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Improvements in or relating to computers for use in sampling procedures.

A computer is disclosed for use in sampling procedures for testing samples of a batch of articles comprising a memory into which is entered one or more tables of data identifying a sample code by batch size and inspection level. Also entered in the memory is a file table of data representing a sampling plan identifying sample size and acceptance and rejection parameters by the sample code and an acceptable quality level. The sample code is identified by means for entering data representing the batch size and a predetermined inspection level. Means is provided for entering data representing a predetermined acceptable quality level and for utilising the identified sample code to identify the corresponding sample size and acceptance and rejection parameters. A visual display responds to the identified sample size to display this sample size. Means is provided which responds to the identified acceptance and rejection parameters to derive and store a value having a magnitude which is a function of such parameters. Means is provided for entering into the computer sample data representing the acceptance and rejection of each sample article tested and comparison means is provided to compare the entered sample data with the derived and stored value to provide a first signal representing batch acceptance or a second signal representing batch rejection.

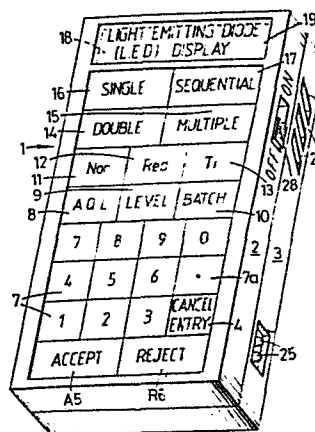


FIG.1

Improvements in or Relating to Computers
for use in Sampling Procedures

This invention relates to improvements in computers for use in sampling procedures.

5 Sampling procedures are known in which a given number of samples of a batch of products is tested to determine the extent of any defective attributes the samples may possess and the result of such a test is used as a measure of whether or not the batch is acceptable. Standards have been worked
10 out and tables compiled for this purpose in which the accept/reject conditions are statistically based upon expansion of the Binomial and Poisson probability distributions. In most mass/batch production companies in the United Kingdom, goods that are received in bulk are
15 inspected in accordance with the various charts and levels detailed in British Standard 6000, 6001 and 6002. However, as will be apparent hereafter, the complications of these charts are such that a considerable degree of training is required to understand the principles involved and inspection is generally held to the simplest plan available which
20 is known as the "single sampling plan" although cost savings could be achieved using the more complicated plan known as the "sequential sampling plan".

The tables and charts referred to, and in particular, B.S.
25 6001:72 will be well known to and understood by those skilled in the art. However, a brief description will be given for the better understanding of the invention.

In sampling procedures it is necessary for the consumer or purchaser and the manufacturer to agree both the inspection
30 level and the Acceptable Quality Level (AQL). BS 6001:72 provides for seven inspection levels of which four levels are special levels S-1; S-2; S-3 and S-4, used only for small sample sizes where relatively large risks can be taken and three general levels LI; LII and LIII of which LII is
35 the most commonly used, level LI being specified where less

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discrimination is needed and level LIII being specified for greater discrimination. For a given batch size, the inspection level provides a code which defines the sample size to be inspected according to the sampling plan to be adopted.

- 5 The AQL represents the minimum quality which can be accepted and may be expressed in per cent defective or in defects per hundred units for values of 10 or less but for values above 10 it must be expressed in terms of defects per hundred units. Inspection for per cent defective assumes that an
10 article with one defect is to be rejected as much as an article with three defects and inspection for defects per hundred units assumes that an article with three defects is of as much concern as three articles with one defect.

- 15 The sampling plans are arranged as columns of numbers, the columns being identified by the agreed AQL and the rows being identified from the code derived from the batch size and the inspection level. For a single sampling plan the columns comprise two sub-columns which identify the condition for acceptance or rejection of a batch.

- 20 The single sampling plan requires all samples to be inspected and the numbers in the sub-columns of the AQL columns define the maximum number of defective articles which can be accepted and the minimum number of defective articles leading to rejection of the batch.

- 25 For example for a batch size of 1201-3200 articles, the inspection level LII code is K. The normal single sample plan identifies this code as requiring a sample size of 125 articles and the AQL column for 1.0% gives the acceptance figure of 3 and the rejection figure of 4. All 125 articles
30 in the sample have to be inspected and if 3 or less are rejected, the batch is considered acceptable and if 4 or more are rejected, the batch is rejected. In addition to the normal single sample plan, there are tightened single

sample plans and reduced single sample plans. Generally, the normal plan is used but when two out of five consecutive batches have been rejected it is normally required to move to the tightened plan until five consecutive batches have proved acceptable when a return may be made to the normal plan. Reduced inspection may be instituted under certain conditions which include:

- a) 10 or more batches or a predetermined number of samples have been normally inspected and the total number of defectives is less than a given number defined on another chart;
 - b) production is at a steady rate, and
 - c) the responsible authority considers reduced inspection desirable.
- Normal inspection is generally resumed if one of these conditions is breached.

Thus in the above example code K for a tightened single sample plan still requires 125 samples but the figures for acceptance or rejection for an AQL of 1.0% are now 2 and 3. In the same example but for a reduced single sample plan the code K only requires 50 samples to be tested and the corresponding AQL numbers are 1 and 4 respectively. This means that if examination of the 50 samples reveals not more than 1 reject the batch is accepted and reduced inspection continues. If the number rejected in the sample is less than 4 but greater than 1 the batch is accepted but the normal sampling plan must be resumed. If the number rejected in the sample is 4 or more, the batch is rejected and the normal sampling plan must be resumed.

In addition to the single sampling plan there are two other similar plans, each with its own normal, reduced and tightened versions. These are known as the "Double Sampling Plan" and the "Multiple Sampling Plan". Double sampling is a system in which a first sample is taken which is of a lesser number than it would be for a single sampling. If the quality is found to be sufficiently good, the batch may

be accepted straight away and, if the quality is found to be sufficiently bad, the batch may be rejected. If, however, the quality is intermediate these two conditions, a second sample of the same size as the first must be taken and
5 inspected before a decision is made, the number of defective articles in the first and second sample sizes being cumulative. Thus, in the above example, the code K gives a first sample size of 80 and a second sample size of 80 and the acceptance and rejection figures for an AQL of 1.0% are
10 respectively 1 and 4 for the first sample and 4 and 5 for the cumulative first and second samples.

The Multiple Sampling Plan is essentially the same as the Double Sampling Plan except that more than two samples may be called for. The plans generally provide for seven
15 sampling stages all of equal size, although it is rare for a seventh stage to be required.

The above described sampling plans require all samples in a sample size to be examined and each sample rejected counts as one, the rejections being cumulative.

20 Another plan which is of importance is known as the "Sequential Sampling Plan" and operates on the basis of a starting handicap and a penalty number. In this plan account is taken also of acceptable articles and, for each acceptable article, 1 is added to the handicap number and,
25 for each rejected article, the penalty number is subtracted from the running total of the handicap number. The batch is deemed acceptable when the running total of the handicap number reaches a value which is twice the initial handicap number and the batch is rejected if the running total
30 reaches zero or less.

The tables for the Sequential Sampling Plans differ from those of the Single Sampling Plans in that the AQL columns are single columns, i.e., there are no sub-columns representing acceptance and rejection numbers, and it is the rows

which comprise two sub-rows, one sub-row representing the handicap (H) figure and the other sub-row representing the (b) penalty number.

5 Referring once more to the above example, the table for Normal Sequential Sampling shows that the code K requires 224 articles in a sample. For an AQL of 1.0% the H figure is 54 and the b figure is 36. For each acceptable article in the sample 1 is added to the handicap figure and for each rejected article in the sample 36 is subtracted from the
10 running total. It will be seen that, if the batch is good, only 54 articles need be inspected to reach the acceptance figure of $2 \times 54 = 108$ as compared with the normal Single Sampling Plan which requires 125.

15 There is also a tightened version of the Sequential Sampling Plan but there is no reduced version.

It will be appreciated from the above discussion that considerable staff training is required to enable full use to be made of the sampling plans.

20 It is an object of the present invention to provide a computer for use in sampling procedures which shall be capable of being produced in portable form and which shall be operable by relatively unskilled staff.

25 According to the present invention there is provided a computer for use in sampling procedures for testing samples of a batch of articles comprising a memory into which is entered at least a first table of data identifying a sample code by batchsize and inspection level and a file comprising at least one sampling plan as a table of data identifying sample size and acceptance and rejection parameters by the
30 sample code and an acceptable quality level (AQL), means for entering into the computer data representing the batch size and a predetermined inspection level to identify in the memory said sample code, means for entering into the computer

data representing a predetermined AQL and for utilising the identified sample code to identify in the memory the corresponding sample size and acceptance and rejection parameters, a visual display responsive to the identified sample size to
5 display said sample size, means responsive to the identified acceptance and rejection parameters to derive and store a value having a magnitude which is a function of said parameters, means for entering into the computer sample data representing the acceptance and rejection of each sample article
10 tested, comparison means operable to compare said entered sample data with said value to derive a first signal representing batch acceptance or a second signal representing batch rejection.

Embodiments of the invention will now be described by way of
15 example, reference being made to the accompanying drawings in which:-

FIG. 1 is a perspective view of a hand-held calculator-type computer embodying the present invention,
FIG. 2 is a plan view of the lower part of the computer case shown in Fig. 1, the top part being removed,
20 FIG. 3 is a plan view of the inside of the top part of the computer case,
FIGS. 4A, 4B, 4C and 4D together represent a flow diagram illustrating one embodiment of the invention, and
25 FIGS. 5A and 5B together represent a flow diagram illustrating another embodiment of the invention.

The computer illustrated in Fig. 1 is similar in configuration to a hand-held calculator and comprises a substantially rectangular case indicated generally at 1 having an upper
30 part 2 and a lower part 3 which can be secured together in any suitable manner. A number of function buttons or keys are mounted on the upper part 2 and comprise a "cancel entry" button 4, accept and reject buttons A5 and R6

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respectively, ten digit buttons 7 representing the digits 0 to 9, a decimal point button 7a, three buttons 8, 9 and 10 identified as the AQL button, the Level button and the Batch button respectively, three buttons 11, 12 and 13 representing the normal sampling plan, the reduced sampling plan and the tightened sampling plan respectively, and four buttons 14, 15, 16 and 17 to identify the plan selected as Double Sampling Plan, Multiple Sampling Plan, Single Sampling Plan and Sequential Sampling Plan. Also mounted in this upper case part 2 is a Texas TIL 398.3 Type 8 digit 7 segment LED display module 18 which is viewed through window 19. The lower case part 3 houses a printed circuit board 20 on which are mounted a Texas TMS 1000 Series Micro-Processor 21 and a memory microchip 22, connections being made between the circuit board 20 and the function keys and the LED display module 18 by a ribbon cable 23. A rechargeable battery power pack 24 is connected to the circuit board 20 and also to pins 25 opening to the exterior of the casing for recharging purposes. An audible alarm 26 incorporating an amplifier is also connected to the circuit board 20 and the lower part 3 of the casing is vented as at 27 to allow the alarm to be heard. An on-off switch 28 is provided and may be located as required; in Fig. 3 it is shown mounted in the lower part 3 of the casing, and in Fig. 1 it is shown mounted in the upper part 2 of the casing. It could equally be provided as an on-off press button.

The embodiment of the invention illustrated in Figs. 4A, 4B, 4C and 4D is intended to provide for both Single and Sequential Sampling Plans including the normal, reduced and tightened versions of the Single Sampling Plan. Note that for convenience of illustration, Fig. 4D is divided into two parts, Fig. 4D' and Fig. 4D''. The tables or charts representing these plans are stored in the memory microchip 22. Each of the function buttons of the computer, when operated, generates its own unique code in binary or equivalent form, e.g., hexadecimal, and the computer is designed, by operation of these function buttons,

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to identify the selected table in the memory, to identify the code corresponding to the batch size and, by this code and the agreed AQL, to identify the appropriate acceptance and rejection numbers or the handicap and penalty numbers as the case may be. Operation of the rejection button R6 in the case of a Single Sampling Plan or operation of the acceptance button A5 and the rejection button R6 in the case of a Sequential Sampling Plan then generate values which are automatically compared with the acceptance and rejection values of the plan to generate an alarm when the batch is to be rejected.

Referring to Figs. 4A, 4B, 4C and 4D, an operation is commenced by switching the computer on by means of switch 27 (Fig. 4A). The operator then operates the selected mode or plan button, let us assume the Single Plan button 16, which then sends its code to a comparator unit 30 which compares the received code with stored codes and, if it identifies the code as acceptable, transmits the code at its Y (Yes) output or, if it is not acceptable, produces an N (No) output, the latter being used to operate the alarm 26 to indicate a malfunction. (All outputs referenced 100 are used to operate the alarm 26.) The coded Y output from comparator unit 30 is supplied to a comparator unit 31 arranged to identify the Single Plan code and to produce a Y output when it identifies that code or to pass the code to its N output when it fails to identify that code. In the latter case, the code is passed to the input of a comparator unit 32 arranged to produce a Y output if it identifies and accepts the code as representing a sequential sampling plan or an N output if it fails to do so in which case the N output actuates the alarm 26. However, assuming a Single Sampling Plan is selected, the Y output from comparator 31 (the Y31 output) opens a gate 33 which is arranged to be supplied with the codes generated by operation of the buttons 11, 12 and 13 representing a normal plan, a reduced plan or a tightened plan respectively.

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Whichever plan is selected (assume normal, i.e., button 11 is operated) the corresponding code is passed to a comparator unit 34 which produces an N output to operate the alarm 26 if the received code is not one of the three permissible codes or, if acceptable, passes the code to a string of comparator units 35, 36 and 37 each arranged separately to identify one of the three permissible codes and when so identified to produce a Y output. The Y output from comparator 35 identifies in the memory 22 the stored Single Sampling Plan (normal inspection) - say Table 1 -; the Y output from comparator 36 identifies in the memory 22 the Single Sampling Plan (tightened inspection) - say Table 2 - and the Y output from the comparator 37 identifies the Single Sampling Plan (reduced inspection). An N output from comparator 37 indicates that the received code has not been accepted by any one of the comparators 35, 36 and 37 and operates the alarm 26. At this stage, the computer has identified the table to be used in the memory 22.

The second stage (Fig.4B) is to identify the required column in that table by entering the agreed AQL. A Single Sampling Plan usually provides for 26 AQL values ranging from 0.010 to 1000 and an appropriate value must be entered to select the appropriate AQL column. This value is entered by the digit keys 7 and is displayed by the LED display 18. If a mistake has been made and the AQL shown is wrong, it can be cancelled by operating the "cancel entry" button 4. However, assuming it to be correct, the AQL button 8 is operated to enter the number which is checked by comparator unit 38 and, if acceptable, is passed to the string of 26 comparator units 39¹ to 39²⁶ and, if one of these accepts the number it produces a Y output which identifies the column in the selected table.

The third stage (Fig.4C) is to identify the sample code from the batch size and the level selected from levels LI, LII and LIII.

To this end, the digit buttons 7 are operated to display the level required, e.g. 1, 2 or 3, in the display 18 and the level button 9 is actuated to enter the displayed level. Actuation of button 9 also instructs the computer that an operation is to be performed on the Level/Batch size table stored in the memory 22. This entered level is checked by comparator unit 40, and passed to a string of three comparators 41, 42, 43 arranged to identify levels I, II and III respectively. Whichever one of the comparators identifies the level, it produces a Y output which identifies the required column 44^1 , 44^2 or 44^3 in the Level/Batch size table. The batch size is then entered by digit keys 7, displayed on display 18 and entered by operating batch button 10. This entered size is checked by comparator unit 45 (Fig.4D) to see if it is acceptable and, if so, is passed through the Y45 output to a string of fifteen comparators 46^1 to 46^{15} which by determining whether the batch size is below a predetermined value determine whether or not the batch size is within a given predetermined range. Thus comparator 46^1 determines whether the entered batch size is less than 8, comparator 46^8 whether it is less than 500, comparator 46^{14} whether it is less than 500,000 and comparator 46^{15} whether it is greater than 500,000. The comparator 46 which identifies the range of the batch size produces a Y output which in turn identifies the line or row 47^1 to 47^{15} in the Level/Batch size table to identify the sample code. This sample code when applied to the selected table does two things, firstly it identifies in the memory 22 the sample size and, secondly, it identifies in the memory 22 the accept/reject numbers for a Single Sampling Plan or the handicap and penalty numbers for a Sequential Sampling Plan. These are read from the memory into a temporary store 48 which transmits the sample size to the display 18 and which also transmits the accept/reject numbers or handicap/penalty numbers to a switch 49 which has inputs 50 and 51 derived respectively from Y31 and Y32 outputs to identify whether a Single or Sequential Sampling Plan has been selected and to route the

5 numbers accordingly. With a Single Sampling Plan selected, the switch 49 routes the accept/reject numbers via lines 52 and 53 respectively to comparator units 55 and 56 to enter the acceptance number into comparator unit 55 and the rejection number into comparator unit 56.

10 The operator now selects from the batch the displayed number of samples and commences testing. For each article of acceptable quality, the A5 button is operated and for each article to be rejected, the R6 button is operated. The operation of buttons A5 and R6 generates a corresponding coded signal which is supplied to switch 57 which is also controlled by the Y31 and Y32 outputs along lines 50 and 51 to distinguish between the Single and Sequential Plans and to route the coded signals accordingly. Also each time the
15 A5 and R6 buttons are operated, a signal is supplied to the display 18 to deduct 1 from the displayed number. Assuming a Single Sampling Plan, the coded signals are routed along line 58 to a comparator unit 59 operable to identify each "Accept" code which produces a Y output for each "Accept" code which is supplied to a store 60 and an N output for each
20 "Reject" code which is identified in comparator unit 61 to produce a Y output which is supplied to the store 60 and to the comparator units 55 and 56. The store 60 is in effect a counter loaded or biased with the sample size number from the temporary store 48 and counts the number of acceptances and rejections to produce an output along line 62 when this
25 count reaches the sample size number.

30 If before the count has been completed, the number of rejects equals the reject number, this is detected by the comparator 56 to produce a Y output which is used to cause the display unit 18 to display "FAIL" to show that the batch is not acceptable. If, however, the full sample size is tested without this occurring, the output from counter 60 along line 62 is passed to gate 63 which is a gate normally
35 held open by the N output from the comparator 55 when the

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reject number is not greater than the acceptance number which has been supplied along line 52. As the acceptance and rejection numbers only differ by 1 unit in the tightened and normal versions of the Single Sampling Plan, the display, for such a selection, will either show FAIL or PASS. However, for the reduced version of the Single Sample Plan, the difference between acceptance and rejection is greater than 1 unit and the corresponding numbers supplied along lines 52 and 53 to the comparators 55 and 56 will differ accordingly. Therefore, at the end of a sampling procedure, if the reject number has not been exceeded, it is necessary to know whether the acceptance number has been exceeded. If it has, the N55 output will disappear leaving gate 63 closed. The Y55 output indicates that the number of rejects exceeds the acceptance number and this is supplied to a gate 64 which is only open when it receives a first input from the N56 output indicating that the number of rejects is less than the reject number and a second input from line 62 indicating that the count is complete. Under such conditions the Y55 output is passed through the gate 64 to cause the display 18 to display "PASS/F" to indicate that the batch can be accepted but that the normal version of the plan must be resumed. The PASS or FAIL display may be accompanied by an audible signal from the alarm 26 such as, for example, a continuous sound representing a PASS and an intermittent "bleep" representing a FAIL.

The description of Figs. 4A, 4B, 4C and 4D has so far largely been concerned with the selection of a Single Sampling Plan. If a Sequential Sampling Plan is selected, the corresponding code is not accepted by the Comparator 31 (Fig. 4A) which passes it through its N output to the comparator 32 where it is accepted to generate a Y output which opens gate 73 which is arranged to be supplied with the codes generated by operation of the buttons 11 and 13 representing a normal or tightened plan respectively. Such a code is passed to comparator unit 74 which produces an N output at line 100 if it

does not identify one of the two acceptable codes or, if the code is acceptable, passes the code through its Y output to comparator unit 75 intended to identify a normal plan and produce a corresponding Y output or pass the code through
5 its N output to comparator 76 intended to identify selection of a tightened plan. The Y75 and Y76 outputs identify that a Sequential Sampling Plan has been selected and whether or not the normal or tightened version is required, thereby enabling the computer to identify the required table in its
10 memory 22, - say tables 10 and 11, respectively.

The subsequent entry of the AQL (Fig.4B), the selected level (Fig.4C) and the batch size (Fig.4D) are as previously described with the result that the display 18 displays the required sample size, and the temporary store receives this sample size and, in this case,
15 the appropriate handicap and penalty numbers H and b. As in this case, the line 51 is energised from Y32, the switch 49 supplies the H and b numbers along lines 77 and 78 respectively, the b number being fed to a store 79 and the H number being supplied to a counter 81 and also being doubled in
20 multiplier 80 and supplied as 2H to comparator 82. The Y32 output along line 51 operates the switch 57 to send the signals from the A5 and R6 buttons along line 82 to comparator unit 83 intended to identify an acceptance and produce a corresponding Y output. If it is a rejection signal, the
25 comparator 83 passes the signal to comparator unit 84 intended to identify a rejection signal and produce a corresponding Y output. Each Y83 output adds 1 to the number in counter 81 and each Y84 output causes the store 79 to transmit the penalty number to the counter 81 where it is
30 subtracted from the running total. The running count in counter 81 is monitored by the comparator 82 and a further comparator 85 which is set to identify when the running count is less than 1, i.e., zero. The comparator 82 produces an output on line 86 when the running count attains
35 the value 2H causing the display unit 18 to display PASS.

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The comparator 85 produces an output on line 87 when the running count falls below 1 or passes through zero to cause the display unit 18 to display FAIL.

5 The embodiment described with reference to Figs. 4A, 4B, 4C and 4D may additionally incorporate the facility of using either one or both of the Double Sampling Plan and the Multiple Sampling Plan in any one or all of the versions reduced, normal and tightened. It will be described as incorporating both plans and all versions. To this end, the comparator 30
10 (Fig. 4A) would additionally store the codes representing the Double and Multiple Sampling Plans which would be selected by the function buttons 14 and 15 and if a Y output is produced would supply this code to the comparator string 31, 32 which would be enlarged by the addition of comparators
15 D31 and M31 (Fig. 5A). The N32 output would no longer go to the 100 line as in Fig. 4A but to the D31 input as is represented by the line 101 (Fig. 5A). As the Double and Multiple Sampling Plans are very similar to the Single Sampling Plan, particularly the reduced version thereof, the references
20 used for the Double and Multiple Sampling Plans will, where appropriate, be the same as those used for the Single Sampling Plan prefixed by the letter D or the letter M to denote "Double" or "Multiple".

25 Fig. 5A shows the arrangement for selecting the appropriate table for a Double or Multiple Sampling Plan from the memory 22 and as it corresponds in substance to that described for the Single Sampling Plan, it need not be further described. Also, the entry of the AQL to identify the column in the selected table, the entry of the level and the batch size to
30 identify the sample size code are all as previously described and are therefore omitted from this description. The derived sample code will identify in the selected table the sample size which, as has been mentioned, is of identical size for each of the two sample sizes which may be required
35 for the Double Sampling Plan and is of identical size for each of the seven sample sizes which may be required for the

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Multiple Sampling Plan. This sample size is read into the temporary store 48 (Fig. 4D) and displayed in the display 18. The derived sample code also identifies the accept/-reject numbers for each sample size so that for the Double
5 Sampling Plan there will be two pairs of accept/reject numbers and for the Multiple Sampling Plan there will be seven such pairs of accept/reject numbers.

The comparators D31 and M31 provide a Y output along line 50, if selected, and this output operates the switches 49
10 and 57 as previously described. The first pair of accept/-reject numbers are fed through switch 49 along lines 52 and 53 respectively to the respective comparators 55 and 56 and the sample size is supplied to store 60. However, in order to accommodate the Double and Multiple Sampling Plans, the
15 block A shown in dotted lines in Fig. 4D needs to be modified and one such possible modification is shown in Fig. 5B. In this modification, the output from gate 64 is supplied to a switch 110 the output of which is normally supplied along line 111 to the memory 22 or is switched along line 112 to
20 the display 18 to display PASS/F. In order to identify whether a Double Sampling Plan or a Multiple Sampling Plan has been selected and hence the possible number of sample sizes which may require to be tested, the comparator D31 (Fig. 5A) has a Y output along line D50 and the comparator
25 M31 has a Y output along line M50 and these outputs are supplied to a counter 113 which is set by a D50 input to count two sample sizes and by the M50 output to count seven sample sizes and when such a count is completed, the counter 113 produces an output along line 114 to operate the switch
30 110 and pass the output from gate 64 to the display 18 to display PASS/F.

Assuming a Multiple Sampling Plan is selected, the store 60 will be supplied from the memory with the sample size for the first testing and the comparators 55 and 56 will be
35 respectively supplied with the accept/reject numbers of the

first pair. As with the reduced version of the Single Sampling Plan if, at the end of testing the first sample size, the acceptance number has not been exceeded, the N55 output will cause the display 18 to indicate PASS and, if
5 the rejection number has been equalled or exceeded, the Y56 output will cause the display 18 to indicate FAIL. If, however, the number is intermediate the acceptance and rejection numbers, there will be an output from gate 64 and a second identical sample size will need to be tested. The
10 output from gate 64 will be supplied to the counter 113 and through the switch 110 along line 111 to the memory 22. This will cause the memory 22 to redisplay the sample size on the display 18, to re-enter the sample size in the store 60 and to supply the second pair of accept/reject numbers to
15 the comparators 55 and 56 respectively. Each time a sample size of a given number of samples is tested, the display 18 will either show PASS or FAIL or there will be an output from gate 64 which passes through switch 110 and along line 111 to the memory 22 to set up the apparatus for the next
20 sample size test. In the event that the display 18 does not previously show PASS or FAIL, the final sample size to be tested will be the seventh. For the normal and tightened versions of the Double and Multiple Sampling Plans, the accept/reject numbers for the final test differ by only one
25 unit so that there can be no intermediate value to operate gate 64 and the display 18 will either show PASS or FAIL. However, for the reduced version, the accept/reject numbers for the final sample size differ by more than one unit and can produce an output at gate 64 if the actual number is
30 intermediate the given values. In this case the output from gate 64, in this case the seventh output, is recognised in the counter 113 which has been set up by the M50 input thereto, and this produces an output along line 114 to operate the switch 110 and direct the output from gate 64
35 along line 115 to the display 18 to produce the display PASS/F.

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If a Double Sampling Plan is selected, it will be appreciated that there is only a first and a last sampling size, i.e., two sampling sizes of identical numbers of articles, to be tested and the operation is otherwise as described
5 above, the counter 113 being set up by the D50 input to operate the switch 110 at the end of the second sample size test.

The tables representing the sampling plans and their alternative versions may be considered as a file of plans stored
10 in the memory 22. For each such file plan, it is necessary to identify the sample code from a table which determines the sample code by the batch size and the inspection level which is predetermined. It will be appreciated that, if
15 desired, the file may only contain one version of one plan so as to materially simplify the device and in any given application prevent an unskilled operator from having the opportunity of selecting an incorrect plan or the version thereof required. The file could, in fact, be in a separate
20 memory capable of being plugged into the apparatus to provide the facility required for any given application. In this way, the apparatus could be issued to an employee set up for the purpose required and the employee would not have to make any selection of the plan or version required.

Where the apparatus holds less than the four plans and the
25 versions thereof described, the number of function buttons can be reduced accordingly.

It will be appreciated that the apparatus may hold any one or more of the plans described and the respective versions thereof.

30 It will be further appreciated that the invention is not limited to the embodiments described by way of example and

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that various equivalents or modifications will be apparent to one skilled in the art and may be employed without departing from the scope of the invention. Such modifications and equivalents are to be considered to be within the
5 scope of the invention disclosed in this specification.

Claims:

1. A computer for use in sampling procedures for testing samples of a batch of articles comprising a memory into which is entered at least a first table of data identifying a sample code by batch size and inspection level, and a file comprising at least one sampling plan as a table of data identifying sample size and acceptance and rejection parameters by the sample code and an acceptable quality level (AQL), means for entering into the computer data representing the batch size and a predetermined inspection level to identify in the memory said sample code, means for entering into the computer data representing a predetermined AQL and for utilising the identified sample code to identify in the memory the corresponding sample size and acceptance and rejection parameters, a visual display responsive to the identified sample size to display said sample size, means responsive to the identified acceptance and rejection parameters to derive and store a value having a magnitude which is a function of said parameters, means for entering into the computer sample data representing the acceptance and rejection of each sample article tested, comparison means operable to compare said entered sample data with said value to derive a first signal representing batch acceptance or a second signal representing batch rejection.

2. A computer according to Claim 1 in which the file table of data represents a single sampling plan in which the rejection parameters represent the minimum number of rejected articles in a sample size requiring batch rejection, the means responsive to said parameters is operable to derive said value as a function of said rejection parameters and said comparison means is operable to compare the entered sample data representing rejection with said value to generate said second signal representing batch rejection when said entered sample data representing rejection corresponds to said value and to generate said first signal representing batch acceptance when said entered sample data representing

rejection has not attained said value and said entered data representing both sample acceptance and rejection identifies completion of testing of the full sample size.

5 3. A computer according to Claim 2 in which the file table includes at least the normal and tightened versions of the single sampling plan, and means is provided for entering into the computer a code identifying the version of the single sampling plan to be used.

10 4. A computer according to Claim 2 or 3 in which the file table includes the reduced version of the single sampling plan in which the acceptance parameters represent the maximum number of rejected articles allowable in a sample size to allow batch acceptance and continued use of the reduced version and any value intermediate said minimum and maximum
15 values allows batch acceptance and denotes that use of the reduced version should be discontinued, said means responsive to the identified acceptance and rejection parameters being arranged to derive and store a first value which is a function of the acceptance parameters and a second value
20 which is a function of the rejection parameters and said comparison means being operable to compare said entered sample data representing rejection of each rejected sample article tested with said first and second values to derive said second signal representing batch rejection in the event
25 said entered sample data representing rejection attains said second value, said first signal at the end of the sample size test representing batch acceptance in the event said entered sample data representing rejection does not exceed said first value and a third signal at the end of the sample
30 size test representing batch acceptance and discontinuance of the reduced version in the event said entered sample data representing rejection is intermediate said first and second values.

5. A computer according to Claim 1 in which the file comprises at least one sequential sampling plan table in which the acceptance and rejection parameters represent handicap and penalty numbers, the means responsive to the parameters
5 is operable to derive and store a first value representing the penalty number, to derive and store a second value representing the handicap number, and to derive and store a third value which is a multiple of said handicap number; and said comparison means is operable to deduct said first value
10 from said second value for each entry of sample data representing rejection of a sample, to add a predetermined value to said second value for each entry of said sample data representing acceptance of a sample to derive a running total and to compare said running total with said third value to
15 generate said first signal representing batch acceptance when said running total attains said third value and said second signal when said running total falls below or attains a predetermined minimum value.
- 20 6. A computer according to Claim 1 in which the file table of data represents at least one sampling plan providing for the testing of at least two sample sizes of a batch in which the rejection parameters for each sample size represent the minimum number of rejected articles in the sample sizes
25 tested requiring batch rejection, the acceptance parameters for each sample size represent the maximum number of rejected articles allowable in the sample sizes tested to allow batch acceptance and any value intermediate said minimum and maximum numbers for all but the last sample size to
30 be tested denotes that a further sample size is to be tested, said means responsive to the identified acceptance and rejection parameters being arranged to derive and store, for each sample size, a first value which is a function of the acceptance parameters and a second value which is a
35 function of the rejection parameters, said comparison means being operable to compare said entered sample data representing rejection of each rejected sample article tested with

5 said first and second values to derive said second signal
representing batch rejection in the event said entered
sample data representing rejection attains said second
value, said first signal at the end of each sample size test
representing batch acceptance in the event said entered data
representing rejection does not exceed said first value and
a third signal at the end of each but the last sample size
to be tested representing the requirement for testing a
further sample size, said third signal being operable to
10 identify the further acceptance and rejection parameters for
such further test said means responsive to said identified
acceptance and rejection values being operable to derive and
store a third value which is a function of the further
acceptance parameter and a fourth value which is a function
15 of the rejection parameter.

7. A computer according to Claim 4 modified in that the
file table represents a sampling plan allowing for the test-
ing of at least two identical sample sizes in a batch in
20 which at least all but the last sample size to be tested
have acceptance and rejection parameters allowing for the
entered sample data to be intermediate said first and second
values for that sample size, characterised in that said
third signal is operable to identify that a further sample
25 size is to be tested and to identify the further acceptance
and rejection parameters for such further sample, the means
responsive to the identified acceptance and rejection
parameters being arranged to derive and store values corres-
ponding to such further acceptance and rejection parameters
30 for the testing of a further sample size.

8. A computer according to Claim 7 in which the sampling
plan is a double sampling plan allowing for the testing of
up to two identical sample sizes in a batch.
35

9. A computer according to Claim 7 in which the sampling
plan is a multiple sampling plan allowing for the testing of
up to seven identical sample sizes in a batch.

10. A computer according to Claim 1 in which the file includes at least one version of at least one of a single sampling plan, a sequential sampling plan, a double sampling plan and a multiple sampling plan constructed and arranged
5 to operate substantially as herein described.

11. A computer for use in sampling procedures having a memory in which is stored at least one version of a sampling plan and a table for identifying a sample code, means operable
10 to enter the batch size to be tested and the inspection level required to identify in the table the sample code, means for entering an acceptable quality level, means responsive to the identified sample code and the entered acceptable quality level to identify the sample size to be
15 tested and to identify acceptance and rejection parameters from the sampling plan, means for entering acceptance and rejection characteristics of samples tested in the identified sample size and means for comparing such entered characteristics with the identified acceptance and rejection
20 parameters to provide a signal representing batch acceptance or rejection.

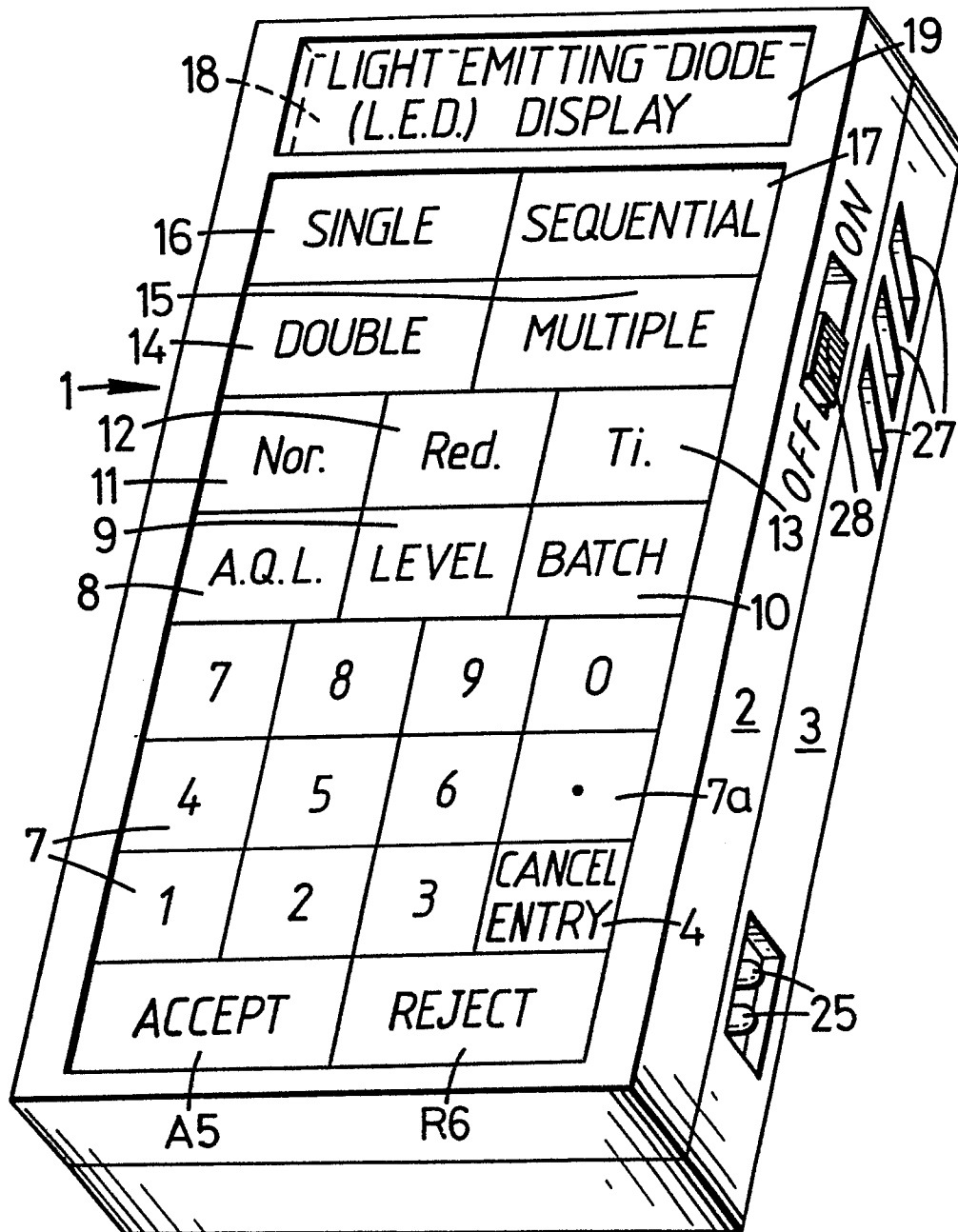


FIG. 1

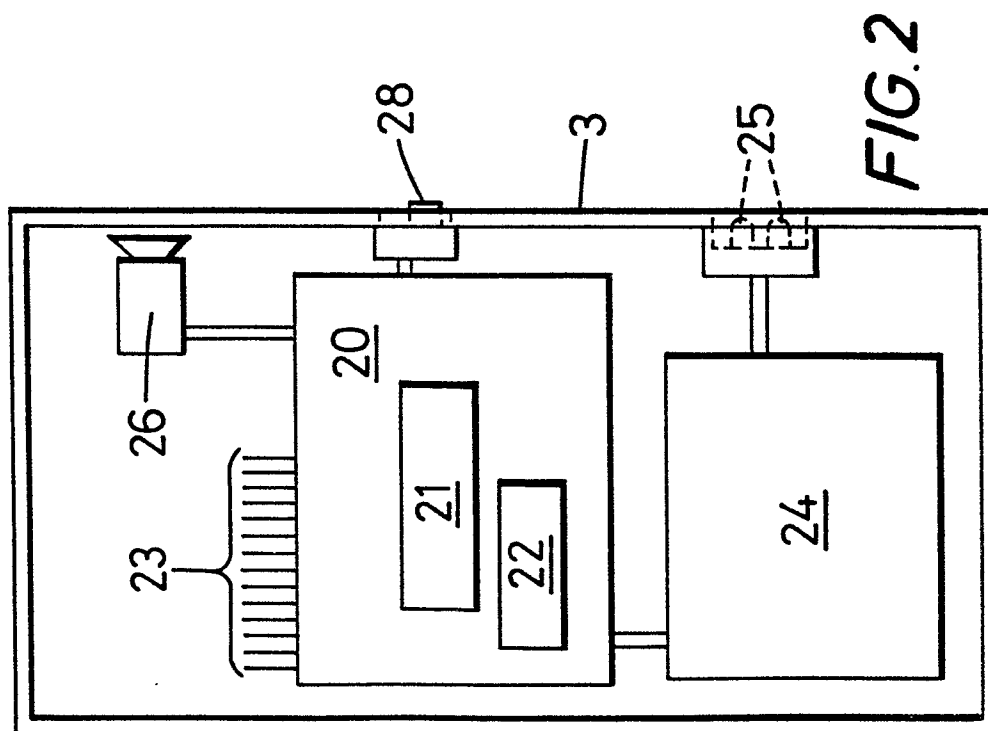
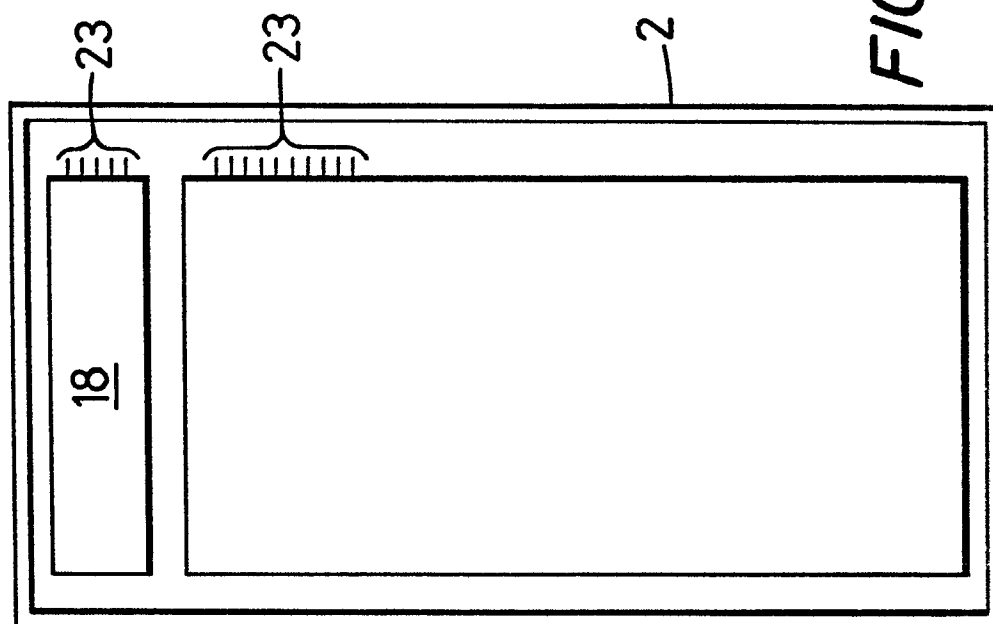
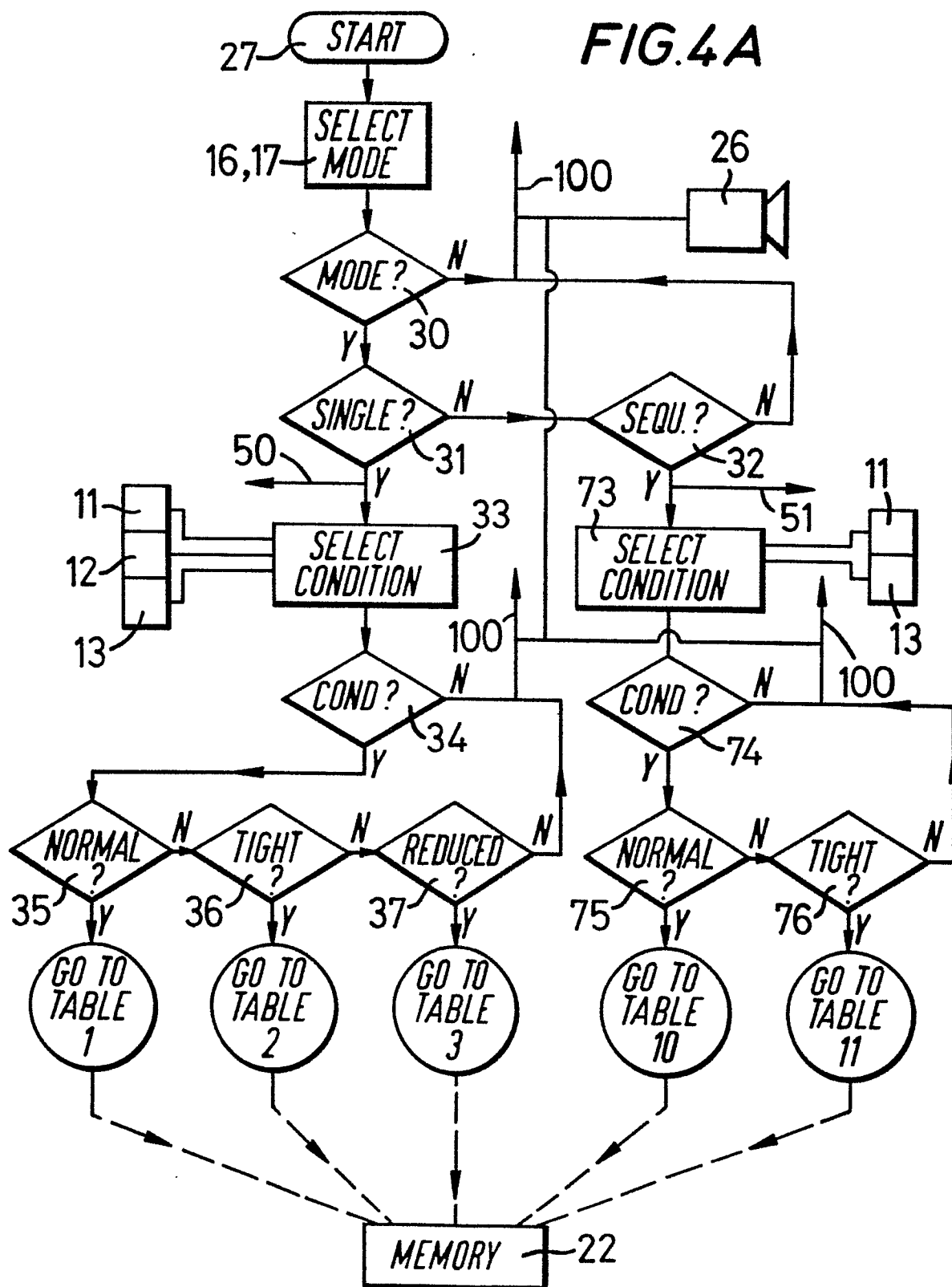


FIG. 4A



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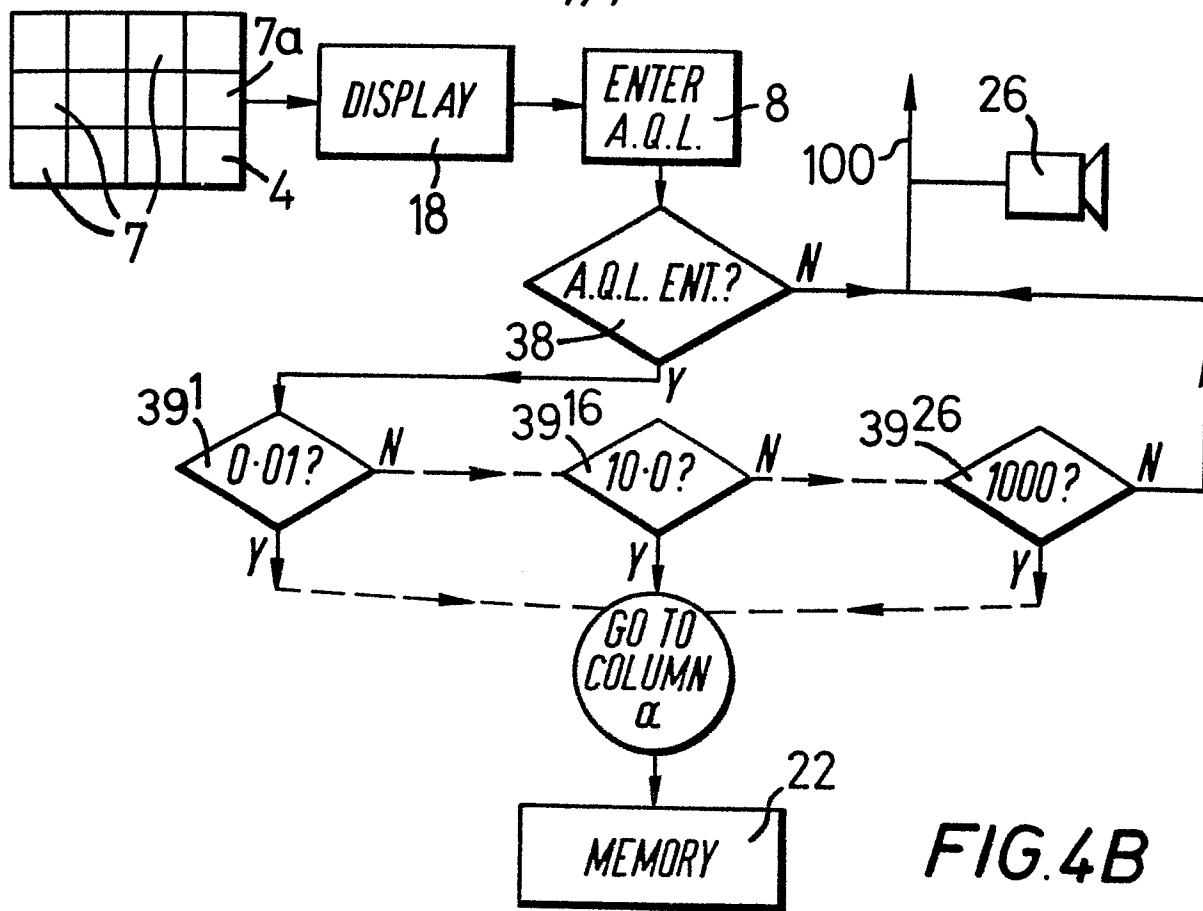


FIG. 4B

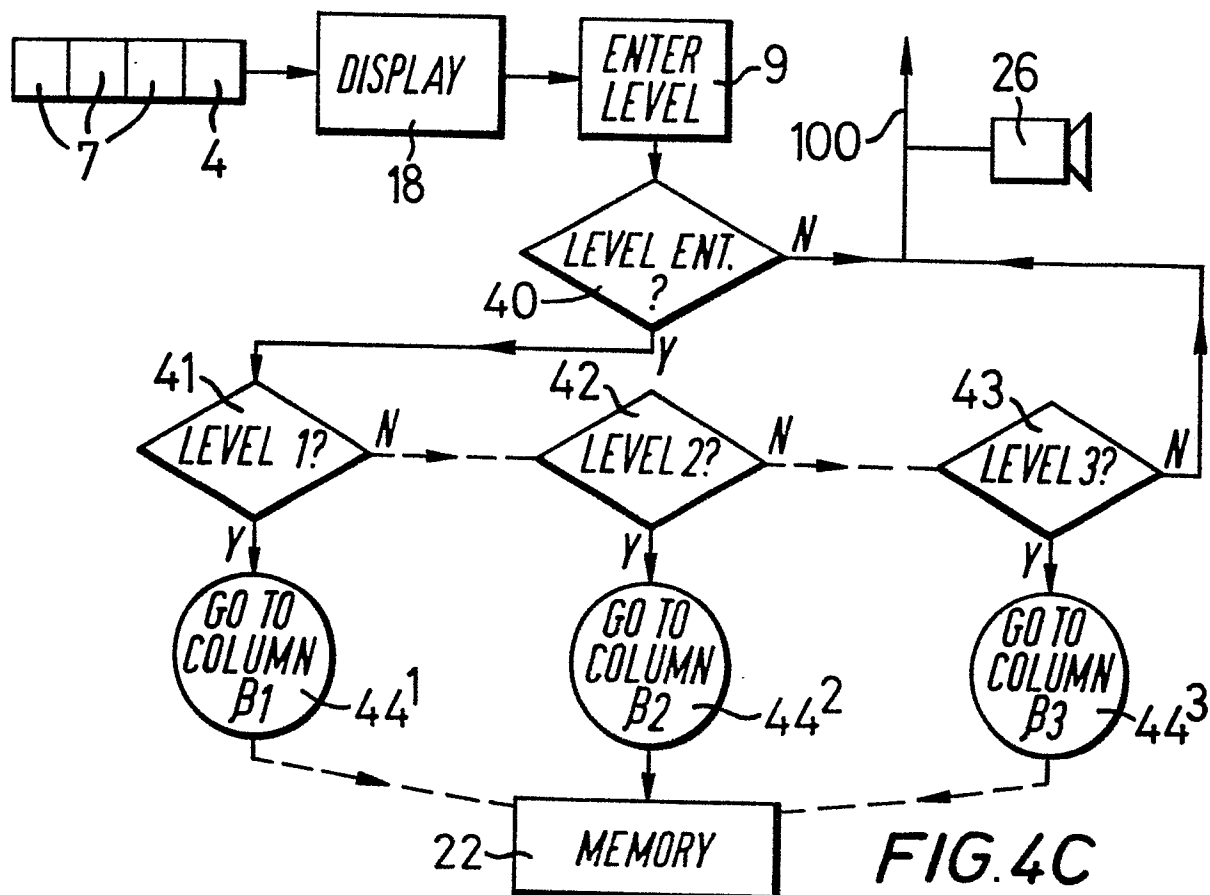


FIG. 4C

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