIC

Setting Up the Preliminary Conditions

In order to execute a multiplication it is first necessary to extend both a multiplier and multiplicand in the operand storage unit. This is accomplished by operating the Sensimatic in a carriage position containing a No. 2 control pin in lane 34 to extend the multiplier or in lane 33 to extend the multiplicand. The operand may be listed on the keyboard or extracted from an accumulator by totaling or subtotaling it.

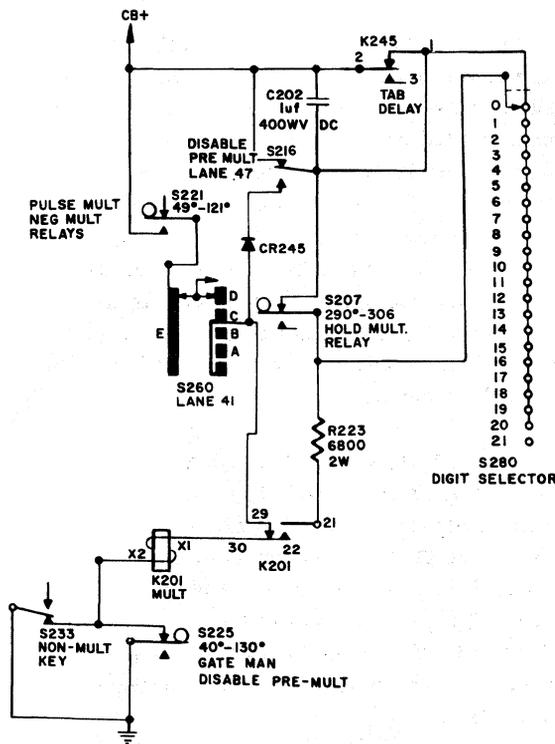


Fig. II-8

In the carriage position just prior to that in which the multiplication is to occur, a pre-multiply condition must be programmed by means of a No. 7 or a No. 5 pin in lane 41. At 49° of the Sensimatic cycle, S221 closes to supply voltage to pad E of S260 (Lane 41), whose wiper has been

positioned through the No. 7 or No. 5 pin to bridge pads E and C. Voltage is supplied from pad C to K201-29 and 30 to pick K201 (Multiply) and set up the pre-multiply condition. Ground is furnished through S233 (Non-Multiply Key), with the non-multiply key normal, in parallel with Sensimatic timing cam switch S225 (Gate Manual Disable Pre-Multiply).

Contacts K201-21 and 22 are designed to make before K201-29 and 30 break. This provides a hold circuit for K201 through contacts K201-21 and 22, resistor R223, S280 (Digit Selector disk) in parallel with S207, and S216 (Lane 62) after S221 opens at 121°. Opening of K201-23 and 24 prevents picking of L222 (Machine Trip Solenoid) in order to delay tripping of the Sensimatic until after completion of the multiplication routine.

Pre-Shift

In order to start the actual multiplication routine, an electrical control pin must be placed in lane 63 (Multiply) of the stop position in which the multiplication is to occur.

With the initial conditions having been set up in the previous step, K245 begins to pick as the carriage reaches the multiplication stop and S257 (Full Power) is normalized. CB+ is applied to K245 through CR246. The ground circuit is through K201-2 and 3, S223 (Gate Multiply Routine) and S257.

CB+ is supplied through K201-24 and 25 to the common of S217 which has been closed by the pin in lane 63. This supplies CB+ to wiper 7 of S279 and through the circuit on S279 to wiper 8 to pick L223 (Directional Key Block), which receives its ground through K245-4 and 5, S223 and S257. Picking of L223 permits S284 (Directional Key Interlock) to close to pick K202 (Start) through K202-6 and 7. K202-1 and 2 are designed to close before K202-6 and 7 open. This provides a CB+ hold circuit for K202 through K201-24 and 25, S217, S205 (Start Relay Hold) and K202-1 and 2. The ground circuit for K202 is the same as the ground circuit for L223.

With K202 picked, CB+ is supplied from S217

through K202-28 and 29 and S240 (C or M key, which will be discussed later) to pick L225 (Decimal Shift) to release the decimal shift tappet (Lane 44). By limiting the movement of the decimal shift tappet, the control pin in lane 44 determines the position of the wipers of S264 and S265. Since K245-4 and 5 are in the ground circuit of L223, it can be seen that the delay-pick characteristic of K245 causes a delay in picking K202 and ultimately delays the release of the decimal shift tappet until the tappet and its control pin are properly aligned.

Release of the decimal shift tappet causes release of the decimal shift timer slide in the auxiliary sensing unit to permit S243 (Decimal Shift Enable) to transfer. The timer slide is required to delay pre-shift until after the shift tappet has settled down if it bounces after it limits on the control pin.

As soon as S243 transfers, L226 (Right Hand Shifter clutch) is energized to move the right hand shifter disk, and L227 (Right Hand Function Table clutch) is permitted to be energized to allow the right hand function table disk to seek the position corresponding to the value of the first multiplier digit if the disk is not already there because of a previous multiplication. The multiplier is "read" from right to left.

CB+ to position the right hand shifter disk is supplied through S243 to pad E of S264. The wiper of S264, previously positioned as the shift tappet limited on the control pin, connects pad E with pad A, B, C or D depending on whether there is a No. 3, No. 5, No. 7 or no pin at all in lane 44 to cause a decimal shift of 2, 5, 7 or 8 places, respectively. This shift is necessary to ensure that the product is generated in the proper product accumulator columns to correspond with the desired decimal point location in the product.

S264-A, B, C and D are connected to wiping contacts on the right hand shifter position selector disk (S277). One of the two pads of each DZ switch of the multiplier storage unit is also connected to a wiping contact as is L226 (Right Hand Shifter clutch) through resistor 2B3. The other DZ switch pads are connected in common to L226, also through resistor 2B3.

As voltage is applied to the selected decimal shift pad of S264, the corresponding wiper gates the voltage to the right hand shifter clutch through the printed circuit configuration of S277 to cause the right hand shifter disk (the same disk as S277) to move one, two, four or seven positions for an 8, 7, 5, or 2 shift, respectively.

When the disk has moved the required number of steps for the programmed decimal shift, the wiping contacts connected to the DZ switches "read" the DZ switches from right to

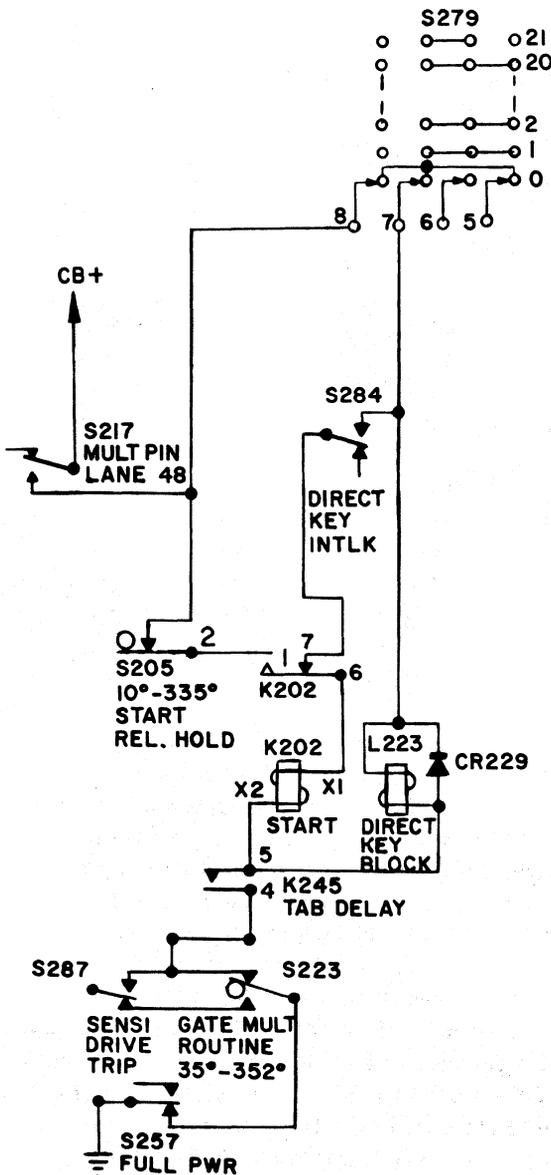


Fig. II-9

left. If there are any zeros to the right of the first multiplier digit, the corresponding DZ switches will be closed. The right hand shifter clutch is held through these switches until an open DZ switch (indicating a significant digit) is sensed. The disk is now in position to gate the first right hand components to the proper product accumulator columns.

The zero pads of all multiplier storage unit columns are connected in series, whereas each digit pad ("1" through "9") of each column is connected in common to the same digit pads of the other columns. These digit commons, or busses, are connected to wiping contacts on S276 (Function Table Position Selector). Two other wipers on S276 are connected to L227 (Right Hand Function Table clutch solenoid) through S239 in parallel with hold resistor 2H3.

As previously mentioned, as soon as S243 closes the right hand function table clutch is energized if it is necessary to move the right hand function table disk to a new position. Voltage is applied through S243 and K202-25 and 26 to the common pad of column one of the multiplier storage unit, through any zero switches closed due to zeros to the right of the least significant digit in the multiplier, to the digit bus corresponding to first significant multiplier digit. L227 may be energized through the selected wiper on S276 and the circuit configuration of S276 to cause the right hand function table disk (the same disk as S276) to turn to the first digit position. If the disk already is in the proper position because of a previous multiplication, the circuit configuration of S276 does not permit L227 to be energized.

As soon as S279 (pinned to the same shaft as the right hand shifter disk) begins to turn, CB+ is supplied from wiper 7 through a disk circuit to wiper 6, and wipers 1 and 2 are bridged by another circuit of the disk. From wiper 6, voltage is supplied through K202-22 and 23, K201-27 and 28, S279-1 and 2 and S203 and S251 in parallel with resistor 2V3 to energize L226 (Left Hand Shifter clutch solenoid) to move the left hand shifter disk. When the left hand shifter disk has reached the same relative position as the right hand shifter disk, the circuit configuration of S279 causes a loss of continuity between wipers 1 and 2, and

the left hand shifter clutch disengages.

With S279 out of home position, wiper 8 becomes isolated and L223 (Directional Key Block) drops.

The left hand function table disk follows the right hand function table disk in a similar manner. As the right hand function table disk begins to turn, disk S278 (Function Table Follow-Up), which is pinned to the same shaft, completes a circuit between S278-1 and 2. Voltage is applied through K201-24 and 25, K202-4 and 5, S278-1 and 2, S204, and S250 in parallel with resistor 2N3 to energize L229 (Left Hand Function Table clutch solenoid). The left hand disk follows the right until S278-1 and 2 open to drop the clutch, indicating that the disks are in the same relative position.

Each of the four disk clutch assemblies contains three switches, generally referred to as interlock switches although they do not all perform interlock functions in the strictest sense. As the clutch engages and begins to turn its disk (or disks), the switches transfer and remain transferred until the clutch disengages. Pick voltage is applied to each clutch solenoid through the contacts of one of these switches in parallel with a resistor. As the clutch shaft begins to turn, the switch opens to cause part of the voltage applied to the solenoid to be dropped across the resistor. This is done for two reasons. Since the disk circuits actually break current to drop out the clutch solenoids, reducing the voltage on the solenoid reduces burning of the printed circuits. Also, the reduced voltage permits a faster drop-out of the solenoids, especially important for the right hand shifter since, if it over-stepped, an entire multiplier digit would be skipped.

When the right hand shifter and right hand function table disks have been positioned, voltage is applied from S279-6 through S249 (a right hand function table interlock switch), S247 (a right hand shifter interlock switch), S206 and K201-5 and 6 to energize L230 (Multiplier Accumulator Clutch solenoid) and trip the multiplier drive for the first right hand accumulator cycle. This occurs even though the left hand disks are still moving since during the first accumulator

cycle only the right hand disks are sensed.

The First Right Hand Stroke

Attached to the product accumulator drive unit is a set of timing cam switches (S201 through S214). The switch camshaft makes one revolution for every two revolutions of the product accumulator. The stated timing to follow will be in relation to rotation of this camshaft unless otherwise specified.

At 10° of the first right hand accumulator cycle S205 (Start Relay Hold) opens to drop K202. Also at 10° S206 (Enable Right Hand Interlock) opens. With S206 open the next voltage path to the multiplier accumulator clutch solenoid must be through S244 (a left hand shifter interlock switch) and S245 (a left hand function table interlock switch). This ensures that both left hand disks are positioned before the accumulator clutch is tripped for a left hand cycle.

S209 is closed from 15° to 110° 30' to apply voltage to the pulse generator to energize the active pinion solenoids through the coding circuits of the components unit.

At 90°, S203 (Gate Left Hand Shifter Clutch) and S204 (Gate Left Hand Function Table Clutch) open and remain open until 315°. This is to prevent repositioning the left hand disks until after completion of the left hand platen stroke.

At 121°, after platen sensing has been completed, S201 (Pulse Shifter Interlock) closes to pick K203 (Shifter Interlock). CB+ is supplied to S201 from S279-5, which receives voltage from wiper 7 through a circuit of S279. K203 is picked by S201 through K203-25 and 26. K203-21 and 22 make before K203-25 and 26 break. After K203-25 and 26 open, a hold circuit is provided from S243, through K202-24 and 25, S235 (a right hand shifter interlock switch) and K203-21 and 22.

If by this time the left hand shifter disk has been positioned, voltage is applied from S279-6 through S244 (a left hand shifter interlock switch), K203-23 and 24 and S246 (a right hand shifter interlock switch) to energize the right hand shifter clutch solenoid. Since the left hand shifter follow circuit disk moves with

the right hand shifter disk, the right hand disk must be prevented from moving until the left hand disk has been positioned. This is accomplished through interlock switch S244.

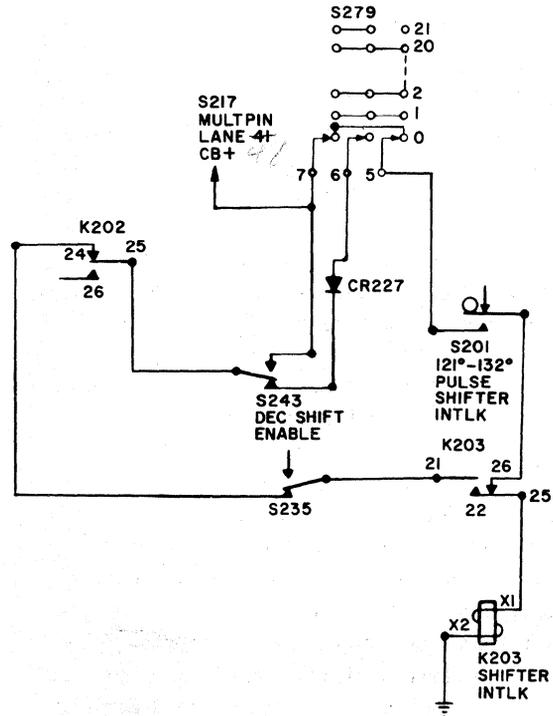


Fig. II-10

As the right hand shifter clutch engages and starts to move its disk, interlock switch S235 opens to drop K203, and S277 wipers "read" the DZ switches as during pre-shift. If there are zeros to the left of the first multiplier digit, a hold circuit is provided for the right hand shifter clutch through the DZ switches in the columns containing the zeros and through resistor 2B3. The first open DZ switch to be "read" causes the clutch to drop. If there is a digit immediately to the left of the first multiplier digit, the disk will move only one position, for which case CR204 is provided to prevent overstepping in case K203 is slow in dropping. If there are no more multiplier digits, the right hand shifter disk will move

all the way to position 21. However, to provide a more complete explanation of the multiply routine, it will be assumed that there are two multiplier digits.

The digit selector disk, S280, is on the back of the left hand shifter disk and is positioned with it. After pre-shift, the digit selector is used to determine subsequent positions of the right hand function table. A wiping contact of S280 connects to each column common, except column 1, of the multiplier storage unit. Other wipers connect to S265-A, B, C and D. The wiper of S265 is positioned by the decimal shift tappet to connect pad E with pad A, B, C or D, depending on the programmed decimal shift. The configuration of S280 is such that with the left hand shifter disk in position, the selected 2, 5, 7 or 8 shift wiper is connected through the multiplier storage unit to the function table position selector (S276) wiper corresponding to value of the next multiplier digit.

S202 (Gate Right Hand Function Table Clutch) closes at 121° . Voltage is applied to S202 from S243 through K202-24 and 25, S236 (a left hand shifter interlock switch) and S237 (a left hand function table interlock switch). S202 applies voltage to S265 to energize the right hand function table clutch solenoid to move the disk to its next position. S236 is necessary to ensure that the left hand shifter disk has been positioned prior to picking the right hand function table clutch since the digit selector on the back of the left hand shifter disk in conjunction with the multiplier storage unit determines to which position the function table disk is to go. Also, since the right hand function table and the left hand function table follow-up disks are pinned to the same shaft, S237 is required to ensure that the left hand function table disk has been positioned prior to moving the right hand function table disk.

As the right hand function table disk begins to turn, S238 (a right hand function table interlock switch) closes to bypass S202 and provide a hold circuit for the right hand function table clutch solenoid in case the disk must be moved so great a distance that it is not fully positioned by the time S202 opens at 270° . The clutch drops out when, as before, the S276 disk opens the cir-

cuit to the clutch solenoid.

The carry pulse is supplied to the product accumulator by S208 from 138° to 170° .

S214 (Enable Left Hand Interlock) is closed from 155° to 190° to energize L230 for the first left hand cycle. The voltage path is from S279-6 through S244 (a left hand shifter interlock switch), S245 (a left hand function table interlock switch), S214 and K201-5 and 6. The interlock switches are necessary to ensure that the left hand shifter and left hand function table disks have been positioned before the accumulator clutch is tripped and the disks are sensed.

The First Left Hand Stroke

If the right hand shifter and right hand function table disks have not been fully repositioned by the time the left hand cycle begins, positioning will be completed during the cycle.

S209 is closed from 195° to $290^{\circ} 30'$ to energize the product accumulator solenoids which are to receive the left hand components.

S207 is open from 290° to 306° . However, two wipers on S280 (Digit Selector) are bridged by a circuit of S280 to provide an alternate circuit to hold K201.

At 315° , after platen sensing, S203 and S204 close to permit the left hand shifter and left hand function table disks to follow-up the right hand disks. The shifter follow circuit is from S279-6 through S249 (a right hand function table interlock switch), K202-21 and -22, K201-27 and 28 and the follow circuit disk. The function table follow circuit is also from S279-6 but through S249, K202-3 and 4 and the follow circuit disk.

The carry pulse is supplied to the product accumulator by S208 from 318° to 350° .

S206 closes at 335° to complete the CB+ circuit from S279-6 through S249 (a right hand function table interlock switch), S247 (a right hand shifter interlock switch) and K201-5 and 6 to pick the multiplier accumulator clutch solenoid for the second right hand cycle.

The Second Right Hand Stroke

At 10° S206 opens, as during the first right hand cycle, to ensure that the subsequent pick circuit for L230 will be through the circuit containing left hand interlock switches.

The active product accumulator pinion solenoids are energized while S209 is closed from 15° to $110^{\circ} 30'$ during platen sensing.

S203 and S204 open at 90° . While the left hand shifter and left hand function table disks are moving, S203 and S204 are paralleled by S251 (a left hand shifter interlock switch) and S250 (a left hand function table switch), respectively. If by 90° either left hand disk has not been fully positioned, its clutch solenoid continues to be energized through S251 or S250 until the follow-up disk opens the circuit to drop the clutch.

From 121° to 132° , S201 is closed to pick K203 to reposition the right hand shifter disk as during the first right hand cycle. However, since it is being assumed that there are no more multiplier digits, all of the remaining DZ switches are assumed closed and the right hand shifter disk moves all the way to position 21 where it stops as disk S277 drops the clutch solenoid.

When S202 closes at 121° , the right hand function table disk will not move because of the lack of an additional multiplier digit.

S208 supplies the carry pulse from 138° to 170° .

The product accumulator clutch solenoid is picked for the second left hand cycle when S214 is closed between 155° and 190° and both left hand disks have been positioned.

The Second Left Hand Stroke

The active product accumulator solenoids are energized by S209 from 195° to $290^{\circ} 30'$.

At 315° S203 and S204 close. The left hand shifter disk begins to follow the right to position 21 but the left hand function table disk does not move since it is still in the same relative position as the right.

S208 supplies the carry pulse to the product accumulator from 318° to 350° .

S206 closes at 335° so that L230 will be picked for the next right hand cycle (round-off) as soon as the right hand shifter disk has been fully positioned in position 21.

The Third Right Hand Stroke (Round-Off)

L231 (Round-Off Release Solenoid) is connected to wiper (S277-A1) on disk S277 (Right Hand Shifter Position Selector). As the right hand shifter disk and consequently S277 reach position 21, the active shift wiper is connected by a disk circuit to the round-off wiper to energize L231 which releases the round-off and clear control tappets in lanes 42 and 43.

At 10° S206 opens the right hand pick circuit for L230.

At 15° S209 closes so that a 5 pulse will be gated by the round-off circuit to the product accumulator column selected through control unit programming to receive the round-off pulse.

S212 (Pulse Total Bail) is closed from 45° to $72^{\circ} 30'$ to complete a circuit from wiper S277-A1 through K201-8 and 9 to pick L235 (Total Bail). This indexes the product accumulator total bail, which will be mechanically actuated during the next cycle.

The pick circuits of the left hand shifter and left hand function table clutch solenoids are opened when S203 and S204 open at 90° .

With disk S279 in position 21, CB+ is removed from wiper 5. This removes CB+ from S201 so that when S201 closes at 121° , K203 will not pick and the right hand shifter disk will not move.

S208 completes the carry circuit from 138° to 170° .

S214 is closed from 155° to 190° to pick the accumulator clutch solenoid with the left hand shifter disk in position 21.

The Third Left Hand Stroke (Clear)

Early in this cycle the total limit bail is mechanically actuated. At 195° S209 closes to apply the clear (9) pulse to the product accumulator solenoids in the columns selected through programming to be cleared.

S207 (Hold Multiply Relay) opens at 290° and K201 drops since the alternate hold circuit which had been provided by disk S280 is open with the disk in position 21.

K201-24 and 25 open to disable the S208 carry circuit.

K201-23 and 24 close to home the right hand shifter disk through wipers S279-3 and 4 bridged by a circuit of S279 until the disk is in home position.

At 300° S213 closes to complete the CB+ circuit from K201-23 and 24 to pick L233 (Mesh Control) which lowers the transfer link. The product will be transferred as the Sensimatic cycles.

The left hand shifter disk homes through its S279 follow circuit and K201-26 and 27 when S203 closes at 315°.

As K201-2 and 3 open and K201-1 and 2 close, S287 (Sensimatic Drive Trip) is inserted in the K245 ground circuit. If a motor bar has been depressed or a repeat of machine operation has been set up, S287 is transferred to complete the ground circuit and K245 is held. CB+ is supplied from K201-23 and 24 through K245-6 and 7 and the crossfooter non-clear lock switch network to energize L222 (Machine Trip) permitting the Sensimatic drive to trip.

DISABLE PRE-MULTIPLY (LANE 62)

In some cases, for reasons of application, it may be desired, after setting up a pre-multiply condition, to vary the machine operation and select a carriage stop position in which it is not desired to multiply. An electrical control pin placed in lane 62 (S216) of this stop position will disable the pre-multiply condition by opening the hold cir-

cuit of K201 as soon as the carriage has settled down. The Sensimatic will then operate normally. Accidental dropping of K201 by lane 62 pins as the carriage moves between stops is prevented by K245 (Tab Delay), contacts 1 and 2.

C AND M KEYS

The C or M key is used in a multiplication stop to override the carriage controlled decimal shift. The C key provides a shift of 7 and the M key a shift of 8.

These keys are most commonly used in a billing operation in conjunction with a carriage controlled shift of 5. Use of the C or M key converts a unit price to a price per hundred or price per thousand, respectively.

Depression of the M key transfers S240, which opens the circuit to L225 (Decimal Shift) so that the shift tappet will not be released, S240, transferred, also bypasses S243 (Decimal Shift Enable) in conjunction with K202-28 and 29. Since the shift tappet does not release, the wipers of S264 and S265 remain in their normal positions, bridging common pads E and 8 shift pads D.

The multiplication circuits are basically the same as during a normal multiplication. However, during pre-shift, voltage is supplied to the right hand shifter and right hand function table circuits through K202-28 and 29, transferred S240 and normal S243 instead of through transferred S243. After K202 drops during the first right hand cycle, voltage is supplied to the right hand clutch circuits from S279-6 through CR227 and normal S243. CR227 is necessary to isolate S279-6 from S279-7 with S279 home to prevent prematurely energizing L230 (Multiplier Accumulator Clutch).

Depression of the C key transfers S241 and S242 as well as S240. S241 and S242 transfer the right hand clutch circuits from the 8 shift wipers of S277 (Right Hand Shifter Position Selector) and S280 (Digit Selector) to the 7 shift wipers.

NEGATIVE MULTIPLY AND NEGATIVE PRE-MULTIPLY

With a negative multiply condition set up, the next product generated will subtract from crossfooter A during product transfer and will be printed in red.

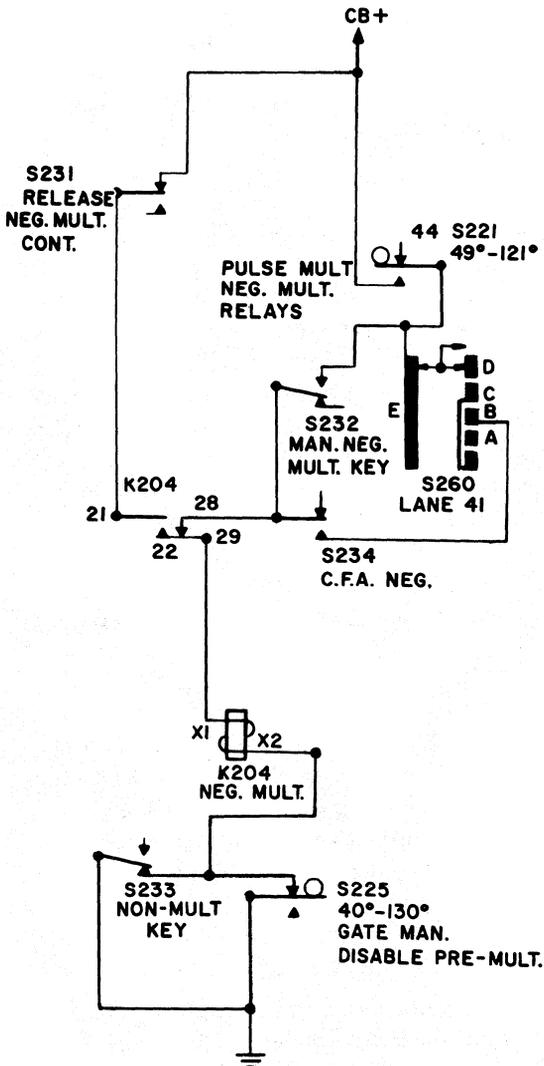


Fig. II-11

Negative multiply may be indexed either through control unit programming or by depression of the negative multiply key. A Sensimatic cycle is always required, and to set up a carriage controlled negative multiply crossfooter A must be in a negative condition and totaled or subtotaled. With carriage controls active, negative multiply remains indexed until a product transfer cycle or until a sensimatic cycle with

the non-multiply key depressed. Release of negative multiply may also be accomplished by momentarily moving the carriage control disabling lever to the rear.

Programmed negative multiply requires a No. 3 pin in lane 41. Negative pre-multiply, which is actually negative multiply and pre-multiply indexed simultaneously, requires a No. 5 pin.

As the Sensimatic is cycled during a negative total or subtotal of crossfooter A, S234 (C.F.A. Negative) closes as the pinions are cross-shifted. A No. 3 or a No. 5 pin in lane 41 causes the wiper of S260 (Lane 41) to be positioned to bridge pads E, B and A, or pads E, C and B, respectively. Pad A is used only with the multiple factor storage feature.

At 49° S221 closes to supply CB+ to S260-E and B and through S234 and K204-28 and 29 to pick K204 (Negative Multiply). With a No. 5 pin active in lane 41, voltage is also supplied to S260-C to pick K201 (Multiply) and set up a pre-multiply condition. Ground is supplied to both K201 and K204 through S233 (Non-Multiply Key) in parallel with S225 (Gate Manual Disable Pre-Multiply).

With the negative multiply key depressed, S232 (Manual Negative Multiply Key) is closed to bypass both S260 and S234 so that K204 may be picked without special programming or crossfooter A controls.

K204-21 and 22 are designed to make before K204-28 and 29 break providing a K204 hold circuit through K204-21 and 22 and S231 (Release Negative Multiply).

With K204 picked, DS204 is illuminated through R227 and K204-26 and 27 to provide a visual indication that a negative multiply condition has been set up.

As the transfer linkage is unlatched during the clear cycle of the subsequent multiplication, S256 (Gate C.F.A. Subtract) transfers. L232 (C.F.A. Subtract) is energized through S256 and K204-26 and 27 to simulate control pins in lanes 7 (C.F.A. Subtract) and 12 (red ribbon). As the product accumulator is meshed, the meshing

link opens S231 to drop K204.

DECIMAL LIGHTS

Decimal point indication lights on the keyboard are provided as standard construction between columns 2 and 3 (.2), 5 and 6 (.5) and 8 and 9 (.8). These are illuminated through control unit programming to indicate in which keyboard columns amounts should be indexed.

With a control pin in lane 64, the light is between columns 5 and 6. A control pin in lane 65 produces a light between columns 8 and 9 and lack of a pin in either lane results in a light between columns 2 and 3.

CB+ is supplied to the decimal lights through CR244 (isolates MB+ from CB+) and R224. Ground is supplied through S223 (Gate Multiply Routine), S218 (Lane 64) and, if programmed, S219 (Lane 65).

With no pin in either lane 64 and 65, the circuit to DS201 (.2) is completed through S218 and S219 in series. A pin in lane 64 transfers S218 to complete the circuit to DS203 (.5). With a pin in lane 65 the circuit to DS202 is completed through S218 by transferred S219.

There is no decimal indication light with the carriage controls inactive.

NON-MULTIPLY KEY

The non-multiply key is used to prevent setting up a programmed pre-multiply or negative multiply condition by overriding the carriage controls. It also prevents setting up a repeat of machine operation, motor bar repeat or carriage controlled repeat of keyboard.

The common ground circuit for K201 and K204 is through normally closed S233 (Non-Multiply Key) in parallel with S225 (Gate Manual Disable Pre-Multiply). With the non-multiply key depressed, ground is removed from K201 and K204 while S225 is open from 40° to 130° of the Sensimatic cycle. Since the pick circuit for the relays is through S221 (Pulse Multiply and Negative Multiply Relays) from 49° to 121°, the relays cannot be

picked because of the open ground.

S225 serves two purposes. It prevents dropping K201 if the non-multiply key is depressed during a multiplication routine, which would result in a wrong product, and it also prevents dropping K201 or K204 if the key is accidentally depressed at any time without cycling the Sensimatic.

CROSSFOOTER NON-CLEAR LOCK

The crossfooter non-clear lock control permits blocking of the Sensimatic drive trip through control unit programming if crossfooter A is not clear. Depression of motor bar No. 1 disables the lock.

To release the Sensimatic drive with carriage controls active L222 (Machine Trip) must be energized through K201-23 and 24, K245-6 and 7 and a switch network consisting of three parallel circuits. Normally closed S220 (Crossfooter Non-Clear Lock - Lane 61) is in parallel with normally open S255 (Release Non-Clear Lock). Both of these switches are in parallel with a switch network consisting of S254 (C.F.A. Sign) in series with S252 (+clear) and S253 (-clear) which are in parallel.

With a control pin in lane 61 to open S220 and motor bar No. 1 normal, L222 can be energized only through S254 and either S252 or S253. Either S252 or S253, but not both, can be closed at one time. With crossfooter A clear in a plus condition S252 is closed and with crossfooter A clear in a minus condition S253 is closed. Both switches are open when the crossfooter is not clear. S254 is normal with crossfooter A in a plus condition and transferred with the crossfooter minus. This forces the machine trip circuit to be through S252 with the crossfooter plus and through S253 with the crossfooter minus. S254 is necessary because when one set of crossfooter pinions is clear the other contains all nines.

Depression of motor bar No. 1 closes S255 which bypasses the parallel switch network to pick L222.

With carriage controls inactive, the

non-clear lock control is disabled since MB+ is then supplied directly to L222 through CR223.

CLEAR PRODUCT ACCUMULATOR

After prorating or after a power failure during multiplication, it may be necessary to clear the product accumulator. This may be done, either by depression of the Δ key with carriage controls disabled or through control unit programming.

Depression of the Δ key trips the Sensimatic drive and closes S248 (Manual Clear), supplying MB+ to S222 (Pulse Multiplier Accumulator Clutch). S222 is closed from 5° to 155° of the Sensimatic cycle to energize L224 (Keyboard Stop), L236 (Symbol Slide Stop) and L237 (Register Designation Stop) and to pick L230 (Multiplier Accumulator Clutch) through S210 (Home Multiplier Accumulator) and K201-4 and 5.

S212 (Pulse Total Bail) is closed from 45° to 72° $30'$ of multiplier timing switch camshaft rotation to energize L235 (Total Bail), which partially indexes the product accumulator total bail.

At 160° S210 (Home Multiplier Accumulator) closes to pick L230 through K201-4 and 5 for a second product accumulator cycle.

Early in the second accumulator cycle the total bail is latched in and at 183° $30'$ S211 (Pulse Clapper Bail) closes to energize L234 to latch the clapper reset bail in active position. With the clappers held clear of the pinions, the accumulator is cleared by rotating the pinions until the total lobes limit on the total bail.

Carriage controlled clearing of the product accumulator is accomplished in a similar manner with a control pin active in lane 66. The Sensimatic drive must be tripped through a programmed repeat or depression of a motor bar. CB+ is supplied to S222 through S256 (Gate C.F.A subtract) and S215 (Lane 66). S256 is in the circuit to ensure that the meshing link has been reset before the accumulator clutch is tripped for a clear operation.

Resistor R225 across S215 is provided to hold L234 if the carriage moves out of the stop position before the clapper reset bail has been latched.

TAB DELAY RELAY (K245)

Because of the complex manner in which it is controlled and since it has several uses, K245 will be treated separately.

K245 is actually a triple purpose, delay pick relay. Its main function, however, is to delay the trip of the Sensimatic drive until the program unit has settled down after the carriage has been tabulated or returned more than two inches.

With the carriage in a non-multiplying stop position, depression of a motor bar transfers S287 (Drive Trip) to complete the ground circuit to K245 through S257-NC (Full Power), S223 (Gate Multiply Routine) and K201-1 and 2. CB+ is supplied through CR246 which isolates CB+ from MB+. When K245 picks, K245-6 and 7 complete the CB+ circuit to L222 (Machine Trip) through K201-23 and 24 and S220 (Lane 61) to release the Sensimatic drive.

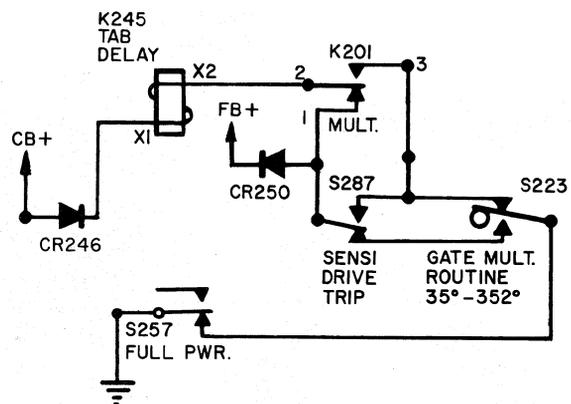


Fig. II-12

When the carriage is moving, S257 is transferred to supply full power to the magnetic carriage drive clutch and also to open the ground circuit of K245. As the carriage reaches a non-multiplying stop position, S257 normalizes and, with a motor bar depressed or a repeat of machine operation set up, K245 begins to pick. The slow pick characteristic of K245 causes a delay

in closing K245-6 and 7 which complete the CB+ circuit to L222. This ensures alignment of control pins and tappets before the Sensimatic drive trips. At 35° of the Sensimatic cycle S223 transfers to drop K245.

Since it is sometimes desired to select a motor bar in a multiply position, to prevent loss of speed multiplication will begin without depression of a motor bar. In order to begin multiplication, however, K245 must be picked. Therefore, since K201 already has been picked before the carriage enters the multiply stop, K201-2 and 3 bypass S287 in the K245 ground circuit.

It is not necessary to delay the Sensimatic drive trip through K245 when the carriage has moved less than two inches since the carriage will have been positioned before the Sensimatic camshaft reaches its home position. A delay is prevented by S223 in conjunction with S287 (Drive Trip). At 35° of the Sensimatic cycle, S223 transfers to drop K245 by opening its ground circuit. S223 remains transferred until 352°. However, at 313°, S287 resets and, since S223 is still transferred, the ground circuit of K245 is remade to repick K245. If, by this time, the carriage has completed its movement, there is virtually no delay of drive trip.

A second function of K245 is to provide an alternate hold circuit for K201 to prevent accidental release of K201 by lane 62 pins as the carriage moves between stops. As previously explained, K245 is always normal when the carriage is moving. Therefore, a set of its normally closed contacts is used to bypass S216 (Lane 62) contacts with the carriage in motion.

In case it is desired to program a DPM (Disable Pre-Multiply - Lane 62) and a PM (Pre-Multiply - Lane 41) in the same carriage position, diode CR245 between S260C and the normally closed contact of S216 (Lane 62) is required to provide an alternate hold circuit for K201. At 35° of the Sensimatic cycle, S223 transfers to drop K245 which will provide the K201 hold through normally closed contacts. At 49°, S221 closes to provide the pulse to pick K201. If K245 does not have time to drop before K201 picks, without CR245 K201 would pick and imme-

diately drop again repeatedly until K245 did drop to provide the K201 hold. This would cause excessive burning of the K201 pick contacts. CR245, however, provides a hold path as long as S221 is closed.

The third purpose of K245 is to delay the release of the decimal shift tappet until the carriage has settled in a stop position. This is covered in detail in the discussion of the pre-shift portion of the multiplication routine.

Arc suppression for K245 is provided by CR250.

POWER SUPPLY

The DC power for the F2000 Computer is provided by a full wave rectified power supply mounted inside the rear gate of the machine stand. An AC powered blower (B202, Fig. II-13) also mounted in the gate serves to cool the various electrical components.

The power transformer (T201) isolates the DC electrical system from the power line and through a center-tapped secondary winding facilitates full wave rectification. Rectification is provided by two silicon diode rectifiers (CR201 and CR202). A 5-ohm series resistor (R228) prevents damage to the rectifiers by reducing the charging current drawn by the filter capacitor (C201) as the AC power is turned on. A 750-ohm bleeder resistor (R221) provides voltage regulation and also discharges the filter capacitor when the AC power is turned off.

Since the current requirements of the F2000 are relatively high, a heavy duty AC relay (K205) is used to control the main input. Depression of the ON key closes S228 completing the AC circuit to K205. The ON key is latched electromechanically through the ON key latch solenoid L221. If the line voltage is interrupted for a period long enough to cause incorrect multiplication (more than 200 milliseconds), L221 drops out to release the ON key and turn off the AC power. Zener diode CR206 in series with L221 always drops 50 volts when it is in a state of conduction so that the voltage applied to L221 is 50 volts less than the DC output of the power supply. This causes

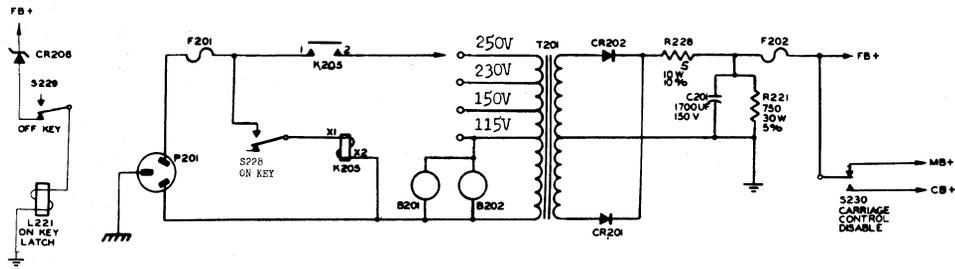


Fig. II-13

the solenoid to be more sensitive to voltage fluctuations, producing a more reliable dropout when the line voltage fails.

directly with the AC input and inversely with the electrical load. An AC input of 115 volts produces a nominal DC output of 130 volts with the machine idling.

The DC output of the power supply varies

INTERLOCKS FOR THE PICK CIRCUIT OF THE CLUTCH SOLENOIDS

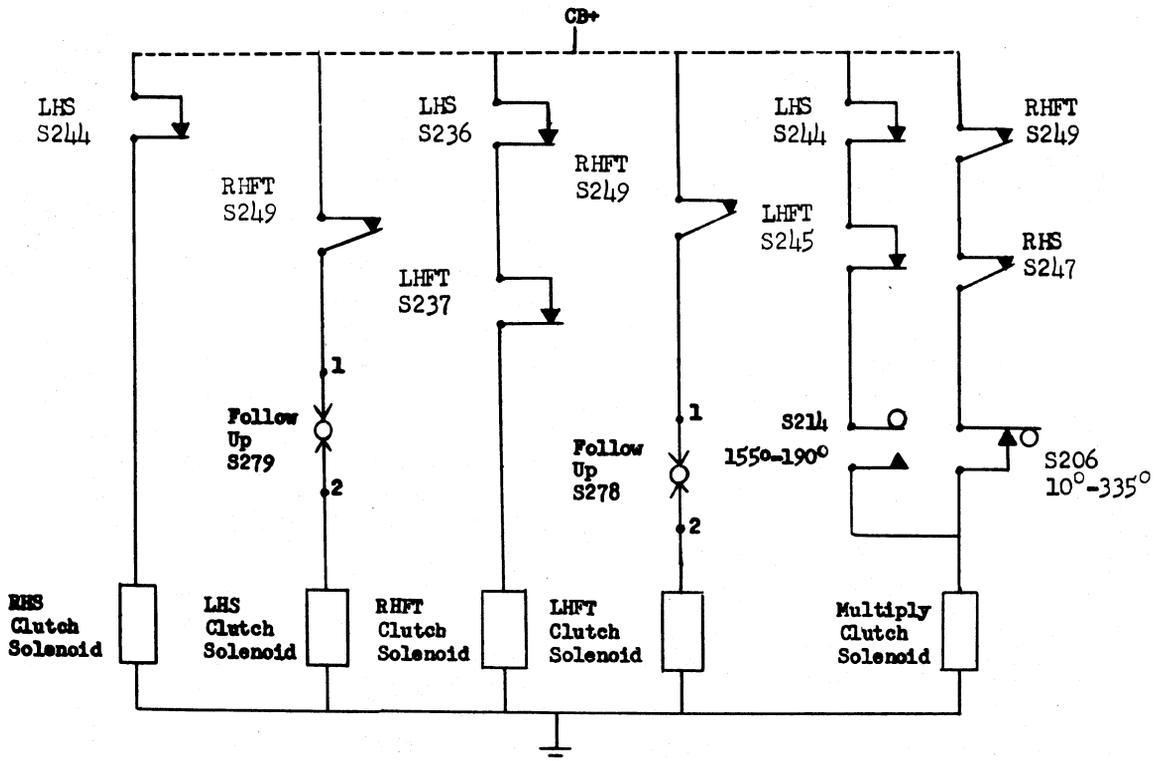


Fig. II-14

BACK UP		ADD RIGHT HAND COMPONENTS										BACK UP		ADD CARRIES			
CARRY RESET		INITIAL CARRY POSITION										POSITION CARRY WIPERS		CARRY PULSE (S208)			
CLAPPER RESET												CLAPPER RESET					
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	
BEGIN R H STROKE	14°	PLATEN SENSING										115°					
	15°	CURRENT TO PULSE GENERATOR										110°					

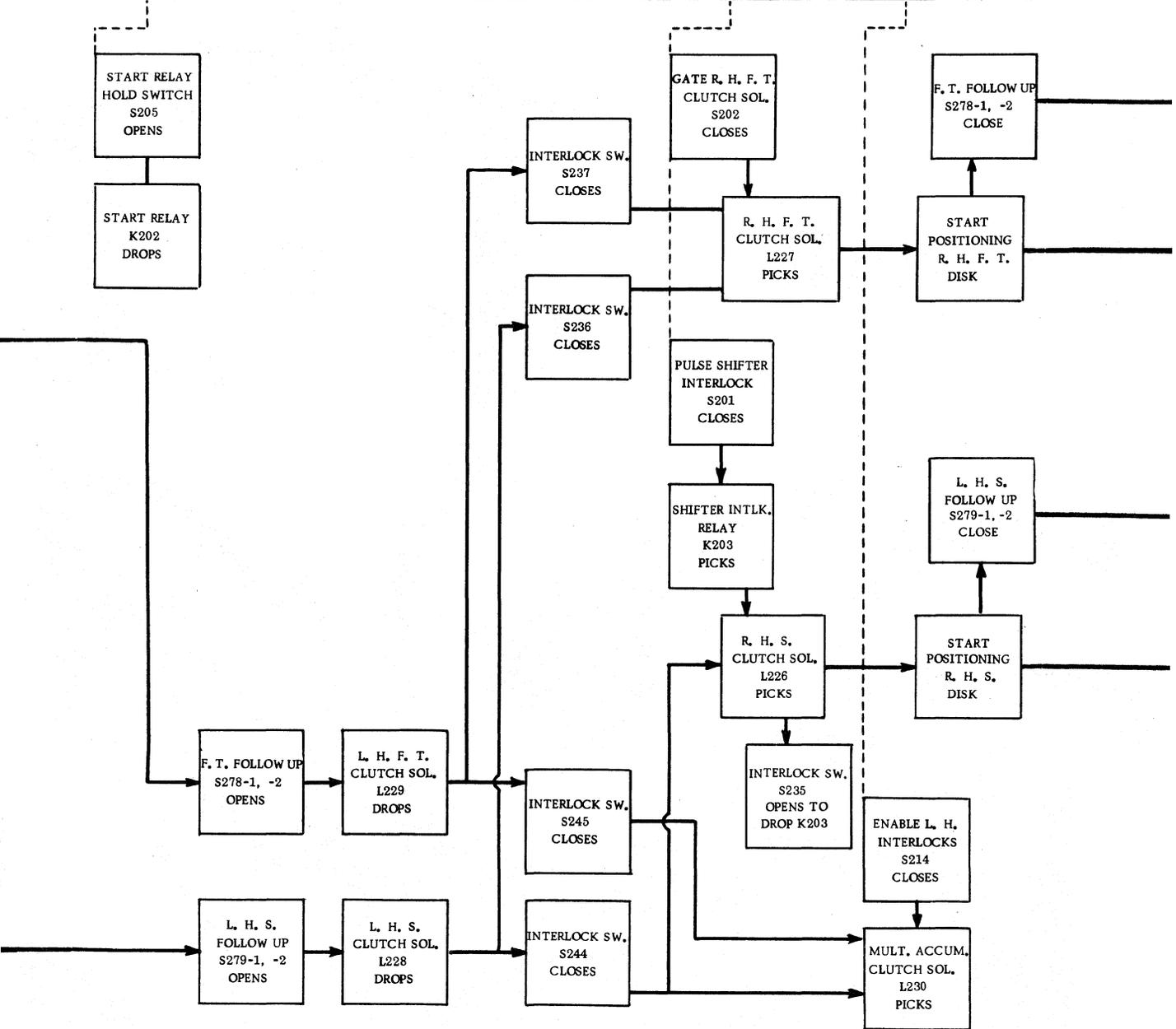


Fig. II-16

BACK UP		ADD LEFT HAND COMPONENTS										BACK UP		ADD CARRIES		
CARRY RESET		INITIAL CARRY POSITION										POSITION CARRY WIPERS		CARRY PULSE (S208)		
CLAPPER RESET												CLAPPER RESET				
2C	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340
19C	20C	210	220	230	240	250	260	270	280	290	300	31C	320	330	340	350
BEGIN L. H. STROKE	194°	PLATEN SENSING										295°				
	195°	CURRENT TO PULSE GENERATOR										290°				

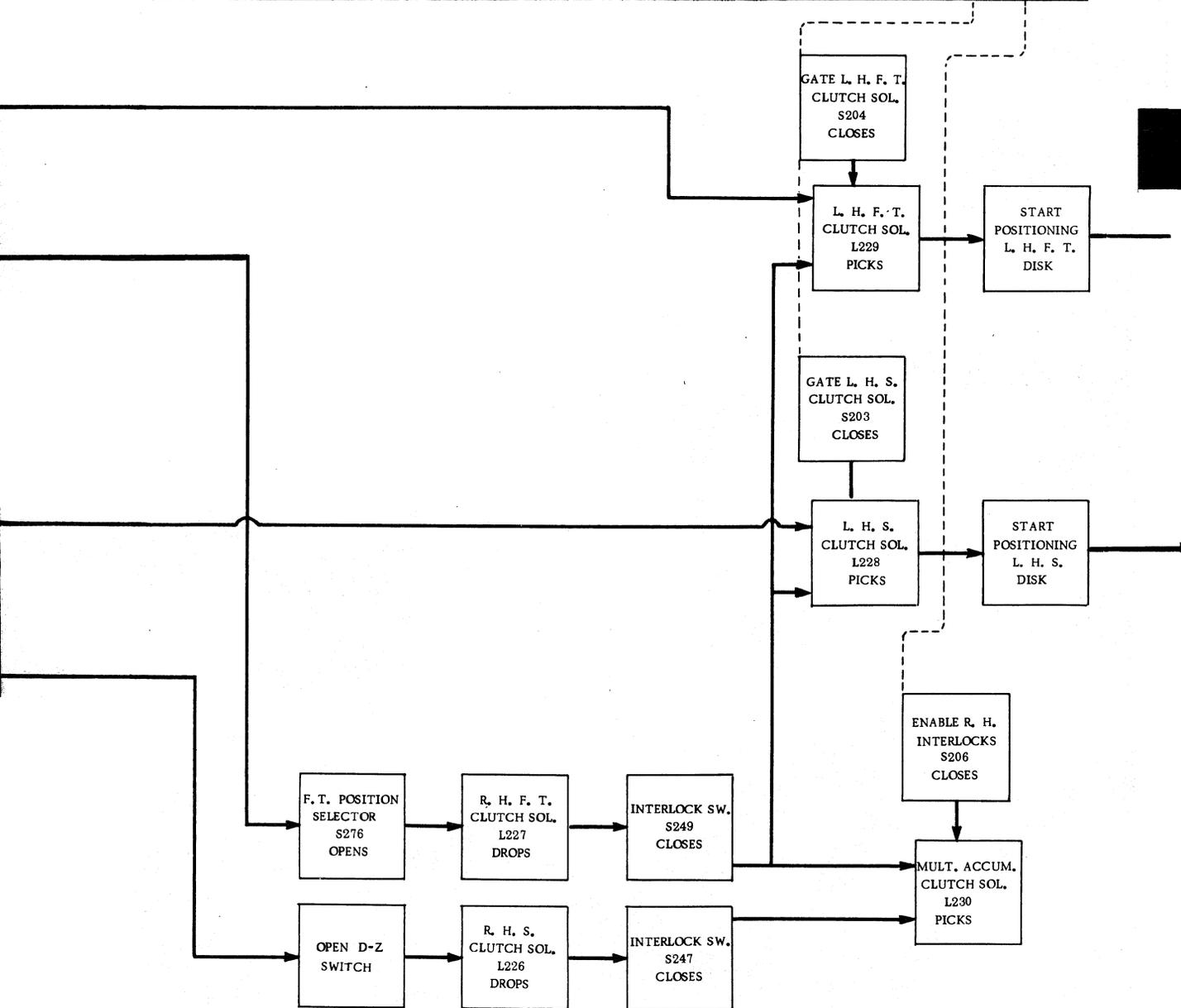


Fig. II-17

BACK UP		ADD RIGHT HAND COMPONENTS										BACK UP		ADD CARRIES																			
CARRY RESET		INITIAL CARRY POSITION										POSITION CARRY WIPERS		CARRY PULSE (S208)																			
CLAPPER RESET												CLAPPER RESET																					
20		40		60		80		100		120		140		160		180		200		220		240		260		280		300		320		340	
10		20		30		40		50		60		70		80		90		100		110		120		130		140		150		160		170	
BEGIN R.H. STROKE		14° PLATEN SENSING										115°																					
15°		CURRENT TO PULSE GENERATOR										110°																					

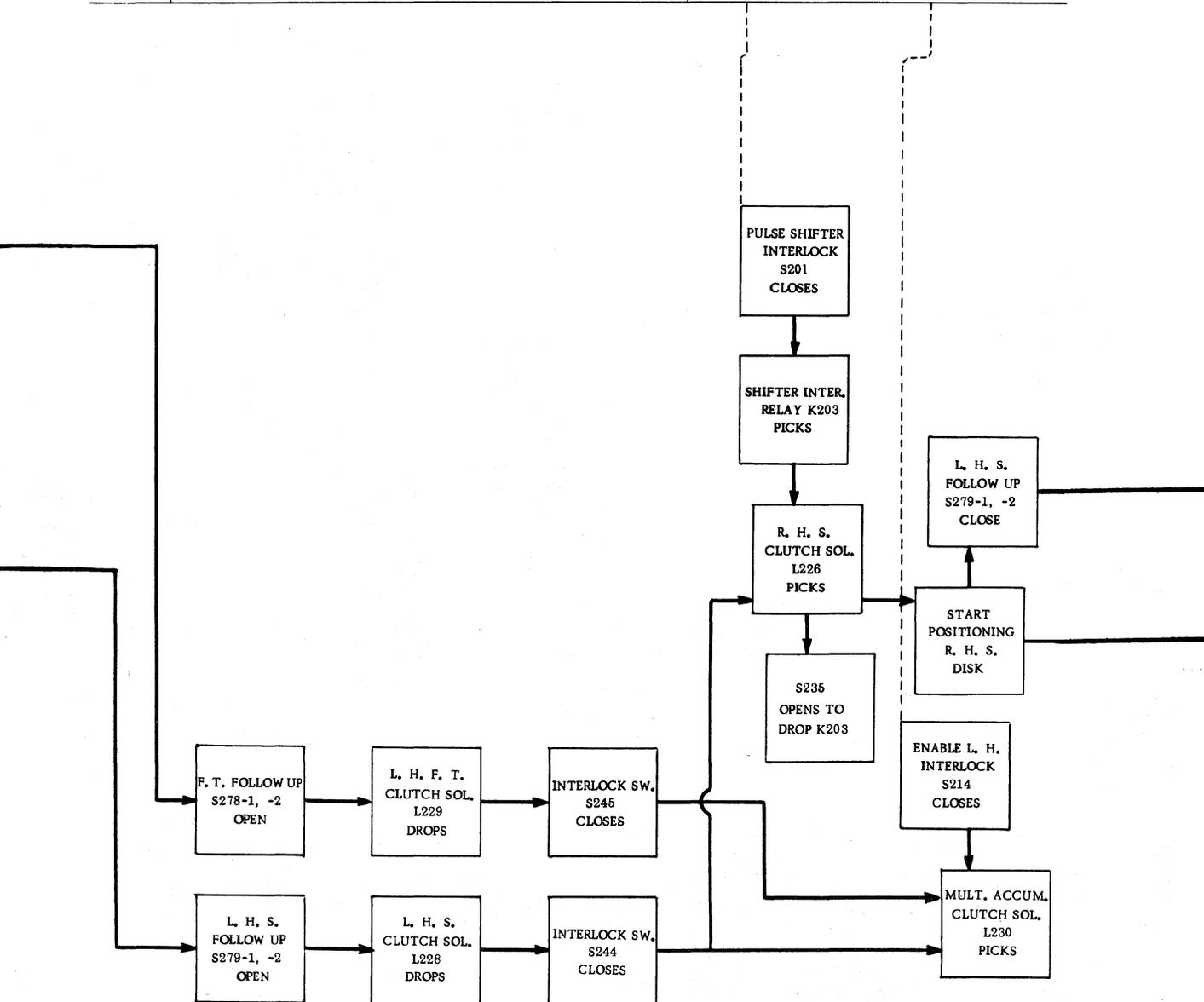


Fig. II-18

BACK UP				ADD LEFT HAND COMPONENTS								BACK UP				ADD CARRIES	
CARRY RESET		INITIAL CARRY POSITION										POSITION CARRY WIPERS		CARRY PULSE (S208)			
CLAPPER RESET												CLAPPER RESET					
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	
190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	
BEGIN L. H. STROKE		PLATEN SENSING															
194°												295°					
195°		CURRENT TO PULSE GENERATOR										290°					

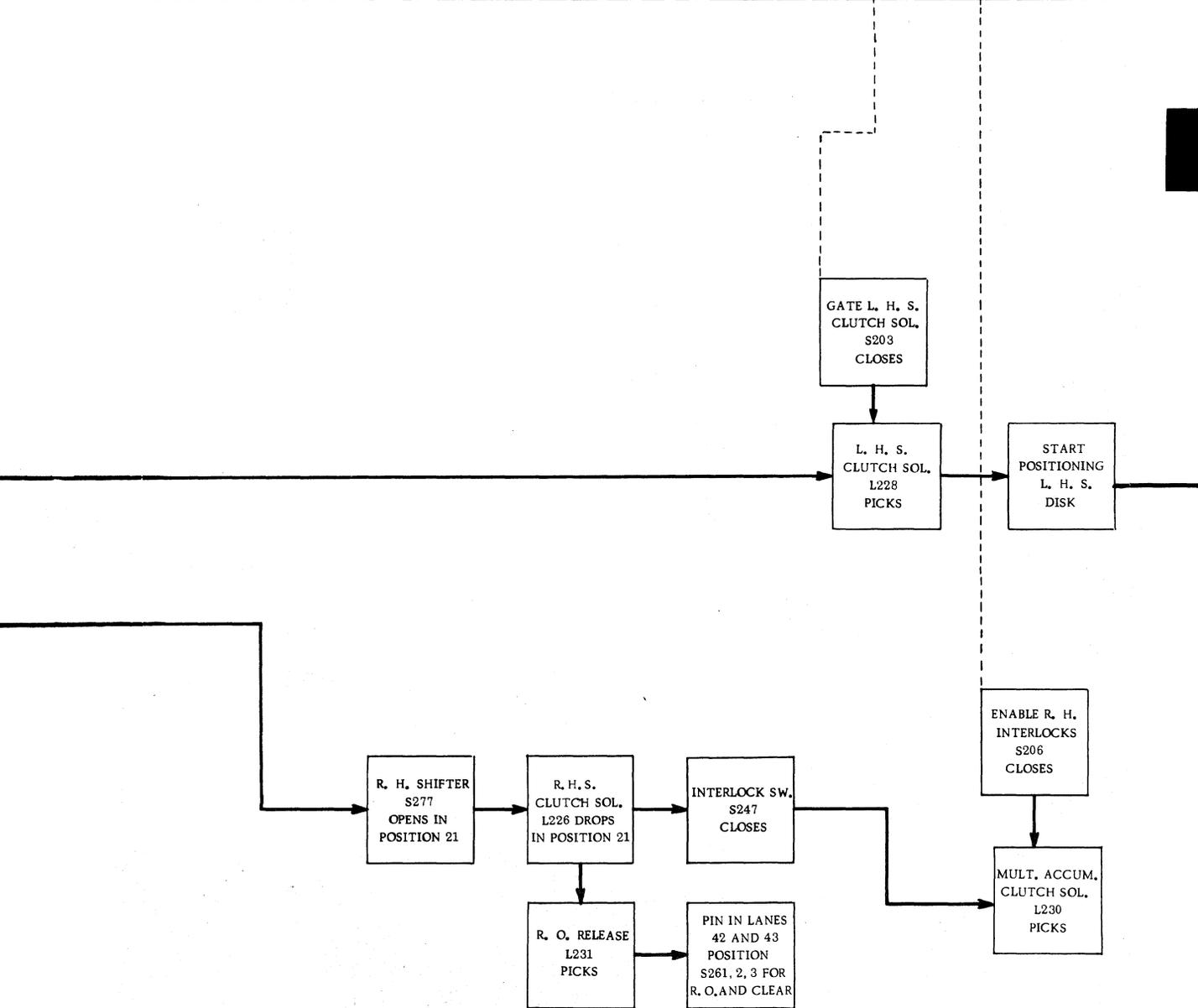


Fig. II-19

BACK UP		ADD ROUND OFF PULSE										BACK UP		ADD CARRIES		
CARRY RESET		INITIAL CARRY POSITION										POSITION CARRY WIPERS		CARRY PULSE-S208		
CLAPPER RESET												CLAPPER RESET				
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
BEGIN R.O. STROKE	14°	PLATEN SENSING										115°				
	15°	"5" PULSE FROM P.G.										74°				

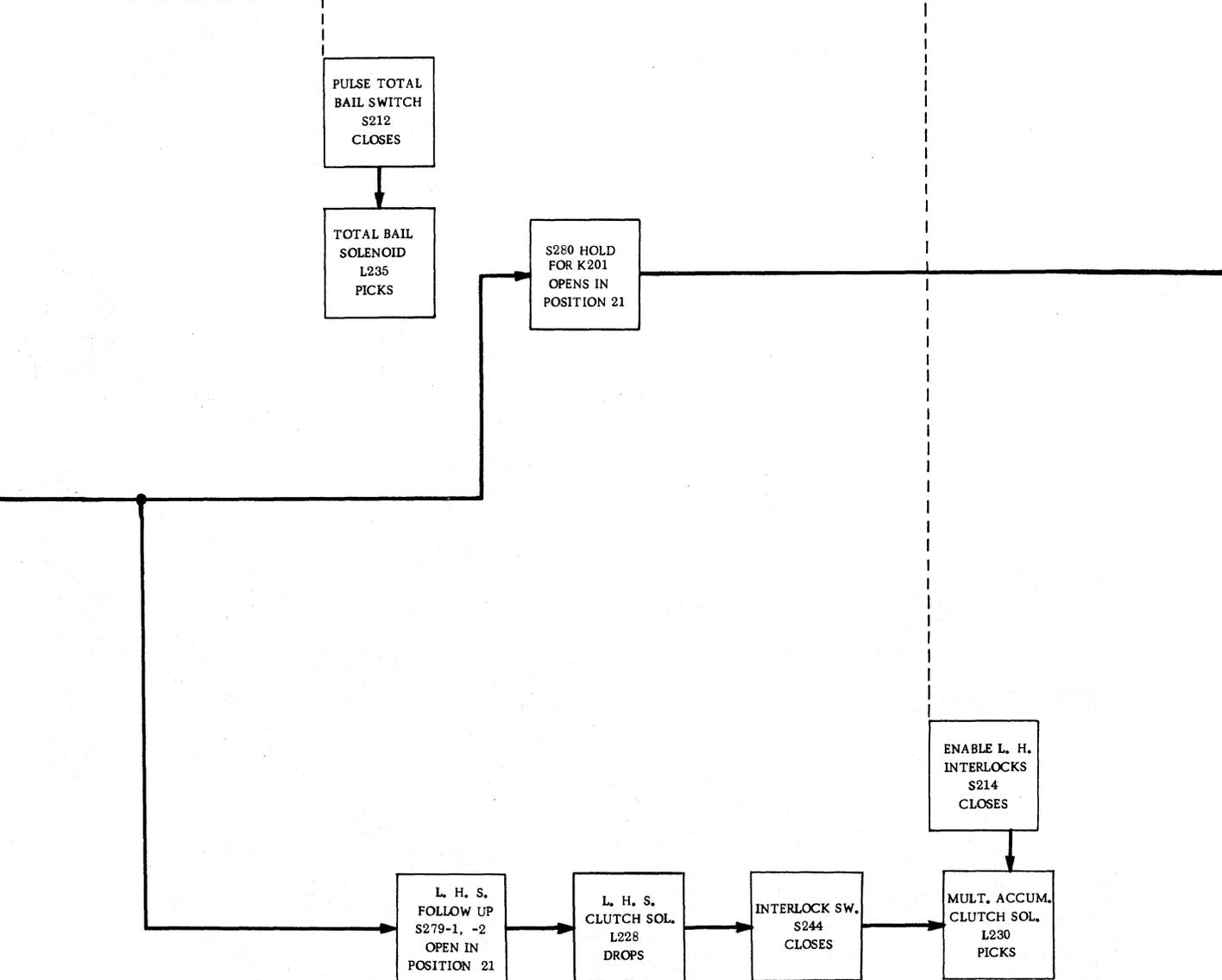


Fig. II-20

OUTLINE OF MULTIPLICATION ON F2000

Including Pick-Ups of Multiplier, Multiplicand, Pre-Multiply and Multiply Routine

- A. Index and extend multiplier (MP)
 - 1. Sensimatic cycle with 2 pin in lane 34.
- B. Index and extend multiplicand (MC)
 - 1. Sensimatic cycle with 2 pin in lane 33.
- C. Pre-Multiply)
 - 1. Sensimatic cycle with 7 or 5 pin in lane 41 (this picks and holds K 201, and, thru points 24 and 25 of K 201, machine block L 222 is picked to prevent next sensimatic cycle till product is ready to transfer)

D. Multiply Routine

- 1. Pick start relay (K 202); this requires 4 conditions:
 - (1) Sensimatic home (re: S 223)
 - (2) Carriage on a stop (re: S 226)
 - (3) An X pin in lane 48 (re: S 217)
 - (4) K 201 picked in next previous stop (re: K 201-2 and 3.)

Note: L 223 directional key block will also be picked when K 202 picks.

- 2. Pick L 225 which releases tappet in lane 44 to sense programmed Decimal Shift. (Sensing lever in lane 44 transfers S 243 and moves wipers in S 264 and S 265 to position designated by pin length)

Note: If "C" or "M" key was used going into multiply routine, ^{S 243} L 225 will not be picked because of S 240 and S ~~241~~ will not be transferred. Also, wipers in S 264 and S 265 will not be positioned. This, in effect, will override programmed Decimal Shift and allow S 241 and S 242 to determine whether an 8 Shift or 7 Shift is to be used.

- 3. Position all discs in components unit, in preparation to start pulse routing (all discs go regardless of interlocks, re: K 202)

- (1) R.H.S. to first position determined by S 264 and D-Z switches (S 279 is pinned to same shaft as R.H.S. so it goes to same position.)
- (2) L.H.S. to first position determined by R.H.S. through follow up circuit (S 280 digit selector is on back of L.H.S. disc so it goes to same position.)

See S 277

see note

Note

Note -

If right & left disks are not in the same position wipers # 1 & 2
will be connected (follow up)

3. (3) R.H.F.T. to first position determined by K 202 - 25 and 26 and value of rightmost digit in multiplier storage (S 278 is pinned to same shaft as R.H.F.T. so it moves with R.H.F.T.).
- (4) L.H.F.T. to first position determined by R.H.F.T. through follow up circuit (S 278).
4. First right hand platen stroke (via S 206)
 - (1) Break start relay hold (via S 205)
 - (2) Pulse route produces right hand components of first MP digit times MC (15° - 110° of S 209).
 - (3) Carry signal anticipates need for carries (138° - 170°) of S 208).
 - (4) R.H.F.T. finds new position as platen moves away from it (120° - 270° of S 202 -- through digit selector, MP storage and R.H.F.T. position digit selector).
 - (5) R.H.S. finds new position as platen moves away from it (121° - 132° of S 201 -- through single position shift from K 203 and subsequent shifting via D-Z switches).
 - (6) Note: Since K 202 has been dropped and S 203 and S 204 opened at 90° - 315° , L.H.F.T. and L.H.S. will not follow-up 'til after left platen stroke.
5. First left hand platen stroke (via S 214)
 - (1) Pulse route produces left hand components of first MP digit times MC (195° - 290° of S 209)
 - (2) Carry signal anticipates need for carries (318° - 350° of S 208)
 - (3) Left hand function table and left hand shifter follow-up to right hand discs positions via follow-up circuits S 278 and S 279 respectively at 315° (re: S 203 and S 204). Note: Digit selector, S 280 moves with L.H.S.
6. Repeat steps D-4 and D-5 for each significant digit in MP storage with following exceptions:
 - (1) After K 202 was broken in first right platen stroke it did not pick again so it would not have to be broken again.
 - (2) After last MP digit, R.H.S. will go to position 21 and fire L 231 (round off release) which allows lanes 42 and 43 to become active. B+ will also be made available to S 212 via K 201 - 9 and 8.
 - (3) After last MP digit, R.H.F.T. will not re-position.
7. Last right platen stroke (Round Off)

7.
 - (1) 5 Pulse from pulse generator to column designated by lanes 42 and 43.
 - (2) Carry signal anticipates need for carry on round off.
 - (3) Total bail set up by L 235 at 45° via S 212.
 - (4) Note: R.H.S. does not re-position as on other right platen strokes since S 279 control circuits have cut off S 201.

8. Last left platen stroke (Clear after Round Off)
 - (1) S 209 sends 9 pulses to columns designated by lanes 42 and 43.
 - (2) Total bail dropped in at beginning of stroke so that pinions in the designated columns would limit at cipher instead of just adding 9's.
 Note: If no round off and no clear was scheduled, pinions would limit on clappers and stay where they were, however, the last right and left strokes of the platen would still take place.

9. Transfer Product. During last left platen stroke the operation of S 207 (which lost its jumper when S 280 reached position 21) breaks hold circuit for K 201 at 290° causing the following to happen:
 - (1) R.H.S. goes to position 0 (Home) via S ~~278~~²⁷⁹-3 and 4.
 - (2) L.H.S. follows R.H.S. to position 0 (Home) via follow up circuit S 279-1 and 2.
 - (3) Lost B+ for carry signal and machine block (K 201 - 24 and 25 opened).
 Note: Machine block could be held if crossfooter non clear lock were called for and crossfooter was not clear.
 - (4) Fire mesh control solenoid (L 233) via K 201 - 2 and 1 and S 213. The mesh control mechanism sets up snatcher bail, transfers S 256 anticipating negative multiply and makes transfer linkage move to a position where it will be active with sensimatic cycle.
 - (5) Sensimatic drive tripped by motor bar or RPT from previous stop causes sensimatic cycle which pulls transfer linkage (via arm driven by main camshaft) to drive total bail in and mesh accumulator pinions with add racks. A helper rack turns pinion shaft so that pinions move at same speed as add racks until pinions limit on total bail; then studs of add racks enter lock plates and transfer of product has been effected. (Note: directional key block was released by a stud on the sensimatic camshaft during the transfer cycle.)

Burroughs
SERIES F2000
COMPUTER

INSTRUCTION BOOK

Section III



**MECHANISMS AND
ADJUSTMENTS**

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MECHANISMS AND ADJUSTMENTS

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ON AND OFF KEYS

Depression of "On" key A, through keystone Q, will swing lip I of bellcrank D away from the plunger of switch G (S228) allowing its points to transfer. With the "On" key depressed and solenoid M (L221) energized, the hook of clapper latch P will latch keystone Q in a depressed position, allowing the points of switch G to remain transferred.

Depression of "Off" key B, through Keystone C, will swing lip J of bellcrank E away from the plunger of switch K (S229) allowing its points to transfer. This breaks the circuit to solenoid M and allows the "On" key mechanism to restore to normal.

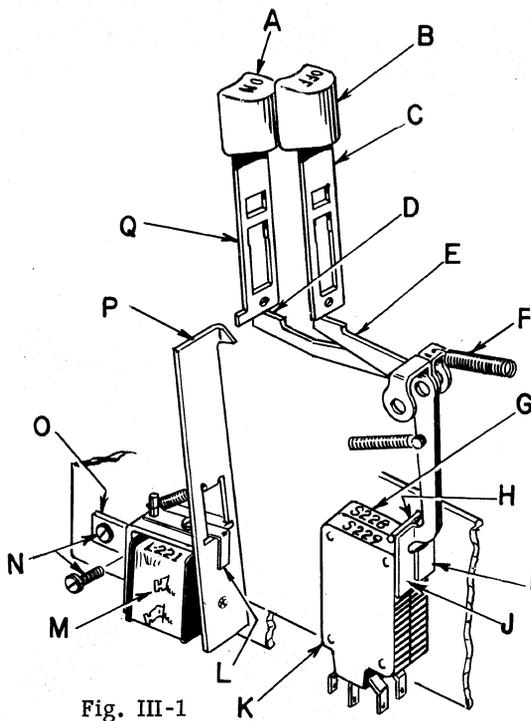


Fig. III-1

TESTS AND ADJUSTMENTS

K7-4-3 With "On" and "Off" keys normal and bellcranks D and E limiting against stud H, there should be .025" to .030" clearance between lips J and I and the bodies of switches G and K.

To Adjust, weave lips J and I as required.
Reason: To ensure that the switch points are transferred at normal without overdriving the switch plunger.

K7-4-5 With the "On" key A depressed and clapper latch P held against its core, clapper latch P should have at least full hold on keystone Q and should not exceed full hold plus .010". Clapper latch P should drop freely onto the step of keystone Q.

To Adjust, loosen screws N and position bracket O.

Reason: To provide the correct hold for retaining the On key in its depressed position.

K7-4-6 With solenoid M de-energized, there should be .005" to .010" passing clearance between the projection of clapper P and lower portion of keystone Q.

To Adjust, bend clapper retainer L as required.
Reason: To ensure pulling clapper P against solenoid M.

"Δ" (DELTA) KEY

Depression of the "Δ" key with the carriage control lever in its rearward position trips the sensimatic drive and releases switch E (S248).

As key lever A is depressed, lip D moves away from the actuator of switch E (S248) allowing its points to transfer. Arm G of key lever A rocks arm F through its stud tripping the sensimatic drive.

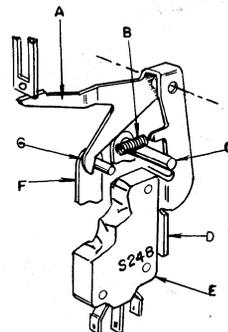


Fig. III-2

TESTS AND ADJUSTMENTS

K7-4-3 With "Δ" key normal and key lever limiting on stud C, there should be .025" to .030" clearance between lip D and the body of switch E.

To Adjust, weave lip D as required.
Reason: To ensure transferring switch point at normal without overdriving actuator or limiting on switch body.

SYMBOL STOP SOLENOID

Located on the right side of the machine, symbol stop solenoid L236 is used to prevent the movement of the symbol slides when a 20 place clear is taken, in order that the Delta sign (Δ) only will print.

When solenoid L236 is energized and attracts clapper G, bail C will be free to pivot when the Sensimatic is operated. As cam I rotates, symbol restoring arm A is pivoted, expanding spring D and releasing bail C, which is pivoted upward by spring H to block the symbol slides. As arm A is restored to normal by spring D, bail C is reset on clapper G by stud B.

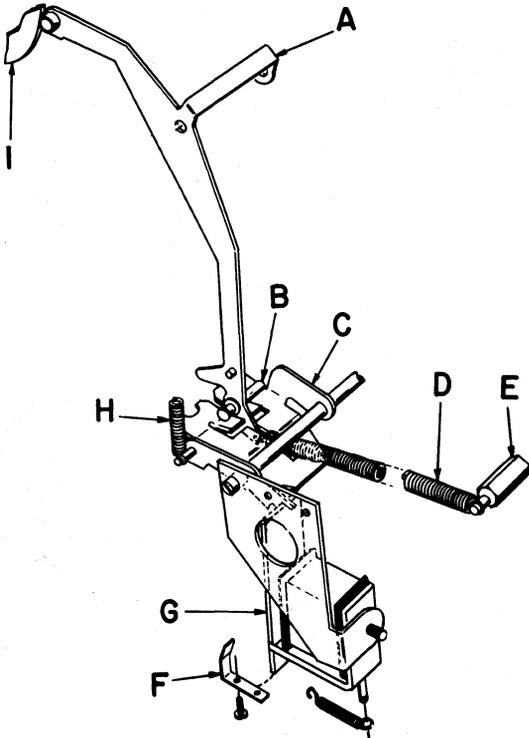


Fig. III-3

TESTS AND ADJUSTMENTS

PR13-1 With the machine normal and the top of clapper G tilted away from the machine, the step of bail C should have at least a full side hold on the upper surface of clapper G.
To Adjust, loosen solenoid bracket mounting nut and position as required.
Reason: To provide a limit for bail C during a machine operation when the solenoid is not energized.

PR13-2 With the machine normal, clapper G should limit against the vertical surface of the lower step on bail C.

To Adjust, bend clapper retainer F as required.
Reason: To ensure that the step of bail C will have a full hold on clapper G.

PR13-3 With the machine normal, there should be .010" to .015" clearance between the upper surface of clapper G and the lower step of bail C.

To Adjust, tip the front of the solenoid bracket up or down as required.

Reason: To ensure the restoring of clapper G under the step of bail C.

PR13-4 During the early portion of the machine cycle, when solenoid L236 is not energized, the projections on the symbol indexing slides should clear bail C and when solenoid L236 is energized, the projections on the symbol indexing slides should have a full hold on bail C.

To Adjust, recheck PR13-3.

Reason: To ensure blocking or indexing of the symbol indexing slides.

NEGATIVE MULTIPLY KEY

Depression of the negative multiply key provides a manual control of multiplication so that the next product will be subtracted from the cross-footer and ribbon shift indexed.

Rocking of bellcrank N moves its lip away from the actuator of switch M (S232) allowing its points to transfer.

TEST AND ADJUSTMENT

K7-4-3 With negative multiply key normal and bellcrank N limiting on stud L, there should be .025" to .030" clearance between the lip of N and the body of switch M.

To Adjust, weave the lip of N as required.

Reason: To ensure that the switch points are transferred at normal without overdriving the switch plunger.

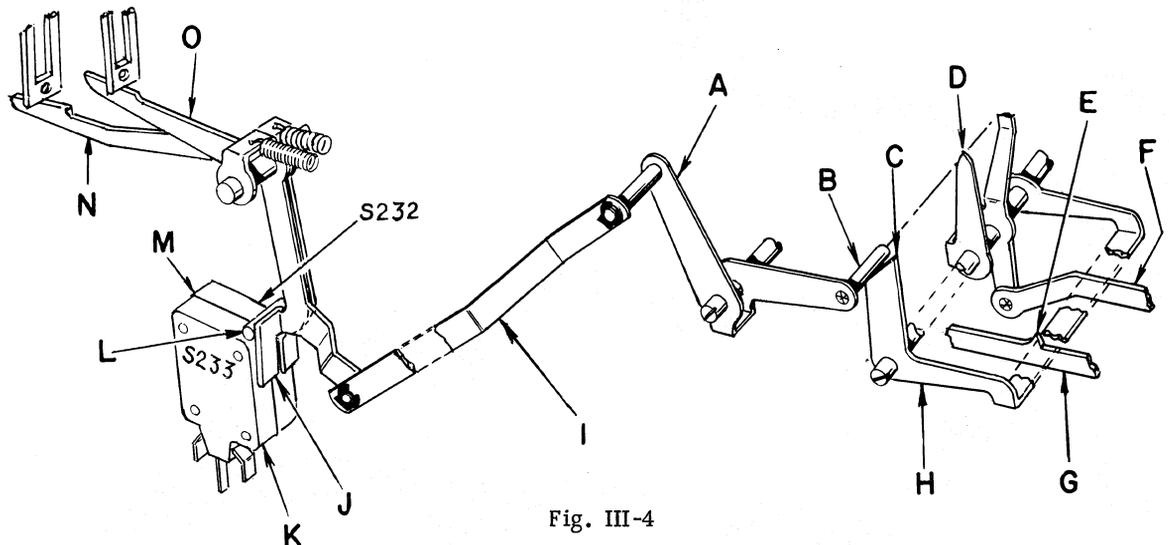


Fig. III-4

NON-MULTIPLY KEY

Depression of the non-multiplying key prevents indexing of pre-multiply functions and disables repeat of machine operation, repeat of keyboard and motor bar repeat.

Rocking of bellcrank O moves lip J away from the actuator of switch K (S233) allowing its points to transfer. As bellcrank O is rocked, link I pivots bellcrank A, swinging stud B down to block forward movement of arm D and to position trap latch H behind projection E on slide G, preventing rearward movement of slide G.

TESTS AND ADJUSTMENTS

- K7-4-1 With the non-multiplying key latched down, latch H should have no less than full hold on projection E of slide G but should not bottom on slide G.
To Adjust, bend forward arm of bellcrank A as required.
Reason: To prevent indexing repeat of machine and keyboard operations.

- K7-4-2 With the non-multiplying key latched down, stud B should have no less than full hold on the vertical surface of step on bail D and stud B should have passing clearance, not to exceed .030", with the vertical surface of the step on bail D.

To Adjust, weave the rear portion of bail D as required.

Reason: To prevent indexing of motor bar repeat.

- K7-4-3 With the non-multiply key normal and bellcrank O limiting against stud L, there should be .025" to .030" clearance between lip J and the body of switch K.

To Adjust, weave lip J as required.

Reason: To ensure transferring the switch at normal without overdriving the switch plunger.

MOTOR BAR #1 RELEASES NON-CLEAR LOCK

A crossfooter non-clear lock can be released by transferring the points of S255 from the depression of motor bar #1.

The points of S255 are transferred by lip D when motor bar #1 is depressed through bellcrank F, link E and bail C.

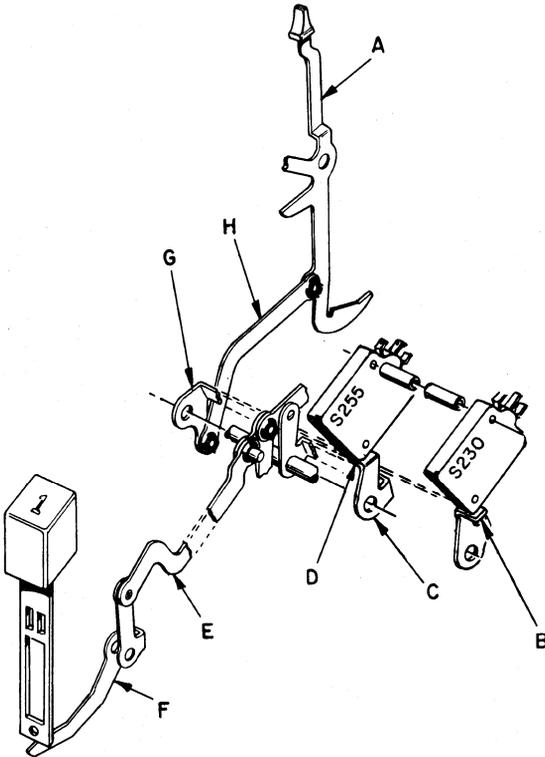


Fig. III-5

TESTS AND ADJUSTMENTS

A21-1-1 With motor bar #1 normal, there should be clearance, not to exceed .005", between lip D and the plunger of S255.

To Adjust, weave bail C as required.

Reason: To ensure transferring switch S255 with motor bar #1 depressed.

CARRIAGE CONTROL LEVER TO TRANSFER S230

CB+ and MB+ voltages to the computer are controlled by the position of the carriage control lever.

When lever A is in a forward position, the points of S230 are transferred through lip B of bail G and link H to supply CB+. When lever A is in a rearward position of the points of S230 are normal to supply MB+.

TEST AND ADJUSTMENT

C11-2-1 With lever A in a forward position, the actuator of S230 should be depressed to within .025" to .030" of switch body.

To Adjust, weave bail G as required.

Reason: To ensure positive transfer of the points of S230.

C & M KEYS

The C & M keys are used by the operator to change the programmed shift of the machine, from a unit price multiplication to a price per hundred by depression of the C key, or a price per thousand from depression the M key.

On 5/8" tab machines depression of the C key transfers the points of switches S241 and S242 through bellcrank C. The lip on bellcrank C pivots bellcrank B, transferring the points of S240. Depression of the M key transfers the points of S240 through bellcrank B.

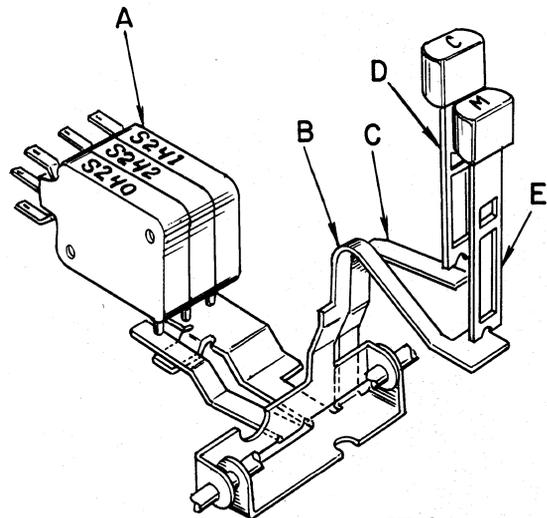


Fig. III-6

TESTS AND ADJUSTMENTS

K1-1 With the M key held depressed, there should be .005" to .010" clearance between keylever B and the body of switch S240.

To Adjust, weave keylever B at the end which contacts keystem E.

Reason: To ensure closing switch S240 without overdriving the plunger or limiting keylever.

K1-2 With the C key held depressed, there should be .005" to .010" clearance between keylevers B and C and the body of their respective switch.

To Adjust, weave keylever C at the end which contacts keystem D.

Reason: To ensure closing switches S240, S241 and S242 without overdriving the plunger or limiting keylever C.

With the mechanism normal, actuator bails J and K limit on post H and hold the switch plungers depressed.

Depression of the "C" key cams slide B forward to rock both actuator bails J and K clear of all three switch plungers. This permits the normally closed switch contacts to close.

As the "M" key is depressed, slide F is cammed forward to rock only actuator bail K. This permits the contacts of only S240 to normal-

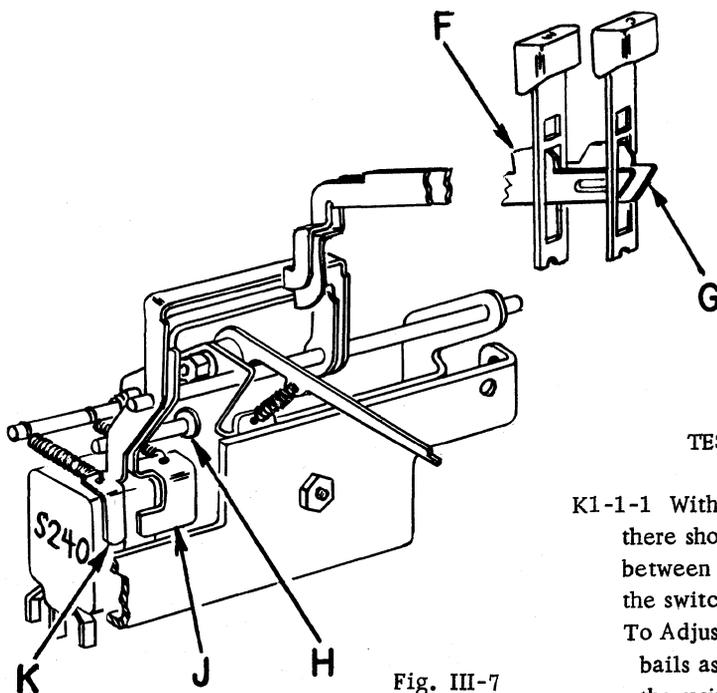


Fig. III-7

On 1/10" tab machines the "C" and "M" keys serve the same purpose as those on earlier machines. The physical layout and mechanical operation of the parts, however, are considerably different.

TESTS AND ADJUSTMENTS

K1-1-1 With the "C" and "M" keys normal, there should be .025" to .030" clearance between the ears of the actuator bails and the switch bodies.

To Adjust, weave the ears of the actuator bails as required where contact is made with the switch plungers.

Reason: To ensure transferring the switches without overdriving their plungers.

REGISTER DESIGNATION BLOCKING SOLENOID

The register designation blocking solenoid located at the front of the machine to the left of the decimal indicator lights, prevents printing the register symbol when a 20 place clear is taken.

When solenoid B is energized clapper D pivots arm G in front of the stud in rack A blocking its movement.

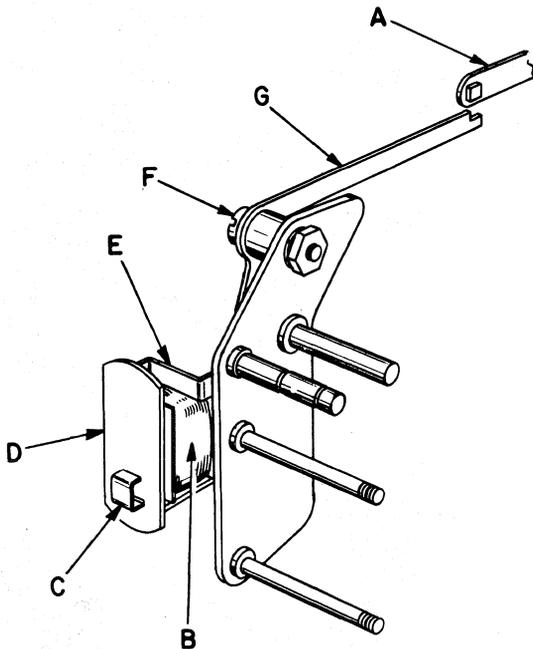


Fig. III-8

TESTS AND ADJUSTMENTS

PR5-2-1 Manually cycle the machine until register designation rack A reaches its maximum rearward travel (approx. 90°). With clapper D held against its core, bail G should:

- align centrally with square stud of rack A.
- have at least 3/4 hold on the square stud of rack A without binding on the vertical surface of the step of bail G.
- have at least 3/4 hold on the square stud of rack A without binding on the horizontal surface of the step of bail G.

To Adjust, (a) bend rear arm of bail G.

(b) starting with the high side at 12 o'clock turn eccentric screw F as required.

(c) bend front projection E of bail G as required.

Reason: To ensure sufficient blocking hold on register designation rack A and to ensure clapper D limiting on the core of solenoid B for maximum efficiency.

PR5-2-2 With clapper D held against its core and register nine selected, manually cycle the machine. The stud on the latch of rack A should enter the cipher tooth space of the lock plate centrally.

To Adjust, recheck step B of PR5-2-1.

Reason: To ensure free entry of the stud into the cipher tooth space of the lock plate.

PR5-2-3 With clapper D limiting against clapper retainer C, there should be .020" to .025" air gap between the button on clapper D and the core of solenoid B.

To Adjust, weave retainer C, as required.

Reason: To ensure that bail G clears rack A with clapper D normal and for minimum air gap.

MACHINE TRIP INTERLOCK SOLENOID

The machine trip interlock solenoid is located on the outside of the left auxiliary sideframe and is used to block the Sensimatic drive trip. The difference in the earlier 5/8" tab and the present 1/10" tab machines is that solenoid L222 must be energized to permit drive trip on 1/10" tab machines, whereas on 5/8" tab machines energizing L222 prevented drive trip.

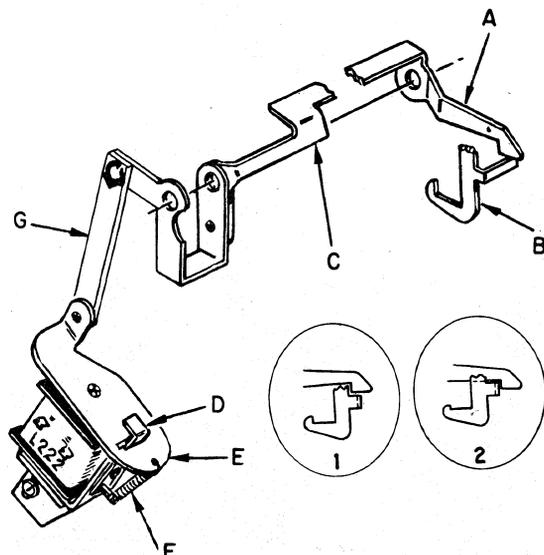


Fig. III-9

When solenoid L222 is de-energized, spring F urges clapper E against link G which rocks bail C to position hook A over the ear of trip bail B and thereby prevents drive trip. When solenoid L222 is energized, clapper E through link G and bail C raises hook A to allow drive trip bail B to move forward and release the clutch dog release arm.

With trip shaft A normal, spring F through lever C holds the points of S287 transferred. As drive trip is set up, trip shaft A rocks lever C away from the plunger of S287, permitting the switch to normalize and complete the ground circuit of L222 through the N.C. contacts of S287.

TESTS AND ADJUSTMENTS

TESTS AND ADJUSTMENTS

- P7-1-2 There should be .010" to .015" passing clearance between hook A and the ear of bail B (see insert 1) with clapper E held against its core.
To Adjust, loosen solenoid bracket mounting screws and position as required.
Reason: To prevent a false limit and to ensure release of trip bail B by hook A.
- P7-2-1 There should be .010" to .015" clearance between the straight portion of hook A and the top edge of the ear of bail B (see insert 2) with clapper E normal.
To Adjust, weave retainer D.
Reason: To ensure sufficient hold of hook A on the ear of bail B to prevent drive trip.

- P19-1 With trip shaft A normal and lever C limiting against stud D, there should be .050" to .060" clearance between ear E and the body of S287.
To Adjust, weave ear E as required.
Reason: To prevent energizing the machine blocking solenoid (L222) with the machine normal.
- P19-2 With a control key partially depressed, depress motor bar 2. The contact of S287 should not transfer.
To Adjust, bend ear B as required.
Reason: To prevent energizing L222 improperly.
- P19-3 With trip shaft A in a tripped position, there should be no less than .020" clearance between ear E and the plunger of S287.
To Adjust, recheck P19-2.
Reason: To permit energizing L222 with drive trip set up.

MACHINE TRIP SWITCH

In order to eliminate the necessity of keeping L222 energized for long periods of time, machine trip switch S287 is wired into the ground circuit of L222 (1/10" tab machines only). The ground circuit to L222 is completed only when drive trip is set up.

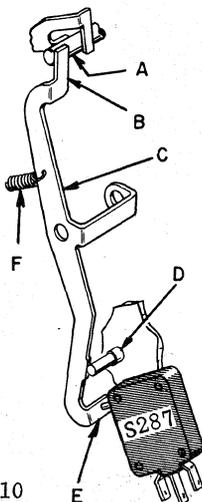


Fig. III-10

Handwritten note:
EX
RIN
475

DIRECTIONAL KEY BLOCK AND INTERLOCK SWITCH

The directional key block prevents the depression of the tab and return keys and disengagement of the carriage control lever during the multiply routine prior to the product transfer cycle. Switch R (S284) will prevent the start of multiplication if the directional keys are partially depressed by blocking slide L.

When solenoid K (L223) is energized, clapper M moves slide L to the right where it is retained by latch G in cutout E through tension of spring F. Latch G releases switch R when it drops into cutout E. With slide L in its latched position, tab and return keys are blocked from depression by ears H and D. Disengagement of carriage control lever A is prevented by lip C blocking ear B. On the next Sensimatic operation, part G will be raised by roller P transferring switch R and allowing spring N to restore slide L and clapper M.

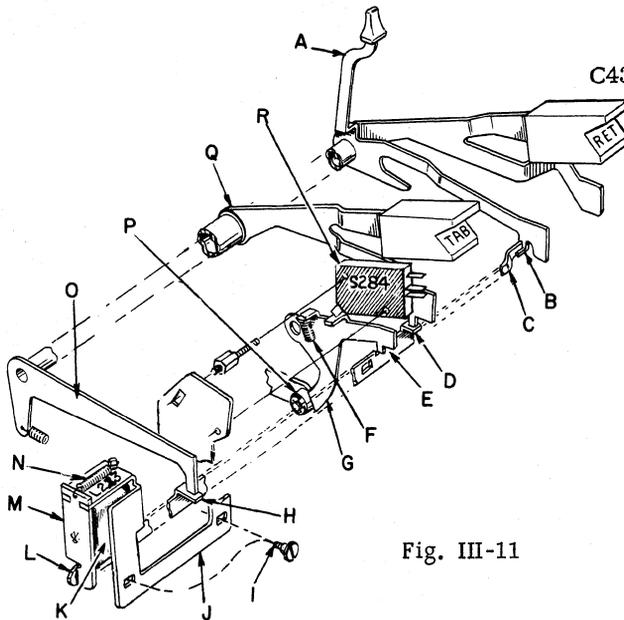


Fig. III-11

TESTS AND ADJUSTMENTS

C43-1 With lever A forward and solenoid clapper M manually held against its core, there should be passing clearance not to exceed .010" between the bottom of lip C and the top of ear B, and there should be .005" to .010" clearance between the end of slide L and lever A when the lateral play of lever A is taken up to the right.

To Adjust, loosen screws I and position bracket J as required.

Reason: To prevent a false limit and to block movement of carriage control lever A.

C43-2 With clapper M manually held against its core and the lateral play of latch G taken up toward the right side frame, there should be .003" to .010" clearance between the right side of latch G and the right end of cutout E. With side L retained by latch G, lip L should have at least 1/2 hold on ear B. To adjust, weave latch G laterally as required.

Reason: To ensure slide L being held by latch G.

C43-3 With slide L latched by latch G, tab lever Q and return lever O should have a full contact with lips D and H.

To Adjust, recheck C43-2 and, if necessary, weave tab lever Q and/or return lever O.

Reason: To prevent depression of tab and return keys when slide L is in its latched position.

C43-4 With latch G limiting in bottom of cutout E and an .006" gauge inserted between ear of latch G and actuator of switch R, the normally closed points of switch R should not open. Inserting a .014" gauge should open the normally closed points of switch R. To Adjust, loosen screws holding switch R and reposition switch.

Reason: To ensure contact of the normally closed points of switch R with solenoid K energized.

DECIMAL INDICATOR LAMPS

The purpose of the decimal indicator lamps is to aid the operator in locating the decimal point when indexing the multiplier or multiplcand into the "D" section of the machine. The location of the light is determined by electrical lane pins in lane 64, 65 or neither. Pins in these lanes in no way effect the multiplication routine. It is possible to change the physical location of the lamps, however no more than three can be installed in any machine.

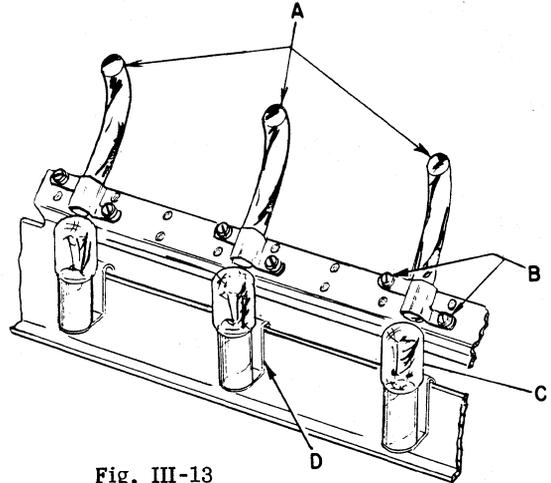


Fig. III-13

MAGNETIC CLUTCH AND FULL POWER SWITCH

The magnetic clutch supplies the power for carriage movement. The full power switch applies full power to the magnetic clutch when carriage movement is indexed. As a tab or return function is indexed, escapement pawl E moves away from the escapement gear, bellcrank D pivots away from the lip on actuator B, and spring C moves actuator B rearward to transfer the points of switch A (S257).

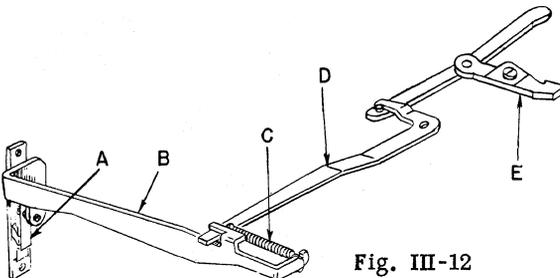


Fig. III-12

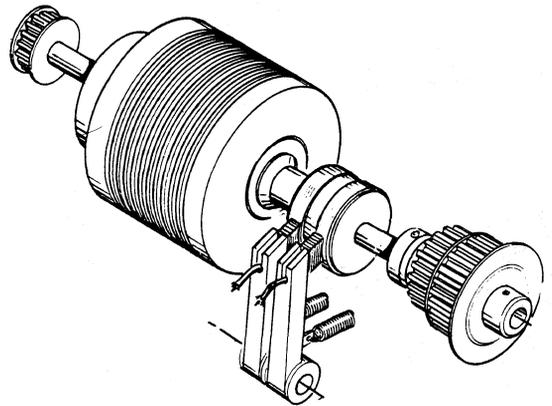


Fig. III-14

TESTS AND ADJUSTMENTS

- P22-1 During the indexing of a tab or return there should be .025" to .35" rearward movement of slide B after contacts of switch A have been transferred for "full power". To Adjust, bend rear formed ear of slide B as required.
Reason: To ensure positive transfer of switch A (S257).
- P22-2 With the power on and full power switch (S257) normal, a) there should be 36 to 42 volts, measured across the brushes of the magnetic clutch. b) using the same measuring points, with S257 transferred, there should be 75 to 85 volts.

- To Adjust, a) on rear inserted panel machine reposition the band on R232. (Not adjustable on side inserted panel machine) b) reposition the band on R231.
NOTE: On side inserted panel machine, removal of the panel opens the B+ circuit to the magnetic clutch.
Reason: To establish correct operating voltages of the magnetic clutch.

FULL POWER INTERLOCK SWITCH

The full power interlock switch E removes power from the magnetic clutch when the control unit is removed from the machine. With the control unit in the machine roller F rides on the casting to hold lever G clear of actuator C. Removal of the control unit allows compression spring B to force the long ear of lever G downward against actuator C transferring switch E. The short ear of lever G latches bearing cage A in the right end position.

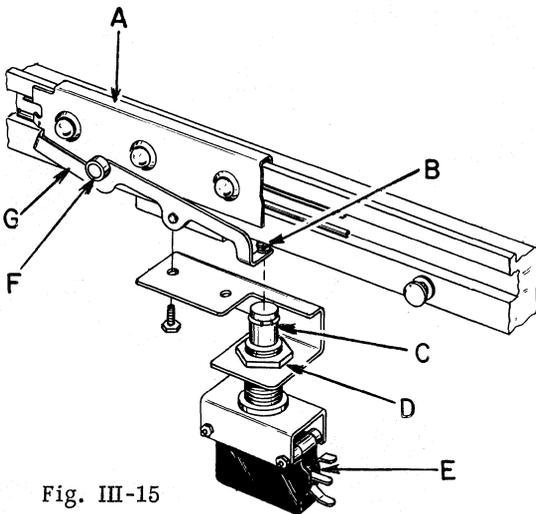


Fig. III-15

TESTS AND ADJUSTMENTS

C10-3-19 The movement of interlock G in locking the ball bearing cage A should cause the actuator C to depress the plunger of switch E and stop the current flow through the coil of the magnetic clutch.

To Adjust: Move actuator C up or down as required and lock in position with the locking nuts D on the sleeve of the actuator assembly.

Reason: To stop the current flow through the coil of the magnetic clutch, when the program unit is removed, and the carriage is in its locked position.

C10-3-18 With the carriage in the extreme right position, and the program unit removed, the ball bearing cage A on the third rail must be blocked by interlock G.

To Adjust: weave ear of interlock G as required.

Reason: To retain the ball bearing cage in the correct position for inserting the program unit.

CF "A" NEGATIVE SWITCH S234

This switch is actuated as the pinions of CF "A" cross-slide when a total or subtotal is taken from the minus pinions of the accumulator.

As the pinions cross-slide arm A is pivoted forward transferring the points of switch E (S234) through stud G, bail C and actuator D.

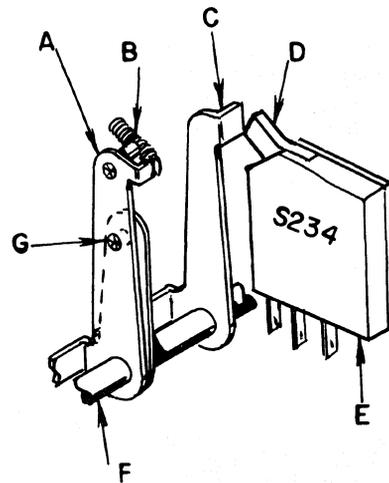


Fig. III-16

TESTS AND ADJUSTMENTS

A43-1 With a minus amount (credit) in cross-footer "A" and a crossfooter "A" total or subtotal indexed, manually cycle the machine until arm C receives its maximum forward movement. There should be .015" to .030" additional movement required before the actuator of switch E bottoms.

To Adjust, weave arm C as required.

Reason: To ensure transferring the points of switch S234 without overdriving the actuator.

NEGATIVE MULTIPLY RELEASE SWITCH

The purpose of the negative multiply release switch (S231) is to open the hold circuit for K204 (Negative Multiply) during product transfer. It is located on the right auxiliary side frame.

At the beginning of the product transfer cycle as link A moves forward, lip B on link A contacts the plunger of switch C (S231) to transfer its contacts.

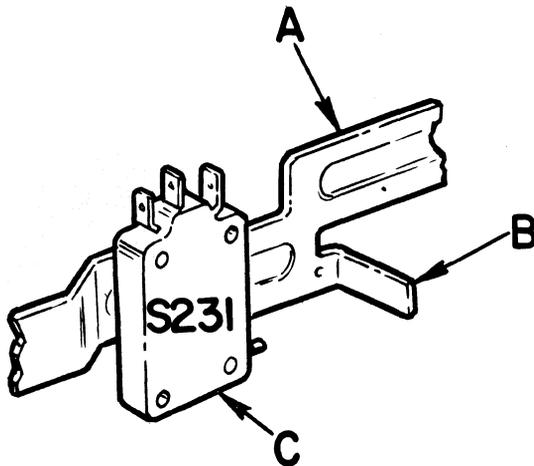


Fig. III-17

TESTS AND ADJUSTMENTS

- A42-1 With the machine manually cycled during a product transfer and transfer link A at its maximum forward position, there should be .025" to .030" clearance between the body of switch C and lip B.
 To Adjust, bend lip B as required.
 Reason: To ensure transferring switch C without overdriving its plunger.

CF "A" SUBTRACT SWITCH

The CF "A" Subtract switch (S256) is located on the right auxiliary side frame. It is actuated by the transfer mechanism and will cause the product of multiplication to be subtracted if negative multiplication (K204) is called for. As transfer link A moves forward, lip C moves away from the plunger of switch B to allow the contacts of the switch B to restore.

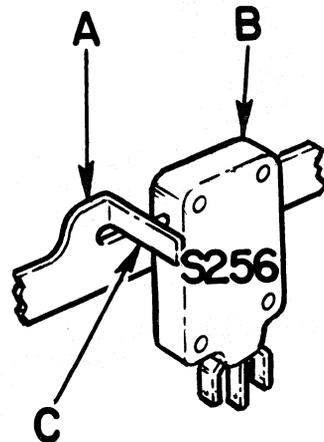


Fig. III-18

TESTS AND ADJUSTMENTS

- A23-7 With the machine and the transfer mechanism normal, there should be .040" to .050" clearance between lip C of link A and the body of switch B.
 To Adjust, bend lip C as required.
 Reason: To ensure transferring switch B without overdriving the switch plunger.

INDEXING OF CF "A" SUBTRACT AND RED RIBBON

When solenoid G (L232) is energized (due to "Negative Multiply") clapper F through link D will position pawls I over the ears of tappets B and A (lanes 7 and 12) preventing their upward movement which will index CF "A" subtract and red ribbon.

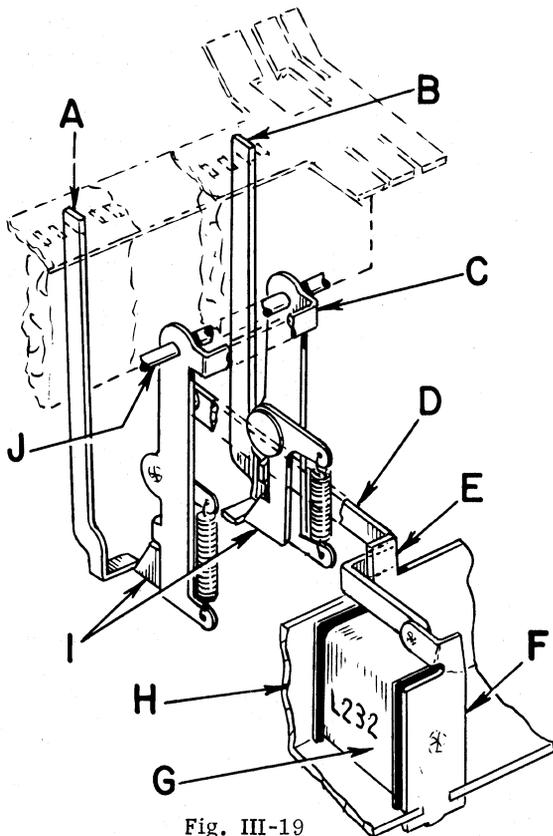


Fig. III-19

TESTS AND ADJUSTMENTS

- C44-1-1 With the clapper F held against its core, pawls I should have full hold on the ears of tappets A and B.
To Adjust, position bracket H as required.
Reason: To establish the correct actuated position of pawls I over the ears of tappets A and B.
- C44-1-2 With the control panel removed and carriage controls active, manually trip the drive. Holding clapper F against its core, manually cycle the machine. The CF subtract hook should have a three quarter (3/4) hold on the square stud in the control slide.

To Adjust, reposition the support bracket for shaft J vertically as required.

Reason: To ensure proper throw of CF "A" subtract and red ribbon mechanism with solenoid G energized.

C44-1-3 With link D limiting against ear E, there should be .015" to .020" passing clearance between the ears of tappets A and B and pawls I, with the play of tappets A and B held toward pawls I. There should also be clearance between pawls I and the return paddle.
To Adjust, weave ear E as required.

Reason: To prevent indexing the mechanisms with clapper F normal and to have minimum air gap.

IN-TAB SWITCHES

The in-tab switches are used for circuit control when the carriage is out of stop position. On 5/8" tab machines in-tab switches E (S227) and D (S226) are mounted on the left side of the gear box and are operated by lever A which is rocked by drive trip interlock C. If either of the gear box bumpers are lowered or if they are spread, the points of the in-tab switches will be transferred.

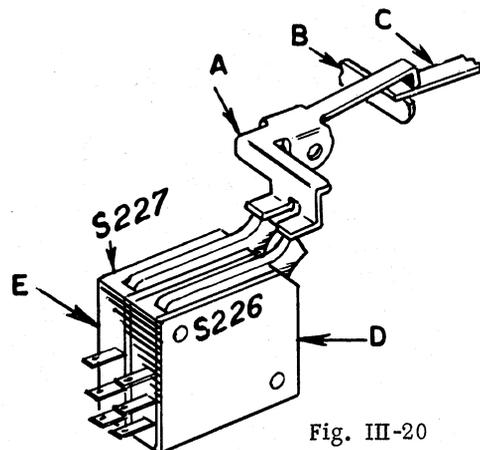


Fig. III-20

TESTS AND ADJUSTMENTS

- G1-1 With carriage gear box bumpers normal, there should be .005" to .010" clearance between nylon actuator of switch D and the lip of bail A.
To Adjust, move mounting bracket for switches D and E and/or weave tail of bail A.

Reason: To ensure immediate actuation of switch E and to allow switch D to close at normal.

On 1/10" tab machines in-tab switches are located to the left of the gear box and are operated either by spearpoint K or arm H (tab and return). Rearward movement of spearpoint K through arm J and ears G transfers switches F. Indexing a tab or return function causes arm H to move forward pivoting lever I, which through the spring connection to arm J causes ears G to transfer switches F.

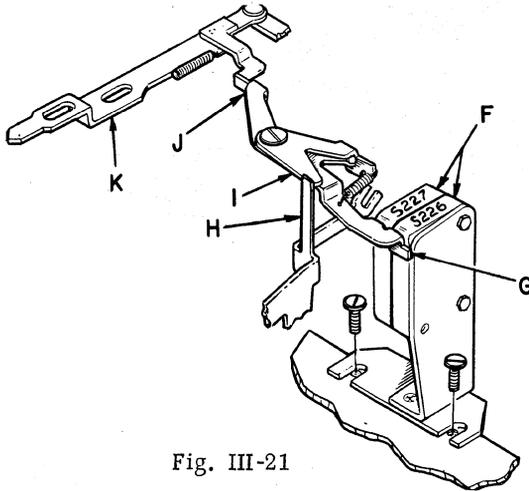


Fig. III-21

TESTS AND ADJUSTMENTS

NOTE: The following tests and adjustments should be made only after all tabulation and return interlock adjustments have been properly made.

C36-1 With the program unit removed and spearpoint K manually held forward, there should be clearance, not to exceed .005", between the plungers of switches F and ears G when lever I is held against arm H.

To Adjust, reposition the switch bracket as required for necessary clearance of the inner switch plunger (S227), maintaining the parallel condition of the switch assembly. If necessary bend arm H. Bend outer ear G for necessary clearance of the outer switch plunger (S226).

Reason: To establish the correct position of the in-tab switch assembly.

C36-2 With the spearpoint held forward and a tab or return manually indexed, the "In-Tab" switches should be actuated by the ear of arm H. When the primary latch on the gear box is released, the slight rearward movement of the interlock latch should not allow the switches to transfer.

To Adjust, recheck C36-1.

Reason: To establish correct position of switches for interlocking during tab and return operations.

C36-3 With the program unit removed and the machine normal, there should be .010" to .015" clearance between outer ear G and the switch bracket.

To Adjust, weave the lip on arm J where contact is made with spearpoint K.

Reason: To correctly actuate the in-tab switches when the carriage is in or out of a stop position.

MOTOR FRICTION CLUTCH

The motor friction clutch is a protective device which prevents serious damage to the machine in case of lock-ups and cushions the initial movement of mechanisms as the drive is engaged.

TEST AND ADJUSTMENT

P13-1-1 The motor friction clutch should be as weak as possible, yet strong enough to accomplish all machine functions.

To Adjust: 1. With the clutch cool, back off adjusting nut until the product accumulator fails to cycle on a 20 place clear operation.

2. Permit the clutch to slip for approximately 15 seconds.

3. Tighten adjusting nut until the clutch will cycle the product accumulator during a 20 place clear operation.

4. Tighten adjusting nut three (3) additional notches.

Reason: To safeguard the machine against possible damage in the event of a malfunction.

Note: On some machines it may be necessary to remove one flat spring.

GEAR BOX

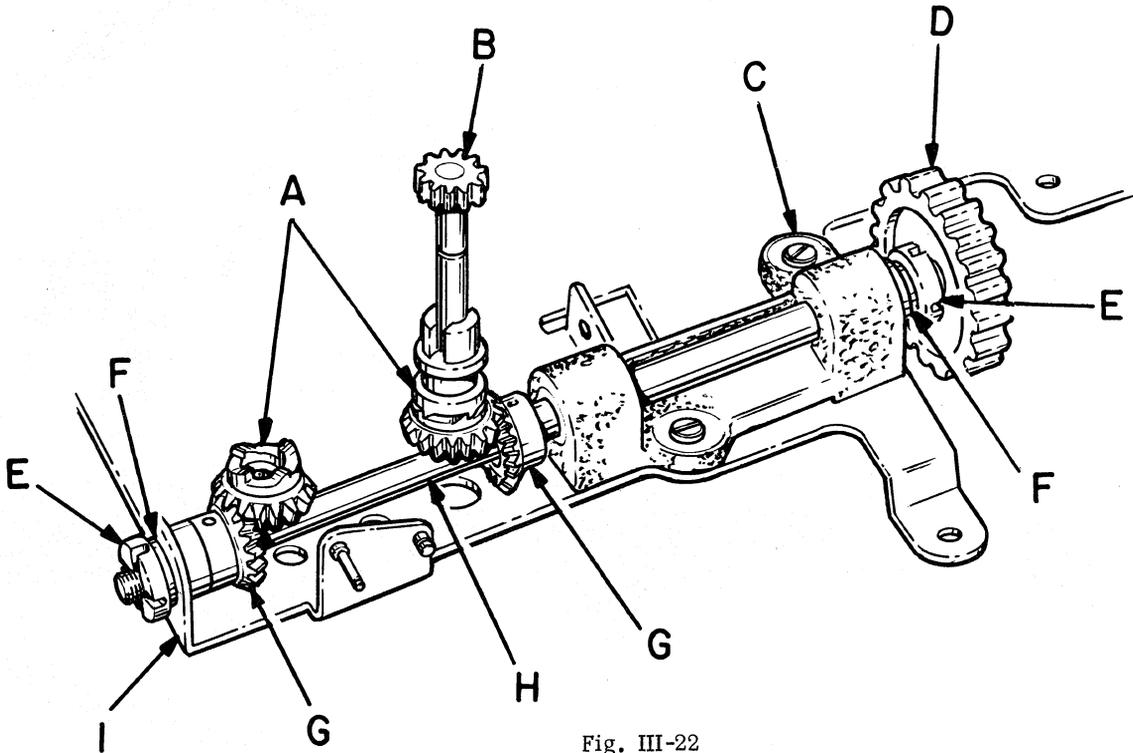


Fig. III-22

The F2000 gear box is basically the same as the F1000 with the following exceptions. The Tab and Return spindles are mounted on the back plate of the gear box and each is individually driven from a common drive shaft. The Tab and Return spindles are supported by needle bearings. Pulley D is belt driven from the magnetic clutch. Rotation of pulley D results in rotation of gears G through their common shaft H. Gears G drive gears A.

TEST AND ADJUSTMENTS

C13-1-32 Gear shaft H should turn freely and gears G should have equal depth mesh with gears A.

To Adjust, a) With carriage return indexed, turn adjusting nut E (right side) for minimum clearance between right spacer F and ear I which will allow free rotation of return spindle B and shaft H.

b) With carriage tabulation indexed, turn adjusting nut E (left side) for minimum clearance between the left spacer F and casting C which will allow free rotation of the tab spindle and shaft H.

Reason: To establish the correct location of gears G with respect to gears A.

LANE 32 - PRORATE

Used in prorating to the nearest dollar by preventing columns 1 and 2 from extending or printing an amount. As a #3 pin is sensed by tappet B, add racks D are blocked by slide H from arm E, link G, lever A and cam C.

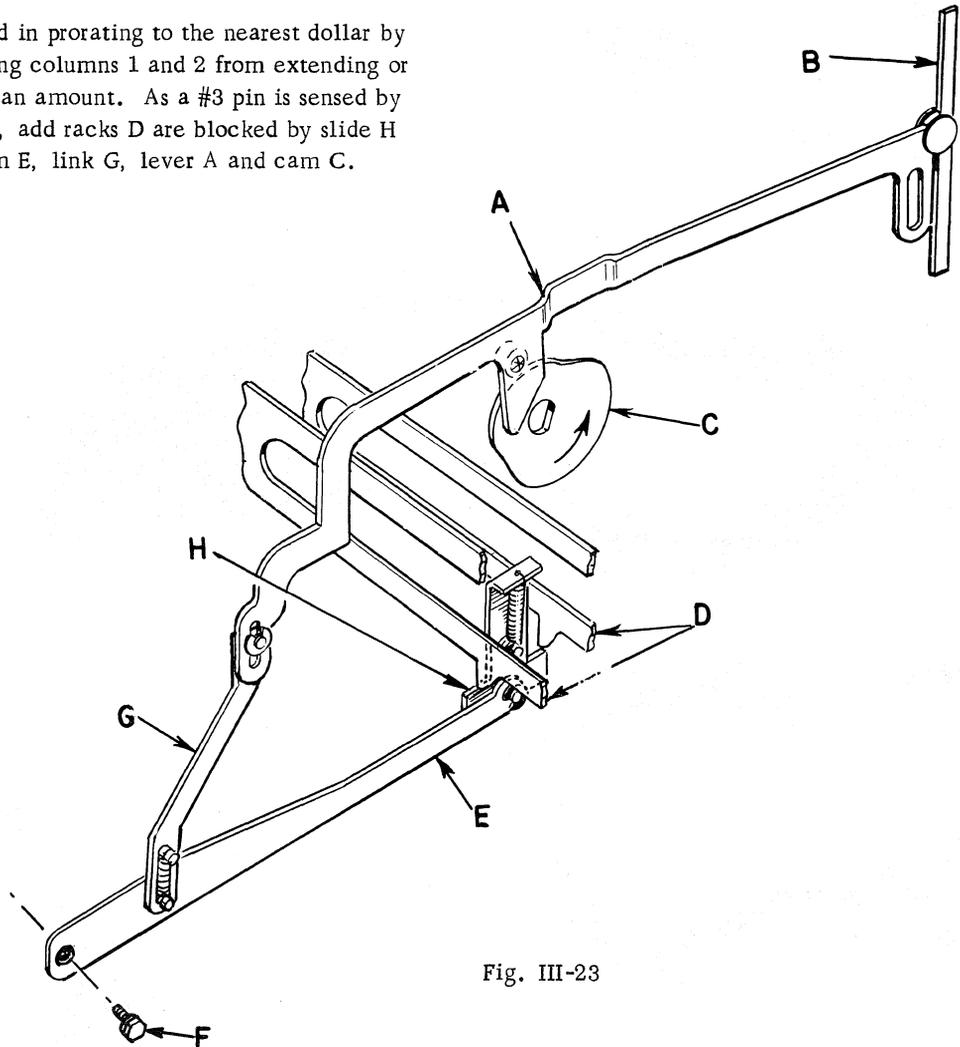


Fig. III-23

TESTS AND ADJUSTMENTS

A38-1 With carriage controls active and a No. 3 pin in lane 32, manually cycle the machine until the roll in sensing lever A is on the high point of cam C. There should be .045" to .060" clearance between the top edge of slide H and the bottom horizontal surface of extensions D.

To Adjust, turn eccentric F as required.
Reason: To ensure sufficient hold of blocking slide H on add rack extensions D.

A38-2 With carriage controls active and a No. 3 pin in lane 32, manually cycle the machine until the roll of sensing lever A is on the high point of cam C. There should be clearance not to exceed .005", between blocking slide H and the vertical surface of the projections on the lower side of add rack extensions D. To Adjust, weave support bracket for blocking slide H, maintaining freedom of slide H to move up or down.

Reason: To ensure free entry of the studs of the add rack latches into the cipher spaces of their lock plates for columns 1 and 2 when prorating.

OPERAND STORAGE UNIT

The function of the operand storage unit is to store the multiplicand and the multiplier. Located in the D section of the Sensimatic, the unit is in constant mesh with the add racks. A #2 pin in lane 33 or 34 of the control unit will allow an amount to be indexed in the multiplicand or multiplier section of the operand storage unit. Early in the machine cycle sensing lever D raises bellcrank C, bellcrank C pulls link F rearward rocking bellcrank G which raises detent bail K. This permits springs L, which couple pinions A to pinions B, to restore the contact gears J to the neutral position. (Contact gears J have wiper contacts facing the printed circuit boards, which index circuits that represent the multiplicand and the multiplier.) As the machine cycle continues, the add racks are driven forward rotating pinions A which, through springs L, turn pinions B, driving contact gears J to position their contacts on the printed circuit boards I. After the stud of the add racks enter the lock plates the sensing lever D is allowed to restore. From the tension of spring H the detent bail K is positioned in the tooth space of contact gears J, holding them in a fixed position. As the racks are restored to normal, pinions A will be rotated to home position. Since contact gears J are held by detent bail K, pinions B will also be held and springs L will be wound up. When detent bail K is raised again, contact gears J will be restored to the same position that pinion A is in, through the tension of springs L.

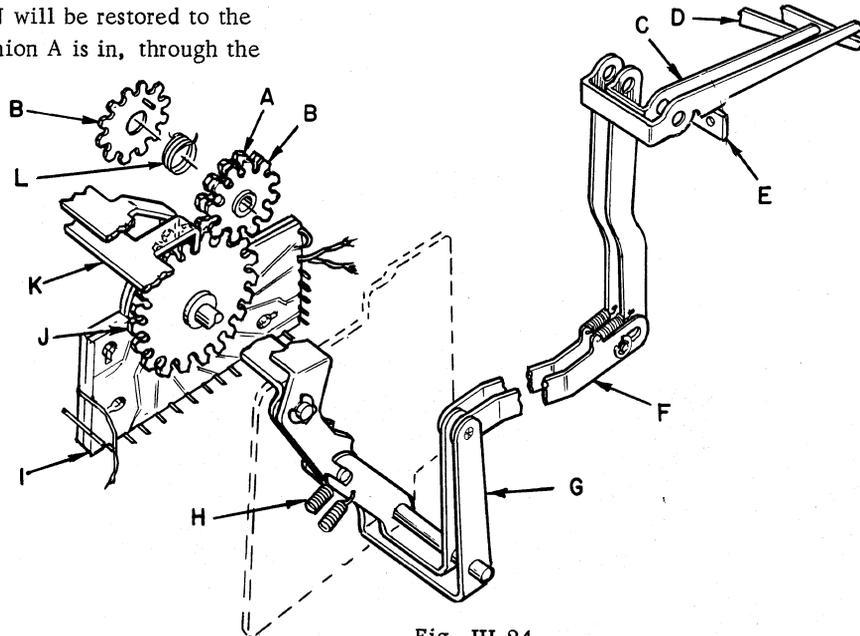


Fig. III-24

TESTS AND ADJUSTMENTS

R5-6 With the machine clear and no amounts indexed, cycle the machine until the locking studs have entered the lock plates fully. When manually raised and lowered in this position, the fingers of detent bail K should enter between the marked teeth of contact gears J with minimum rotation of gears J. To Adjust, reposition operand storage unit forward or rearward as required.

Reason: To ensure proper positioning of the Operand Storage Unit.

R-5-9 With detent bail K limiting in the tooth spaces of pinions J and the upward play of bellcrank C taken up, there should be line to line contact between bellcrank C and limit blank E.

To Adjust, position limit blank E as required.

Reason: To ensure positive detenting of contact gears J with bail K lowered and free rotation with bail K raised.

R-5-10 With the machine normal, there should be clearance, not to exceed .003", between bellcranks C and sensing levers D.

To Adjust, weave bellcranks C as required.

Reason: To ensure sufficient throw to raise detent bail K out of mesh with pinions J without raising the tappets at normal.

PRINTED CIRCUIT SWITCH ASSEMBLY

This assembly is made up of six printed circuit switches controlled by lanes 41 through 44.

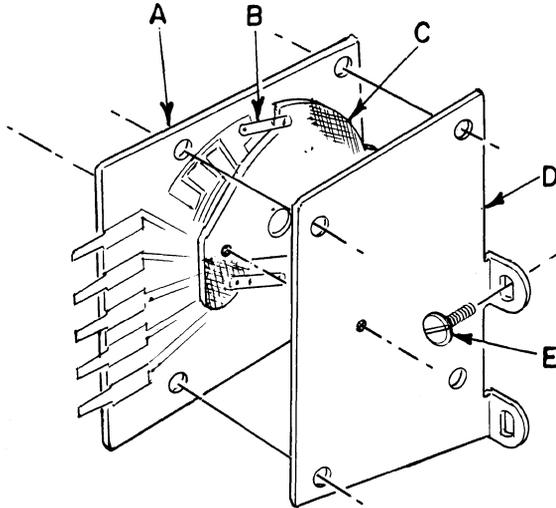


Fig. III-25

TESTS AND ADJUSTMENTS

C37-6 With the machine normal, printed circuit assembly D should be centrally aligned with the sensing levers and should be squarely mounted. With control pins active in lanes 41, 42, 43 or 44, release the sensing levers of these lanes and check to determine if the wipers are centered on the pads of the printed circuits.

To Adjust, loosen screws E and position assembly D as required. Readjust lane 41 if required.

Reason: To ensure that wiper contacts are centered on the printed circuit pads.

LANES 41, 42 and 43

The sensing of pins in lane 41 positions the wiper of printed circuit switch S260. As cam J is rotated, cam follower assembly K raises the pivot point of sensing lever L and allows tappet N to move upward to sense the control pin. When a control pin is contacted by tappet N, sensing lever L pivots at its stud connection with cam follower K and positions the wiper for S260, which is connected to the stud in the right end of sens-

ing lever L. As cam J continues to rotate to home position cam follower assembly K will be restored to normal by the roll on adjustable link H.

The sensing of pins in lane 42 positions the wiper of printed circuit switch S261. The sensing of pins in lane 43 positions the wipers of printed circuit switches S262 and S263. Sensing levers C and D of lanes 42 and 43 are held at normal by arm F which is latched down by clapper P. When solenoid O is energized, it will attract clapper P, releasing arm F. The spring on the lower projection of arm F will cause arm F to pivot on shaft G and raise pivot point E of sensing levers C and D. As control pins are sensed by tappets A and B, which are moved upward by springs Q, sensing levers C and D, pivoting at stud E, position the wipers of the printed circuit switches as determined by the length of the control pin. Tappets A and B are restored to normal when cam M contacts the roll in the lower projection of arm F and relatches arm F on clapper P.

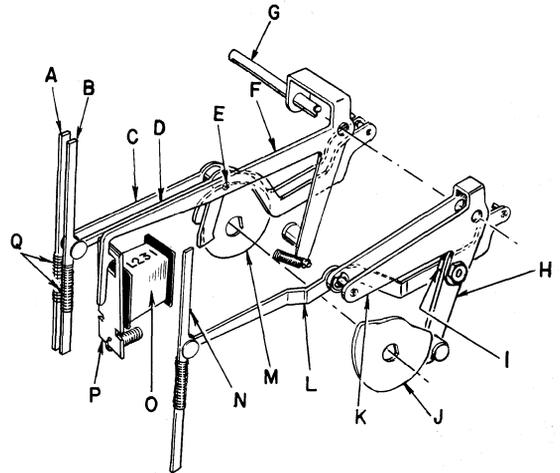


Fig. III-26

TESTS AND ADJUSTMENTS

C37-5 With the auxiliary sensing unit in normal position and a No. 1 pin in lane 41, there should be .030" to .050" clearance between tappet N and the No. 1 pin.

To Adjust, turn eccentric I in arm H as required.

Reason: To maintain proper clearance between tappet N and control pins in lane 41.

C37-7 With control pins active in lane 41, cycle the auxiliary sensing unit until lane 41 is fully actuated. Check the wiper contact on S260 to determine if it is centered on the pads of the printed circuit.

To Adjust, recheck adjustment (C37-6) of the Printed Circuit Switch Assembly.

Reason: To ensure that the wiper contacts are centered on the printed circuit pads.

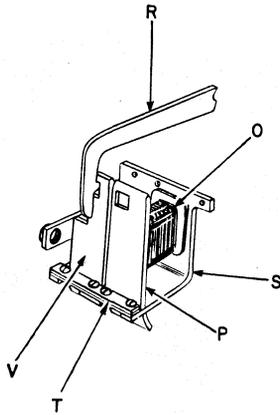


Fig. III-27

C37-1 With arm R and F released, there should be .040" to .060" air gap between the solenoid cores (L225 and L231) and the non-magnetic pads on their clappers P and V. To Adjust, position limit blanks T as required.

Reason: To ensure sufficient hold on latch arms R and F (lanes 42, 43 and 44) at normal and to permit relatching.

C37-2 With clapper P or V held against its core, there should be .005" to .015" releasing clearance with latch arm F or R.

To Adjust, reposition bracket S.

Reason: To ensure positive release of latch arms F and R.

LANE 44 AND DECIMAL SHIFT ENABLE SWITCH

Lane 44 is used to position the wiper on printed circuit switches S264 and S265 and cause the transfer of decimal shift enable switch S243.

When solenoid T (L225) is energized, it will attract its clapper V releasing latch arm J. Spring N swings arm J upward until roller K limits on cam O. With arm J in this position, the pivot point of arm Q is raised through stud L.

As a pin is sensed by tappet R through spring S, arm Q is pivoted at stud L; this positions the wipers of S264 and S265 through stud M.

As spring N raises arm J, screw H releases latch F allowing spring X to position slide D to the left, transferring the points of switch A (S243).

When the sensing camshaft is rotated, cam O will reset arms Q and J through roller K and stud L. Arm J being latched by clapper latch V from tension of spring U.

Slide D is reset by roller P on cam O which pivots arm E moving slide D to the right through stud W where it is latched by part F and spring G.

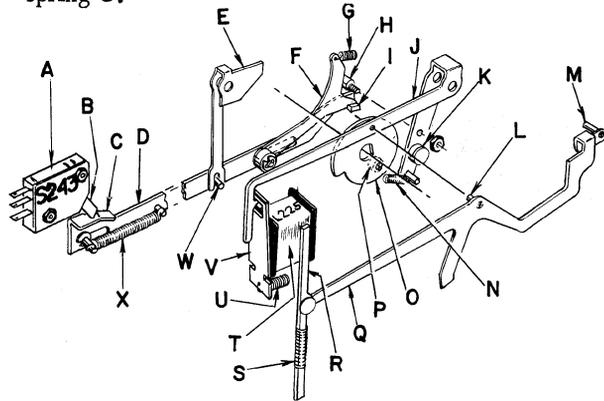


Fig. III-28

Tests and Adjustments

C37-3 With the machine at home position and latch arm J manually released, there should be .005" to .015" releasing clearance between latch F and ear I on slide D.

To Adjust, turn eccentric screw H in arm J as required.

Reason: To ensure a positive release of slide D as late as possible.

C37-4 With slide D released by latch F, there should be .020" to .025" clearance between ear C and switch actuator B.

To Adjust, reposition switch A as required.

Reason: To ensure transfer of switch A when slide D is released.

ELECTRICAL LANE SWITCHES

Six electrical lane switches provide a means of controlling certain electrical functions. These switches are located at the rear of the auxiliary sensing unit and are controlled by the last six lanes of the control panel. Pins of only one length are used since the switches are toggle action, single pole, double throw type.

With the lane switch actuators A, normal, springs G urge levers F against shaft E to depress the switch plungers. In this manner, the contacts of the lane switches are kept transferred when there are no corresponding pins in the control panel.

As a control pin depresses actuator A, lever F is rocked by the stud in the actuator to clear the switch plunger. This permits the switch contacts to return to normal.

C37-11 With a control pin positioned directly over actuator A, there should be approximately 3/32" clearance between the switch plunger and lever F, but the actuator should not be bottomed. Make this test with the carriage at each end and in a central position.

To Adjust, turn eccentrics B as required and repeat C37-10.

Reason: To ensure proper depression of actuators A by control pins.

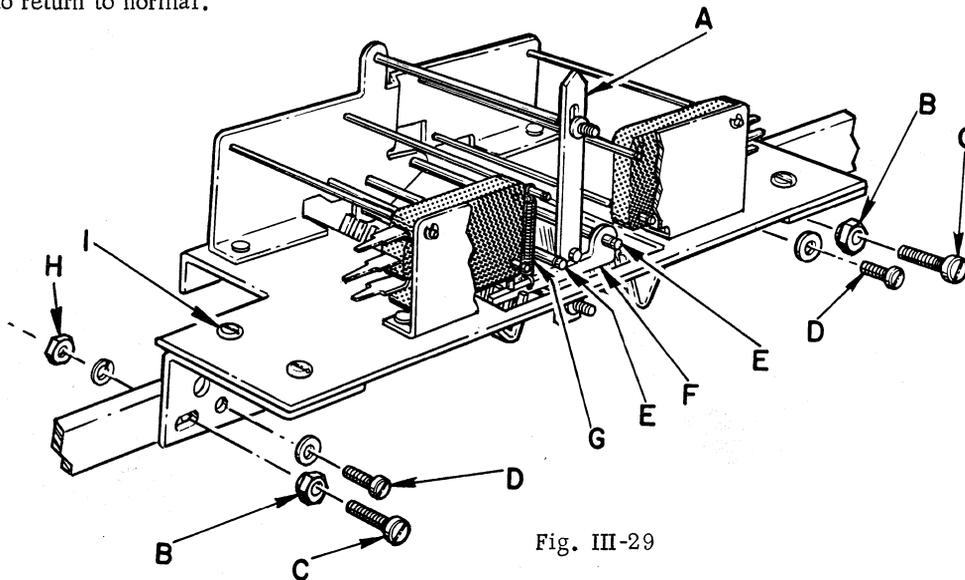


Fig. III-29

TESTS AND ADJUSTMENTS

C37-10 With machine turned on to apply "hold" power to the carriage, actuators A should be centrally aligned with the control pins.

To Adjust, loosen screws C and D slightly and move the switch assembly laterally, as required. It may be necessary in some instances to weave individual control pins.

Reason: To ensure full actuation of switches by the proper control pins.

C14-5-4 Switch actuators A must be centrally aligned with their respective control pins in lanes 61 and 66.

To Adjust, loosen four (4) screws I and reposition the switch assembly forward or rearward as required.

REASON: To ensure alignment of the control pins and actuators A.

COMPUTER TIMING CAM ASSEMBLY

The purpose of the computer timing cam assembly is to provide the timing of electrical functions during the multiply routine. It is turned 180° during the right-hand platen stroke and 180° during the left-hand platen stroke.

The timing cam shaft D is turned by pulley H which is connected to the computer drive by a timing belt.

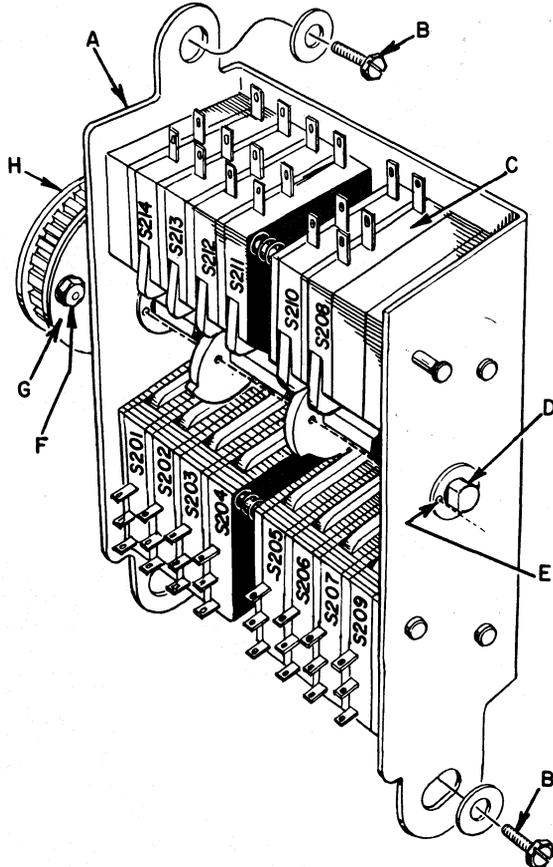


Fig. III-30

TESTS AND ADJUSTMENTS

- A2-1-10 (a) The timing cam belt should be snug without binding the bearing points.
 (b) With the multiplier drive detented in home position, the pilot holes in the timing cams should align with holes E in bracket A.
 To Adjust, (a) loosen screws B and pivot bracket A as required.
 (b) loosen nuts F and move adjusting plate G as required.
 If necessary remesh the timing belt.

Reason: To ensure proper timing of the cam switches without straining the timing cam belt.

SENSIMATIC TIMING CAM ASSEMBLY

The Sensimatic timing cam assembly provides electrical timing based upon the relative position of the Sensimatic camshaft.

Timing camshaft H is turned by gear C, which is turned by pulley B. This pulley is connected to the Sensimatic camshaft by timing belt A and pulley J.

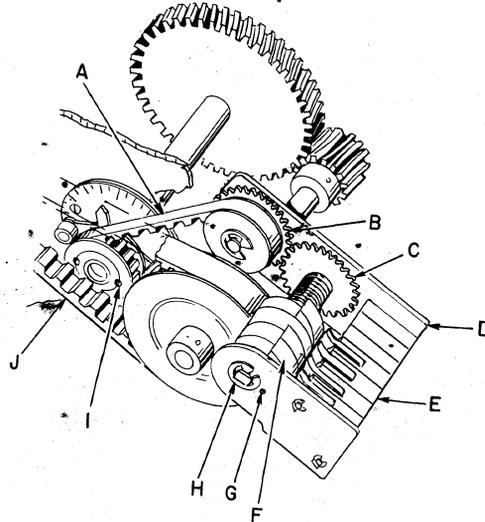


Fig. III-31

TESTS AND ADJUSTMENTS

P25-1-1 With the machine normal, (a) there should be a minimum amount of slack in driving belt A and (b) the pilot holes in the cams should align with hole G.

- To Adjust, (a) loosen front and rear screws which hold bracket D to the left auxiliary sideframe and position as required;
 (b) remesh pulley B with timing belt (for broad adjustment); remesh gears B and C (for intermediate adjustment); tighten pulley J on sensimatic camshaft using wrench in holes I (for very fine adjustment) in the order listed as required.

PULSE GENERATOR

The pulse generator is a cam operated, circuit breaking device which applies to the components unit pulses of varying length synchronized with the rotation of the product accumulator pinion shaft. It is these pulses, routed by the components unit to the product accumulator pinion solenoids, which affects the accumulation of various numbers one through eight. The nine pulse, which is the longest pulse required, is generated by a timing cam switch (S209).

The pulse generator is attached to the outside of the left sideframe of the multiplier drive unit. Cam D is located on the left end of the drive unit shaft which turns the product accumulator pinion assembly. As cam D is rotated, the lobe of the cam contacts nylon actuator B and causes contact C to open.

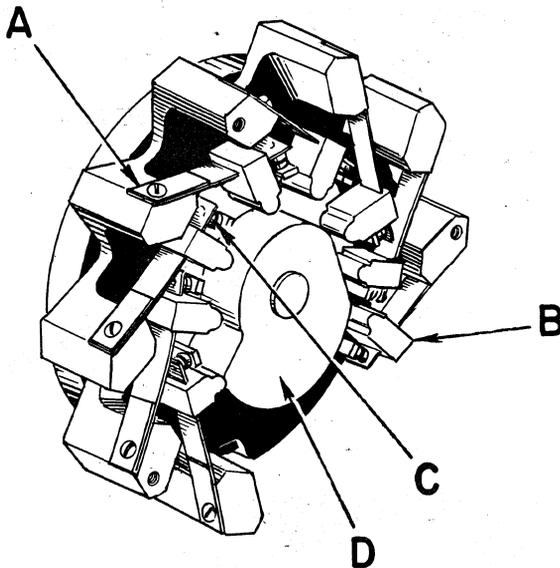


Fig. III-32

TESTS AND ADJUSTMENTS

A2-1-12 With nylon actuator B of each contact assembly in turn located on the high point of cam D, there should be .035" to .045" clearance between contacts C.

To Adjust, weave stationary contacts as required.

Reason: To ensure proper pulse length.

A2-1-13 With contacts C closed, a pressure of 75 to 150 grams, slowly applied to nylon actuator B, should be required to open the contacts. Use gram gauge Kit 408 No. 2. To Adjust, replace backup leaf A and/or contact assembly B as required.

Reason: To provide uniform contact pressure.

A2-5 With cam D positioned .015" from the nylon actuator of the No. 1 contact, index 1,234,567.89 as the multiplicand and 1 as the multiplier. Manually operate the machine through a multiply routine and observe when the product accumulator pinion clappers are released. At this point the clapper should cover the flat surface of the pinion ratchet gear within $\pm 1/32"$.

To Adjust, reposition cam D.

Reason: To synchronize the opening of contacts C with the rotation of the product accumulator pinion shaft.

DRIVE UNIT ASSEMBLY

The drive unit is used to furnish and control power to the components unit and the product accumulator. The drive unit is controlled by a solenoid operated clutch. Tripping of the drive, which is belt driven from the constant running sensimatic motor, results in one cycle of the product accumulator and one-half cycle of the components unit.

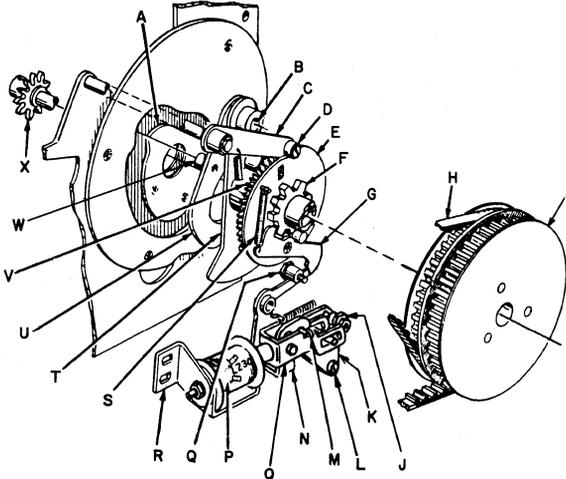


Fig. III-33

When the computer clutch solenoid **P** is energized, plunger assembly **O** pulls release bail **N** rearward (through the connecting pin). Pivoting on its shoulder screw, the forward projection of release bail **N** is rocked below the foot of clutch dog **G**. Spring **S** on the clutch dog, pulls the engaging tooth of the clutch dog into mesh with the constant running clutch spline **F**. Limit **M** on plunger assembly **O** prevents a premature release of clutch dog **G** by blocking the downward movement of the hooked portion of release bail **N**. The enlarged hole in release bail **N** allows limit **M** to be moved rearward, by plunger assembly **O**, out of the path of the hooked portion of release bail **N** when solenoid **P** is energized.

The clutch dog is attached to cam **E**. Cam **E** is attached to a drive unit assembly made up of cam **E**, gear **V**, segment gear mounting blank **T** and segment gear **U**. Segment gear **U** pivots at point **B**; its movement is controlled by roller **W** riding in enclosed cam **A**, and by the rotation of its mounting blank **T**. If the segment gear **U** was not allowed to float on its mounting blank **T**, gear **Y** would make a full rotation at the same speed as gear **V**. Since segment gear **U** floats,

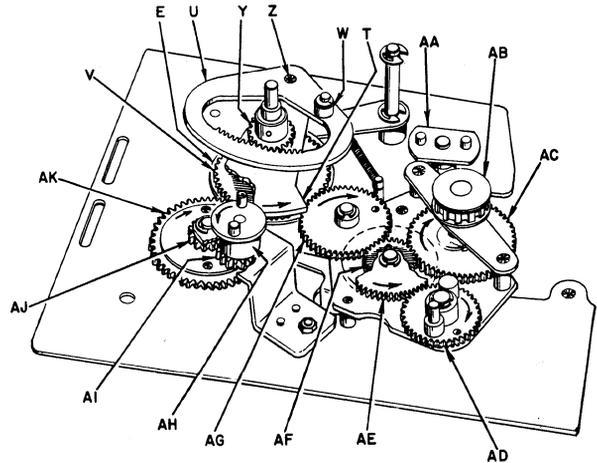


Fig. III-34

and is controlled through roller **W**, and cam **A**, and due to the configuration of cam **A**, a reverse, forward, reverse and then forward motion is imparted to gear **Y**. Gear **Y** turns gear **X** through their common shaft to supply power to the product accumulator pinion shaft.

Gear **V** meshes with gear **AK** to drive the main camshaft of the product accumulator through gears **AJ**, **AI** and coupler member **AH**.

Power to turn the computer timing cams is supplied by pulley **AB** which is pinned to the same shaft as gear **AC**. Gear **AC** is turned by the smaller gear **AF** on gear **AE**. Gear **AF** is driven by idler gear **AG** from gear **V**.

Power is supplied to the components unit platen camshaft through coupler member **AD** from gear **AE**.

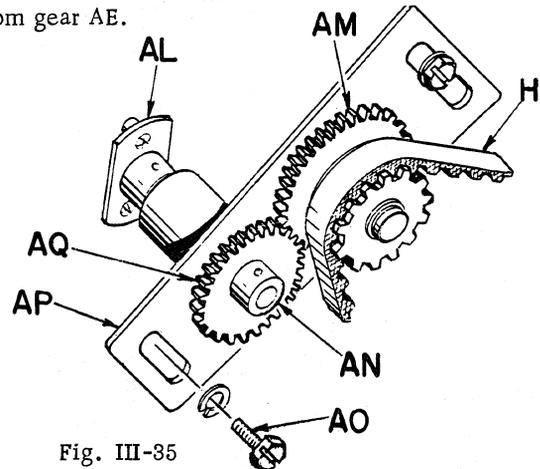


Fig. III-35

Coupler member **AL** supplies constant power to the components unit clutch drive shaft. The coupler member is pinned to shaft **AN** which is turned by gear **AQ** from gear **AM**. Gear **AM** is driven by belt **H** from pulley **I**.

TESTS AND ADJUSTMENTS

NOTE: The first four adjustments are for the proper assembly of the drive unit. They need be made only if it has been necessary to disassemble the drive.

- A2-1-1 The high side of eccentric screw in D should be in its extreme downward position. To Adjust, turn eccentric screw as required. Reason: Basic adjustment to enable proper meshing of the drive gears.
- A2-1-2 With detent roll of arm C in the pocket of cam E, punch mark on gear V should align with the punch mark on gear AK. To Adjust, remesh gear AK as required. Reason: Basic adjustment for proper timing relationship between the component unit and product Accumulator.
- A2-1-3 With the punch mark on gear V aligned with the punch mark on gear AK, the studs in the hub of gear assembly AH should align vertically with the punch marked stud towards gear Y. To Adjust, remesh gear AI with gear AJ. Reason: Basic adjustment for the home position of the product accumulator.
- A2-1-4 With detent roll of arm C in the pocket of cam E, the punch mark on gear Y should align with the punch mark on segment gear U. To Adjust, remesh gear Y with segment gear U. Reason: To permit proper meshing of pinion cluster drive gear with the drive rack.
- A2-1-5 With clutch dog G disengaged in home position, release bail N should have .070" to .080" hold on clutch dog G. To Adjust, turn eccentric shoulder screw Q as required. Reason: To ensure disengaging clutch and have minimum air gap.
- A2-1-6 a) With the roller of detent arm C in the pocket of cam E and release bail N limiting against eccentric Q, there should be .005" to .009" clearance (.007" nominal) between release bail N and the top of limit M. (b) With the roller of detent arm C limiting on cam E just prior to dropping into the pocket and with solenoid plunger O bottomed, there should be .015" to .020" clearance between clutch dog G and release bail N.

To Adjust, a) loosen screw L and position blank K as required.
b) reposition solenoid bracket R as required, maintaining freedom of plunger O. Recheck step (a).

Reason: To establish correct relationship between release bail N and plunger assembly O.

- A2-1-7 With the drive unit in home position, clutch dog G disengaged, and solenoid plunger O normal, the inner edge of the hooked portion of release bail N must have a flush hold with the rear edge of limit M. To Adjust, rotate eccentric sleeve J as required.

Reason: To ensure minimum air gap for solenoid plunger assembly O.

- A2-1-8 With the play of gear V taken up in home position in the direction of normal rotation, there should be .010" to .015" clearance between the roller of detent arm C and the edge of the drop off of detent cam E.

To Adjust, turn the eccentric screw holding the roller of detent arm C as required.

Reason: To ensure detenting the drive unit in home position without excessive play.

- A2-1-11 Belt H should be snug without binding the bearing points.

To Adjust, loosen screws AO and with a spring scale in the upper screw slot, position bracket AP for 1/2 lb. pull against belt H.

Reason: To ensure positive drive without straining belt H or cramping the bearing.

COMPONENTS UNIT

The components unit is located behind the product accumulator, below the add rack extensions, in the "F" section of the F2000. It is an electro-mechanical unit whose purpose is to route pulses from the pulse generator to the product accumulator. The unit consists of four clutch assemblies, two disk assemblies and two types of sensing switch assemblies.

CLUTCH ASSEMBLIES

The clutch assemblies provide a means of positioning the discs in the disc assemblies. The clutch is indexed electrically by a solenoid and power is supplied by a constant running belt and pulley assembly which works off the Computer drive. The disks are moved from one position to the next in twenty-five milliseconds.

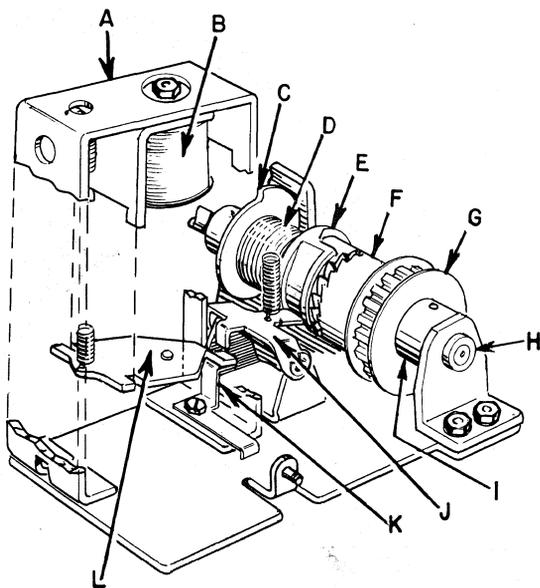


Fig. III-36

When clutch solenoid B is energized, clapper L contacts clutch reset arm J, pivoting it down out of engagement with clutch member E. This allows spring D to engage clutch members E and F. Pulley G through clutch member F turns clutch member E. Clutch member E is keyed to cam C, which is pinned to the clutch shaft. One half cycle of the clutch shaft advances the disk, or disks, one position.

As the clutch shaft rotates, roll P on bail Q rides up the inclined surface of snailback cam C, causing bail Q to pivot and transfer interlock switches U. As roll P reaches the high point of cam C, latch S is positioned over latch bail R (riveted to bail Q) to hold the switches transferred while the clutch is engaged.

In order to disengage the clutch members, solenoid B is de-energized to allow reset arm J to return (by spring tension) against clutch member E. As the clutch shaft continues to rotate, reset arm J cams clutch members E and F apart, by contacting the cam surface of member E. As the members disengage, member E contacts the tail of latch S to release latch bail R and allow the clutch to detent in home position.

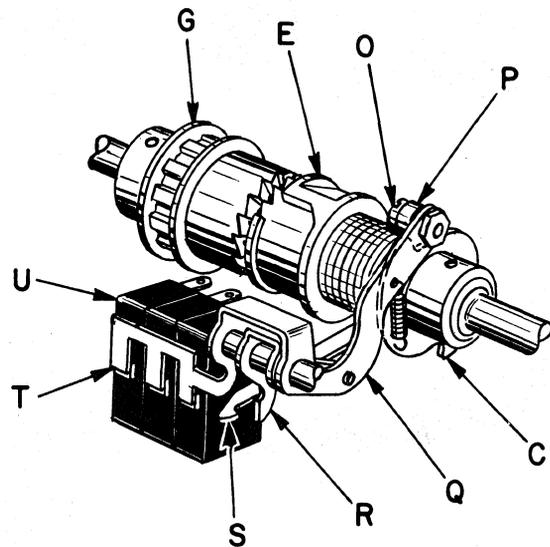


Fig. III-37

TESTS AND ADJUSTMENTS

- R10-1 (a) With the clutch shaft held tight against nylon bearing H, on the pulley end of the shaft, reset bail J should have .003" to .006" clearance with the flange of driven member E at any position during rotation except when camming the clutch members apart.
- (b) Total end play of the clutch shaft should not exceed .006". (Some end play is required). To Adjust: (a) Place .011" shims (811 1/2) or .006" shims (8823 1/2) as required between pinned clutch collar I and nylon bearing H. (b) Place shims as required between the worm gear on the clutch shaft and nylon bearing.

Reason: To ensure positioning reset bail J clear of the flange on member E as clutch solenoid B is de-energized and to have free running clutch shaft without excessive free play of disks.

R10-2: With the clutch disengaged in home position, there should be .030" to .060" clearance between the mounting bracket and latch arm S. To Adjust, loosen bracket mounting screws and reposition bracket as required.

Reason: To prevent a false limit of clutch member E in reset position and to ensure releasing latch arm S in time to allow roll P on eccentric O to detent cam C smoothly without binding.

X R10-3: With the high side of eccentric screw O toward cam C and toward the end of detent bail Q, latch arm S should latch bail R with no more than .004" latching lead when the detent roller is on either high point of cam C. With the clutch disengaged in each home position and the end play of driving member F taken up toward driven member E, there should be not less than .005" clearance between the teeth of the clutch members.

To Adjust, turn eccentric screw O as required.

Reason: To ensure latching detent arm S, to prevent excessive bounce of interlock switches U, to ensure driving clutch home through momentum, and to prevent clutch teeth from rubbing when disengaged.

R10-4: With the clutch disengaged there should be at least .005" clearance between the forward end of reset bail J and clutch driven member E. To Adjust, recheck R10-2 and R10-3 and readjust, if necessary.

Reason: To prevent driving clutch member E into a bind against the end of reset bail J.

X R10-5: With roll P of detent arm Q on the high point of cam C (left hand clutches) and the interlock switches manually bottomed, there should be .005" to .010" clearance between the switch plunger and the fingers of the switch actuators.

To Adjust, weave the fingers of the switch actuator as required.

Reason: To prevent a false limit of the left hand interlock switches at normal and to ensure transferring the switches when actuated.

X R10-6: With the right hand clutches disengaged in

each home position and each switch plunger manually bottomed, there should be .005" to .010" clearance between the switch actuator and the switch plunger.

To Adjust, weave switch actuator as required.

Reason: To ensure transferring the switch without overdriving the switch plunger.

R10-7: With clapper L held against clutch solenoid B, reset bail J should clear driven clutch member E by .030" to .040".

To Adjust, weave tip of clapper L as required.

Reason: To provide proper indexing and releasing of clapper L and reset bail J.

R10-8: With the clutch disengaged in home position and clapper L limiting against limit blank K, there should be .120" to .130" (approximately 1/8") clearance between clapper L and reset bail J.

To Adjust, weave limit blank K as required.

Reason: To ensure full release of reset bail J through momentum of clapper L without excessive air gap.

X See c 1 1048

DISK ASSEMBLIES:

The components unit contains two printed circuit disk assemblies; the function table assembly and the shifter assembly. Each assembly consists of three printed circuit disks. The two outer disks (A and D) of each assembly are pinned to the disk shaft and positioned mechanically by a gear on the disk shaft similar to C and a clutch worm similar to G. Center disk B is mechanically independent of the other disks and is positioned by gear C and worm G. The positioning of these disks (A and B) is controlled electrically and will determine which pulse from the pulse generator is to be applied to a specific column or columns of the product accumulator.

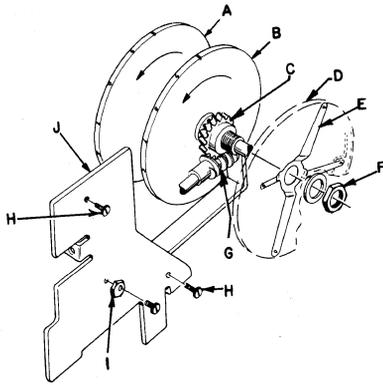


Fig. III-38

SENSING SWITCH ASSEMBLIES

There are two types of sensing switch assemblies in the components unit; the sensing contacts (the platen) and the wiping contacts. The platen is located between the right hand disks (A) and the left hand disks (B). The platen is moved rearward and then forward (by one revolution of the platen camshaft) to sense the right and left hand disks respectively. Two cycles of the multiplier drive are required to accomplish one revolution of the platen camshaft. The wiping contacts are in constant contact with their respective disks to sense and/or control the positioning of the disks.

Coupler V connects platen drive shaft T to the multiplier drive unit. Each cycle of the drive unit results in two and one-half revolutions of drive shaft T. Five revolutions of drive shaft T, through worm gear S and camshaft gear R, result in one cycle of camshaft N. The 180° rotation of camshaft N by the first cycle of the drive unit,

causes platen P to move (through rolls L and brackets O) rearward against disks A and back to normal position. This is commonly called a right hand platen stroke. The second cycle of the drive unit, in a like manner, will cause the platen to move forward against disks B and back to normal position. This is commonly called a left hand platen stroke.

The wiping contact assemblies are in constant contact with their respective printed circuit disks. As the disks are positioned, these contacts will make or break various circuits to help control the process of multiplication.

TESTS AND ADJUSTMENTS

NOTE: Before making any adjustment to the disks, all adjustments for the clutches and the following three adjustments should be checked.

- R11-3 With holes M in alignment, the open slot of coupler plate V should be at 12 o'clock.
To Adjust, remesh gears R and S as required.
REASON: To bring the platen camshaft within the adjustment range of coupler V.
- R11-4 The platen camshaft assembly should be free with no more than .003" end play between its support brackets.
To Adjust, reposition set collar W as required.
REASON: To maintain alignment of gears R and S.
- R11-5 Platen drive shaft T should be free with no more than .003" end play.
To Adjust, reposition set collar U as required.
REASON: To prevent erratic platen timing.
- R11-1 In all positions, disks A and B should have .025" to .035" play, measured on the circumference of the disks.
To Adjust, loosen screws H and position the clutch unit for proper vertical mesh of gears G and C.
REASON: To maintain alignment of the disks and sensing contacts without binding the drive gears.
- R11-2 With all disks home and the clutches disengaged, home position indication marks on the right hand disks should align with the right edge of the slots in the front and back plates of the components unit facing the rear of the machine. Use Kit F605.
To Adjust, slightly loosen screws H and turn eccentric I as required. Recheck R11-1.

REASON: To establish proper relative starting positions of disks.

R11-7 With all clutch assemblies in home position, the pins of platen P should align with the etched circuitry of the printed circuit disks. To Adjust, (a) with eccentric guide post Q loose to prevent interference, loosen platen mounting screws K and position platen as required to align with right hand disks A.

REASON: To ensure that the left hand shifter disk follows up properly.

R11-10 The contact fingers of wiper contacts E should contact the disks with 18 to 20 grams pressure (use gram gauge kit #408 No. 2).

To Adjust, bend the contact fingers at their off-set.

REASON: To ensure uniform contact pressure between wipers E and the printed circuit disks.

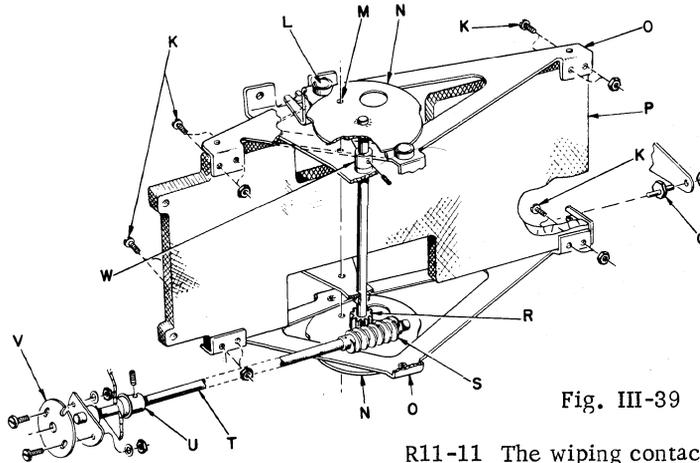


Fig. III-39

(NOTE: In some cases it may be necessary to reposition the right hand disks slightly). Retighten screws K and recheck alignment. (b) Loosen screws H and turn eccentric I on the left hand clutch assemblies to align left hand disks B with the pins in platen P.

REASON: To ensure alignment of platen pins and printed circuit disks for electrical continuity.

R11-8 With the function table disks A and B both located in position 3 or 7, the intermediate length finger of wiper contact E should be approximately 1/16" from the edge of the printed circuit breaker point (see left hand function table follow-up circuit disk in Section VII).

To Adjust, loosen nut F and reposition wiper E as required.

REASON: To ensure that the left hand function table disk follows up properly.

R11-9 With the shifter disks (A and B) both located in position 9 or 20, the intermediate length finger of wiper contact E should be approximately 1/16" from the edge of the printed circuit breaker point. (See left hand follow-up circuit-shifter in Section VII).

To Adjust, loosen nut F and reposition wiper E as required.

R11-11 The wiping contact assembly which contacts the digit selector disk (back of left hand shifter) should be positioned to the extreme left (facing the rear of the unit).

To Adjust, loosen mounting screws and reposition as required.

REASON: To ensure proper timing of the Right Hand Shifter clutch.

R11-12 Timing belt X should be snug without cramping the bearings.

To Adjust, loosen nuts Y and position bracket Z as required.

REASON: To ensure positive drive to the component unit clutches without straining belt X.

R11-6 Eccentric guide post Q should be centrally located in the slot of platen P mounting plate. To Adjust, turn eccentric guide post Q as required.

REASON: To maintain alignment between the platen pins and the disks without restricting normal platen movement.

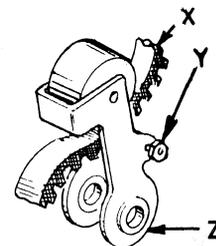


Fig. III-40

THE PRODUCT ACCUMULATOR

The product accumulator provides an electro-mechanical means of accumulating the product of multiplication. There are four steps required in obtaining this product of multiplication in a usable form. They are:

1. Accumulation of amounts, one to nine, on individual pinions.
2. Carry mechanism; adding one to the next left column when nine is exceeded on any pinion.
3. Rounding off the product in the desired column and clearing the rounded off column and those to the right of it.
4. Transferring this product into the basic machine.

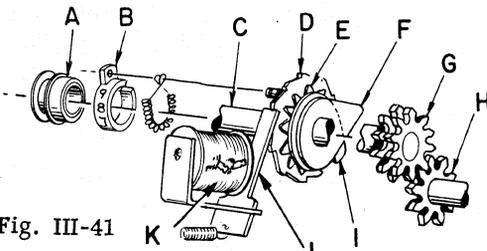


Fig. III-41

ACCUMULATION OF AMOUNTS

As in other accumulating sections, amounts are indexed into the product accumulator by rotating the pinions. The degree of rotation indicates the number accumulated. The power for pinion rotation is derived from gear H (on the multiplier drive unit) to gear G and shaft C. Each individual pinion is connected to shaft C by a slip clutch. The clutch drum A is pinned to shaft C. Clutch band B is connected to the pinion assembly by the stud in D. At normal clapper J is located against pinion ratchet gear D. In order to rotate the pinion, clapper J must be moved away from gear D and held away until the proper number has been accumulated. Due to the large air gap between clapper J and solenoid K, the strong restoring spring on clapper J and the small voltage (hold voltage only) applied to solenoid K, it is necessary to mechanically reset the clappers against their solenoid cores. As the clappers are being reset, gear H through gear G imparts a reverse rotation (backup) of 12° to pinion shaft C. This reverse (clockwise) rotation is necessary to allow clapper J to catch the same tooth of gear D if no amount is to be accumulated in that column. As

the product accumulator camshaft is rotated cam M through roller O pivots arm N upward. Since arm N and reset arm Q are both pinned to shaft P, reset arm Q will pivot upward, plunger L will contact clapper J and move the clapper against solenoid K. Due to the configuration of cam M reset arm Q moves away from clapper J before pinion shaft C starts its forward (counterclockwise) rotation at approximately 73° of the product accumulator cycle. The pulse applied to solenoid K will determine how long clapper J is held by solenoid K and the amount accumulated (one through nine). If no amount or an amount less than nine is to be accumulated, clapper J will limit the rotation of pinion ratchet gear D and cause clutch band B to slip on clutch drum A.

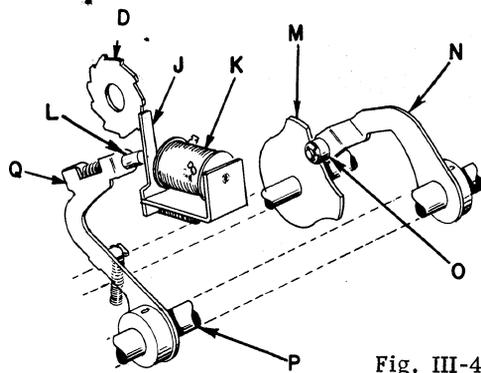


Fig. III-42

Rebound of clapper reset arms Q and possible interference with the return of clapper J to the proper step of ratchet gear D is prevented by two trap-latches S. At normal traplatch S is held out of the path of ear T (pinned to shaft P) by cam R. At approximately 20° cam R releases traplatch S. When clapper reset shaft P restores to normal, at approximately 50° , traplatch S moves behind ear T to prevent rebound. This is the add portion ($0^\circ - 230^\circ$) of the product accumulator cycle and is followed immediately by the carry portion.

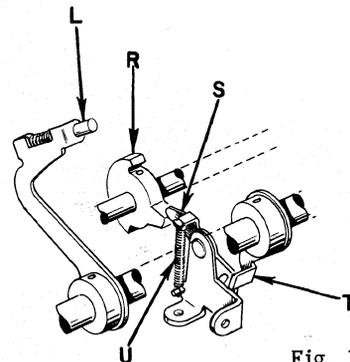


Fig. III-43

TESTS AND ADJUSTMENTS

A36-2 There should be .002" to .008" end play of the total bail shaft, the carry reset shaft, the transfer shaft, the clapper reset shaft and the product accumulator camshaft between the sideframes of the product accumulator.

To Adjust, add the following shims as required: 811 1/2 (.006"), FX1-32 (.005"), FX1-93 (.008"), FX1-64 (.011") or FX1-94 (.006"). Note: Shims for the carry reset shaft should be placed next to the left side frame and for the camshaft next to the right side frame.

Reason: To maintain alignment of component parts.

A36-20 Trap latch pawl S should have at least a full side hold on cam R and spring U should clear adjacent parts.

To Adjust, position trap latch bracket as required.

Reason: To ensure proper actuation of the trap latch assembly.

THE CARRY MECHANISM

The high speed of the product accumulator can be attributed in part to its unique carry mechanism. All carries, direct or relay, occur simultaneously. This system requires not only an indication of direct carries but also an indication of which pinions, if any, are in the nine position (for relay carries). These indications are provided by positioning carry wipers W on the printed circuit board as shown. The "A" pads are "dead" and have no electrical function. They are present only to prevent wear of the printed circuit board by wipers W. All pads "B" are connected in common to the normally open contact of timing cam switch S208, which supplies the carry pulse (276° to 340°). Pads "C" are connected through pads "D" to the dropping resistor of the next left adjacent pinion solenoid.

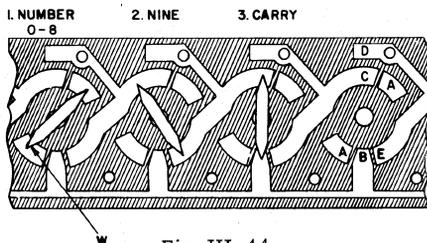


Fig. III-44

With the carry mechanism normal (0 through 8 on the pinion) pads "A" are bridged by carry wiper W. When there is a nine on the pinion pads "C" and "E" are bridged. When a carry has been initiated, wiper W will be positioned to bridge pads "B" and "C". As can be seen by the illustration of these three conditions, the carry pulse received on the "B" pads is bridged, in the carry position to the "D" and "E" pads of the next left pinion. If this next left pinion is in the nine position ("C" and "E" pads bridged) the "D" and "E" pads of the second left pinion will also receive the carry pulse. In this manner direct and relay carries are accomplished simultaneously using the same pulse.

At the beginning of the product accumulator cycle (add portion) reset arms AE move carry wiper positioning arms AB (commonly called the hatchet) upward. Hatchet AB moving upward contacts stud Z in carry latch Y to reset the carry latch in front of latch bail X (carry reset). By 55° carry reset arms AE have moved into the initial carry position and will remain in this position (Fig. III-45) until the end of the of the add portion of the cycle (245°). At this time clapper reset and pinion "backup" again take place. At the same time reset arms AE move downward to allow hatchet Ab to limit in either number, nine or carry position as determined by pinion rotation during the add portion of the cycle.

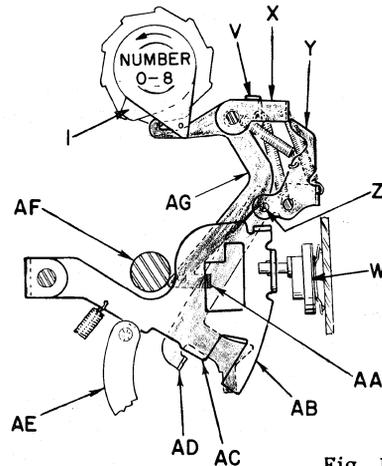


Fig. III-45

If the amount on a pinion has not exceeded eight (8) during the add portion of the cycle, hatchet AB will be limited at point AC by ear AD on carry latch Y. In this position the "A" pads of the printed circuit board are bridged by the carry wiper in this column.

If, during the add portion of the cycle, the pinion is rotated to nine, follower arm AG will be located on the high point of carry cam I. Tip AA of follower arm AG will be positioned forward (toward carry wiper W). As follower arm AG rides up the incline of carry cam I, it will contact lip V of release bail X, pivoting the release bail upward to release carry latch Y. As the carry latch is released, lip AD on the tail of the carry latch will be positioned forward to align with the cutout in the lower side of hatchet AB. At 245° when hatched AB is allowed to drop, lip AA on follower arm AG will limit the hatchet as shown. In this position pads "C" and "E" are bridged by carry wiper W.

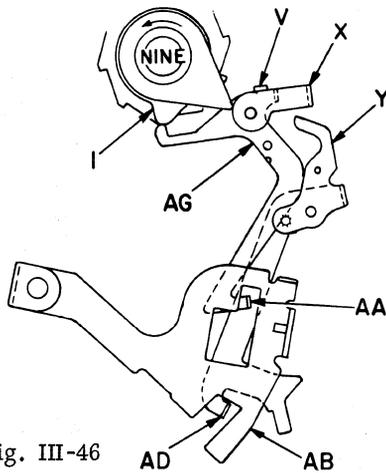


Fig. III-46

When an amount greater than nine is accumulated during the add portion of the cycle, follower arm AG will ride over the high point of carry cam I, releasing carry latch Y as before to position lip AD forward to align with the cutout in the lower side of hatchet AB. Since follower arm

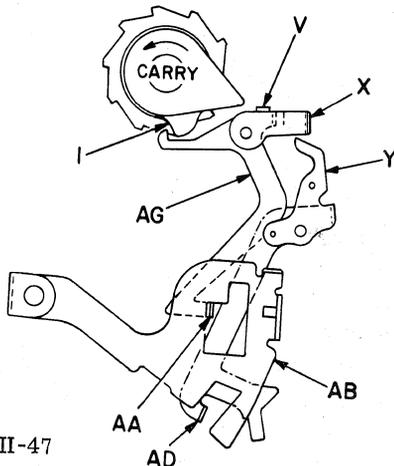


Fig. III-47

AG is not held by carry cam I, lip AA will return to its normal (0 to 8) position. At 245°, when hatchet AB is allowed to drop, lip AD on carry latch Y will limit the hatchet on the step as shown. In this position, pads "B" and "C" will be bridged by carry wiper W.

Reset arms AE are actuated from three sets of double cams AK on the product accumulator cam shaft, through arms AJ and rollers AI assisted by springs AH. As can be seen from the product accumulator timing chart in Section VII, carry reset begins at approximately 345° of the previous cycle and is completed by 55° of the current cycle. From 55° to 245°, reset arms AE are in pre-carry position. It is during this time that the carry wiper position is indexed by releasing carry latch Y and positioning cam follower AG. Hatchet AB is prevented from dropping by reset arms AE. From 245° to 345° reset arms AE move downward allowing hatchets to seek their limit as determined by the positioning of carry latches Y and cam followers AG. It will be noted that carry latch Y cannot be reset behind latch bail X if the pinion is in nine position during carry reset.

TESTS AND ADJUSTMENTS

- A36-1 (a) Cam follower arms AG must be free with no more than .003" side play between the "U" forms of latch bails X.
 (b) Latch bails X must be free with no more than .003" side play and with the play of the pinion shaft taken up to the right or left, follower arms AG should have no less than 2/3 hold on cams I.
 To Adjust: (a) Weave the "U" form of follower arms AG as required.
 (b) Reposition retaining set collars as required.

Reason: To ensure freedom of latch bails X and follower arms AG and to maintain alignment of follower arms AG with carry cams I.

- A36-3 Hatchets AB must be free in their guide comb, have a full hold on lip AA of follower arm AG and lip AD of carry latch Y.

To Adjust, reposition retaining set collars for hatchets AB as required.

Reason: To ensure free movement of hatchets AB and alignment with component parts.

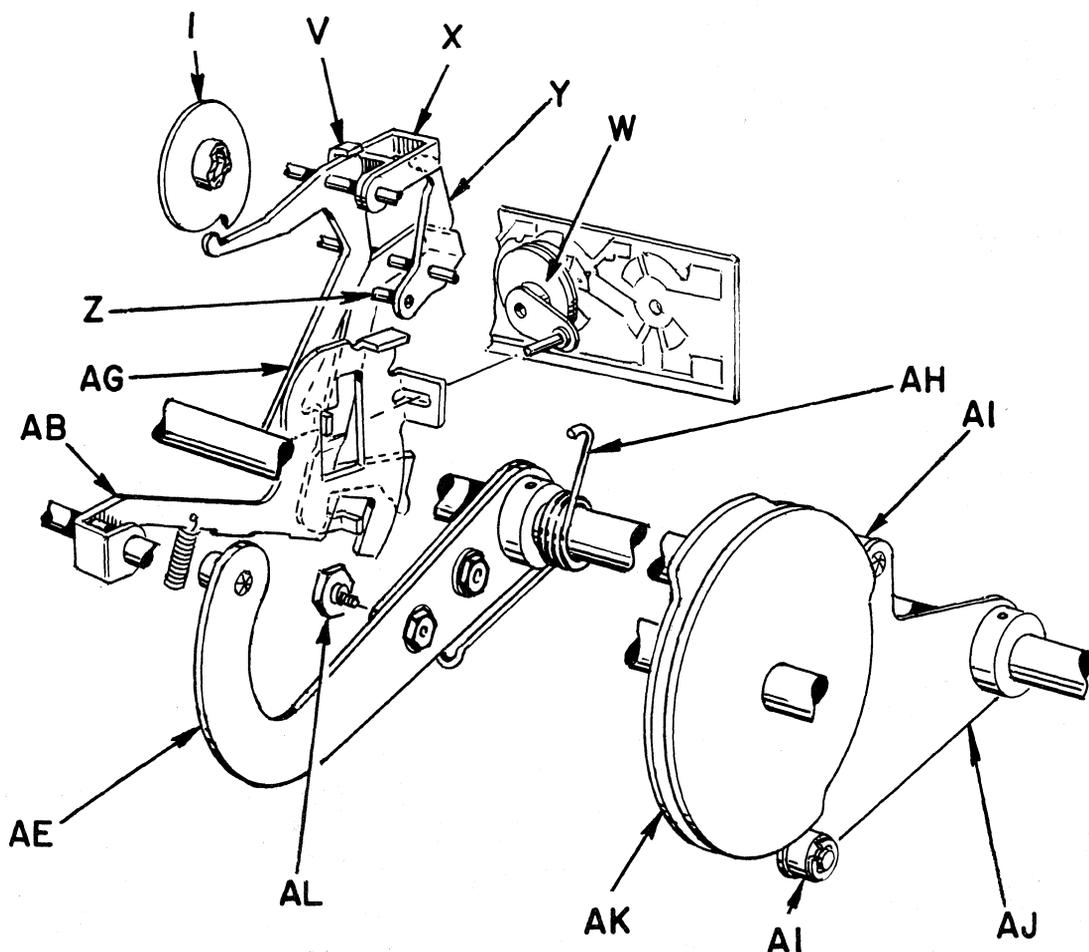


Fig. III-48

A36-4 Carry latches Y must be free in their guide comb, have side clearance with follower arms AG and should have no more than .010" side play.

To Adjust, reposition retaining set collars for latches Y as required.

Reason: To ensure free movement of carry latches Y.

A36-11 With springs AH unhooked from reset arms AE and a #5 roller on the top stud of arms AJ (3 places), cycle the product accumulator to between 20 and 30 degrees. There should be clearance, not to exceed .008", between the bottom rollers AI and cam AK, when the top roller AI is limiting against cam AK.

To Adjust, select the correct roller (#1 through #5) for bottom roller AI.

Reason: To ensure free rotation of the carry reset shaft.

A36-12 With follower arms AG on the high point of carry Cam I, there should be .020" to .025" releasing clearance between carry latch Y and latch bail X.

To Adjust, weave formed ear V on latch bail X as required.

Reason: To ensure releasing carry latches Y.

A36-13 With carry reset arms AE at their extreme upward position (approximately 30), there should be .025" to .030" resetting clearance between carry latches Y and latch bails X.

To Adjust, turn eccentric screws AL as required.

Reason: To ensure resetting carries without driving hatchets AB out of their guide comb.

ROUNDING-OFF AND CLEARING

It is often necessary to round-off products to the nearest cent, dime, dollar, or ten dollars. This is controlled through control panel programming and is accomplished during the right hand accumulator cycle in shifter position 21, by adding five to the product accumulator column corresponding to keyboard column zero, one, two, or three. If the amount on the selected pinion is five or more, a carry into the left adjacent accumulator column will result.

For greater accuracy of products, eight of the twenty accumulator pinions are located to the right of the first add rack. Since there is no mechanical shift, these pinions cannot be cleared of amounts by the add racks and consequently have no gears to mesh with add racks. Clearing is accomplished by latching in the total bail, which performs the same function as the total bail of a basic mechanical accumulator, and turning the pinions through the accumulator drive until their total lobes limit on the underside of the total bail.

During the left hand accumulator cycle in shifter position 21, prior to transferring the product, the accumulator column to which the five had been added during round-off and all columns to its right are cleared. This "clear" accumulator cycle is identical to an add cycle except that the total bail is latched in and the only pulse re-

ceived by the pinion solenoids is the "nine" pulse from S209. This "nine" pulse is gated to the accumulator columns designated to be cleared by control panel programming. When a designated solenoid is receiving its "nine" pulse and the total bail is latched in, the corresponding pinion rotates with the pinion drive shaft until its total lobe limits on the total bail. At this point, the pinion clutch slips as the drive shaft continues to turn.

Through control panel programming, both rounding-off and clearing or rounding-off only may be prevented. This is accomplished by disabling the electrical circuits for the round-off and/or clear pulses which would ordinarily reach the pinion solenoids. Disabling of both rounding-off and clearing is known as prorating. However, the "round-off" and "clear" accumulator cycles as previously described are always required.

During a normal add accumulator cycle the total bail is ultimately retained in inactive position by total bail solenoid clapper AM. The clapper retains bail AN which is urged against the clapper by spring AV.

Initial indexing of the total bail mechanism occurs at approximately 90° of the "round-off" accumulator cycle when total bail solenoid BD (L235) is energized to pull in and hold clapper AM out of the path of bail AN. Spring AV urges bail AN to limit its roller AU against cam AW of the accumulator camshaft assembly.

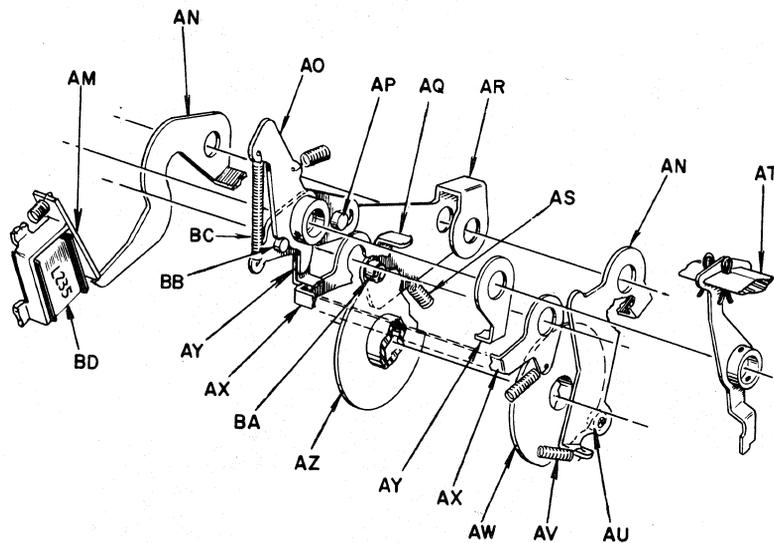


Fig. III-49

Early in the next accumulator cycle, which is the "clear" cycle, bail AN follows cam AW and contacts ear AQ of latch bail AX to rock bail AX clear of bail AY. Roller BA of bail AR follows cam AZ, urged by spring AS. Bail AR rocks bail AY through stud AP in bail AR and the slot in bail AY. Stud BB in bail AY contacts arm AO, which is pinned to the total bail shaft, rocking total bail AT into active position. Movement of the total bail is limited when arms AO and BH contact eccentric posts BE and BI, respectively, in the accumulator side frames. Bail AN is reset at approximately 45° of the clear cycle.

With the accumulator normal, the rollers of two total bail latches BJ, one of which is shown, are urged against cams BG of the accumulator camshaft by springs BF. In this position the latches are held clear of latching arms BK of total bail assembly AT, and arms BN of the total bail assembly rest against bumpers BM on transfer shaft BL to establish the normal position of the total bail. For simplicity, only one arm BN and bumper BM are shown in the illustration.

At approximately 25° of the accumulator cycle, cams BG permit the springs to rock the latches against the lower ends of the latching arms. If the total bail has not been brought into active position, the latches merely contact the flat surface at the ends of the latching arms. If, however, the total bail is in active position, the latches contact the latching arms behind the latching step and retain the total bail. The total bail is latched in to prevent camming of the bail by the total lobes.

The total bail is restored late in the accumulator cycle. At approximately 350°, the total bail latches BJ, driven by cams BG, release the total bail. Bail AR is restored by its cam at approximately the same time, restoring the total bail through spring BC.

TESTS AND ADJUSTMENTS

A36-10 With total bail solenoid clapper AM manually picked to release arm AN and the product accumulator manually cycled until the total bail assembly is limiting on the two cam operated latches BJ, there should be equal clearance of .010" to .015" between overthrow arms AO or BH and their respective eccentric limit posts BE or BI.

To Adjust, turn eccentric post BE or BI as required.

Reason: To ensure latching the total bail.

A36-8 With clapper AM of solenoid BD held against its core, there should be .010" to .020" releasing clearance between clapper AM and arm AN.

To Adjust, move solenoid bracket as required.

Reason: To ensure releasing arm AN with minimum air gap.

A36-9 With clapper AM limiting against its retainer, clapper AM should have a flush hold on arm AN.

To adjust, weave the retainer for clapper AM.

Reason: To ensure latching arm AN with minimum air gap.

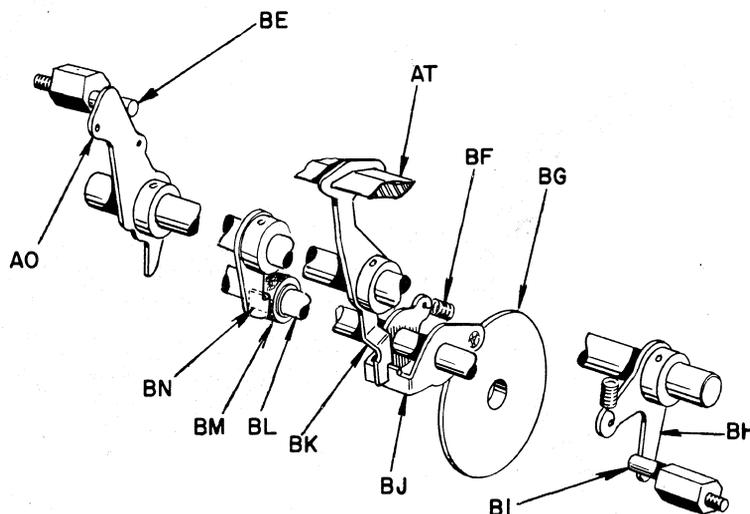


Fig. III-50

TRANSFERRING THE PRODUCT

Transferring the product is, in effect, totaling the product accumulator. This transferring, or totaling, is indexed during the multiplication routine and occurs during the sensimatic opera-

clapper CC to release bail CD. Releasing bail CD allows spring BX to pivot bellcrank BS and lower transfer link BZ. Lowering link BZ will position the pocket in link BZ over screw post CA in drive arm BR. Projection CE on bail CD indexes the index strip blocking bail.

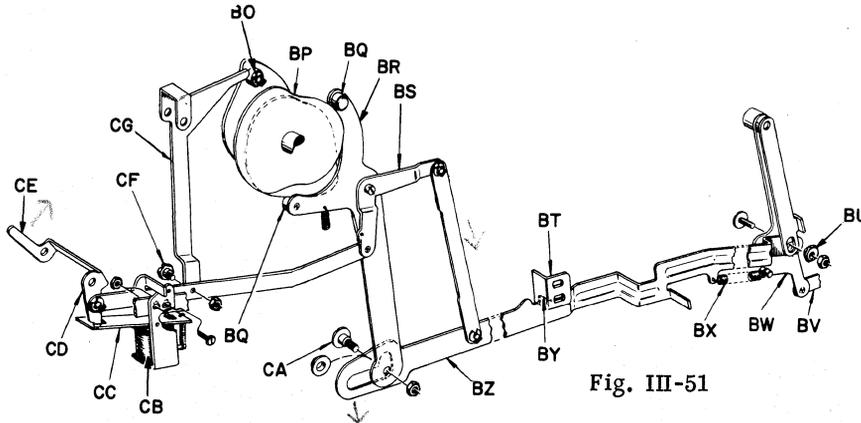


Fig. III-51

tion following multiplication and in the same stop position. Only the amounts in columns which mesh with add rack extensions can be transferred. The product thus obtained can be non-added, added or subtracted in either or all of the basic mechanical accumulators or indexed into the "D" section by control panel programming. The product accumulator cannot be subtotaled.

The transfer operation is initiated during the last (clear) cycle of the product accumulator, when solenoid CB (L233) is pulsed to attract

Early in the sensimatic cycle, cam assembly BP on the sensimatic camshaft rocks drive arm BR through roller BQ, to pull transfer link BZ forward. Arm BW and link BV follow transfer link BZ forward through broken joint spring BX. Link BV through arm CQ rotates transfer shaft CP. Enclosed cams CI, which are pinned to transfer shaft CP, raise product accumulator pinion assembly CN into mesh with the add rack extensions. Rotation of the first eight pinions during transfer operations is prevented by the ears on bails CJ.

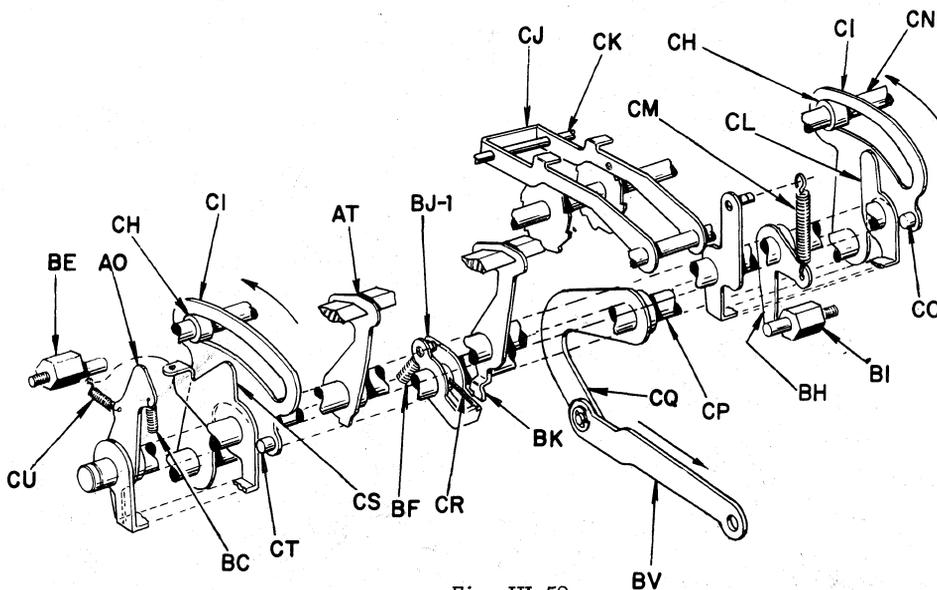


Fig. III-52

As enclosed cams CI pivot to raise the pinion assembly, studs CT and CO contact bails CS and CL, of the total bail shaft assembly, to rock the total bail through springs CM and CU into position to limit the total lobe of the pinions on the top side of the total bail. As during the clear operation, it is necessary to latch the total bail in active position. However, since the product accumulator is not cycled, this cannot be accomplished by latches BJ. For this reason, two additional latches BJ-1 are provided. At normal these latches are held inactive by two pins CR located in transfer shaft CP. As the transfer shaft is rotated at the beginning of the transfer operation, pins CR move away from latches BJ-1 to allow the latches to lock the total bail in active position. Movement of the total bail toward the pinions is limited as before by arms AO and BH contacting eccentric posts BE and BI.

If the add racks were required to overcome the friction clutches to turn the pinions, the load would be so great that add rack latches would position in the lock plates before the total lobes could limit on the total bail. To prevent this, an auxiliary drive rack CW (helper rack) drives the pinions at the same speed as the add racks thru a link which in turn, connects to the left end of the add rack control shaft. As the pinion assembly is raised, the pinion drive gear G leaves its mating gear H of the drive unit and meshes with auxiliary drive rack CW. The pinions are turned until their total lobes limit on the top of the total bail, limiting the movement of the add racks and causing the add rack latch studs to enter the lock plates.

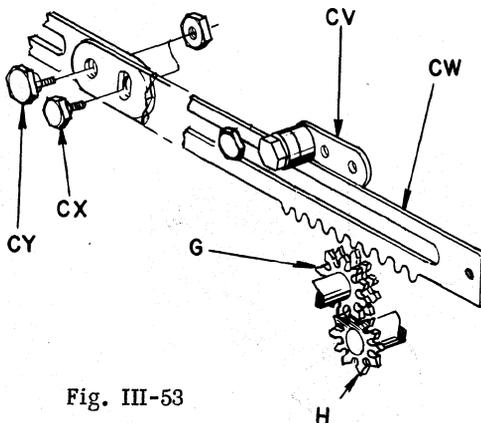


Fig. III-53

At approximately 170° of the machine cycle drive arm BW is restored through roller BQ and

cam assembly BP, driving the transfer link rearward and restoring the transfer shaft assembly. Release bail CD is relatched on clapper CC and the forward end of link BZ is raised to clear screw stud CA when roller BO contacts bellcrank CG. As the transfer shaft assembly returns to normal, pins CR again contact the total bail latches to release the total bail, which is then restored by spring BC.

TESTS AND ADJUSTMENTS

A23-1 With the machine normal, the flanged roller on screw CA should be centrally located in the horizontal slot of link BZ.

To Adjust, with limit blank BT loosened to prevent interference, reposition the bracket for mesh control solenoid CB forward or rearward as required.

REASON: To permit free movement of the flanged roller in the horizontal slot of link BZ during non-transfer operations.

A23-2 With clapper CC manually held against the core of mesh control solenoid CB, there should be passing clearance, not to exceed .003", between latch arm CD and the surface of clapper CC.

To Adjust, reposition the bracket for mesh control solenoid CB up or down as required.

REASON: To provide minimum air gap between clapper CC and the core of solenoid CB.

A23-3 With the machine cycled until arm CG receives maximum throw from roller BO (approximately 350° to 355°), there should be latching lead, not to exceed .005" between latch arm CD and the front of the window in clapper CC.

To Adjust, starting with the high side down, turn eccentric CF as required.

REASON: To ensure latching transfer linkage without excessive overthrow.

A23-4 a. With the machine normal, there should be .010" to .015" clearance between the rear of limit blank BT and the forward surface of projection BY. b. With the machine cycled until arm CG receives maximum throw from roller BO, there should be .010" to .015" clearance between the bottom of limit blank BT and transfer link BZ. c. With clapper CC manually bottomed and the machine

cycled to position link BZ forward, there should be passing clearance between projection BY and limit blank BT.

To Adjust, (a) reposition limit blank BT forward or rearward. (b) and (c) reposition limit blank BT up or down.

REASON: To ensure holding transfer link inactive during non-transfer operations and to prevent interference between limit blank BT and transfer link BZ.

A24-5 With the drive tripped and the sensimatic cycled to approximately 70° , the rear surface of gear G should just contact the front surface of the tooth in drive rack CW.

To Adjust, rotate eccentric CX as required.

REASON: To ensure that the add racks will not be required to turn the pinions during a transfer operation.

A36-14 With the machine normal, two rollers CH should not limit in the ends of enclosed cams CI. With transfer solenoid clapper CC manually actuated, cycle the machine to 100° (two rollers CH should be on the flat of enclosed cam CI). Total bail AT should be latched by latches BJ-1.

To adjust, turn eccentric BU as required.

Reason: To ensure latching total bail and to ensure normalizing the pinion assembly and total bail.

A36-16 The two (2) limit pins CR should have a flush hold on latches BJ-1.

To adjust, locate limit pins CR as required.

Reason: To ensure locking total limit bail AT during a transfer operation.

A36-15 (a) Shaft CK should have .002" to .008" clearance between the left side frame and the clips on the end of the shaft.

(b) There should be at least .005" clearance between ratchet retainer CJ and cams I.

(c) Cycle the product accumulator under power to seat clappers J firmly against pinion ratchet D. With the play of shaft CK held toward the left side frame, there should be at least .005" clearance between retainers CJ and clappers J. To Adjust, (a) add shims (X1-19) as required.

(b) weave ratchet retainers CJ as required

(c) recheck adjustments (a) and

(b) above

Reason: To maintain alignment of component parts.

TWENTY-PLACE CLEAR

After prorating or after a power failure during a multiplication it is necessary to clear all of the twenty accumulator pinions. This may be done through control panel programming, or by depression of the delta key with the carriage controls disabled.

To initiate a twenty-place clear operation it is necessary to trip the Sensimatic drive. This is done by depressing the delta key in the case of a manual clear or by programming a repeat for a carriage controlled clear.

At 5° of the Sensimatic cycle, S222 of the Sensimatic timing cam assembly closes. Voltage is applied to S222 through S248 for a manual clear or through S215 for a programmed clear. S222 energizes the keyboard stop solenoid, symbol slide stop solenoid, and the register designation stop solenoid, all of which are discussed in detail under their own headings. Closing S222 also trips the accumulator clutch.

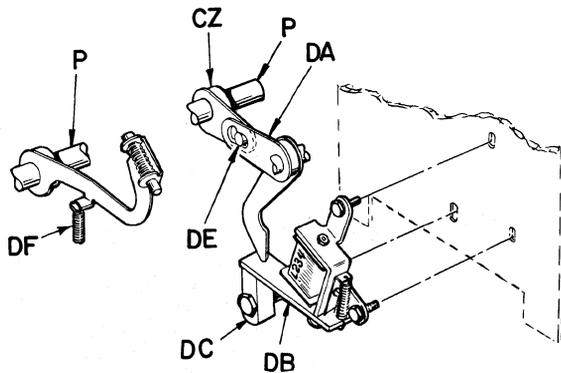


Fig. III-54

Two accumulator cycles are required. As in "round-off" and "clear", the total bail solenoid L235 is pulsed at 90° of the first cycle and the total bail is actually latched in during the second cycle. However, instead of gating "nine" pulses to the pinion solenoids as during "clear", a solenoid controlled mechanism is provided to retain the clapper reset bail in its clapper reset position to simulate the "nine" pulses.

At approximately 7° of the second accumulator cycle the clapper bail solenoid (L234) is energized to pull in clapper DB. As clapper reset shaft P is rocked to reset the clappers, arm CZ rocks arm DA through stud DE and arm DA clears

the end of clapper DB. As springs DF attempt to restore the clapper reset bail, clapper DB blocks arm DA and the reset bail, holding the pinion clappers in reset position.

With the clappers held in this manner and the total bail latched in, the pinion drive shaft turns the pinions until their total lobes limit on the underside of the total bail. The clapper reset solenoid is de-energized at 262 during the second clapper reset movement (carry portion) and clapper DB is permitted to drop out.

TESTS AND ADJUSTMENTS

- A36-5 With clapper DB held against its core, the clapper should have a flush hold on arm DA.
To Adjust, reposition solenoid mounting bracket as required.
Reason: To ensure latching the clapper reset shaft assembly without retarding clapper drop out.
- A36-6 With clapper DB limiting against limit DC, there should be .045" to .050" passing clearance between clapper DB and arm DA.
To Adjust, reposition limit DC as required.
Reason: To have normal air gap to prevent pulling in clapper DB from hold voltage, but to ensure pulling in with full voltage.

KEYBOARD STOPS

When a manual or programmed twenty place clear (Δ) is taken, the basic machine is cycled for the sole purpose of obtaining a visual indication (.00 Δ) that we have performed this operation. In order to ensure that only the clear sign prints from the keyboard, keyboard stop solenoid G (L224) is energized to pull plunger A forward, rocking fingers C down into the notches of add rack extensions F and thereby limiting the add racks at cipher position. Plunger A and fingers C are restored to normal by spring E.

Tests and Adjustments

- A24-1 Add rack extensions F should be free and the teeth of extensions F should align centrally with teeth of the product accumulator pinions.

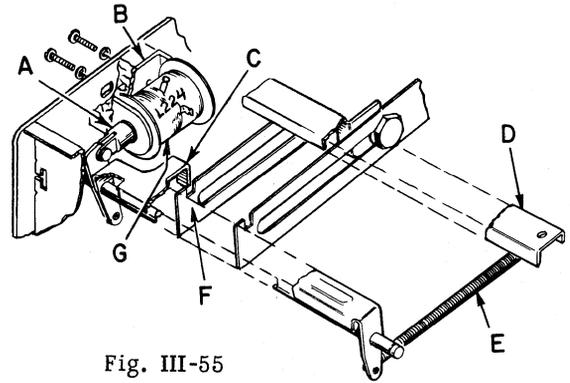


Fig. III-55

To Adjust, loosen mounting screws and position guide brace D laterally as required.
Reason: To ensure a full hold of add rack extensions F with the product accumulator pinions.

- A24-3 Plunger A should be free and when manually bottomed there should be .010" to .030" clearance between the ends of fingers C and bottom of the cutouts in add rack extensions F.

To Adjust, reposition solenoid bracket B as required.

Reason: To retain add rack extensions F at normal position.

- A24-4 With the machine normal and plunger A bottomed, there should be clearance, not to exceed .004", between fingers C and the rear edge of the cut out in extensions F.
To Adjust, bend fingers C as required and recheck A24-3.

Reason: To ensure holding the add racks in cipher position during a twenty place clear operation and the release of fingers C at the end of the operation.

SIDE INSERTION CONTROL UNIT

The Side Insertion Control Unit is designed to give rigid support to its 22" carriage construction and the potential of greater programming flexibility.

It is an independently supported mechanism which travels on ball bearings between the rear carriage rail and a stationary third rail. The carriage drive is furnished through a conventional type gear box with spindles mounted on the back plate, supported with ball bearings.

With the carriage in its right end position, the panel is inserted from the right side, using a guide channel to help locate the panel between the raceways. The panel will latch in position when the ram lug on the end of the skip and return shaft closes the jaws of the latch plate mechanism.

To remove the panel from the machine, return the carriage to the right end limit and position lever A rearward to release the latch plate mechanism.

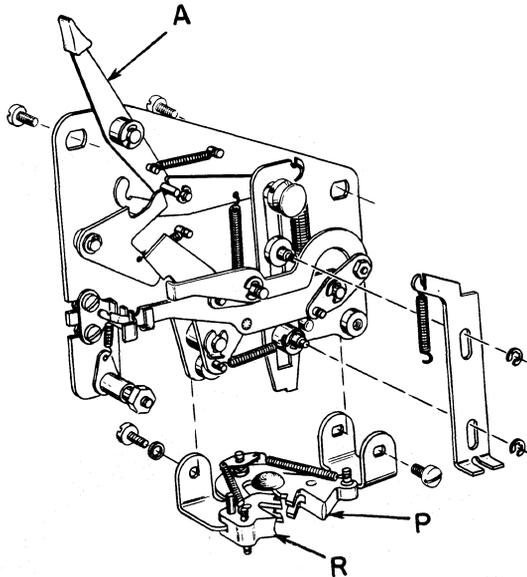


Fig. III-56

As the panel is removed from the right side of the machine the ram lug will open jaws P and R which will actuate a lock to retain the carriage in the right end position. If it is necessary to move the carriage when the control unit is out

of the machine the front jaw must be manually closed to release this lock. Before inserting the panel the jaw must be re-opened to accept the ram lug.

To change schedules the carriage must be in the right end position and the job selector knob pressed in and rotated to the desired schedule. The knob will return to its detented position in any schedule selected.

The only change in programming the lanes of control is that lanes 61 thru 66 are used for functions formerly programmed in lanes 46 thru 51.

The following is a detailed description of the mechanisms and adjustments.

CONTROL UNIT CONSTRUCTION

Structural Frame

The structural frame of the control unit is a rigid casting with grooves milled along the front and rear edges. These grooves are fitted with selective race way shafts A to provide bearing points for the ball bearings. Five different size shafts are available, each increasing in diameter by .001", and are precision selected at the factory to provide control units of uniform width. The size of the shafts can be determined by the number of grooves cut in the recessed portion of the shafts.

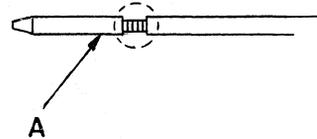


Fig. III-57

The No. 1 shaft is the smallest (.123") and will have no grooves; No. 2 shaft, one groove; No. 3 shaft, two grooves; No. 4 shaft, three grooves; and No. 5 shaft, the largest (.127") will have four grooves. There should be no need to change the size of these shafts after they have been selected at the Factory, however, if an analysis of a problem proves this necessary always maintain equal size shafts in any one race way.

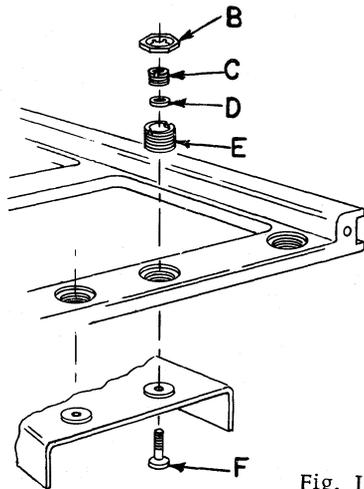


Fig. III-58

Adjustable Inserts

Twenty-eight adjustable inserts E are fitted to the casting to adjust and anchor the stop, disk and control pin assemblies. The insert is a hollow screw which threads thru the casting and is locked in place by lock nut B.

The stop, disk and control pin assemblies are anchored to the adjustable inserts by flat head screw F, lock washer D and round nut C. This method of attachment permits vertical and some lateral adjustment of these assemblies the full length of the carriage. The inserts have been adjusted at the factory to a pre-determined dimension and only minor vertical adjustment should be necessary to obtain the correct relationship between the control pins or disks and sensing tappets.

Adjustable Side Plates

Adjustable side plates AI are fastened to the ends of the casting to give support and location to the stop and disk shafts. Eccentric G is pre-set at the factory to position the stop dogs and skip disks in correct relationship with their respective latches. Brace J is a support for the right side plate and should be held against the side plate when screws H are tightened.

To assemble or change stops or disks the left side plate is removed by unpinning or disassembling necessary parts on left end of stop and disk shaft, removing 2 mounting screws and screw cap AJ.

When stops and disks have been assembled, locate stop and disk shaft braces against front and rear edges of support plate P and tighten securely. The side plate is reassembled using the stop and disk shaft and eccentric G as locating points. Reassemble screws and pins.

Stop and Disk Shaft Assembly

The stop and disk shafts are attached to support plate P by braces W and O. Six adjustable inserts are located above this assembly with support plate P being anchored at 4 places.

Braces W and O can be located at any point on the support plate with the exception of the areas around the four screws Q. When locating braces on the shafts it is not necessary to allow room for lateral movement of the stops and disks as the braces move with these parts during schedule changes.

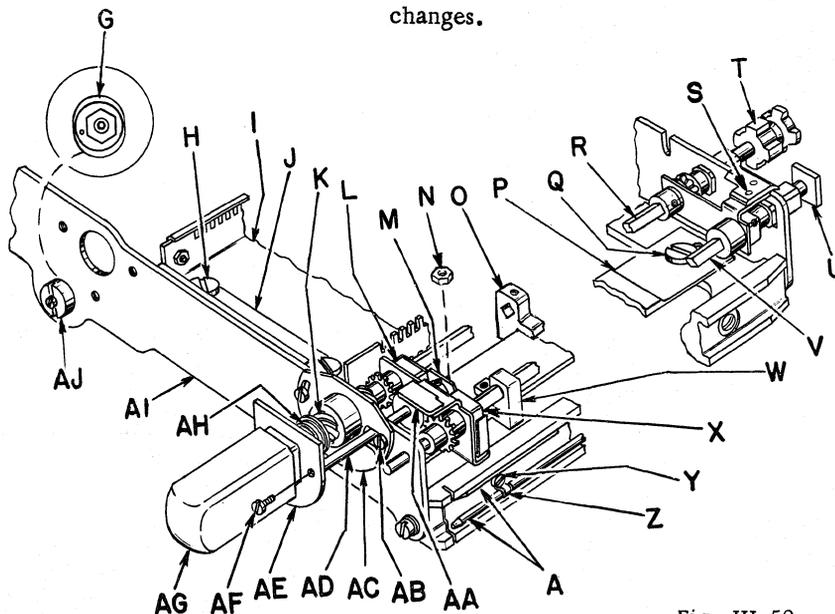


Fig. III-59

Job selector knob AG is attached to the disk shaft through a pin and slot connection. To change schedules the knob must be pressed in before rotating, which moves detent M thru shaft AD and plate AE out of the path of blocks L and X on the stop and disk shafts. When the schedule change has been completed, spring AH restores knob AG to normal and allows detent M to seat between blocks L and X. Detent M is not only a means to hold the stop and disk shafts in a stationary position but is also adjustable to provide a parallel condition between the disks and the skip and return latches and sensing tappets. The end position release arms for the latches have been removed from the carriage side frames and this function will now be performed by brackets AA and S mounted on the stop and disk shafts.

The spiral worm gear K thru worm nut AC will move the control unit pins 1/10" to the right or left for each quarter turn of the job selector knob. Worm nut AC is adjustable to align the control pins with the sensing tappets.

Magazine Trays

The control pins and magazines for lanes 6 thru 25 and 31 thru 50 are contained in magazine trays I, each of which is secured to the casting by 8 adjustable inserts. Four reference magazines are required in each tray and they should be located close to the adjustable inserts to ensure uniform height of the pins with the tappets the full length of the carriage.

The control pins and magazines for the electrical lanes 51 thru 66 are in a magazine tray which is attached to the casting by 6 adjustable inserts. Four magazines with ground pins are in this tray as reference points for factory setting of the magazine tray.

To reduce the side play of the electrical magazines a notched scale has been placed in the bottom of the tray. In addition to this the electrical sensing pins have been shortened to reduce the arc thru which the pin will travel when the magazine moves from side to side. To compensate for the shorter pin the switch actuators have been lengthened. The adjustment of the lane switch assembly should be made in the same manner and meet the same conditions as previous 1/10" machines.

NOTE: On early control units the front two magazine trays are attached to the casting with only 6 adjustable inserts. To stabilize the center section of the trays 8 allen screws have been added to the casting. After the trays have been adjusted for height the allen screws should be screwed down to the tray to keep it from tilting during machine operation.

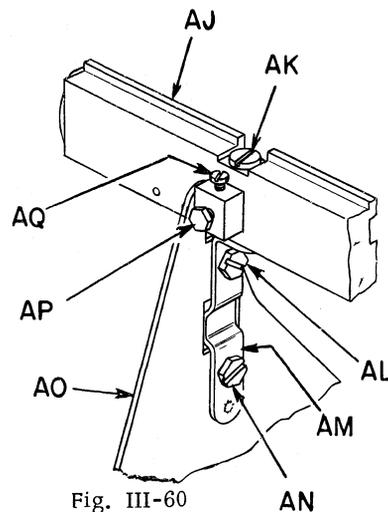


Fig. III-60

Support Rails for Control Unit

To support the control unit in the machine the rear carriage rail, which is fixed to the machine side frames, has been modified to include a groove, milled along its rear edge. A similarly grooved third rail located to the rear of the machine is mounted on auxiliary side frames fastened to the base of the machine. Both rails are fitted with raceway bearing shafts held in place by the rail end caps. A bearing cage containing 12 ball bearings is attached to each rail to provide free movement of the control unit between the two rails.

The third rail can be adjusted vertically thru bracket AM and eccentric AN to obtain a parallel condition of the control pins with the tappets. The distance between the two rails is adjusted by set screw AP to provide a free running unit without sag.

Easy insertion of the control unit into the raceways has been obtained thru the use of a guide channel AR which is fitted to the top of the casting. The unit is inserted from the right side of the machine by engaging the guide pins AS into the grooved bar which is attached to the carriage, and sliding the unit into position.

TESTS AND ADJUSTMENTS

C10-3-35 Race way shafts must limit normally in the race ways and be free to rotate.

To Adjust: Adjust retaining ears of spring clips Z as required and secure with screws Y. Reason: To help prevent wear of the race way shafts and ensure retaining shafts in their normal position.

C10-3-41 With the Schedule Selector knob positioned in schedule 4, there should be .034" \pm .010" clearance between the right end of the support plate P and the inside of the right end plate.

To Adjust: With nut N loose and braces loose on the disk and stop dog shafts, position support plate P as required and tighten nut N. Reason: To equalize overthrow of the Schedule Selector knob in positions No. 1 and No. 4.

C10-3-12 (a) With the Schedule Selector knob moved inward and rotated a distance of approximately 45°, the idler shaft detent M should have passing clearance of .003" to .008" with the locking blocks L and X. In the normal position detent M must not limit against bracket AA.

(b) With detent M seated firmly between locking blocks L and X the active surfaces of the disks and stop dogs must be parallel with support plate P.

To Adjust: (a) With the stop dog and disk assembly in schedule No. 4, move detent M on shaft AD as required and tighten set screw in detent M.

(b) Loosen screw AF and with selector knob moved inward to disengage detent M from locking blocks, align shafts as required. Release selector knob to engage detent between locking blocks and tighten screw AF.

Reason: To ensure release and restoring of the detent M and ensure that stop dogs are in their nominal function position.

C10-3-4 The stop dogs must align directly with control pins.

To Adjust: Locate stop dogs as required. Reason: To ensure correct alignment of stop dogs with control pins.

C10-3-5 Set up disks must be aligned with control pins, within \pm .005".

To Adjust: Position disks as required to align with control pins.

Reason: To have set up disks in correct alignment with the stop dogs and control pins, with control pins aligned over tappets and stop dogs located between stop latches.

C10-3-2 There should be no less than three bearing braces to a maximum of five, spaced as close as possible in equal increments along the length of the stop shaft with no portion of the shaft unsupported for a distance greater than 7 inches. Bearing braces should be placed alternately against the right and left sides of stop dogs with clearance not to exceed .003" between braces and stop dogs.

To Adjust: Place bearing braces as required. Reason: To ensure uniform support to the stop dog shaft and limit lateral movement of stop dog assembly within Engineering specifications.

C10-3-1 (a) There should be no less than three and a maximum of five bearing braces, spaced as close as possible in equal increments along the length of the disk shaft with no portion of the shaft unsupported for a distance greater than 7 inches.

(b) Bearing braces should be placed alternately against the right and left sides of the disks with clearance not to exceed .003" between braces and disks.

To Adjust: Position bearing braces on support plate as required.

Reason: (a) To ensure uniform support of the disk shaft. (b) To limit the lateral movement of the disk shaft.

C10-3-14 (a) The third rail must be in correct vertical alignment with the fixed rear carriage rail. (b) The control unit must move freely between the rails with .001" to .003" side movement between the bearings and the race way shafts.

NOTE: These adjustments have been made at the factory with a special height and level gauge. Do not disturb the third rail setting unless analysis of a problem indicates that this is necessary.

To Adjust: (a) With the third rail held securely by screws AK and a straight edge held against bottom of the two carriage rails and the third rail, turn eccentric AN until vertical alignment of the three rails is obtained. Tighten nuts for screws AN and AL to

hold bracket AM in place. Repeat for other side of machine. (b) With carriage in right end position and screw AK snug exert pressure against third rail to firmly hold the ball bearings against the raceway rods. Turn screw AP in or out to provide .001" to .003" clearance between screw AP and the rear surface of the third rail. Tighten screws AK and AQ. Repeat adjustment with carriage in left end position.

Reason: To provide a free running carriage with minimum play between the raceways.

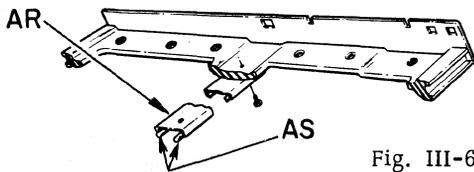


Fig. III-61

C10-3-15 With the guiding portion of the pilot track AR on the program unit engaged in the guide bar on the carriage, the rails of the program unit must be in correct vertical alignment with the fixed carriage rail and the third rail.

To Adjust: With right carriage side frame set for maximum height thru eccentric on right end of center rail, turn eccentrics in brackets for guide bar as required.

Reason: For easy insertion of program unit into rails.

C10-3-27 With worm sleeve AC located to center the clamp screws in their elongated slots, install program unit in carriage and manually hold carriage in the tab direction. (a) Stop dogs should align centrally between stop latches. (b) Control pins must be in correct lateral location over tappets.

To Adjust: (a) Turn eccentric on escapement assembly as required. (b) Loosen the three clamp screws AB and turn worm sleeve AC as required and tighten screws.

Reason: (a) To establish the correct relationship between stop dogs and latches and ensure release of spear point interlock. (b) To align control pins with tappets while maintaining conditions in adjustment (a).

C10-3-9 (a) There should be .047" to .053" clearance between the tappets in lanes No. 6 and No. 21 and the four reference magazines located as near to the adjustable inserts as possible.

(b) The height of the stop dogs should be relative to the height of the control pins as per Kit 427-1.

To Adjust: (a) Loosen nuts C and lock nuts B in the area that is being adjusted and turn adjustable limit inserts E as required to raise or lower magazine tray. Tighten lock nuts B. Snug all nuts, C. (b) Place Kit 427-1 in magazine tray and turn adjustable limit inserts E in stop dog assembly as required.

NOTE: When the above Test and Adjustment is completed; loosen nuts C (one at a time) in front magazine channel and in the stop dog assembly; apply loctite to nut C and retighten nut.

Reason: To ensure correct operating clearance of control pins with tappets, and stop dog and disk assembly with related components.

C10-3-10 There should be .047" to .053" clearance between the tappets in lanes No. 32 and the four reference magazines.

To Adjust: Loosen nuts C and lock nuts B in the area that is being adjusted and turn adjustable limit inserts E as required for correct clearance.

NOTE: When the above Test and Adjustment is completed, loosen nuts C in center magazine tray one at a time, and apply Loctite to nut C and retighten nut and lock nut B.

Reason: To ensure correct operating clearance of control pins in relation to tappets.

C10-3-31 With the carriage in the extreme right or left positions, the limit detents S and AA must limit and hold the carriage, and must depress the latches sufficiently to release the paddles.

To Adjust: Re-check Test and Adjustment, Code C10-3-9.

Reason: To ensure release of indexed latches.

C10-3-13 The support arms from the chassis must provide rigid support to the rear auxiliary side frames.

To Adjust: (With computer section removed) turn eccentrics as required to align holes in support arms with holes in auxiliary side frames.

Reason: To prevent distortion of the chassis and the setting of the third rail by the weight of the computer section.

NOTE: Do not disconnect support arms with computer section in the machine.

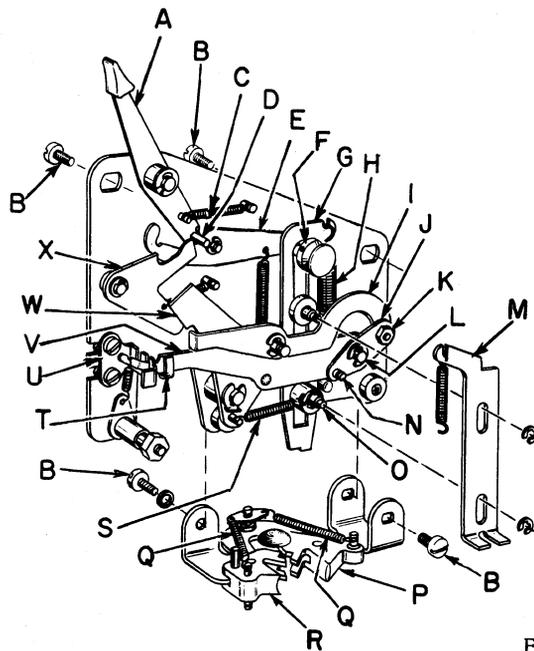


Fig. III-62

LATCH PLATE ASSEMBLY

The latch plate mechanism, attached to the outside of the left carriage side frame, provides the means of coupling the control unit to the carriage. This coupling action is performed by toggle jaws P and R closing around the ram lug on the left end of the disk shaft. To prevent disengagement of toggle jaws during carriage movement, wedge slide G is positioned by spring H between the toggle jaws causing them to be locked in the closed position when the carriage is out of the right end position. Rotation of the job selector knob is prevented when the lower cut-out in slide M is seated around the projections on the ram lug. To change schedules the carriage is moved to its extreme right position where arm V is raised when the nylon skid on the rear carriage rail contacts welded tab T. Arm V pivoting at stud L, contacts the forward lip of arm I and pivots the curved end downward against eccentric K. This action pivots link J around stud L to raise lock slide M, thru stud N, clear of the projections on the ram lug. As lock slide M is raised, it contacts eccentric collar F to raise wedge slide G slightly to release the pressure of spring H on toggle jaws R and P.

The raising of arm V by the nylon skid also rocks arm W, thru spring S to swing the upper projection of bellcrank X out of the path of stud D on release lever A. This will allow arm A to be positioned rearward to initiate removal of the control unit. When release lever A is manually

moved rearward the camming action of stud D against arm E raises wedge slide G from between toggle jaws P and R. Release lever A is retained in its rearward position by the spring tension on wedge slide G holding arm E in a detenting position for stud D.

When the control unit is removed from machine, jaws P and R pivot open and are held in this position by the toggle action of springs Q. As jaw P opens, its button stud cams wedge slide G further upward releasing its pressure on arm E. This allows release arm A to return to its forward position thru spring C.

When the control unit is re-inserted into the machine, the ram lug contacts the rear portion of jaws P and R causing them to close around the ram lug. As the button stud on jaw P moves out of the path of wedge slide G the slide is moved to its locking position between the toggle jaws.

Carriage Lock

The purpose of the carriage lock is to retain the carriage in its extreme right end position when the control unit is being installed or until a schedule change has been completed. With the carriage in its extreme right position and release lever A moved rearward to its detented position, arm E thru link Y, lifts arm Z away from stud AA in blocking arm AC. Spring AB will cause arm AC to pivot into a

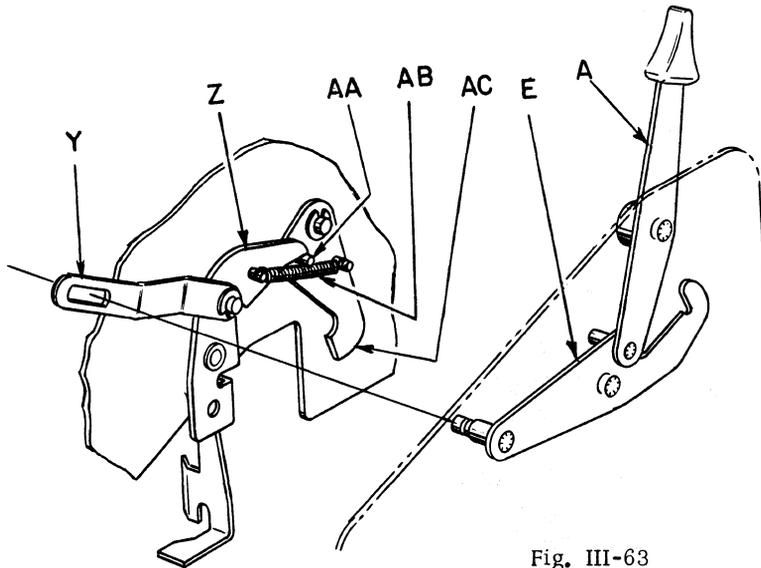


Fig. III-63

slot in the front side of the rear carriage rail, locking the carriage in the end position.

To prevent release of the lock when the control unit is removed and release lever A is restored to normal, jaw R contacts the lower lip on arm Z to maintain arm Z in its actuated position. When the control unit is re-inserted the ram lug closes jaw R into its coupling position thereby releasing the carriage lock. With the carriage in the extreme right position and the job selector knob partially rotated the square block on the left end of the stop shaft, contacts the vertical lip on arm Z to pivot arm Z away from stud AA. Spring AB moves arm AC into the slot of the rear carriage rail locking the carriage in the end position until the stop and disk shafts are detented squarely.

End Position Limit Post

The end position limit post is located on the inside of the left carriage side frame and will establish the extreme right position of the carriage. It is adjusted to ensure that the carriage lock is aligned with the cut out in the carriage rail.

TESTS AND ADJUSTMENTS

C10-3-20 With the program unit inserted into carriage, the ram lug must be centrally located between the toggle jaws P and R.
To Adjust: With 4 mounting screws B that secure the latch plate to the carriage loose,

position latch plate assembly as required and tighten screws.

Reason: To establish the normal position of the latch plate assembly prior to the following adjustments.

NOTE: After making above adjustments, move carriage to the extreme right position, and check schedule selector knob to turn freely to each schedule.

C10-3-21 With carriage in the extreme right position the welded tab T on interlock actuator, V must be centered in the cut-out in the top of the nylon skid on the fixed carriage rail.

To Adjust: Loosen screws and align nylon skid as required and tighten screws.

Reason: To enable latch M to be raised, allowing a change of schedule.

C10-3-22 The welded tab T on interlock actuator V must clear the fixed carriage rail by .010" to .020".

To Adjust: Turn eccentric guide post O for required clearance. (Interlock actuator must have clearance at bottom of comb U).

Reason: To prevent damage to interlock when traveling over rail.

C10-3-24 With carriage in the extreme right position, lock slide M must be cammed upward to clear tooth on ram lug by at least .025".

To Adjust: Turn eccentric screw K as required.

Reason: To allow operator to select schedules.

C10-3-26 With the carriage in the extreme right position and release lever A indexed rearward, wedge slide G should be raised to clear toggle jaws P and R.

To Adjust: Parts specifications should provide this condition.

Reason: To allow removal of program unit.

C10-3-23 With the toggle jaws P and R held in the latched position by the ram lug, the wedge slide G should be centrally located in the cut out steps of the toggle jaws.

To Adjust: Loosen nut and locate eccentric guide post O laterally as required, keeping the high side of the eccentric positioned as per previous test, and tighten nut.

Reason: To enable easy indexing of program unit release lever and ensure locking of the toggle jaws when program unit is inserted into carriage.

C10-3-45 With the carriage in the extreme right hand position, wedge slide G should be raised, as lock slide M is cammed upward, to allow free rotation of job selector knob.

To Adjust: While rotating the job selector knob, turn eccentric collar F as required for free rotation.

Reason: To ensure easy selection of program schedules by relieving the pressure of wedge slide G on toggle jaws R and P.

C10-3-39 With the carriage in the extreme right hand position, the escapement pawls should engage tooth space of ratchet with .005" to .020" passing clearance.

To Adjust: Add or remove shims on the end position limit post as required.

NOTE: If latch plate assembly is removed recheck Test, Code C10-3-20.

Reason: To ensure engagement of escapement pawls when the carriage is in the extreme right hand position.

C10-3-25 With the carriage in the extreme right position, and the program unit release lever A indexed to the rear, the upward movement of the stud in actuating arm E should cause link Y to set up the initial locking of the carriage, by moving carriage lock AC into the slot of the fixed carriage rail.

To Adjust: Parts specifications should provide this condition.

Reason: To ensure the carriage being locked before removal of the program unit.

C10-3-36 (a) With the control unit latched in the carriage, and the carriage in the extreme right position, interlock AC should clear the fixed rail by .030" to .075", and with the stop dog shaft rotated approximately 7°, interlock AC must locate in the slot of the fixed rail to lock the carriage. (b) With carriage interlock located in the slot of the fixed rail, there should be at least .020" clearance between the leading edge of the interlock and the edge of the slot in rail.

To Adjust: (a) Weave actuating arm Z as required. Make certain the ear of arm Z has full vertical surface contact with the square block on the end of the stop shaft. (b) Parts specifications should provide this condition.

Reason: To ensure interlock clearing the fixed rail with carriage in an operating position, and locking the carriage when stop dog shaft is out of normal position, or when program unit is removed.

C10-3-28 With the carriage in the extreme right position, index the program unit release lever A to the rear. Removal of the program unit should cause the toggle jaw to retain carriage lock AC in the slot of the fixed carriage rail.

To Adjust: Bend formed ear of actuating arm Z as required.

Reason: To retain carriage in a locked position until the stop dog and disk shafts are in their square detented positions.

C10-3-29 With the carriage in an operating position, program unit release lever A must be latched in its forward position by interlock X.

To Adjust: Recheck Test and Adjustment Code C10-3-22.

Reason: To prevent indexing the release lever and raising wedge slide G which would allow program unit to be removed in a position where damage might result to control pins and tappets.

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Section V



FEATURES

MULTIPLE FACTOR STORAGE

Multiple factor storage is an optional feature of F2000 machines with 1/10" tabulation. It greatly increases the storage capacity of the machine by permitting the multiplicand storage unit to be "split" electrically and only certain sequential columns of the multiplicand to be "read" through control panel programming.

Indexing of the multiplicand is accomplished in the same manner as with other machines. However, two or three multiplicand factors may be indexed simultaneously if the multiplicand is later "split" through the multiple factor controls. This, of course, results in considerable saving of time.

The multiple factor components are arranged in a single unit mounted inside the door of the machine stand. The functional components include four relays, nine diodes and two five-position switches. For reference, the wiring diagram designations of the relays are K206 through K209, the diodes CR210 through CR218, and the switches S281 and S282.

Utilization of multiple factor storage is begun by manually positioning rotary switches S281 and S282. The switches may be set to divide the multiplicand storage unit into either two or three parts. With the switches set as shown in Figure V-1, for example, the splits are between Columns 4 and 5, and between Columns 8 and 9. This divides the multiplicand data into three parts.

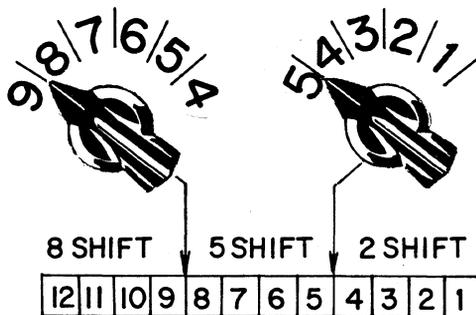


Fig. V-1

Multiple factor split-active relay K206 is normally picked in the same carriage position as pre-multiply relay K201. To accomplish this a

1 pin is used in Lane 41 (on machines without the adjustable mechanism in Lane 41 it is necessary to use a "1A" pin which is copper plated for identification). The sensing of the 1 (or "1A") pin causes not only the multiply relay (K201) but also the split-active relay (K206) to be picked. K206 is held through a 10K resistor and a set of its own normally open contacts from S207-C (same as K201). K206 is also picked when a "3" pin (Negative-Multiply) is used in Lane 41. Since it may not be desirable to have split-factors every time Negative Multiply is set up with a "3" pin, K206 can be dropped in the next carriage position by the use of an electrical pin in Lane 47 (DPM) which breaks the hold circuit to K206.

During the pre-shift portion of the multiply routine, two of the three matrix relays, K207 through K209, are picked. Which two depends upon which decimal shift is being used. As shown in the diagram in Figure V-2, the B+ from the selected pad of S264 (Lane 44 - Decimal Shift) is applied to the diode matrix on TB203. These diodes gate the B+ to the proper relays. The ground circuit for the matrix relays contains a set of normally open contacts of K206.

With K206 picked in a multiply position, a shift of 2 will cause energizing of matrix relays K208 and K209, a shift of 5 will cause energizing of K207 and K209, and a shift of 8 will cause energizing of K207 and K208. A shift of 7 is not designed to permit a multiplicand split but will cause all of the data in the multiplicand storage unit to be utilized. This is because the 7 shift would be more difficult to program due to a decimal point consideration.

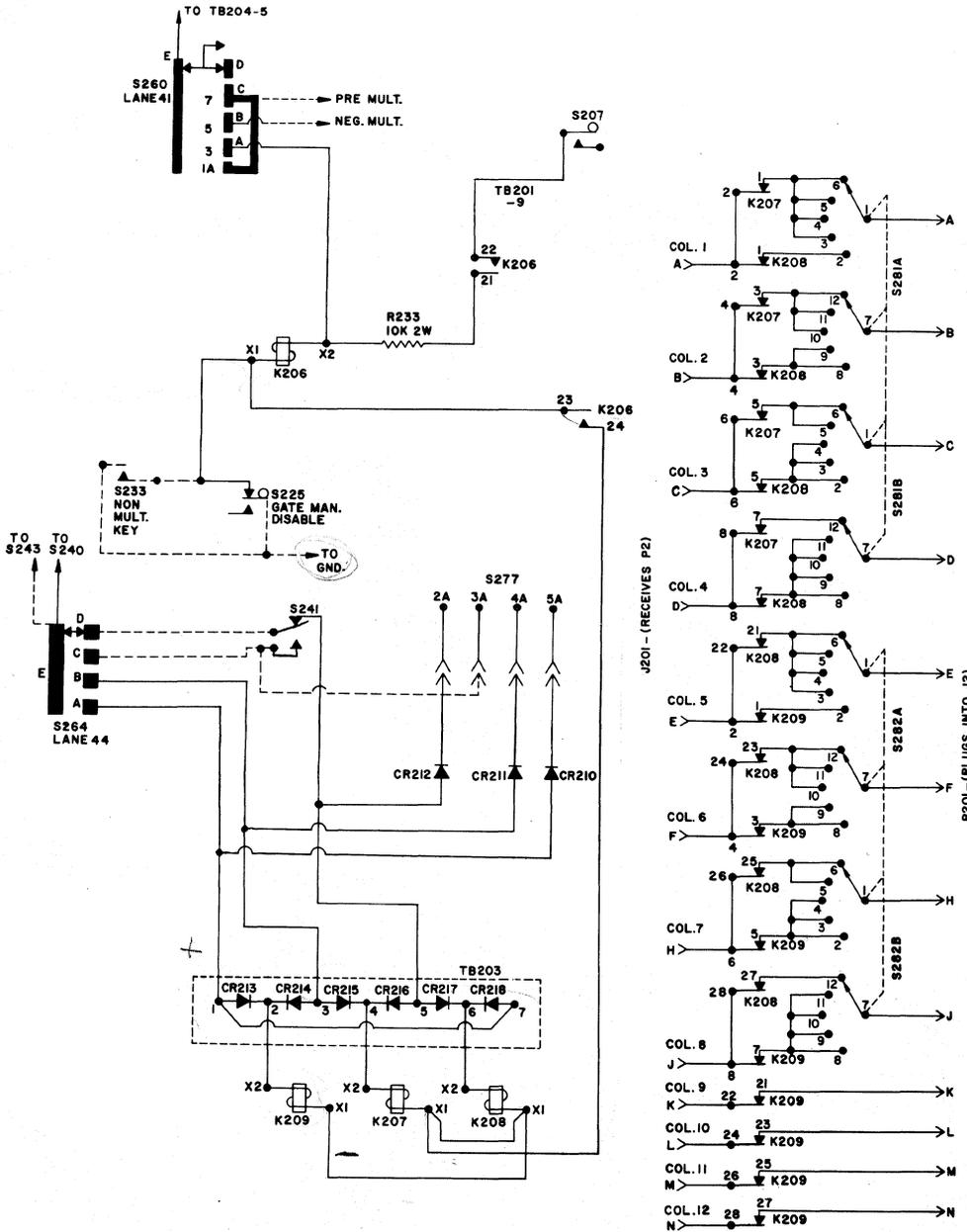
Only normally closed contacts of the matrix relays are used. These contacts have been inserted in the column common lines of the multiplicand storage unit. Therefore, picking a matrix relay causes its contacts to open and, in effect, disconnect certain columns of the multiplicand storage unit. This gives an indication of zero in the affected columns.

The diagram in Figure V-1 shows the inter-relationship between the rotary switches and the matrix relays. It should be noted that switch settings have no effect on columns 9, 10, 11 and 12.

Back voltages from S277 (Right Hand Shifter Position Selector) are blocked by diodes CR210, CR211 and CR212. Without these diodes matrix relays would be momentarily picked and dropped as S277 is moved to different positions. This would cause loss of various parts of the multiplicand during the multiplication routine and would result, of course, in wrong products.

Since the hold circuit for K206 gets its B+ from the same point as the hold circuit for K201, the same means used to drop K201 will also drop K206.

Dropping of K206 causes any matrix relays previously picked also to drop because a set of normally open contacts of K206 are in their ground circuit.



Note: S281 shown at 4 / 5 split. S282 shown at 8 / 9 split.

Fig. V-2

MULTIPLE FACTOR RELAY AND SWITCH ASSEMBLY

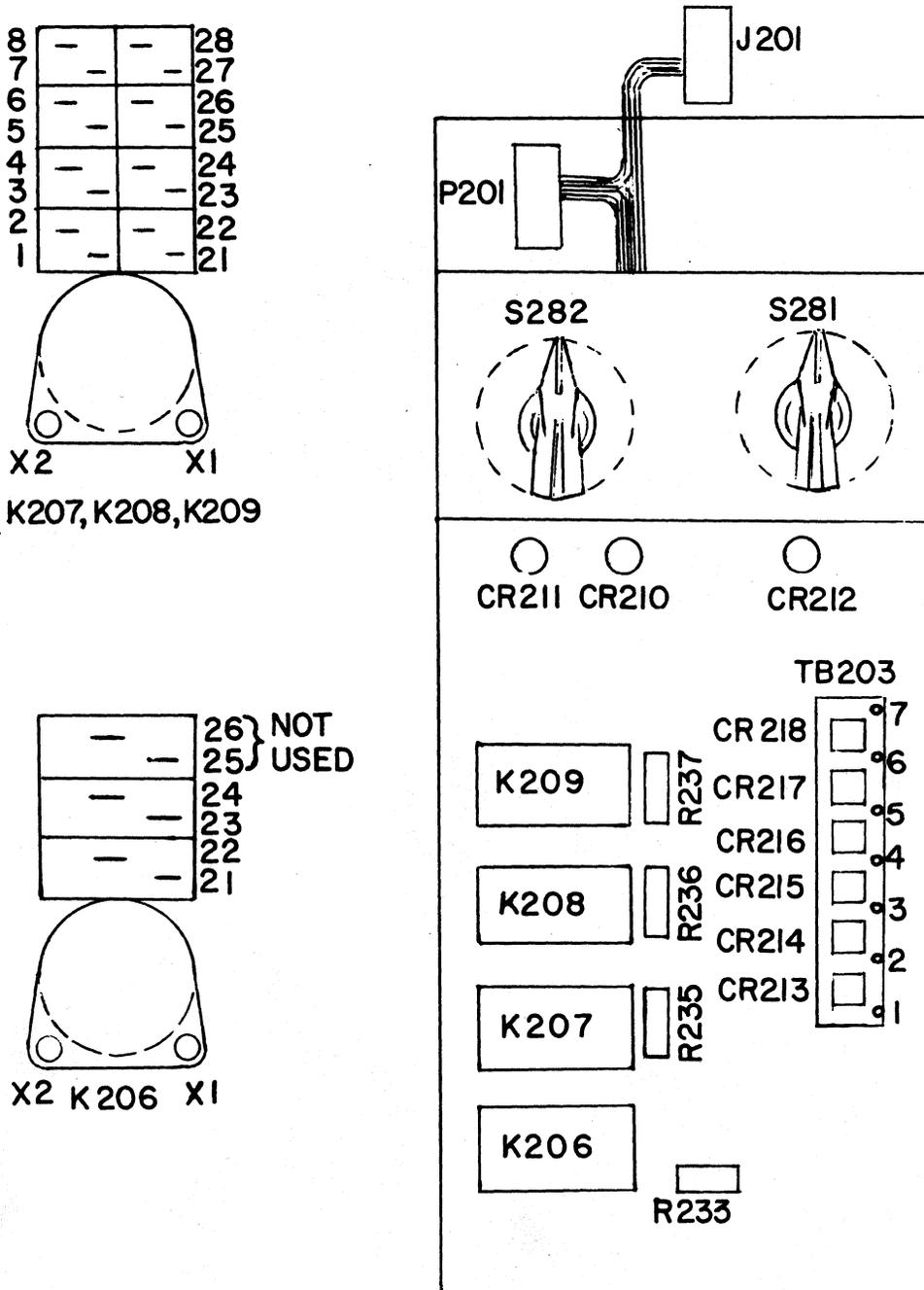


Fig. V-3

MULTIPLE FACTOR SWITCH - S281 and/or S282

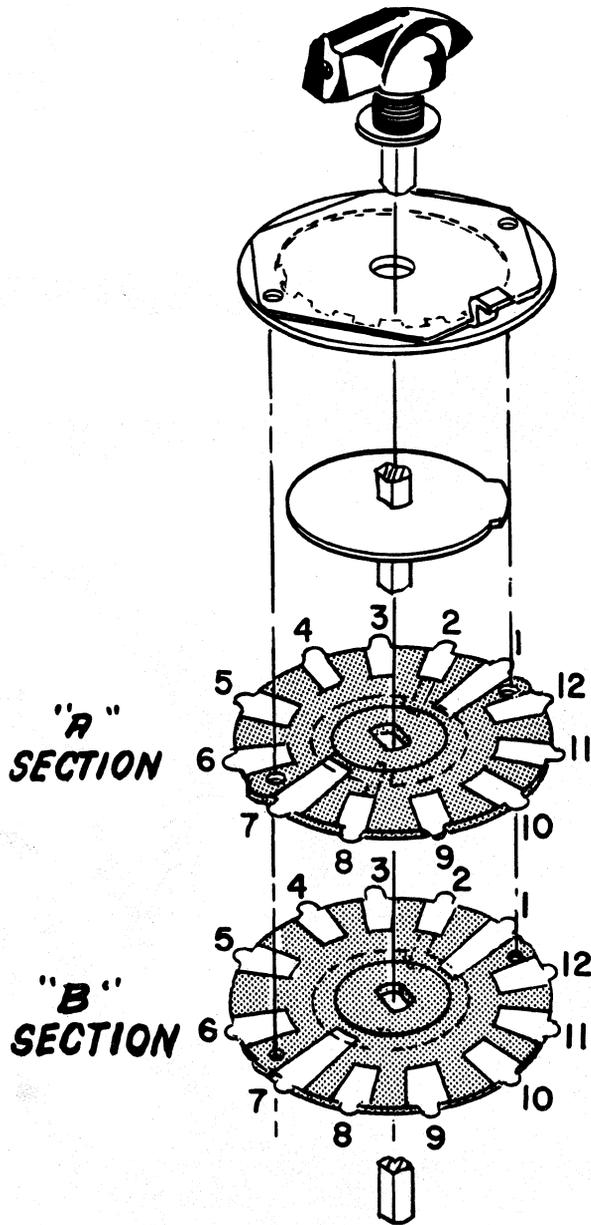


Fig. V-4

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Section VI



SERVICING PROCEDURES

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SERVICING PROCEDURES

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Removal and Replacement Procedures	7

PREVENTIVE MAINTENANCE GUIDE

The following is an outline of the procedure to follow on a Preventive Maintenance Attention to a Series F2000 Machine.

A. INITIAL PROCEDURE:

Prior to any mechanical work, perform the following steps:

1. Inquire of the operator of any conditions that he (or she) has noticed that require correction.
2. Determine from the operator if there are any stored factors, or totals in the machine. When P.M. is completed, make sure that they are re-entered correctly.
3. Make operating tests of the machine. Use all keys, operator control keys, motor bars, etc. Note any peculiarities of operation with respect to machine speed, unusual sounds, printing, carriage movement, accumulation, etc.

B. APPROVED LUBRICANTS AND CLEANING AGENTS:

The lubricants and cleaning agents used in this product are listed here, and apply in general as stated. Special lubrication instructions will be found under the "Specific Instructions" part of this guide.

1. Machine Oil S131A - to be used on all shaft bearings, pivot points, rollers, oil holes, and metal to metal contact of moving parts.
2. Grease S167 $\frac{1}{4}$ A - to be used on the periphery of all cams, forked arms, and slots where contact is made with studs, all metal gears, and metal to metal contact of moving parts where oil will not suffice.
3. Grease S173 Texaco Uni temp. - to be used on the plastic or nylon actuators of all switches, and in place of S167 $\frac{1}{4}$ A grease wherever there is a danger of grease thinning out and dropping onto electrical components.
4. Cleaning Agents: Platen Restorer (S3) and Case Cleaner and Polish (S11).

NOTE: Care should always be taken when lubricating mechanisms where an excess of lubricant may get onto electrical components and cause a malfunction.

C. GENERAL INSTRUCTIONS:

The inspection should be performed systematically, and cover all sections of the machine. Special attention should be given to areas where experience has indicated that trouble may exist.

1. Each section should be properly cleaned of all dust, old grease, and foreign matter, and properly lubricated.
2. All parts and mechanisms should operate freely, without interference from adjacent parts, and perform according to tests and adjustments. Make necessary corrections to meet these conditions.
3. All sections should be inspected for worn, broken, or defective parts. Replace any found to be faulty. All loose nuts, screws etc. should be detected and tightened.
4. All wiring should be checked to be in good condition and to be clear of moving parts. All taper tabs and other connections should be tight. Correct when necessary.
5. Correction Index improvements should be installed to maintain the machine in the best condition.

D. SPECIFIC INSTRUCTIONS:

The Basic Sensimatic and F1000 Preventive Maintenance Guides are to be used for that portion of the F2000 to which they apply. Listed here are sections in addition to the Basic Machine, and the Servicing procedures to follow.

1. Component Unit:
 - a. Apply general instructions.
 - b. On new machines the printed circuit discs should be cleaned with platen restorer and a cotton swab or soft clean cloth during the routine shop check out procedure. They should be cleaned again in three months. Thereafter, the normal servicing requirement should be followed.
 - c. Check adjustments of clutches, discs, and switches.
 - d. Lubricate section sparingly with machine oil and S173 grease.

NOTE: Nylon gears do not require lubrication.

2. Product Accumulator:
 - a. Apply general instructions.

- b. The carry printed circuit board should be checked and cleaned any time that a section is serviced for other reasons, or as often as individual conditions warrant.
 - c. Nylon clutch bands and drums should be cleaned of all dirt and foreign matter to perform properly. Lubricating these parts is not necessary.
 - d. Lubricate section with machine oil and S173 grease.
3. Multiplier Drive Unit:
- a. Apply general instructions.
 - b. Check pulse generator contacts.
 - c. Lubricate with machine oil (note oil holes) and S167 $\frac{1}{4}$ A grease. Use S173 grease on timing cam switch actuators.
4. Operand Storage Unit (D Section):
- a. Apply general instructions.
 - b. Check printed circuit boards; clean whenever foreign matter has accumulated.
 - c. Lubricate with machine oil and S167 $\frac{1}{4}$ A grease.
5. Auxiliary Sensing Unit:
- a. Apply general instructions.
 - b. Check printed circuit switches and clean when foreign matter accumulates.
 - c. Lubricate switch actuators with S173 grease; elsewhere with machine oil and S167 $\frac{1}{4}$ A grease as prescribed.
6. Power Section:
- a. Apply general instructions.
 - b. Check motor overload clutch adjustment.
 - c. Lubricate with machine oil, S167 $\frac{1}{4}$ A grease, and S173 grease on Sensimatic timing cam switch actuators.

NOTE: If adjustments, other than adjustments contained in Series F25-F500 Instruction Book, Form 3740, and Series F2000

Instruction Book, Form 3747, are necessary to maintain a satisfactory level of operation of the system, a complete report describing the need for such adjustment must be made to the Accounting Machine Products Group, Home Office.

After the completion of inspection, have operator test machine while preparing Service Reports.

REMOVAL AND REPLACEMENT PROCEDURES

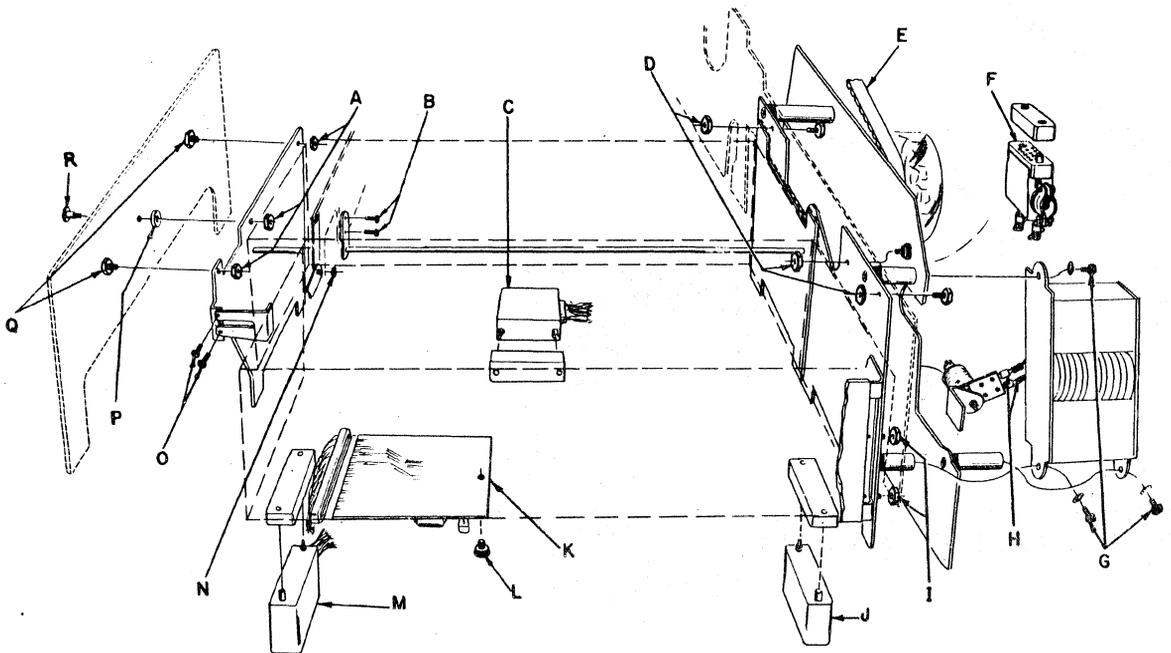


Figure 1

Removal of Multiply Unit

NOTE: Right and left directions are given facing the rear of the machine.

1. Remove printed circuit board K.
 2. Disconnect pin connectors M and J on bottom of the component unit.
 3. Disconnect pin connector C on bottom of the product accumulator unit.
 4. Remove the two screws B that hold the brace for the shaft across the top of the product accumulator. Care should be taken to prevent dropping the nuts or lockwashers into the product accumulator.
 5. Remove the clip N from the stud on the transfer link and separate the parts.
 6. Remove the three screws G that hold the computer timing cam switches, and the belt from the pulley.
 7. Remove the two wires H from the clutch coil terminal board. (Note location).
 8. Disconnect pin connector F on left side of drive unit.
 9. Remove belt E after first removing its idler roller.
 10. Remove the three nuts A.
 11. Remove screw R and space collar P.
- NOTE: Do not remove parts Q.
12. Supporting the multiply unit from the bottom, remove nuts D and their respective screws. The unit will now be free to be removed. Move the unit to the right until the side frame clears the studs of parts Q, lower the unit and remove.

CONTINUED ON NEXT PAGE

REPLACEMENT:

Replacement is accomplished by reversing the removal procedure.

NOTE: Adjustment of the computer timing cam switches (step 6) is covered in Section III Mechanisms and Adjustments.

Removal of the Components Unit

NOTE: Right and left directions are given facing the rear of the machine.

1. Remove printed circuit board K.
2. Disconnect pin connectors M and J on bottom of component unit.
3. Remove the three nuts I on the right hand side of the unit.
4. Remove the two screws O on the left side of the unit.
5. Position the flat surface of the coupler on the component clutch drive shaft in line with the cut out in the side frame.
6. Move the left side of the unit far enough rearward so the fork will clear the stud between the holes for screws O. Lower the left side and move the unit to the left until the coupler member on the component clutch drive shaft clears the side frame. Remove the unit from the machine being careful not to lose the leather coupler.

REPLACE:

- a. Machine should be in home position.
- b. Component unit should be in home position.

NOTE: Check the guide holes in the platen drive cams to be in line. With these conditions, the members of the component platen drive shaft should mesh without binding. (Adjustment of these parts is covered in Section III Mechanisms and Adjustments).

Removal of Drive Unit

1. Remove multiply unit from machine.
2. Remove component unit from the multiply unit.
3. Set the product accumulator on its end, (with the pulse generator up and cluster accumulator pinions toward the person doing the removing).
4. Remove the four screws and nuts that hold the side frames of the drive unit and the product accumulator together. Pull the transfer link, this will unmesh the gears of the cluster accumulator pinion shaft and the gear on the drive unit.
5. Holding the product accumulator unit with the left hand turn the drive unit to the right and lift up, separating the two units.

REPLACE:

- a. Set accumulator on its end. Pull the transfer link and trip clutch on the drive unit.
- b. When replacing the drive unit, first mesh the coupler members that drive the product accumulator main cam shaft. Then lower the drive unit into place and replace the four screws and nuts.

COMPONENT UNIT - DISASSEMBLY AND REASSEMBLY

1. Remove the constant running clutch drive shaft.
2. Remove eight screws and nuts holding the end plates to the front and back plates.
3. Remove two screws holding the bracket for J204 and J207 to the right end plate.
4. Remove four screws holding the lower crossbrace to the back and front plate.
5. Remove four screws holding the lower platen camshaft brace to back and front plates.
6. Remove the mounting screws for the four clutches plate assemblies (1 for adjustment eccentric and 2 others per assembly).
7. Remove three screws holding the wiping contact assembly which contacts the digit selector (on the back of the left hand shifter disk).
8. Remove four screws holding the upper platen camshaft brace to the back and front plates.
9. Carefully lower the front and back plates and the right end plate.
10. Remove the bearing bracket for the left hand clutches to allow removal of driving belts (note location of shims, if any, on clutch shaft).
11. Carefully disengage and lower clutches.
12. Lifting up on the wiping contact assembly which contacts the digit selector (on the back of the left hand shifter disk), carefully remove the shifter disk assembly.
13. Remove the function table disks.
14. For platen removal, remove eight mounting screws.
15. Assemble in reverse order.

NOTE: In reassembling care should be taken to prevent distortion of wiping contacts and to ensure that the left hand function table clutch engages its nylon gear in home position within range of the adjusting eccentrics. The three other clutches can be disengaged after the unit is reassembled.

F2000 PRODUCT ACCUMULATOR

To replace total bail shaft assembly - 2FMA 6: (References are to F2000 Symbol Book dated 12-1-60).

1. Remove coupler and degree indicator dial from PA camshaft R, Plate 33.
2. Remove both end plates of PA, (AK and A, Plate 30). (Be careful to set these plates down without pulling wires). 3 springs on one plate.
3. Remove pinion solenoid assembly (includes P & N, Plate 35). Be careful to set this assembly down without pulling wires.
4. Remove clapper, reset shaft assembly L, Plate 34. (Four springs Q, two springs S & V and brace O).
5. Remove screws and clip from brace M, Plate 33 (there are 2 of these braces; this step applies only to the one nearest the degree indicator end of shaft B).
6. Remove four springs T. Plate 32, two springs O and X and link S; also two braces F. Plate 31.
7. Remove pinion shaft assembly G & Q, Plate 31, and transfer shaft assembly N, Plate 32, together noting positions of four latches H and V and arm Q.
8. Slide total bail F. Plate 32, out of assembly after removing keys E.
9. Remove total bail shaft assembly AA after removing brace K.
10. Replace in reverse order, remembering to have P. A. on flat surface for reassembly so that the unit will not be twisted after assembling.

Estimated time four hours.

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Section VII



**ELECTRICAL REFERENCE
INFORMATION**

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TOP VIEW

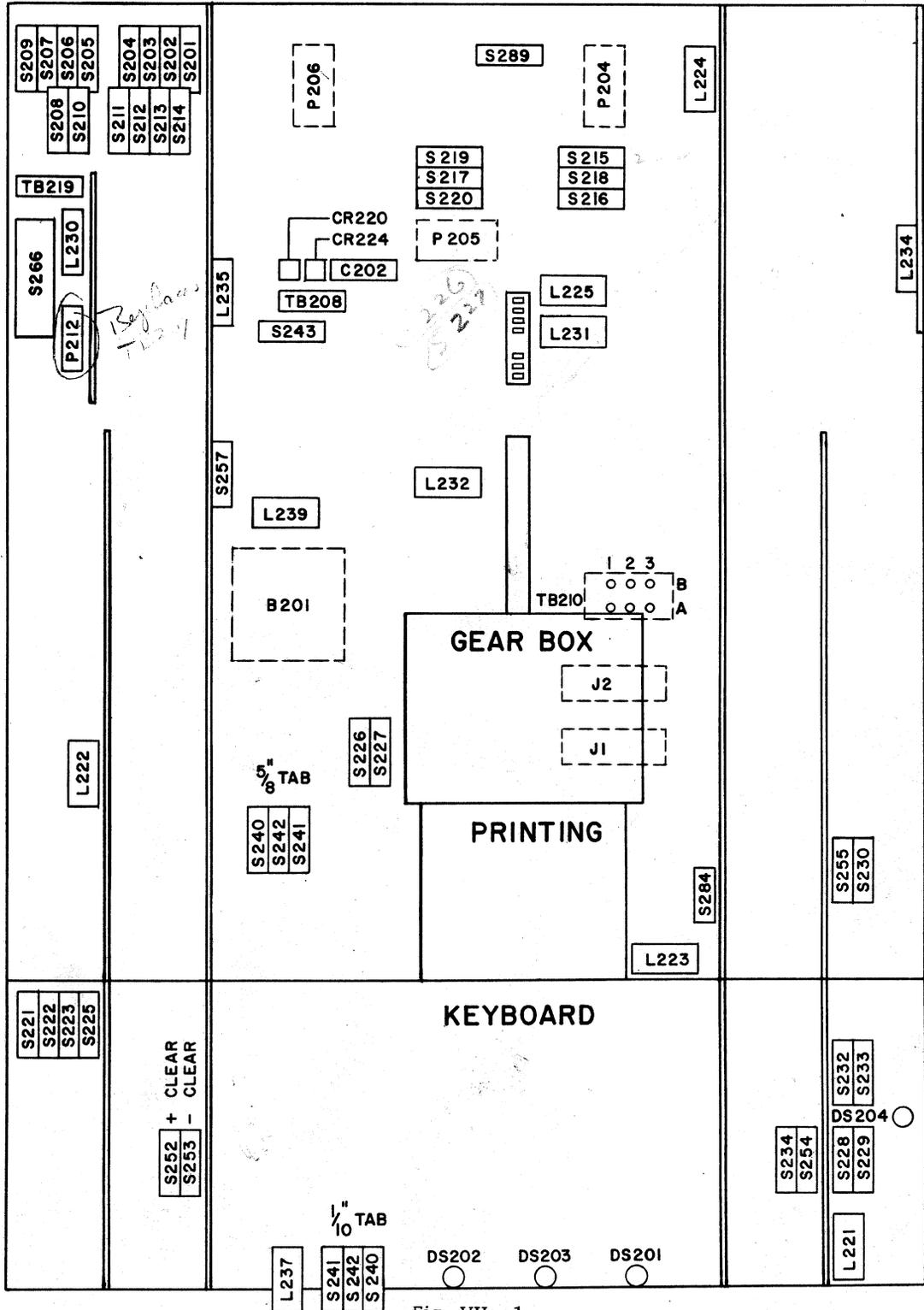
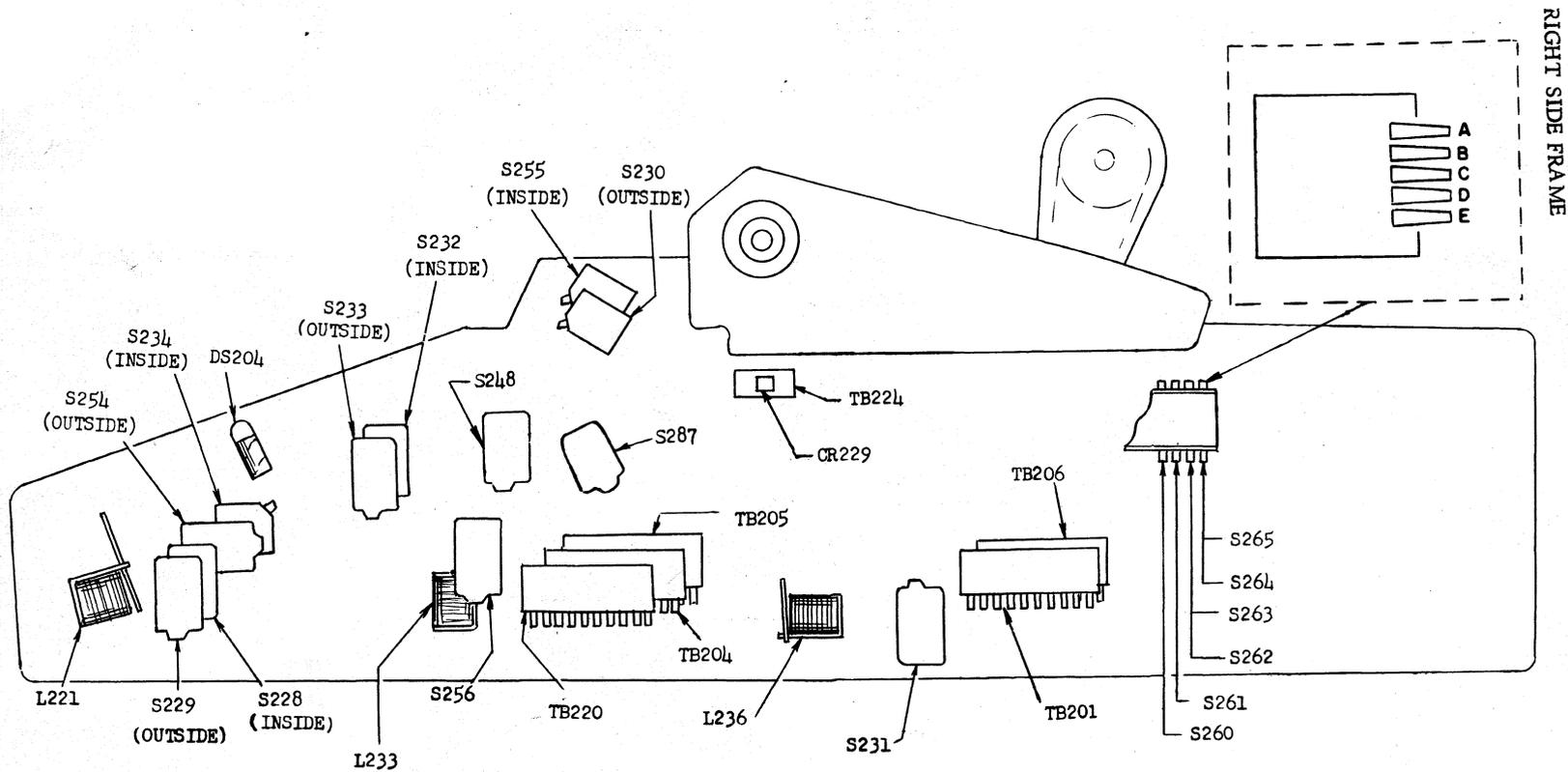


Fig. VII - 1



Note:
 All terminal boards shown are numbered left to right. A terminals outside, B terminals inside, except for TB205 which is reversed.

Fig. VII - 2

1. Disk #1 front - Right hand shifter position selector
Disk #1 rear - Right hand shifter

3. Disk #2 front - Left hand shifter
Disk #2 rear - Digit selector

2. Disk #3 front - Left hand follow up circuit
Disk #3 rear - Left hand shifter follow up commutator & right
auxiliary controls

4. Disk #4 front - Right hand function table position selector
Disk #4 rear - Right hand function table

6. Disk #5 front - Left hand function table
Disk #5 rear - blank

5. Disk #6 front - Left hand follow circuit function table
Disk #6 rear - Left hand function table follow up commutator

COMPONENTS UNIT

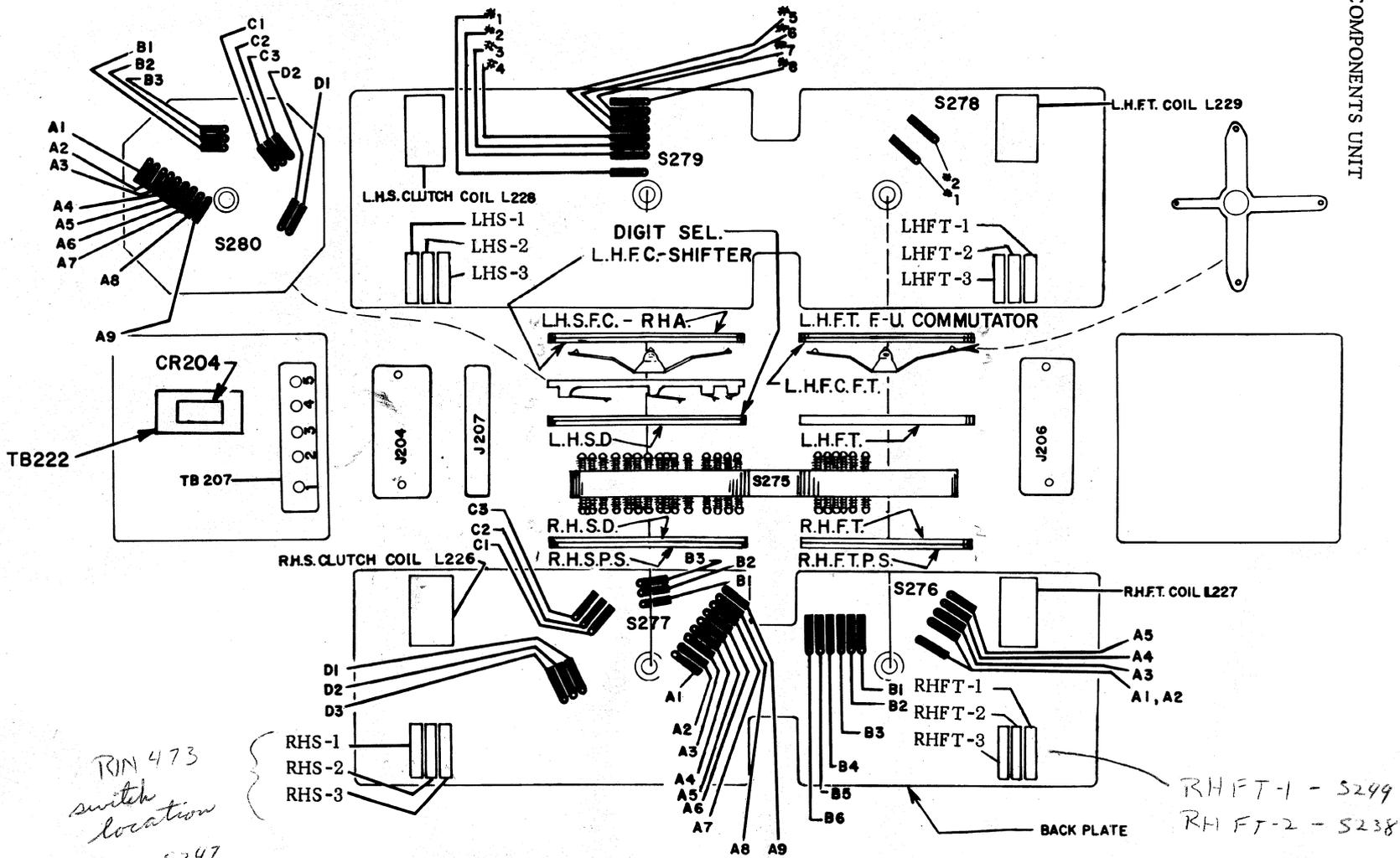


Fig. VII - 3

POWER SUPPLY

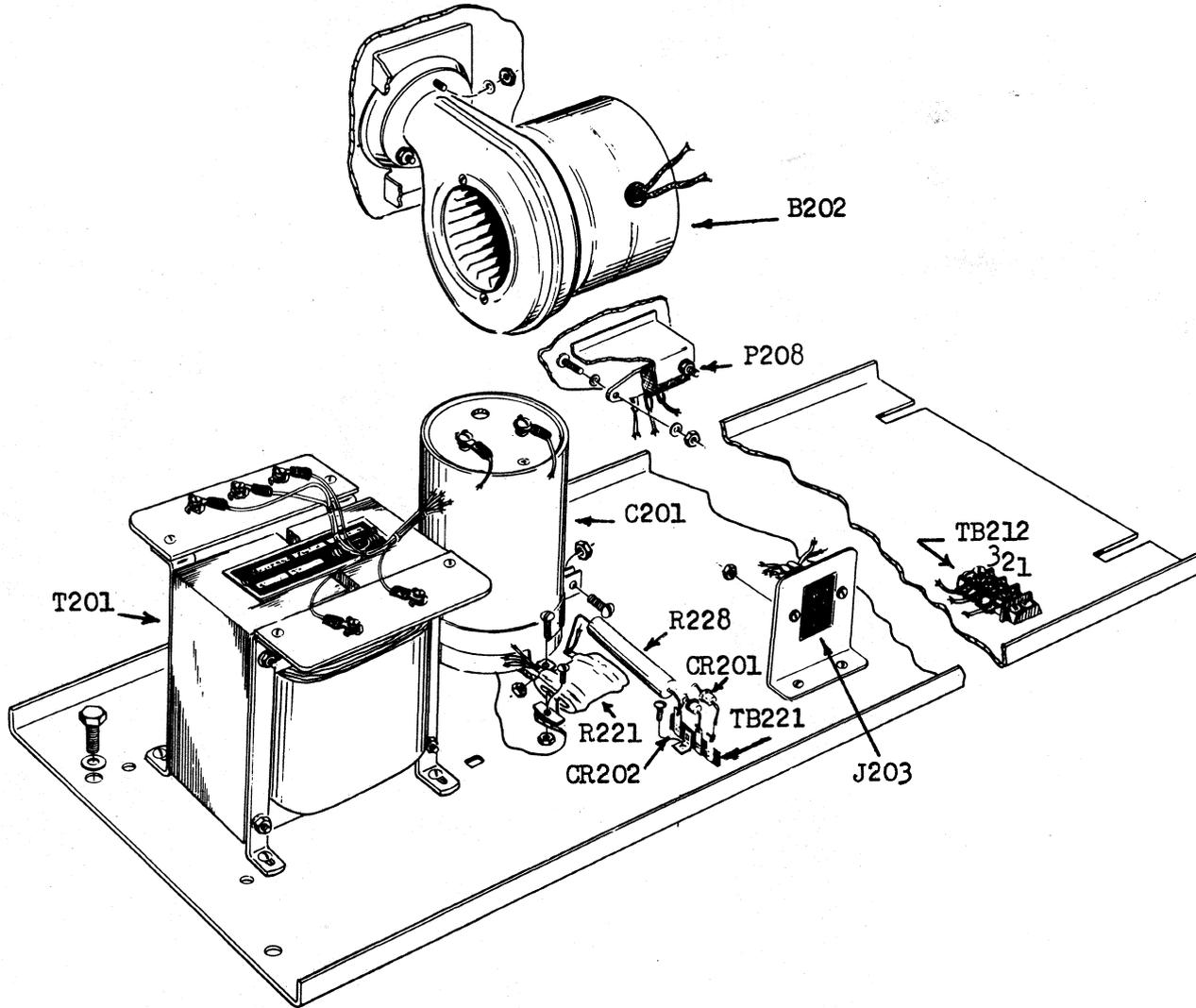
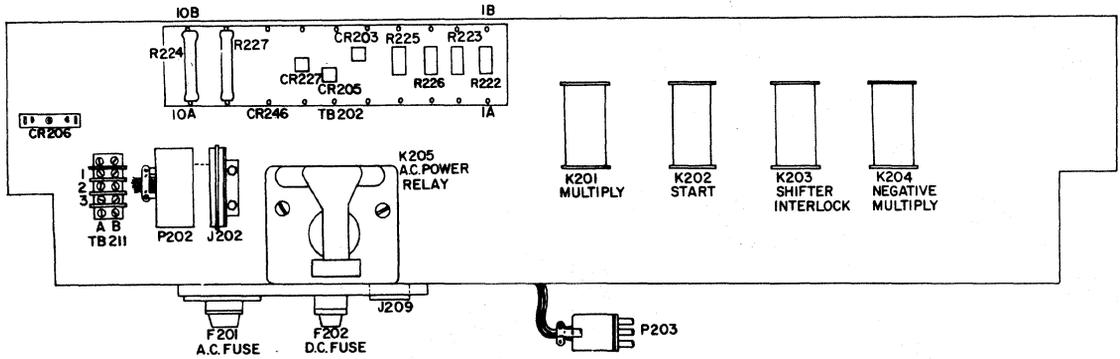
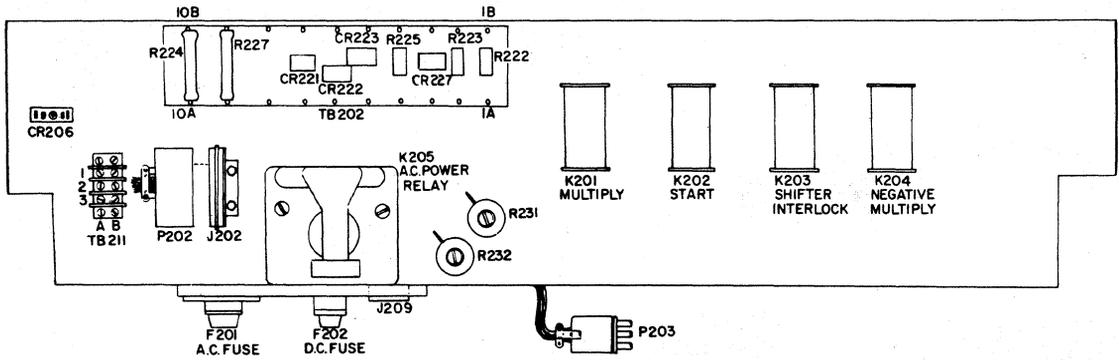


Fig. VII - 4

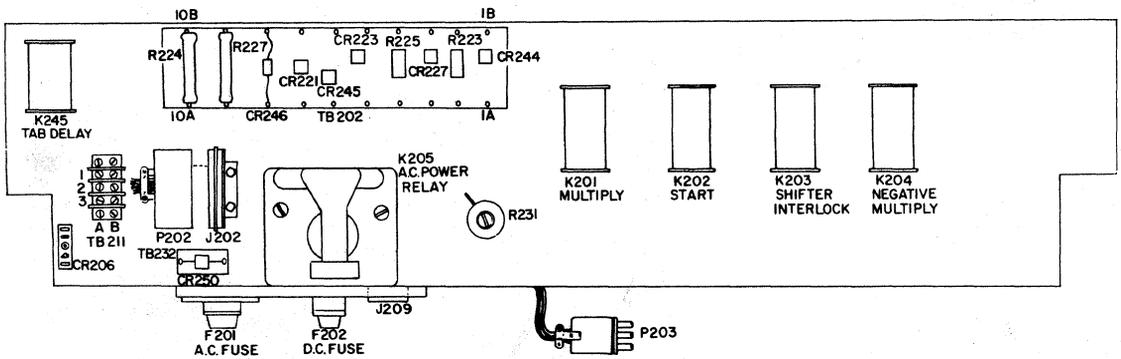
RELAY PLATE



5/8" Tab



1/10" Tab



Side Insertion
Fig. VII - 5

OPERAND STORAGE UNIT PRINTED CIRCUITS

MULTIPLIER STORAGE

One printed circuit required for each column of machine capacity. The D pads are not used. Each O pad is connected to its left adjacent C pad. Terminal of pads 1 thru 9 and the lower Z pads are connected by buss wires to corresponding 1 thru 9 lower Z pads on all other multiplier printed circuits.

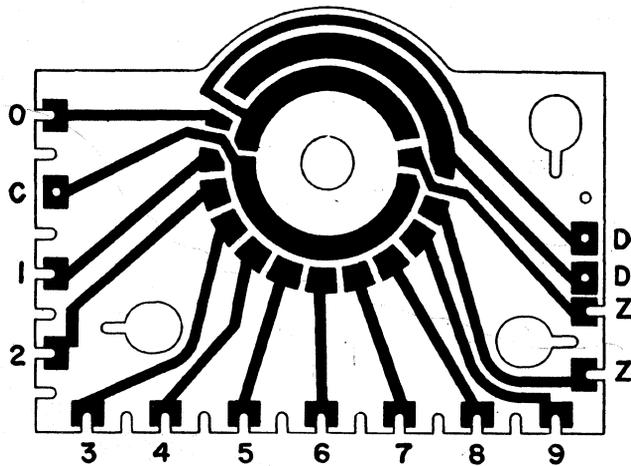


Fig. VII - 6

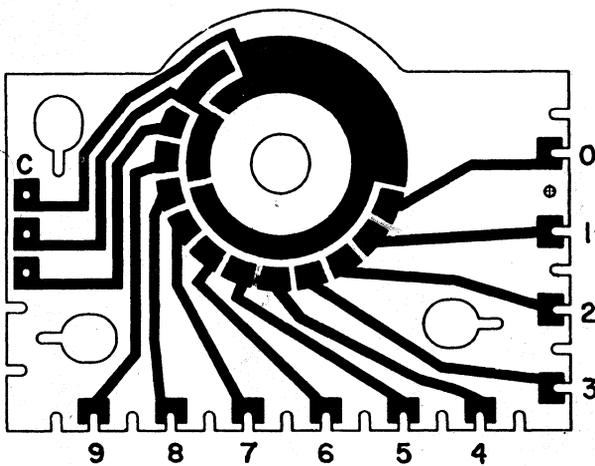


Fig. VII - 7

MULTIPLICAND STORAGE

One printed circuit required for each column of machine capacity. The two unnumbered pads and the O pad are not used. All 1 thru 9 pads are connected by buss wires to corresponding 1 thru 9 pads on all other multiplicand printed circuits.

Nylon gear and wiper contact assembly - viewed from contact side.

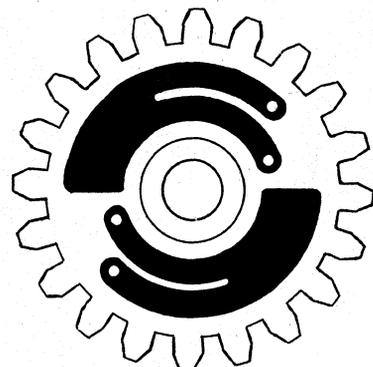


Fig. VII - 8

TIMING CAMS

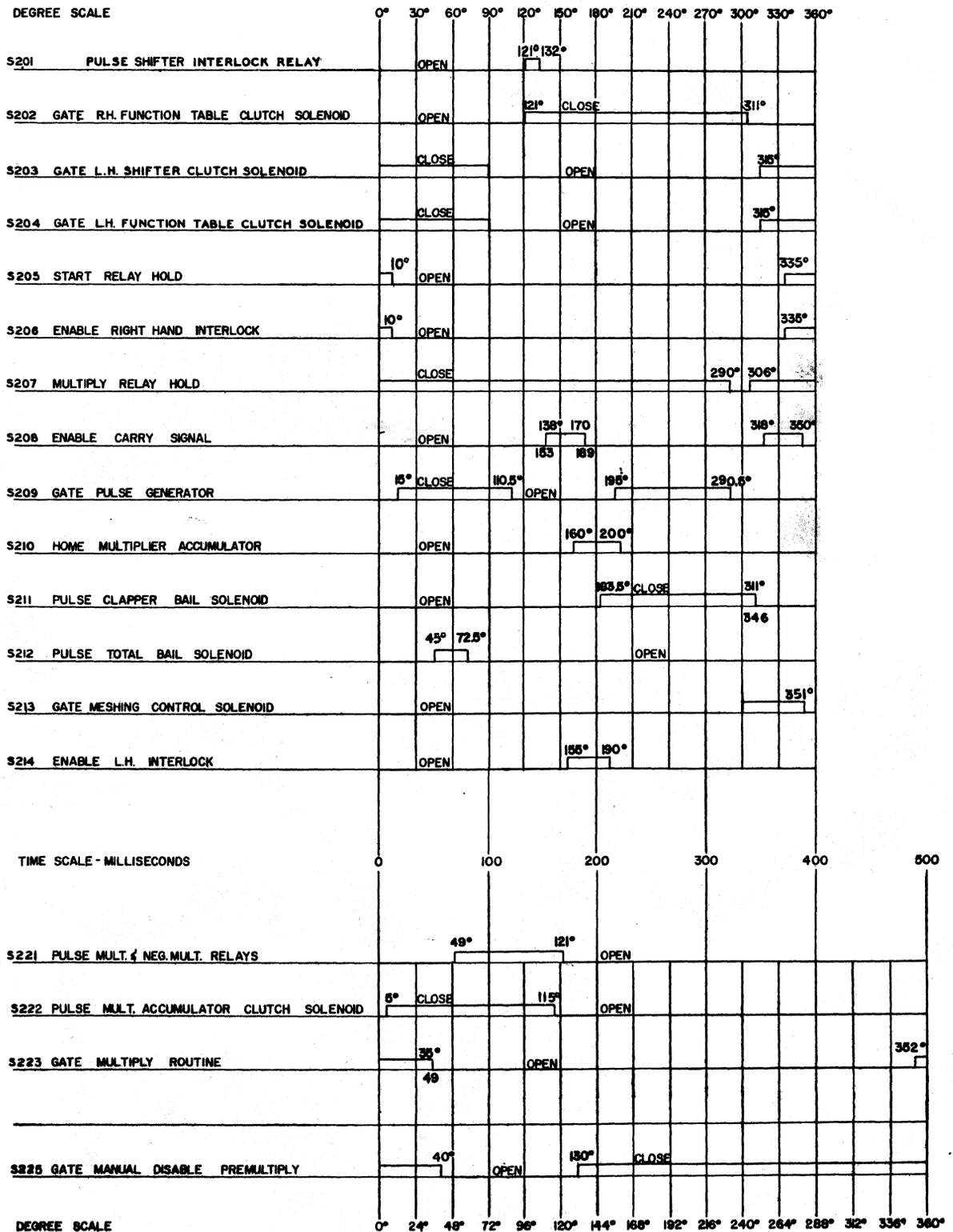
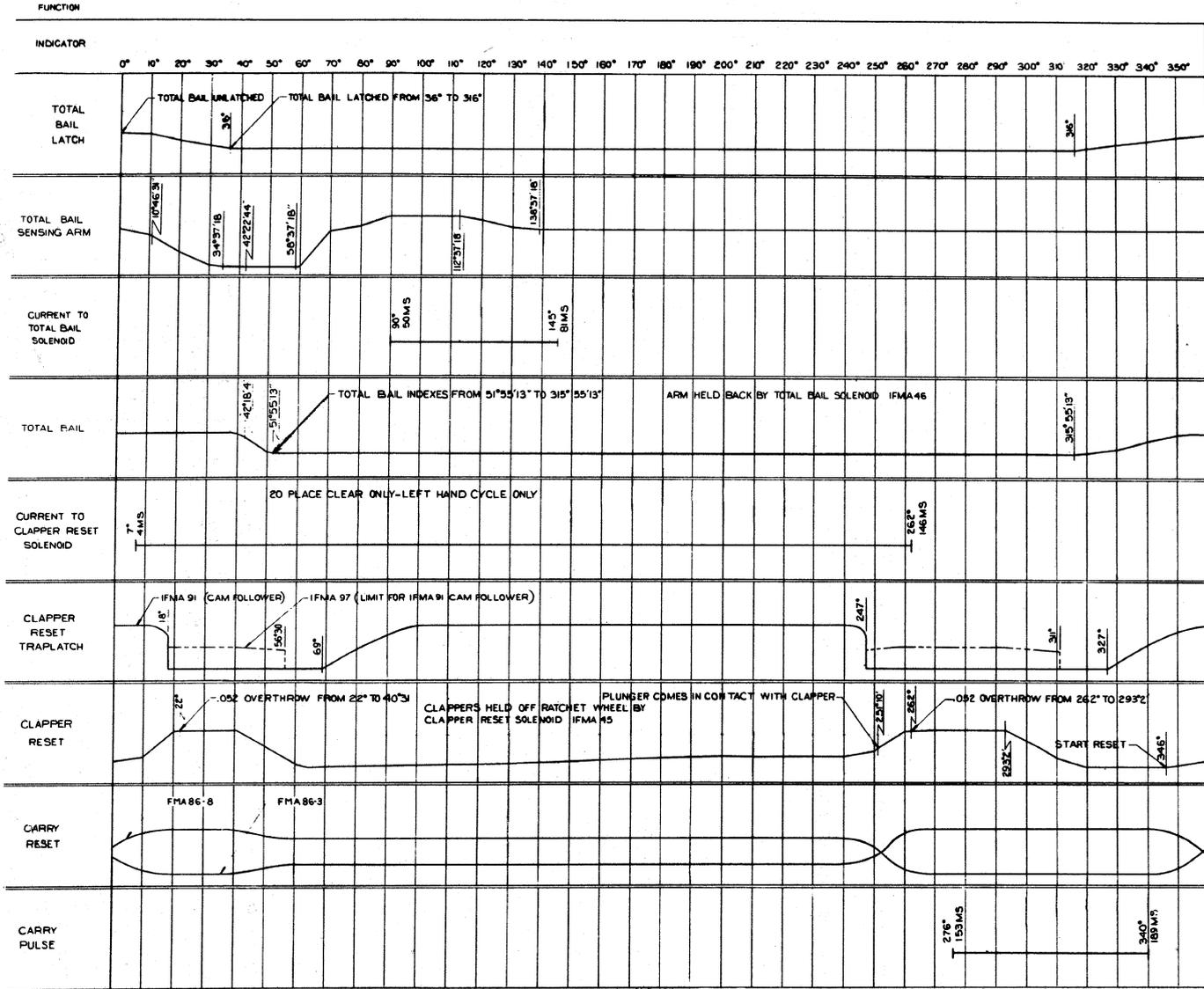


Fig. VII - 9

PRODUCT ACCUMULATOR TIMING



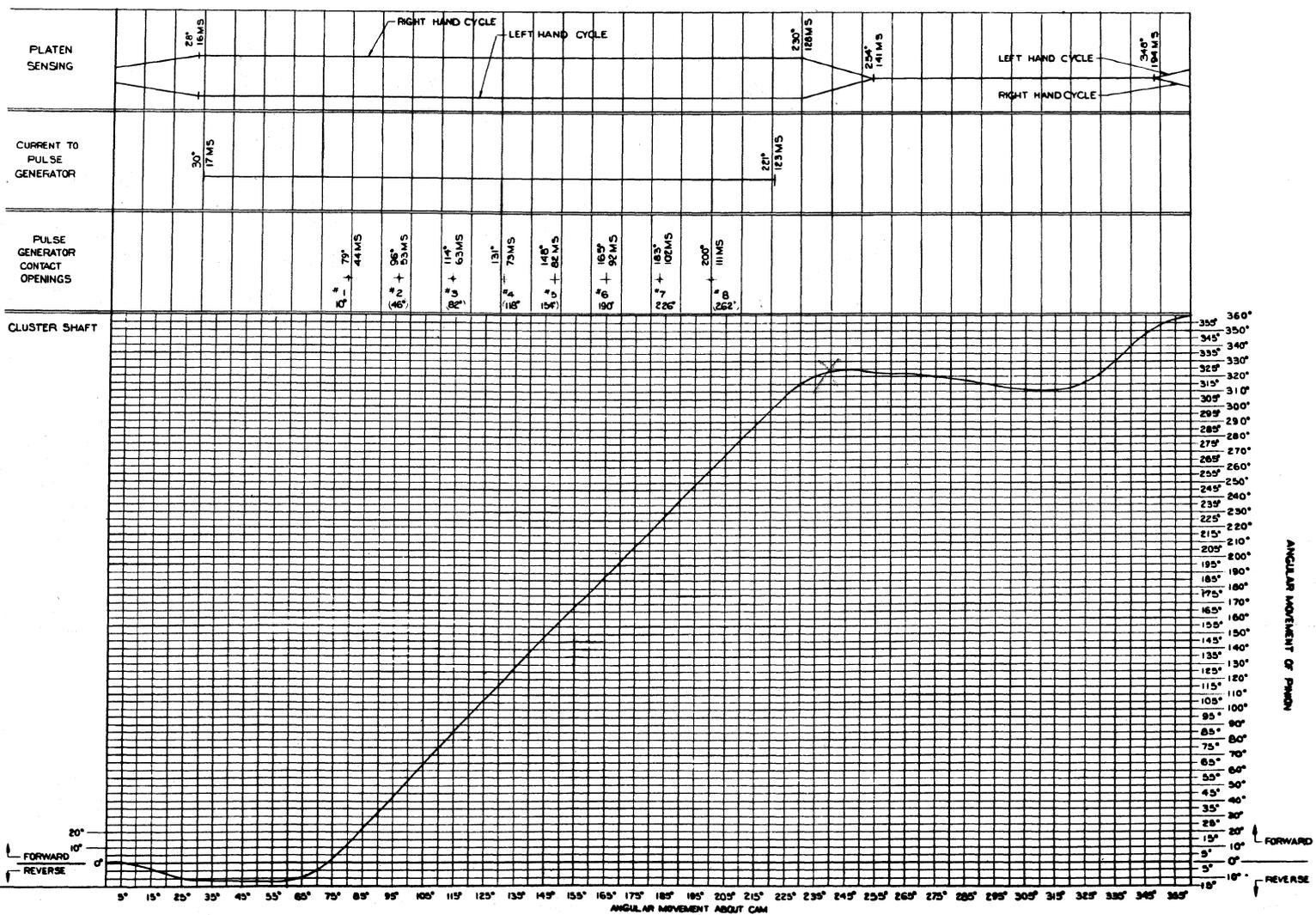
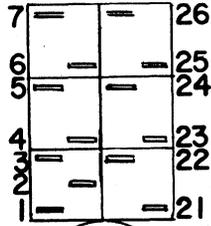


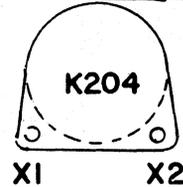
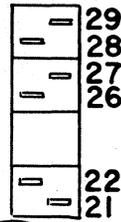
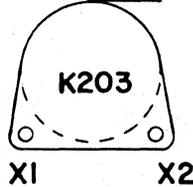
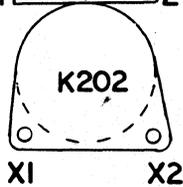
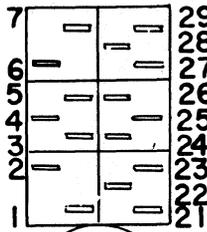
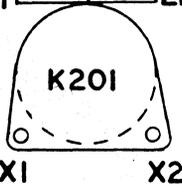
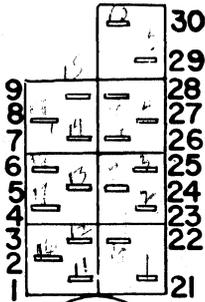
Fig. VII-10

RELAYS

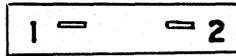
7 Pk + white
 6 2 white
 5 2 ylo
 4 2 Bl + white
 2-2 Red
 1 Brown



Blue White



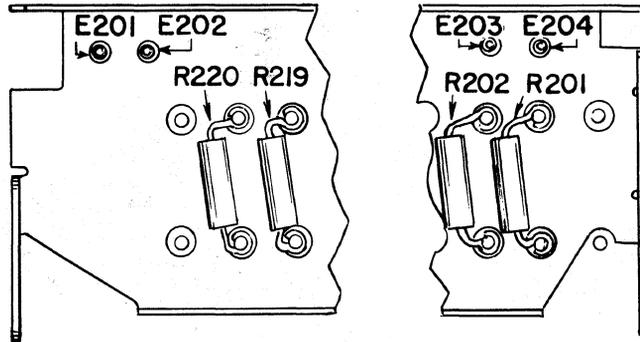
VIEW FROM TERMINAL END



TOP VIEW

Fig. VII-11

PRODUCT ACCUMULATOR RESISTOR BOARD



Note: E201, 2, 3, 4 were formerly TB213, 14, 15, and 16.

COLOR CODE

- 0 - BLACK
- 1 - BROWN
- 2 - RED
- 3 - ORANGE
- 4 - YELLOW
- 5 - GREEN
- 6 - BLUE
- 7 - VIOLET
- 8 - GRAY
- 9 - WHITE

Fig. VII - 12

PLATEN PIN CHART

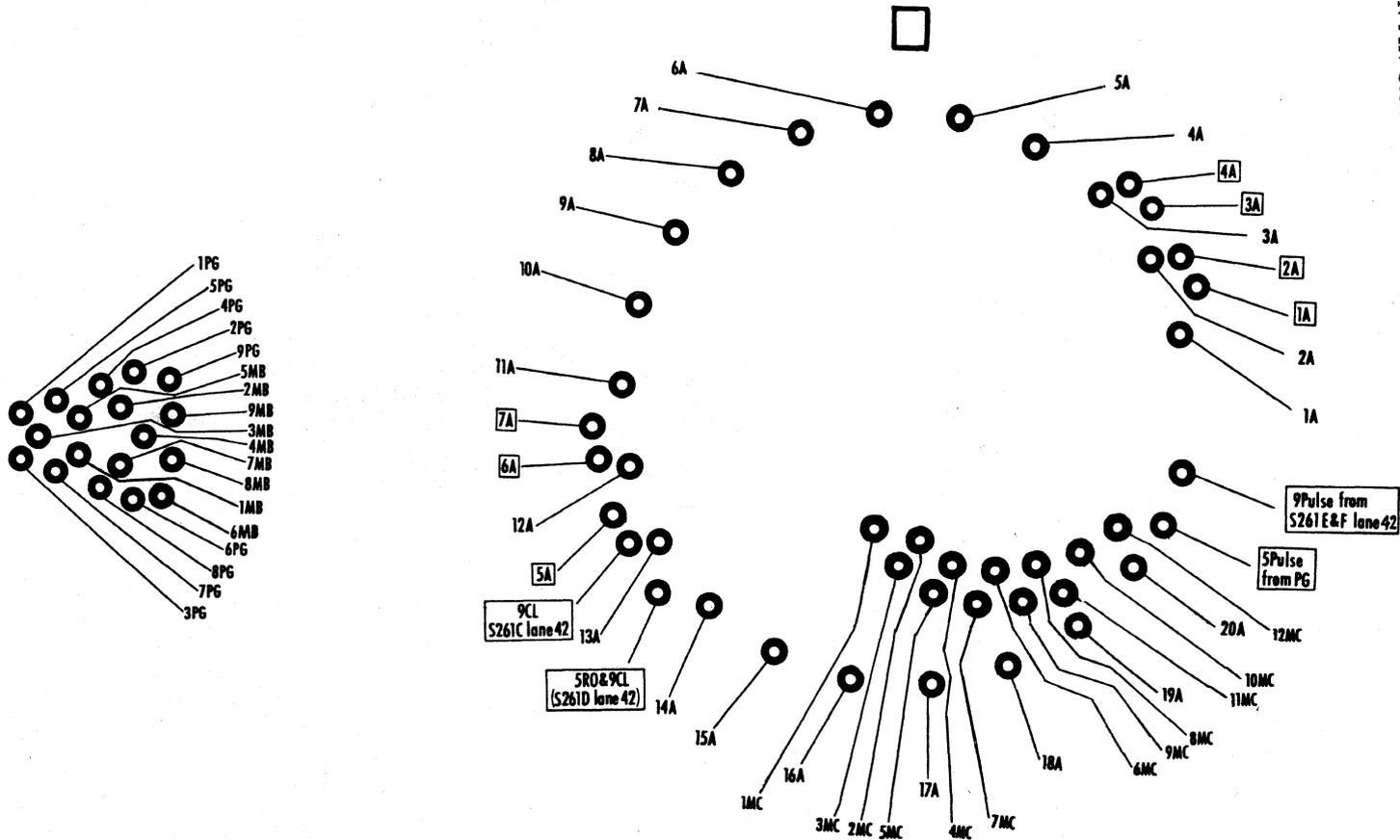
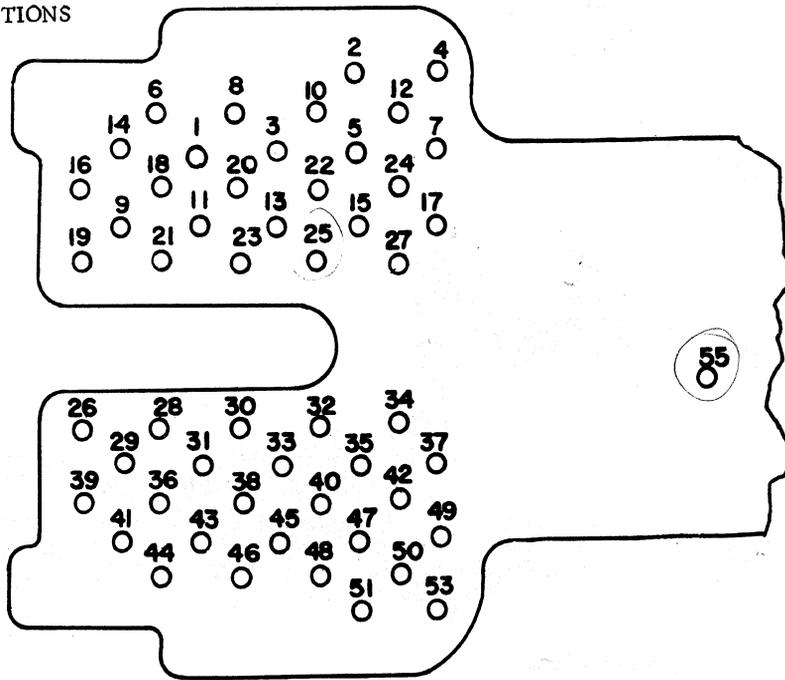


Fig. VII - 13

PIN TERMINATIONS
ON PLATEN



Pin - Term.

- 1PG - 21
- 5PG - 25
- 4PG - 13
- 2PG - 17
- 9PG - 11
- 6PG - 15
- 8PG - 9
- 7PG - 27
- 3PG - 23

- 5MB - 32
- 2MB - 33
- 9MB - 35
- 3MB - 28
- 4MB - 29
- 7MB - 34
- 8MB - 37
- 1MB - 30
- 6MB - 31

Pin - Term.

- 4A, 4A - 4
- 3A, 3A - 2
- 2A, 2A - 14
- 1A, 1A - 16
- 9 pulse - 55
- 5 pulse - 25
- 20A - 46
- 19A - 48
- 18A - 42
- 17A - 24
- 16A - 22
- 15A - 40
- 14A - 50
- 5R, 0. - 44

Pin - Term.

- 13A - 38
- 9CL - 41
- 5A, 5A - 8
- 12A - 26
- 6A, 6A - 10
- 7A, 7A - 12
- 11A - 36
- 10A - 20
- 9A - 18
- 8A - 6
- 7A - 12
- 6A - 10

Pin - Term.

- 12MC - 1
- 10MC - 7
- 11MC - 53
- 8MC - 19
- 9MC - 51
- 6MC - 5
- 7MC - 39
- 4MC - 49
- 5MC - 43
- 2MC - 45
- 3MC - 47
- 1MC - 3

LEGEND: A - Accumulator Column
 MB - Multiplicand Bus
 MC - Multiplicand Column
 PG - Pulse Generator Contact
 - Used on Clear

Fig. VII - 14

RIGHT HAND SHIFTER DISK

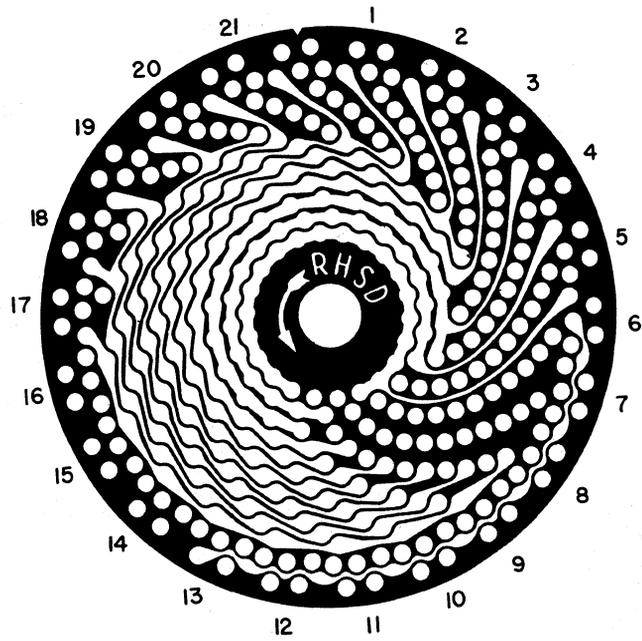


Fig. VII - 15

LEFT HAND SHIFTER DISK

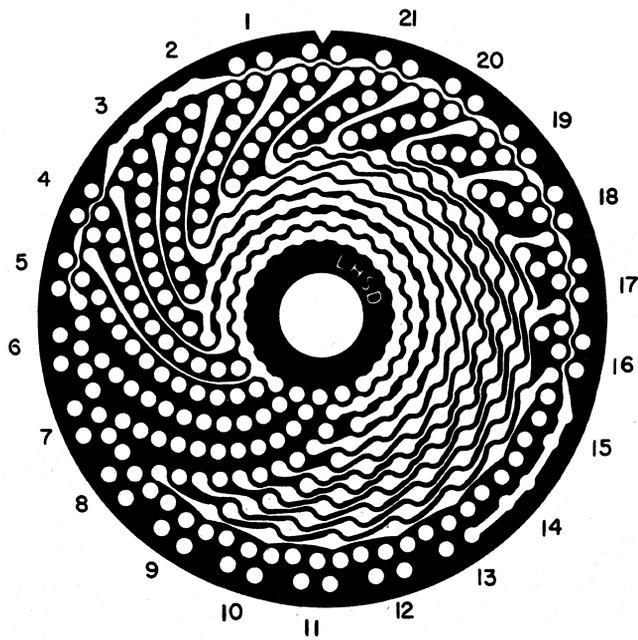


Fig. VII - 16

RIGHT HAND SHIFTER POSITION SELECTOR DISK (S277)

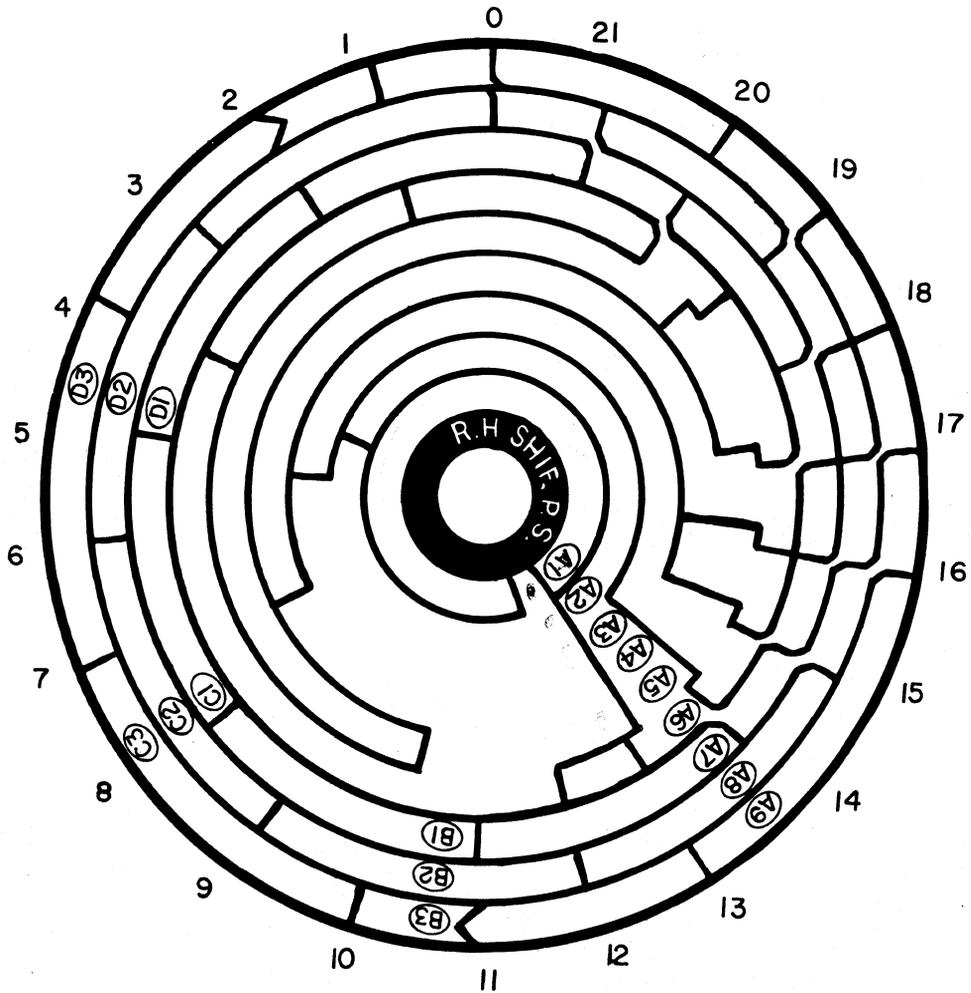


Fig. VII - 17

Disk shown in home position

Wiping contact connections (logical):

- | | |
|-----------------------------|-------------------------|
| A1 - R.O. release solenoid | B1 - DZ switch, col. 4 |
| A2 - S264D (8 shift) | B2 - DZ switch, col. 5 |
| A3 - S264C (7 shift) | B3 - DZ switch, col. 6 |
| A4 - S264B (5 shift) | C1 - DZ switch, col. 7 |
| A5 - S264A (2 shift) | C2 - DZ switch, col. 8 |
| A6 - R.H.S. clutch solenoid | C3 - DZ switch, col. 9 |
| A7 - DZ switch, col. 1 | D1 - DZ switch, col. 10 |
| A8 - DZ switch, col. 2 | D2 - DZ switch, col. 11 |
| A9 - DZ switch, col. 3 | D3 - DZ switch, col. 12 |

LEFT HAND SHIFTER FOLLOW - UP COMMUTATOR
AND RIGHT HAND AUXILIARY CONTROL DISK (S279)

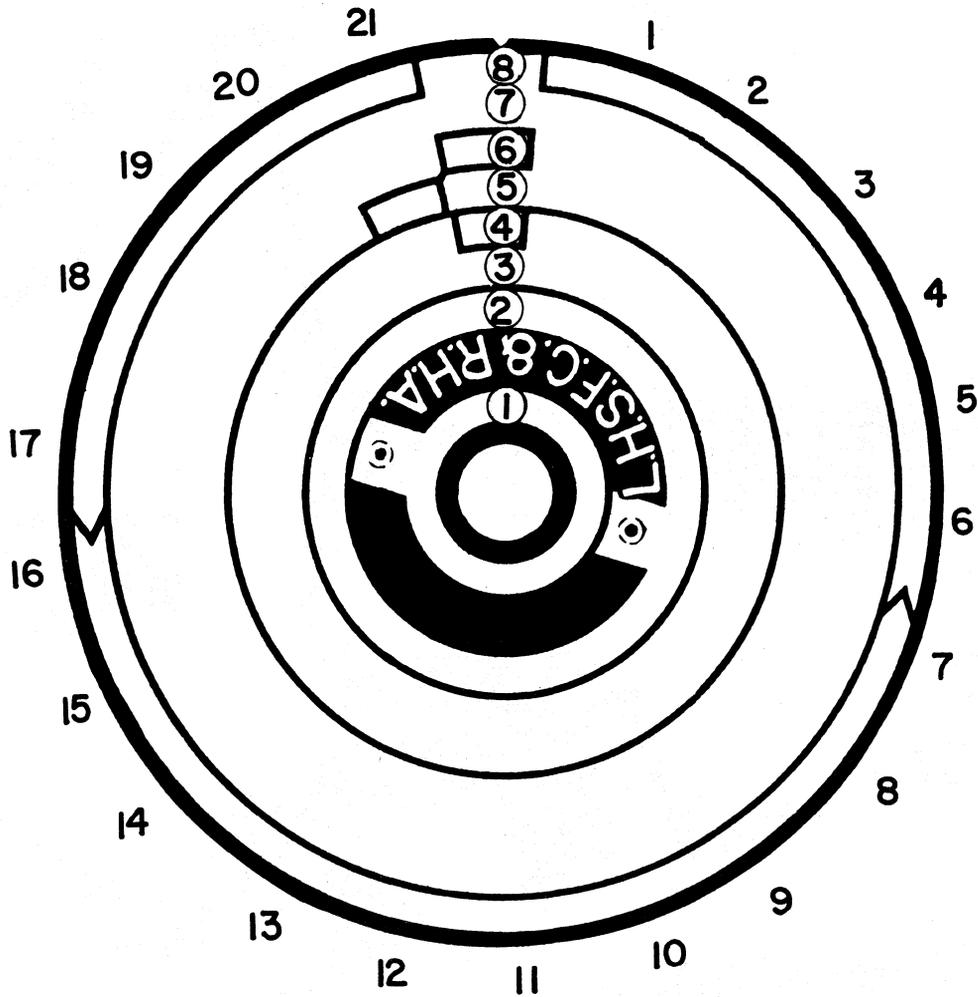


Fig. VII - 18

Disk shown in home position

Wiping contact connections (logical):

- 1- K201-27 (CB+)
- 2- S203-NC (L. H. S. clutch solenoid)
- 3- K201-23 (CB+ for homing)
- 4- R. H. S. clutch solenoid (for homing)

- 5- S201-NO (K203 pick circuit)
- 6- CB+ with disk out of home during multiplication
- 7- Supplies CB+ to 5, 6 and 8 during multiplication
- 8- Directional key block solenoid and S284-NC

DIGIT SELECTOR DISK (S280)

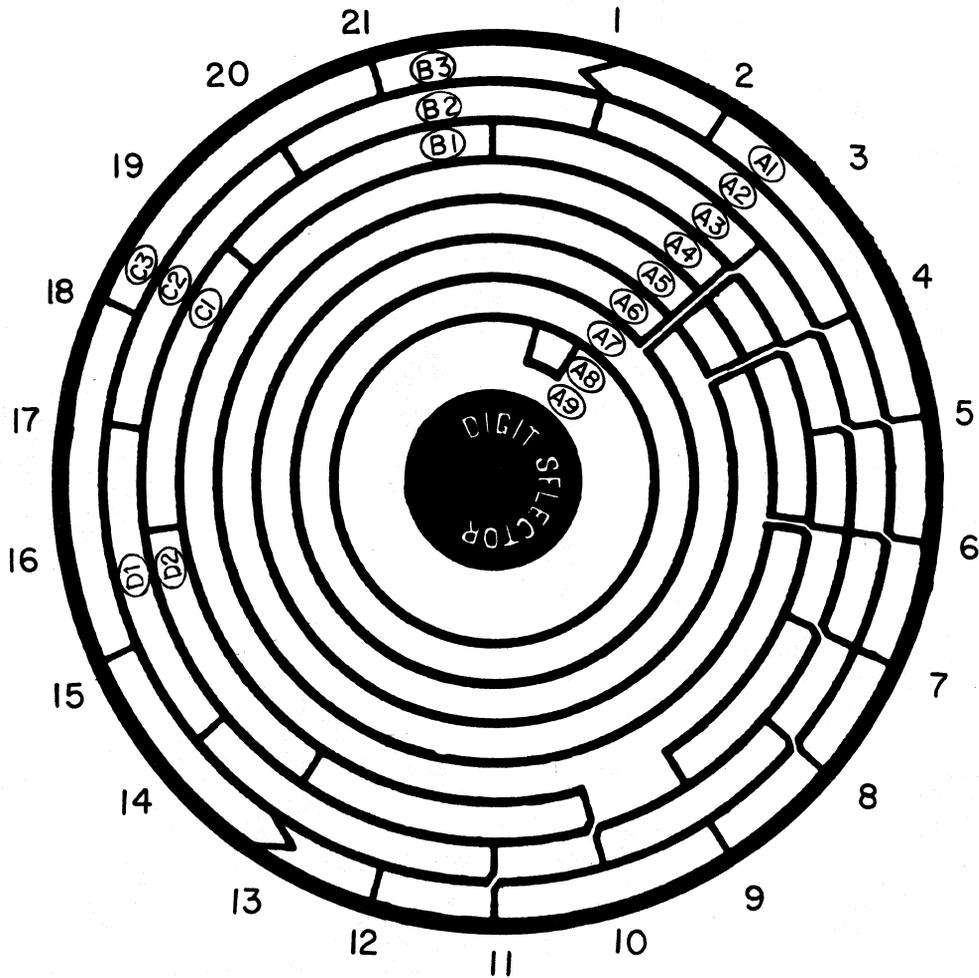


Fig. VII - 19

Disk shown in home position

Wiping contact connections (logical):

- A1 - Mult. storage col. 4 com.
- A2 - Mult. storage col. 3 com.
- A3 - Mult. storage col. 2 com.
- A4 - S265A (2 shift)
- A5 - S265B (5 shift)
- A6 - S265C (7 shift)
- A7 - S265D (8 shift)
- A8 - S207-C (K 201 hold circuit)
- A9 - CB+ (to hold K 201)

- B1 - Mult. storage col. 5 com.
- B2 - Mult. storage col. 6 com.
- B3 - Mult. storage col. 7 com.
- C1 - Mult. storage col. 8 com.
- C2 - Mult. storage col. 9 com.
- C3 - Mult. storage col. 10 com.
- D1 - Mult. storage col. 12 com.
- D2 - Mult. storage col. 11 com.

RIGHT HAND FUNCTION TABLE DISK

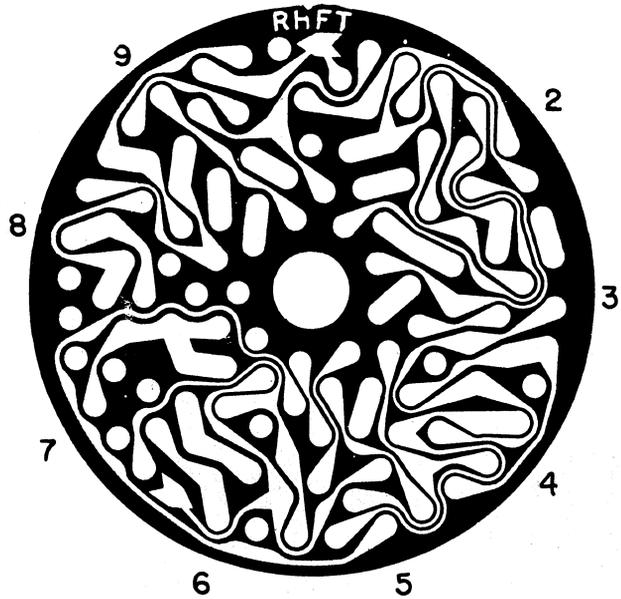


Fig. VII - 20

LEFT HAND FUNCTION TABLE DISK

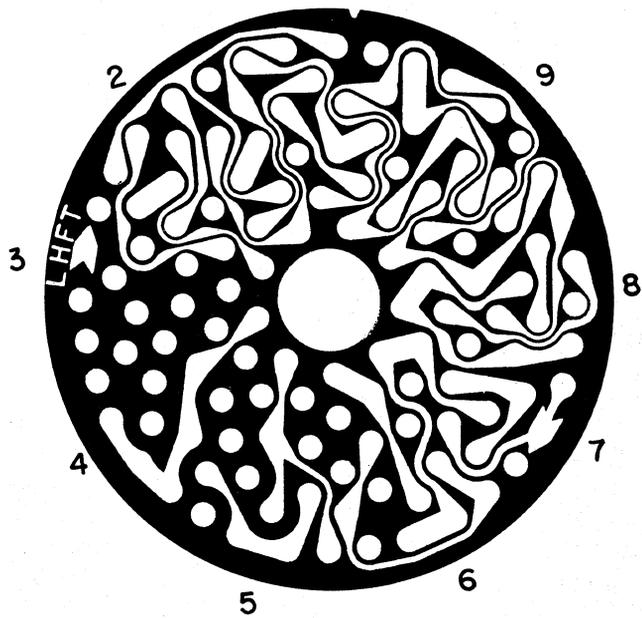


Fig. VII - 21

RIGHT HAND FUNCTION TABLE POSITION SELECTOR DISK (S276)

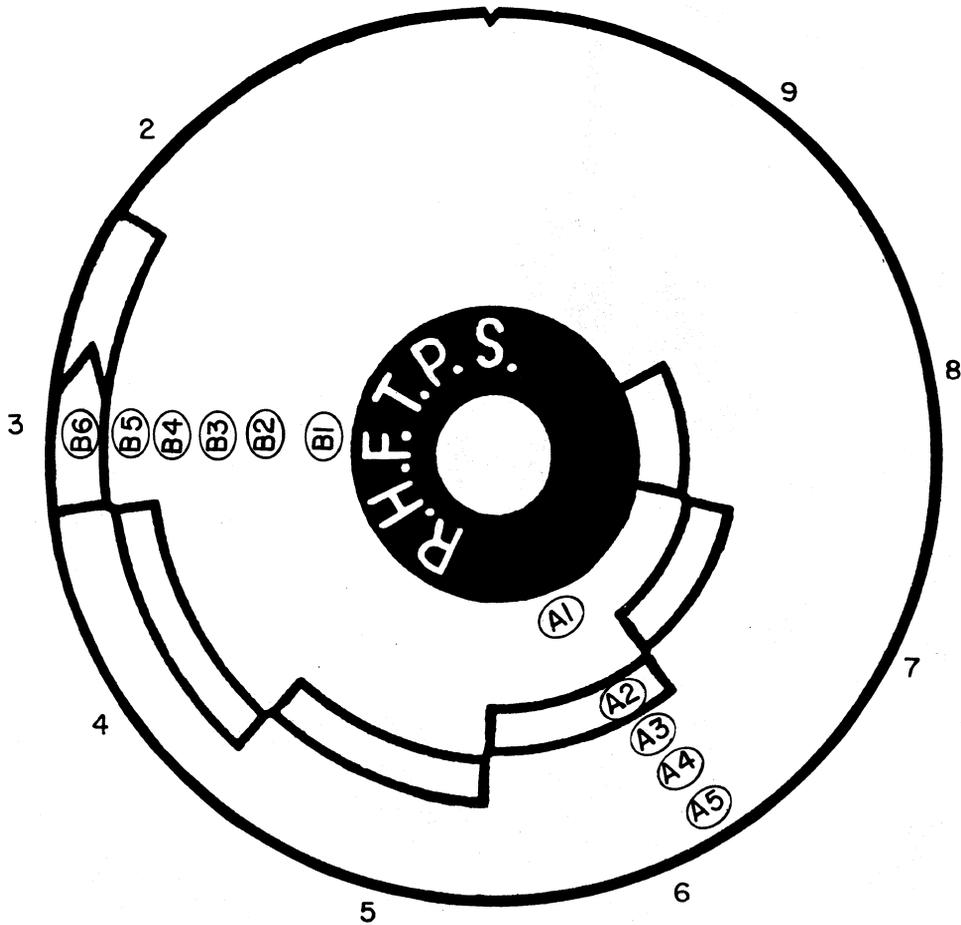


Fig. VII - 22

Disk shown in function table 1 position

Wiping contact connections (logical):

- A1 - R.H.F.T. clutch solenoid
- A2 - R.H.F.T. clutch solenoid
- A3 - Mult. storage 9 bus
- A4 - Mult. storage 8 bus
- A5 - Mult. storage 7 bus

- B1 - Mult. storage 6 bus
- B2 - Mult. storage 5 bus
- B3 - Mult. storage 4 bus
- B4 - Mult. storage 3 bus
- B5 - Mult. storage 2 bus
- B6 - Mult. storage 1 bus

LEFT HAND FUNCTION TABLE FOLLOW - UP COMMUTATOR
(S278)



Fig. VII - 23

Wiping contact connections (logical):

1-K202-4 (C.B.+)

2-S204 - NC (L.H.F. T. clutch solenoid)

LEFT HAND FOLLOW - UP CIRCUIT DISK - SHIFTER

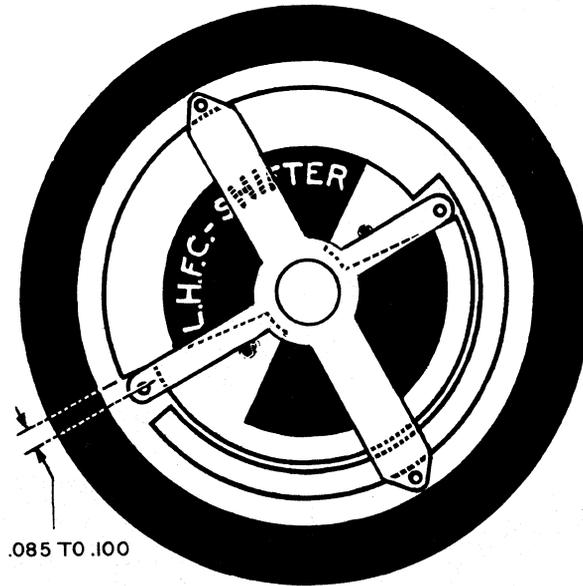


Fig. VII-24

LEFT HAND FOLLOW - UP CIRCUIT DISK - FUNCTION TABLE

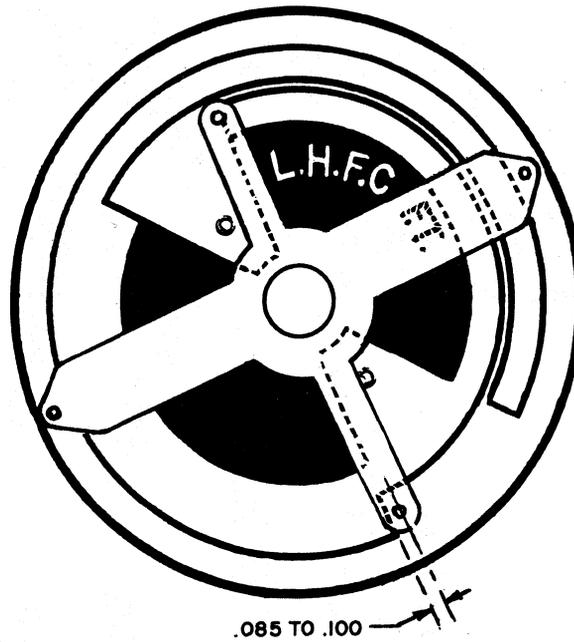


Fig. VII-25

ELECTRICAL COMPONENT FUNCTION CHART

S201 - S214 all ⊗ switches

<u>COMPONENT</u>	<u>FUNCTION</u>
S201	Picks K203 during multiply routine to enable the R.H.S. to shift one position when required.
S202	Gates R.H.F. T. clutch.
S203	Gates L.H.S. clutch.
S204	Gates L.H.F. T. clutch.
S205	Times drop out of K202.
S206	Makes the right hand interlocks active prior to picking the accumulator clutch solenoid for the right hand platen stroke.
S207	Provides hold circuit for K201 in L.H.S. position 21 where S280 opens.
S208	Provides carry pulse for product accumulator.
S209	Gates pulse generator and 9 pulse for clear after round off.
S210	Ensures that the multiplier unit is in home position before starting a multiply routine.
S211	Pulses clapper bail solenoid on manual or programmed clear. (Δ)
S212	Pulses total bail solenoid for manual or programmed clear (Δ) and clear after round-off. ^{✓²7}
S213	Pulses meshing control solenoid when K201 drops out.
S214	Makes left hand interlocks active prior to picking the accumulator clutch solenoid for the left hand platen stroke.
S215	Program clear (Δ) lane 51 (66).
S216	Disables a pre-multiply set up in previous stop - lane 47 (62).
S217	Start multiply - lane 48 (63).
S218	In B+ circuit to decimal light, DS203 - lane 49 (64).
S219	In B+ circuit to decimal light, DS201, DS202 - lane 50 (65).
S220	Enables crossfooter non-clear lock - lane 46 (61).
S221	Provides CB+ to S260 (lane 41) and to Man. Neg. Mult. S232
S222	Pulses multiplier accumulator clutch solenoid, keyboard stop solenoid, symbol slide stop solenoid, and register designation stop solenoid during manual or programmed clear
S223	Delays starting of multiplication until completion of previous sensimatic cycle. Drops K245 at 35° of Sensimatic cycle.
S225	Prevents dropping K201, and/or K204, if the non-multiply key has been depressed with the Sensimatic home.
S226	1/10" and 5/8" tab: Prevents start of multiplication when carriage is in motion.
S227	1/10" and 5/8" tab: Supplies CB+ to hold K201 when carriage is in motion.
S228	Completes AC circuit to K205.
S229	Breaks DC circuit to On Key Latch solenoid.
S230	Supplies CB+ or MB+ depending on position of carriage control disabling lever.
S231	Drops the hold circuit for K204 during product transfer.
S232	Allows K204 to be picked at 49° of Sensimatic cycle.

<u>COMPONENT</u>	<u>FUNCTION</u>
S233	Non-multiply switch. Prevents picking K201 and/or K204 with NON X key depressed.
S234	In a programmed negative multiply position, allows K204 to be picked at 49 ⁰ of CF "A" negative total or subtotal Sensimatic cycle.
✓ S235	R.H.S. 2, drops K203.
✓ S236	L.H.S. 3, in CB+ circuit to digit selector
✓ S237	L.H.F.T. 2, in CB+ circuit to digit selector
✓ S238	R.H.F.T. 1, alternate hold circuit for R.H.F.T. clutch solenoid. — R/N 473
✓ S239	R.H.F.T. 3, breaks pick circuit for R.H.F.T. clutch solenoid.
S240	Breaks pick circuit for decimal shift solenoid. By-passes decimal shift enable switch for pre-shift when the C or M key is used.
S241	In CB+ circuit to R.H. shifter position selector when the C or M key is used or when a decimal shift of 8 is programmed.
S242	In CB+ circuit to digit selector when C or M key is used or when a decimal shift of 8 is programmed.
S243	Transferred by the decimal shift timer slide when the decimal shift tappet is released. In CB+ circuit to R.H.F.T. clutch solenoid and R.H.S. clutch solenoid.
✓ S244	L.H.S. 2, prevents left land platen stroke or R.H.S. single column shift when L.H.S. is moving.
✓ S245	L.H.F.T. 3, prevents left hand platen stroke when L.H.F.T. is moving.
✓ S246	R.H.S. 1, breaks pick circuit to R.H.S. clutch solenoid
✓ S247	R.H.S. 3, prevents right hand platen stroke when R.H.S. is moving. — R/N 473
S248	Manual delta clear switch (Δ).
✓ S249	R.H.F.T. 2, prevents start of right hand platen stroke, L.H.S. clutch solenoid, and L.H.F.T. clutch solenoid while R.H.F.T. is moving.
✓ S250	L.H.F.T. 1, alternate hold circuit for L.H.F.T. clutch solenoid.
✓ S251	L.H.S. 1, alternate hold circuit for L.H.S. clutch solenoid.
S252	Transferred when front pinions of crossfooter are clear.
S253	Transferred when rear pinions of crossfooter are clear.
S254	Transferred when sign of crossfooter is minus.
S255	Releases non-clear lock when Bar # 1 is depressed.
S256	Transferred by meshing control assembly during indexing of product transfer. Picks L232 if K204 is picked.
S257	Side insertion: Normally closed contacts in ground circuit of K245. Transferred by tab and return mechanism to apply full power to L239. 1/10" tab: Transferred by tab and return mechanism to apply full power to L239.
S260	Controls picking of K201 and K204 - lane 41.
S261	Round off and/or clear - lane 42.
S262	Round off and/or clear position selector - lane 43.
S263	Clear position selector - lane 43.
S264	Decimal shift selector - lane 44.

<u>COMPONENT</u>	<u>FUNCTION</u>
S265	Co-ordinates digit selection with decimal shift selection - lane 44
S266	Pulse generator.
S274	Carry printed circuit and wipers.
S275	Platen and disks it contacts.
S276	R.H.F. T. position selector.
S277	R.H. shifter position selector.
S278	L.H.F. T. follow up.
S279-1 & 2	L.H.S. follow up.
S279-3 & 4	R.H.S. homing circuit
S279-5, 6, 7, 8	Control circuit for multiply routine
S280	Digit selector and alternate hold for K201.
S284	Directional key interlock transferred by L223.
S287	Side insertion: In ground circuits of K245 and L222. 1/10" tab: In ground circuit of L222.
S289	Side insertion : Opens circuit to L239 with program unit removed.
K201	Multiply relay
K201-1 & 2	Side insertion: In ground circuit of K245 1/10" and 5/8" tab: In pick circuit of L233. Provides alternate path for CB+ to decimal lights.
K201-2 & 3	Side insertion: Provide ground to K245 during multiplication. 1/10" and 5/8" tab: In hold circuit for K202 and in CB+ circuit to S279-7.
K201-4 & 5	In CB+ circuit to L230 for delta clear and for homing product accumulator.
K201-5 & 6	In CB+ circuit to L230 during multiplication
K201-7 & 8	In pick circuit of L235 during delta clear (Δ).
K201-8 & 9	In pick circuit of L235 during multiplication
K201-21 & 22	In hold circuit of K201
K201-23 & 24	In CB+ circuit to home R.H.S. and in CB+ circuit to L222
K201-24 & 25	In L.H.F. T. follow circuit during pre-shift; in carry circuit; in circuit for all multiply routine controls.
K201-26 & 27	In L.H.S. homing circuit.
K201-27 & 28	In L.H.S. follow up circuit during multiplication.
K201-29 & 30	In pick circuit of K201.
K202	Start relay.
K202-1 & 2	In hold circuit for K202.
K202-3 & 4	In CB+ circuit to function table follow up.
K202-4 & 5	In CB+ circuit to function table follow up during pre-shift.
K202-21 & 22	In CB+ circuit to left hand shifter follow up.
K202-22 & 23	In CB+ circuit to left hand shifter follow up during pre-shift.
K202-24 & 25	In CB+ circuit to R.H.F. T. clutch circuit; hold for K203.
K202-25 & 26	In CB+ circuit to R.H.F. T. clutch circuit during pre-shift.
K202-28 & 29	In CB+ circuit to the R.H.S. for pre-shift if C or M key is depressed. In CB+ circuit to L225 if the C or M keys are normal.
K203	Shifter Interlock relay.
K203-21 & 22	In hold circuit for K203.

<u>COMPONENT</u>	<u>FUNCTION</u>
✓✓ K203-23 & 24	In CB+ circuit to R.H.S. clutch for moving the R.H.S. one position.
✓✓ K203-25 & 26	In pick circuit for K203.
K204	Negative Multiply relay
K204-21 & 22	In hold circuit for K204.
K204-26 & 27	Provides ground circuit to CFA subtract and red ribbon solenoid and signal light.
K204-28 & 29	In pick circuit to K204.
K205	Power relay.
K205-1 & 2	Supplies AC to transformer, blower motor and Sensimatic motor.
✓ K245	Side insertion: Tab delay relay
✓ K245-1 & 2	Side insertion: Supplies CB+ to hold K201 when carriage is in motion.
✓ K245-4 & 5	Side insertion: In ground circuit of K202 and L223 to delay release of decimal shift tappet.
✓ K245-6 & 7	Side insertion: In pick circuit to L222; isolates MB+ from CB+
L201-L220	Product accumulator pinion clapper solenoids.
L221	On key latch solenoid
L222	Machine trip solenoid - allows Sensimatic drive to be tripped.
L223	Directional key block solenoid.
L224	Keyboard stop solenoid - blocks rack bars in adding columns.
L225	Decimal shift solenoid - releases lane 44 tappet and transfers S243.
✓ L226	R.H.S. clutch solenoid.
✓ L227	R.H.F.T. clutch solenoid
✓ L228	L.H.S. clutch solenoid
✓ L229	L.H.F.T. clutch solenoid
L230	Multiplier accumulator clutch solenoid - trips computer drive. - TRIN 473
L231	Controls release of tappets in lanes 42 and 43 for round off and clear.
L232	When picked, blocks tappets in lanes 7 and 12.
L233	Releases product transfer linkage. Transfers S256 to pick L232 if K204 is picked.
L234	Latches clapper bail reset mechanism for delta clear (Δ).
L235	Indexes total bail for delta clear and clear after round off.
L236	Blocks symbol slides for printing delta sign.
L237	Blocks register designation on manual or programmed delta clear (Δ).
L239	Magnetic carriage drive clutch.
CR201	Silicon diode rectifier.
CR202	Silicon diode rectifier.
CR203	5/8" tab - Isolates carry circuit from L222.
CR204	Isolates RHS hold circuit from K203, 23 & 24 pick circuit.
CR205	5/8" tab - Delays drop of L222.
CR206	Zener diode for on key latch solenoid.
CR220	Arc suppression for L231.
CR221	Side insertion and 1/10" tab: Isolates L222 from R.H.S. circuits.
CR222	1/10" tab: Isolates MB+ from CB+
CR223	Side insertion and 1/10" tab: Isolates CB+ from MB+
CR224	Arc suppression for L225.

<u>COMPONENT</u>	<u>FUNCTION</u>
CR227	Isolates S279-6 from S279-7 with S279 home.
CR228	Arc suppression for L230
CR229	Arc suppression for L223
CR244	Side insertion: Isolates CB+ from MB+
CR245	Side insertion: Isolates S260 from CB+ with DPM pin active. Provides hold for K201 if K245 is slow in dropping when trying to PM with DPM active.
CR246	Side insertion: Isolates CB+ from MB+
CR250	Side insertion: Arc suppression for K245
A6C	Arc suppression for R.H.S. clutch solenoid.
E6K	Arc suppression for R.H.F.T. clutch solenoid.
N4R6	Arc suppression for L.H.F.T. clutch solenoid.
V4W6	Arc suppression for L.H.S. clutch solenoid.
DS201	Keyboard decimal light - .2
DS202	Keyboard decimal light - .8
DS203	Keyboard decimal light - .5
DS204	Indicates that negative multiply (K204) has been set up.
F201	AC fuse - four-amp. slow blow.
F202	DC fuse - one amp. fast blow.
R201-R220	Reduces voltage on pinion clapper solenoids for faster release of clappers.
R221	Bleeder resistor for power supply.
R222	1/10" and 5/8" tab - In hold circuit of K204
R223	In hold circuit of K201.
R224	Voltage dropping resistor for decimal indicator lights.
R225	In hold circuit of L234.
R226	5/8" tab: Reduces voltage to L222 when L222 is held through crossfooter non-clear circuit.
R227	Voltage dropping resistor for negative multiply indicator light.
R228	Limits current during charging of C201.
R231	Variable resistor - In full power circuit of L239
R232	1/10" tab: Variable resistor - In hold power circuit of L239
2B3	In hold circuit of L226.
2H3	In hold circuit of L227.
2N3	In hold circuit of L229.
2V3	In hold circuit of L228.
4B5	Speeds drop out of L226.
4H5	Speeds drop out of L227.
C201	Filters DC and prevents multiplication interruptions by line fluctuations.
C202	Prevents accidental drop of K201 by a momentary opening of S216.

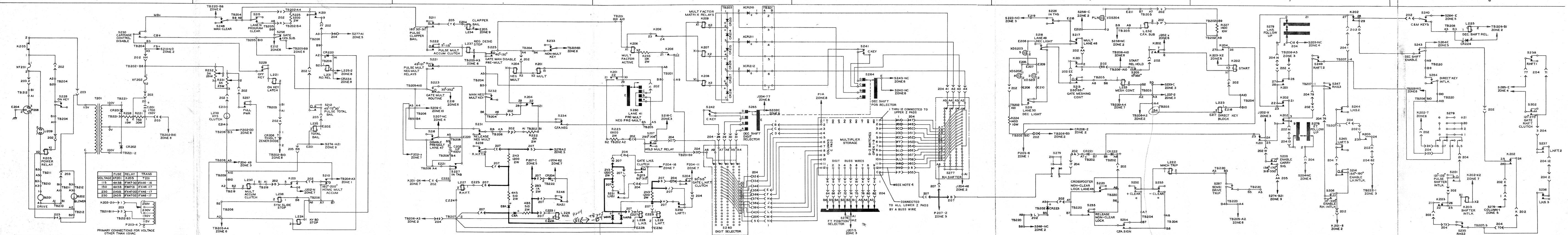
Approximate resistance of L201 through L239:

<u>SOLENOID</u>	<u>RESISTANCE (ohms)</u>
L201-L220 (2FMA52)	2200
L221 (2FB614-13)	2300
L222 (1FB614-9)	3600
L223 (1FB614-11)	1200
L224 (1FB614-8)	1200
L225 (1FB614-1)	1200
L226 (1FX76-12)	450
L227 (1FX76-12)	450
L228 (1FX76-12)	450
L229 (1FX76-12)	450
L230 (1FX614-8)	1200
L231 (1FX614-1)	1200
L232 (1FX614-9)	3600
L233 (1FX614-2)	1200
L234 (1FX73-1)	1200
L235 (1FX73-1)	1200
L236 (1FB614-4)	3600
L237 (1FB614-9)	3600
L239 (2FW166)	1150
Coil used with L230 as per C.I. 1007 (1FB614-11)	1200

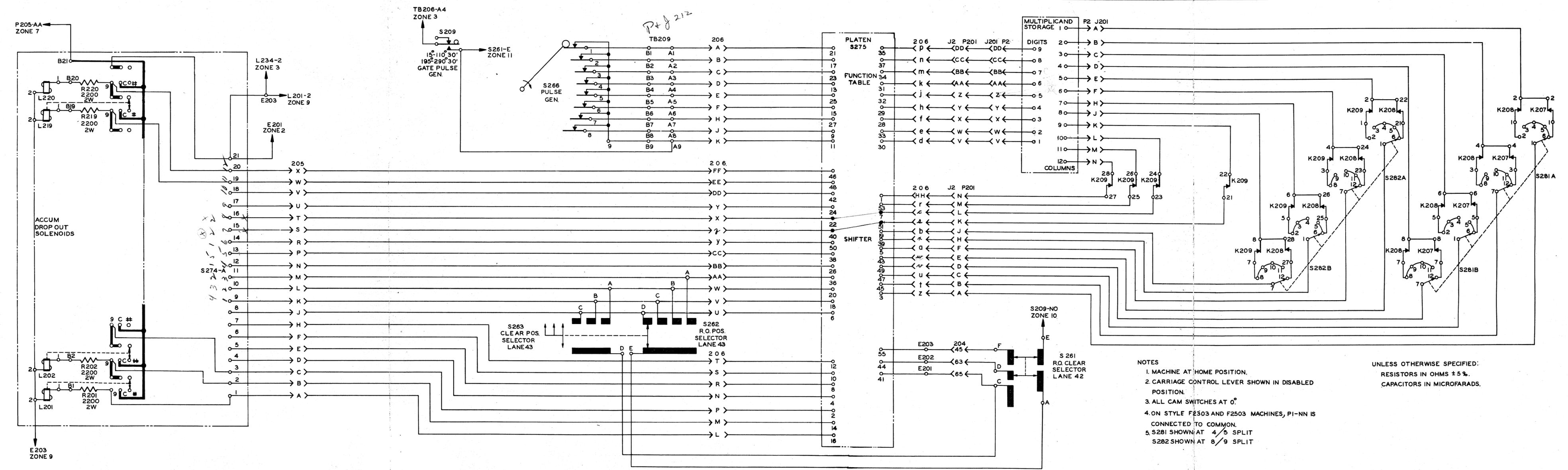
The values given above may vary slightly from machine to machine and with the accuracy of the measuring device.

Cathode side of diodes is marked by manufacturer with + or dot.

07-30 - 07-36 to be added



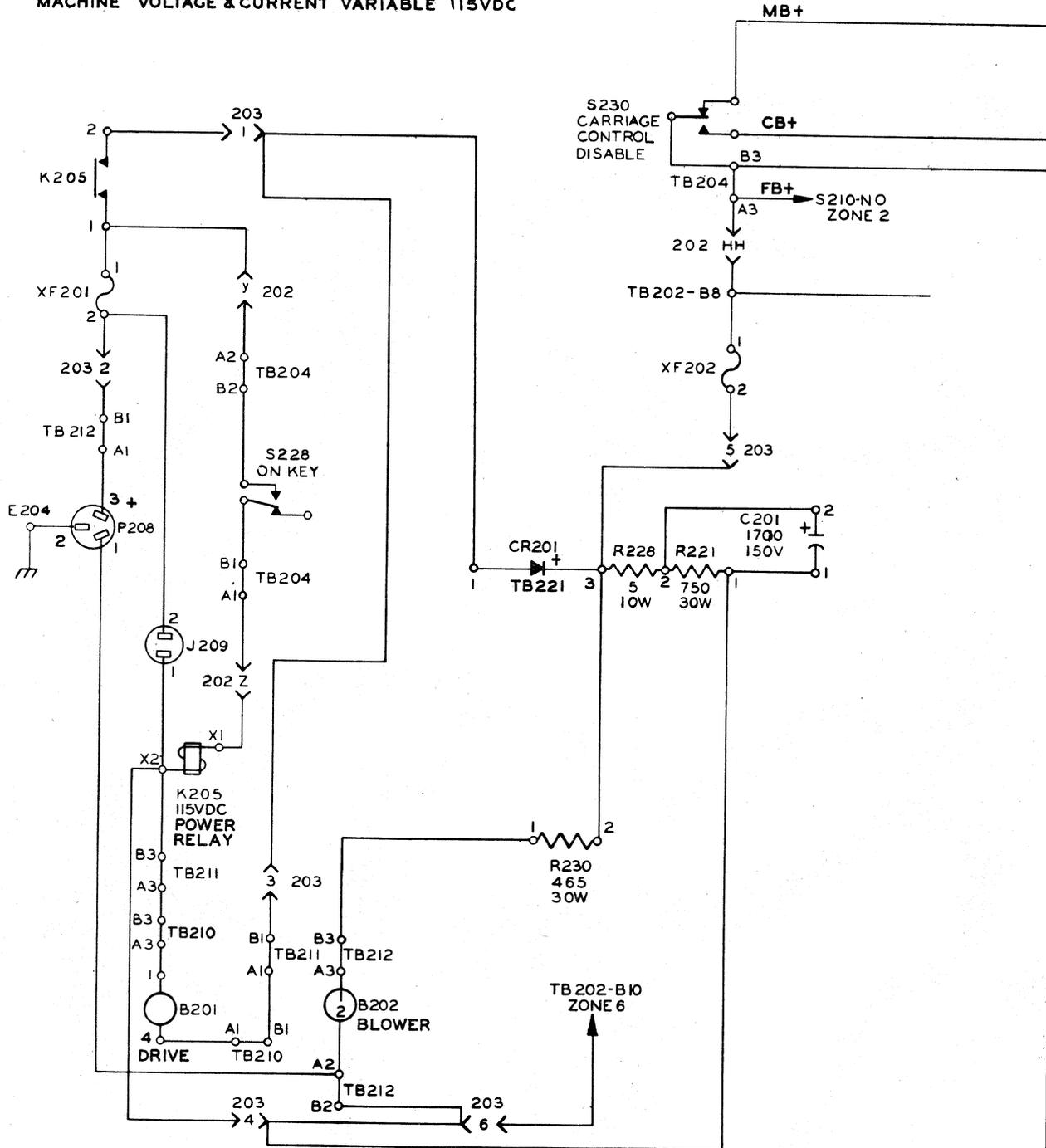
* S252 Actuated by the upper CFNC bail.
* S253 Actuated by the lower CFNC bail.



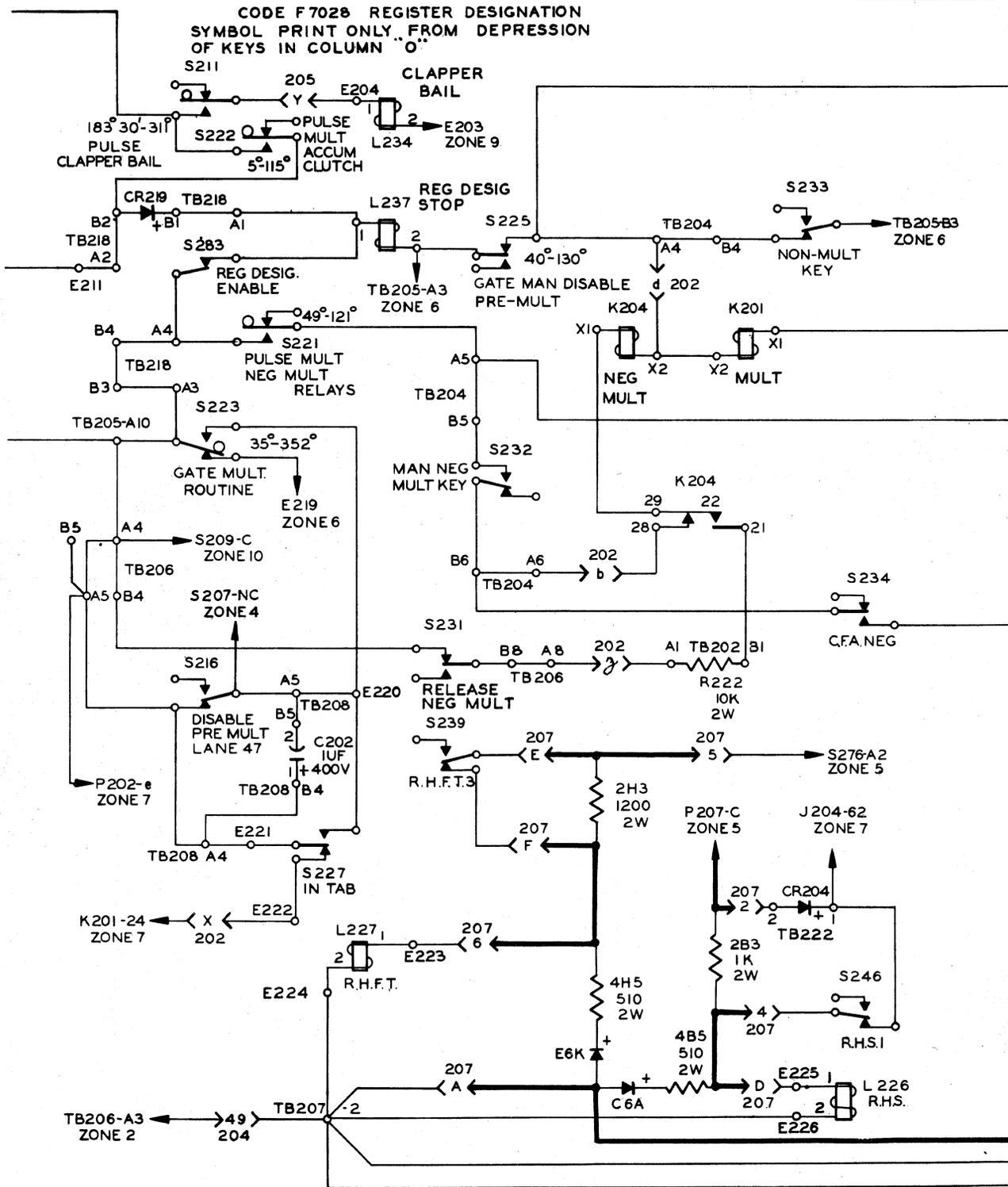
- NOTES
1. MACHINE AT HOME POSITION.
 2. CARRIAGE CONTROL LEVER SHOWN IN DISABLED POSITION.
 3. ALL CAM SWITCHES AT 0°.
 4. ON STYLE F2303 AND F2503 MACHINES, P1-NN IS CONNECTED TO COMMON.
 5. S281 SHOWN AT 4/5 SPLIT
S282 SHOWN AT 8/9 SPLIT

UNLESS OTHERWISE SPECIFIED:
 RESISTORS IN OHMS ± 5%
 CAPACITORS IN MICROFARADS.

CODE F 4007
 MACHINE VOLTAGE & CURRENT VARIABLE 115VDC



SCHEMATIC WIRING DIAGRAM I/O TAB SUPPLEMENT



Burroughs
SERIES F2000
COMPUTER

INSTRUCTION BOOK

Section VIII



CORRECTION INDEX

CORRECTION INDEX

CONDITION: Bending or breaking of the decimal shift tappet.

CAUSE: Operator manually tabbing or returning the carriage through a multiply position with a pre-multiply condition previously indexed.

CORRECTION: Install decimal shift interlock switch, S284, if the above situation is observed.

The interlock switch prevents energizing of the decimal shift solenoid (L225) unless the directional key block latch (similar to part B, Plate 12, Series F2000 Symbol Book) has dropped into the cut-out of the blocking slide (K, same plate) to prevent depression of the TAB or RET key. Wiring of the switch is shown in Figure 1.

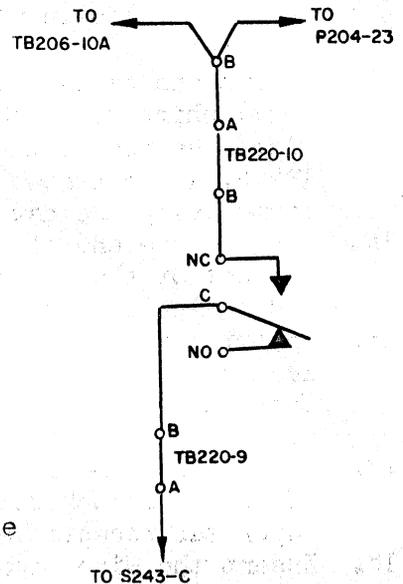


Fig.1

PROCEDURES:

1. Remove the keyboard.
2. Remove the two screws in bracket K, (Plate 9-1, Series F Symbol Book).
3. Remove the old drive arm brace and latch assembly.
4. Remove the two directional key block bracket screws. (Caution: Do not drop space washers that are under bracket.)
5. Assemble the new latch to the new drive arm brace as shown in Figure 2, using the screw from the old assembly.
6. Install the new drive arm brace in the machine.
7. Install the old latch spring on the new latch and brace.
8. Assemble the switch to the brace as shown in Figure 2.
9. Connect springs to the drive arm brace and replace screws removed in step 2.
10. Replace and adjust the directional key block assembly. Refer to Tests and Adjustments, page 3, Section IV, F2000 Instruction Book.
11. Momentarily hold the directional key blocking slide to the left to permit the latch to drop into the cutout of the slide. With the latch in this position, there should be .003" to .005" clearance between the ear of the latch and the switch actuator.

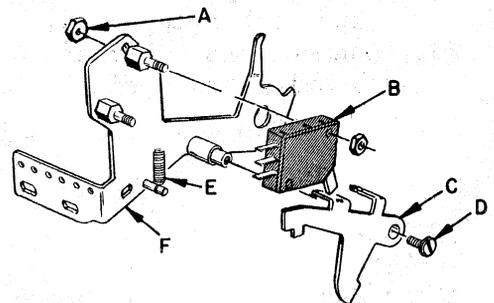


Fig.2

PROCEDURES: Cont'd

To adjust, loosen nut A, Figure 2, and move switch up or down as required.

12. Remove and discard the screws (AD, Plate ⁵⁸53, Series F2000 Symbol Book) which hold TB204 and TB205.
13. Place the new terminal board, TB220, on the outside, adjacent to TB204, and reassemble the terminal boards to the auxiliary side frame using the new longer mounting screws.
14. Connect one end of a 15-inch length of wire to the normally closed contact of the interlock switch, S284, using spaghetti sleeving and a single taper tab receptacle.
15. Insert the wire through the spaghetti sleeving around the wires leading to the directional key solenoid.
16. Connect the other end of the wire to TB220B-10 using spaghetti sleeving and a single taper tab receptacle.
17. Connect one end of a 15-inch length of wire to the common terminal of the interlock switch, using spaghetti sleeving and a single taper tab receptacle.
18. Insert the wire through the spaghetti sleeving around the wires leading to the directional key solenoid.
19. Connect the other end of the wire to TB220B-9 using spaghetti sleeving and a single taper tab receptacle.
20. Remove the taper tab receptacle from TB206B-10, cut the wires from the receptacle, and splice a 13-inch length of wire to the wire that goes to the decimal shift enable switch, S243. Tape the splice.
21. Connect the other end of the new wire to TB220A-9 using spaghetti sleeving and a single taper tab receptacle.
22. Connect a 13-inch length of wire together with the remaining wire previously cut to TB206B-10 using spaghetti sleeving and a double taper tab receptacle.
23. Connect the other end of the new wire to TB220A-10 using spaghetti sleeving and a single taper tab receptacle.

PARTS REQUIRED FOR FIELD INSTALLATION:

<u>Part No.</u>	<u>Description</u>	<u>Number Required</u>
✓ LFX83-17	Switch	1
✓ LFB238-3	Brace	1
✓ LFB748	Latch	1
✓ LAEA252-4	Terminal board	1
✓ FX45-29	Post	2
✓ FX60-203	Screw FX60-302- (C1-1013)	2
✓ X170-36	Nut	2
✓ X170-46	Nut	2
✓ X42-1	Single taper tab receptacle	6
✓ 24B No. 12	Double taper tab receptacle	1
✓ FX415-5	Spaghetti sleeving for X42-1	6
✓ 4398 7/8	Spaghetti sleeving for 24B No. 12	1

Approximately 3 hours are required to make this correction. (Machines with serial number F101479 or higher incorporate this correction.)

CORRECTION INDEX

I

On May 5+L

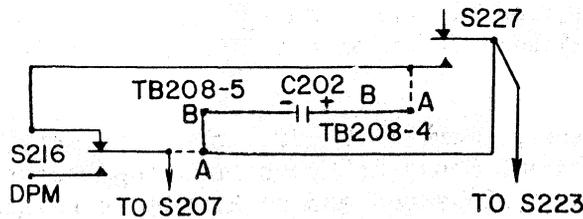
CONDITION: Failing to multiply as a result of dropping the pre-multiply relay in a carriage position where an adjacent magazine contains a DPM pin.

CAUSE: Carriage overthrow, at the completion of a tabulation or return, permits the DPM pin, located in the magazine next to the active magazine, to momentarily open S216 before S227 is closed again, allowing K201 to drop out.

CORRECTION: Install, as required, a capacitor in parallel with the normally closed contacts of S216, to delay the drop out of K201 from transfer of S216.

PROCEDURE:

1. Cut the taper tab receptacle off the single wire on S227 N.O. terminal.
2. Crimp a double taper tab receptacle, to the end of an 18" length of wire, together with the wire in Step 1 and place on tab of S227 N.O.
3. Using a solderless terminal, connect the other end of the 18" wire to TB208A-4. (Move 6 wires located at TB208A and B2, 3, 4, one place to the right, facing the rear of machine, leaving terminals 4 and 5 free for new wiring.) Keep all new wires parallel and secured to existing harness wiring.
4. Remove the wires from S216C.
5. Using a solderless terminal, connect the wires that connected S216C to S227C (step 4) together with one end of an 8" wire to TB208A-5.
6. Using a double taper tab receptacle, connect the other end of the 8" wire to S216C along with the wire that goes to S207NC.
7. Connect the + lead of the capacitor to TB208B-4 and the - lead to TB208B-5.



On May 5+L

PARTS REQUIRED FOR FIELD INSTALLATION:

<u>Part Number</u>	<u>Description</u>	<u>Number Required</u>
1AEX89-1	1 Mfd. 600 V capacitor assembly	1
24A No. 10	Solderless terminal	2
M3202-40	Wire (18" long)	1
M3202-40	Wire (8" long)	1
24B No. 12	Double taper tab receptacle	2

I (Cont'd)

This change will be incorporated in all F2000 machines with 1/10" tab.

Approximately one hour is required to install this correction.

II

CONDITION: Breaking off of the threaded portion or stripping of the threads of the core (N, Plate ~~27~~²⁸, Series F2000 Symbol Book) of the total bail solenoid or clapper bail solenoid assembly of the product accumulator while tightening the retaining nut.

CAUSE: Excessive pressure used when tightening the retaining nut.

CORRECTION: Replace the coil and core as required with a new cemented coil and core assembly. The new core is not threaded but is retained on its bracket by a speed nut. The old style core is no longer available for service replacement. The service replacement for an old core is the coil and core assembly and the speed nut. Coils without the core, however, are still available (no change in symbol) as replacements where the original cores are still usable.

Symbols of the new parts are, 2FX73-1 for the coil and core assembly and 22 No. 3 for the speed nut. Improved parts are incorporated in machines beginning with F101479P.

Installation time is approximately 2 hours.

III

CONDITION: Failing to clear product accumulator on a transfer operation.

CAUSE: Product accumulator pinions meshing too deep with teeth of adding racks, resulting in too much friction and premature limiting of adding racks.

CORRECTION: Install one or more 3220 1/2 washers between add rack brace "E" (Plate ~~20~~²³, F2000 Symbol Book) and each mounting bracket, to ensure a non-binding mesh of all pinions and add racks when screws "F" are replaced and tightened.

NOTE: After installation of washers, make the following test.

1. To ensure positive drive of product accumulator pinions by add rack extensions --

Add rack extensions should be free and centrally aligned with pinions of product accumulator.

To adjust, move guide brace "E" (Plate ~~20~~²³, F2000 Symbol Book) laterally as required.

Installation time is approximately one hour.

CORRECTION INDEX - CHANGE NOTICE

CONDITION: Wrong multiplication.

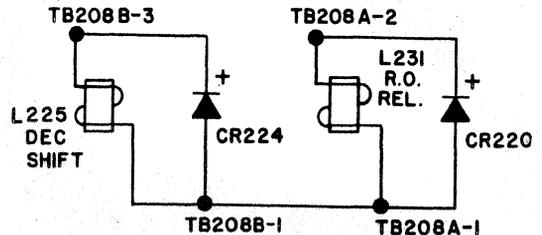
CAUSE: Induced voltage surges when L231 or L225 drop out results in the breakdown of CR204. The breakdown of CR204 causes the right hand shifter to overstep on one step shifts due to the hold circuit created by the shorted CR204 and resistor 2B3 holding L226 picked until K203 drops out.

CORRECTION: Install arc suppression diodes (1FB906) across L231 and L225.

INSTALLATION REQUIREMENTS: Install on all machines on the next service attention.

INSTALLATION TIME: Less than one (1) hour.

INCORPORATION DATE: All 1/10" tab machines incorporate this change.



PROCEDURE:

1. Move six (6) wires located at TB208A and B, 2, 3 and 4, one place to the right (facing the rear of the machine) leaving terminals 4 and 5 free for new wiring (terminal A is at top, terminal B at bottom). If Correction Index No. 1009 (installation of C202) has been applied to the machine, omit this step.
2. Connect the unmarked lead of CR220 to TB208A-1.
3. Connect the unmarked lead of CR224 to TB208B-1.
4. Connect the + marked lead of CR220 to TB208A-2.
5. Connect the + marked lead of CR224 to TB208B-3.
6. Correct the schematic wiring and logic diagrams.

PARTS REQUIRED: Two (2) 1FB906 diode assemblies.

On May 5th

CORRECTION INDEX

CONDITION: Wrong products.

CAUSE: Shorted diode in multiple factor circuit (1/10" tab machines) causing incorrect shift.

- ✓ CORRECTION: Replace diodes CR213, 214, 215, 216, 217 and CR218 (located on TB203) with FX43-13 diodes.

INSTALLATION REQUIREMENTS: The new diodes should be installed on all machines with multiple factor storage. The diodes removed may be retained in Branch and grip stock for use elsewhere in the F2000 and in other products.

INSTALLATION TIME: Approximately 1 hour is required for this correction.

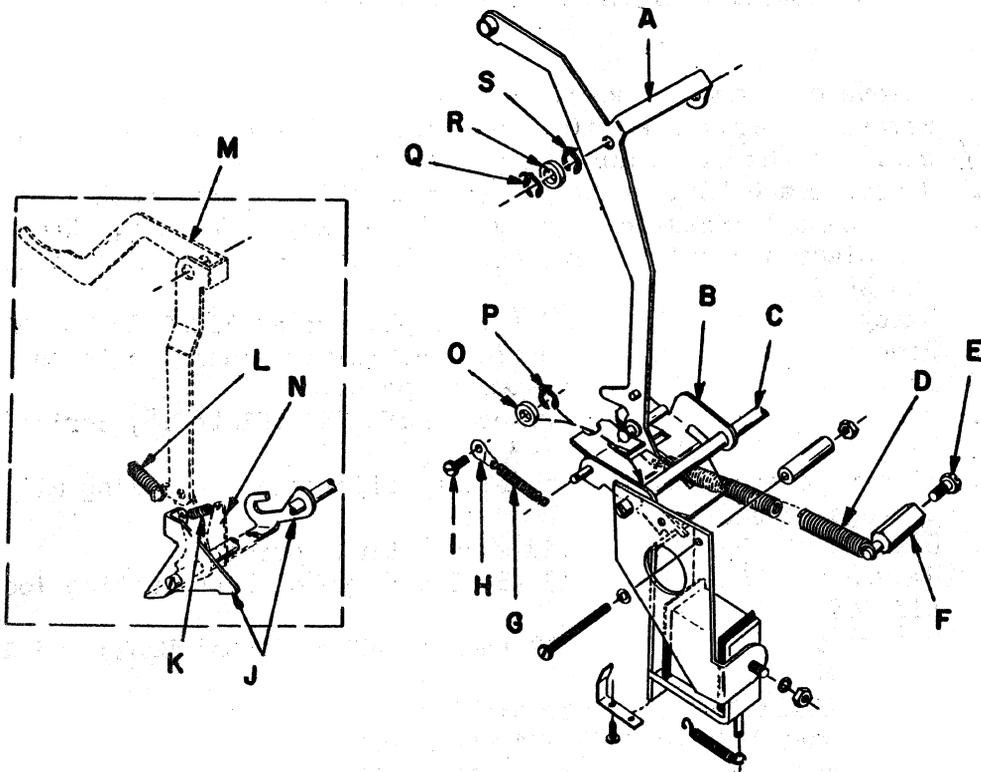
- ✓ INCORPORATION DATE: Side insertion machines incorporate this change.

PROCEDURE: In removing the old and installing the new diodes, care must be taken to prevent heat damage to the diodes. The diode leads should be left as long as possible and the leads held with a pair of pliers (between the diode and solder point) while soldering.

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit List Price</u>
✓ FX43-13	6	Diode	1.83

CORRECTION INDEX



CONDITION: Failing to release repeat of machine operation or locking of machine.

CAUSE: Bending of symbol restoring arm due to obstructions or malfunctions in symbol mechanisms.

CORRECTION: Install redesigned symbol restoring arm, which is cam driven away from the symbol slides thereby allowing them to seek their normal limits. The new arm and the symbol slides are returned to normal by spring tension.

INSTALLATION REQUIREMENTS: This correction should be installed whenever it becomes necessary to replace the symbol restoring arm (1FB153-1) or when work is being done on the machine that exposes the restoring arm.

INSTALLATION TIME: Approximately five (5) hours are required for this correction.

(Cont'd)

INCORPORATION DATE: 1/10" tab machine, serial F1071146P (Canadian F8200C) and above, will incorporate this correction.

PROCEDURE:

1. Remove case and keyboard.
2. Remove the screws holding the terminal boards (TB204, 205, 206 etc.) to the right auxiliary sideframe.
3. Remove brace "N", Plate 53, (Series F2000 Symbol Book).
4. Remove bellcranks for "On" key, "Off" key, "Neg. X", "Non X", "Δ" clear and drive trip interlock, noting location of clips and springs.
5. Remove S287 and plate "E" (Plate 53, Series F2000 Symbol Book).
6. Remove screws holding the right auxiliary sideframe to the base, the back plate and support posts.
7. Noting location of "N", remove shaft "K" (Plate 18, Series F2000 Symbol Book).
8. Slowly remove the right auxiliary sideframe, unhooking all springs carefully.
9. Disconnect the symbol slides actuating springs.
10. Remove arm "AA", Plate 13 (Series F Symbol Book) noting location of collar "Z".
11. Remove shaft "K", Plate 17 (Series F2000 Symbol Book) and discard space collar "U".
12. Remove shaft "C" (illustration).
13. Remove and discard "J", "K", "L", "M", and "N". (illustration).
14. Remove nuts "AF" and space collar "AG", Plate 55, Series F2000 Symbol Book.
15. Remove arm "D", Plate 35, Series F2000 Symbol Book.
16. Remove arm "A" and outer cam on right end of main camshaft, marking outside of cam as identification for replacement.
17. Remove print control actuating cam from camshaft, marking outside of cam.
18. Remove symbol restoring arm actuating cam and discard.
19. Remove slides "R" and "M", Plate 51, Series F2000 Symbol Book. Disconnect slide "L" at front only. Note location of clips and collar.
20. Remove arm "AF", Plate 13, Series F Symbol Book.
21. Remove arm "Z", Plate 47, Series F Symbol Book.
22. Remove the symbol restoring arm by spreading the symbol slides enough to work the arm up between the slides.
23. Install new symbol restoring arm "A" (illustration).
24. Replace the parts removed or disconnected in step 19, 20 and 21.
25. Replace shaft removed in step 11.
26. Install new symbol restoring arm actuating cam, roller toward inside.
27. Replace print control actuating cam, marked side outward.
28. Replace cam and arm removed in step 16.
29. Replace nuts and spacer removed in step 14.

(Cont'd)

PROCEDURE (Cont'd)

30. Install new symbol slide block bail "B" and space collar "O" (illustration).
31. Rehook symbol slide springs.
32. Replace arm "T", Plate 17, Series F2000 Symbol Book, and new space collar (R of illustration), which replaces collar "U", Plate 17.
33. Replace arm removed in step 15.
34. Replace parts removed in step 10.
35. Install spring anchor post "F" (illustration) in position 153, Plate 55, Series F Symbol Book.
36. Install spring "D" (illustration) from symbol restoring arm to new spring anchor post.
37. Replace auxiliary sideframe, rehooking all springs, and replacing parts removed in steps 2, 3 and 4.
38. Replace plate "E", Plate 53, Series F2000 Symbol Book, installing screw "I" (illustration) and spring anchor "H" in place of the rear mounting screw.
39. Install spring "G" (illustration).
40. Turn the machine over slowly by hand to ensure proper operation.
41. Recheck adjustments for the symbol stop solenoid (page 9, Sec. IV, Series F2000 Instruction Book) and transfer mechanisms (pages 38 and 39, Sec. IV).

PARTS REQUIRED: Reference illustration.

<u>Reference</u>	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
A	1FB153-2	1	Symbol restoring arm
B	1FB698-1	1	Latch
(not shown)	*1FD185- 22 23	1	Cam
F	FX52-31	1	Post
D	FX80-172	1	Spring
O	74335	1	Spacer
I	X232-852	1	Screw
E	X233-178	1	Screw
H	20 No. 116	1	Spring anchor
R	FX10-420	1	Spacer
P	21 No. 8	1	Clip
G	72830	1	Spring
	*FX10-589	1	Spacer for cam

CORRECTION INDEX

I

CONDITION: Wrong multiplication - under ones or over nines.

CAUSE: A loose or improperly adjusted bracket ⁰I, Plate ³⁴31, Series F2000 Symbol Book, allowing clapper reset arms ^WN, Plate ^X31 Series F2000 Symbol Book to interfere with the rearward portion of hatchets ^WX, Plate ³⁰30, Series F2000 Symbol Book, which results in improper positioning of carry wiper ^BD, Plate ³³33, Series F2000 Symbol Book. This may result in the loss of a carry pulse (or under one) or loss of the pulse for a relay carry (under one or over nine).

CORRECTION: Remove screw ^PJ (Plate ³⁴31, Series F2000 Symbol Book) and install one FX60-320 shoulder screw. This will position the bracket in an upward position, preventing any interference between the parts. Removal of the components unit is necessary in order to make this change.

INSTALLATION REQUIREMENTS: Install new screw when this condition occurs or anytime it is necessary to remove the components unit for other causes.

INSTALLATION TIME: Approximately one (1) hour is required for this correction.

INCORPORATION DATE: Machines above serial number F110369P will contain this new screw.

PARTS REQUIRED: One (1) shoulder screw FX60-320.

II

CONDITION: Printing less than correct amount.

CAUSE: Studs on add rack latches entering the lock plates prematurely due to weak springs ^LF, (Plate ¹⁹19, Series F2000 Symbol Book) aggravated by necessary tight adjustment of motor clutch for F2000 machines.

CORRECTION: Install stronger springs (FX80-54) on add rack latches, replacing spring ^LF, Plate ¹⁹19.

INSTALLATION REQUIREMENTS: Install the stronger springs when this condition is encountered. It should be determined before installing these stronger springs that the add racks are free, that the register pinions and crossfooter pinions are free, that the carry mechanism is free and that the motor clutch is properly adjusted. Branch and grip stock of weaker latch spring, 406801 #1, should be retained for use in the Basic F machines.

II - Cont'd

INSTALLATION TIME: Approximately two hours are required for this correction.

INCORPORATION DATE: This change was incorporated beginning approximately with machine number F103042P.

PARTS REQUIRED:	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
	FX80-54	12	Spring

CORRECTION INDEX

I

CONDITION: Wrong multiplication and/or odd noises from the Product Accumulator.

CAUSE: Loss of back up or driving force to the Product Accumulator due to shearing of pin A, Plate 50, Series F2000 Symbol Book dated 12-1-60, and/or wear of the bronze bushing in bracket C.

CORRECTION: Replace coupler T and bracket C (if it is worn or contains a bronze bushing). The new parts can be identified as follows: coupler T has a larger hardened pin A and bracket C now has a steel bushing.

INSTALLATION REQUIREMENTS: This correction should be installed when the above condition occurs.

INSTALLATION TIME: Approximately one (1) hour is required for this correction.

INCORPORATION DATE: The improved coupler was incorporated in machines beginning with serial number F110369P. The steel bushing in bracket C was incorporated in machines with approximate serial number F100000P.

PROCEDURE:

1. Remove the drive unit.
2. Replace coupler T and, if necessary, bracket C, Plate 50, Series F2000 Symbol Book dated 12-1-60.

NOTE: See Section IV, Page 22, Series F2000 Instruction Book dated 8-1-60 for Basic adjustments for proper assembly of the drive unit.

3. Replace the drive unit and multiplier package.

PARTS REQUIRED:	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
	1FMD35	1	Coupler
	1FMD36	1	Bracket

II

CONDITION: Wrong multiplication.

CAUSE: Failure of the component unit interlock switches due to breakage of the stud in bracket B, Plate 47, Series F2000 Symbol Book, dated 12-1-60.

II (Cont'd).

CORRECTION: To prevent breakage of the stud, adjust the bracket B for .030" to .060" clearance of the interlock latch G, with the clutch disengaged in the home position. Check this adjustment when replacing the bracket or on the next Preventive Maintenance Attention.

NOTE: Adjustment number two of Correction Index 1010, Series F2000 Symbol Book should be changed to agree with above.

INSTALLATION TIME: Less than one hour is required to make this correction.

PROCEDURE: To adjust, loosen the bracket mounting screws C, and reposition bracket B as required.

CORRECTION INDEX

Om Niay STL

CONDITION: Machine locking (5/8" tab machines only).

CAUSE: Operating off pins due to failure of drive trip interlocks.

CORRECTION: Make the wiring changes as listed below to utilize the in-tab switch (S227) for interlock purposes.

INSTALLATION REQUIREMENTS: This correction should be made on those machines in which this problem is encountered with the mechanical interlocks adjusted properly. This change does not replace the mechanical interlocks.

NOTE: This change effects the function of lane 46 (DNCL changed to CFNC). The machine block solenoid will be picked on every machine operation by the in-tab switch (S227) therefore, a pin in lane 46 in any stop position will complete the hold circuit if the C.F. is not clear.

INSTALLATION TIME: Approximately two (2) hours are required for this correction.

PROCEDURE: Before installation of this correction, all mechanical interlocks should be rechecked and adjusted if necessary. In-tab switch (S227) must transfer quickly for this electrical interlock to be effective. Adjust the lip of the actuator for S227 for slight contact with the nylon switch actuator.

1. Mount the 1X41-1 terminal block on the sensing unit back plate (AB, Plate 5, F2000 Symbol Book 12-1-60), using one X228-433 screw and 409314 nut, in the hole located 5 1/2" from the left sideframe and 1/4" from the top of the sensing unit.
2. Mount two AEX43-3 diodes as shown in Fig. 1, using three spade lugs.
3. Remove the two (2) wires from S227-C. Remove the taper tab in order that they can be pulled back out of the harness far enough so that they can be connected to TB250-3 with a spade lug.
4. Using a taper tab, connect a one foot length of wire to S227-C. Run the wire through the harness and connect with a spade lug to TB250-2.
5. Using a spade lug, connect a six (6) foot length of wire to TB250-1. Run this wire through the harness and solder it to TB202-A3.

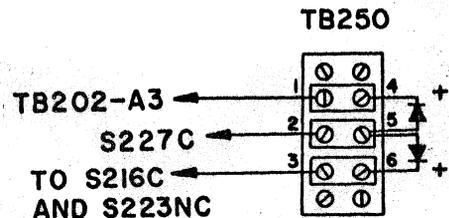


Fig. 1

PROCEDURE (Cont'd).

6. Move the taper tab receptacle from S215-NC and connect to S215-NO (lane 46). S215 now becomes CFNC and must be transferred to test the C.F.

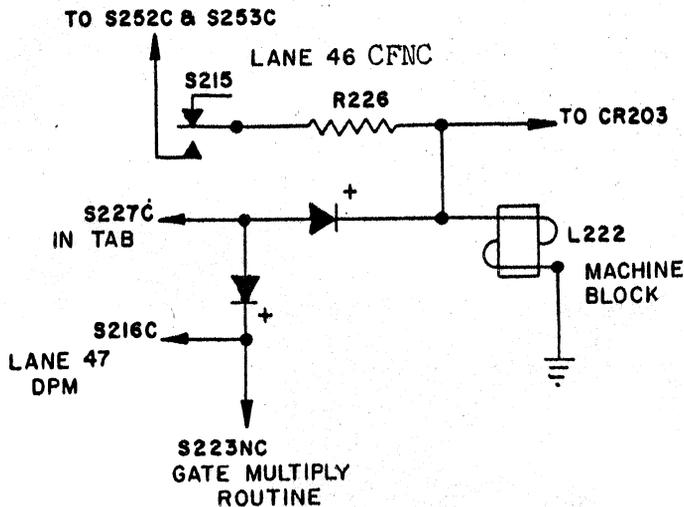


Fig. 2

7. Remove all lane 46 pins from the panel(s) and insert pins in lane 46 in positions where a non-clear lock is desired.
8. Note these changes on the machine wiring schematic. Fig. 2 shows the logic schematic for this correction.

PARTS REQUIRED:

<u>Quantity</u>	<u>Symbol</u>	<u>Description</u>
2	AEX43-3	Diodes
1	X42-1	Taper tab receptacle
1	1X41-1	Terminal block
1	X228-433	Screw
1	409314	Nut
6	24B #8	Spade lugs
7 ft.	M3202-40	Wire

*Ordered
2-12-63
on May 5th*

CORRECTION INDEX - CHANGE NOTICE

CONDITION: Wrong multiplication or failure to complete multiplication.

CAUSE: Burning of interlock switches and/or contacts 6 and 7 of S279 (R.H. Auxiliary Control).

CORRECTION: Install arc suppression diode (AEX43-3) across L230 (Multiplier Drive Clutch).

INSTALLATION REQUIREMENTS: This correction MUST be installed on all machines.

INSTALLATION TIME: Less than one (1) hour is required for this improvement.

INCORPORATION DATE: Machines with a serial number F113716P or above will incorporate this improvement.

PROCEDURE: Solder the diode across the terminals of TB219. (If C.I. 1013 has not been installed it is necessary that it be done prior to installing this correction.) Care should be taken to ensure that the cathode (marked +) of the diode is connected to the B+ side of L230 (determined with a meter) when installing the diode or at any time that it has been necessary to disconnect the wiring at TB219. Correct wiring and logic schematics. The new diode is CR228.

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
AEX43-3	1	Diode

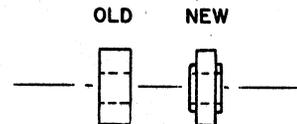
CORRECTION INDEX

CONDITION: Wrong multiplication due to loss of back-up of the cluster assemblies in the Product Accumulator.

CAUSE: Roller "C", Plate ⁵¹46, Series F2000 Symbol Book, binding against part "D", Plate ⁵¹46, causing a bind in the multiplier drive.

CORRECTION: Install a redesigned roller (no change in symbol) which may be identified as shown in the illustration.

INSTALLATION REQUIREMENTS: The redesigned roller should be installed at the next service attention. Branch and grip stock of the old style rollers should be discarded upon receipt of the redesigned rollers.



INSTALLATION TIME: Less than one (1) hour is required for this correction.

INCORPORATION DATE: Machines above serial number F108141P will incorporate this correction.

PROCEDURE:

1. Loosen the two (2) top screws connecting sideframe ^TR, Plate ⁵¹46, Series F2000 Symbol Book and sideframe ⁵¹G, Plate ⁵¹45, Series F2000 Symbol Book to allow the sideframes to be spread slightly.
2. Remove clip "B" and roller "C", Plate ^{AE}46, Series F2000 Symbol Book.
3. Install redesigned FX10-300 roller and reassemble.

PARTS REQUIRED: One (1) roller, FX10-300 (redesigned).

CORRECTION INDEX

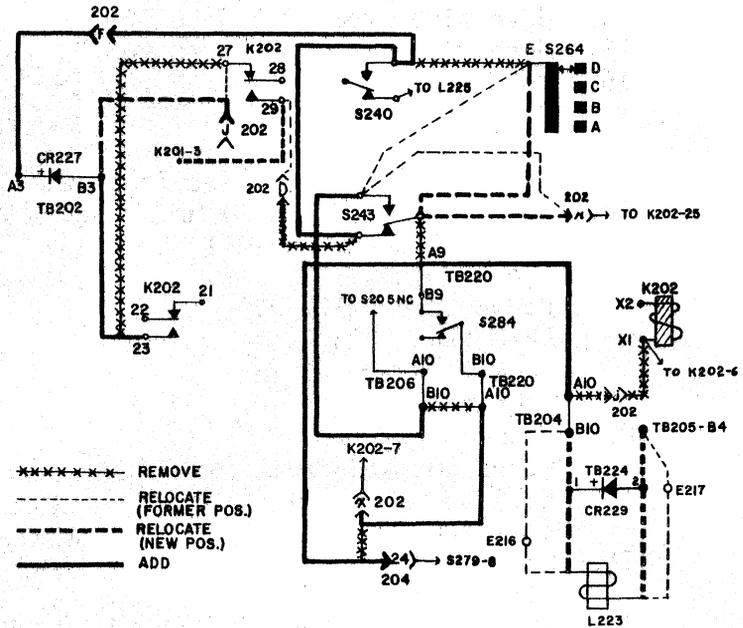
CONDITION: Wrong multiplication - 1/10" tab only.

- CAUSE: 1. Failure to energize "Round-Off" (L231) due to magnetic field of L225.
 2. Wrong shift due to bent or broken tappet or panel pin in lane 44.

CORRECTION: Make wiring changes as listed below. These changes (1) eliminate the hold circuit for L225, thereby preventing failure to pick L231 (Round-Off) and (2) delay the pick of K202 (START Relay) until the directional key blocking mechanism has been actuated.

INSTALLATION REQUIREMENTS: These changes should be made when either of these conditions are encountered.

INSTALLATION TIME: Approximately five (5) hours are required for this correction.



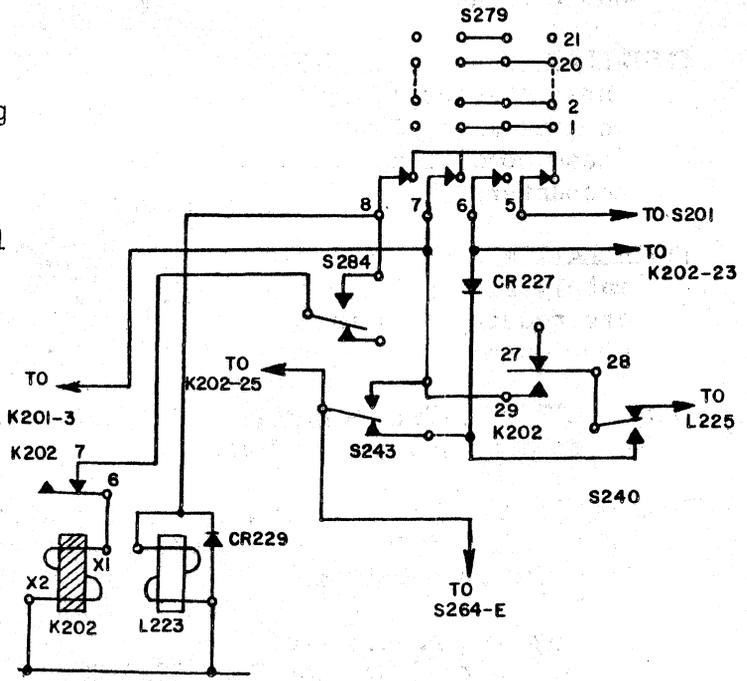
INCORPORATION DATE: Machines with serial number F113716P and above incorporate this correction. In Canada, Number F8777C and above.

PROCEDURE: In the following procedure, wire lengths given are approximate. New wiring added should be incorporated into existing harnesses as often as possible.

1. Remove and discard:
 - a. wire from S264-E to S240-NC.
 - b. wire from S243-C to TB220-A9.
 - c. wire from TB206-B10 to TB220-A10.
2. Remove two (2) wires from S243-NC and connect to S243-C.
3. Install two new wires (6 ft. and 5½ ft.) to S240-NC. Connect 6 ft. wire to P202-F (Point P202-F not shown on wiring schematic).
4. Remove and discard wire from S243-NO to P202-D. Remove wire from J202-D and connect to K201-3.
5. Remove the remaining wire on TB206-B10, and using a double taper tab, connect it and a 2½ ft. wire to TB206-B10. Connect the other end of the 2½ ft. wire to S243-NC.

6. Connect 5½ ft. wire (see step 3) to S243-NO.
7. Install new wire (6 in.) from J202-F to TB202-A3. (These points not shown on schematic.)
8. Install CR227 (AEX43-3) across TB202-A3 to B3 (cathode, marked +, to TB202-A3).
9. Remove the two (2) wires from K202-27.
10. Remove the wire from K202-23 (to K202-27) and discard.
11. Connect the remaining wire (removed from K202-27, Step 9) to TB202-B3,
12. Install new wire (1 ft.) from TB202-B3 to K202-23.
13. Remove wire from P204-24 to P202-x and discard.
14. Move wire from P202-j to P202-x.
15. Move wire from TB204-A10 to TB220-A10.
16. Using a double taper tab connect two (2) wires to TB220-A9. Connect one wire (3 in.) to TB204-A10 and one wire (3½ ft.) to P204-24.
17. Remove and discard wire from K202-X1 to J202-j.
18. Mount TB224 (FX41-11) under screw I (plate 58, Series F2000 Symbol Book dated 12-1-60.
19. Remove Bombtail connectors E217 and E216 (see L223, zone 7, F2000 Wiring Schematic).

20. Connect the two wires removed from E217 to one terminal of TB224.
21. Connect the two wires removed from E216 to the other terminal of TB224.
22. Connect CR229 (AEX 43-1), across TB224 with the cathode (marked +) on the terminal with the two wires removed from E216 (B+ side of L223).



23. Make notations on the machine wiring schematic that these changes have been made.

PARTS REQUIRED:

Symbol	Quantity	Description
AEX43-3	1	Isolation diode (CR227)
AEX43-1	1	Arc suppression diode (CR229)
24B No. 12	3	Double taper tabs
X42-1	2	Single taper tabs
FX41-11	1	Terminal board (TB224)
M3202-40	23 ft.	Wire

CORRECTION INDEX

CONDITION: Unusual noise or locking on product transfers.

CAUSE: Wear of cadmium plated nuts "H" (Plate 22, Series F2000 Symbol Book, dated 12-1-60) or unhardened add rack extensions "A" (Plate 23, Series F2000 Symbol Book, dated 12-1-60) results in the stud on the add rack latch failing to enter the lock plate centrally on a product transfer.

CORRECTION: Install new hardened concentric nut FX57-88 (no change in symbol) or eccentric FX57-44 (early construction, no change in symbol) and new hardened add rack extensions FMT110-1 (no change in symbol). Hardened FMT110-1 extensions ordered prior to 11-1-60 can be identified by the red marking on their upper edge. Parts ordered after 11-1-60 are of improved type regardless of marking. The new hardened nuts can be identified due to their unplated finish.

INSTALLATION REQUIREMENTS: Machines which have worn nuts require new hardened nuts and hardened extensions.

Machines which have worn extensions require the new hardened extensions. These machines will have black or copper plated nuts which may be used with the new extensions.

When installing add racks, the unplated nuts and hardened extensions should be used. Use of only one hardened part accelerates wear of the other.

Branch and grip stock of all extensions without the red marking which were stocked prior to 11-1-60 should be discarded upon receipt of the new parts. Branch and grip stock of all FX57-44 and FX57-88 plated nuts should be discarded upon receipt of the new unplated nuts.

INSTALLATION TIME: Approximately three hours are required to replace these nuts and extensions in one machine.

INCORPORATION DATE: Machines above serial number F105000P contain hardened concentric nuts and extensions.

PROCEDURE: Reference Plate 23, Series F2000 Symbol Book. (Dated 12-1-60)

1. Remove the four mounting screws from auxiliary sensing unit.
2. Remove bail L.
3. Remove the four screws F from guide combs E noting location of any space washers under the combs.
4. Remove extensions A and guide combs E as a unit by tilting the rear ends of the extensions up and front ends down to disconnect from the add racks.
5. After replacing the extensions, reassemble in reverse order.
6. Remove the "D" section to replace the FX57-44 or FX57-88 nuts.

PARTS REQUIRED: Reference Series F2000 Symbol Book. (Dated 12-1-60)

<u>Reference</u>	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
A (Plate 23)	FMT110-1	12	Add rack extension
H (Plate 22)	FX57-44 or	12	Eccentric nut
	FX57-88	12	Concentric nut

On May 54

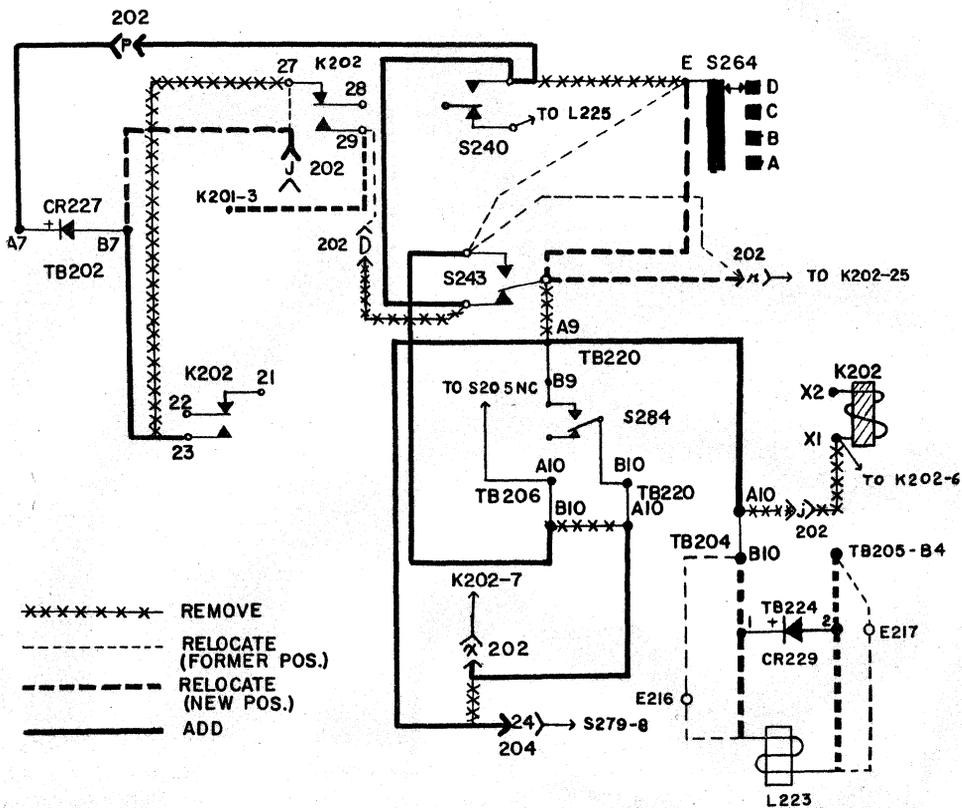
On Nag St

CORRECTION INDEX

CONDITION: Wrong multiplication or failure to multiply (5/8" tab machines).

CAUSE: Failure of lane switches due to various causes.

CORRECTION: Install 1/10 auxiliary sensing unit 3FMS1-1 (replacing 3FMS1) which has new style lane switches. The listed wiring changes MUST be made to ensure accurate operation.



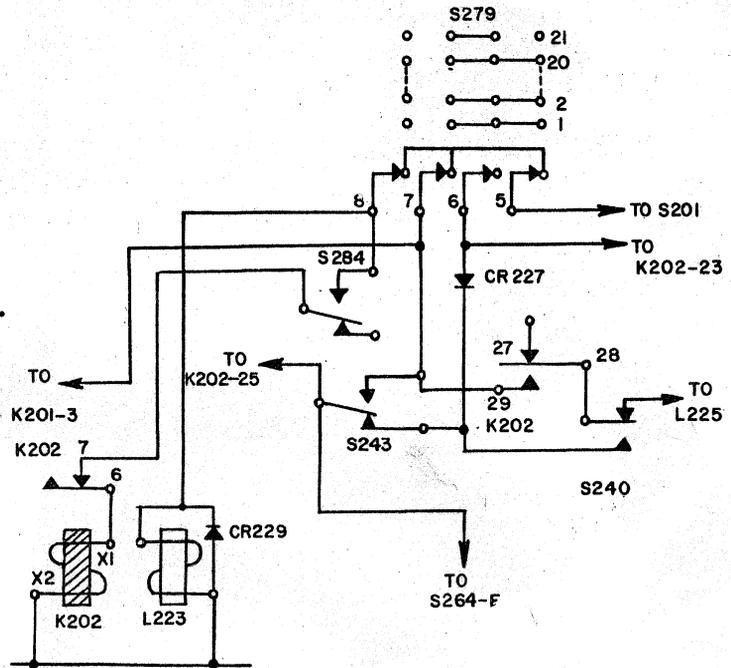
INSTALLATION REQUIREMENTS: This correction should be made when excessive failures of the lane switches are encountered. This correction requires installation of CI1008. (Note step 8 of procedure.) Installation of CI1024 is recommended for improved operation.

INSTALLATION TIME: Approximately six (6) hours are required for this correction if CI1008 and CI1024 have already been installed.

3 hrs *2 hrs*

PROCEDURE: References are made to the F2000 Symbol Book dated 12-1-60.

1. LABEL and remove wires on TB208 and wires connected to the lane switches.
2. Remove the Auxiliary Sensing Unit (3FMS1) by:
 - a. Removing three mounting screws I (Plate 7) and screw C (Plate 7).
 - b. Disconnect sensing levers.
3. Remove cross brace O (Plate 10) by removing four mounting screws N (Plate 10) and disconnecting link D (Plate 14).
4. Install new cross brace. Parts E, F, G and H (Plate 14) should be transferred to the new cross brace prior to installation.
5. Install the 3FMS1-1 auxiliary sensing unit. Secure it to the new cross brace by using spacer M (Plate 10) and two screws J and lockwashers L (Plate 10).
6. Reconnect wires removed in step one. As the lane switches are now transferred at normal, reverse the N.O. and N.C. leads of each switch. For example, the N.O. wire from S217 (lane 48) is now connected to the N.C. terminal. The leads of each common are not changed.
7. Replace all electrical pins in lanes 46 thru 51 with new steel pins (FC56-85). It will be necessary to grind off some stock at the side of FC56-85 pins for use in lane 51. Use the FC56-34 pin as a template.
8. (a) For machines below F101479 which do not incorporate CI1008 (S284).
 1. Install CI1008, but omit steps 14 to 23.
 2. Install 15 in. wire from S284-NC to TB220-B9.
 3. Install 15 in. wire from S284C to TB220-B10.
 4. Remove and discard wire from S243-C to TB206-B10.
 (b) For machines above F101479 or those in which CI1008 (S284) has been installed previously.
 1. Remove and discard wire from S243-C to TB220-A9.
 2. Remove and discard wire from TB206-B10 to TB220-A10.
9. Remove and discard wire from S264-E to S240-NO.
10. Remove two wires from S243-NC and connect to S243-C.



PROCEDURE: Continued

11. Install two new wires (6 ft. and 1 1/2 ft.) to S240-NO. Connect the 6 ft. wire to P202-P.
12. Remove and discard wire from S243-NO to P202-D. Remove wire from J202-D and connect to K201-3.
13. Using a taper tab connect a 2 1/2 ft. wire to S243-NC.
14. Remove the remaining wire on TB206-B10 and using a double taper tab connect it and the 2 1/2 ft. wire (Step 13) to TB206-B10.
15. Connect the 1 1/2 ft. wire (Step 11) to S243-NO by using a single taper tab.
16. Install 6 in. wire from J202-P to TB202-A7.
17. Install CR227 (AEX43-3) across TB202-A7 to TB202-B7. (Cathode, marked +, at TB202-A7 side.)
18. Remove the two wires from K202-27.
19. Remove the wire from K202-23 (to K202-27) and discard.
20. Connect the remaining wire removed from K202-27 (Step 18) to TB202-B7.
21. Install a 1 ft. wire from TB202-B7 to K202-23.
22. Remove the wire from P204-24 to P202-x and discard.
23. Move wire from P202-j to P202-x.
24. Move wire from TB204-A10 to TB220-A10.
25. Using a double taper tab connect two wires (3 in and 3 1/2 ft.) to TB220-A9. Connect the 3 in. wire to TB204-A10. Connect the 3 1/2 ft. wire to P204-24.
26. Remove and discard wire from K202-X1 to J202-j.
27. Mount TB224 (FX41-11) under screw I (Plate 58 Series F2000 Symbol Book dated 12-1-60) on the outside of the right auxiliary sideframe.
28. Remove Bombtail connectors E216 and E217 (see L223, zone 7 F2000 Wiring Schematic for 1/10" tab machines).
29. Connect the two wires removed from E216 to one terminal of TB224.
30. Connect the two wires removed from E217 to the other terminal of TB224.
31. Connect CR229 (AEX43-1) across the terminals of TB224 with the cathode (marked +) on the terminal with the two wires removed from E216 (B+ side of L223).
32. Make notation on machine wiring schematic that these changes have been made.

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
3FMS1-1	1	Aux. sensing unit
AEX43-1	1	Diode (CR229)
AEX43-3	1	Diode (CR227)
FC56-85	15 (approx.)	Steel pins (electrical lanes)
FMB36	1	Spacer
FMB21	1	Crossbrace
X228-447	2	Screw
X275-120	2	Lockwasher
24B No. 12	-	Taper tab - double
X42-1	-	Taper tab - single
FX41-11	1	TB224
M3202-40	23 ft.	Wire

CORRECTION INDEX

CONDITION: Wrong multiplication.

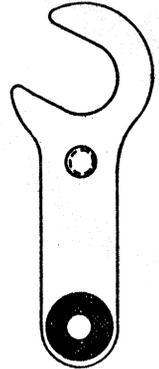
CAUSE: Breakage of a carry latch (G Plate 33, Series F2000 Symbol Book, dated 12-1-60) due to contact with the transfer shaft (N Plate 32, Series F2000 Symbol Book, dated 12-1-60).

CORRECTION: Install 1FMA103 (illustrated) brace to stabilize the 1FMA58 transfer shaft.

INSTALLATION REQUIREMENTS: This brace MUST be installed at the next service attention on all machines.

INSTALLATION TIME: Approximately one (1) hour is required for this correction.

INCORPORATION DATE: Machines above serial #F116658P incorporate this correction.



PROCEDURE:

1. Remove components unit.
2. Remove and discard parts K and J (Plate 34, Series F2000 Symbol Book dated 12-1-60).
3. Remove screw P. (Note screw P is changed on C.I. 1022 Item I).
4. Install the new brace on the left side of part O (Plate 34) facing machine from the rear with the U shaped portion around transfer shaft N (Plate 32).
5. Replace screw P (Plate 34)
6. Install new clip replacing J (Plate 34).

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
1FMA103	1	New brace
X133-105	1	Clip

*VOID
all 2000's
new numbers*

*Ordered
5-26-61*

*Recd 6-12-61
On King St
6-13-61*

CORRECTION INDEX

CONDITION: Wrong multiplication or failure to multiply.

CAUSE: Failure of component unit interlock switches (1FX83-45).

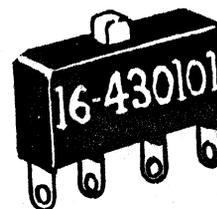
CORRECTION: Install new 1FX83-73 switches, which can be identified by the number 16-430101 stamped on the case of the switch.

INSTALLATION REQUIREMENTS: Install improved parts when this condition occurs. Branch and grip stock of 1FX83-45 switches can be retained for use on other products.

INSTALLATION TIME: Less than three hours are required to install this correction in one components unit.

INCORPORATION DATE: All machines with the side inserted program unit incorporate this correction.

PROCEDURE: After installing the new switches, make the following adjustment to ensure closing the switches without bottoming them. With the switch plungers transferred by their actuator bail and the plungers manually bottomed, there should be .005" to .010" clearance between the switch actuator bail and the switch plungers. To adjust, bend the switch actuator as required.



PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit List Price</u>
1FX83-73	12	Licon switch	N.A.

*Ordered
2-25-63
Reed*

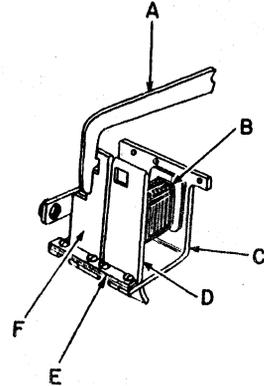
CORRECTION INDEX

CONDITION: Wrong multiplication - 1/10" tab machines.

CAUSE: Wrong shift due to premature release or failure to reset the tappet in lane 44, caused by residual magnetism of the clapper.

CORRECTION: Install improved clappers for L225 and L231 (no change in symbol) which may be identified by the larger non-magnetic button on the clappers.

INSTALLATION REQUIREMENTS: Install improved parts when this condition occurs. Branch and grip stock of old style clappers (with the small round non-magnetic button) should be discarded upon receipt of the improved clappers. The solenoid bracket should be checked to ensure that the clappers in actuated position are parallel with the face of the solenoid core and replaced if this condition is not met.



INSTALLATION TIME: Approximately one (1) hour is required for this correction.

INCORPORATION DATE: Machine beginning with serial number F118492P incorporate this correction.

PROCEDURE: After installing the improved parts the following adjustments should be made. These adjustments apply to both solenoids.

1. To ensure sufficient hold of arm A at normal and to permit re-latching --
With arm A released, there should be .040" to .060" air gap between the solenoid core and the non-magnetic pad of clapper F. To adjust: Position limit blanks E as required.
2. To ensure a positive release of arm A --
With clapper F held against its core, there should be .005" to .015" releasing clearance between the clapper and arm A. To adjust: Position bracket C.

PARTS REQUIRED: See illustration.

<u>Reference</u>	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
D	1FMS7-3	1	Clapper - lanes 42-43
F	1FMS7-4	1	Clapper - lane 44
C	1FMS11-1	1	Bracket, includes solenoids

CORRECTION INDEX

CONDITION: The wiring schematic furnished with a limited number of machines does not show the correct contact points for relay K202.

A limited number of service parts orders for the 1FX47-35 (relay K202) were filled with a substitute relay.

CAUSE: These machines and parts orders were supplied with an Automatic Electric relay in place of the Clare relay normally furnished for K202. The Automatic Electric relay has a different contact arrangement (see Fig. 1) which requires wiring changes not shown on the wiring schematic.

The relays can be identified by the manufacturers name stamped on the coil.

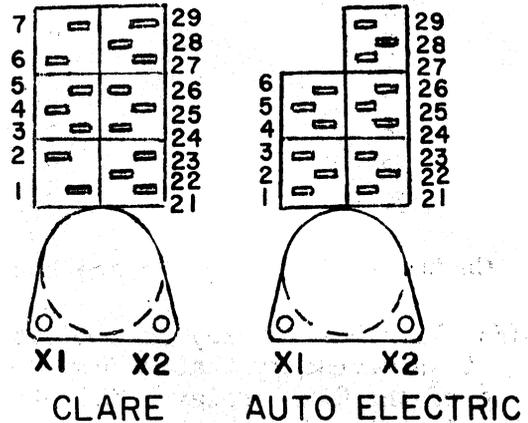


Fig. 1

CORRECTION: Correct the machine wiring schematic as shown in Fig. 2.

INSTALLATION REQUIREMENTS: On the next service attention to any machine between serial numbers F111000P and F116434P, which contain a relay in position K202 manufactured by Automatic Electric, correct the machine wiring schematic.

Any 1FX47-35 relays in stock of the Automatic Electric type should be discarded.

INSTALLATION TIME: Less than one (1) hour is required to correct the wiring schematic.

PROCEDURE: To replace the Automatic Electric Relay with a Clare relay, use the following chart.

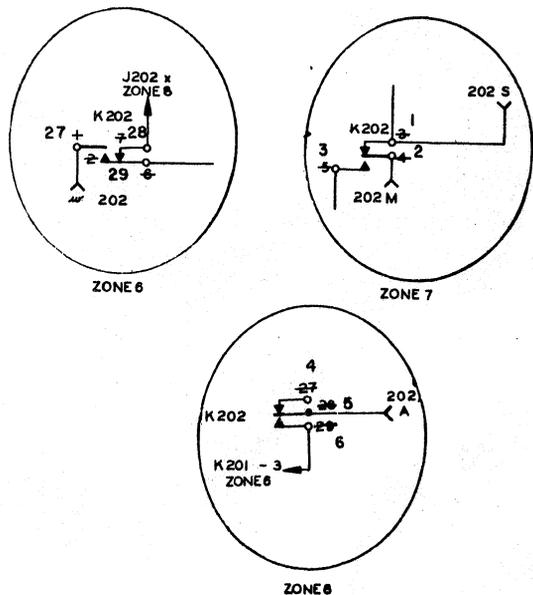


Fig. 2

PROCEDURE: (Cont'd).

<u>Clare Contact Number</u>	<u>Wiring Schematic Location (Zone)</u>	<u>Corresponding Automatic Electric Contact Number</u>
1	6	27
2	6	Delete
3	7	1
4	7	2
5	7	3
6	6	29
7	6	28
27	8	4
28	8	5
29	8	6

Contacts 21 through 26 are the same on both types of relay.

NOTE: If a Clare relay is used to replace an Automatic Electric relay, it is necessary that a jumper wire be added between contacts 2 and 6 of the Clare relay. This is not necessary on the Automatic Electric relay due to the construction of contacts 27, 28 and 29.

PROCEDURE: (Cont'd).

10. Install parts AK, Plate 70, Series F2000 Symbol Book, dated 12-1-60, as shown in the illustration. (It may be necessary to reposition parts B and J of illustration).
11. Reassemble in reverse order.
12. After completing the assembly make the following adjustment for proper belt tension.

There should be $3/4$ to 1 lb. tension when the belt is deflected $1/2$ inch at its center point. (Use Kit #408.)

To adjust, position nuts E. The two nuts D and E, just above Plate H should be locked together. (Care should be taken to keep the front edge of Plate H parallel with the base casting.)

PARTS REQUIRED:

<u>Reference</u>	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
B	FX60-373	2	Rear mounting screw
C	BX-1-14	4	Washers
D & E	X170-81	8	Nuts (front)
F	X228-1058	2	Front mounting screw
G	X275-7	6	Lockwashers
J	X170-229	2	Nuts (rear)
K	X275-185	2	Washers

*On Way
Stk*

CORRECTION INDEX - CHANGE NOTICE

CONDITION: Wrong indexing or accumulation.

CAUSE: Unable to maintain adjustment of motor overload clutch.

CORRECTION: Install improved 1FD66-5 overload clutch (no change in symbol) which can be identified by the bronze bushing in the driven member, the black oxide finish and the single set screw.

INSTALLATION REQUIREMENTS: A new improved clutch must be installed on the next service attention. A frozen clutch can cause considerable damage to the machine in case of lock-ups. Branch and grip stock of 1FD66-5 clutches without the bronze bushing in the driven member should be discarded upon receipt of new clutches.

INSTALLATION TIME: Less than one (1) hour is required for this correction.

INCORPORATION DATE: The improved clutches were incorporated beginning with machine number F122244P.

PROCEDURE: After installing the improved clutch, make the following adjustment. To safeguard the machine against possible damage in the event of a lockup --

To adjust:

1. With the clutch cool, back off adjusting nut until the clutch is too weak to cycle the Product Accumulator during a 20 place clear operation.
2. Permit clutch to slip for approximately 15 seconds to warm clutch.
3. Tighten adjusting nut until clutch will just cycle the Product Accumulator during a 20 place clear operation.
4. Tighten adjusting nut three (3) additional notches.

PARTS REQUIRED:	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
	1FD66-5	1	Overload Clutch

CORRECTION INDEX

I

CONDITION: Wrong multiplication.

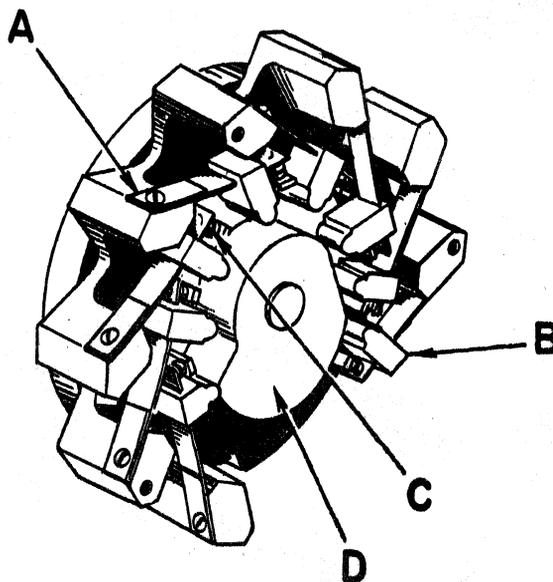
CAUSE: Loss of a pulse from the pulse generator due to insufficient contact pressure.

CORRECTION: Install an FX80-205 backup leaf for each 2FMB10 contact (part A of illustration).

INSTALLATION REQUIREMENTS: This correction should be made when this problem is encountered.

INSTALLATION TIME: Less than one (1) hour is required for this correction.

INCORPORATION DATE: Machines starting approximately with serial number F126945P will incorporate this change.



PROCEDURE: After installing the FX80-205 leaves, check each set of contacts to break at 75 to 150 grams pressure (applied slowly to the nylon actuator) using the 2X leaf of gram gauge Kit No. 408 No. 2 (shop tool). If necessary, replace the 2FMB10 contact. 2FMB10 contacts with FX80-205 backup leaves should not be bent for adjustment.

PARTS REQUIRED: Eight (8) FX80-205 leaves per machine.

NOTE: This correction cancels C.I. 1033, Item I, dated 5-25-61.

*on 7/11/61
SK*

II

CONDITION: Wrong multiplication.

CAUSE: Loss of pulses from Pulse Generator due to dirty contact points.

CORRECTION: Install seal (FMB39) under Pulse Generator cover.

INSTALLATION REQUIREMENTS: Install the seal at the next service attention.

II - CONTINUED

INSTALLATION TIME: Approximately one (1) hour is required for this correction.

INCORPORATION DATE: Machines with a serial number F119500P and above will incorporate this seal for the Pulse Generator cover.

PROCEDURE: Refer to Plate 52, Series F2000 Symbol Book, dated 12-1-60.

1. Remove cover P by removing three (3) screws Q.
2. Remove cam R.
3. Remove assembly H by removing three (3) screws T.
4. Reassemble with the FMB39 seal between bracket F and assembly H.
5. See section IV, Series F2000 Instruction Book, for adjustment of cam R.

PARTS REQUIREMENTS: One (1) seal FMB39.

CORRECTION INDEX

CONDITION: Loose tabs on TB209.

CAUSE: Frequent disconnection for removal of the multiplier package.

CORRECTION: Replace TB209 with P and J connector 212 to permit easy removal and replacement of wires when it is necessary to remove the multiplier package.

INSTALLATION REQUIREMENTS: Install this correction to prevent the above condition. Retain TB209 (1AEA252-4) for possible use elsewhere as TB201, 204, 205, 206, or 220.

INSTALLATION TIME: Approximately two (2) hours are required for the above correction.

INCORPORATION DATE: This change will be incorporated beginning with serial number F122244P.

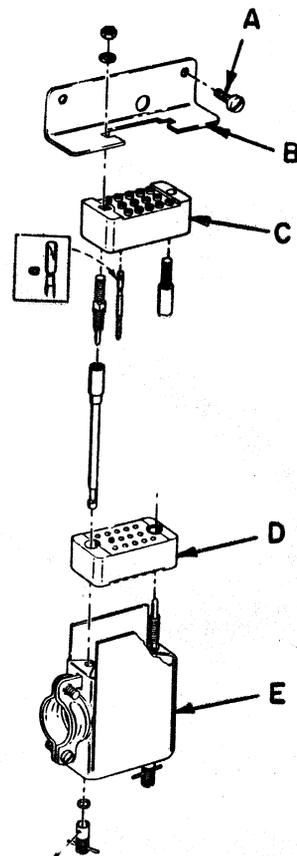
PROCEDURE:

1. Remove and discard wire from TB209-B10 to TB219-A2. (Reference - C.I. 1013, dated 7-14-60).
2. Remove two wires from TB209-A10 and connect to TB219-A2.
3. Remove wire from P206K to TB209-A9.
4. Add a new wire (3½ ft.) from P206K to S261-E (use double taper tab).
5. Transfer the remaining wires on TB209 as follows:

NOTE: Before soldering any wires to J212, slide the 1FX67-20 hood onto the harness in order that it can be attached to J212.

TB209A-1 to J212-A	TB209B-1 to P212-A
TB209A-2 to J212-B	TB209B-2 to P212-B
TB209A-3 to J212-C	TB209B-3 to P212-C
TB209A-4 to J212-D	TB209B-4 to P212-D
TB209A-5 to J212-E	TB209B-5 to P212-E
TB209A-6 to J212-F	TB209B-6 to P212-F
TB209A-7 to J212-H	TB209B-7 to P212-H
TB209A-8 to J212-J	TB209B-8 to P212-J
TB209A-9 to J212-K	TB209B-9 to P212-K

NOTE: P and J212 can be connected in reverse. Make sure the letters match when reassembling the guide pins.



PROCEDURE: (cont'd)

6. Remove TB209 and mount FMD55 bracket in the same mounting holes using two (2) 702500 $\frac{1}{2}$ screws.
7. Mount P212 to the FMD55 bracket, pin side down, using the screws of P212.
8. Connect P212 and J212.

PARTS REQUIRED:

<u>Reference</u>	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>
C	1FX12-90	1	P212
D	1FX12-91	1	J212
E	1FX67-20	1	Hood for J212
B	FMD55	1	Bracket for mounting P212
A	702500 $\frac{1}{2}$	2	Screw for mounting FMD55
	24B No. 12	1	Double taper tab

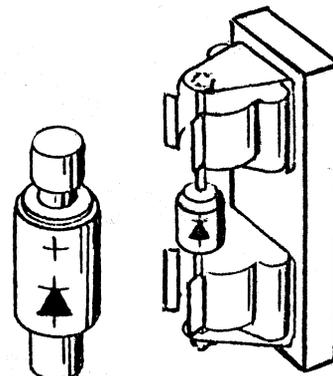
CORRECTION INDEX

CONDITION: Wrong product when multiple factor section is indexed.

CAUSE: K207, K208 and K209 picking at the same time due to a shorted CR210, CR211 or CR212. (FX43-9, G Plate 66 dated 12-1-60 F2000 Symbol Book).

CORRECTION:

1. Replace the diodes in these positions with FX43-13 diodes.
2. Add XL429-383 resistor across the coil of K207, K208 and K209 for arc suppression.



INSTALLATION REQUIREMENTS: This correction should be made when the above condition is encountered. The FX43-9 diode is no longer available. Branch and grip stock of this diode should be discarded.

INSTALLATION TIME: Approximately one hour is required for this correction.

INCORPORATION DATE: Machines above F125000P will incorporate this correction.

PROCEDURE:

1. Solder the FX43-13 diodes directly to the solder lugs of the old diode clip holders with the cathode (as illustrated) on the end which previously held the notched end of the cartridge type diode. Hold the diode leads with pliers while soldering to prevent heat damage to the diode.
2. Solder the resistors directly across the coils of the relays.

PARTS REQUIRED:

<u>Symbols</u>	<u>No. Req'd</u>	<u>Description</u>	<u>Unit List Price</u>
FX43-13	3	Diode	\$ 1.83
XL429-383	3	Resistor - 22K 1/2W	.05

*ordered
1-3-63
Reed - 2/11/63*

CORRECTION INDEX

CONDITION: "On" key will not latch down.

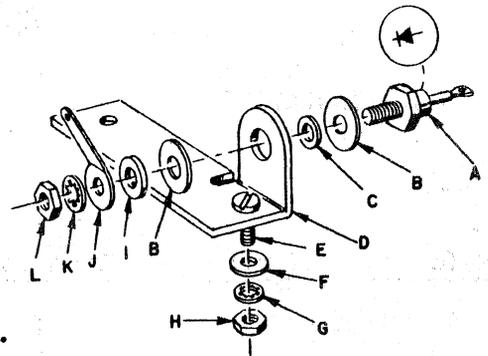
Plate 19

CAUSE: Failure of the "On" key solenoid and/or zener diode.

CORRECTION: Install new "On" key solenoid 2FB614-13 (2300 ohms) and a new zener diode 1BX58-323. The new zener will drop 50v D.C. The remainder of the input voltage will drop across the "On" key solenoid.

The new solenoid can be identified by the three (3) blue dots on the body of the coil.

INSTALLATION REQUIREMENTS: Install this correction when failure of either the "On" key solenoid or the zener diode is experienced.



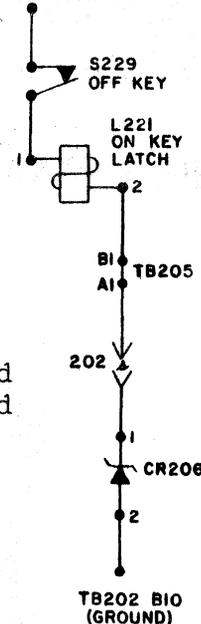
INSTALLATION TIME: Approximately one (1) hour is required for this correction.

INCORPORATION DATE: Machines beginning with serial number F134702P and above will incorporate the new coil and diode.

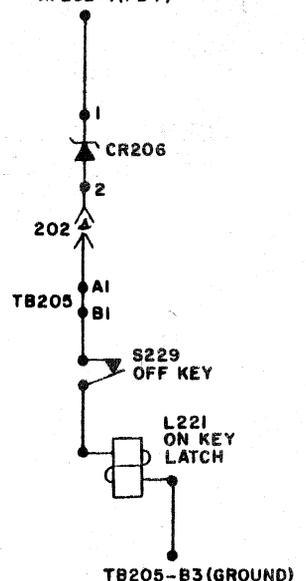
PROCEDURE:

1. Remove the old zener diode and "On" key solenoid.
2. Assemble the new zener diode, as shown, on the AHE101 bracket. Apply a thin film of S137 silicone compound between the parts to ensure proper heat transfer from the 1BX58-323 diode to the AHE101 bracket.
3. Mount the AHE101 bracket to the relay plate in the forward mounting hole for the replaced diode, applying S137 silicone compound between the bracket and relay plate. Use an X225-686 screw, X275-135 washer, X275-5 lockwasher and X170-56 nut as illustrated.

PREVIOUS WIRING
TB204-B3(FB+)



REVISED WIRING
XF202-1(FB+)



(Continued)

4. Make the following wiring changes:
- ✓ a. Remove wire from TB205-B1 (from L221-2) and, using a double taper tab, connect it and the wire on TB205-B3 to TB205-B3.
 - ✓ b. Remove wire from TB204-B3 (S229-NO) and using a single taper tab connect it to TB205-B1.
 - ✓ c. Remove and discard wire from CR206-2 to TB202-B10.
Note: On some late style machines which can be identified by two wires on CR206-2, remove and discard wire from CR206-2 to J202-DD. Move remaining wire on CR206-2 (from K203-X2) to J202-DD.
 - ✓ d. Remove wire on CR206-1 and connect to CR206-2.
 - e. Add a new wire from CR206-1 to XF202-1 (fuse holder).
5. Install "On" Key solenoid 2FB614-13 and make necessary adjustments per F2000 Instruction Book.

PARTS REQUIRED:

<u>Reference</u>	<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit List Price</u>
	2FB614-13	1	"On" key solenoid	6.00
A	1BX58-323 (Includes B, C, I, J, K, L)	1	Zener diode	23.25
D	AHE101	1	Bracket	.88
E	X225-686	1	Screw	.04
F	X275-135	1	Washer	.04
G	X275-5	1	Lockwasher	.04
H	X170-56	1	Nut	.04
	S137	1 per branch	silicone compound	

THIS CORRECTION CANCELS ITEM III OF CORRECTION INDEX 1001 (dated 11-25-59)
 AND ITEM III OF CORRECTION INDEX 1005 (dated 2-8-60).

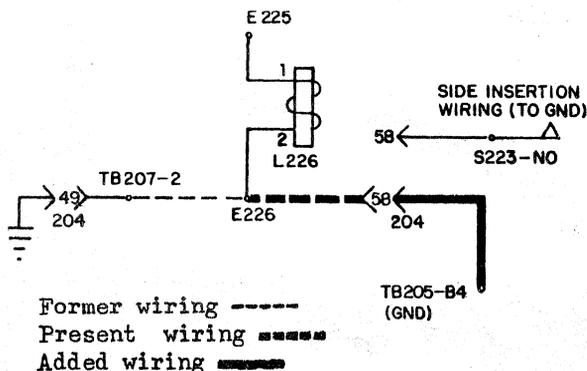
CORRECTION INDEX

CONDITION: Failing to multiply after installation of a new or rebuilt component unit (2FMC110-1) in any 18" carriage machine.

CAUSE: The ground circuit for the right hand shifter L226 is changed due to new wiring in 22" side insertion panel machines.

CORRECTION: Add a wire from P204-58 to TB205-B4 in all 18" carriage machines to provide a ground circuit for L226. (This wire will not affect the operation when the machine contains a component unit with the original wiring.)

Service replacement units that contain the new wiring are tagged. The tag indicates date of completion, 9-26-62 or later. Do not remove this tag from the unit.



INSTALLATION REQUIREMENTS: This change should be made at the next P.M. attention or must be made whenever the component unit is replaced with one containing the new wiring. (The machine should be marked indicating that this change has been made.)

INSTALLATION TIME: Less than one hour is required for this correction.

INCORPORATION DATE: All Side Insertion Panel machines incorporate the change in wiring of L226. Service replacement component units after 9-26-62 are constructed with the new wiring.

PROCEDURE:

- All 18" carriage machines:
- Disassemble P204 and solder a wire (approx. 30 inches) to P204-58.
 - With a double taper tab connect the other end of this wire and the black wire on TB205-B4 to TB205-B4.

CAUTION:

Due to the possibility of variations in the order of location of TB204, TB205, and TB220, make sure that this connection is made to the correct board.

NOTE:

If it becomes necessary to install an early component unit in a Side Insertion Panel machine, the unit can be modified as follows:

PROCEDURE: (Continued)

- A. Remove wire on TB207-2 (to bomb tail connector E226 and L226-2) and connect to J204-58. (Mark the unit indicating that this change is made.)

Failure to make this change may result in the Right Hand Shifter occasionally cycling during a transfer operation.

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit List Price</u>
M302-40	2½ ft.	Wire	.04/ft.
24B No. 12	1	Double taper tab	.04 ea.

CORRECTION INDEX

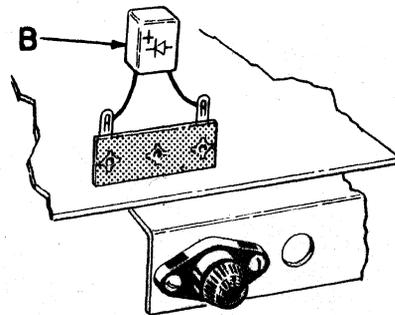
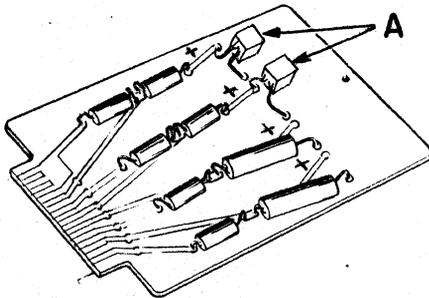
CHANGE NOTICE - SIDE INSERTION PANEL MACHINES ONLY

CONDITION:

1. Failing to multiply or machine operating with carriage out of stop position
Failing to set up a pre-multiply in a stop position containing a DPM pin.
2. Blowing D.C. fuse when S287 (Sensimatic Drive Trip-zone 6A, Logic Schematic) transfers.

CAUSE:

1. Shorted arc suppression diode A6C (Zone 4A).
K245 not dropping due to ground circuit provided thru diode A6C, resistor 4B5, L226, S287 (transferred) and K201-1 and 2.
K245-6 and 7 always closed will allow L222 (machine trip) to be picked prematurely.
K245-1 and 2 open, will cause loss of alternate hold for K201.
2. Isolation diode CR250 (Zone 6A) shorted.



CORRECTION:

1. Replace the two AEX43-1 diodes (A in illustration) located in positions A6C and E6K on 1FMC57 printed circuit card with FX58-11 diodes.
2. Replace the AEX43-1 diode (B in illustration) located on the relay plate with an FX58-11 diode.

INSTALLATION REQUIREMENTS: These diodes should be replaced on all Side Insertion panel machines as soon as possible.

INSTALLATION TIME: Less than one hour is required for this correction.

INCORPORATION DATE:

1. Machines above serial no. F136598P contain FX58-11 diodes in positions A6C and E6K.
2. Machines above serial no. F135804P incorporate an FX58-11 diode as CR250.

(Continued)

PROCEDURE: In replacing the diodes care should be taken to observe polarity and not to damage the printed circuit card.

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit List Price</u>
FX58-11	3	Diode	1.13

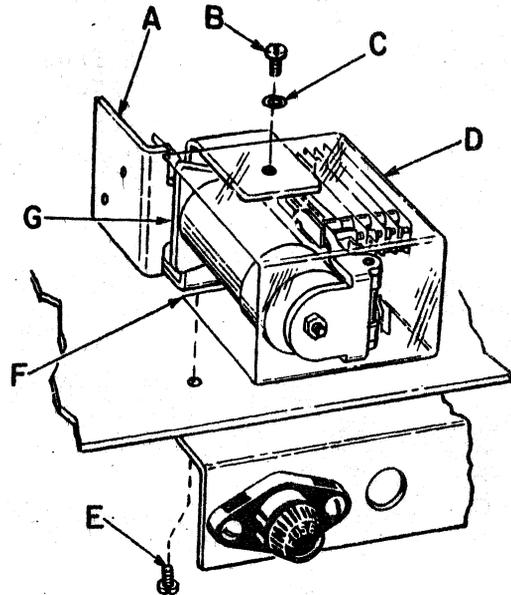
CORRECTION INDEX

CONDITION: Machine malfunction due to operating out of stop position, 18" carriage 1/10" tab machines only.

CAUSE: Failure of drive trip interlocks to prevent machine operation before the carriage has settled in a stop position.

CORRECTION: Install delay pick relay 1FX47-48 (K245) and the listed wiring changes. The normally open contacts of K245 in the machine trip and start multiply circuits prevent a machine operation or start of multiplication until K245 is picked by In Tab Switch 227.

On any carriage movement of more than two inches, the delay pick characteristic of K245 (approx. 35-75 ms.) allows time for the carriage to settle down before the next machine function.



INSTALLATION REQUIREMENTS: This correction should be installed when the above condition is encountered.

INSTALLATION TIME: Approximately one hour is required for this correction.

INCORPORATION DATE: Field modification only. Side insertion panel machines incorporate a similar circuit for the same purpose.

PROCEDURE: The complete relay plate may be removed to facilitate the following changes.

1. Mount the 1FX47-48 relay on the FST18-1 bracket, and attach to the right rear of the relay plate as shown in the illustration. Discard the screw and nut removed. Trim the plastic cover at point F.
2. Make the following wiring changes using single taper tabs at the K245 connections and soldering all other connections.

(Continued)

CORRECTION INDEX

I

CONDITION: Wrong multiplication resulting in over nine or under one in any column.

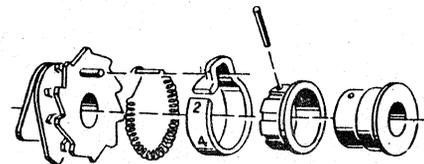
CAUSE: Pinion failing to advance on carry because of slipping nylon clutch band FMA33.

CORRECTION: Install redesigned pinion assembly 2FMA27; no change in symbol. (Plate 31, dated 9-25-61, Series F2000 Symbol Book).

The nylon drum in the new assembly has cross grooves which are filled with Alvania EP No. 1 grease. The nylon band uses a stronger girth spring FX80-146 (no change in part number). With this design, foreign matter is trapped in the grooves and a more constant clutch tension is assured. Inspection of the nylon drums should be made on each P.M. to ensure presence of grease in grooves. Use only Alvania EP No. 1 when filling grooves (SF136).

These new sections can be identified by the gray color of the pinion shaft next to bronze bearing (in R, Plate 31) and/or the FMA33 clutch band having only the numerals 2,4,6 and 8.

INSTALLATION REQUIREMENTS: Install this correction when this condition is encountered or as a Preventive Maintenance measure.



INSTALLATION TIME: Approximately 4 hours.

INCORPORATION DATE: Machines beginning with No. F136463P.

PROCEDURE:

- A. Prior to removal of the multiplier package consider Item II of this correction index.
- B. Removal of 2FMA27 pinion assembly (Plate references, F2000 Symbol Book, dated 12-1-60).
 1. Remove the taper pin holding the drive gear on the left end of the pinion shaft. (Part V, Plate 31)
 2. Remove the taper pin holding the bearing bracket arm supporting the left end of the pinion shaft. (Part T, Plate 31)
 3. Remove the pinion solenoid assembly. (Plate 35)
 4. Remove the taper pin holding the dial indicator to the camshaft and two screws for the pointer.

PROCEDURE: (Cont'd)

5. Remove the dial indicator.
6. Remove the right side frame. Be careful not to damage L234 and its wires. Note location of shims, if any.
7. Remove the screws holding the two bearing brackets for the pinion assembly pivot shaft to the carry circuit channel.
8. Remove clip from left end of pinion assembly pivot shaft and disengage the pinion shaft from the right enclosed cam.
9. Remove the pinion assembly by moving it to the right, at the same time slipping off the left bearing support arm and gear, and disengage it from the left enclosed cam.

- C. To install the new assembly follow the above procedure in reverse order. Install shims FX1-32 and/or FX1-33 (S, Plate 31) to provide not more than .005 end play of pivot shaft (Q) and for carry cam follower arms FMA2 (D, Plate 33) to have at least 2/3 hold on carry lobe.

Note: Prior to test run, check all drivebelts to be in good condition and tightened to proper adjustment. Until the new 2FMA27 assembly is "run in" it will increase the load of the product accumulator. It may be necessary to increase the tension of the motor overload clutch. Adjust as required.

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit List Price</u>
2FMA27	1	Pinion Assembly	\$356.13

II

CONDITION: Wrong multiplication - under various amounts.

CAUSE: Clapper reset failure due to weak FX80-104 plunger springs and/or worn clappers.

CORRECTION: Install parts per test given under "Procedure".

INSTALLATION REQUIREMENTS: This should be done on all machines with above condition and as a Preventive Maintenance measure.

INSTALLATION TIME: Approximately 4 hours to perform the procedure. Corrective action for irregularities will vary.

INCORPORATION DATE: Stress relieved FX80-104 springs were used beginning with machine no. F129941.

PROCEDURE:

1. Prior to removal of Product Accumulator make the following test: Manually cycle the unit to clapper reset position (approximately 30° or 270°). In either position, manually push each clapper away from the core. Clapper should relocate freely against the core when released.

Wear of the clapper at the pivot point or improper balance of plunger and clapper springs can cause loss of reset. To correct; replace worn clappers and all questionable FX80-104 plunger springs. The FX80-104 springs are now stress relieved to retain proper tension. Use the same clapper springs (FX80-106) unless they have been altered or damaged.

2. Remove Product Accumulator and separate Drive Unit
3. Check the following items for wear.
 - a. Clapper reset rolls
 - b. Carry reset rolls
 - c. Total bail to be staked tight to its bearing hub
4. Remove and clean carry wiper assembly as required.
5. Replace 2FMA27 pinion assembly, if required, using procedure under Item I of this C.I..
6. Check tests and adjustments for Product Accumulator mechanisms (Section III, F2000 Instruction Book, dated 12-1-62).
7. Replace any worn or defective parts in the Drive Unit. Check tests and adjustments under Drive Unit Assembly.
8. Reassemble Drive Unit to Product Accumulator and install in machine.
9. Check carry reset and adjust if required. (The amount of reset is not the same with the unit removed).
10. Check Test and Adjustments under "Transferring the Product;" Section III of Instruction Book.

PARTS REQUIRED:

<u>Symbol</u>	<u>Quantity</u>	<u>Description</u>	<u>Unit List Price</u>
FX80-104	20 per machine	Plunger spring	\$.19
FX80-106	As required	Clapper spring	.25
1FMA51	As required	Clapper	1.46

CORRECTION INDEX

Information Only

I

Multiple Factor Storage

Beginning with machine number F137298P and Canadian number F10632C, the wiring for the M.F.S. feature is changed and uses a later style 2FMRL-1 Multiple Factor Storage unit. The later style 2FMRL-1 provides for a 7 shift and a 5 shift to activate the middle section of the MC. With early 2FMRL-1 units, the 7 shift did not activate the feature. This change primarily is to accommodate the rate change in F.I.C.A. deductions from 3% (.03) to 3 5/8% (.03625).

The wiring schematic furnished with the machine will show if the machine is wired for the early or late style FMRL-1 unit. Order the units from Parts Distribution as 2FMRL-1 Early Style or 2FMRL-1 Late Style.

Beginning with machine number F126931, the lane 41 sensing lever assembly incorporates an eccentric to aid in adjusting the position of the wipers on S260. In machines with this eccentric, the Multiple Factor Storage feature (either early or late style) is indexed with a 1 pin instead of the 1A pin used previously. (See Page 19, Section III, Tests C37-6 and C 37-5, and Page 3, Section V.)

II

Part Number Change

✓ Make following change on Plate 43, dated 12-1-60, F2000 Symbol Book. Part D described as "Included in AI" is part number FX87-30. *Done*

This pin and the spring retainer ring FX10-482 (part F) are used for replacement in both new and old style platen assemblies.

This information is supplied to provide the means of replacing a broken platen spring (part E). Press the spring retainer ring onto the FX87-30 pin a distance equal to that of adjacent pins. It will be helpful to slightly chamfer the end of the pin, but do not mar the end surface that contacts the printed circuit disk.

III

Adjusting Side Insertion Panels

All side insertion control units are factory adjusted to pre-determined height in a test fixture. This height setting should be very close to the required adjustment in any machine, but it must be checked and refined if necessary during shop checkout. Once made in the machine, it should not be necessary to readjust. However, the lateral alignment of the pins and tappets must be checked and adjusted during checkout procedures. Refer to Page 45, Section III, dated 12-1-62, Tests C10-3-9, C10-3-10, and C10-3-27.

Slight lateral movement of the trays can be obtained within the tolerance of the mounting inserts. Slightly loosen the screws holding the magazine tray and move the tray in the direction required. The tray can also be moved forward or rearward with the screws loose. The Auxiliary Sensing Unit tappet block, and the lane switch assembly also can be moved laterally to improve pin and tappet alignment.

CORRECTION INDEX

CONDITION: A. Wrong multiplication
B. Machine locked

CAUSE: Worn components unit clutches causing:

- A. Premature cycling of the product accumulator. This is evidenced by marks on the platen side of the printed circuit disks indicating sensing of the disks while they are moving. However, this could be caused also by a malfunctioning interlock switch. Therefore, interlock switches and adjustments (Section III, Page 27, dated 12-1-62, tests R10-3, R10-5 and R10-6) should be checked first.
- B. Failure of a components unit clutch to fully detent in home position.

CORRECTION: Install improved clutch members.

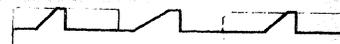
The number of teeth and the tooth profile have been changed as illustrated to provide greater contact area per tooth which increases the reliability and durability of the clutch.



OLD STYLE

INSTALLATION REQUIREMENTS: Install the new

parts when wear of the clutch members is encountered. Old style parts (12 teeth) are no longer available and such parts in stock should be discarded. Since new parts (8 teeth) will not mate properly with the old ones, clutch members must be ordered and replaced in pairs.



NEW STYLE

INSTALLATION TIME: Approximately one hour is required to repair one clutch assembly.

INCORPORATION DATE: Improved clutches are incorporated in machines beginning with serial F139949P.

PROCEDURE: If one or both function table clutches or one or both shifter clutches are to be replaced, use the following procedure:

1. Remove the components unit.
2. Remove the corresponding components unit end plate.
3. Remove the screws holding the clutch shaft end bracket and remove the bracket.
4. Remove the clutch shaft. Observe the number and position of clutch shaft shims.
5. Remove the pin and collar from the end of the shaft.
6. Remove and discard the old clutch members.
7. Install the new clutch members and reassemble the collar and pin.

PROCEDURE: (continued)

8. Check the driving clutch member to be free. If it is not free, disassemble the pin and collar. Using a file or emery cloth, remove enough stock from the inside surface of the collar to permit the clutch to turn freely and reassemble the pin and collar.
9. Reassemble the remaining parts in reverse order. Care should be observed to have the printed circuit disk in the proper position as the worm gear on the clutch shaft is remeshed with the nylon gear on the disk. Refer to Section III, pages 28 and 29, dated 12-1-62, tests R11-1, R11-2 and R11-7. If the gears are incorrectly meshed, it will be impossible to meet tests R11-2 and R11-7 without remeshing them.

If both a function table clutch and a shifter clutch or all of the clutches are to be replaced, disregard Step 2. Instead, remove the three screws holding the clutch assemblies to the front and/or back plate and remove the front and/or back plate. Continue the procedure as outlined above.

PARTS REQUIRED: Individual clutch members.

<u>Symbol</u>	<u>Quantity</u>	<u>Use</u>	<u>Replaces</u>	<u>Unit List Price</u>
15060692	1	RHFT Clutch	FMC27-1	24.00
	1	LHFT "	FMC27-1	
15060700	1	RHS "	FMC27-2	23.00
	1	LHS "	FMC27-2	
15060734	1	RHS "	1FMC27-4	15.00
15060742	1	RHFT "	1FMC27-5	16.00
15060759	1	LHS "	1FMC27-6	13.00
15060767	1	LHFT "	1FMC27-7	11.00

The part number for a complete clutch shaft assembly has not been changed. Refer to the F2000 Symbol Book.

Important: Initial orders should be for immediate minimum requirement only and not for branch stock.

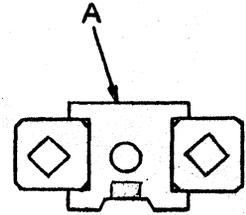
RELIABILITY IMPROVEMENT NOTICE

File after "Correction Index" No. 1048

CONDITION: Wrong carriage movement or failure to trip drive after change of schedules on machines equipped with side insertion panels.

CAUSE: Program panel schedule selector not positioned properly.

CORRECTION: Install improved detent A (replacing AJ, plate 4-1, dated 8-13-62, Form 2947) when this condition occurs. The new detent is designed to hold the skip shaft and stop shaft securely in position when once detented.



INSTALLATION TIME: Less than one hour.

INCORPORATION DATE: The new detent was incorporated in machines beginning with serial number F142588P.

PARTS REQUIRED:

Part No.	Description	Unit List Price
15110356	Detent	\$ 1.95

RELIABILITY IMPROVEMENT NOTICE

CONDITION: Carriage failing to tab or return or wrong carriage movement.

CAUSE: Gear box back plate, 2FG112-4, broken at lower formed ear allowing full or partial loss of driving force to the tab and return clutches.

CORRECTION: Install improved back plate assembly 15025885, which has the cutout at point E removed to correct this breakage. Installation of the improved back plate requires removal of projection C from the gearbox bottom plate and a slight change in spring arrangement.

INSTALLATION REQUIREMENTS:

This correction must be installed when the above failure occurs.

INSTALLATION TIME:

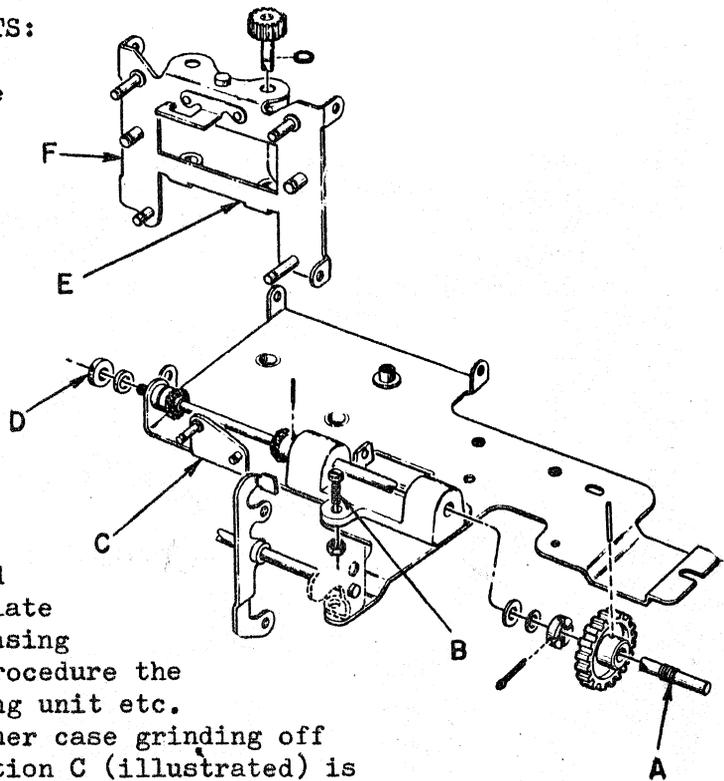
Approximately 4 hours are required for this correction.

INCORPORATION DATE:

Improved back plates were incorporated in machines beginning with Serial F146481P.

PROCEDURE: This procedure provides a method of replacing the back plate without removing the sensing unit. As an optional procedure the multiply package, sensing unit etc. may be removed. In either case grinding off of spring anchor projection C (illustrated) is required.

1. Remove the carriage and carriage rails as a unit. Note location of shims, if any.
2. Remove open-close slide and spearpoint.
3. Remove the "D" section for access to grind off spring anchor projection C to allow easier removal of back plate. Rags should be used to catch the filings.
4. Remove the escapement gear assembly.
5. Remove the four mounting screws for the gear box back plate.
6. Remove spindle drive shaft A by removing nut D and mounting screws B.
7. Remove primary and secondary latches.



8. The following references are to figure II-64 page 46 Section II Series F1000 Instruction Book, Form 3741, dated 6-1-61. Remove parts W, AT, and AG. To remove AG, it is necessary to disconnect AG from AM. This is accomplished by moving parts AF and Z rearward to allow AM to be moved off the hub of AF. Discard the spring on part Z.
9. Remove the back plate by moving it upward, the top slightly to the left and slowly pivoting the top rearward and the bottom forward.
10. With the back plate removed, mark eccentric AD figure II-64 page 46 Section II Series F1000 Instruction Book and replace the 49 1/2 nut on this eccentric with the 20 No. 119 spring anchor and the 49 1/4 nut from the new assembly. The spring on part AG will connect to this spring anchor and will do the additional job of the spring discarded in step 8. The spring from AG to the spring anchor is the same spring as that used from AG to the stud in the back plate.
11. Remove all parts from the new back plate assembly and transfer those remaining on the old back plate (parts Z, AF and AM) to the new back plate.
NOTE: Use of these old parts will minimize the necessity of readjustment. The complete assembled back plate is furnished, however, in the event parts on the old back plate are worn, or damaged in removal.
12. Insert the new back plate but do not attach to gear box until drive shaft A has been installed.
13. Reinstall the remaining parts in reverse order.
14. Check the gearbox adjustments as given on pages 44 thru 49 of Section II Series F1000 Instruction Book, dated 6-1-61.

PARTS REQUIRED:

Part Number	Description	Unit List Price
15025885	Back Plate Assembly	\$ 185.00

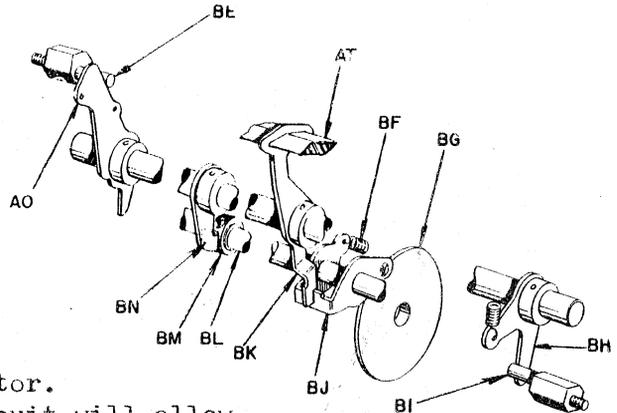
RELIABILITY IMPROVEMENT NOTICE

Information Only

I

Total Bail Assembly

A repair part is now available for replacement of part AO (illustrated), eliminating the necessity for replacing the LFMA6 total bail assembly due to shearing of part AO from its hub. This repair part can be installed in approximately two hours by removing the left end plate and the carry printed circuit assembly of the Product Accumulator. Removal of the carry printed circuit will allow the repair part to be tightly pinned to its shaft.



Part Number	Unit List Price
LFMA13	\$ 1.85

II

Interlock Switches in Components Unit

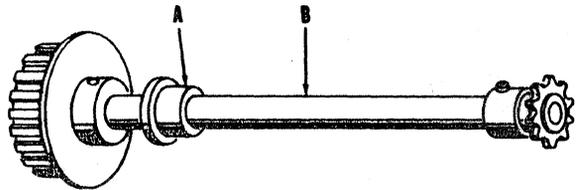
The arrangement of some of the right hand interlock switches has been changed to reduce wrong multiplication due to failure of the switches in the number one position (RHS-1 and RHFT-1). These switches fail more frequently than those in the other positions due to the more severe actuation. S246 is now located in the RHS-3 position, S247 in the RHS-1 position, S249 in the RHFT-1 position and S238 in the RHFT-2 position. Failure of the switch in the number one position will now result in failure to pick Multiplier Drive trip solenoid L230 rather than wrong multiplication.

on V9

RELIABILITY IMPROVEMENT NOTICE

CONDITION: Excessive noise or machine lock-up.

CAUSE: Loose horizontal belt due to wear of bearing A (in left auxiliary sideframe) and shaft B (open-close drive shaft).



CORRECTION: Install improved 15025380 shaft assembly, which can be identified either by red marking on belt pulley end or by dull gray finish to shaft B. The bearing is available for service replacement under part number FX20-23.

INSTALLATION REQUIREMENTS: This correction should be installed when this condition occurs.

INSTALLATION TIME: Less than one hour is required for this correction.

INCORPORATION DATE: Improved shaft assemblies were incorporated beginning with Serial F149534P.

PROCEDURE: Replace parts.

PARTS REQUIRED:

Part Number	Description	Unit List Price
15025380	Shaft assembly	\$ 8.75
FX20-23	Bearing	.07

RELIABILITY IMPROVEMENT NOTICE

CONDITION: Machine fails to operate.

CAUSE: Failure of machine trip switch S287, Fig. III-10, F2000 Instruction Book, dated 12-1-62.

CORRECTION: Install 1FX83-51 and two space washers FX10-147 in place of the 1X83-34 for S287. The adjustment P19-1, Section III, Page 9, dated 12-1-62, F2000 Instruction Book is changed to read .030" to .040" clearance between ear E and the body of S287. The adjustment was .050" to .060".

INSTALLATION REQUIREMENTS: This correction should be installed when this condition occurs and as a preventive maintenance measure.

INSTALLATION TIME: Less than 1 hour.

INCORPORATION DATE: The 1FX83-51 was installed beginning with machine F142106P.

PROCEDURE: Install 1FX83-51 with the two washers between the switch body and retaining clips. Adjust as required.

PARTS REQUIRED:

Part Number	Description	Unit List Price
1FX83-51	Switch	\$ 2.20
FX10-147 (2 required)	Space Washer	.05

*Ordered 6+12
2-15-65*

RELIABILITY IMPROVEMENT NOTICE

CONDITION: One cent (.01) over on multiplication.

CAUSE: Failure to clear after round off due to burned spot on Right Hand Shifter Position Selector Disc S277 in position 21 at wiper A1. The disc is damaged when Round Off Solenoid L231 picks as the disc moves to position 21. This opens the circuit to Total Bail Solenoid L235.

CORRECTION: Make wiring changes listed under Procedure. Replace Shifter Disc assembly if necessary.

The wiring change will cause Round Off Release Solenoid L231 to fire early in the multiply cycle through K202 contacts 28 and 29. The circuit to L231 from S277 in position 21 is removed to prevent burning S277.

The isolation diodes in the circuits to S263 prevent back circuits between product accumulator pinion solenoids during multiplication, if the wipers of S263 are positioned to bridge the pads.

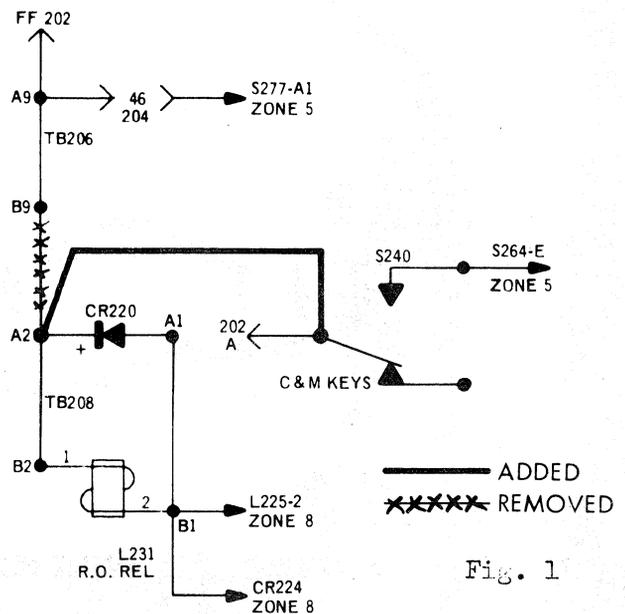


Fig. 1

Diode CR263 is for arc suppression to protect S212.

Diode CR264 (steps 11 thru 13) is required on Side Insertion Panel machines only. It prevents a kickback voltage from K245 firing L231 during a sensimatic operation if the C or M key is used. This could result in breaking the lane 43 tappet during carriage tabulation.

INSTALLATION REQUIREMENTS: This change should be made to correct or prevent this condition.

INSTALLATION TIME: Approximately 1 hour to make wiring changes. Approximately 4 hours if shifter disc assembly is changed.

INCORPORATION DATE: Field modification only.

PROCEDURE:

1. Remove wire from TB206-B9 to TB208-A2.

PROCEDURE: (continued)

2. Add a wire from TB208-A2 to S240 common.
3. Mount TB236 on outside of TB201 with tabs facing up. The mounting holes must be reamed.
4. Remove tab from S263-A and connect to TB236-6 (cathode, marked + on CR260).
5. Add a wire from TB236-5 (anode of CR260) to S263-A.
6. Remove tab from S263-B and connect to TB236-4.
7. Add a wire from TB236-3 to S263-B.
8. Remove tab from S263-C and connect to TB236-2.
9. Add a wire from TB236-1 to S263-C.

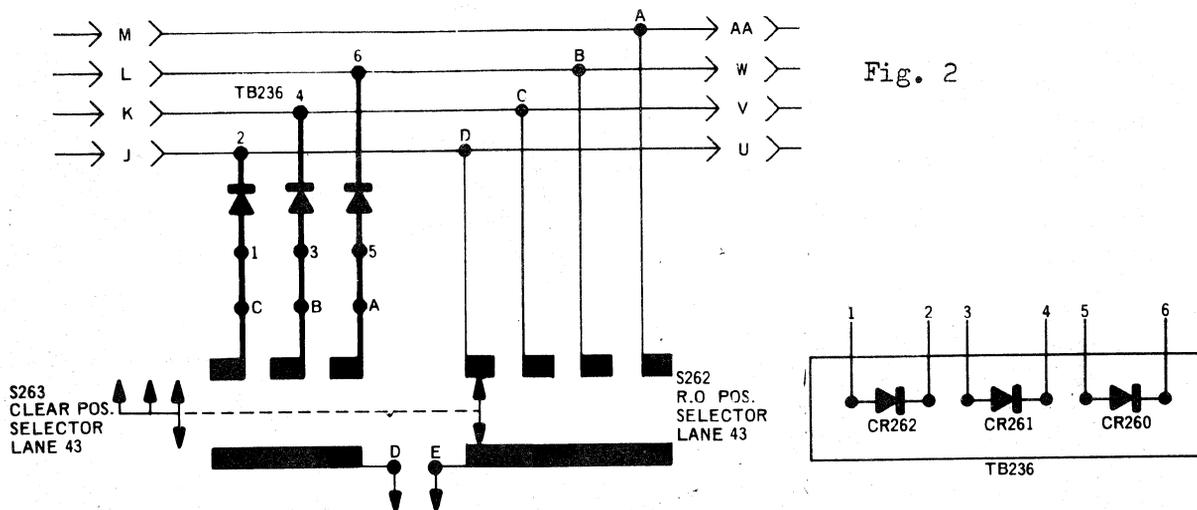


Fig. 2

10. Solder a AEX43-1 (CR263) across E201 and E202 with cathode (marked +) on E202. See Figure VII-12, Series F2000 Instruction Book, dated 12-1-62.

The following steps are required only on Side Insertion Panel machines.

11. Mount TB237 on lower rear post of S260 switches assembly and connect AEX43-1 diode (CR264) across the terminals.
- ✓ 12. Remove tab from S264-E and connect to the anode (opposite + mark) of CR264.
- ✓ 13. Add a wire from the cathode (+) of CR264 to S264E.

Burroughs

FIELD ENGINEERING TECHNICAL OPERATIONS

NO. 2004

TECHNICAL INFORMATION NOTICE

PAGE: 1 OF

DATE: 3-25-6

TO: BRANCH/DISTRICT FIELD ENGINEERING MANAGERS

FROM: GROUP II

SUBJECT: F2000, E2000 - SPLIT PLATEN SPACING LOCK-UP

This occurs when the left and/or right actuating arm lowers during a spacing operation and the space bail restores, jamming the small stud on the toggle on top of the ^{IGN} actuating arm. This prevents the space bail from restoring to normal and also prevents a drive trip.

A temporary solution is to weld a #5 control pin to the actuating arm, thereby increasing its length so that it cannot be trapped under the stud on the toggle.

Burroughs FIELD ENGINEERING TECHNICAL OPERATIONS		R ELIABILITY I MPROVEMENT N OTICE	SYSTEM SERIES F2000	No. 3747-007 REVISED
			STYLE/MODEL All	PAGE 1 OF 2
			TOP UNIT NO.	
INCORPORATION DATE 6-14-65	UNITS AFFECTED Below F159904P	UNIT DESCRIPTION Carriage Drive Clutch		
STD. INSTALL. TIME Approx. 1 hour	INSTALLATION PACKAGE NO. AND PKG. PRICE	DATE 5-10-66		
TITLE Faulty Electro Magnetic Clutch				

CONDITION: Faulty electro magnetic clutch 3FG252-1 or 1502 5414 (part C Plate V-11, F2000 Parts Catalog, dated 2-3-64).

CORRECTION: Install permanent magnet clutch as outlined below.

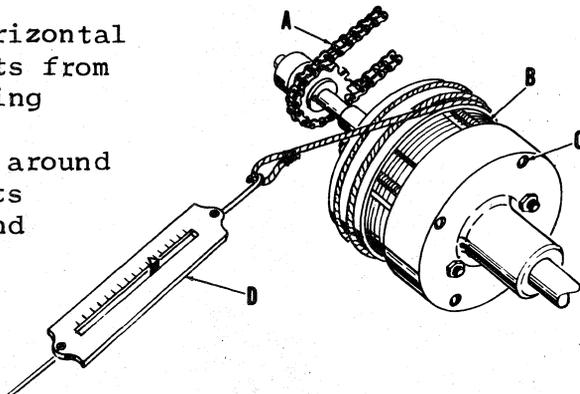
PROCEDURE:

1. For all F2000 rear insertion panel machines, install clutch 1502 7279 and parts listed below.
2. For all side insertion panel machines, install clutch 1502 8103 and parts listed below.

NOTE: The only difference between the F1000 and E2000 permanent magnet clutch is the pre-set torque adjustment and the parts on outer shaft, which are interchangeable.

3. For either clutch used, replace the outside pulley or sprocket with pulleys 1502 8541 and 1502 8533, key 1502 8525, spacer 1502 8517 and the lock washer and nut that was removed.
4. The 1FX29-35 pulley is used on the inside shaft of the clutch in place of the sprocket if belt driven tab and return is required. The 1FX29-35 is drilled for a pin and also cut for a keyway. Use parts removed to retain the pulley on the shaft.
5. Remove the slip ring brushes and brush holders. No other electrical changes are required.

- ✓ TO TEST:
1. Remove all horizontal chains or belts from the left driving sprockets.
 2. Loop a string around one of the nuts on screws C and rotate the clutch until 2 or 3 wraps have been made around the outer circumference as illustrated.



✓ Changes or additions since last issue.

3. Block the movement of clutch output chain at A.
4. Attach a 0-32 oz. scale (1623 0609) as illustrated and pull evenly towards the rear of machine. The output torque should be 16 to 17 oz. for rear insertion machines; 18 to 19 oz. for side insertion. The output torque should never be adjusted to exceed 19 oz.

✓ TO ADJUST: Loosen screws C and rotate center ring B a few thousandths forward or rearward and recheck output torque. (Direction to move center ring to adjust torque on unmarked clutches cannot be determined. Later clutches will be marked with an arrow indicating direction to turn ring to decrease output torque).

✓ Caution: Permanent magnet clutches are constructed having .008 to .015 air gap between magnetized rings and disks. To retain the proper air gap when making the output torque adjustment, the four screws C must be torqued down evenly.

PARTS REQUIRED:

Order permanent magnet clutches separately for machine having either side or rear insertion panel, as they will not be included in parts package listed below.

<u>Number</u>	<u>Description</u>	<u>Qty.</u>	<u>Unit List Price</u>
1502 7279	Permanent magnet clutch for rear insertion panel machine	1	\$ 100.00
1502 8103	Permanent magnet clutch for side insertion panel machine	1	114.00

1625 3510 PARTS PACKAGE NO. (Pkg. Price \$16.24)
(includes one set of the following parts:)

<u>Number</u>	<u>Description</u>	<u>Qty.</u>	<u>Unit List Price</u>
1502 8533	Pulley	1	\$ 7.25
1502 8541	Pulley	1	6.65
1502 8525	Key	1	.54
1502 8517	Spacer	1	1.80

The following additional parts are required to install a permanent magnet clutch on machines having belt driven tab and return.

(These parts are not included in above parts package).

<u>Number</u>	<u>Description</u>	<u>Qty.</u>	<u>Unit List Price</u>
1FX29-35	Belt Pulley	1	\$ 7.25
1625	Washer	1	.18

Burroughs		R ELIABILITY I MPROVEMENT N OTICE	SYSTEM SERIES	No. 3747-008
			F2000	
			FIELD ENGINEERING TECHNICAL OPERATIONS	STYLE/MODEL
	* See Below	1 of 1		
	TOP UNIT NO.			
STD. INSTALL. TIME	UNITS AFFECTED	UNIT DESCRIPTION		
Approx. 1 Hour	Below F159904P	Electro Magnetic Clutch		
TITLE			DATE	
Machine Malfunctions			9-20-66	

* F2000 with Electro Magnetic Clutch 3FG252-1.

CONDITION: Wrong multiplication or erratic carriage movement.

CAUSE: Outside belt pulleys on electro magnetic clutch worn causing belt slippage.

CORRECTION: Install service replacement pulleys 1502 8988 and 1502 8798.

This eliminates the necessity of installing a complete permanent magnet clutch.

PARTS REQUIRED:

<u>Number</u>	<u>Description</u>	<u>Qty.</u>	<u>Unit List Price</u>
1502 8988	Inside belt pulley	1	\$ 7.25
1502 8798	Outside belt pulley	1	7.25