July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

Filed Jan. 20, 1960 17 Sheets-Sheet 1

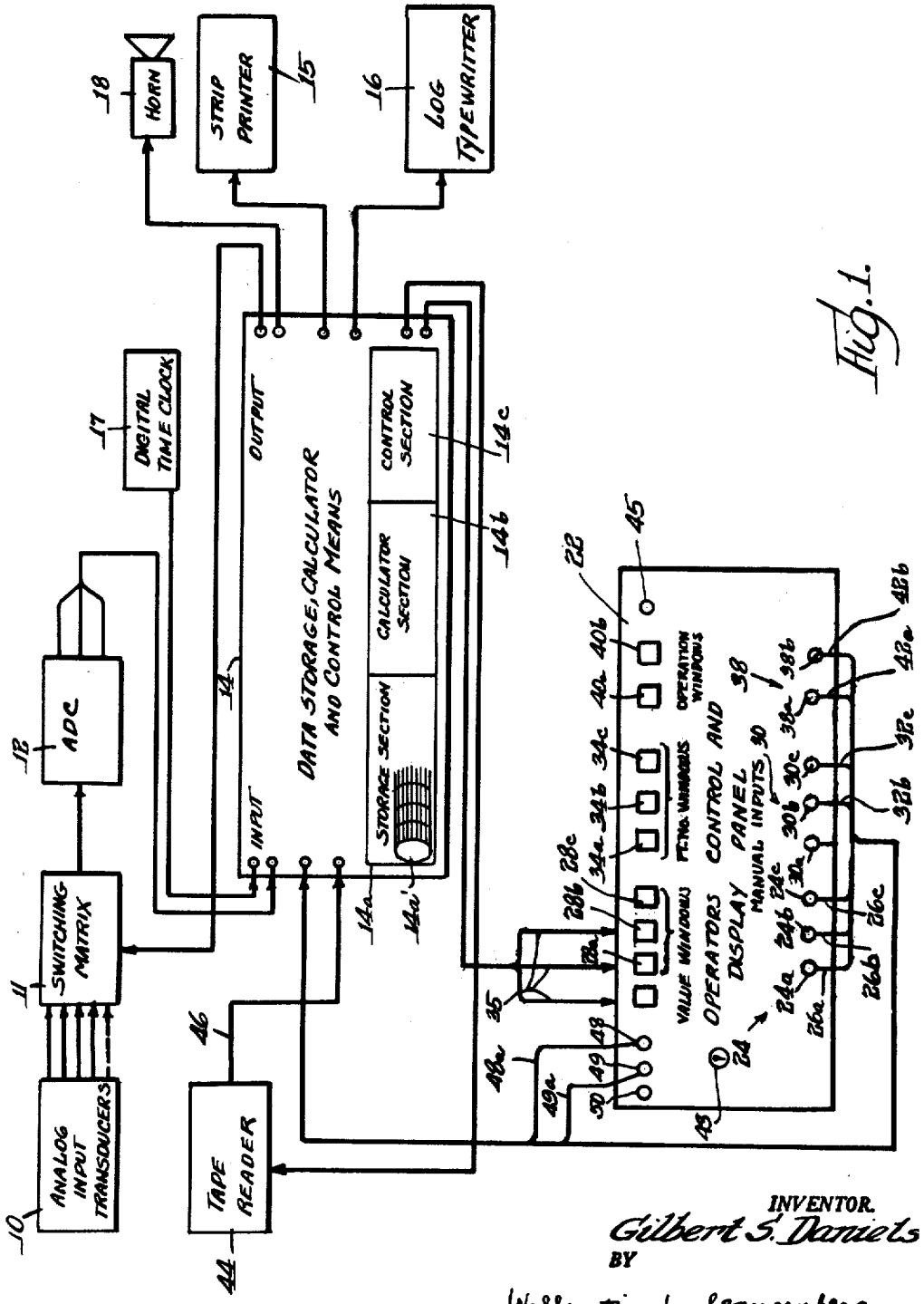

Fig. 1.

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July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

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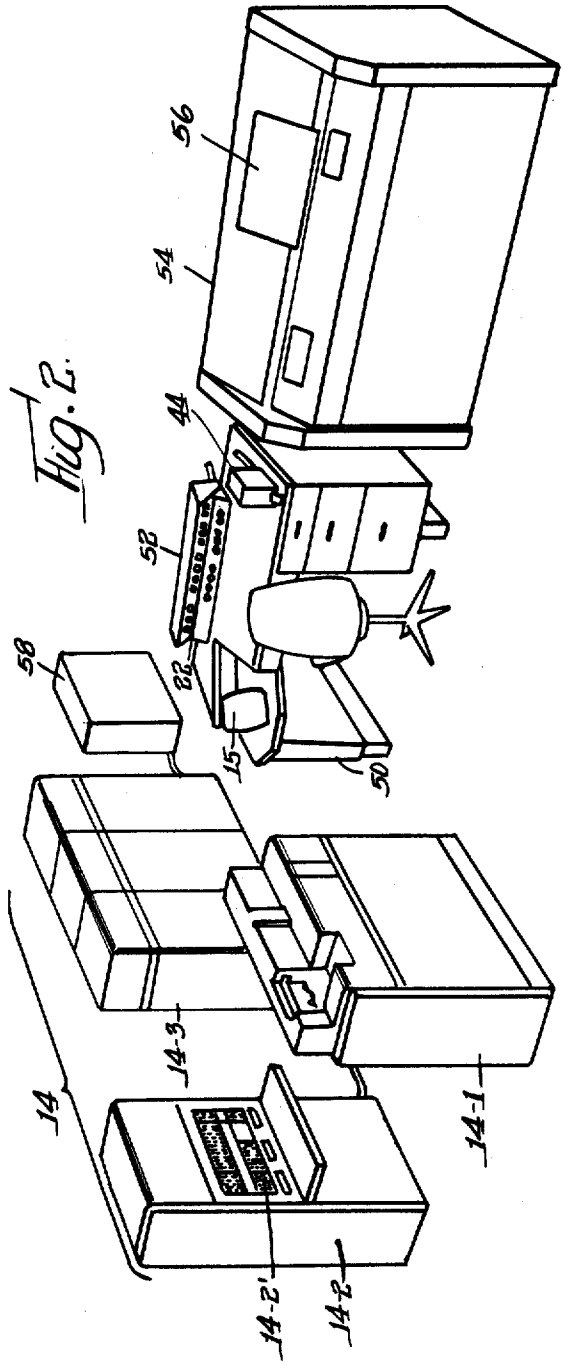

Fig. 2.

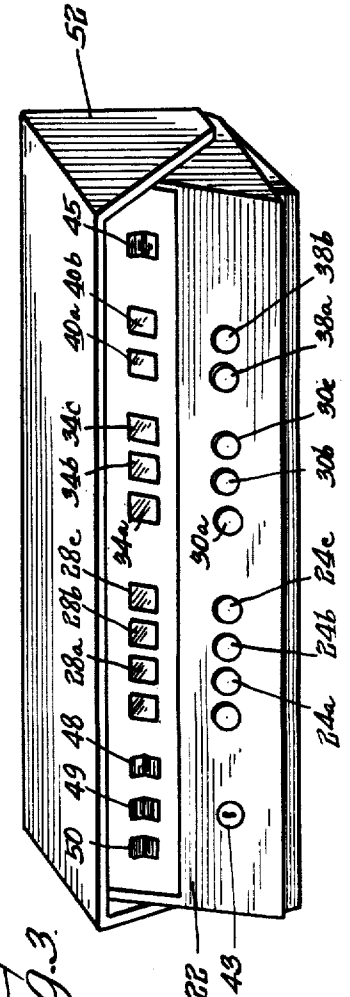

Fig. 3.

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Fig. 4a. OPERATION SWITCH TABLE

	FUNCTION	VISUAL DISPLAY	OPERATION SWITCH POSITION
INFORMATION TYPE	SPARE	BLANK	SWITCH 38a 0
	POINT SKIP THRU RESTORE	POINT SKIP RESTORE	1
	POINT SKIP THRU	POINT SKIP	2
	POINT ELIMINATE RESTORE	POINT SKIP RESTORE	3
	POINT ELIMINATE	POINT ELIMINATE	4
	DISPLAY	DISPLAY	5
	SUMMARIZE	SUMMARY	6
	PRINT	PRINT	7
	STORE	STORE	8
	SPARE	BLANK	9
GENERAL OPERATION	SPARE	BLANK	SWITCH 38b 0
	LOG SEQUENCE	LOG SEQUENCE	1
	OFF SET	OFF SET	2
	GAIN	GAIN	3
	FUNCTION	FUNCTION	4
	LOW ALARM LIMIT	LOW ALARM LIMIT	5
	HIGH ALARM LIMIT	HIGH ALARM LIMIT	6
	SCAN SEQUENCE	SCAN SEQUENCE	7
	VALUE	VALUE	8
	SPARE	BLANK	9

POSITION OF GENERAL OPERATION SWITCH 38a	CONDITION OF DISPLAY WINDOWS			
	VALUE WINDOWS 28a-c	PT. No. WINDOWS 34b+c	GENERAL OPERATION WINDOW 40a	INFORMATION TYPE WINDOW 40b
PT. SKIP RES. 1	OFF	ON	ON	OFF
PT. SKIP THRU 2	OFF	ON	ON	OFF
PT. ELIM RES 3	OFF	ON	ON	OFF
POINT ELIM. 4	OFF	ON	ON	OFF
DISPLAY 5	ON	ON	ON	ON
SUMMARY 6	OFF	OFF	ON	ON
PRINT 7	OFF	ON	ON	ON
STORE 8	ON	ON	ON	ON

Fig. 4b.

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July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

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STORAGE ENTRE C 1 HUBS — INPUTS TO UNIT 14-1

WORD 1 DIGIT 1 HOURLY TIME PULSE
2 DEMAND LOG
3 DEMAND TAPE READER
4 ACTION SWITCH
5 STRIP PRINTER BUSY
6 TYPEWRITER BUSY
7 A.D.C. READY

WORD 2 DIGIT 1 BIT 1
2 BIT 2
3 BIT 3
4 BIT 4
5 BIT 5
} TAPE READER

WORD 3 DIGIT 3 HUNDREDS
2 TENS
1 UNITS
} ADC

WORD 4 DIGIT 7 GENERAL
6 INFORMATION TYPE
} OPERATION SWITCHES
5 TENS
4 UNITS
} POINT NO.
3 HUNDREDS
2 TENS
1 UNIT
} VALUE
} OPERATION CONSOLE

WORD 5 DIGIT 4 HOURS TENS
3 HOURS UNITS
2 MINUTES TENS
1 MINUTES UNITS
} CLOCK

Fig. 5a.

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VARIABLE MONITORING AND RECORDING SYSTEM

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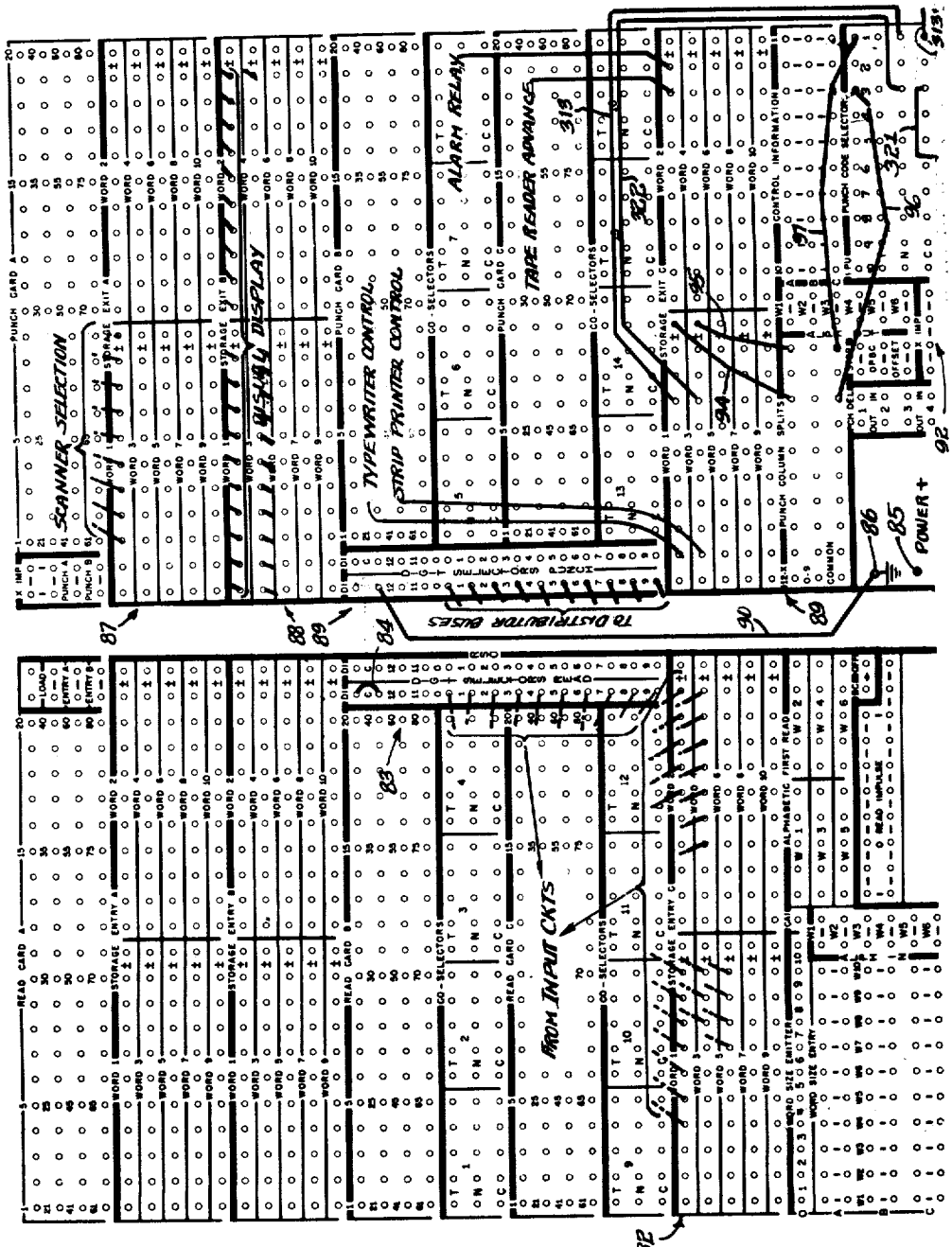

Fig. 5b.

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July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

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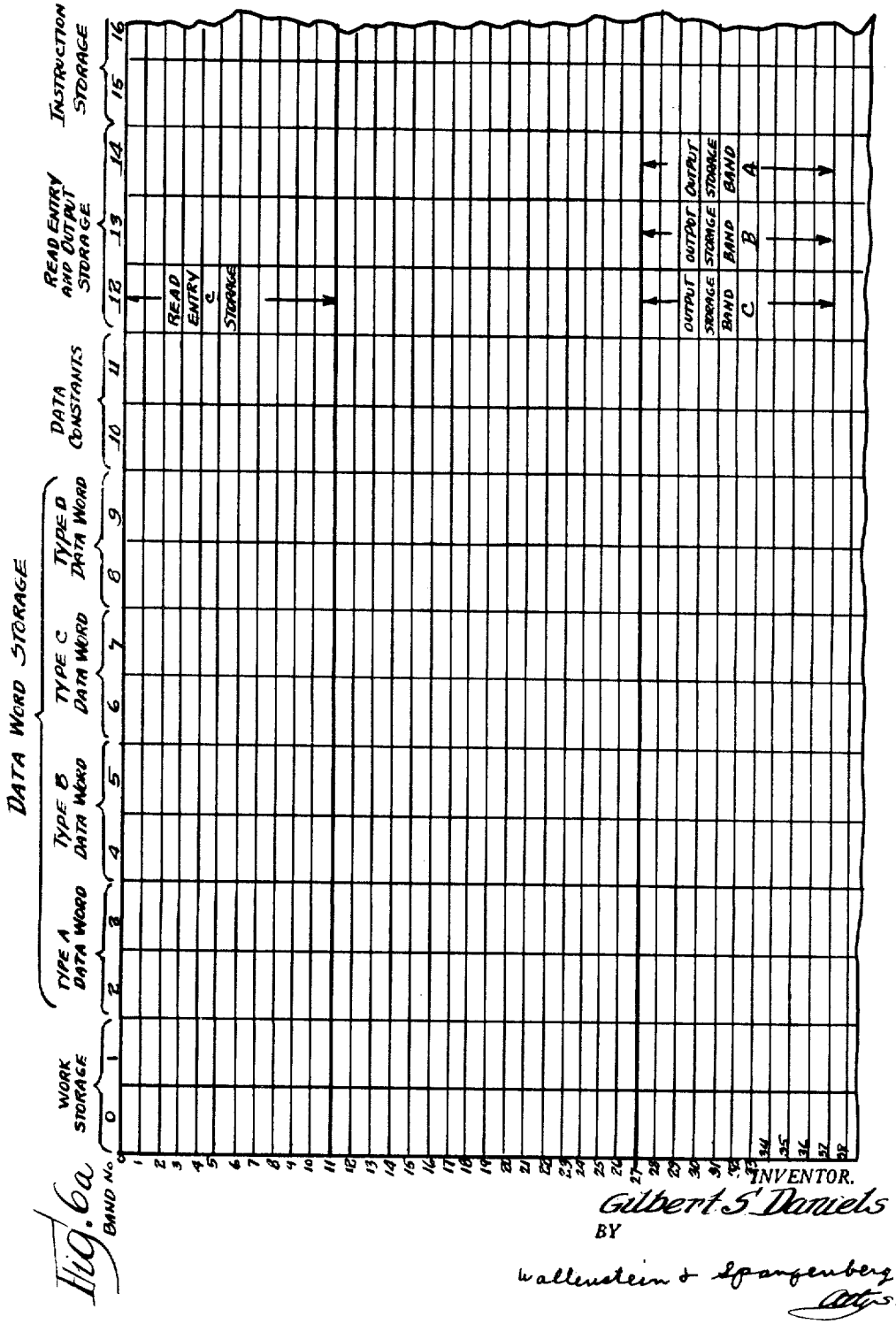

Fig. 6a

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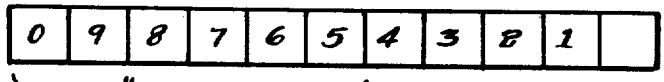
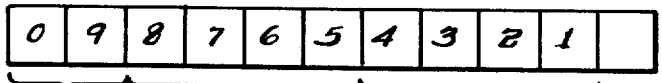
OPERATION INSTRUCTION WORD



ORDER CODE | DATA ADDRESS TO READ | NEXT INSTRUCTION ADDRESS

(a)

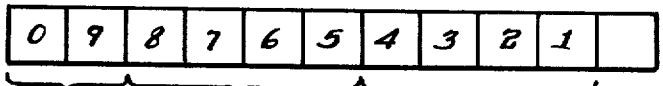
BRANCHING INSTRUCTION WORD



ORDER CODE | "YES" INSTRUCTION ADDRESS | "NO" INSTRUCTION ADDRESS

(b)

LINK INSTRUCTION WORD



ORDER CODE (ZEROES) | NOT USED ALL ZEROES | LINK ADDRESS

(c)

Fig. 10.

Type A		Type B		Type C		Type D	
BLANK	POINT 50	BLANK	POINT 50	BLANK	POINT 50	BLANK	POINT 50
POINT 1	POINT 51	POINT 1	POINT 51	POINT 1	POINT 51	POINT 1	POINT 51
POINT 2	POINT 52	POINT 2	POINT 52	POINT 2	POINT 52	POINT 2	POINT 52

Fig. 6b.

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DATA WORD FORMAT

WORD A

			0 9 8 7 6 5 4 3 2 1
LOW ALARM SET POINT		(5-6-7)=L	0 0 0 L L L 0 H H H
HIGH ALARM SET POINT		(1,2,3)=H	
REMAINING DIGIT POSITIONS ARE ZEROED		(0,9,8,4)	

WORD B

			0 9 8 7 6 5 4 3 2 1
FUNCTION MARKER	DIGIT POSITION	(9) = F	0 F 0 S S S 0 G G G
OFFSET FACTOR	DIGIT POSITION	(5,6,7,)=S	
GAIN FACTOR	DIGIT POSITION	(1,2,3)=G	
ZEROES	DIGIT POSITION	(4,8,)	

WORD C

			0 9 8 7 6 5 4 3 2 1
ALARM PRINT MARKER	DIGIT POSITION	(0) = N	N P 0 A A A 0 B B B
POINT OFF NORMAL MARKER	DIGIT POSITION	(9) = P	
ALARM VALUE	DIGIT POSITION	(5,6,7)=A	
LOG VALUE	DIGIT POSITION	(1,2,3)=B	
ZEROES	DIGIT POSITION	(4,8)	

WORD D

			0 9 8 7 6 5 4 3 2 1
LOG LOADED MARKER	DIGIT POSITION	(0) = W	W E T 0 R R 0 0 U U
POINT ELIMINATE MARKER	DIGIT POSITION	(9) = E	
POINT SKIP THROUGH MARKER	DIGIT POSITION	(8) = T	
LOG SEQUENCE PT. NO.	DIGIT POSITION	(5-6) = R	
SCAN SEQUENCE PT. NO.	DIGIT POSITION	(1,2) = U	
ZEROES	DIGIT POSITION	(3,4,7)	

Fig. 6c

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July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

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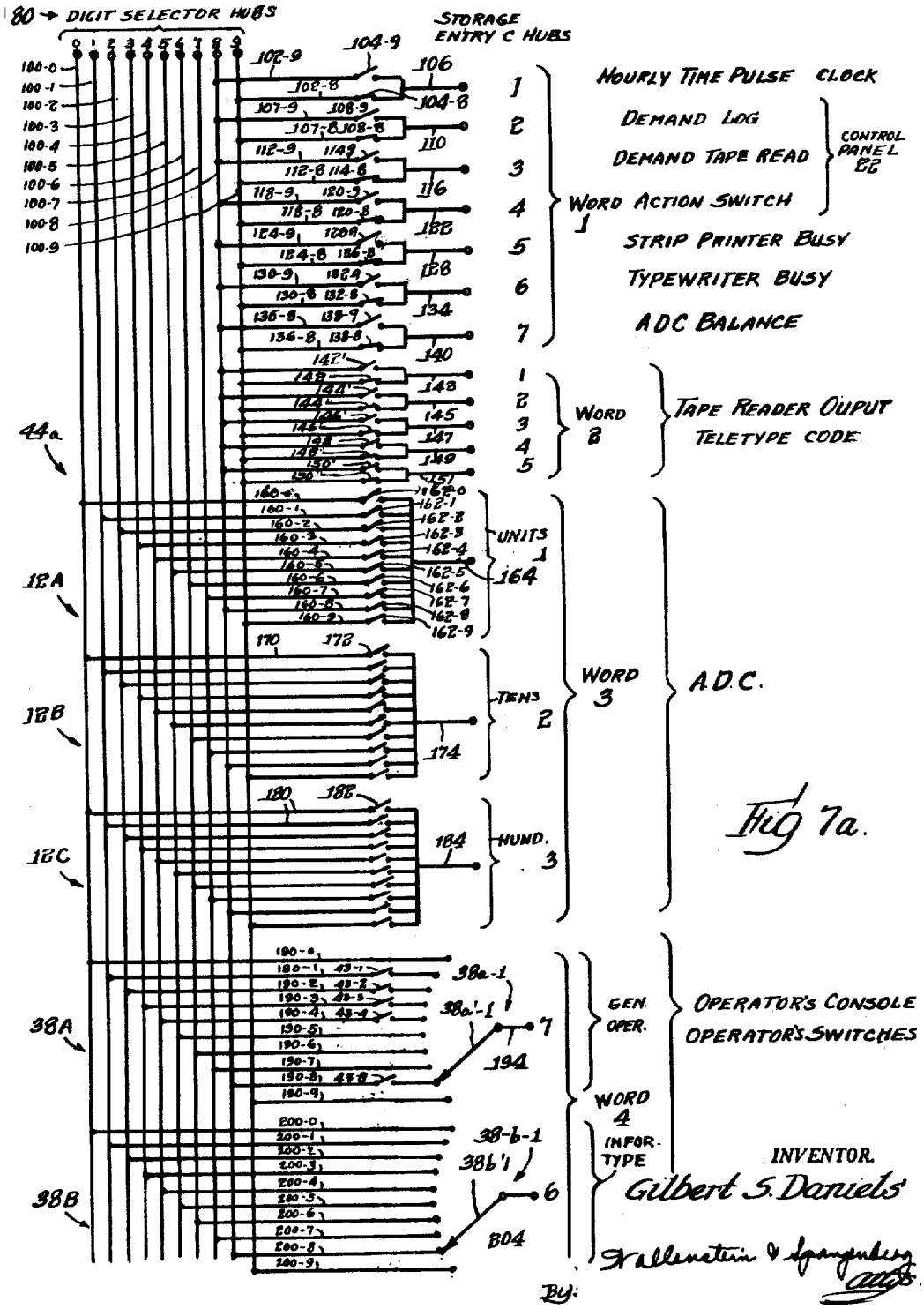

Fig 7a.

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July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

Filed Jan. 20, 1960 17 Sheets-Sheet 10

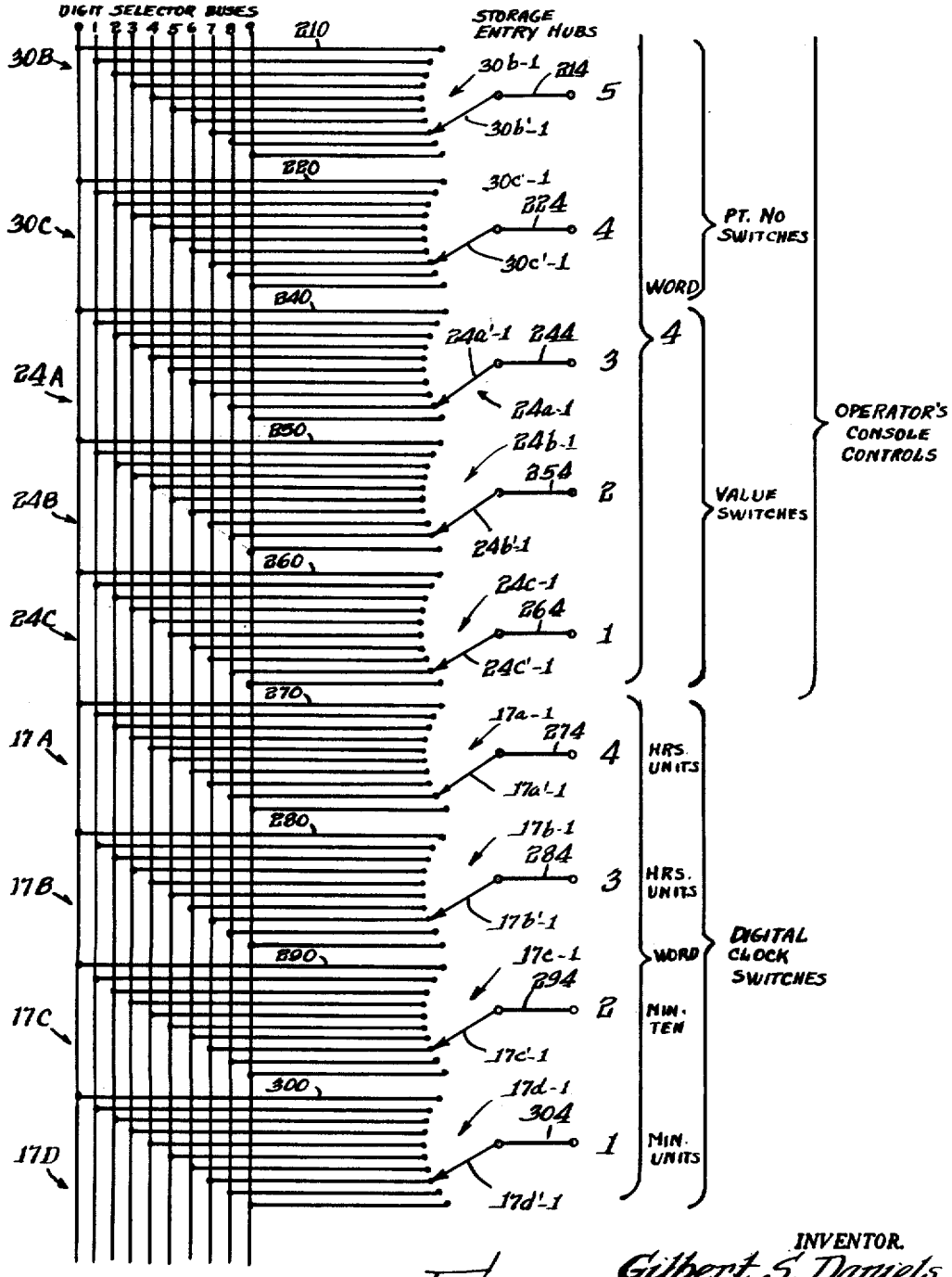

Fig. 7b.

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July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

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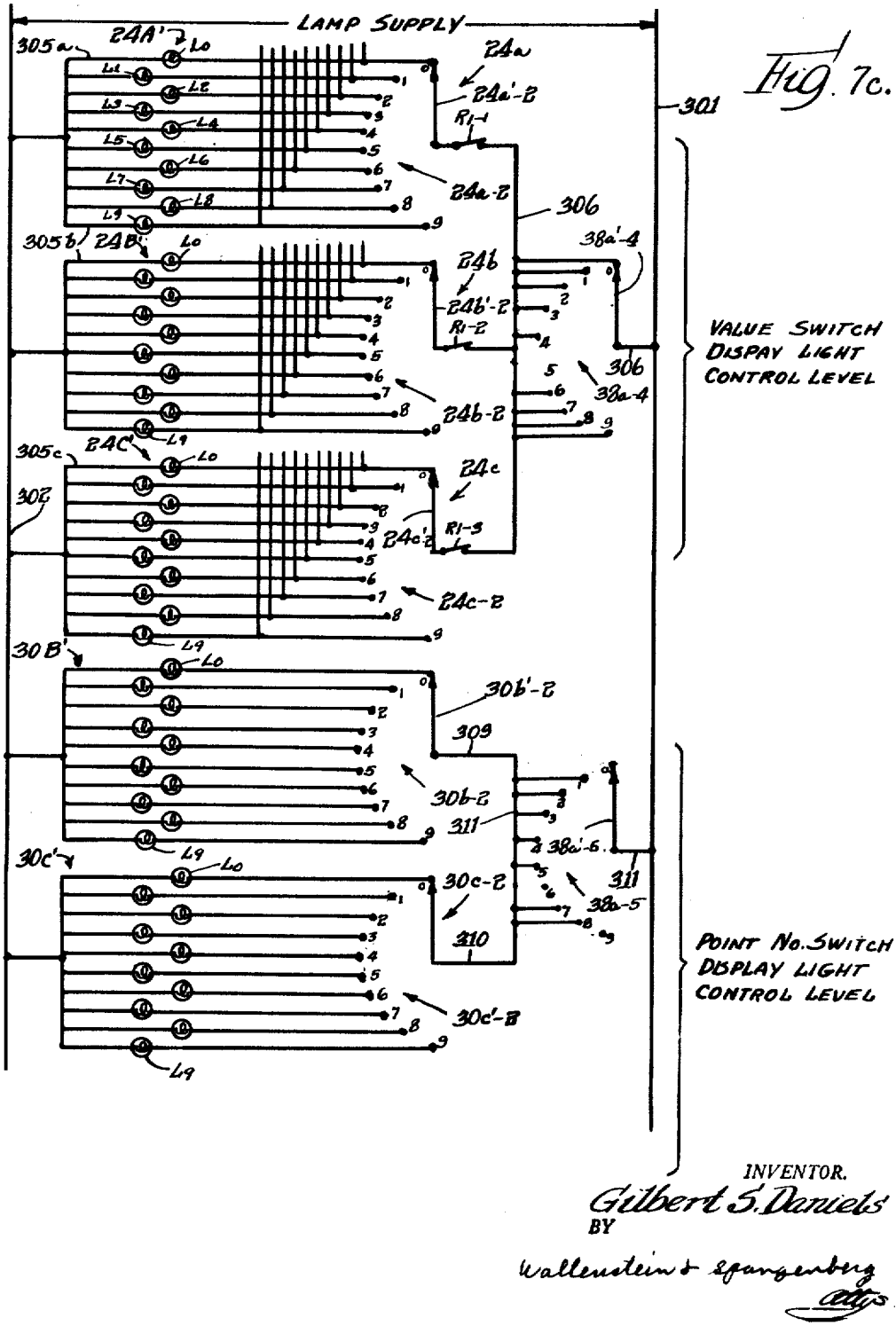

Fig. 7c.

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July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

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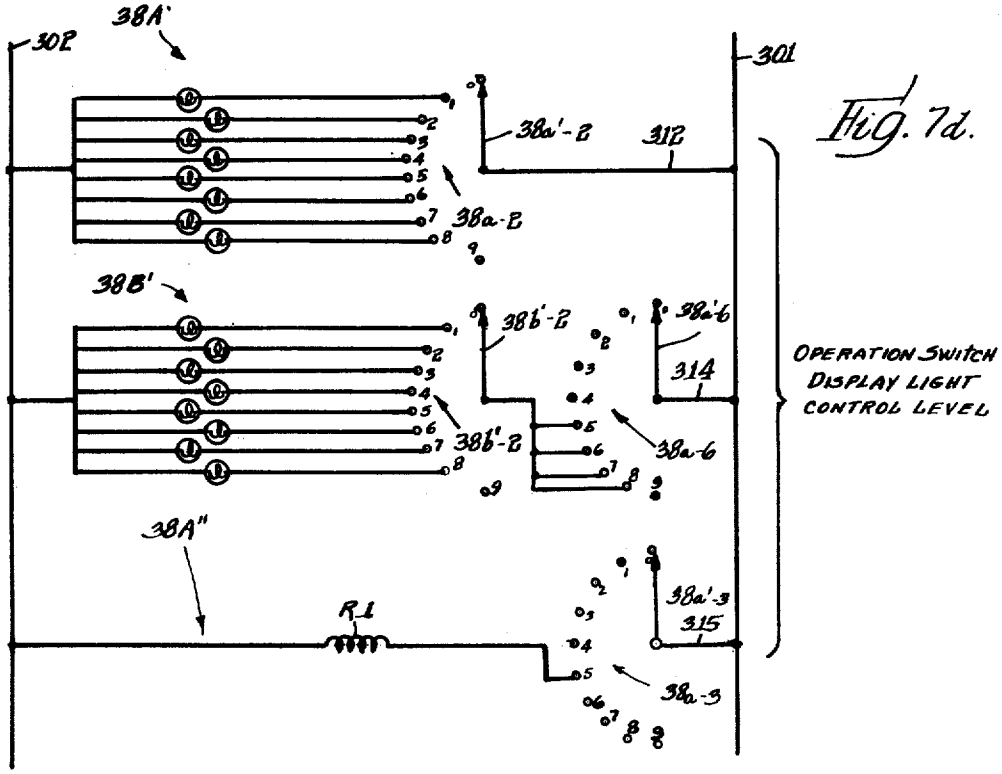

Fig. 7d.

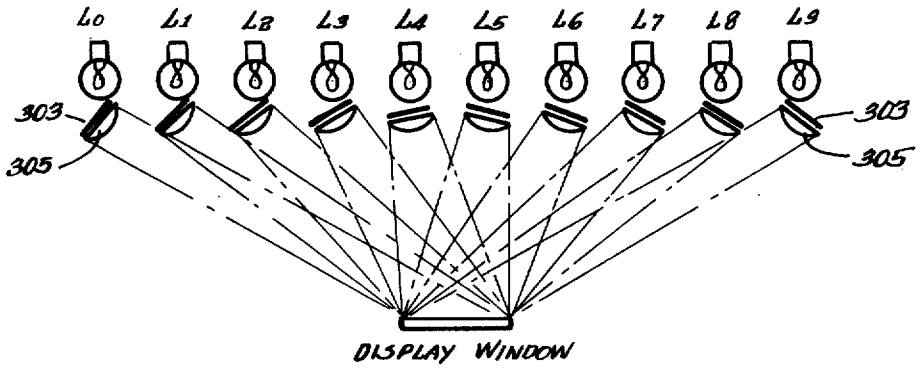

Fig. 7e.

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VARIABLE MONITORING AND RECORDING SYSTEM

Filed Jan. 20, 1960 17 Sheets-Sheet 13

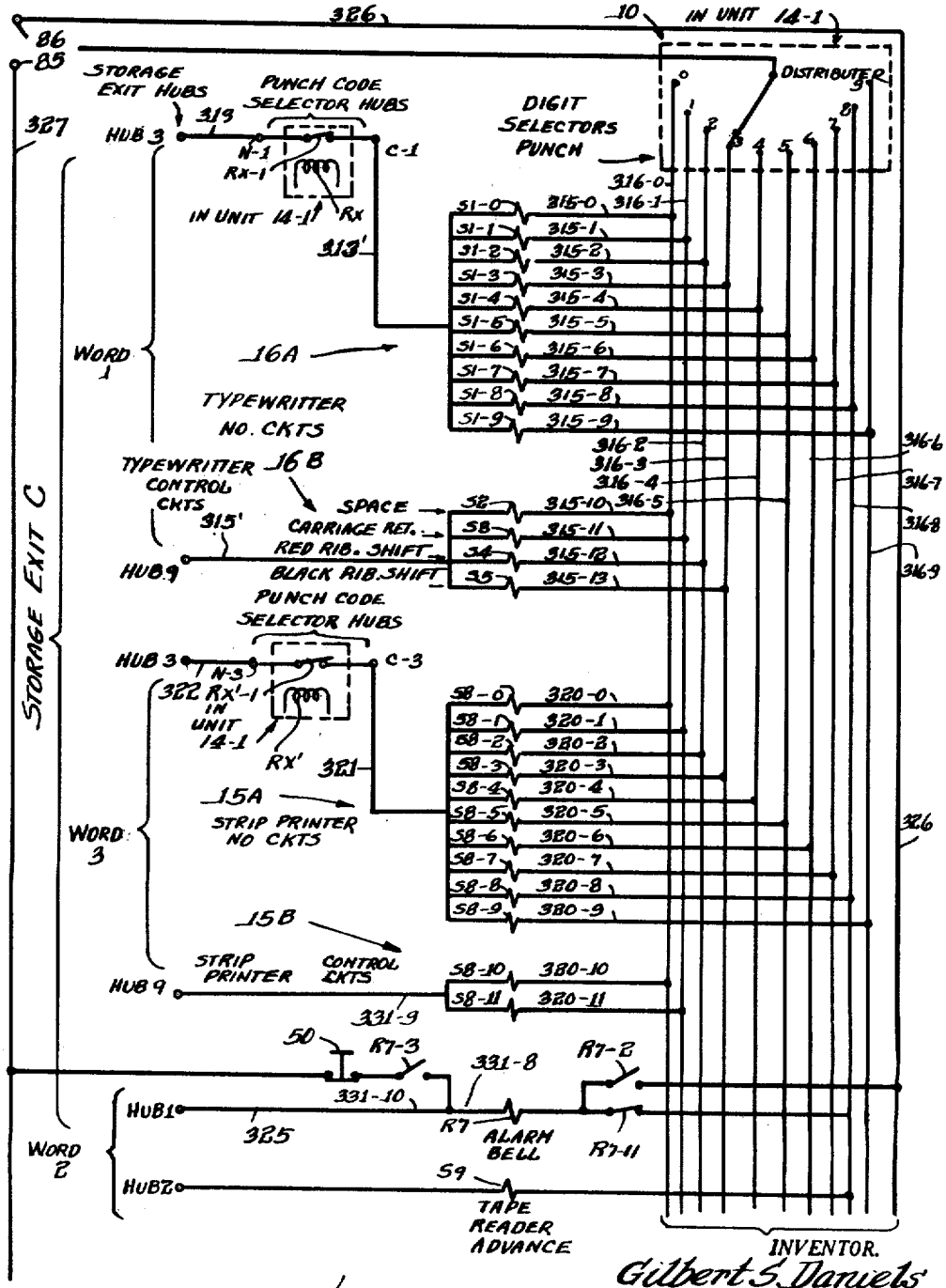

Fig 8a

July 28, 1964 G. S. DANIELS 3,142,820

VARIABLE MONITORING AND RECORDING SYSTEM

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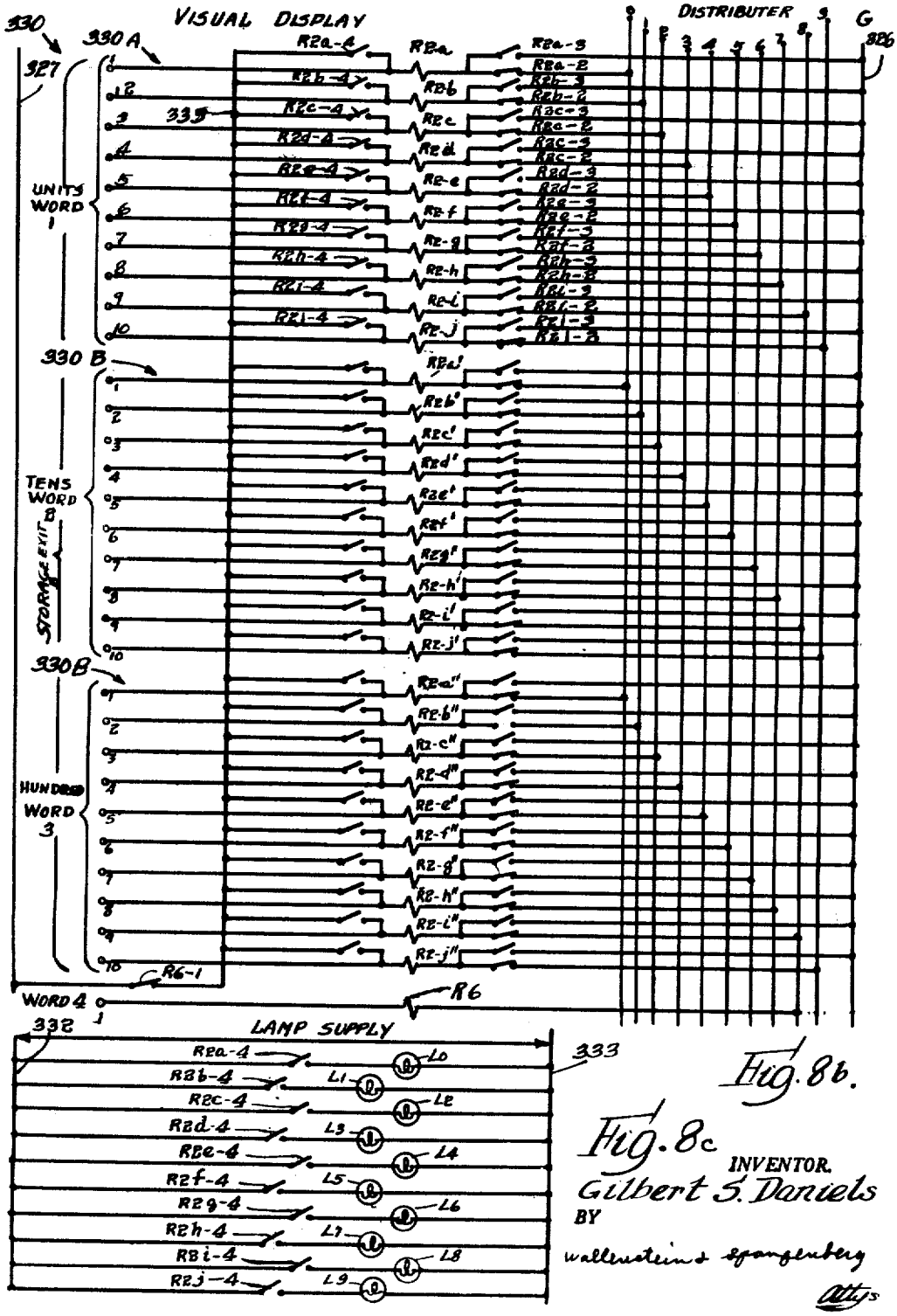

Fig. 8b.

Fig. 8c

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VARIABLE MONITORING AND RECORDING SYSTEM

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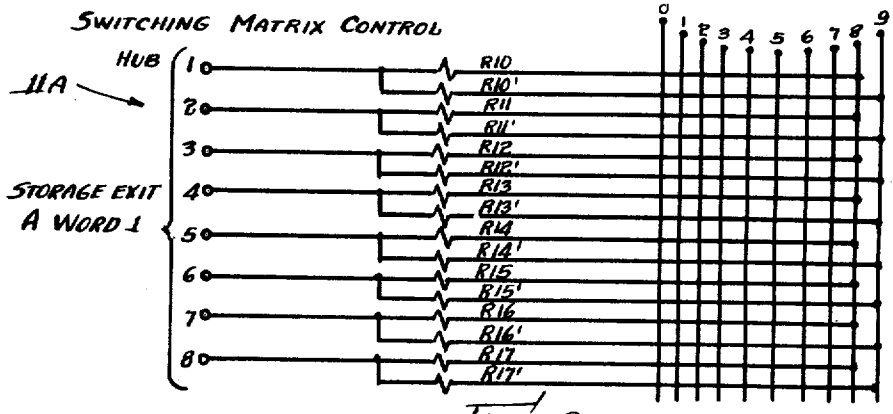

Fig. 8d

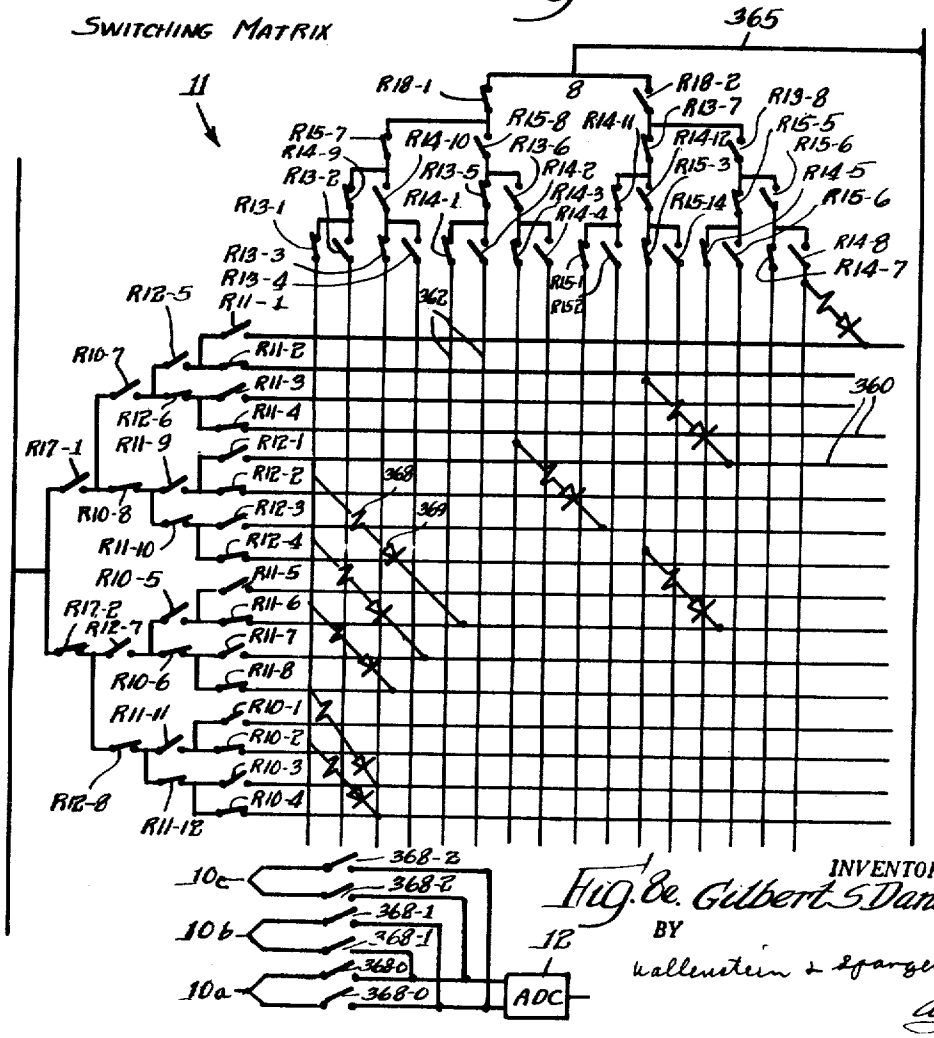

Fig. 8e.

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VARIABLE MONITORING AND RECORDING SYSTEM

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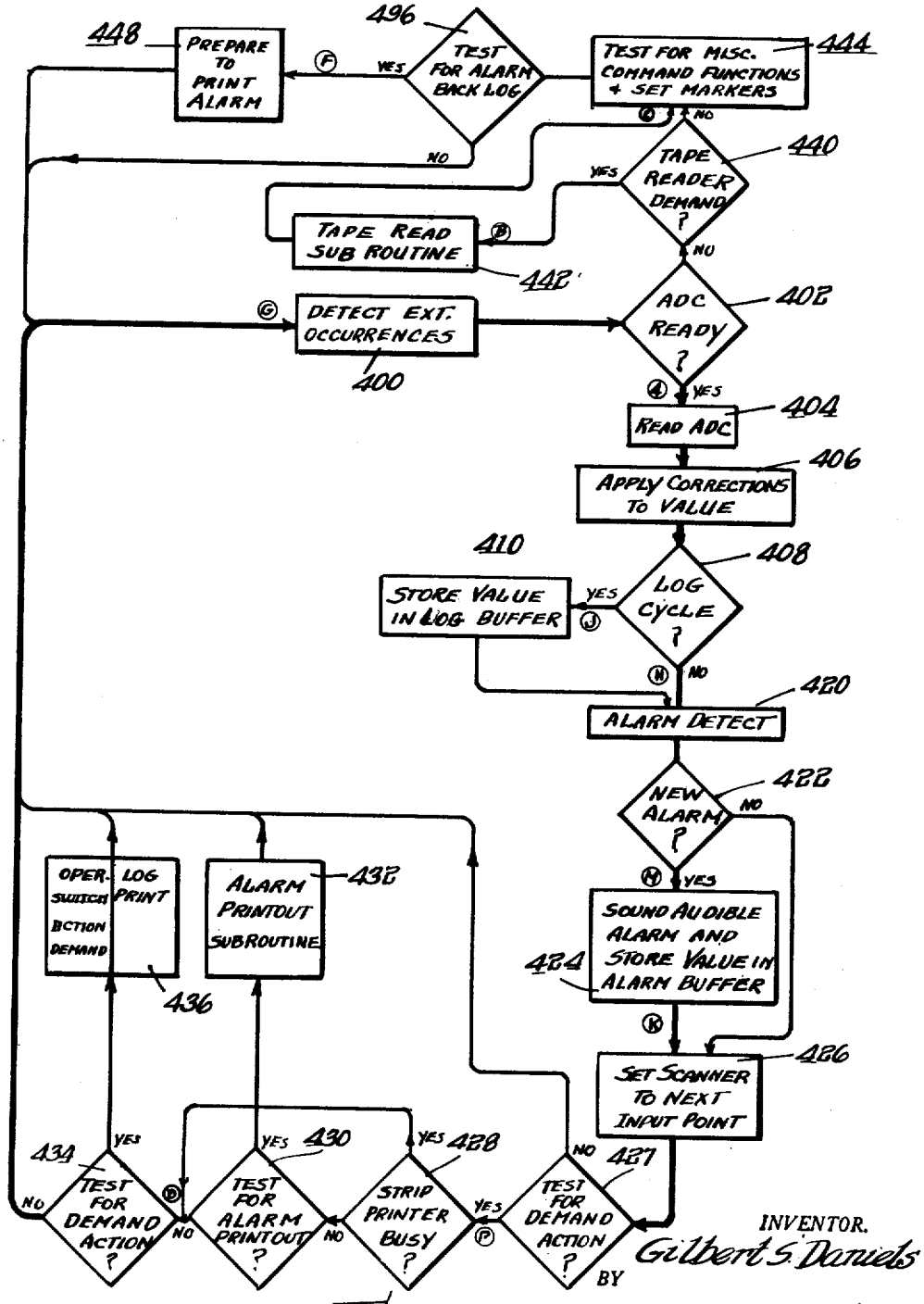

Fig. 9.

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VARIABLE MONITORING AND RECORDING SYSTEM

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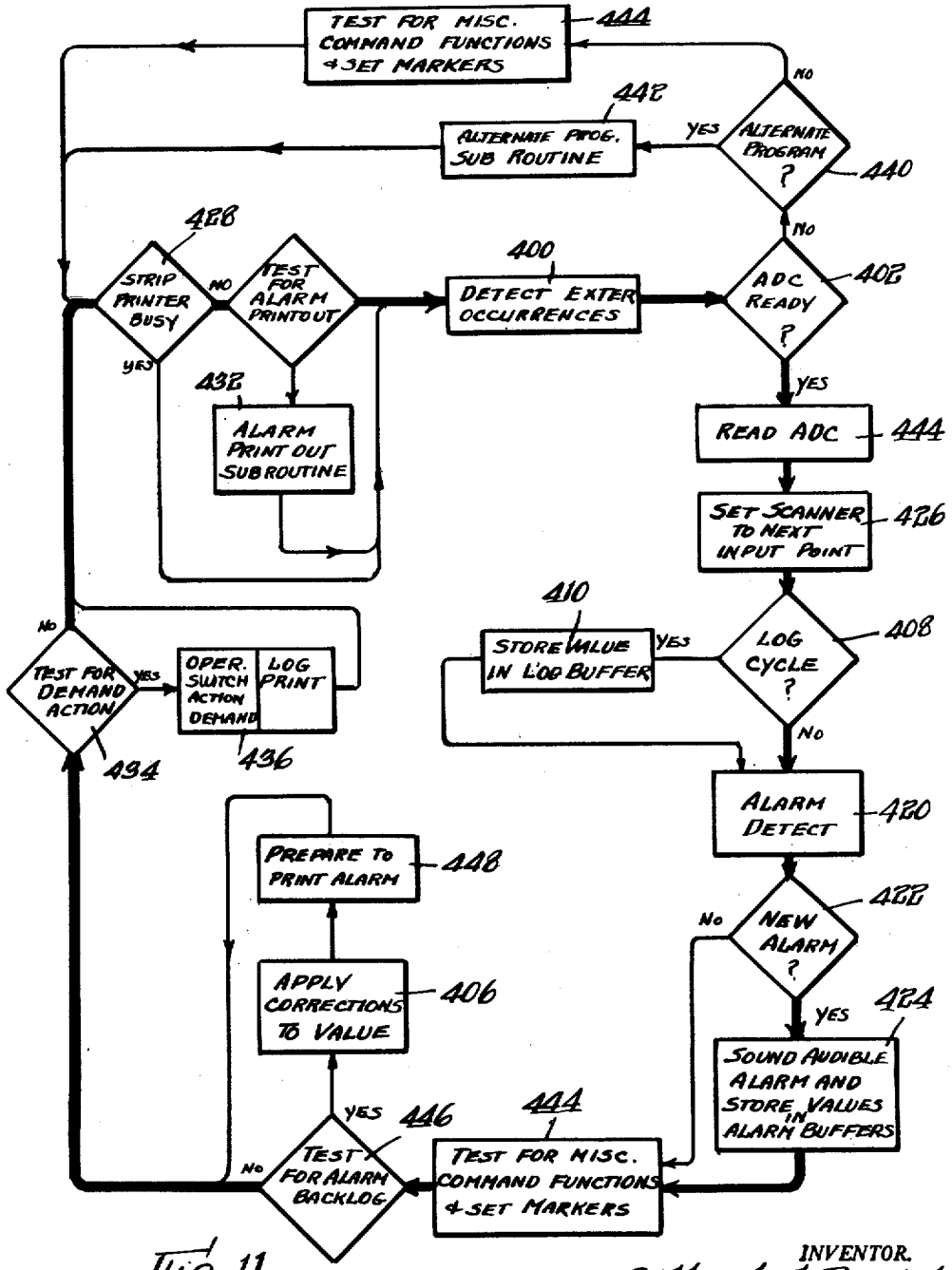

Fig. 11

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United States Patent Office 3,142,820 Patented July 28, 1964

3,142,820 VARIABLE MONITORING AND RECORDING SYSTEM

Gilbert S. Daniels, Evanston, Ill., assignor to The Scam Instrument Corporation, a corporation of Illinois

Filed Jan. 20, 1960, Ser. No. 3,535
33 Claims. (Cl. 340—172.5)

The present invention relates to apparatus for continuously monitoring the conditions of variables and for recording the values thereof. The invention concerns itself primarily with a system for continuously monitoring a large number of variables for abnormal conditions and for placing before an operator large masses of information concerning most of the variables in printed numerical form so that such information can be quickly digested by an operator of the system. Such a system, for example, is disclosed and claimed in U.S. Patent No. 2,922,990 to be granted January 26, 1960, from application Serial No. 630,721, filed December 20, 1956. The present invention is an improvement over the variable monitoring and recording system disclosed and claimed therein.

Variable monitoring and recording systems commonly include scanning means for sequentially scanning a large number of variables in a predetermined order and an alarm detecting means for detecting alarm conditions by comparing signals from transducers associated with the variables with pre-set signals representing upper and lower alarm limits of the variables. The upper and lower alarm limits are generally manually set by individual manually adjustable potentiometers, or plugboards which vary the tap-off points of tapped resistance elements. In a similar way, gain correction and scale offset factors are sometimes set for the various variables. The values of the variables scanned are sometimes read or "logged" out immediately upon an output printing device, such as a typewriter, and, more recently, have been stored in storage means such as magnetic drum or core storage means for later read-out automatically or on demand upon an output printing device. In a few instances, by making adjustments of physical terminal connections, the sequence in which the variables are scanned or data thereon printed out can be varied somewhat. However, the various techniques heretofore used for inserting gain, offset and high and low alarm limit data constants and for varying the order of scanning or print-out of data on the variables has been cumbersome.

It is, accordingly, an object of the present invention to provide continuous monitoring and recording apparatus with greatly improved flexibility, particularly with regard to the manner in which the apparatus may be modified to monitor and record new variables having different data constants or to change the order in which variables are scanned or in which data thereon is printed out, or to temporarily eliminate certain selected variables from the scanning program or to eliminate temporarily the print-out of data on selected variables.

Another object of the present invention is to provide monitoring and recording apparatus as just described wherein such data constants as high and low alarm limits, gain and zero offset factors, etc., may be changed for the variables individually or en masse and without interrupting the scanning or recording operations being performed thereby, which is of great importance in a monitoring system where even temporary shutdown of the system for modifications might endanger the equipment and personnel handling the same.

In accordance with the most preferred form of the present invention, the variable monitoring and recording system includes a unique and highly advantageous remote

operator's control panel which is most advantageously located remotely from a master operator's station at which the master controls of the variable monitoring system are located. The master controls, for example, may include major programs varying controls and start-stop switches which can be handled by only highly skilled and qualified personnel. Any incorrect adjustments here could severely disrupt and even cause complete breakdown of the variable monitoring system. The remote operator's control panel is used to modify data constants, scan sequence orders, etc. for one variable at a time and other functions to be described, none of which can shut down the variable monitoring system or change the basic program set therein. Different operators may work independently at the master control station and the remote operator's control panel. The remote operator's control panel has a series of value and point (i.e., variable) identifying digit switches and a pair of operation switches, one of which sets up a basic or general operation to be performed by the operator from the panel (such as a store, print, summarize, display stored values of variables and constants stored, eliminate variables from scan or print-out, and change scan and print-out sequence operations). The other operation switch, which will be referred to sometimes as an information type operation switch, characterizes more fully the specific operations to be carried out from the panel. The different positions of the information type operation switch may be respectively variable value, scan sequence, high alarm limit, low alarm limit, function, gain, offset and log sequence affecting operations.

The "store" operation set up by the general operation switch is one where the value, scan sequence, high or low alarm limit, function, gain, offset or log sequence information set up on the aforesaid value digit switches will be stored in a data storage section of the variable monitoring and recording system determined by the positions set on the point identifying switches. The "print" operation set up by another position of the general operation switch is one where the variable value, high alarm limit, low alarm limit, gain or offset data constant values stored in a data storage location for the variable identified by the number set up on the point identifying switches will be printed out on one of the output printing devices used in the system. The "summarize" operation set up by the general operation is one where the values of the data constant type set up on the information type operation switch will be printed out on one of the output printing devices for all pre-determined variables on which summarizing is desired.

The operator's control panel is also provided with a series of display windows which indicate in numerical digital form the values and point numbers set up on the value and point identifying switches, and, in the language of the operator, the operation set up on the operation switches.

The "display" operation set up on the general operation switch is one where the type of information set up on the information type operation switch, such as data value, gain, offset, high or low alarm limit is displayed on a series of value display windows on the operator's panel for the variable set up on the point identifying switches thereof by an operation which feeds control signals from the storage section of the monitoring system to a series of control relays or the like controlling the lights of a projection system which project the proper numbers upon the display windows.

The "point eliminate" operation set up on the general operation switch is one where the variable set up on the point identifying switches is eliminated from both scan-

ning and printing operations. The "point eliminate restore" operation set up on the general operation switch is one which cancels the effect of a previous point eliminate operation for the particular variable set up on the point identifying switches.

The "point skip through" operation set up on the general operation switch eliminates only print-out of the variable value for the variable identified by the number set up on the point identifying switches. The "point skip through restore" operation set up on the general operation switch cancels the previous point skip through operation set up for the variable identified by the number set up on the point identifying switches.

The "store scan sequence" or "store log sequence" operations set up on the operation switches is one where the order of scanning or print-out of data on the variable identified by the number set up one group of digit switches on the operator's control panel (preferably the value switches) is the number set up on another group of digit switches thereon (preferably the point identifying switches).

A data storage section is provided for storing the information set up on the operator's control panel, and this preferably comprises a magnetic storage means such as a magnetic drum or core storage means on which data for the variables are most advantageously arranged in groups called data blocks. Other storage locations are provided in which general instructions are preferably stored to provide a series of program sub-routines arranged in order of certain pre-determined priorities and which adapt the system for a wide variety of operations depending, among other things, on the setting of the switches on the operators' control panel. The data storage section is preferably operated in conjunction with conventional computer components that perform alone or through program instructions various arithmetic calculations for introducing said gain and offset factors and performing alarm detection operations.

Location address numbers are assigned to the data blocks which numbers may correspond to the numbers identifying the variable to which the data constants in the blocks involved pertain and which are positioned for access in the order corresponding to the address number. Each of the data blocks in addition to containing high and low alarm limit, gain, offset, function information, etc., additionally includes storage locations for scan and log sequence affecting numbers completely unconnected with the variable involved, such numbers being the numbers set therein by the aforesaid scan and log sequence changing operations and comprising the numbers identifying the variables which are respectively to be scanned and logged in accordance with the position or address number of the data block involved. When a scanning operation is called for by the program, the scan sequence affecting number is read out from the data block having the next higher address than the data block previously used for obtaining this number, and a switching matrix is set up according to the scan sequence identifying number to select the proper variable input. It can be seen that the order in which a variable is scanned may be changed by simply changing the stored variable identifying number (i.e., the scan sequence affecting number) in the data block having the address number corresponding to the order in which the variable involved is to be scanned. The order in which a variable is printed out is determined in a similar manner.

The operator's control panel is further provided with an "action" switch which is depressed after the other switches thereon have been set up. Until the "action" switch is operated, nothing results from the adjustment of the switches on the panel. Then, only when the program calls for the particular information set up on the control panel switches will a particular operation be carried out, and without requiring any shutdown of the monitoring system or affecting any alarm detection or other operation being carried out when the action button is depressed.

Once the action switch is depressed, the operation set up on the control switches cannot again be carried out until the action button is again depressed.

It is apparent that the operator's control panel is so designed that persons having ordinary skill may readily operate the same. However, in some cases, it may be desirable to prevent less skilled personnel from operating the control panel in a manner which would result in the changing of important data constant information into the data storage section of the system. To this end, the control panel is provided with a key-operated lock switch which, when actuated to an interlock position, will prevent any store operations from being performed thereby.

Where data constants for a large number of variables are to be changed, the new data constants are read-in to the associated data blocks by a tape reader controlled by the aforesaid program so that the monitoring system need not be shut down. In such case, the tape reader is operated to feed in limited amounts of information each program cycle so that the main program alarm detection program of the monitoring system is not held up to any significant degree. The program sub-routine involving the feeding in of information from the tape reader is thus interwoven with the main program of the monitoring system.

Other objects, advantages and features of this invention will become apparent upon making reference to the specification to follow, the claims and the drawings wherein:

FIG. 1 is a simplified box diagram of the various components of an exemplary variable monitoring and recording system utilizing the features of the present invention;

FIG. 2 is a perspective view of an exemplary installation of the present invention;

FIG. 3 is a perspective view of the operator's control and display console;

FIG. 4*a* is a chart showing the various functions which are effected by the operation switches **38***a* and **38***b* and the visual displays which are shown on the associated display windows of the operator's control and display console for each position of the switches;

FIG. 4*b* is a chart showing the interlocks between the switches and the display lights which light up the display windows on the operator's control and display panel;

FIG. 5*a* is a chart illustrating the various input connections to the IBM Type 650 data processing machine;

FIG. 5*b* is a view of the input and output terminal hub strip on the IBM Type 650 read-punch unit and various connections made thereto when used with the present invention;

FIGS. 6*a* and 6*b* illustrate the layout of various types of information on the drum storage unit of the IBM machine;

FIG. 6*c* is a chart showing the various data word types forming a data block of information related to a particular variable and the information contained therein;

FIGS. 7*a*, 7*b*, 7*c* and 7*d* are the circuit diagrams for the input circuits of the present invention which are fed into said IBM machine;

FIG. 7*e* is a diagram illustrating the manner in which information is projected upon a display window on the operator's control and display panel;

FIGS. 8*a*, 8*b*, 8*c*, 8*d* and 8*e* are circuit diagrams of the various output circuits of the invention which are connected to said IBM machine;

FIG. 9 is a flow sheet showing an exemplary program format used in connection with the present invention;

FIG. 10 is a diagram illustrating the makeup of operation instruction, branching instruction and link instruction words which are used in forming the program used in FIG. 9; and

FIG. 11 is an exemplary alternate program which is used in connection with the present invention where a very high speed data processing machine is used therewith.

GENERAL DESCRIPTION

Refer now to FIG. 1 which shows the basic elements of an exemplary form of the present invention. The recording system there shown includes a series of analog input devices generally indicated by reference numeral **10** which provide voltage outputs having amplitudes which are respectively a measure of the values of the variables involved. The analog inputs, for example, could be thermocouples in the case of temperature variables or bellows-operated potentiometers in the case of pressure variables, etc. The various analog inputs are fed to a switching matrix generally indicated by reference numeral **11** which is a switching system which sequentially connects various analog inputs in a predetermined order (and under control of various components forming one aspect of the present invention) to the input of a conventional analog to digital converter **12** which has at least three groups of outputs which respectively indicate the hundreds, tens and units digits of the apparent value of the variable being scanned by the switching matrix **11**. These three groups of digital outputs are fed to input terminals of data storage, calculator and control means generally indicated by reference numeral **14** which most desirably comprises any one of a number of presently available data processing machines or computers, such as the Model 803 computer manufactured by Elliott Bros. Ltd., of London, England. However, although the latter computer is highly preferred for its speed of operation, particularly in its electronic switching of external inputs and its use of high speed of access core storage, the much slower IBM type 650 magnetic drum data processing machine is used in the present description in connection with the present invention because the machine has been in general use and has been well known in this country for many years and the necessity for disclosing the internal make-up of the machine is obviously unnecessary for the purposes of the present disclosure. An exemplary program which is fed electrically into the magnetic drum thereof will, however, be disclosed since it ties together and includes many unique features of the present invention. It should be understood, however, that the particular storage calculation and control means **14** used forms no part of the present invention.

The storage, calculator and control means illustrated in FIG. 1 has a storage unit **14***a'* in which is stored in various addressable locations the values of the variables scanned, data constants and operation and branching instructions forming the aforesaid program. A number of related storage positions in the storage unit **14***a'* for data on a particular variable will be referred to as a data block.

The data storage section **14***a* may also include a calculator section **14***b* which has suitable addition and complementing circuits as, for example, disclosed in U.S. Patent No. 2,901,166, and a control section **14***c* which, among other things, responds to the various instructions fed from the storage unit **14***a* by controlling the feeding of various signals to and from the storage unit **14***a'*, calculator section **14***b* and other parts of the machine in a manner well known in the art.

In addition to storing the values of the variables indicated by the outputs of the analog to digital converter **12**, the data storage calculator and control means **14** (under control of a continuously recycling main program and sub-programs called for at times by various externally controlled conditions to be described) compares the value of the variable scanned at any instant with high and/or low alarm values stored in magnetic storage unit **14***a'*, and effects operation of a horn **18** and a printout of the identity of any new abnormal variable and its value thereof on a strip printer **14** or other desired output printing device, such as typewriter **16**. In the case where the analog inputs **10** to the machine involve different analog input devices having different scale offset and gain factors,

in order to print out on the strip printer **15** the actual values of the variables, both an offset and a gain correction operation must be carried out in a manner well known in the art.

At regular intervals, such as hourly, it is customary in variable monitoring and recording systems to print out the values of certain preselected variables so that a permanent readily usable record of these variables is made and checked by an operator. This data is preferably printed out on the typewriter **16**. A digital time clock **17** having timing contacts is provided which feeds a signal into the input of the control means **14** hourly to effect storage of the hourly values of the variables to be printed out in designated positions in the storage unit **14***a'*. Then, signals indicating the values of these variables corrected for gain and offset factors are fed to the typewriter **16** together with time information obtained from the digital time clock **17** to indicate the time at which the variable measurements were taken.

In accordance with the present invention, the variable monitoring and recording system is provided with a means for readily enabling modification of data constants, such as high and low alarm limits, gain and offset factors, etc., the order of scanning the variables, the order in which the data of the variables is printed out on the output printers **15** or **16** or whether a given variable is scanned or data thereon printed out at all. This means includes an operator's control and display panel **22** most advantageously including a first group of manual controls **24** forming the operating portions of three value switches **24***a*, **24***b* and **24***c* which respectively set up the hundreds, tens and units digits of a number represented by signals appearing on corresponding output lines **26***a*, **26***b* and **26***c*. Each of these value switches has 10 positions representing the digits 0 through 9. The value switches are also effective to set up a visual digital display of the number set up thereon upon a series of value windows **28***a*, **28***b* and **28***c*. (In case a thousand digit is desired, an additional value switch and an associated window may, of course, be added to the operator's control and display panel **22**.) The value switches are, for the most part, used to set up the various aforesaid data constant values for a particular variable which is to be stored in the storage unit **14***a'*.

The operator's control and display panel **22** has a second group of manual controls **30** forming the operating portions of point identifying digit switches **36***a*, **36***b* and **30***c*. Only switches **30***b* and **30***c* will be used in the exemplary form of the invention being described. The switches **30***b* and **30***c* each has ten positions representing the digits 0 through 9 and are adapted to set up signals on output lines **32***b* and **32***c* respectively representing the tens and units digits of a number which, for the most part, identifies the variable to which the number appearing in the value display windows **28***a*, **28***b* and **28***c* relates. The switches **30***a*, **30***b* and **30***c* are also operative to set up a visual digital display of the number set up thereon upon a pair of display windows **34***b* and **34***c*. The various signal output lines **26***b* and **26***c*, and **32***b* and **32***c* extend to the input of storage unit **14***a'*.

In addition to reading information in the storage unit **14***a'*, the operator's control and display panel **22** is used to display on the value display windows **28***a*, **28***b* and **28***c* data constant and variable value information stored in the storage unit **14***a'* for the particular variable set up on the display windows **34***b* and **34***c* by the point number switches. A series of conductors **35** accordingly extend from the output of the data storage calculator and control means **14** to various control circuits which may be contained within a console or housing behind the panel **22** to be referred to as the operator's console.

To enable the operator to select the path of flow of signals to or from the various controls and display windows just described, and to readily identify the information displayed in the value windows **28***a*, **28***b* and **28***c*

and the point number windows **34***a*, **34***b* and **34***c*, the panel **22** is further provided with a pair of manual controls **38** forming the operating portions of a pair of switches **38***a* and **38***b* to be referred to as the general operation switch and the information type operation switch, respectively, and associated operation display windows **40***a* and **40***b*. The general operation switch **38***a* has ten digit positions 0 through 9, some of which set up in associated display window **40***a* in the language of the operator the general operation to be initiated by the controls on the panel **22**. These general operations are:

Store
Print
Summarize
Display
Point eliminate
Point eliminate restore
Point skip through
Point skip through restore

The information type operation switch **38***b* has ten digit positions 0 through 9 some of which set up in the associated display window **40***b* in the language of the operator any one of the following elements of information which together with the information in the display window **40***a* represents the complete operation set up by the controls on the panel **22**:

Value
Scan sequence
High alarm limit
Low alarm limit
Function
Gain
Offset
Log sequence

Some of the information set up in the display windows **40***a* and **40***b* may be abbreviated as indicated by the table of FIG. 4*a*.

The operation switches **38***a* and **38***b* also set up signals representing the digit positions thereof on lines **42***a* and **42***b* which extend to the input of the storage unit **14***a'*. Not all the combinations of the information appearing in the windows **40***a* and **40***b* together form a useful operation command and the value and point number display windows do not contain useful information for every position of the general operation switch **38***a*. For example, for the point eliminate, point eliminate restore, point skip through and point skip through restore positions of the general operation switch **38***a*, the variable type operation switch **38***b* has no use and no information thus should be displayed on the other window **40***b* for these positions of the switch **38***a*. Also, the value switches have no use in these positions of switch **38***a*. To this end, various interlocks are provided for shutting off the displays on the various display windows in accordance with the chart of FIG. 4*b*.

When the "store" operation appears in the operation window **40***a*, this means that the controls on the panel **22** will be operative to store in an appropriate storage position in the storage unit **14***a'* for the type of information displayed in operation window **40***b* in the data block for the variable involved the number set in the value display windows **28***a*, **28***b* and **28***c*. The store operation is possible only when a key lock switch **43** on the panel **22** is turned by a key inserted into a key slot thereof. This prevents unauthorized personnel from reading incorrect or unwanted data constants into the storage unit **14***a'* which would be particularly serious where high or low alarm limits are involved.

When the operation display window **40***a* shows that a "print" operation is involved, the type of information identified in the operation display window **40***b* for the variable identified in the point number windows **34***b* and **34***c* will be fed from the appropriate storage position of storage unit **14***a'* to strip printer **15**.

When the display window **40***a* indicates that a "summarize" operation is involved, the type of information on operation display window **40***b* is fed from the storage unit **14***a'* to the strip printer **15** for substantially all variables.

When the operation display window **40***a* indicates that a "display" operation is involved, then information is fed from storage unit **14***a'* to the input of the operator's control and display console which will present a value number in the value windows **28***a*, **28***b* and **28***c* for the type of information set up on the display window **40***b* for the variable identified on the point number windows **34***b* and **34***c*.

When the operation window **40***a* shows that a point eliminate operation is involved, the variable identified by the number in the point number windows **34***b* and **34***c* is not scanned and its data is not printed out for the time being.

A "point skip through operation" indicated on window **40***a* is one wherein the value of the variable identified in point number windows **34***b* and **34***c* is not printed out during the regular hourly print-out intervals. This may be desired, for example, where a variable is one which is relatively unimportant or whose value is generally a steady value and only detection of off-normal conditions is of importance.

The aforesaid "restore" operations indicated on window **40***a* cancel a previous skip through or point eliminate operation so that the variable is scanned and/or its value printed out as the case may be.

The "function" data constant is a word or marker which is usually stored in substantially every data block of the storage unit **14***a'* and in general is related to the type of variable being scanned where different variable types are involved, such as temperature, pressure, etc. Certain subroutine programs may be set up, such as linearization, square root programs, or special printout programs, which depend upon the type of variable being scanned. Although only a square root sub-routine is used in the example of the present invention being discussed much more complex and diverse computations within the ability of the particular data processing machine involved and other operation functions could be initiated by the function constant. Quite apart from these computations the functions carried out by the variable monitoring system can include computations involving data on many variables or on all variables and, on a time shared program set-up can even carry on computations from data manually fed into the machine and independent of the variable data involved.

A particularly important aspect of the present invention is the manner in which the scanning sequence and log sequence may be readily modified from the controls on the operator's control and display panel **22**. Cooperating with the controls on this panel to simplify this sequence modification is the manner in which the information is stored in the data blocks of storage unit **14***a'* and used therefrom. As previously indicated, the data constants for and value of each variable are preferably stored in storage unit **14***a'* in related address locations collectively called a data block and which has an address number (or numbers) identifying or related to the variable involved. For readout, the data block or corresponding portions thereof can be looked at normally in sequential order in accordance with their address numbers. Scan and log sequence affecting numbers are stored in each data block which numbers identify the variables respectively to be scanned and logged (i.e., values printed out) in the order identified by the address number of the data block involved. Then scan and log sequence affecting numbers can be separately set up on the value number windows **34***a*, **34***b* and **34***c* on the operator's control and display panel **22** and read into the data block having the address number corresponding or related to the sequence or order

in which the variable is to be scanned or logged by setting the number of the variable whose data constants are in the data block involved in the point number windows **34***b* and **34***c* and setting the operation switches to display a "store scan sequence" or "store log sequence" in the operation windows **40***a* and **40***b*. The data storage, calculator and control means **14** is programmed so that during successive scanning operations the scan sequence affecting numbers in successively numbered data blocks or data block positions are read-out in the same sequence as the address number of the blocks or block positions and the input corresponding to the scan sequence affecting number is selected by a switching matrix controlled by the latter number. The log sequence affecting numbers are handled in a similar way to control the order of printout of the data values on the output printers **15** or **16**.

Before any of the operations called for by the value point and operation switches on the panel **22** are performed, an action switch **45** on the panel **22** must be operated and the program being carried out by the data storage, calculator and control means must call for the operation set up on the panel **22**. In this way, the variable monitoring and recording functions carried out by the system of the present invention are not interrupted, which is especially important for continuous variable monitoring systems. If the monitoring function of the system were to be curtailed in order for the information set up on panel **22** to be changed, dangerous consequences could result.

When the data constants of a whole series of variables is to be changed, the present invention preferably utilizes a tape reader or the like generally indicated by reference numeral **44** in FIG. 1 to read in the information under control of the program stored in storage unit **14***a'*. The tape reader may be a conventional type reader **44** having a series of output lines represented by the single line **46** which extends to the input of the data storage, calculator and control means **14**. The operation of the tape reader is controlled by an output signal from the output of the latter means. A tape read operation is initiated by a tape read switch **48** on the operator's control panel **22** which effects closure of a circuit extending through a line **48***a* to the input to the storage unit **14***a'*. The aforesaid program is such that the tape reader feeds information in short bursts or groups for a short period in each program cycle if called for until all of the information is fed into the storage unit **14***a'*. Thusly, it is possible in a matter of a minute to a few seconds to automatically change, for example, all high and low alarm limits by running a suitably punched tape through the tape reader **44** without interrupting the operation of the monitoring system.

The operator's control panel **22** may additionally be provided with a demand log switch **49** which when operated effects closure of a circuit extending through a line **49***a* also extending to the input of storage unit **14***a'*. This sets up a program sub-routine which effects substantially immediate printout on typewriter **16** of the values of all variable which are normally logged hourly, unless a backlog of alarms is present.

The operator's control panel **22** may also include an acknowledgement switch **50** which is a push-button switch or the like which when depressed silences the horn **18**.

FIG. 2 shows an actual installation which includes the components shown in box form in FIG. 1. Thus, an operator's desk **50** is provided upon which sets an operator's control and display console **52** (shown most clearly in FIG. 3) containing the aforesaid control and display panel **22** on the front thereof. The desk may also support the aforesaid tape reader **44** on one side and the strip printer **15** on the other side. The log typewriter **16** is housed in a large cabinet **54** with only the log sheet **56** extending on the outside thereof. The typewriter contained within the housing **54** is most advantageously a segmental chart recording typewriter of the type disclosed in U.S. Patent No. 2,917,153, granted December 15, 1959, only provided with a much wider carriage than shown therein. The analog input transducer **10**, switching matrix **11**, analog to digital recorder **12** and other components if desired can be housed in a cabinet **58**.

As previously indicated, for illustrative purposes only, the data storage, calculator and control means **14** to be described is the well-known IBM Type 650 data processing machine which comprises a read-punch unit **14–1** (designated by IBM as Type 533) which, in addition to input punching and output punching devices, also includes among other things the input and output terminals shown in FIG. 6. The IBM Type 650 machine also includes a console unit **14–2** (designated by IBM as Type 650) which includes the storage, calculator and control sections **14***a*, **14***b* and **14***c* above mentioned and a master operator's control panel **14–2'** from which the main system checks and controls may be carried out, and a power supply unit **14–3** (designated by IBM as Type 655).

In summary, the various inputs above described to the storage unit **14***a'* include signals initiated by the operation, point number and value input switches and rendered effective by the action switch **45**, and the demand tape reader and log switches on the operator's control panel **22**. Other inputs to the storage unit **14***a'* extend from the outputs of the tape reader **44**, analog to digital converter **12**, and the digital clock **17**, and still others, such as the "busy" input signals from the analog to digital converter **12**, the typewriter **16** and the strip printer **15** which are present when these units are busy and thus are not ready to receive new information. In such case, the variable monitoring system will continue to carry out other important functions.

STORAGE UNIT 14*a'* AND INPUT TERMINALS THERETO

As previously indicated, an IBM Type 650 data processing machine is used as an exemplary data storage, calculator and control means in the instant disclosure of the present invention. The read-punch unit **14–1** of this machine includes a series of input and output terminal hubs which are shown in FIG. 5*b*, the input terminals being shown on the left hand portion of this figure and the output terminals being shown on the right hand portion of this figure. The input terminal hubs to which the various input circuits are connected include a group of input terminals referred to as storage entry C hubs **82** arranged in ten word groups with ten hubs 1–10 per group, and a series of input terminals referred to as digit selector read hubs **83**. A jumper **84** extends between the uppermost and subjacent hubs in order to activate the left hand column of selector read hubs identified by digit numbers 0 through 9. In the IBM machine being described, when a read entry operation is called for, which is an operation which reads the inputs to the storage entry C hubs into storage unit **14***a'*, timed digit-indicating pulses are fed to the aforesaid digit selector hubs 0 through 9 in time sequence, the particular time position of the pulses determining the digit value which is being read into the storage unit. The various input circuits are wired between the digit selector hubs 0 through 9 and the storage entry C hubs so that the latter hubs receive variously timed pulses indicating the particular digits being read thereinto.

The decimal coded information fed into the storage entry C hubs **82** are stored by the IBM machine in what is referred to as read entry word positions in the storage unit **14***a'*. In the IBM machine now being described, the storage unit **14***a'* is a magnetic drum, consisting of 40 axially spaced word bands, some of which are shown in FIG. 6*a*. There are 50 word positions in each band, and in the example being described, the word positions in bands 0 through 9 have address numbers 0 through 49, 50 through 99, 100 through 149, 150 through 199, 200 through 249, 250 through 299, 300 through

349, 350 through 399, 400 through 449 and 450 through 499, and the higher numbered bands have progressively increasing address numbers following this pattern. The inputs from the storage entry C hubs are read into the first 10 word positions of band 12 in the example of the invention being described. Bands 0 through 1 are used exclusively for work storage and, in general, handle the temporary results of various calculations or operations carried out by the machine, and include various count numbers, special instructions which depend upon system demands and the like.

In bands 2 through 9, there are stored data values and data constants referred to as data words. All of the data words associated with a particular variable are located in related positions in these bands to be described collectively as a data block. The data words (which consist of ten digits each), in addition to the aforementioned high or low alarm limits, function, gain, offset, scan and log sequence information, include information on the value of the variable when last scanned and the value of the variable which is to be logged out or printed on the typewriter **16**, which may be the hourly value of the variable or the value of the variable when the log demand switch **49** is operated. In the particular format used in the present example of the invention being described, the various kinds of data information just described are distributed through the digits of four word positions on the drum, which words are referred to as Type A, B, C and D data words. For convenience in programming, the four data words making up a data block for each variable are stored in corresponding word positions or addresses of alternate bands, as illustrated in FIG. 6*b*. Bands 2 and 3 are used for Type A only, bands 6 and 7 are used for Type C data words only, and bands 8 and 9 are used for Type D data words only. For convenience in programming, no data is stored in the first or zero address word positions of bands 2, 4, 6 and 8. The variable whose Type A data word is stored in the first word position of band 2 (the word address 1) is referred to as Point No. 1, so that its Type B, C and D data words will respectively be stored in address positions 10', 20' and 30', respectively, of bands 4, 6 and 8. Data on the second word position of these bands will be identified as Point No. 2, etc. Data words A, B, C and D for point 50 are in the first word positions of bands 3, 5, 7 and 9 which have drum addresses 50, 150, 250 and 350 and so on. Since there are 49 used word positions on the drum in each band, the succeeding word positions of these bands will be for variables 50 through 99, respectively. In the example of the invention being illustrated, therefore, 99 points, or variables are being monitored, it being understood that many more variables could be monitored if the drum were enlarged or other bands thereof used for data word storage. Bands 15 through 39 are used for instruction word storage, the instruction words representing orders and address locations as is well known in the art.

The format for the Type A, B, C and D data words are illustrated in FIG. 6*c*, which shows the various types of information contained therein and the digit positions thereof.

With the format for the word addresses and point numbers explained above, it is apparent that the data words for a particular point or variable number N have addresses determined by the formula:

$$\text{Address}=100+\text{Pt. No.}+K100$$

(where K is 0–3 for data words A, B, C and D respectively).

INPUT CIRCUITS
(FIGS. 7*a*, 7*b*, 7*c* and 7*d*)

The program which is set up in the IBM Type 650 data processing machine is one which responds to various external occurrences or conditions when the particular points of the program call for these particular conditions by setting up particular sub-routine programs or operations. FIGS. 7*a*, 7*b*, 7*c* and 7*d* include the input circuits to the IBM machine which set up these external conditions as well as the main variable responsive inputs which are the digital outputs of the analog to digital converter **12**. FIG. 5*a* summarizes the various connections of the input circuit to the storage entry C hubs on the IBM machine.

Referring now to FIG. 7*a*, the various circuits shown therein will be described proceeding from the top of the figure down to the bottom thereof. At the upper left hand section of the figure are shown the digit selector hubs **80** designated as hubs 0 through 9. Connections are brought out from these hubs to terminal buses **100–0**, **100–1**, **100–2**, **100–3**, **100–4**, **100–5**, **100–6**, **100–7**, **100–8** and **100–9** which respectively extend from the digit selector hubs Nos. 0 through 9 respectively. These buses will be referred to as digit selector buses. The first circuit connected to the digit selector buses is one having a pair of branch lines **102–8** and **102–9** extending from the 9's and 8's digit pulse buses **100–9** and **100–8** and connected to a set of normally-open time clock contacts **104–8** and a set of normally-closed contacts **104–9** which are connected to a common conductor **106** extending to the storage entry C hub 1 for word one. Contacts **104–8** and **104–9** are a form C set of contacts which operate together so that one set of contacts is always open while the other set is closed and vice versa. These contacts are operated in a well-known manner by the digital clock **17** such that on the hour or other selected time interval, the normally-open contacts **104–8** will close and the normally-closed contacts **104–9** will open for a sufficient interval to enable the particular control function involved to be carried out. It is thus apparent that substantially at the beginning of each hour, when the program cycle requests a read entry operation, an 8's digit pulse will be coupled from the 8's digit selector hub, through the digit selector bus **100–9**, line **102–9**, the then closed contacts **104–9** and the common conductor **106** leading to the storage entry C hub 1 for word one. A 9's digit pulse is coupled from the 9's digit selector hub through the normally-closed contacts **104–8** to the storage entry C hub 1 to indicate the absence of the hourly condition inquired about. This code, where the presence of an 8's digit will indicate the presence of a condition inquired about and the presence of a 9's digit will indicate the absence of the condition inquired about, is used throughout the inquiry steps of the program of the variable monitoring system.

The next circuit shown at FIG. 7*a* comprises a pair of branch lines **107–9** and **107–8** respectively connected to the 8's and 9's digit selector buses **100–8** and **100–9**. Lines **107–9** and **107–8** respectively extend through normally-open and normally-closed demand log contacts **108–9** and **108–8** connected to a common conductor **110** leading to the storage entry C hub 2 for word one. Contacts **108–9** and **108–8** are also a set of form C contacts which are reversed from their position shown when the demand log switch **49** on the operator's control panel **22** is operated. When this switch is operated, the printout of the values of all of the variables which are normally printed out hourly is effected on the log typewriter **16**. If the switch **49** is a momentarily depressible push-buttom switch, it should be held for a sufficiently long period that the print operation requested by it will be initiated.

The next circuit in FIG. 7*a* comprises a pair of branch lines **112–9** and **112–8** respectively extending from digit selector buses **100–8** and **100–9**. Lines **112–9** and **112–8** are respectively connected through normally-open and normally-closed reader contacts **112–9** and **112–8** which are operated by the demand tape reader switch **48** on the operator's control panel. The latter contacts form a set of form C contacts which are connected to a com-

mon conductor **116** extending to storage entry C hub 3 for word one. The position of the contacts **112–9** and **112–8** are reversed from that shown upon operation of the demand tape reader switch **48** on the opeartor's control panel **22**.

The next circuit comprises a pair of branch lines **118–9** and **118–8** respectively connected to digit selector buses **100–8** and **100–9**. The lines **118–9** and **118–8** are connected respectively through normally-open and normally-closed action switch contacts **120–9** and **120–8** which are a set of form C contacts which are reversed from their indicated positions by operation of the action switch **45** on the operator's control panel **22**. The action switch also may be a momentarily depressible switch which is depressed for a sufficient period to be effective in carrying out its function. In the case where the program of the system cycles very quickly, just a momentary hold down is required. If desired, the switch may operate a relay controlling the contacts **120–9** and **120–8** which relay is locked in and later reset by the program after it calls for the information set by the manual switches in panel **22**. The contacts **120–8** and **120–9** are connected to a common conductor **122** which extends to storage entry C hub 4 for word one.

The next circuit includes a pair of branch lines **124–9** and **124–8** respectively extending from the digit selector buses **100–8** and **100–9**. Lines **124–8** and **124–9** respectively are connected to normally-open and normally-closed strip printer busy contacts **126–9** and **126–8** which are form C contacts which are reversed from their positions shown when the strip printer **15** is busy. Strip printers are often provided with contacts like **126–8** and **126–9** which are operated when the strip printer is actively engaged in printing some information. Contacts **126–8** and **126–9** are connected to a common conductor **128** extending to storage entry C hub 5 for word one.

The next circuit includes a pair of branch lines **130–9** and **130–8** respectively extending from digit selector buses **100–8** and **100–9**. The lines **130–9** and **130–8** are respectively connected to normally-open and normally-closed typewriter busy contacts **132–9** and normally-closed contacts **132–8** which are a set of form C contacts which are reversed from their positions shown when the typewriter **16** is busy. Typewriters used in the data recording field are often provided with form C busy contacts which are operated when the typewriter is in the process of printing information. Contacts **132–9** and **132–8** are connected to a common conductor **134** extending to storage entry C hub 6 for word one.

The next circuit includes a pair of branch lines **136–9** and **136–8** which respectively extend from digit selector buses **100–9** and **100–8**. The branch lines **130–9** and **130–8** are respectively connected to normally-open and normally-closed ADC balance contacts **138–9** and normally-closed contacts **138–8** which are a set of form C contacts which are reversed from their positions indicated when the analog to digital converter **12** is in balance. The contacts **138–9** and **138–8** are connected to a common conductor **140** extending to storage entry C hub 7 for word one. The analog to digital converter **12** may be a conventional type contact operating analog to digital converter including a servo drive operating a balancing potentiometer slide wire to a voltage balanced condition. This type of analog to digital converter often has a set of form C balance contacts which are reversed in position when the ADC circuit is in balance.

It is apparent that when an external occurrence identified by the position of one of the form C contacts just described is called for by the program of the data processing machine **14**, and the occurrence inquired about is present, a pulse indicating the digit 9 will appear at the various storage entry C hubs involved. Conversely, if the condition inquired about is not present, then an 8's digit pulse appears at the storage entry C hubs involved.

The next series of circuits shown in FIG. *7a* are related to the output of the tape reader **44**. Tape reader **44** is a tape reader having a series of pairs of form C contacts **142–142'**, **144–144'**, **146–146'** and **150–150'** on which is produced a 5-bit binary Teletype code which results from the opening or closure of the various sets of normally-open contacts **142'**, **144'**, **146'**, **148'** and **150'**, depending upon the location of various holes punched in the tape read by the tape reader. The latter contacts are connected to the 9's digit selector bus **100–9** and the normally-closed contacts **142**, **144**, **146**, **148** and **150** are connected to the 8's digit selector bus **100–8**. The contact pairs **142–142'**, **144–144'**, **146–146'**, **148–148'** and **150–150'** are respectively connected by conductors **143**, **145**, **147**, **149** and **151** to the storage entry C hubs 1 through 5 for word 2. As previously indicated briefly, the advancement of the tape through the tape reader is controlled from the output of the data processing machine **14** in a manner to be explained in more detail hereinafter.

The binary code signals comprising 8's and 9's digits on the hubs 1 through 5 may be a 5-channel binary code of any type such as a standard Teletype code and represents one decimal digit. When the signals on hubs 1 through 5 are all the 9's digit signal this means that there is nothing to read on the tape. When the code group indicates a given number above 10, such as 18, this indicates that the tape read operation should terminate. In the example of the invention being described, when changing data constants, the first four digits sequentially read on the tape will represent the A, B, C or D data word drum address into which the digital information to follow is to be inserted. The next ten code groups read out represent the digits to be inserted into the ten digit positions of the word. In the exemplary program to be described, all ten digits of a data word must be changed at a time. The following code groups may be other groups of ten value digits to be inserted in adjacent data word positions on another group of four code groups identifying a remote data word location followed by ten succeeding value digit code groups.

The next series of circuits are related to the output of the analog to digital converter **12**. There are three groups of such circuits **12A**, **12B** and **12C** which respectively provide the hundreds, tens and units digit outputs of the analog to digital converter. The circuits of group **12A** include a series of lines **160–0** through **160–9** which are respectively connected to the digit selector buses **100–0** through **100–9** for providing digit signals representing digits 0 through 9 of the hundreds digit. Normally-open contacts **162–0** through **162–9** are connected to the respective lines **160–0** through **160–9**. The hundreds digit section of the analog to digital converter **12** closes the contacts **162** corresponding to the hundreds digit of the value of the variable involved as determined from the output of the particular transducer being scanned at the moment. This will produce the proper digit signal on a common conductor **164** connected to storage entry C hub 1 for word three.

The tens and hundreds circuits **12B** and **12C** are each identical to the circuit **12A** just described and each accordingly includes a series of lines **170** or **180** which respectively extend from the digit selector buses **100–0** through **100–9**. Digit indicating contacts **172** and **182** in series with these respective lines are connected to common conductors **174** and **184** leading respectively to storage entry hubs 2 and 3 for word three.

Next in FIG. *7a* there is shown a first and second group of circuits **38A** and **38B** respectively which include one of the levels of a bank of switches operated by the general operation switch **38***a* and information type operation switch **38***b*. The first levels of these switches are respectively identified by reference characters **38***a*–**1** and **38***b*–**1** and have wipers **38***a*'–**1** and **38***b*'–**1** which make selective contact with ten stationary associated digit con-

tacts 0 through 9. The latter contacts of the switch **38***a*–**1** are respectively connected to lines **190–0** through **190–9** which are respectively connected to digit selector buses **100–0** through **100–9**. Normally-open contacts **43–1** through **43–4** and **43–8** operated by key lock switch **43** on the operator's control panel are located in lines **190–1** through **190–4** and **190–8** and prevent inadvertent storage of data constants and scan and log sequence by unauthorized personnel. The wiper **28***a*'–**1** is connected to a conductor **194** which extends to storage entry C hub 7 for word four. It is apparent that a digit pulse will appear on the wiper **38***a*'–**1** which represents the digit corresponding to the digit contact on which the wiper **38***a*'–**1** rests. The circuitry associated with the information type command switch level **38***b*–**1** is the same as that just described and thus comprises a series of ten lines **200** extending respectively from the stationary digit contacts 0 through 9 of the switch and connected to the respective digit selector buses **100–0** through **100–9**. The wiper **38***b*'–**1** of the switch level **38***b*–**1** is connected to a common conductor **204** extending to storage entry C hub 6 for word four.

Reference should now be made to FIG. 7*b* which shows other groups of input circuits to the data processing machine **14**. These circuits include at the top of FIG. 7*b* two groups of circuits **30B** and **30C** which respectively include the first level of a bank of switches **30***b*–**1** and **30***c*–**1** which are operated by the point number switches **30***b* and **30***c* on the operator's control panel **22**. These switches set up the tens and units digit which normally represent the number assigned to the variable to which the particular information being set up on the panel **22** relates. Switches **30***b*–**1** and **30***c*–**1** respectively have wipers **30***b*'–**1** and **30***c*'–**1** which are adapted to make selective contact with ten associated digit contacts 0 through 9. The 0 through 9 contacts of these switches respectively extend through lines **210** and **220** to the ten digit selector buses **100–0** through **100–9** in the same manner as described in connection with switches **38***a*–**1** and **38***b*–**1**. The wipers **30***b*'–**1** and **30***c*'–**1** are respectively connected to conductors **214** and **224** leading to the storage entry C hubs 5 and 4 for word four.

Next, there are three groups of circuits **24A**, **24B** and **24C** which respectively include the first levels **24***a*–**1**, **24***b*–**1** and **24***c*–**1** of a bank of switches operated by the value switches **24***a*, **24***b* and **24***c* on the operator's control and display panel **22**. The switches **24***a*–**1**, **24***b*–**1** and **24***c*–**1** respectively have wipers **24***a*'–**1**, **24***b*'–**1** and **24***c*'–**1** which are adapted to make selective connection with ten associated stationary digit contacts representing the digits of the hundreds, tens and units digits of the value numbers set up on the operator's control panel **22**. Sets of ten conductors **240**, **250** and **260** respectively extend from the stationary contacts of these switches to the digit selector buses **100–0** through **100–9** in the same manner as described in connection with the switches **30***b*–**1** and **30***c*–**1**. The wipers **24***a*'–**1**, **24***b*'–**1** and **24***c*'–**1** are respectively connected to conductors **244**, **254** and **264** extending to the storage entry C hubs 3, 2 and 1 for word four.

The next groups of circuits appearing in FIG. 7*b* are circuits **17A**, **17B**, **17C** and **17D** which are operated by the digit time clock **17** (FIG. 1). The digit time clock is provided with a series of four digit switches **17***a*, **17***b*, **17***c* and **17***d*. Switches **17***a* and **17***b* are positioned to respectively represent the tens and units digits of the hour involved and the switches **17***c* and **17***d* are respectively positioned to indicate the tens and units digits of the minutes involved. These switches respectively have wipers **17***a*', **17***b*', **17***c*' and **17***d*' which are adapted to make a selective connection with associated digit contacts 0 through 9 representing the digits 0 through 9. These contacts respectively extend through sets of ten conductors **270**, **280**, **290** and **300** to the digit selector buses **100–0** through **100–9** in the same manner as the previously described switches. The wipers **17***a*', **17***b*', **17***c*' and **17***d*' are respectively connected to conductors **274**, **284**, **294** and **304** which extend to the storage entry C hubs 4, 3, 2 and 1 for word five.

Reference should now be made to FIG. 7*c* which shows a continuation of the input circuits shown in FIGS. 7*a* and 7*b*. The circuits there shown are for controlling sets of 10 display lamps associated with each of the display windows on the operator's control panel **22**. As shown in FIG. 7*e*, each lamp is positioned opposite a transparent slide plate **303** upon which is printed one of the information elements to be projected upon the associated display window. For example, in the case of the display windows **28***a*, **28***b*, **28***c*, **34***b* and **34***c* which are to contain numbers, the plates **303** associated with the 10 lamps for each display window respectively have opaque areas constituting the digits 0 through 9. In the case of the plates **303** associated with the operation display window **40***a* or **40***b*, the various plates **303** associated therewith will contain the various operation designations shown in the table of FIG. 4*a*. A lens element **305** is associated with each of the plates **303** and is adapted to project the information on the associated plate **303** upon the associated display window.

The first group of circuits shown at the top of FIG. 7*c* are circuits **24A'**, **24B'** and **24C'** which respectively include the second levels of the bank of switches operated by the value switches **24***a*, **24***b* and **24***c* on the operator's control panel **22**. The second levels of these switches are identified by reference characters **24***a*–**2**, **24***b*–**2** and **24***c*–**2**. These switches respectively have wipers **24***a*'–**2**, **24***b*'–**2** and **24***c*'–**2** which are adapted to make selective connection with the associated digit contacts 0 through 9. Contacts 0 through 9 of each of the switches are respectively connected to ten conductors **305***a*, **305***b* or **305***c* in turn respectively connected to display lamps **L0** through **L9**. The latter lamps are connected in turn to a power bus **302** supplying energy for lighting the lamps. The wipers **24***a*'–**2**, **24***b*'–**2** and **24***c*'–**2** are respectively connected through normally-closed contacts **R1–1** through **R1–3** of a display relay **R1** which, in a manner to be described, is energized whenever the general operation switch **38***a* is in position 5 indicating a display operation. As previously indicated, a display operation is one wherein a data constant or value stored in the data words of the storage unit **14***a*' for a designated variable is displayed upon the value display windows **28***a*, **28***b* and **28***c*. Under these circumstances, energization of the lamps associated with the value windows is not to be under control of the value switches **24***a*, **24***b* and **24***c*. At all other times, however, the lamps in question are under control of the value switches and this is the reason for the use of normally-closed contacts **R1–1** in series with the wiper **24***a*'–**2**. The normally-closed contacts **R1–1**, **R1–2** and **R1–3** are connected to a common conductor **306** leading to the No. 5 ("display") contacts of a fourth level **38***a*–**4** of the general operation switch so that the value display windows are lighted at all applicable times execept for a "display" operation. The switch level **38***a*–**4** has a wiper **38***a*'–**4** connected to the other bus **301** of the lamp power supply. For a "store" operation, the value lamps **L0** through **L9** are controlled by an alternate circuit to be described. It is apparent that when a "display" operation is called for by the general operation switch **38***a*, that one of the lamps associated with each of the switches **24***a*–**2**, **24***b*–**2** and **24***c*–**2** will be lighted to project a digit upon the associated value display window **28***a*, **28***b* and **28***c*.

The next group of circuits shown in FIG. 7*c* are circuits **30B'** and **30C'** which include the second levels **30***b*–**2** and **30***c*–**2** of the bank of switches operated by the point number **30***b* and **30***c* on the operator's control panel **22**. The switches **30***b*–**2** and **30***c*–**2** respectively have wipers **30***b*'–**2** and **30***c*'–**2** which are adapted to make selective connection with 10 associated digit contacts 0 through

9. Ten digit lamps **L0** through **L9** respectively are connected between each of the sets of 10 digit switch contacts and the supply bus **302** in the same manner as in the case of the circuits **24A'**, **24B'**, etc. Wipers **30***b'*–**2** and **30***c'*–**2** are connected by lines **309** and **310** to a common line **311** extending to all but the 0, 6 and 9 contacts of the fifth level of general operation switch **38***a*–**5** so that the point number windows are dark on a "summary" operation. The switch lead **38***a*–**5** has a wiper **38***a'*–**5** connected to the lamp supply bus **301**.

The next group of lamp circuits shown in FIG. 7*d* are circuits **38A'**, **38B'** and **38A''**. Circuits **38A'** and **38B'** include the second levels **38***a*–**2** and **38***b*–**2** of the bank of switches controlled by the operation control switches **38***a* and **38***b* on the operator's control panel **22**. Switches **38***a*–2 and **38***b*–2 respectively have wipers **38***a*–2 and **38***b'*–**2** which are adapted to make selective connection with 10 associated stationary contacts 0 through 9. A set of 10 operation lamps **L0** through **L9** are respectively connected between each of the sets of 10 contacts and the bus **302** in the manner explained in connection with the other just described circuits. Wiper **38***a'*–2 of switch lead **38***a'*–**2** is connected by a conductor **312** to power bus **301**. Wiper **38***b'*–**2** of switch lead **38***b*–**2** is connected to the No. 5–8 contacts of the sixth level **38***a*–**6** of operation switch **38***a* so that the operation lamps associated with the information type display window **40***b* will be dark for the "skip through" operation and the "point eliminate" operation. The switch level **38***a*–**6** has a wiper **38***a'*–**6** connected by a conductor **314** to line **301**.

The circuit **38A''** includes the third level **38***a*–**3** of the bank of switches controlled by the operation switch **38***a* and is for the purpose of controlling the energization of the display relay **R1** above-mentioned. Switch **38***a*–**3** has a wiper **38***a'*–**2** which is adapted to make selective contact with the 10 associated stationary contacts 0 through 9, only the fifth of which is an active contact. The relay **R1** is connected between the No. 5 contact and the power bus **302**. Wiper **38***a'*–**3** is connected by a line **315** to the power bus **301**. It is apparent that the relay **R1** is energized only when the operation switch knob **38***a* is in its "display" position.

OUTPUT TERMINALS OF UNIT 14–1

The output terminal strip of the IBM read-punch unit **14–1** is shown in FIG. 5*b* and is modified to the extent of adding two additional hubs **85** and **86** to give access points to the positive direct current supply and to the system ground. The output terminal strip of the IBM read-punch unit **14–1** is used to connect the various output circuits to be described and includes a first group of terminal hubs identified by reference numeral **87** and by the designation storage exit A hubs. Hubs **87** are divided into ten word sub-groups with ten digit hubs 1 through 10 and a sign or negate hub (as is true with all of the word sub-groups). Two other similar groups of storage exit hubs are provided identified respectively by reference numerals **88** and **89**, and by the designations storage exit B hubs and storage exit C hubs. These storage exit B and C hubs respectively receive signals controlled by the digits sequentially fed from adjacent digit positions of the corresponding word locations of the output word storage sections of bands 14, 13 and 12, respectively (FIG. 6*a*) in the well known manner of the IBM Type 650 machine. All of the storage exit hubs in a particular group A, B or C will receive timed digit pulses when an output operation designating that particular group is called for by the program. The particular timing of the pulse fed to a particular hub is an indicaton of the digit represented by such pulse in the same manner previously described in connection with the pulses fed by the digit selector hubs **83** in the input side of the terminal strip.

As will appear from a description of the output circuits, the storage exit A hubs are used to control the switching matrix, storage exit B hubs are used to control the aforesaid value display lamps associated with the value windows on the operator's control panel **22**, and the storage exit C hubs are used for controlling the strip printer, the typewriter, the alarm relay which operates the horn **18**, and the solenoid which controls the advancement of the tape reader unit.

Since, in a given read-out operation, only one of the timed digit pulses at a particular storage exit hub within group A, B or C will be used to perform a control function, it is necessary to provide gating means which prevent the pulses on the unused hubs from having any effect on the output devices connected thereto. To this end, a group of terminal hubs, generally indicated by reference numeral **89**, and referred to as digit selector hubs, is provided. When a ground jumper **90** is used to interconnect the ground hub **86** with the No. 12 digit selector hub in the left hand column of this group of hubs, a gating distributor switch **D1** (FIG. 8*a*) within the IBM read-punch unit **14–1** is rendered operative to connect ground potential in timed succession to the hubs 0 through 9 of the digit selector hubs **89** and in synchronism with the generation of the digit pulses fed to the storage exit hubs. The distributor **D1** has a wiper **D1'** which makes selective contact with stationary contacts 0 through 9 in timed synchronism with the generation of the timed digit pulses representing digits 0 through 9 fed to the storage exit terminals.

Another group of terminals used on the output terminal strip shown in FIG. 5*a* is a group identified by reference numeral **92** and referred to as punch code selector hubs identified by column Nos. 1 through 10. The hubs are also arranged in rows identified as rows T, N and C. The hubs of the N row are each connected to the C hub in the associated column by a set of normally-closed contacts R*x*–**1** which are controlled by a relay R*x* (see FIG. 8*a*) which is energized when the program of the machine calls for a punch "X" operation. The punch code selectors as well as the distributor switch **D–1** and the associated contacts operate to gate the outputs from the various storage exit hubs in the manner to be explained in connection with the description of the output circuits of FIGS. 8*a*–8*d*.

To activate the punch code selector hubs, various jumpers **92–97** are placed between the terminal hubs indicated in FIG. 5*a*. The jumpers **94–95** extend from the sign hubs of storage exit C, words 1 and 3 and which receive the signals which energize the appropriate R*x* relay.

OUTPUT CIRCUITS

(*FIGS. 8a–8d*)

The first group of circuits shown at the top of FIG. 8*a* are typewriter control circuits **16A** and **16B**. The circuits **16A** control the number solenoids **S1–0** through **S1–9** which effect the printing of the numbers 0 through 9. The circuits **16A** have a common branch extending from the storage exit C hub 3 for word one and through a jumper conductor **313'**, an N punch code selector hub N–1 of one of the columns of the punch code selector hubs **92**, the normally-closed contacts R*x*–**1** of the associated relay R*x*, the punch code selector hub **C–1**, and then through a conductor **313'** connected in common with one side of the typewriter solenoids **S1–0** through **S1–9**. The other ends of the latter solenoids are connected through leads **315–0** through **315–9**, respectively to distributor buses **316–0** through **316–9** respectively connected to the digit selector punch hubs **89** for digits 0 through 9. The latter hubs, as above explained, are sequentially scanned by the wiper **D1'** of a distributor switch **D1** within the punch-read unit **14–1**. The distributor wiper **D1'** is connected to a ground point within the unit to which the ground hub **86** on the input-output terminal strip is also connected.

The typewriter control circuits **16B** have a common branch line **315'** which is connected between the storage

exit C hub 9 for word one and one side of a number of solenoids S2, S3 and S4 and S5 which respectively control spacing, carriage return, red ribbon shift and black ribbon shift operations of the typewriter **16**. The other ends of the latter solenoids are connected by conductors **315–10**, **315–11**, **315–12** and **315–13** respectively to the distributor buses **316–0**, **316–1**, **316–2** and **316–3**. As is common in automatic typewriters (and strip printers) once a red or black ribbon shift solenoid is energized, the red or black shift operation continues automatically until a change in the color of the printing is demanded by energization of the other shift solenoid.

The next group of circuits shown in FIG. 8*a* are circuits **15A** and **15B**. The circuit **15A** controls the operation of number solenoids **S8–0** through **S8–9** which respectively effect the printing of the numbers 0 through 9 on the strip printer **15**. The latter solenoids are respectively connected to the distributor buses **316–0** through **316–9** by conductors **320–0** through **320–9**. The ends of the latter solenoids remote from the distributor buses are connected through a common conductor **321** to the C hub C–3 of a different column of the punch code selector hubs **92** than the column to which the typewriter number control circuits are connected as above described. Normally-closed contacts R*x*'–**1** of a relay R*x*' within the punch-read unit **14–1** is connected between the latter punch code selector hub C–3 and the punch code selector hub N–3 in row N. The latter hub is connected by a conductor **322** to the storage exit C hub 3 for word three.

The circuits **15B** control the red motor bar and black motor bar of the strip printer for printing respectively in red and black and include solenoids **S8–10** and **S8–11** in the strip printer which are connected respectively by conductors **320–10** and **320–11** to the distributor buses **316–0** and **316–1**. The ends of the latter solenoids remote from the distributor buses are connected by a common conductor **324** to the storage exit C hub 9 for word three.

As previously explained, during a read out operation, each of the storage exit C hubs is pulsed with a timed digit pulse and the distributor wiper **D1'** contacts only one of the associated contacts at a time thereby energizing only one of the distributor buses **316–0** through **316–9** at a time. It should be noted that there several of the typewriter and strip printer circuits are connected to the same distributor buses so, in the absence of the gating operation now to be described, it is apparent that the various solenoids connected to the common bus would all be energized by the timed digit pulses fed thereto from the associated storage exit C hubs. In the case of the typewriter control circuits **16B** and the strip inner control circuits **15B** no real problem of this kind exists because so that when these circuits are not to be operated, the associated storage exit C hubs can be pulsed by a timed digit pulse 4–9 (referred to as a null digit) representing a digit which is out of synchronism with the scanning of the associated distributor buses **360–0**, **360–1**, **360–2** and **360–3**. The typewriter number circuits **16A** and the strip printer circuits **15A**, on the other hand, are associated with all of the distributor buses and there will, therefore, always be synchronism between the timing of the digit pulses fed to the associated storage exit C hubs and the scanning of one of the associated distributor buses **316–0** through **316–9**. Therefore, whenever it is desired to prevent operation of either of these two circuits **16A** or **15A**, the program will effect a punch "X" operation for the particular relay R*x* or R*x*' of a circuit which is to be gated out of the system. Energization of any of the relays R*x*, R*x*', etc. will, of course, open the associated normally-closed contacts R*x*–1 or R*x*'–**1** to ensure de-energization of the associated circuits.

The storage hubs of a particular storage exit A, B or C group receive signals controlled from the word locations of the separate output A, B and C storage bands in the drum storage unit **14***a*'. Information read into the output storage bands must affect one complete word location at a time, and when a number of control digits are set within a particular word location of an output storage section, the unused digit positions of that word will regularly be filled with a null digit or (punch X) marker to ensure that only the proper solenoid is actuated. In the IBM machine each word contains a sign digit position which, in the application of the present invention, is filled with a negative sign or negate marker (i.e., the word stored in the output band involved) when a punch X operation is desired. After completion of a printing operation on the strip printer or typewriter, the word location of the output storage band involved will be nulled, that is will have the proper null digit or punch marker stored therein so that the signals thereafter appearing on the associated output hubs will have no effect until fresh information to be printed on the typewriter or strip printer is fed to the output hubs involved.

The next circuit shown in FIG. 8*a* is an alarm relay control circuit which includes an alarm relay R7 which controls energization of the horn **18**. The alarm relay has one end connected through a set of normally-closed holding contacts of that relay identified by reference numeral R7–**1** to the distributor bus **316–8**. A first holding branch circuit for relay R7 is provided extending between the distributor bus side of the relay R7 and a ground bus **326**. This holding circuit includes a set of normally-open contacts R7–**2** of the alarm relay which seal in the latter relay when it is energized. The other end of the alarm relay R7 is connected by a conductor **325** to storage exit C hub 1 for word two. The relay R7 requires a second holding branch extending from the ungrounded side of the relay **R7** and through a set of normally-open contacts **R7–3** and the normally-closed acknowledgment pushbutton switch **50** on the front of the operator's control panel **22**. The switch **50** is connected to positive bus **327** connected to positive hub **85** on the terminal strip of read-punch unit **14–1** (FIG. 5*a*). Thus, when a timed positive digit pulse appears on hub 1 of word two, the relay **R7** will seal-in through the aforementioned holding branches and will remain energized until the normally-closed pushbutton switch **50** is momentarily depressed.

The next circuit in FIG. 8*a* is a tape reader advance circuit including a solenoid **S9** which, when energized, advances the tape through the tape reader. One end of the solenoid **S9** is connected to the distributor bus **316–8** and the other end thereof is connected to a storage entry C hub 2 for word two.

Refer now to FIG. 8*b* which shows the continuation of the output circuit of FIG. 8*a*. A group of circuits shown at the top thereof and generally indicated by reference numeral **330** comprise units tens and hundreds digit display lamp control circuits **330A**, **330B** and **330C** which respectively control the display lamps **L0** through **L9** of the hundreds, tens and units value display windows **28***a*, **28***b* and **28***c*. The circuits **330A** include 10 lamp control relays R2*a* through R2*j* associated with storage exit B hubs, word one and in series with display lamps **L0** through **L9** (FIG. 8*c*) connected in branch circuits extending between lamps supply lines **332** and **333**. The other circuits **330B** and **330C** include similar sets of lamp control relays R2*a*' through R2*j*' and R2*a*'' through R2*j*'' associated with storage exit B hubs words 2 and 3, respectively, and in series with respective sets of display lamps (not shown) like that shown in FIG. 8*c*. The corresponding ends of each set of lamp control relays are respectively connected to B hubs 1 through 10 of the associated word. The other end of these relays are respectively connected through normally-closed contacts R2*a*–**2** through R2*j*–**2** of the respective relays to the respective distributor buses **316–0** through **316–9**. A holding branch circuit extends from the distributor bus side of the relays R2–*a* through R2–*j* and associated normally-closed holding contacts of these relays R2*a*–**3** through R2*j*–**3** to ground bus **326**. The other ends of these relays extend through holding branch circuits including normally-open

contacts R2*a*–4 through R2*j*–4 of the associated relays which, in turn, are connected to a lock-in bus **335**. The lock-in bus **335** is connected through a set of normally-closed contacts R6–1 of a visual reset relay R6 to the positive bus **327**. The visual reset relay R6 is connected between the storage exit B hub 1 for word four and the distributor bus **316–8**.

It is apparent that when a timed digit pulse appears on one of the storage exit B hubs when the associated circuit is connected to a distributor bus then being scanned, the relay involved will be energized to turn on the associated display lamp. Initial energization of any of the relays will be locked in through the holding branches above mentioned when the associated holding contacts close. When it is desired to reset the display lamp circuit involved, the program of the data storage, calculator and control means **14** will send a timed digit 8 pulse to the storage exit B hub 1 for word four momentarily to energize the visual display reset relay R6 connected to the distributor bus **316–8**. This, in turn, will open the normally-closed reset contacts R6–1 connected in series with the reset bus **335** to reset the lamp control relays.

Refer now to the output circuit **11**A shown in FIG. 8*d*, which is the switching matrix control circuit. This circuit includes eight relay circuits which are connected respectively to the storage exit A hubs 1 through 8 for word one. Double coiled relays of the self-latching reset type are used in these circuits. These relays each comprise a pair of coils such as R10–R10′ or R11–R11′, etc. which are respectively connected to the 8 and 9 digit distributor buses **316**–*a* and **316**–**9** at one end thereof. The opposite ends of each of the pairs of relay coils are connected together and through a common wire to the associated storage exit A hub. With any of the relay coils R10 through R17 momentarily energized, the relay is operated to a set position to close the normally-open contacts of that relay and to open the normally-closed contacts of that relay. These set contact positions will be maintained even though the relay coils are not continuously energized, until the associated relay coil R10′ or R11′ etc. is energized. This will reverse the position of the contacts until the first-mentioned relay coil is again energized and constitutes the reset position of the relays. Relays of this nature are presently available. It is apparent that one of the relay coils R10 through R17 is momentarily energized by feeding a timed 8 digit pulse to the associated storage exit A hub. In such case, the other storage A hubs will be fed with a timed digit pulse for any digit other than the 8 or 9 digit. To reset a previously set relay, a timed 9 digit pulse is fed to the storage exit A hub of the relay involved.

FIG. 8*d* shows the switching matrix circuit controlled by the relay circuit **11**A. Sets of normally-closed and normally-open contacts of the various aforesaid relays are shown therein. The positions of the contacts shown in FIG. 8*d* are those when the associated relay unit is in its reset position.

The various self-latching relays are set in accordance with a straight binary code so that the relay pairs R10–R10′, R11–R11′, etc. of the 8 relay circuits respectively represent numbers of two to the zero power through two to the eighth power. The contacts of the switching matrix are so arranged that an input will be selected having a point number corresponding to the sum of the binary number representations set up in the set of eight relays.

The switching matrix, of course, is adapted to handle many more than the 99 points or variables involved in the example of the present invention being described.

The switching matrix **11** controlled by the aforesaid relays R10–R10′, R11–R11′, etc. includes a circuit connected between the aforesaid positive voltage bus **327** and the ground bus **326**. Basically, the circuit comprises a series of what will be referred to as row conductors **360** and column conductors **362** which respectively extend through different branches of the matrix control relays. The contact branches associated with the column conductors **362** are connected to the bus **327** by a conductor **365** and the contact branches associated with the row conductors **360** are connected by a conductor **367** to the ground bus **326**. Extending between each of the column conductors **362** and each of the row conductors **360** is a relay branch comprising a relay **368** in series with a polarizing diode **369**. The contact branches are so arranged that only one relay branch is energized for any particular combination of the matrix control relays. Each of the relays **368** has one or more contacts **368–1**, **368–2** or **368–3**, etc. which interconnect a particular transducer.

PROGRAM

A practically unlimited number of specific programs can be used in connection with the persent invention, one such program which is more suitable to a relatively slow operating data processing machine is shown in FIG. 9, the detailed steps of which are outlined in this specification. The basic exemplary program shown in FIG. 9 represents a number of broad program steps which may be carried out by a series of numerical instructions which are stored in the magnetic storage section of the machine involved. One format and method for storing these instructions is disclosed in the Manual of Operation for the IBM Type 650 Machine, Form 22–60–1, 9–56:15M–ZO, copyrighted June 1955 by International Business Machines Corporation, New York City, New York. Later on in the specification, an actual exemplary program using the operation and branching codes contained in said Manual of Operation will be given to illustrate one specific manner of setting up the IBM Type 650 machine in using the same in conjunction with the present invention.

As previously indicated, an important feature of the present variable monitoring system is that the various data constant, log and sequence modifying operations set by the tape printer and the manual controls on the operator's control panel **22** can be set and read into the data storage unit **14***a*′ where they will be effective to modify the information involved without disturbing any current operation being carried out by the variable monitoring system and so that no shutdown of the system is required, wherein alarm detection scanning operations continue at a very high rate. To this end, the variable monitoring system is caused to operate in a program which consists of a number of various combinations of program steps, many of which are cyclically carried out. One or more of the program steps will make inquiries as to whether one of the operations called for by the manual operation switches of the operator's control panel has been set and, if so, the program automatically carries this out at the proper stage of the program so that alarm detection and alarm scanning programs will not be adversely affected.

To understand the operation of the program set into the IBM Type 650 data processing machine as shown in FIG. 9 and in much more detailed program flow diagrams to follow, familiarity with the meanings of certain terminology to be used and types of information stored in the work storage section of the machine and in the data storage word bands 2 through 9 and instruction word bands would be helpful. Reference to FIG. 6*c* should now be made which shows the format for the aforementioned data words A, B, C and D. In the digit locations 1 through 3 and 5 through 7 of data word A are stored the upper and lower alarm limits or set points of the variables. In word B, the digit number 9 contains the function word information which, in the example now being illustrated, is only a function marker digit which indicates whether or not a square rooting operation is to be carried out. Such a square rooting operation, for example, is used in the computation of a flow rate. Other digit positions of word B contain the offset factor and gain factor information previously briefly mentioned. The offset factor is a number which indicates the numbers of units from zero which the minimum output of the transducer involved

represents, and is a number which is added to the number which is obtained by multiplying the apparent or ADC output value of the variable by the gain factor.

The word C contains a condition marker in the zero digit position (which marker is referred to as the alarm print marker). If this is a digit 8, it indicates that an alarm value of the variable involved, which is in digit positions 5 through 7 of word C, has not yet been printed out. The nines digit of word C contains a marker which, if digit 8, indicates that the variable involved was abnormal when last scanned. Digit positions 1 through 3 of word C contain a number indicating the hourly or on demand value of the variable to be printed out.

Word D contains in the zero digit position thereof a marker which, if digit 8, indicates that a value is stored in the log value section of word C (digits 1 through 3) for printout. Digit 9 is a point eliminate marker digit which, if digit 8, indicates that the point involved is not to be scanned or logged (i.e., hourly or on demand). This is a marker which is set into the machine by the point eliminate position of the general operation switch **38***a* on the operator's control panel **22**. The eighth digit of word D is a marker position, which, if digit 8, indicates that the variable involved is to be scanned for alarm hourly or on demand but not logged. This marker is set by the general operation switch **38***a* on the operator's control panel **22**. The eight and nine digit markers of word C are set to 9 respectively by the points skip through restore and point eliminate restore operations respectively of the general operation switch 38*a*. Digit positions 5 and 6 of word D contain the log sequence point or address number which identifies the data block or address (i.e., identifies the variable) whose data value and point number are to be printed out in accordance with the position or address number of the data block containing the data word D now being discussed. That is, if word D is in the data block for point No. 36, the data value of the data block identified by the log sequence point number (which, say, is 53) will be printed out in the 36th column of the log sheet of typewriter **16**. The first and second digit positions of word D is the scan sequence address or point number which identifies the variable or point number which is to be printed out in accordance with the position of the data block in which word D appears (i.e., point 53 is the 36th variable scanned).

The work storage section of bands 0 and 1 of the drum **14***a'* contain in various word positions thereof different types of information which are used in the description of the detailed program flow diagrams to follow and, to some extent, also in describing the broad program outline of FIG. 9. One of the word positions of the work storage section of the drum contain a log printout count number which is the numerical count of the number of log values remaining to be printed out in typewriter **16**. This number is zero when all log values to be printed out have been printed and is used to indicate the end of a log print cycle.

Another position of the work storage contains a log read-in count number which is a numerical count of the number of data points which are yet to receive the hourly or on demand scanned values of data word C thereof. This number is zero when the log values of all variables have been read into the data storage section of the drum and is used to indicate the end of a log value read-in cycle. As, for example, if there are 99 variables and 50 have already been scanned during an hourly log cycle and its data values read into the log value digits of word C thereof, the log read-in count number will be 49. If none of these log values have been printed out yet, the log printout count number will be 99.

Another position of work storage contains a tape reader B1 digit count number which is reset to 4 to indicate there are four digits to be read from the tape to complete an address indicating the location of the value digits to follow. As each address digit is read on the tape reader (at each tape advance operation) the count is reduced by 1 until zero is reached, indicating completion of the reading of a drum address on the tape.

Another position of work storage contains a tape reader B2 digit count number which is reset to 10 to indicate there are ten digits to be read from the tape to complete the ten digits which are read into any data word position. As each digit is read on the tape reader, the latter count is reduced by 1 until zero is reached, indicating completion of the reading of the ten digits into the drum.

Another position of work storage receives an action demand marker word, which is storage entry C word 4, when an action demand marker set operation is called for. If all digit positions are zero of this work storage word, this indicates that no action demand has been set from the operation switches **38***a* and **38***b* and the presence of any non-zero digits indicates that such an action demand has been made.

Another position of work storage receives a log printout and storage marker word, which is storage entry C word one, when a log demand marker set operation is called for. This marker then contains non-zero digits which indicates that log printout and storage cycle is involved. If no log printout was demanded, then the storage entry word one is not transferred to the work storage position now being discussed so that the digits thereof will be zero which indicates that log printout and storage cycle is not involved.

Another position of work storage receives a log printout transfer link instruction from constants storage which address first instruction of log printout sub-routine.

Another position of work storage contains an action required count number word which is numerical count of all pending demands to be operated on by the program. These action demands are hourly log printout, on demand printout, operation switch demand, and alarm log printout.

Another storage position of the work storage section of the drum contains an alarm backlog count number which is a numerical count of alarm value printouts to be performed and is similar to the log read-in count number as applied to the alarm value print function.

Another storage position of the work storage contains an alarm printout storage word which contains the data word C of the next alarm point to be printed. The number is zero when the point involved has been printed and is non-zero when the word C has an alarm value therein which has not be printed.

Another storage position of the work storage section of the drum contains an alarm printout address which identifies the data block address in the data word section of the drum of bands 2 through 9 which contain the next alarm point to be printed.

Another storage position of the work storage section of the drum contains a word referred to as alarm search sequence operation instruction word (see FIG. 10*a* for operation instruction format) which has in the data address position a number which identifies the data word D address of the previous point tested for an alarm printout marker. The order code positions of the instruction calls for a readout command. When the last data block has been examined, the data address is reset to that of the first data block.

Another storage position of the work storage section of the drum contains a log printout search sequence instruction which has in the data address section thereof a number identifying the present data word D address to be looked at for log sequence determination. It is reset to the first data block address after the last variable is logged. The instruction contains in the order code positions thereof a readout command.

Another storage position of the work storage section of the drum contains a scan sequence operation instruction which has in the data address section thereof a number identifying the present data word D address looked

at for scan sequence determination. This is reset to the first data word D address when a scan cycle is completed. This instruction also has a "read" order code therein.

Another position of work storage contains a summary printout search sequence instruction which has in the data address section thereof a number identifying the present data word D address to be looked at for log sequence determination during a summary readout operation of data constants. It is reset to the first data block address after the last summary value is logged. The instruction contains in the order code positions thereof a readout command.

Another position of work storage contains what is referred to as a sub-routine alarm printout link instruction which has the format of a link instruction shown in FIG. 10*c*. The order code No. 00 in the 9th and zero positions of the instruction word indicates a link instruction. In a link instruction, the data address positions 5 through 8 have all zeroes and the positions 1 through 4 contain an instruction address for the instruction storage section of the drum which identifies the address of the first instruction of a sub-routine A1, A2 or A3 which respectively are sub-routines for effecting printout of the point number, the alarm value and the time information on the strip printer during an alarm readout operation.

Another position of work storage contains a tape reader transfer link instruction addressing the first instruction in a group forming a tape reading program sub-routine.

Another position of work storage contains a "store" data word instruction in which is developed a drum address for the point identified, for example, by storage entry word 4, digits 4 and 5 set up by the point switches on the control panel **22** in accordance with the aforesaid formula (Address=Pt. No. +100+K100).

One position of work storage is used for a log transfer link instruction which gives access to the first instruction in a group of instructions forming a log print sub-routine.

The work storage section of the drum also contains an action demand transfer link instruction for addressing the first instruction of one of a number of groups of instructions forming various program sub-routines used respectively to carry out the various aforesaid operations set by the manual operation switches **38***a* and **38***b*. This address will consist of a constant (such as 1,000) plus the number set up on the manual operation switch and read into the storage unit **14***a*'.

Refer now to FIG. 9. This program contains a main program loop which is outlined in heavy lines and which represents the series of program steps of highest priority. Other program loops are shown which have a secondary priority as will be explained. Within the main program loop also a series of alternate program paths are found which are set up in accordance with a priority where alarm detection and printout operations are treated immediately, so that alarm points are indicated to the operator as fast as possible.

The first program section **400** in the main program loop shown in FIG. 9 is one which detects external occurrences which, for the most part, relate to the various inputs outlined in FIG. 5*b*. These inputs are merely read into the storage unit **14***a*' and are not acted upon in this section of the program.

The next program section is a branching or conditional transfer section which looks at the 7th digit of storage entry word one to see whether the analog to digital converter **12** is ready to feed out a signal indicating the apparent value of the variable involved. This information is obtained from storage entry word one, digit 7 just read into the storage unit **14***a*'. If the analog to digital converter is ready, then a next program section **404** extracts digits 1 through 3 of storage entry word three which is the apparent value of the variable involved. The digit 7 of storage entry word C is reset to indicate ADC not ready. Next, a program section **406** applies the gain and offset factors stored in the data block of the variable involved in a manner to be explained in more detail hereinafter to determine the actual value of the variable. If the function marker digit 9 of data word B indicates that a square root operation is required, the program computes this value also.

Next, a branching or conditional transfer program section **408** inquires whether a log cycle is involved, which is determined by looking at the log printout and storage cycle marker word position in work storage which is stored here only if a log printout was demanded. Any non-zero digits indicates that a regular hourly printout cycle or an on demand printout cycle has been initiated. If a log cycle is not involved, an alarm detect program section **420** becomes operative. If a log cycle is not involved, an alarm detect program section **420** becomes operative. If a log cycle is involved and no "print skip through" marker is set, then a program section **410** stores the corrected value of the variable involved in digit positions 1 through 3 of data word C of the data block for the variable being scanned, a log to be printed marker is set in digit 0 of data word D, and one is subtracted from the aforesaid log read-in count number. If the count number is zero, the log cycle marker is reset after this operation is completed. If a print skip through marker is set, then the value of the variable is not entered into the word C section of the data block involved.

Next, a program section **420** carries out an alarm detection operation which compares the corrected value of the variable with the high and low alarm limits found in digit positions 1 through 3 and 5 through 7 of word A for the variable data word section of the drum for the particular variable being scanned. If an abnormal variable is detected, the next program section **422** will check the number stored in digit position 9 of data word C for the variable involved which indicates whether the variable was abnormal when last scanned. If it was, then no new alarm is involved and the next program section **424** to be described is bypassed. However, if a new alarm is involved, program section **424** sounds the audible alarm **18** and stores the value of the variable in digits positions 5 through 7 in the data word C for the variable involved and also sets a number in digit position 0 for data word C which indicates that an alarm print marker is present, which will be looked at to see whether the alarm value of the variable has been printed. When the variable is printed, the alarm print marker is reset to a number indicating that an alarm printout has taken place for the alarm value of the variable. The actual program steps for a printout value of the variable comes later on in the program.

The next program section **426** controls the particular transducer means scanned by the switching matrix **11**. As previously indicated, the particular variable next scanned is determined by a number stored in the storage unit **14***a*', referred to as a scan sequence instruction whose data address identifies the last data block looked at for scan sequence determination and can be identified by the "store scan sequence" operation set on the operator's control panel **22**. One is added to the latter data address to identify the new data block to be looked at for scan sequence determination and the number (referred to as a scan sequence number) stored in digit positions 1 and 2 of data word D of the latter data block is looked at to identify the next transducer means to be scanned. As previously indicated, the scan sequence point number has no necessary relationship to the latter data block. A binary coded control signal is developed which is fed to the switching matrix **11** to select the transducer means.

The next program section **427** includes a conditional transfer or branching step which inquires whether any action demand operations have to be performed by testing the aforesaid action count number for zero. If it is zero, the beginning of the main program loop is entered to start a new program cycle. If the action count number

is greater than zero, a branching step **428** operates which inquires whether the strip printer **15** is busy as determined by looking at digit 5 of storage entry word one which was previously read into the storage unit **14***a*'. If the strip printer is busy, the next stage set into operation would be the first aforesaid program section **400** which initiates another program cycle. However, if the strip printer is not busy, a branching program **430** inquires whether an alarm printout is in order. An alarm printout is in order if there are any alarm values left to be printed on strip printer **15** which may be determined by looking at alarm printout storage word C in work storage or the alarm printout count number. In any event, if an alarm printout is in order, a program step **432** is initiated which carries out a sequence of operations which, among other things, scans the various data blocks and looks for an alarm print marker in digit zero of word C. Whenever such marker is found, the alarm value, point number and the approximate time involved are read into the storage exit section of the storage unit **14***a*'. The point number is obtained from a number stored in the storage unit **14***a*' to be referred to as an alarm printout address which contains the data block or data point number of the variable whose data is now being printed out. The time information may be obtained from storage entry C word five stored in the storage unit **14***a*' by the first program step **400**. After a printout is effected, the particular alarm print marker involved is reset as above indicated and the alarm backlog count number is reduced by 1, as is the action required count number.

If program step **430** indicates that an alarm printout is not involved, that is, all alarm printouts have been finished, a program section **434** next inquires whether any action demand operations are still pending such as hourly or on demand printouts or an operation set by the operation switches **38***a* and **38***b*. An action required count number other than zero indicates such pending operations to be carried out. If this count number is greater than zero, then a program section **436** is entered which includes a series of sub-routines arranged in order of a given priority, the first priority being a log print sub-routine and other priorities involving operation switch demand sub-routines. Access to the log print sub-routine and the other sub-routines are obtained by use of a link instruction shown in FIG. 10*c*. The link instruction has a link address which identifies the first instruction in a series of sequentially addressed instructions carrying a program sub-routine. The program section **436** includes a branching step (not shown in FIG. 9) which inquires whether an operation switch action demand routine has been requested as determined from the aforesaid action demand marker word in work storage. This marker word is storage entry word 4, the 6th and 7th digit positions of which indicate the position of the operation switches **38***a* and **38***b* if an action demand operation was requested. A proper link instruction is generated by generating a number in the link address positions of the instruction which is a number having the tens and units digit positions of the operation switches **38***a* and **38***b* plus a constant which may be 1000. Thus, if the operation switches have a number of 56 therein, an instruction 1056 of a particular sub-routine required is addressed to start the selected sub-routine.

If no operation switch action demand is involved, then an inquiry is made whether a log printout operation is requested by looking at the log print marker word in work storage.

Once the particular operation required by the operation switches has been carried out, the action demand marker in work storage is reset to zero and the action required count number is reduced by **1**. The system is now ready to receive a new operation read in from the operator's control panel **22**.

In case an hourly log or on demand log operation is to be carried out, a sub-routine is initiated which effects the readout of the log value of one variable in digit positions 1 through 3 of word C to an output storage band of the drum **14***a*', the variable which is logged being determined by a method similar to that in which the scan sequence was determined. Thus, a log printout search operation instruction is stored in work storage, the data address positions of which identify the last data block which was looked at for log sequence determination. One is added to the data address to locate the new data block looked at for the aforesaid log sequence address point number in digit positions 5 and 6 of word D thereof.

The aforesaid log prinout count number identifies the number of log points still to be printed out, one such log point being printed out each program cycle. When this number reaches zero, then the action required count number is reduced by one and the log printout and storage cycle word is reset indicating the end of an hourly log cycle or on demand log cycle.

After the program section **432** has completed its operation, the program cycle begins again with the operation of the detect external occurrence section **400**. Thus far, the main program branch of the program has been described. However, it was not stated what occurred if the ADC ready step **402** detected an ADC not ready condition. In such case, a program step **440** is initiated which inquires whether a tape reader demand operation has been requested. This information is obtained from storage entry word one, digit 5. If a tape reader demand operation is involved, then a program section **442** effects the tape read step routine to be described. In general, this tape sub-routine effects the advancement of the tape reader a given number of positions to read a limited number of data constant values into the machine. The tape being read includes similar types of data constant modifying information with operation codes to indicate the particular data constant affected. After the limited number of data constants have been read from the tape reader **442**, the main program branch is entered and the detect external occurrence program section **444** becomes operative. The demand tape reader marker is not reset to zero until all of the numbers set into the tape reader have been completed. The reading of the tape reader is thus interwoven into the main program so that the program is not held up too long for read-in of large numbers of new data constants.

If a tape reader demand operation is not required, then the program section **444** is rendered operative which looks at digits 1, 2 and 4 of storage entry word one to see whether there are any hourly time pulse demand log and action switch command functions and, if so, markers are set to indicate the fact. These markers are looked at during the main program loop to indicate operation in the program section **436**.

Next, a program section **446** is rendered operative which includes a conditional transfer or branching step which tests for an alarm backlog. If not, the main program branch is entered at G. If an alarm backlog is involved, then a program section **448** is entered which, among other things, locates the next alarm point to be printed out and sets up the information to be printed out in the alarm printout sub-routine **428**. It is thus apparent that if the analog digit converter is not ready that the spare time is used to carry out alternate programs including the digit read sub-routine and prepare for printout for alarm backlogs.

As previously indicated, the various boxes in FIG. 9, for the most part, represent a number of broad program steps which are carried out by various combinations of more basic program steps. These basic steps are outlined in the more detailed program flow diagrams to follow. In many cases here also, the individual basic program steps shown in these flow diagrams can be further broken down into specific program operations which

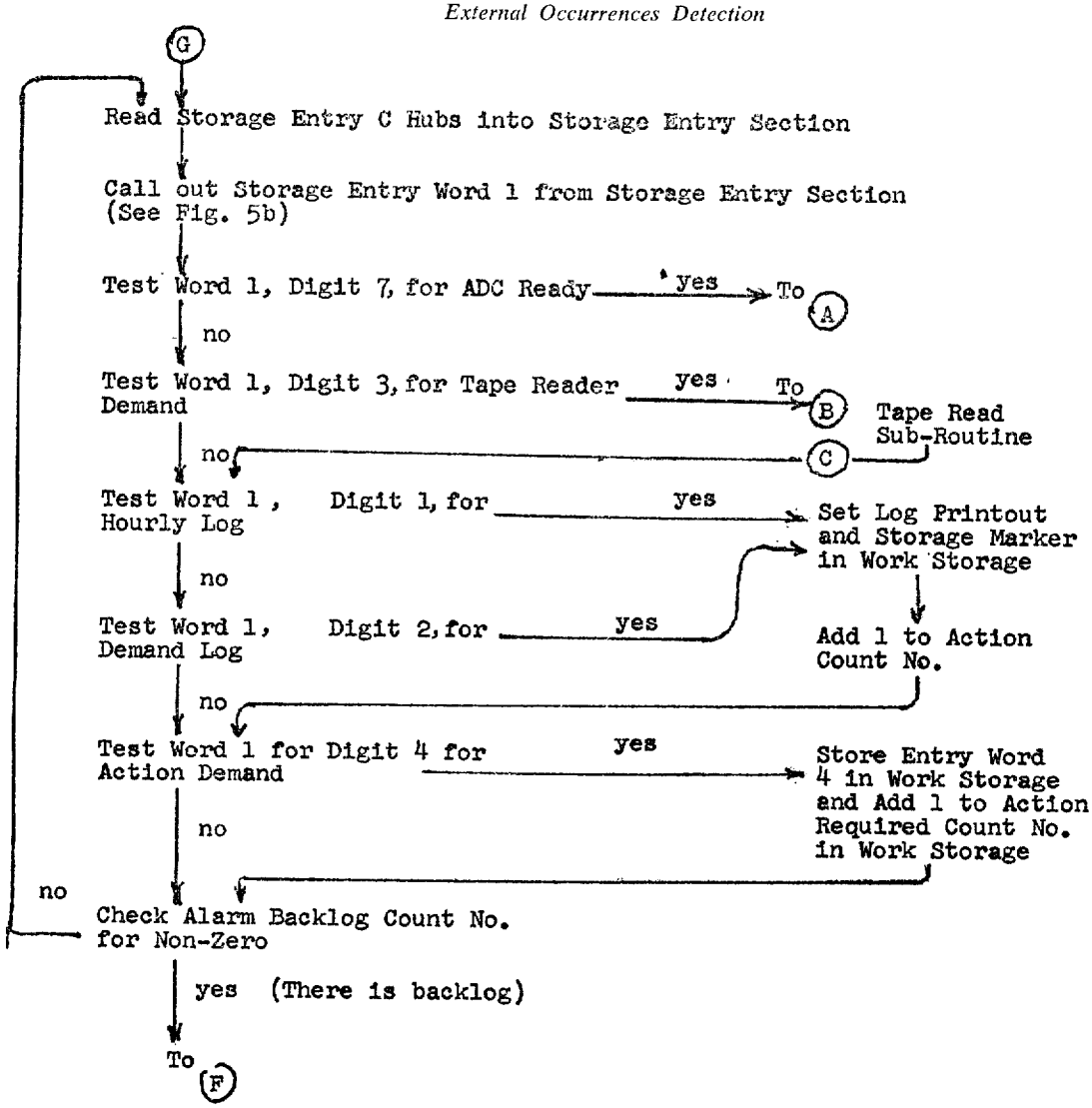
are carried out in the IBM Type 650 data processing machine. These specific instruction orders for this machine will be given hereinafter showing an exemplary detailed program for the IBM Type 650 machine.

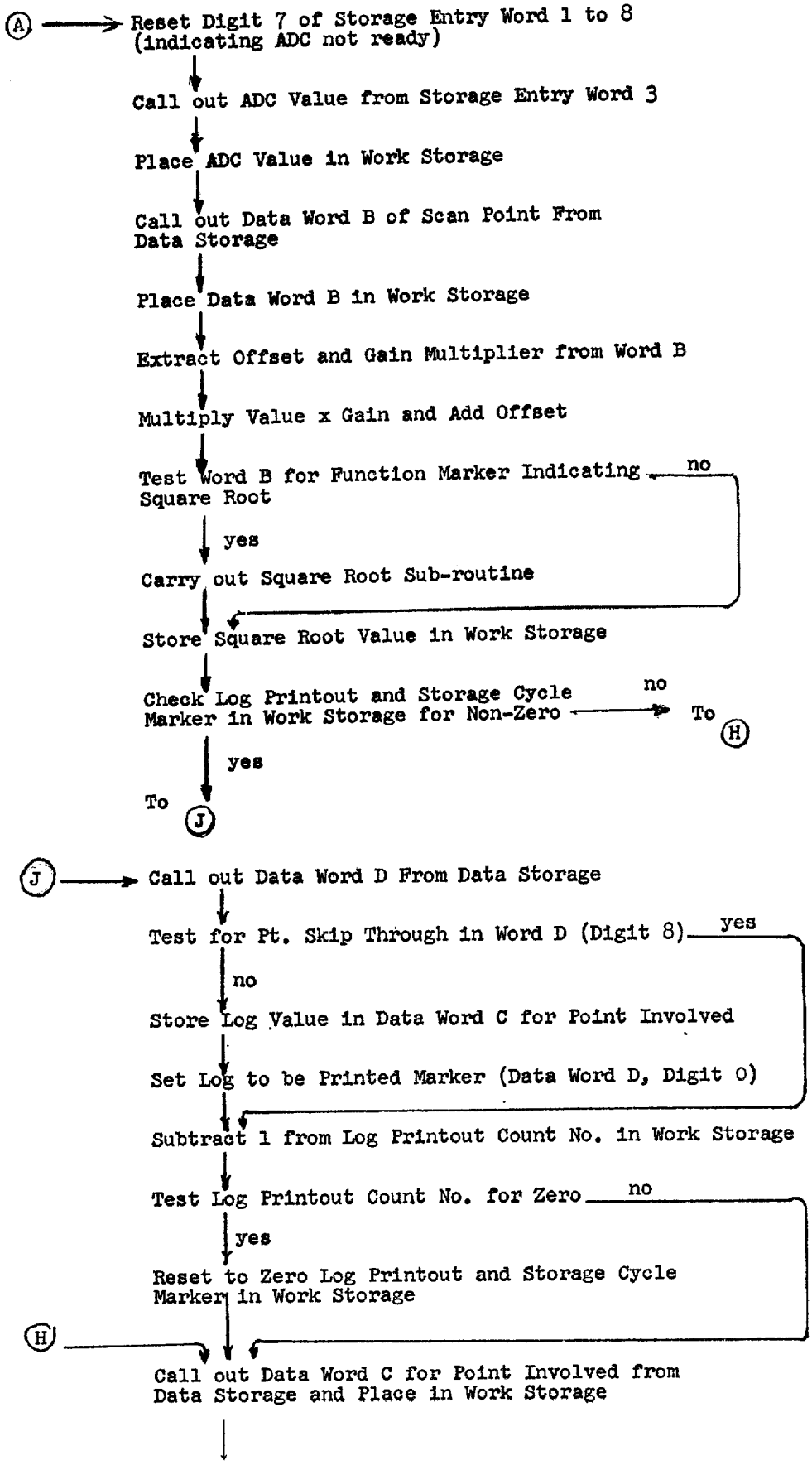
As previously indicated, the possible programs useable with most aspects of the invention are practically unlimited. FIG. 11 shows, for example, one possible variation of the program outlined in FIG. 9 which is a more efficient and advantageous program when used with much faster machines than the IBM Type 650 data processing machine. The corresponding sections of the programs of FIGS. 9 and 11 have been similarly numbered. The type reader demand and tape read sub-routine program sections **440** and **442**, however, have been replaced by more generalized program sections referred to as alternate program (branching section) and alternate program sub-routine. Thus, in addition to or in place of the tape reader program sections, other alternate programs could be used such as an alternate computation sub-routine which responds to an externally fed computing program unconnected with the variable monitoring system operations.

PROGRAM FLOW DIAGRAMS

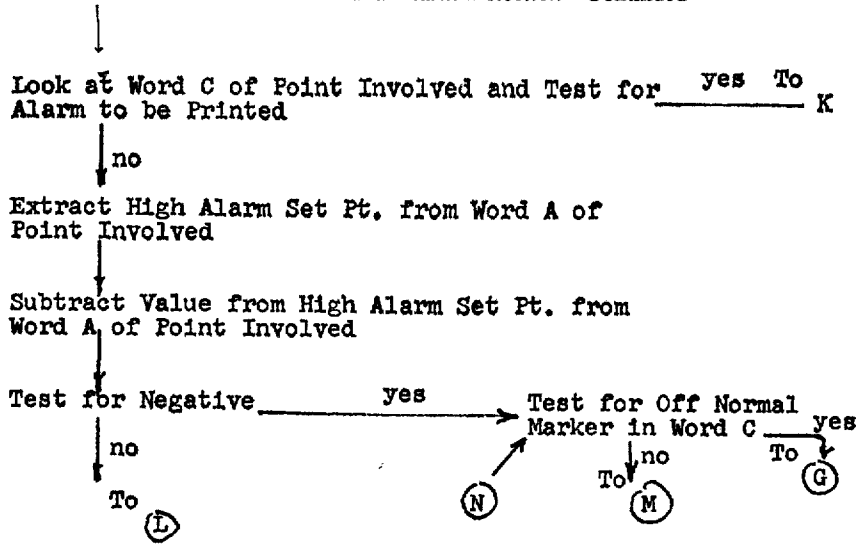
The flow diagrams to follow show the more basic program steps carried out by the storage, calculator and control means **14** for various typical types of operations performed by the program of FIG. 9. The various alphabetical reference points in FIG. 9 correspond to the like alphabetical reference points used in the flow diagrams, the latter, however, using many more of same than FIG. 9 (as connecting points between the flow diagrams). The detailed coded program which follows the flow diagrams is an actual exemplary program using the IBM program code found in the aforesaid IBM Type 650 Manual of Operation which carries out all the steps necessary to effect the program of FIG. 9. The data constants and tables stored in the machine together with their address locations are also given.

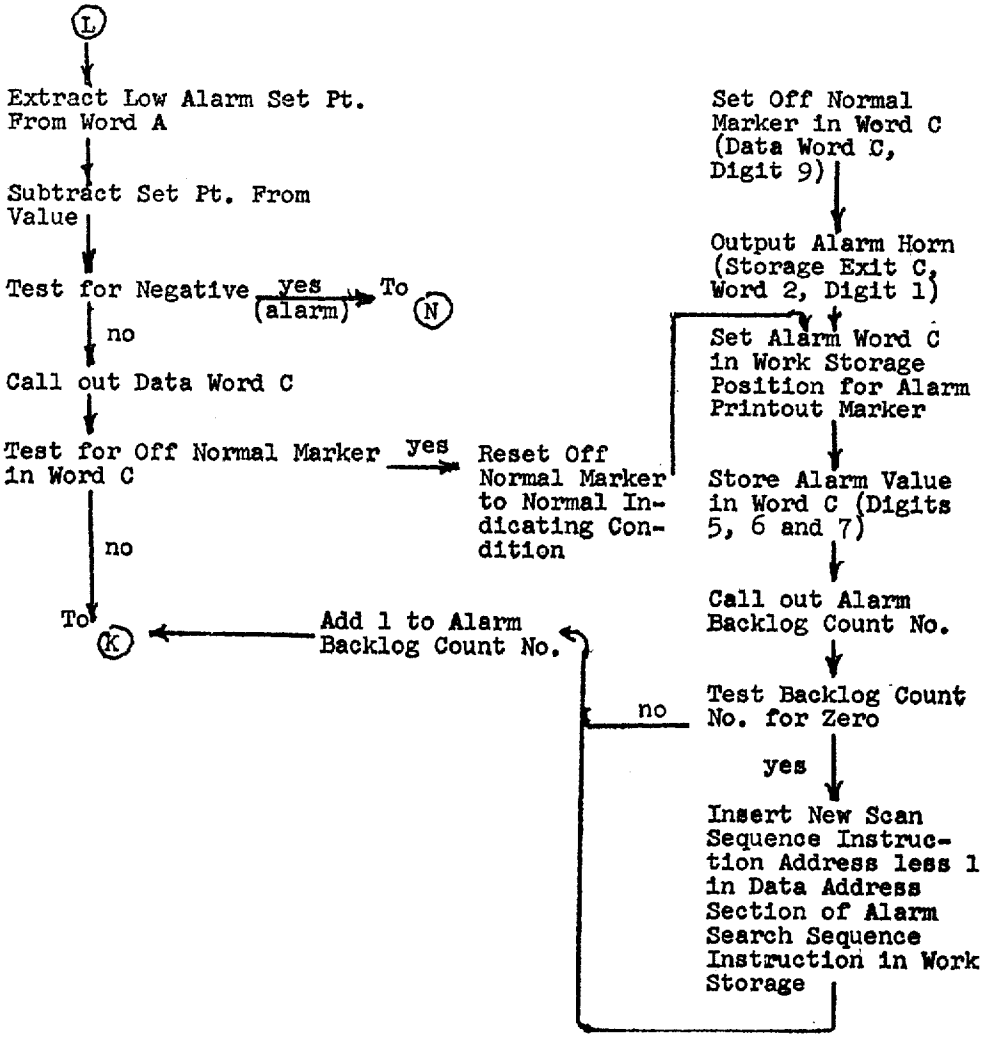
External Occurrences Detection



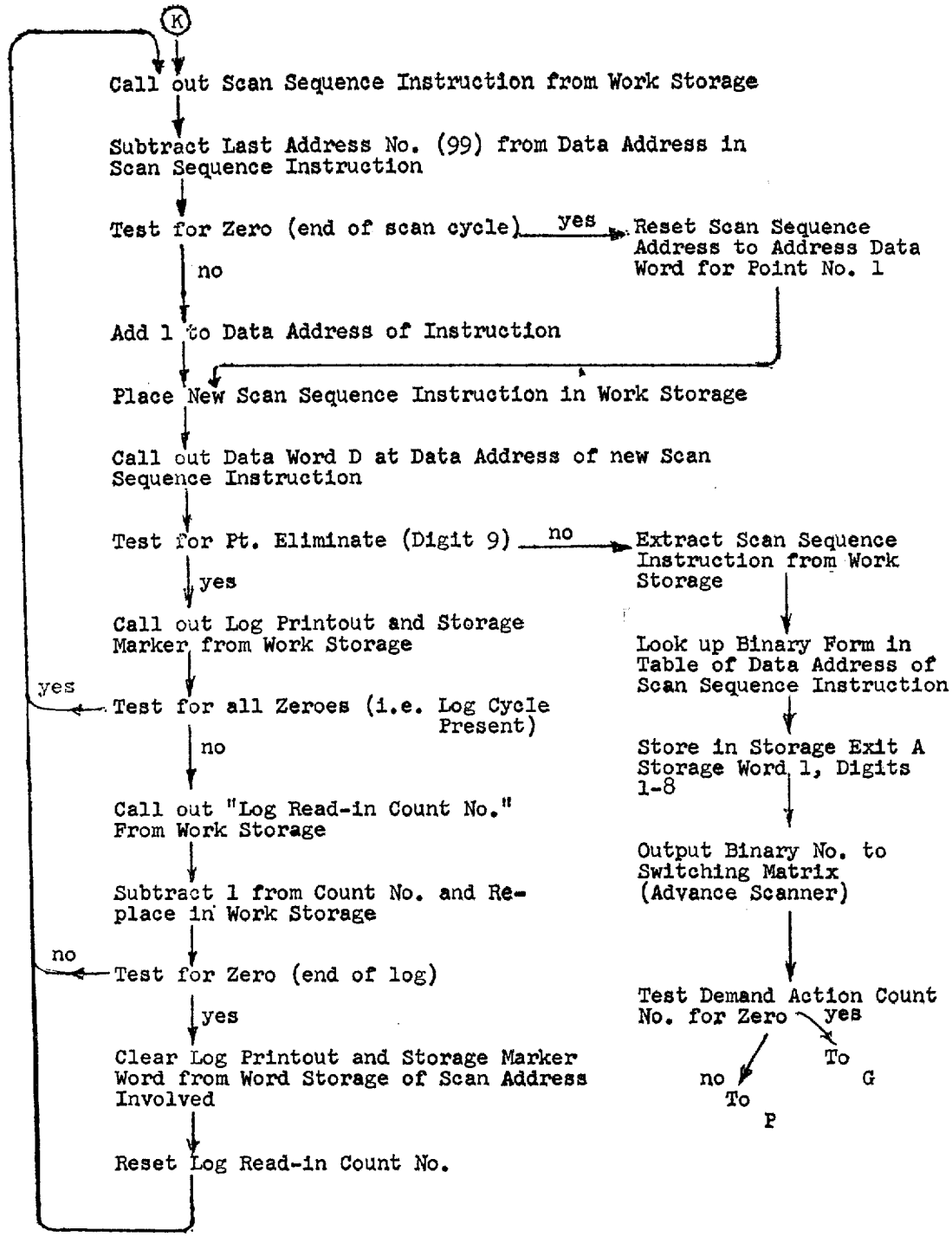

A
Reset Digit 7 of Storage Entry Word 1 to 8 (indicating ADC not ready)
Call out ADC Value from Storage Entry Word 3
Place ADC Value in Work Storage
Call out Data Word B of Scan Point From Data Storage
Place Data Word B in Work Storage
Extract Offset and Gain Multiplier from Word B
Multiply Value x Gain and Add Offset
Test Word B for Function Marker Indicating Square Root
no
yes
Carry out Square Root Sub-routine
Store Square Root Value in Work Storage
Check Log Printout and Storage Cycle Marker in Work Storage for Non-Zero
no
To H
yes
To J
J
Call out Data Word D From Data Storage
Test for Pt. Skip Through in Word D (Digit 8)
yes
no
Store Log Value in Data Word C for Point Involved
Set Log to be Printed Marker (Data Word D, Digit 0)
Subtract 1 from Log Printout Count No. in Work Storage
Test Log Printout Count No. for Zero
no
yes
Reset to Zero Log Printout and Storage Cycle Marker in Work Storage
H
Call out Data Word C for Point Involved from Data Storage and Place in Work Storage

Measurement and Alarm Detection—Continued

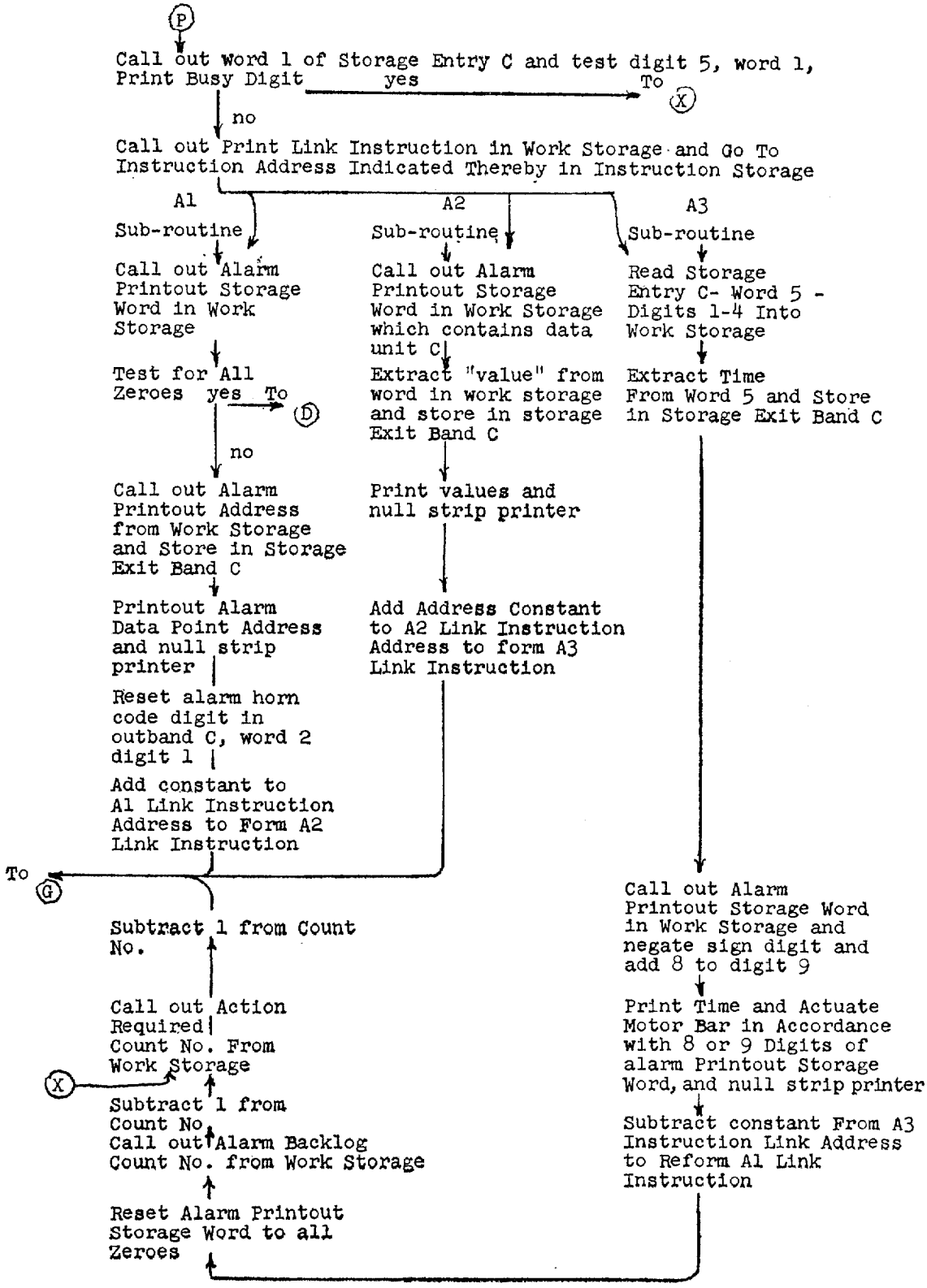




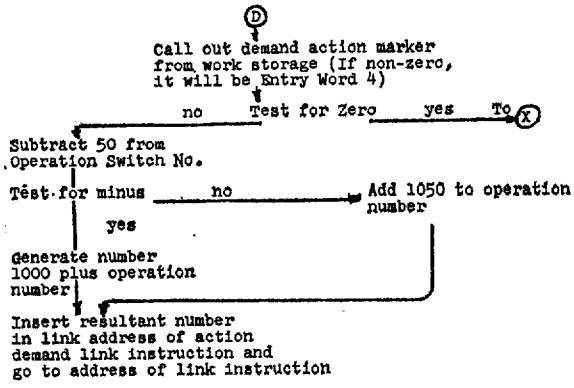
Scanner Advance and Log Storage Cycle Count



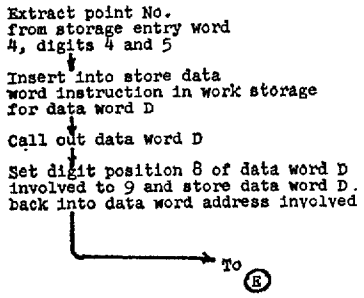
Alarm Printout



Action Demand Sub-Routines



Point Skip Through Restore Sub-Routine
(Link Address 1001)



Display High Alarm Limit Sub-Routine
(Link Address 1056)

Extract point No. from Entry Word 4 now in work storage as action demand marker

↓

Develop data word address for data word A from point number

↓

Extract high alarm limit from data word A

↓

Store digits of alarm limit sequentially in output storage Band B

↓

Output sequentially to Storage Exit hubs B, for display

↓

To Ⓔ

Print High Alarm Limit Sub-Routine
(Link Address 1076)

Extract point No. from Entry Word 4 now in work storage as action demand marker

↓

Develop data word address for data word A from point number

↓

Extract high alarm limit from Data word A

↓

Store alarm limit digits in output Band C, output alarm limit sequentially to strip printer and null strip printer

↓

To Ⓔ

Point Skip Through Set Sub-Routines
(Link Address 1002)

Extract point No. from storage entry word 4, digits 4 and 5

↓

Insert into store data word instruction in work storage address for data word D of point No. involved

↓

Call out data word D

↓

Set digit position 8 of data word D to (8) and store back in data word storage address involved

↓

To Ⓔ

Set Point Eliminate Sub-Routine
(Link Address 1002)

Extract point No. from storage entry word 4, digits 4 and 5

↓

Insert into store data word instruction in work storage address for data word D of point No. involved

↓

Call out data word D

↓

Set digit position 9 of data word D to (8) and store back in data word address involved

↓

To Ⓔ

Point Eliminate Restore Sub-Routine
(Link Address 1003)

Extract point No. from storage entry word 4, digits 4 and 5

↓

Insert into store data word instruction in work storage address for data word D of point No. involved

↓

Call out data word D

↓

Set digit position 9 of data word D to (9) and store back in data word address involved

↓

To Ⓔ

Exit of Demand Actions

Ⓔ

↓

Zero action demand marker in work storage

↓

Reduce action required count No. by 1

↓

To Ⓖ

"Store" High Alarm Limit Sub-Routine
(Link Address 1086)

Extract value digits from storage entry word 4 (digits 1–3)

↓

Extract point number and develop store instruction with address of data word A

↓

Call out data word A and store value in digit positions 1–3 of data word A and

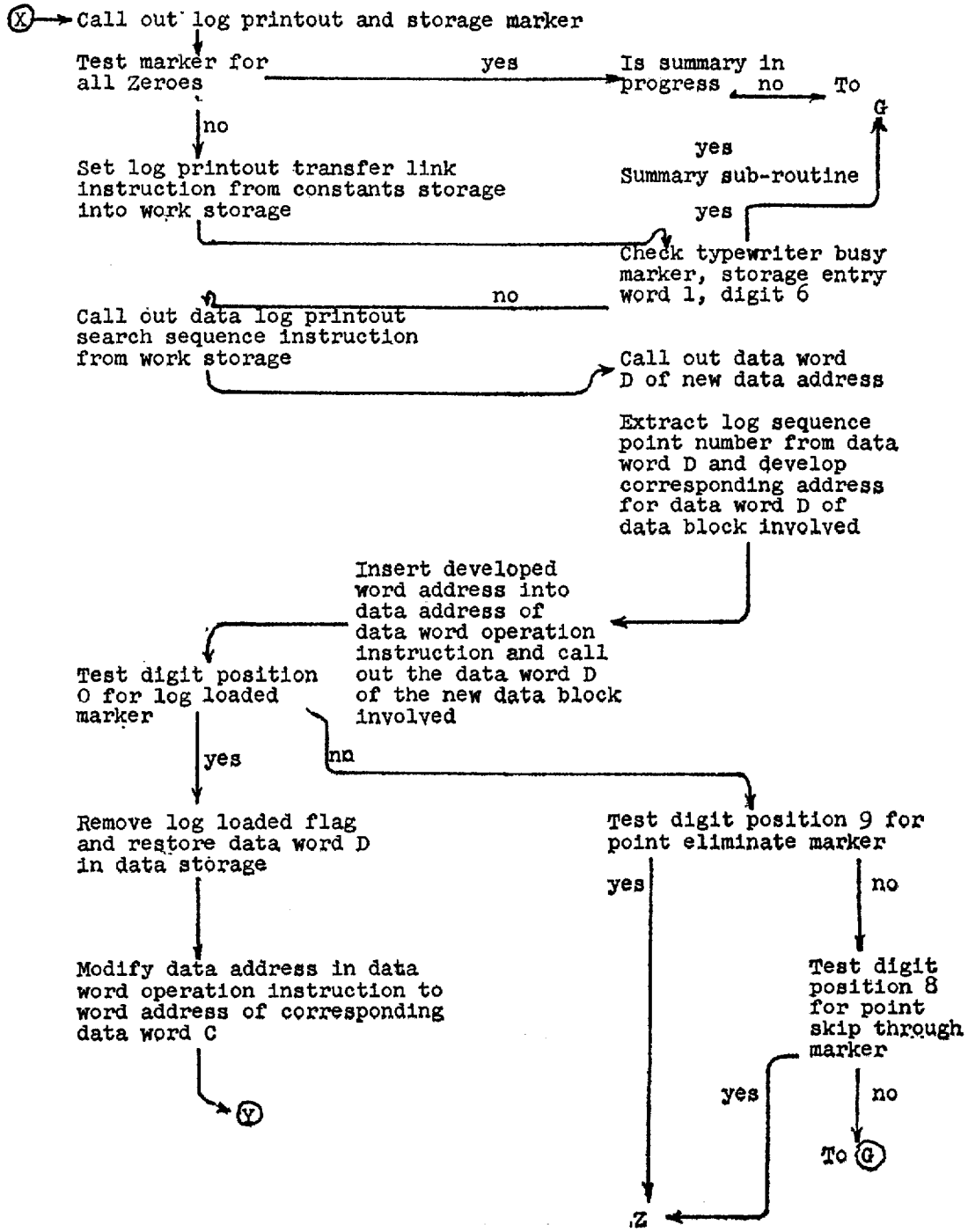
↓

Return new data word to its drum address

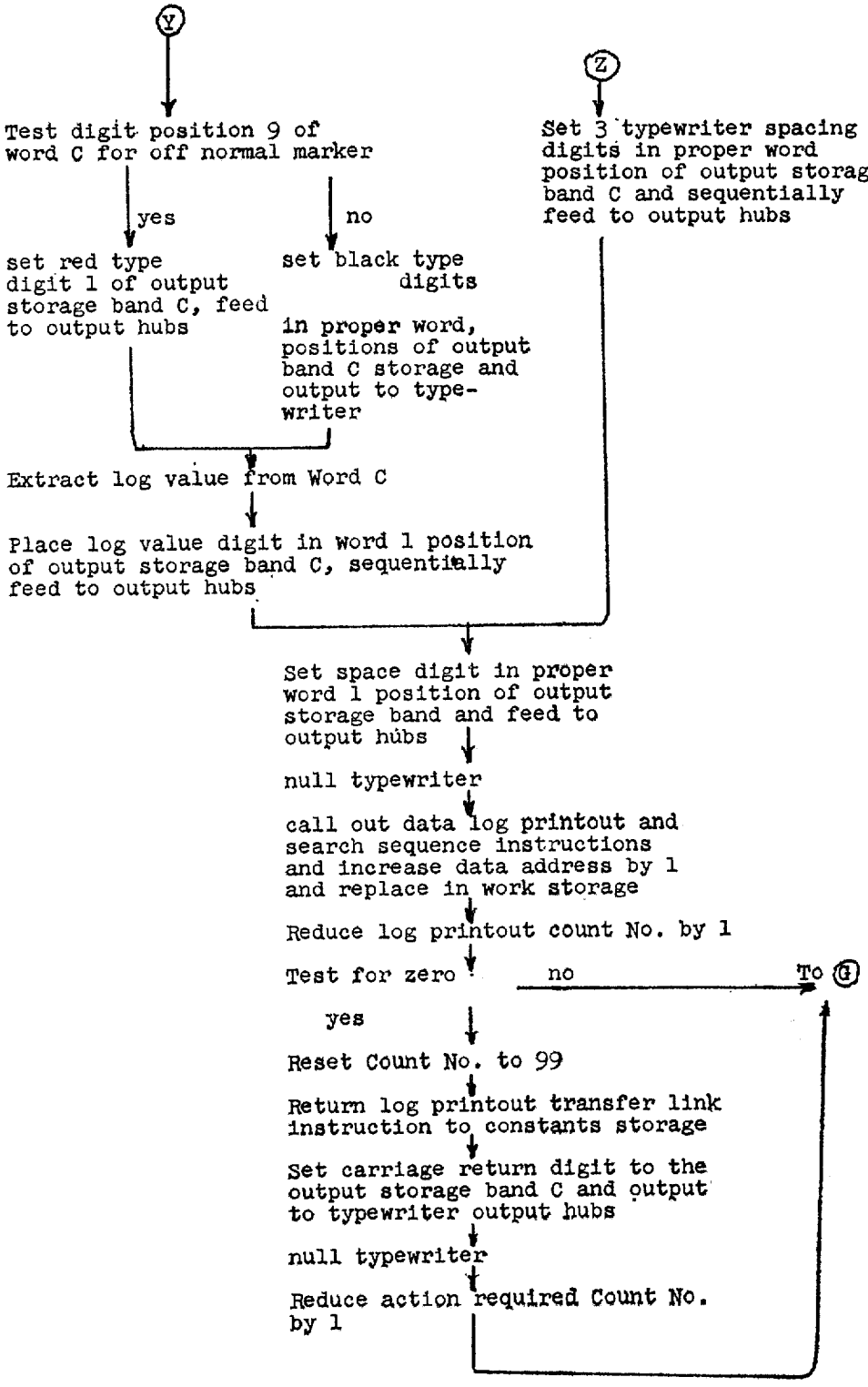
↓

Ⓔ

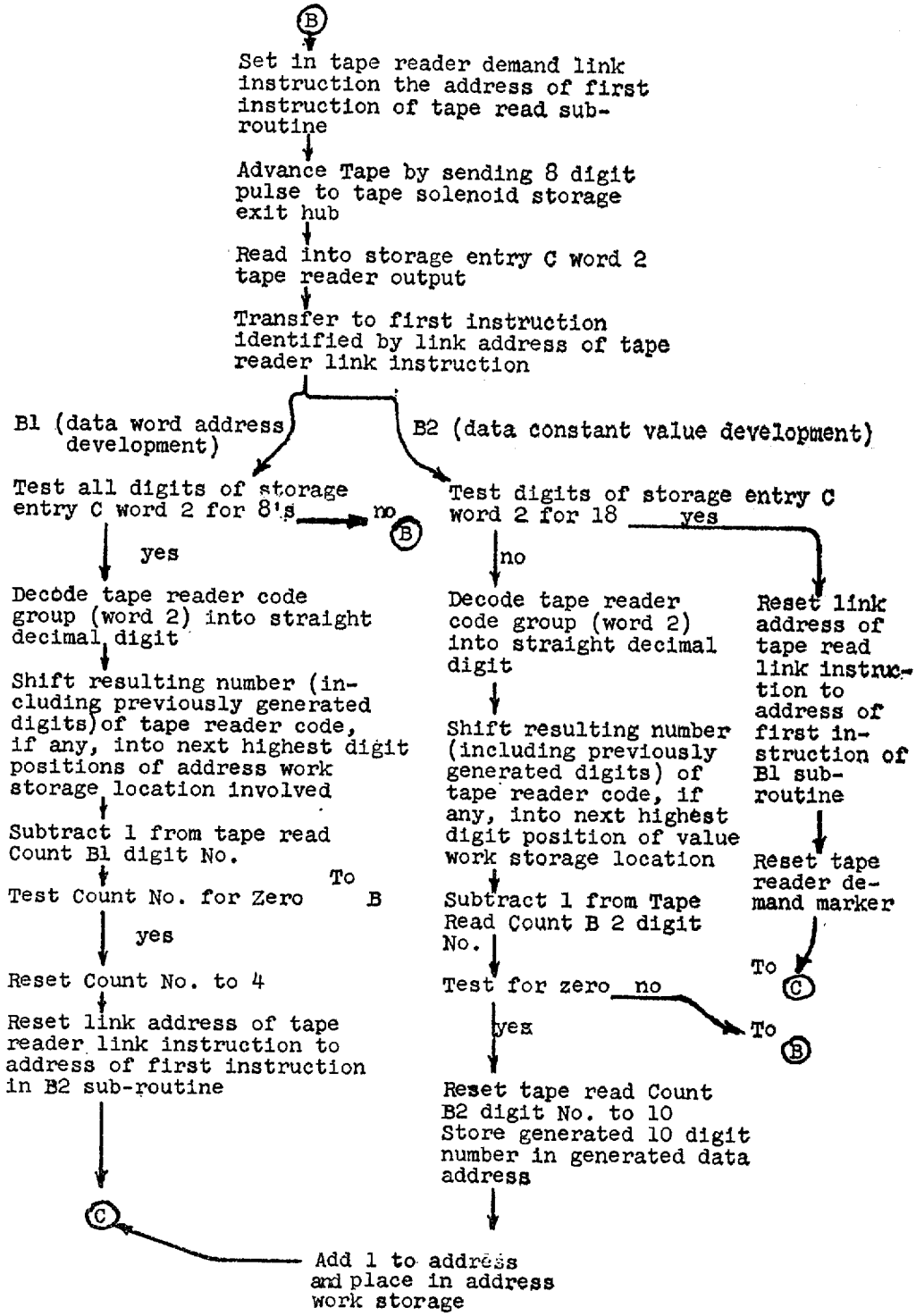
Log Print Sub-Routine



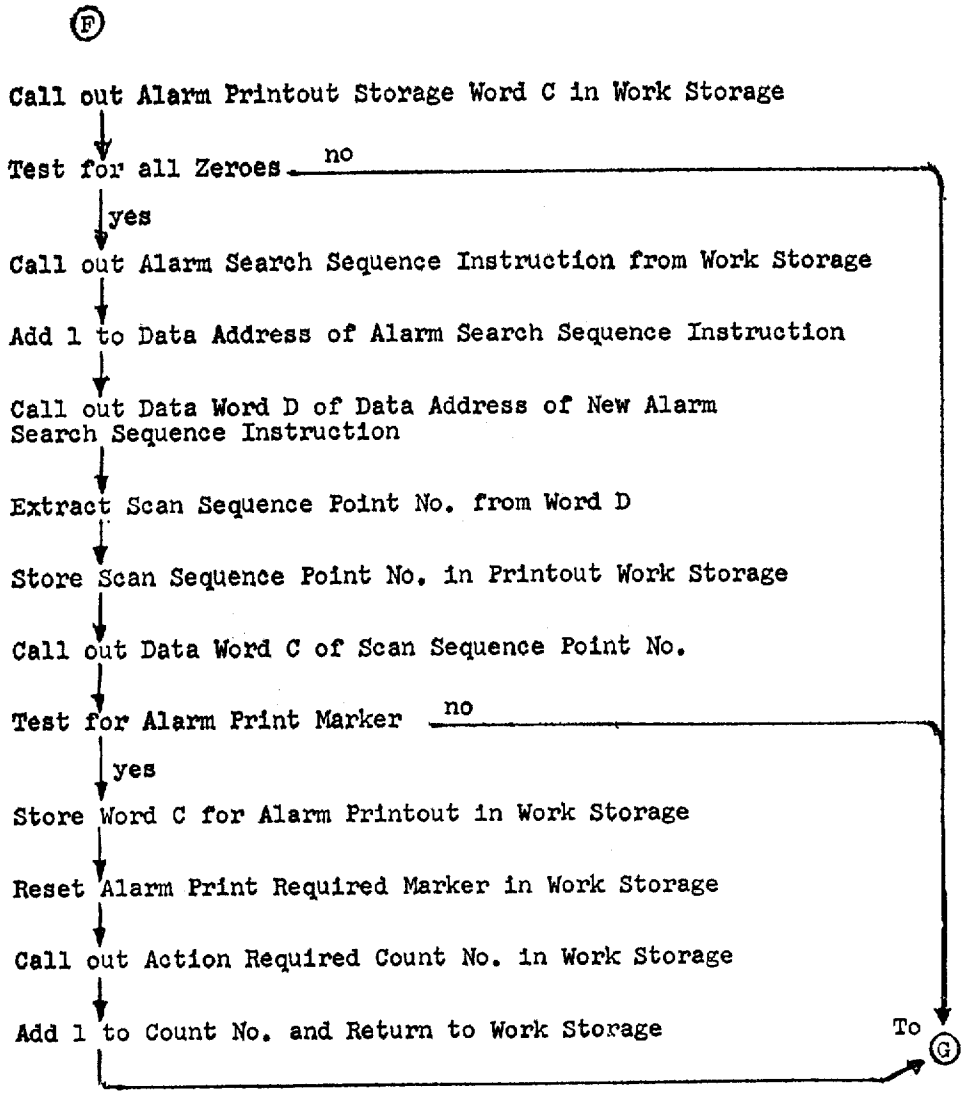
Log Print Sub-Routine—Continued



Tape Read Sub-Routine



Prepare to Print Alarm



The following pages list the instruction and constant words which are set into the IBM Type 650 data processing machine in adapting the same for use in the present invention. The format of the various instructions is shown in FIGS. 10*a* through 10*c*. The instructions were developed in accordance with the instruction procedures and order codes disclosed in the aforementioned Manual of Operation for the IBM Type 650 Machine. The operation or order code numbers which appear in digit positions 8 and 9 of the instructions as contained in said manual are as follows:

00 No-Operation (NO-OP)
01 Stop (Stop)
10 Add Upper (AU)
11 Subtract Upper (SU)
14 Divide (DIV)
15 Add Lower (AL)
16 Subtract Lower (SL)
17 Add Absolute (AABL)
18 Subtract Absolute (SABL)
19 Multiply (MULT)
20 Store Lower (STL)
21 Store Upper (STU)
22 Store Data Address (STDA)
23 Store Instruction Address (STIA)
24 Store Distributor (STD)
30 Shift Right (SRT)
31 Shift and Round (SRD)
35 Shift Left (SLT)
36 Shift and Count (SCT)
44 Branch Non-Zero Upper (BRNZU)
45 Branch Non-Zero (BRNZ)
46 Branch Minus (BRMIN)
47 Branch Overflow (BROV)
60 Reset Add Upper (RAU)
61 Reset Subtract Upper (RSU)
64 Divide-Reset Upper (DIVRU)
65 Reset Add Lower (RAL)
66 Reset Subtract Lower (RSL)
67 Reset Add Absolute (RAABL)
68 Reset Subtract Absolute (RSABL)
69 Load Distributor (LD)
70 Read (RD)
71 Punch (PCH)
84 Table Lookup (TLU)
90 Branch on Distributor Digit Position 0
91 Branch on Distributor Digit Position 1
92 Branch on Distributor Digit Position 2
93 Branch on Distributor Digit Position 3
94 Branch on Distributor Digit Position 4
95 Branch on Distributor Digit Position 5
96 Branch on Distributor Digit Position 6
97 Branch on Distributor Digit Position 7
98 Branch on Distributor Digit Position 8
99 Branch on Distributor Digit Position 9

The pages to follow list the instructions and constants which go into the IBM Type 650 data processing machine to carry out the program of FIG. 9 using the order codes just outlined and the instruction format of FIG. 10.

TEST FOR EXTERNAL OCCURRENCES AND SET UP ALARM PRINT

Drum Address Location		Instruction		
0901	70	0601	0902	
0902	65	0601	0903	
0903	97	0904	0940	
0904	93	1951	0905	
0905	91	0906	0910	
0906	24	0050	0907	
0907	65	0030	0908	
0908	15	0527	0909	
0909	20	0030	0910	
0910	92	0906	0911	
0911	69	0601	0912	
0912	94	0913	0918	
0913	69	0604	0914	
0914	24	0035	0915	
0915	65	0030	0916	
0916	15	0527	0917	
0917	20	0030	0918	
0918	65	0070	0919	
0919	45	0920	0901	
0920	65	0075	0921	
0921	45	0901	0922	
0922	65	0077	0923	
0923	16	0531	0924	
0924	46	0925	0981	
0925	15	8001	0926	
0926	15	0527	0927	
0927	20	0077	8002	
8002	60	04__	0928	
0928	35	0006	0929	
0929	21	0072	0930	
0930	30	0002	0931	
0931	10	0532	0981	
0981	65	0542	8003	
8003	15	03__	0932	
0932	90	0933	0901	
0933	24	0075	0934	
0934	15	0522	0935	
0935	10	0538	8003	
8003	20	03__	0936	
0936	65	0030	0937	
0937	15	0527	0938	
0938	20	0030	0901	

SET UP CORRECTED VALUE

0940	16	0533	0941	
0941	20	0601	0942	
0942	65	0603	0943	
0943	20	0011	0945	
0945	65	0013	0946	
0946	15	0534	0947	
0947	20	0015	0948	
0948	15	0535	8002	
8002	65	02__	0949	
0949	20	0017	0950	
0950	69	0536	0951	
0951	22	0019	0952	
0952	60	8002	0953	
0953	35	0007	0954	
0954	19	0011	0955	
0955	30	0006	0956	
0956	15	0019	0957	
0957	31	0004	0958	
0958	20	0023	0959	
0959	69	0017	0960	
0960	99	1901	0961	
0961	65	0050	0962	
0962	45	0963	0801	

STORE LOG BUFFER

Drum Address Location		Instruction		
0963	60	0013	0964	
0964	10	0537	8003	
8003	15	04__	0965	
0965	98	0975	0966	
0966	90	0968	0967	
0967	16	0522	0968	
0968	10	0538	8003	
8003	20	04__	0969	
0969	60	8003	0970	
0970	15	0023	0971	
0971	10	0539	8003	
8003	69	03__	0972	
0972	23	0021	0973	
0973	11	0540	0974	
0974	69	0021	8003	
8003	24	03__	0975	
0975	65	0042	0976	
0976	16	0527	0977	
0977	45	0978	0979	
0978	20	0042	0801	
0979	20	0050	0980	
0980	65	0528	0978	

TEST VALUE FOR LIMITS AND SET UP ALARM IF OUTSIDE

0801	65	0013	0802	
0802	15	0541	8002	
8002	69	03__	0803	
0803	24	0025	0804	
0804	90	0015	1201	
0015	65	01__	0805	
0805	69	8003	0806	
0806	23	0027	0807	
0807	30	0004	0808	
0808	66	8002	0809	
0809	15	0023	0810	
0810	46	0817	0811	
0811	66	8001	0812	
0812	15	0027	0813	
0813	46	0817	0814	
0814	60	0025	0815	
0815	99	0816	1201	
0816	10	0530	0822	
0817	60	0025	0818	
0818	99	1201	0819	
0819	11	0530	0820	
0820	69	0543	0821	
0821	24	0628	0822	
0822	11	0522	0823	
0823	15	0023	0824	
0824	69	8003	0825	
0825	35	0004	0826	
0826	22	0021	0827	
0827	65	0013	0828	
0828	15	0544	0829	
0829	69	0021	8002	
8002	24	03__	0830	
0830	60	0070	0831	
0831	45	0836	0832	
0832	15	0079	0833	
0833	16	0527	0834	
0834	69	0077	0835	
0835	22	0077	0836	
0836	10	0527	0837	
0837	21	0070	1201	

SCANNER ADVANCE AND SELECTION

1201	65	0079	1202
1202	16	0545	1203
1203	46	1206	1204
1204	65	8001	1205
1205	16	0528	1207
1206	15	8001	1207
1207	15	0527	1208

SCANNER ADVANCE AND SELECTION—Continued

Drum Address Location	Instruction		
1208	20	0079	8002
8002	60	04__	1209
1209	35	0008	1210
1210	30	0004	1211
1211	21	0013	1212
1212	10	0546	8003
8003	69	04__	1213
1213	99	1217	1214
1214	10	0547	8003
8003	69	18__	1215
1215	24	0727	1216
1216	71	0727	0851
1217	65	0050	1218
1218	45	1219	1201
1219	65	0042	1220
1220	16	0527	1221
1221	45	1222	1223
1222	20	0042	1201
1223	20	0050	1224
1224	65	0528	1222

ALARM PRINT ROUTINE OF DATA POINT ADDRESS

0851	65	0030	0852
0852	45	0853	0901
0853	69	0601	0854
0854	95	1251	0855
0855	65	0075	0856
0856	45	0857	1251
0857	65	0072	0858
0858	30	0005	0859
0859	15	0526	0860
0860	20	0629	0861
0861	71	0627	0862
0862	35	0001	0863
0863	20	0629	0864
0864	21	0628	0865
0865	71	0627	0866
0866	66	0548	0867
0867	20	0629	0868
0868	71	0627	0869
0869	69	0549	0870
0870	24	0851	0750
0750	66	0526	0751
0751	20	0629	0901

ALARM PRINT ROUTINE OF DATA POINT VALUE

0871	65	0075	0872
0872	69	0526	0873
0873	30	0004	0874
0874	23	0629	0875
0875	71	0627	0876
0876	65	8001	0877
0877	35	0001	0878
0878	20	0629	0879
0879	71	0627	0880
0880	35	0001	0881
0881	20	0629	0882
0882	71	0627	0883
0883	66	0548	0884
0884	20	0629	0885
0885	71	0627	0886
0886	69	0550	0870

ALARM PRINT ROUTINE OF CLOCK ENTRY

0887	60	0605	0888
0888	10	0526	0889
0889	30	0001	0890
0890	21	0629	0891
0891	71	0627	0892
0892	35	0001	0893
0893	21	0629	0894
0894	71	0627	0895
0895	35	0001	0896
0896	21	0629	0897
0897	71	0627	0898

ALARM PRINT ROUTINE OF CLOCK ENTRY—Continued

Drum Address Location	Instruction		
0898	35	0001	0899
0899	21	0629	0900
0900	71	0627	0841
0841	66	0075	0842
0842	15	0551	0843
0843	20	0629	0844
0844	71	0627	0845
0845	65	0070	0846
0846	16	0527	0847
0847	20	0070	0848
0848	65	0030	0849
0849	16	0527	0850
0850	20	0030	0839
0839	21	0075	0840
0840	69	0552	0870

SET UP ACTION DEMAND IF PRESENT

1251	65	0035	1252
1252	45	1253	0049
1253	35	0005	1254
1254	11	0553	1255
1255	46	1256	1268
1256	30	0001	1257
1257	10	0554	1258
1258	21	0032	1259
1259	60	0035	1260
1260	30	0003	1261
1261	20	0038	1262
1262	60	8003	1263
1263	30	0002	1264
1264	20	0037	1265
1265	65	8002	1266
1266	30	0004	1267
1267	20	0037	0032
1268	10	0555	1258

EXIT OF DEMAND ACTION

1000	65	0030	1006
1006	16	0527	1007
1007	20	0030	1008
1008	21	0035	0901

SKIP THROUGH RESTORE

1001	15	0556	8002
8002	10	04__	1011
1011	98	1012	1000
1012	10	0557	1013
1013	69	0558	1014
1014	22	0021	8001
8001	21	04__	1000

SKIP THROUGH SET

1002	15	0559	8002
8002	10	04__	1015
1015	98	1000	1016
1016	11	0557	1013

POINT ELIMINATE RESTORE

1003	15	0560	8002
8002	10	04__	1017
1017	99	1018	1000
1018	10	0530	1013

POINT ELIMINATE SET

1004	15	0561	8002
8002	10	04__	1019
1019	99	1000	1020
1020	11	0530	1013

DO NOTHING SUB-ROUTINE

1090	00	0000	1000
1091	00	0000	1000
1092	00	0000	1000
1093	00	0000	1000
1094	00	0000	1000
1095	00	0000	1000
1096	00	0000	1000
1097	00	0000	1000

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DO NOTHING SUB-ROUTINE—Continued

Drum Address Location	Instruction		
1098	00	0000	1000
1099	00	0000	1000
1050	00	0000	1000
1060	00	0000	1000
1070	00	0000	1000
1080	00	0000	1000
1068	00	0000	1000
1088	00	0000	1000
1059	00	0000	1000
1069	00	0000	1000
1079	00	0000	1000
1089	00	0000	1000
1030	30	0007	1033

DISPLAY ROUTINES

1051	15	0562	8002
8002	65	04__	1032
1032	30	0004	1033
1033	20	0727	1034
1034	71	0727	1035
1035	35	0001	1036
1036	20	0727	1037
1037	71	0727	1038
1038	35	0001	1039
1039	20	0727	1040
1040	71	0727	1000
1057	15	0563	8002
8002	65	04__	1033
1054	15	0564	8002
8002	65	03__	1030
1053	15	0565	8002
8002	65	02__	1033
1052	15	0566	8002
8002	65	02__	1032
1056	15	0567	8002
8002	65	01__	1033
1055	15	0568	8002
8002	65	01__	1032

STORE ROUTINES

1081	15	0569	8002
8002	65	04__	1041
1041	21	0021	1021
1021	23	0021	1042
1042	35	0003	1043
1043	60	8003	1044
1044	15	0038	1045
1045	35	0007	1046
1046	10	0021	1047
1047	15	0037	1013
1087	15	0570	8002
8002	65	04__	1048
1048	30	0003	1049
1049	60	8002	1009
1009	15	0038	1010
1010	35	0003	1047
1083	15	0571	8002
8002	65	02__	1048
1082	15	0572	8002
8002	65	02__	1041
1086	15	0573	8002
8002	65	01__	1048
1085	15	0574	8002
8002	65	01__	1041

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PRINT ROUTINES

Drum Address Location	Instruction		
1071	15	0575	8002
8002	65	04__	1022
1022	30	0004	1023
1023	69	0526	1024
1024	23	0021	1025
1025	65	0037	1026
1026	30	0004	1027
1027	69	0526	1028
1028	23	0629	1029
1029	71	0627	1501
1501	35	0001	1502
1502	20	0629	1503
1503	71	0627	1504
1504	66	0548	1505
1505	20	0629	1506
1506	71	0627	1507
1507	65	0021	1508
1508	20	0629	1509
1509	71	0627	1510
1510	35	0001	1511
1511	20	0629	1512
1512	71	0627	1513
1513	35	0001	1514
1514	20	0629	1515
1515	71	0627	1516
1516	66	0530	1517
1517	20	0629	1518
1518	71	0627	1519
1519	66	0526	1520
1520	20	0629	1000

LOG TYPE ROUTINE

0049	65	0050	1102
1102	45	1103	1160
1103	65	0520	1104
1104	24	0049	1138
8002	65	0401	1105
1105	35	0006	1106
1106	65	8002	1107
1107	30	0002	1108
1108	15	0521	8002
8002	10	04__	1109
1109	90	1110	1149
1110	10	0522	1111
1111	15	0523	8002
8002	21	04__	1112
1112	15	0524	8002
8002	66	03__	1113
1113	15	0525	1114
1114	20	0627	1115
1115	71	0627	1116
1116	69	0526	1117
1117	23	0627	1118
1118	65	8001	1119
1119	71	0627	1120
1120	35	0001	1121
1121	20	0627	1122
1122	71	0627	1123
1123	35	0001	1124
1124	20	0627	1125
1125	71	0627	1126
1126	66	0527	1127
1127	20	0627	1128
1128	71	0627	1129
1129	66	0526	1130
1130	20	0627	1131
1131	65	0049	1132
1132	15	0527	1133
1133	20	0049	1134
1134	65	0040	1135
1135	16	0527	1136
1136	45	1137	1140
1137	20	0040	0901

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LOG TYPE ROUTINE—Continued

Drum Address Location	Instruction		
1138	69	0601	1139
1139	96	1160	8002
1140	69	0528	1141
1141	24	0040	1142
1142	69	0529	1143
1143	24	0049	1144
1144	66	0530	1145
1145	20	0627	1146
1146	71	0627	1147
1147	66	0526	1148
1148	20	0627	1000
1149	99	1150	1155
1150	66	0527	1151
1151	20	0627	1152
1152	71	0627	1153
1153	71	0627	1154
1154	71	0627	1128
1155	98	1150	0901
1160	65	0086	1161
1161	45	0083	0901

PRINT ROUTINE

1077	15	0576	8002
8002	65	04__	1023
1074	15	0577	8002
8002	65	02__	1031
1031	30	0007	1023
1073	15	0578	8002
8002	65	02__	1023
1072	15	0579	8002
8002	65	02__	1022
1076	15	0580	8002
8002	65	01__	1023
1075	15	0581	8002
8002	65	01__	1022

STORE ROUTINES

1084	15	0582	8002
8002	60	02__	1521
1521	35	0003	1522
1522	30	0003	1523
1523	15	0038	1047

SPECIAL DISPLAY VALUE ROUTINE AND PRINT VALUE ROUTINE

1058	69	0583	1524
1524	24	0961	1525
1525	69	0584	1526
1526	24	1008	1527
1527	65	0079	1528
1528	16	0527	1529
1529	20	0079	1530
1530	65	0037	1531
1531	15	0585	8002
8002	69	18__	1215
1008	29	0035	1532
1532	69	0586	1533
1533	24	0961	1534
1534	69	0587	1535
1535	24	1008	1201
1078	69	0588	1524

SUMMARY ROUTINE

1541	65	0605	1542
1542	15	0526	1543
1543	20	0021	1544
1544	30	0001	1545
1545	24	0086	1505
1549	69	0590	1550

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SUMMARY ROUTINE—Continued

Drum Address Location	Instruction		
1550	24	1520	1507
1520	20	0629	1551
1551	69	0591	1552
1552	24	1520	1553
1553	65	0083	1554
1554	16	0592	1555
1555	46	1556	1559
1556	15	8001	1557
1557	15	0527	1558
1558	20	0083	0901
1559	65	0593	1560
1560	21	0086	1558
1062	65	0502	1562
1562	10	0086	1563
1563	44	0083	1564
1564	20	0089	1541
0083	60	04__	1565
1565	35	0003	1566
1566	30	0005	1567
1567	60	8003	1568
1568	35	0002	1569
1569	10	0089	8003
8003	65	02__	1570
1570	30	0004	1571
1571	30	0007	1572
1572	69	0526	1573
1573	23	0021	1549
1063	65	0503	1562
1064	65	0504	1562
1065	65	0505	1562
1066	65	0506	1562
1067	65	0507	1562
1061	65	0501	1562
1575	65	8003	1570

SQUARE ROOT SUB-ROUTINE

1901	35	0002	1902
1902	20	0021	1903
1903	20	0068	1904
1904	65	0021	1905
1905	64	1914	1906
1906	15	8001	1907
1907	64	1915	1908
1908	16	0068	1909
1909	46	1910	1911
1910	15	8001	1903
1911	15	8001	1912
1912	31	0001	1913
1913	20	0023	0961
1914	00	0000	0500
1915	00	0000	0002

TAPE READ ROUTINE

1951	69	0510	1952
1952	24	0903	1953
1953	69	0511	1954
1954	24	1977	1955
1955	65	0543	1956
1956	35	0001	1957
1957	20	0628	1958
1958	71	0627	1959
1959	70	0601	1960
1960	60	0602	1961
1961	35	0005	1962

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TAPE READ ROUTINE—Continued

Drum Address Location	Instruction		
1962	15	0512	1963
1963	11	8003	1964
1964	84	1700	8002
8002	60	17__	1965
1965	46	1971	1966
1966	35	0008	1967
1967	15	0095	1968
1968	35	0001	1969
1969	15	8003	1970
1970	20	0095	1958
1971	35	0005	1972
1972	44	1973	1983
1973	92	1990	1974
1974	91	1975	1975
1975	66	0095	1976
1976	65	0095	1977
1977	00	0000	1978
1978	35	0004	1979
1979	15	0513	1980
1980	20	0099	1981
1981	69	0514	1982
1982	24	1977	1983
1983	21	0095	1958
1977	00	0000	0099
0099	20	____	1984
1984	65	0099	1985
1985	15	0527	1986
1986	20	0099	1987
1987	21	0095	1988
1988	24	0628	1989
1989	65	0601	0905
1990	65	0515	1991
1991	20	0903	1987

CONSTANTS FOR PROGRAM

0520	65	0401	1105
0521	10	0400	1109
0522	10	0000	0000
0523	11	0000	0003
0524	44	9900	0001
0525	06	0000	0000
0526	99	9999	0000
0527	00	0001	0000
0528	00	0099	0000
0529	65	0050	1102
0530	01	0000	0000
0531	60	0499	0928
0532	15	0300	0933
0533	00	0100	0000
0534	65	0100	0805
0535	00	0100	0144
0536	00	0000	0000
0537	15	0400	0965
0538	05	0000	0004
0539	48	9900	0003
0540	44	9999	9997
0541	69	0300	0803
0542	60	0401	0928
0543	00	0000	0008
0544	24	0300	0830
0545	60	0499	1209
0546	69	0400	1213
0547	00	1400	0002
0548	02	0000	0000
0549	00	0000	0871
0550	00	0000	0887
0551	08	0000	0000
0552	65	0300	0852
0553	00	0000	0050
0554	00	0000	1005
0555	00	0000	1000

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CONSTANTS FOR PROGRAM—Continued

Drum Address Location	Instruction		
0556	10	0400	1011
0557	00	1000	0000
0558	21	0000	1000
0559	10	0400	1015
0560	10	0400	1017
0561	10	0400	1019
0562	65	0400	1032
0563	65	0400	1033
0564	65	0200	1030
0565	65	0200	1033
0566	65	0200	1032
0567	65	0100	1033
0568	65	0100	1032
0569	65	0400	1041
0570	65	0400	1048
0571	65	0200	1048
0572	65	0200	1041
0573	65	0100	1048
0574	65	0100	1041
0575	65	0400	1022
0576	65	0400	1023
0577	65	0200	1031
0578	65	0200	1023
0579	65	0200	1022
0580	65	0100	1023
0581	65	0100	1022
0582	60	0200	1521
0583	00	0000	1033
0584	21	0035	1532
0585	69	1800	1215
0586	65	0050	0962
0587	21	0035	0901
0588	00	0000	1023
0590	20	0629	1551
0591	20	0629	1000
0592	60	0499	1565
0593	60	0400	1565
0501	00	0000	1575
0502	65	0200	1570
0503	65	0200	1572
0504	65	0200	1571
0505	65	0100	1570
0506	65	0100	1572
0507	65	0400	1572
0510	97	1955	0940
0511	00	0000	1978
0512	60	1700	1965
0513	20	0000	1984
0514	00	0000	0099
0515	97	1951	0940

BINARY TO DECIMAL TABLE FOR TAPE READ ROUTINE

1700	88	9890	0000
1701	88	9980	0009
1702	88	9990	0000
1703	89	8880	0000
1704	89	8890	0006
1705	89	8980	0005
1706	89	8990	0000
1707	89	9880	0003
1708	89	9890	0088
1709	89	9980	0000
1710	89	9990	0000
1711	98	8880	0000
1712	98	8890	0000
1713	98	8980	0098
1714	98	8990	0000
1715	98	9880	0099
1716	98	9890	0000
1717	98	9980	0000

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BINARY TO DECIMAL TABLE FOR TAPE READ ROUTINE—Continued

Drum Address Location	Instruction		
1718	98	9990	0008
1719	99	8880	0007
1720	99	8890	0000
1721	99	8980	0000
1722	99	8990	0004
1723	99	9880	0000
1724	99	9890	0002
1725	99	9980	0001
1726	99	9990	0000
1727	99	9999	9999

BINARY TABLES FOR DECIMAL CONVERSION

1801	00	9999	9998
1802	00	9999	9989
1803	00	9999	9988
1804	00	9999	9899
1805	00	9999	9898
1806	00	9999	9889
1807	00	9999	9888
1808	00	9999	8999
1809	00	9999	8998
1810	00	9999	8989
1811	00	9999	8988
1812	00	9999	8899
1813	00	9999	8898
1814	00	9999	8889
1815	00	9999	8888
1816	00	9998	9999
1817	00	9998	9998
1818	00	9998	9989
1819	00	9998	9988
1820	00	9998	9899
1821	00	9998	9898
1822	00	9998	9889
1823	00	9998	9888
1824	00	9998	8999
1825	00	9998	8998
1826	00	9998	8989
1827	00	9998	8988
1828	00	9998	8899
1829	00	9998	8898
1830	00	9998	8889
1831	00	9998	8888
1832	00	9989	9999
1833	00	9989	9998
1834	00	9989	9989
1835	00	9989	9988
1836	00	9989	9899
1837	00	9989	9898
1838	00	0089	9889
1839	00	0089	9888
1840	00	9989	8999
1841	00	9989	8998
1842	00	9989	8989
1843	00	9989	8988
1844	00	9989	8899
1845	00	9989	8898
1846	00	9989	8889
1847	00	9989	8888
1848	00	9988	9999
1849	00	9988	9998
1850	00	9988	9989
1851	00	9988	9988
1852	00	9988	9899
1853	00	9988	9898
1854	00	9988	9889
1855	00	9988	9888
1856	00	9988	8999
1857	00	9988	8998
1858	00	9988	8989
1859	00	9988	8988
1860	00	9988	8899
1861	00	9988	8898
1862	00	9988	8889

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BINARY TABLES FOR DECIMAL CONVERSION—Cont.

Drum Address Location	Instruction		
1863	00	9988	8888
1864	00	9899	9999
1865	00	9899	9998
1866	00	9899	9989
1867	00	9899	9988
1868	00	9899	9899
1869	00	9899	9898
1870	00	9899	9889
1871	00	9899	9888
1872	00	9899	8999
1873	00	9899	8998
1874	00	9899	8989
1875	00	9899	8988
1876	00	9899	8899
1877	00	9899	8898
1878	00	9899	8889
1879	00	9899	8888
1880	00	9898	9999
1881	00	9898	9998
1882	00	9898	9989
1883	00	9898	9988
1884	00	9898	9899
1885	00	9898	9898
1886	00	9898	9889
1887	00	9898	9888
1888	00	9898	8999
1889	00	9898	8998
1890	00	9898	8989
1891	00	9898	8988
1892	00	9898	8899
1893	00	9898	8898
1894	00	9898	8889
1895	00	9898	8888
1896	00	9889	9999
1897	00	9889	9998
1898	00	9889	9989
1899	00	9889	9988

The various operation codes and constants are read into the machine using load cards in the conventional way in which instructions are set into the Type 650 machine and as outlined in said Manual of Operation.

As previously indicated, it should be understood that the specific programs disclosed in this application are exemplary programs only and are used to illustrate a specific application of the present invention. It should be further understood that numerous variations may be made in various details of the invention described above without deviating from the broader aspects of the invention.

What I claim as new and desire to protect by Letters Patent of the United States is:

1. A continuous variable monitoring system comprising: respective variable responsive analog signal input means providing analog electrical signals indicative of the values of the variables to be continuously monitored, switching means for cyclically continuously sequentially feeding the analog outputs of said signal input means in a random sequence to a common output, storage means including a series of sequentially addressable storage locations in which are respectively stored variable identifying numbers identifying signal input means to be scanned in the order in which access to the storage location is obtained, first manual switch means for setting the variable identifying number and a second manual switch means for setitng a number identifying the storage location in which said variable identifying number is to be stored, means responsive to said first and second manual switches for substituing the variable identifying number set on said first manual switch means for the variable identifying number in the storage location set on said second manual switch means, means for controlling the switching means to scan said analog signal input means in the same order as the corresponding variable identifying numbers appear

in said sequentially addressable storage locations, and means responsive to the signals at said common output for indicaitng the presence of abnormal variables.

2. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the outputs of said signal input means to a common output, and data processing means having an input into which said common output of said scanning means is connected, storage means having sequentially addressable data blocks each having various storage positions for storing data constants associated with a variable, and an operator's master control station for providing a stored program for performing a computation operation using variable value signals derived from said common output and the data constants on the associated variable, the improvement comprising: an operator's control panel remote from said operator's master control station for performing limited functions, including modifying said data constants, which cannot stop the variable monitoring system or change the storage program in said data processing means, said operator's control panel including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a first series of "store" settings for the respective data constants operated when said value and point number switch means have been set, manually operable action switch means, said data processing means including program control means for cyclically carrying out a series of control functions in sequence including said computation operation and an action switch operation detection operation, said program control means including means following the detection of the operation of said action switch means which responds to the "store" settings of said operation switch means by storing the number set by said value switch means in the storage position for the data constant involved of the data block identified by the setting of said point number switch means without stopping the variable monitoring system.

3. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, data processing means having an input into which said common output of said scanning means is connected, storage means having sequentially addressable data blocks each having various storage positions for storing data constants associated with a variable, and a program for performing a computation operation using variable value signals derived from said common output and the data constants on the associated variable, the improvement comprising: operator control means for modifying said data constants and including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, first and second display window means and associated display control means for displaying in said respective window means the numbers set by said value and point number switch means, manually adjustable operation switch means having a number of possible settings for controlling the effect of the settings of said value and point number switch means and which include a first series of "store" setitngs for the respective data constants, manually operable action switch means, display window means and associated control means for displaying in the latter window means in the language of the operator the various "store" operations effected by the different settings of said operation switch means, said data processing means including program control means for cyclically carrying out a series of control functions in sequence including said computation operation, said program control means including means following the detection of the operation of said action switch means which responds to the "store" settings of said operation switch means by storing the number set by said value switch means in the storage position for the data constant involved of the data block identified by the setting of said point number switch means without stopping the variable monitoring system.

4. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the outputs of said signal input means to a common output, and data processing means having an input into which said common output of said scanning means is connected, storage means having sequentially addressable data blocks each having various storage positions for storing data constants associated with a variable, and a program for performing a computation operation using variable value signals derived from said common output and the data constant on the associated variable, the improvement comprising: operator control means for modifying said data constants and including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a number of possible settings for controlling the effect of the settings of said value and point number switch means and which include a first series of "store" settings for the respective data constants, and a second series of "display" settings for the respective data constants, display means, manually operable action switch means operated when said value and point number switch means have been set, said data processing means including program control means for cyclically carrying out a series of control functions in sequence including said computation operation and an action switch operation detection operation, said program control means including means following the detection of the operation of said action switch means which responds to the "store" settings of said operation switch means by storing the number set by said value switch means in the storage position for the data constant involved of the data block identified by the setting of said point number switch means, and which responds to the "display" settings on said operation switch means by displaying on said display means the data constant involved stored in the data block identified by said point number switch means, without stopping the variable monitoring system.

5. In a continuous variable monitoring system including variable responsive analog signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, an output printing device, data processing means having an input into which said common output of said scanning means is connected, an output to which said printing device is connected, storage means having sequentially addressable data blocks each having various storage positions for storing data constants, and a program for performing a computation operation using variable value signals derived from said common output and the data constant on the associated variable, the improvement comprising: operator control means for modifying said data constant, and including manually adjustable value switch means for setting a

number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, and manually adjustable operation switch means having a first series of "store" settings for the respective data constants for storing the number set by said value switch means in the storage position for the data constant involved in the data block identified by the setting of said point number switch means, and having a second series of "print" settings for printing on said output printing means the data constant involved stored in the data block identified by said point number switch means.

6. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output and including an output printing device, data processing means having an input into which said common output of said scanning means is connected, an output to which said printing device is connected, storage means therein having sequentially addressable data blocks each having various storage positions for storing data constants, an operator's master control station for providing a stored program for performing a computation operation using variable value signals derived from said common output and the data constants on the associated variable, the improvement comprising: an operator's control panel remote from said main operator's control station for performing limited functions which cannot stop the variable monitoring system or change the stored program in said data processing means, said operator's control panel including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a first series of "store" settings for the respective data constants, a second series of "print" settings for the respective data constants, manually operable action switch means, said data processing means including program control means for cyclically carrying out a series of control functions in sequence including said computation operation and an action switch operation detection operation, said program control means including means following the detection of the operation of said action switch means which responds to the "store" settings of said operation switch means for storing the number set by said value switch means in the storage position for the data constant involved in the data block identified by the setting of said point number switch means, and which responds to the "print" settings on said operation switch means by printing on said output printing means the data constant involved stored in the data block identified by said point number switch means, without stopping the variable monitoring system.

7. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, data processing means, said latter means having an input into which said common output of said scanning means is connected, storage means therein having sequentially addressable data blocks each having various storage positions for storing data constants and a "point eliminate" marker, program means for performing a computation operation using variable value signals derived from said common output and the data constants on the associated variable, the improvement comprising: operator's control means for modifying said data constants and "point eliminate" marker on a selected variable, said operator's control means including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a first series of "store" settings for the respective data constants and a second series of settings including "point eliminate" and "point eliminate restore" settings, means responsive to said "store" settings of said operation switch means for storing the number set by said value switch means in the storage position for the data constant involved in the data block identified by the setting of said point number switch means and for setting a "point eliminate" marker in the "point eliminate" marker storage position of the latter data block, control means responsive to a "point eliminate" setting of said operation switch means for skipping said computation operation for the variable identified by the setting on said point number switch means when a "point eliminate" marker is present in the data block for the variable being scanned, and control means responsive to the "point eliminate restore" setting on said operation switch means for canceling the "point eliminate" marker previously stored in the data block identified by the setting of said point number switch means.

8. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling in a random order the analog outputs of said signal input means to a common output and including a control circuit for controlling the selection of the signal input means, data processing means for storing data and performing computation functions with signals derived from said common output, said data processing means having an input into which said common output of said scanning means is connected, an output to which said scanning means control circuit is connected, and storage means having sequentially addressable data blocks each having various storage positions for storing scan sequence effecting numbers, the improvement comprising: operator's control means for modifying the scanning sequence, said operator's control means including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a "store" setting for the scan sequence effecting numbers, said data processing means including program control means for sequentially and cyclically carrying out a series of control functions in sequence including said computation and said scanning sequence modifying operations, said control means including means responsive to said "store" settings of said operation switch means for storing the number set by said value switch means in the storage position for the scan sequence effecting number involved in the data block identified by the setting of said point number switch means, and control means for scanning a different data block each program cycle and in a definite predetermined order, deriving a scanning means control signal corresponding to the scan sequence effecting number in the data block involved for feeding the signal to said control circuit of said scanning means to scan the selected signal input means, without stopping the variable monitoring system.

9. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling in a random order the analog outputs of said signal input means to a common output and including a control circuit for controlling the selection of the signal input means, data processing means for storing data and performing computing functions with the signal derived from said common output in accordance with a given predetermined program set therein, said data processing means having an input into which said common output of said scanning means is connected, an output to which said scanning means control circuit is connected, storage means having sequentially addressable data blocks each having various storage positions for storing data constants, scan sequence effecting numbers, and a "point elminate" marker, the improvement comprising: operator's control means for modifying said data constants, scan sequence effecting numbers and "point eliminate" marker on a selected variable, said operator's control means including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a first series of settings of "store" settings for the respective data constants and scan sequence effecting numbers and a second series of settings of said operation switch means which are "point eliminate" and "point eliminate restore" settings, said data processing means including program control means for cyclically sequentially repeatedly carrying out a series of control functions in sequence including said computation and modifying operations, said control means including means responsive to said "store" settings of said operation switch means for storing the number set by said value switch means in the storage position for the data constant or scan sequence effecting number involved in the data block identified by the setting of said point number switch means and for setting "point eliminate" markers in the "point elminate" marker storage position of the latter data block, control means for scanning a different data block each program cycle and in a definite predetermined order, deriving a scanning means control signal corresponding to the scan sequence effecting number in the data block involved and feeding the signal to said control circuit of said scanning means to scan the selected signal input means, control means responsive to a "point eliminate" setting of said operation switch means for skipping said computation operation for the variable identified by the setting on said point number switch means when a "point eliminate" marker is present in the data block for the variable being scanned, and control means responsive to the "point eliminate restore" setting on said operation switch means for canceling the "point eliminate" marker previously stored in the data block identified by the setting of said point number switch means.

10. A continuous variable monitoring system comprising: respective variable responsive signal input means for providing analog electrical signals indicative of the values of the variables to be continuously monitored, switching matrix means responsive to binary coded input signals for cyclically and continuously sequentially feeding the analog outputs of said signal input means to a common output and in a sequence determined by the order in which said binary coded signals are received thereby, storage means including a series of cyclically sequentially addressable storage locations in which are respectively stored variable identifying numbers identifying the signal input means to be scanned in the order in which access to the associated storage locations is obtained, manual input means for selectively changing the variable identifying numbers in any selected storage location to vary the scanning order of the signal input means, means for cyclically and sequentially scanning said storage locations for said variable identifying numbers and for deriving binary coded signals corresponding to the variable identifying numbers in said storage locations and occurring in the same sequence in which they appear in the sequentially addressable storage locations, means for feeding said binary coded signals in said sequence to said switching matrix means to control the scanning order in accordance therewith, and means responsive to the signals and said common output for indicating the presence of abnormal variables.

11. A continuous variable monitoring and recording system comprising: a number of variable responsive signal inputs for providing analog signals which are indicative of the values of the associated variables, switching means for repeatedly sequentially feeding the analog outputs of said signal input means to a common output, analog to digital converter means coupled to said common output providing digital signals indicating the values of the variables involved, magnetic storage means having a number of sequentially addressable storage locations for storing the values of the variables indicated by the output of said analog to digital converter means, means responsive to the signal output of said analog to digital converter means for storing in said respective storage locations the values of the associated variables, said series of sequentially addressable storage locations also containing variable identifying numbers which respectively identify storage locations containing data on the values of the variables to be printed in the order in which the variable identifying numbers appear in said sequentially addressable storage locations, a printing device for printing the values of the variables stored in said data storage locations, and means for feeding the data values of said data storage location to said printing means for printout in the order in which the associated variable identifying numbers appear in said sequentially addressable storage locations.

12. A continuous variable monitoring and recording system comprising: a number of variable responsive signal inputs for providing analog signals which are indicative of the values of the associated variables, switching means for repeatedly sequentially feeding the outputs of said signal input means to a common output, storage means having a number of sequentially addressable storage locations for storing the values of the variables indicated by the outputs of said signal input means, means responsive to the signals at said common output for storing in said respective storage locations the values of the associated variables, said series of sequentially addressable storage locations also containing variable identifying numbers which respectively identify storage locations containing data on the values of the variables to be printed in the order in which the variable identifying numbers appear in said sequentially addressable storage locations, a printing device for printing the values of the variables stored in said data storage locations, and means for feeding the data values of said data storage location to said printing means for printout in the order in which the associated variable identifying numbers appear in said sequentially addressable storage locations.

13. A continuous variable monitoring system comprising: respective variable responsive signal input means for providing analog electrical signals indicative of the values of the variables to be continuously monitored, switching means for cyclically and continuously sequentially feeding the analog outputs of said signal input means in a random sequence to a common output, storage means including a series of sequentially addressable storage locations in which are respectively stored scan

sequence effecting numbers respectively identifying the signal input means to be scanned in the order in which the numbers appear in the sequentially addressable storage locations, manual input means for selectively changing the variable identifying numbers in any selected storage locations to vary the scaning order of the signal input means, means for controlling said switching means to scan said signal input means in the same order as the associated variable identifying numbers appear in said sequentially addressable storage locations, and means responsive to the signals at said common output for indicating the presence of abnormal variables.

14. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the outputs of said signal input means to a common output, storage means having sequentially addressable data blocks each having storage positions for storing data constants of a variable, system control means for cyclically operating said scanning means, effecting a computation with signals derived from said common output and at least one of the data constants, the improvement comprising: manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said first switch means is to be stored, manually adjustable operation switch means for controlling the effect of the settings of said first value and point number switch means and including a general operation switch having a "store" position and at least one other position for carrying out a function other than a store function, and an information type operation switch having different positions respectively identifying different data constants, manually operable action switch means, said system control means sequentially continuously and cylically carrying out a series of program steps which include said computation and storage operation and one which responds to the settings of said value point number and operation switch means subsequent to the operation of said action switch means, and said system control means including: means responsive to the "store" position of said general operation switch for storing the number set by said value switch means in the data block identified by the setting of said point number switch means and in the storage position thereof for the type of information identified by said information type operation switch without stopping the variable monitoring system.

15. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the outputs of said signal input means to a common output, storage means having sequentially addressable data blocks each having storage positions for storing data constants of a variable including at least one alarm limit thereof and system control means for cyclically operating said scaning means, effecting an alarm detection operation by comparing a signal derived from said common output with the alarm limit stored in the alarm limit storage position of the associated data block, the improvement comprising: manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said first switch means is to be stored, manually adjustable operation switch means for controlling the effect of the settings of said first value and point number switch means and including at least high alarm limit "store" setting and at least one other setting for carrying out an operation other than a "store" operation, manually operable action switch means, said system control means sequentially continuously and cyclically carrying out a series of program steps which include said alarm detection operation and also one which responds to the settings of said value point number and operation switch means subsequent to the operation of said action switch means, said system control means including: means responsive to said "store" setting of said operation switch means for storing the number set by said value switch means in the alarm limit storage position of the data block identified by the setting of said point number switch means without stopping the variable monitoring system.

16. The variable monitoring system of claim 15 wherein there is provided manually operable "store" lock-out means having a releasable locked position for preventing said "store" operation of said operation switch means, whereby unauthorized personnel may not change the alarm limit of a particular variable.

17. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable data blocks each having storage positions for storing data constants of a variable and the value of the variables and system control means for operating said scanning means, effecting a computation with signals derived from said common output and at least one of the data constants, storing the detected value of the variable in the value storage position of the associated data block, the improvement comprising: manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said first switch means is to be stored, display means, manually adjustable operation switch means for controlling the effect of the settings of said first value and point number switch means and including a general operation switch having "store" and display positions and an information type operation switch having different positions respectively identifying "value" and different data constants, means responsive to the "store" position of said general operation switch for storing the number set by said value switch means in the data block identified by the setting of said point number switch means and in the storage position thereof for the type of information identified by said information type operation switch, and means responsive to the "display" position of said general operation switch for displaying on said display means the information stored in the data block identified by said point number switch means at the storage location containing the type of information set on said information type operation switch.

18. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable data blocks each having storage positions for storing data constants of a variable and the value of the variable, an output printing device upon which data on the variable is to be printed, system control means for operating said scanning means, effecting a computation with signals derived from said common output and at least one of the data constants storing the detected value of the variable in the value storage position of the associated data block and subsequently sequentially feeding the value information stored in said data blocks to said output printing device, the improvement comprising: manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said first switch means is to be

stored, manually adjustable operation switch means for controlling the effect of the settings of said first value and point number switch means and including a general operation switch having "store," "print" and "display" positions and an information type operation switch having different positions respectively identifying "value" and different data constants, display window means and associated control means for displaying in the language of the operator the operation and information types set on said operation switches, means responsive to the "store" position of said general operation switch for storing the number set by said value switch means in the data block identified by the setting of said point number switch means and in the storage position thereof for the type of information identified by said information type operation switch, means responsive to the "print" position of said general operation switch for printing on said output printing device the information stored in the data block identified by said point number switch means at the storage location containing the type of information set on said information type operation switch, and means responsive to the "display" position of said general operation switch for displaying on said display window means the information stored in the data block identified by said point number switch means at the storage location containing the type of information set on said information type operation switch.

19. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing coded information, and means for deriving a signal from said common output which signal indicates the value of the variables being scanned, the improvement in means for changing said coded information without requiring shutdown of the monitoring system comprising: an input feeding device for feeding coded information into designated ones of said storage locations, said input feeding device having advancing means for advancing new information into said storage locations of said storage means when actuated, and control means for sequentially and repeatedly carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, one of said program steps effecting the actuation of said advancing means to feed a limited amount of new information during each of a number of different program cycles until all of the new information is fed by the input feeding device without stopping the variable monitoring system.

20. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing data constants thereon, and means for deriving a signal from said common output which signal indicates the value of the variables being scanned and effecting a computation involving a value signal derived from the signal at said common output and at least one data constant of the associated variable, the improvement in means for changing said data constants en masse comprising: an input data feeding device for feeding coded data constants into designated ones of said storage locations, said input data feeding device having data advancing means for advancing new data into said storage locations of said storage means when actuated, and control means for sequentially and repeatedly carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, at least one of said program steps effecting said computation operation and another one of said program steps effecting the actuation of said data advancing means to feed a limited amount of new data constants during each of a number of different program cycles until all of the new data constants are fed by the input feeding device without stopping the variable monitoring system.

21. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing coded information, and means for deriving a signal from said common output which signal indicates the value of the variables being scanned and effecting a computation involving a value signal derived from the signal at said common output and said coded information, the improvement in means for changing said coded information without requiring shutdown of the monitoring system comprising: an input feeding device for feeding coded information into designated ones of said storage locations, said input data feeding device having advancing means for advancing new information into said storage locations of said storage means when actuated, manually operable switch means for initiating a feed operation by said input feeding device, and control means for sequentially and repeatedly carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, at least one of said program steps effecting said computation operation and another one of said program steps being responsive to operation of said manually operable switch means by actuating said advancing means to feed a limited amount of new information during each of a number of different program cycles until all of the new information is fed by the input feeding device without stopping the variable monitoring system.

22. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing data constants thereon, and means for deriving a signal from said common output which signal indicates the value of the variables being scanned and effecting a computation involving a value signal derived from the signal at said common output and at least one data constant of the associated variable, the improvement in means for changing said data constants en masse comprising: an input data feeding device for feeding coded data constants into designated ones of said storage locations, said input data feeding device having data advancing means for advancing new data into said storage locations of said storage means when actuated, manually operable switch means for initiating an en masse data feed operation by said input data feeding device without requiring shutdown of the monitoring system, and control means for sequentially and repeatedly carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, at least one of said program steps effecting said computation operation, and another one of said program steps being responsive to operation of said manually operable switch means by actuating said data advancing means to feed a limited amount of new data constants during each of a number of different program cycles until all of the new data constants are fed by the input feeding device without stopping the variable monitoring system.

23. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially cou-

pling the outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing the values of the variables and data constants thereon including at least one alarm limit, an output printing device on which data on the variables is to be printed, and means for deriving a signal from said common output which signal indicates the value of the variables being scanner, effecting an alarm detection operation by comparing said signal with the alarm limits stored in the associated storage location, storing the detected value of the variable in the corresponding storage location of said storage means and subsequently sequentially feeding the value information in said storage locations for the variables to said output printing device, the improvement comprising: value switch means for setting up a value number, point number switch means for setting up a number identifying a particular storage location in said storage means, operation switch means having a number of positions for respectively effecting a point eliminate operation which eliminates said alarm detect operation and the print out of the variable identified by the number set up by said point number switch means, changing the order in which said signal input means is scanned by effecting a scanning order determined by the number set up on one of said value and point number switch means for the variable identified by the number set up in the other of same, and changing the order in which data on the variables is printed out on said output printing device by effecting a print out order determined by the number set up in one of said value and point number switch means for the variable identified in the other of same, manually operable action switch means, and control means for sequentially and cyclically carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, at least one of said steps effecting the operation set by said operation switch means subsequent to the operation of said action switch means without stopping the variable monitoring system.

24. In a variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing data on the variables, and means for deriving a signal from said common output which signal indicates the value of the variable being scanned, effecting an operation involving said signal, and storing the information resulting from said operation in the corresponding storage location of said storage means, the improvement comprising: point number switch means for setting up a number identifying a particular storage location in said storage means, means including manually adjustable operation switch means having a first position for storing an operation eliminate marker in the storage location for the variable set up by said point number switch means which marker eliminates said operation for the variable involving said data constants and a second-position which removes said marker to re-establish said operation, manually operable action switch means, and control means for sequentially and cyclically carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, at least one of said steps effecting the operation set by said operation switch means if the action switch means was just operated without stopping the variable monitoring system.

25. In a variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing data on the variables, and means for deriving a signal from said common output which signal indicates the value of the variable being scanned, effecting an operation involving said signal, and storing the information resulting from said operation in the corresponding storage location of said storage means, the improvement comprising: point number switch means for setting up a number identifying a particular storage location in said storage means, and means including manually adjustable operation switch means having a first position for storing an operation eliminate marker in the storage location for the variable set up by said point number switch means which marker eliminates said operation for the variable involving said data constants and a second-position which removes said marker to reestablish said operation.

26. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing the values of the variables and an output printing device on which data on the variables is to be printed, and means for deriving a signal from said common output which signal indicates the value of the variable being scanned, storing the detected value of the variable in the corresponding storage location of said storage means and subsequently sequentially feeding the value information in said storage locations for the variables to said output printing device, the improvement comprising: point number switch means for setting up a number identifying a particular storage location in said storage means, and means including manually adjustable operation switch means having a first position for storing an operation eliminate marker in the storage location for the variable set up by said point number switch means which marker eliminates the print out of the value of the variable from said storage means and a second-position which removes said marker to re-establish said print out operation.

27. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the outputs of said signal input means to a common output, storage means having sequentially addressable storage locations for storing data on the variables including at least one alarm limit, means for deriving a signal from said common output which signal indicates the value of the variable being scanned, effecting an alarm detection operation by comparing said signal with the alarm limit stored in the associated storage location, and storing information involving the result of said comparison operation, the improvement comprising: point number switch means for setting up a number identifying a particular storage location in said storage means, means including manually adjustable operation switch means having a first position for storing an operation eliminate marker in the storage location for the variable set up by said point number switch means which marker eliminates said alarm detect operation and a second-position which removes said marker to re-establish said alarm detect operation, manually operable action switch means, and control means for sequentially and cyclically carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, at least one of said steps effecting the operation set by said operation switch means if said action switch means was just operated without stopping the variable monitoring system.

28. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning switch means for repeatedly sequentially coupling the outputs of said signal input means to a common output, storage means having sequentially addressable

storage locations for storing the values of the variables and data constants thereon including at least one alarm limit, an output printing device on which data on the variables is to be printed, and means for deriving a signal from said common output which signal indicates the value of the variables being scanned and effecting an alarm detection operation by comparing said signal with the associated alarm limit stored in the associated storage location of said storage means, storing the detected value of the variable in the appropriate associated storage location of said storage means and subsequently sequentially feeding the value information in said storage locations to said output printing device, the improvement comprising: value switch means for setting up a value number, point number switch means for setting up a number identifying a particular storage location in said storage means, operation switch means having a number of positions for effecting respectively the storing of the number set up on said value switch means in the alarm limit location for the variable set up on said point number switch means and the printing out on said output printing device of the alarm limit stored in the storage location identified by the number set up on said point number switch means, action switch means for rendering effective the adjustments of said value and point number switch means and said operation switch means, and control means for sequentially and separately carrying out a series of program steps which control the timing and sequence of the various operations performed by the variable monitoring system, at least one of said program steps effecting the operation set by said operation switch means subsequent to operation of said action switch means without stopping the variable monitoring system, and another one of said program steps effecting said alarm detection operation in time displacement from the former program step, wherein an alarm detection operation cannot be adversely affected by the setting up of said operation switch means.

29. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the outputs of said signal input means to a common output, and data processing means having an input into which said common output of said scanning means is connected, storage means having sequentially addressable data blocks each having various storage positions for storing data constants associated with a variable, and a program for performing a computation operation using variable value signals derived from said common output and the data constants on the associated variable, the improvement comprising: operator control means for modifying said data constants and including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a number of possible settings for controlling the effect of the settings of said value and point number switch means and which include a first series of "store" settings for the respective data constants, manually operable action switch means, said data processing means including program control means for cyclically carrying out a series of control functions in sequence including said computation operation and an action switch operation detection operation, said program control means including means following the detection of the operation of said action switch means which responds to the "store" settings of said operation switch means by storing the number set by said value switch means in the storage position for the data constant involved of the data block identified by the setting of said point number switch means without stopping the variable monitoring system.

30. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the outputs of said signal input means to a common output and including an output printing device, and data processing means having an input into which said common output of said scanning means is connected, an output to which said printing device is connected, storage means therein having sequentially addressable data blocks each having various storage positions for storing data constants, an operator's master control station, and a stored program for performing a computation operation using variable value signals derived from said common output and the data constants on the associated variable, the improvement comprising: an operator's control panel remote from said main operator's control station for performing limited functions which cannot stop the variable monitoring system or change the stored program in said data processing means, said operator's control panel including manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said value switch means is to be stored, manually adjustable operation switch means having a first series of "store" settings for the respective data constants, a second series of "print" settings for the respective data constants, manually operable action switch means, said data processing means including program control means for cyclically carrying out a series of control functions in sequence including said computation operation and an action switch operation detection operation, said program control means including means following the detection of the operation of said action switch means which responds to the "store" settings of said operation switch means for storing the number set by said value switch means in the storage position for the data constant involved in the data block identified by the setting of said point number switch means, and which responds to the "print" settings on said operation switch means by printing on said output printing means the data constant involved stored in the data block identified by said point number switch means, without stopping the variable monitoring system.

31. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable data blocks each having storage positions for storing gain and offset data constants of a variable and the value of the variable, and system control means for operating said scanning means, effecting a computation with signals derived from said common output and at least one of the data constants, and storing the computed value in the value storage position of the associated data block, the improvement comprising: manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said first switch means is to be stored, manually adjustable operation switch means for controlling the effect of the settings of said first value and point number switch means and including a general operation switch having "store" and "display" positions and an information type operation switch having different positions respectively identifying variable value information and gain and offset data constants, display means, means responsive to the "store" position of said general operation switch for storing the number set by said value switch means in the data block identified by the setting of said point number switch means and in the storage

position thereof for the type of information identified by said information type operation switch, and means responsive to the "display" position of said general operation switch for displaying on said display means the information stored in the data block identified by said point number switch means at the storage location containing the type of information set on said information type operation switch.

32. In a continuous variable monitoring system including variable responsive signal input means providing analog signal outputs indicating the values of associated variables, scanning means for repeatedly sequentially coupling the analog outputs of said signal input means to a common output, storage means having sequentially addressable data blocks each having storage positions for storing data constants of a variable including at least one alarm limit thereof and system control means for cyclically operating said scanning means, and effecting an alarm detection operation by comparing a signal derived from said common output with the alarm limit stored in the alarm limit storage position of the associated data block, the improvement comprising: manually adjustable value switch means for setting a number to be stored in one of the aforesaid storage positions in a data block, manually adjustable point number switch means for setting a number which identifies the data block into which the number set by said first switch means is to be stored, manually adjustable operation switch means for controlling the effect of the settings of said first value and point number switch means and including at least high alarm limit "store" setting, said system control means including: means responsive to said "store" setting of said operation switch means for storing the number set by said value switch means in the alarm limit storage position of the data block identified by the setting of said point number switch means, and manually operable "store" lockout means having a releasable locked position for preventing said "store" operation of said operation switch means, whereby unauthorized personnel may not change the alarm limit of a particular variable.

33. In a continuous variable monitoring system including variable responsive signal input means providing signal outputs indicating the values of associated variables, and data processing means having an input to which said signal outputs are coupled, storage means having addressable data blocks each having storage positions for storing different kinds of information associated with a different variable, program means including means responsive to said signal outputs for storing data on the values of the variables in appropriate storage positions of the associated data blocks of the storage means, and output means for indicating the information in said storage positions of said storage means, the improvement comprising: manually adjustable point number switch means for setting a number which identifies any one of said data blocks, manually adjustable operation switch means having a series of settings relating respectively to the different kinds of information in each data block to be read-out from a storage block, manually operable action switch means, said program means cyclically carrying out a series of program functions in sequence including the feeding of information on the values of the variables to the proper storage positions of the data blocks and an action switch operation detection operation, said program means including means following the detection of the operation of said action switch means which responds to said settings of said operation switch means by feeding to said output means the kind of information indicated by the setting of the operation switch means from the appropriate storage position of the data block identified by the setting of said point number switch means, without requiring shutdown of the variable monitoring system.

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