



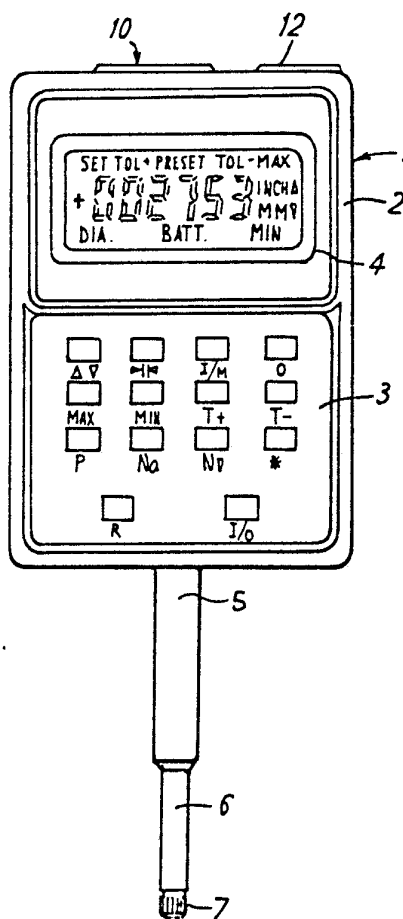
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(54) Title: DIMENSION GAUGE HAVING MEMORY FACILITIES

(57) Abstract

A digital linear gauge uses Moire fringe effect for obtaining a countable output related to relative movement of two gauge elements. A microprocessor circuit receives the output and counts it and applies it as drive to a visual display. The microprocessor permits modification of the output, and also has memory means capable of storing, and providing access to, stored counts and inserted values and/or instructions, prior to an end result being shown on the display.



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DIMENSION GAUGE HAVING MEMORY FACILITIES

This invention relates to a dimension gauge and particularly, but not exclusively, to a linear gauge as exemplified by the known engineer's dial gauge and
05 micrometer.

The object of the invention is to provide an improved construction of dimension gauge having memory facilities which enable the user to insert certain values, such as maximum and minimum tolerances and/or
10 to take into account certain values which have previously been inserted or read off during use of the gauge.

According to the present invention a dimension gauge comprises, in combination:

- 15 (i) means for producing, by Moire fringe effect, a countable output related to relative movement of two gauge elements,
- (ii) microprocessor circuitry receiving the countable output, said circuitry including
20 counter means for counting the output, numeric modifying means for modifying the counted output, and memory means capable of storing and providing access to stored counts and inserted values and/or
25 instructions, and
- (iii) a visual display means driven by the micro-processor circuitry.

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The memory means may receive and provide access to, for example, maximum and/or minimum dimensions, and/or a previous reading or readings.

There may be instances in practical use of a
05 gauge where it is not desired to read off any given dimension of a workpiece, but merely to know whether a gauge dimension falls within predetermined upper and lower limits, or is greater than a lower limit or is less than an upper limit. The micro-computer may be
10 constructed to include means for the pre-setting of upper and/or lower limits, and to give rise to an appropriate visual indication as to a correct or incorrect dimension gauged.

It is also a known workshop system to have each
15 of the gauged dimensions of a series of measurements allocated to one or another of a series of dimension ranges, without it being necessary to know the precise dimension gauged. The micro-computer may be constructed so that it is possible to insert a series
20 of such dimension ranges so that when a series of workpieces are subsequently gauged, the instrument will give an indication of which range of dimensions that workpiece will fall within.

The microprocessor may be in the form of a micro-
25 computer which may be associated with a custom chip containing, for example, a crystal frequency source and serving as a basic counter from which the remainder of the electronic circuitry operates.

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A pulsed light signal for a LED light source of the Moire fringe means may conveniently serve as a clock for the remainder of the system.

An embodiment of gauge in accordance with the invention is hereinafter particularly described by way of non-limiting example with reference to the figures of the accompanying drawings, wherein:-

Fig. 1 is a front elevation of the gauge;

Fig. 2 is a side elevation;

10 Fig. 3 is a plan view;

Fig. 4 is a sectional elevation viewed on a first plane parallel to the front face of the gauge;

Fig. 5 is a sectional elevation viewed on a second plane normal to the front face of the gauge;

15 Fig. 6 is a perspective elevation of two Moire fringe grating elements, seen in separated condition;

Fig. 7 is a front elevation of the assembled grating elements;

20 Fig. 8 is an edge elevation of the assembled grating elements;

Fig. 9 is a front elevation showing the grating assembly with light source LED's and photoreceptor transistors;

25 Fig. 10 is a schematic side elevation corresponding to Fig. 9;

Figs. 11a - 11d show the entire circuitry.

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The gauge comprises a housing 1 with a front cover 2 having a keyboard 3 and a display 4, advantageously a liquid crystal display. From the lower end of the housing there extends a gauge stem 5
05 carrying a spindle 6 terminating in an exchangeable anvil 7. On the rear face of the housing 1 is a backplate 8 having a hole 9 to receive a securing bolt or the like for stand mounting. On the upper end of the housing 1 there is communication outlet 10, such
10 as a multiple connector, terminal block, jack point or the like. Also on the upper end there is provided an accessory mounting point 11, e.g. for the addition of dead- weights for use in gauging depression of resilient materials. Item 12 is a cover for a battery
15 space.

The stem 5 is movable axially in an internal main frame of the housing 1 under the action of a coiled tension spring 13 which urges it towards its fully extended position. Axial end points of the movement
20 of the stem 5 are determined by rubber buffers 14, 15.

If two diffraction gratings having suitable characteristics are moved in a particular manner one relative to the other, and if electromagnetic wave
25 energy, e.g. light, is passed through the gratings transversely to their direction of relative movement, there is produced a pattern of "lines" alternating

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with "spaces" which also moves transversely to the direction of relative movement of the gratings and the movement of which bears a relationship to the extent of relative movement of the gratings. This is known as the "Moire fringe" effect.

On the stem 5 is mounted a member 16 which holds the movable elongated grating of a pair of gratings suitable for creating the Moire fringe effect. Secured on the housing is a pressure spring 17 serving to hold the two grating elements in rubbing contact, and a guidance spring 18 for the two grating elements.

A block 19 supports the stationary grating element or "index" 20, and photoreceptor transistors 21, and a further block 22 supports the pulsed light sources 23 (see Fig. 10). A printed circuit board 24 serves to connect the light sources 23 and photoreceptors 21 to main circuit boards 25 and 26 (see Fig. 5). Batteries 27 are housed in the battery space 28.

Referring to Fig. 5, the keyboard 3 comprises keys 29 for the operation of switch means 30 which are coupled through a printed circuit board 31 to the boards 25 and 26. The display 4 comprises a liquid crystal element carried by clips on supports 32 and covered by a fascia 33.

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Referring to Figs. 6 to 10, the elongated movable grating element 34 moves with the stem 5. The grating elements 20 and 34 are each made of glass with a diffraction grating formed thereon. The grating elements are provided with edge strips 35, 36 of chromium to act as rubbing contacting faces and serving also to retain the two gratings at a pre-determined very small air-filled spacing from each other.

10 Fig. 10 shows the pulsed LED light sources 23 which transmit their light through a transparent angled optical element 37 in which the direction of the rays of light is reversed through 180° so as to pass in the direction from the moving grating element
15 34 to the index grating element 20, and thence to the photoreceptor transistors 21.

The direction of movement of the lines and spaces of the Moire fringe effect is indicated by the arrow "A" in Fig. 9. The photoreceptor transistors are
20 arranged in two pairs. A first pair (the right hand pair in Fig. 9) has its individual transistors spaced by a distance which is 180° of the cyclical spacing of the Moire fringe line/space pattern. Accordingly, the pair of transistors give a differential output signal
25 which is greater, for a given light quantity, than would be obtained with a single transistor sensing

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the changes from light to dark. The second pair (the left hand pair in Fig. 9) is arranged, along the line of movement of the fringe effect pattern, at a spacing which is 90° out of phase with the first pair. This arrangement permits the micro-computer to determine the direction of relative movement of the grating element at any instant.

Referring now to Figs. 11a - 11d, a pulse generator 38 feeds the two LED light sources 23, 23 passing their light through the gratings 34, 20 to be received by the photoreceptor transistors 21,21 and 21,21. The output from the transistors passes to a conditioning circuit 39 which feeds information in the form of square waves to a custom chip 40 and processor 41.

Connectors are provided from the keyboard PCB 31 to the remainder of the components. Output from the chip and processor are fed to the display.

A clock circuit 42 for the chip, and also possibly for the pulse generator 38 if required, is connected to the chip 40.

A first voltage regulator 43 provides a regulated nominal 3 volts to the processor 41, and a second voltage regulator 44 provides a regulated 5 volt supply. The communications link 10 (see Fig. 1) is connected into the remainder of the circuitry.

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At switch-on, the gauge will automatically revert to the mode of operation and display at the time of switch-off, including values of present tolerance +/-.

If it is the first switch-on after battery insertion, 05 this mode will be standard, and the display will directly indicate displacement, from zero position, with upward movement of the spindle regarded as "positive". The gauge is automatically re-zeroed at switch-on.

10 The zero or 'datum point' of the gauge can be repositioned by resting the spindle on a datum plane and pressing the zero/reset key. The display will zero, if in 'standard mode', and max/min will both assume displayed value.

15 The direction which the gauge regards as "positive" displacement can be changed by pressing the arrowed key. This also reverses the polarity of displacement from zero position, i.e. in "standard mode" it changes the polarity of the displayed figure.

20 The arrow flag on the display reverses. However, pressing the arrowed key does not change the values stored in maximum/minimum, preset, or tolerance +/-.

The units can be changed from metric to imperial or vice versa by pressing the inch/mm key for change 25 of unit of the display, and the appropriate unit flag (inch/mm) appears. All the values held in maximum/

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minimum, tolerance +/- or preset memories, as well as the displayed value, are converted to the new unit.

The display may be changed from high to low resolution units and vice versa by pressing the
05 resolution key for change of resolution into either imperial or metric units:

A diameter value may be displayed while reading a radius by pressing the diameter key. The displayed value is doubled and the diameter flag appears.
10 Memory values of tolerance +/- preset, and maximum/minimum are not affected but are used for calculation of display value before it is doubled, i.e. tolerance +/- modes causes "hi", "lo" and "pass" flags to appear at the same positions of the spindle
15 whether in "Diameter" or not.

A preset value may be set and a preset mode entered, providing a "set" flag is not displayed, by pressing the preset key to enter "set preset" mode. The "set" flag will appear on the display, along with
20 "preset" flag flashing, and the value presently held in the preset memory is then displayed. This figure can then be adjusted with the inc/dec. and +/- keys to reach a desired value for preset. The figure is then set into the preset memory and the preset mode entered
25 by re-pressing the preset key. The preset mode is shown by the "set" flag disappearing and the "preset" flag becoming steady.

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If a unit of measure is changed while setting, conversion of a set figure is not carried out. However, if a unit is changed while not in "set", preset, and tolerance +/-, the memory figure is
05 converted.

A tolerance + value can be set, and a tolerance + mode entered by using a similar process to the last described above, except that once the tolerance + mode is entered, the display shows "hi" or "pass" depending
10 on the position of the spindle and the tolerance + value set.

A tolerance - value may be set and a tolerance - mode entered using a similar process to that described in the preceding paragraph.

15 A tolerance +/- or preset mode may be exited by selecting which mode is to be exited and pressing the appropriate key, i.e. Tol +/- or "preset". "Set" appears and the selected mode flag flashes as when setting. Upon pressing the "mode off" key, the "set"
20 and selected mode flag disappear and operation of the device reverts to the modes left selected.

A maximum or minimum value may be viewed from within any mode. Pressing the maximum or minimum key causes the "Max" flag or "min" flag to appear and the
25 display to show the value of maximum or minimum excursion of the spindle since the maximum or minimum

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memory was last reset or the device zeroed.

A maximum or minimum viewing mode may be exited and, while viewing maximum, the previous display mode may be restored by re-pressing the "max" key.

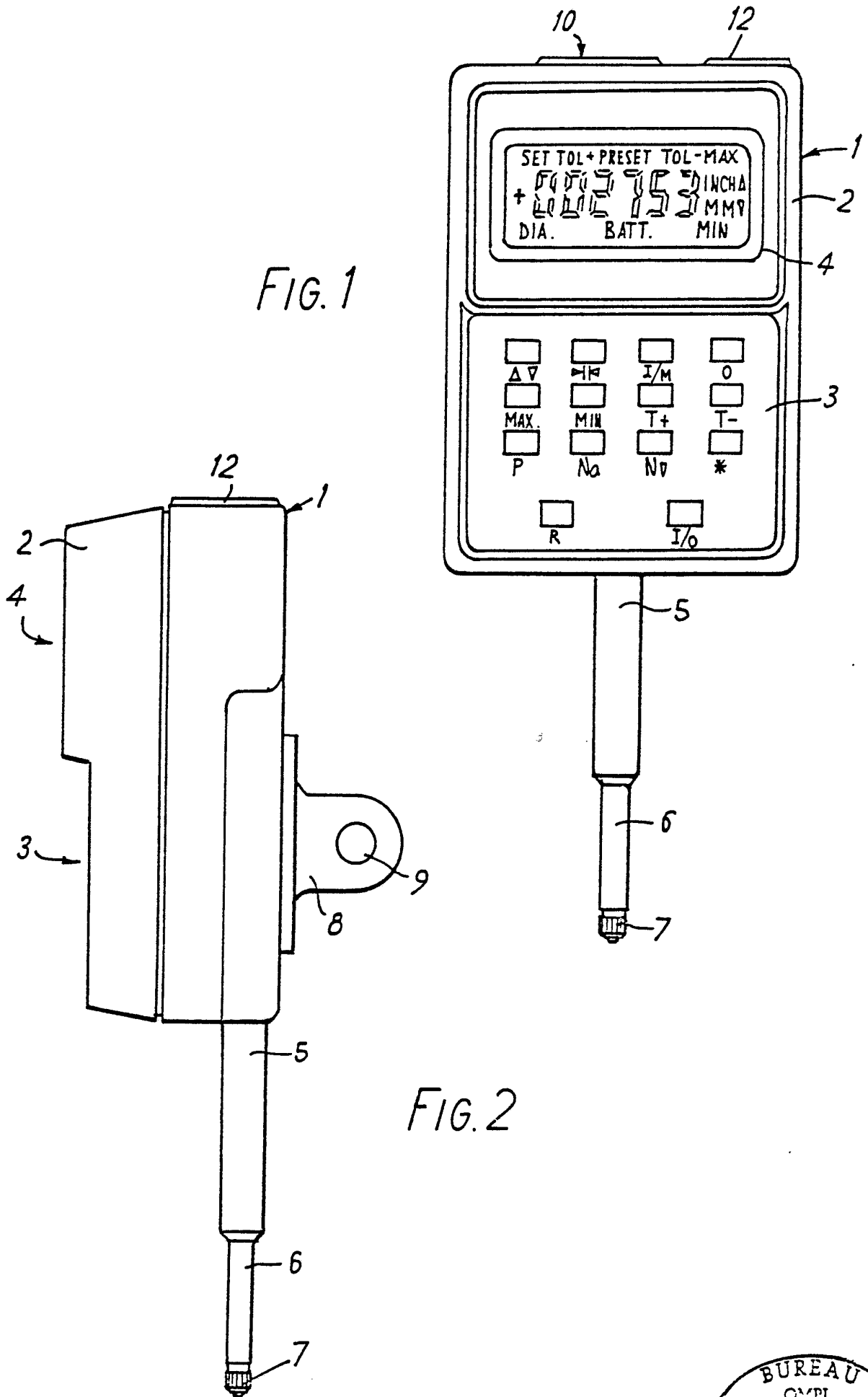
05 Alternatively, the "mode off" key may be pressed to achieve the same result, and similarly for minimum. When viewing maximum, minimum may be viewed by pressing the minimum key, and vice versa.

A maximum or minimum value may be reset, e.g.
10 maximum may be reset to a current displayed value by pressing zero/reset whilst viewing the maximum value. This process clears any previous storage of a maximum value, and similarly for minimum value. It does not affect "zero" position.

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CLAIMS

1. A dimension gauge comprising, in combination, means for producing, by Moire fringe effect, a
05 countable output related to relative movement of two gauge elements, microprocessor circuitry receiving the countable output, said circuitry including counter means for counting the output, numeric modifying means for modifying the counted output, and memory means
10 capable of storing and providing access to stored counts and inserted values and/or instructions, and a visual display means driven by the microprocessor circuitry.
2. A dimension gauge, as claimed in claim 1, wherein
15 the microprocessor circuitry includes means for the presetting of upper and/or lower limits of dimension.
3. A dimension gauge, as claimed in claim 1 or claim 2, wherein the microprocessor circuitry is arranged to permit insertion of a series of dimension ranges such
20 that, when an item is gauged, the gauge provides an indication of which range of dimensions appertains to that item.
4. A dimension gauge substantially as described herein with reference to the accompanying drawings.



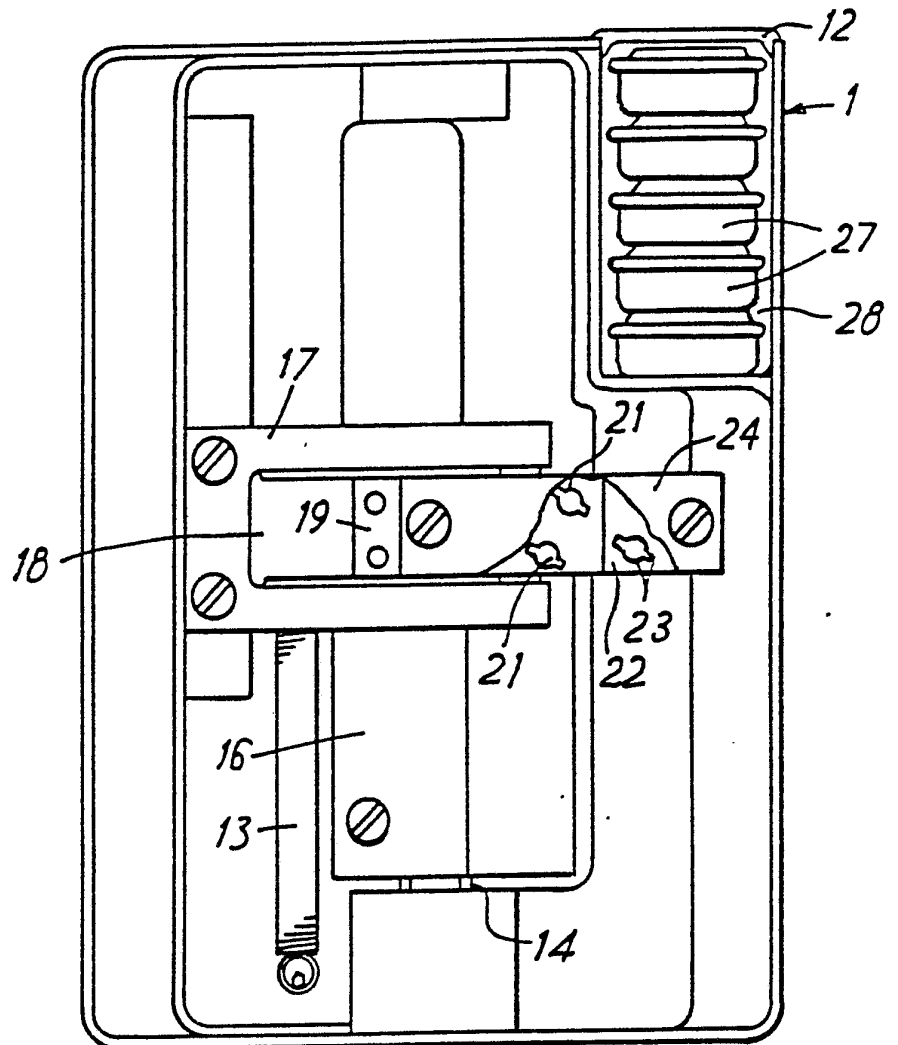


FIG. 4

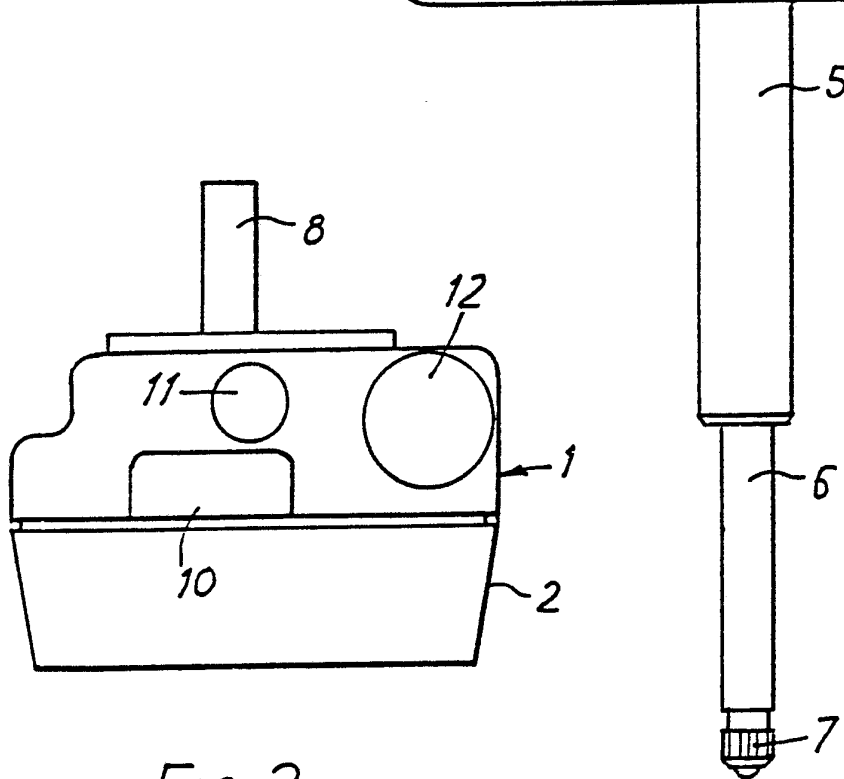


FIG. 3

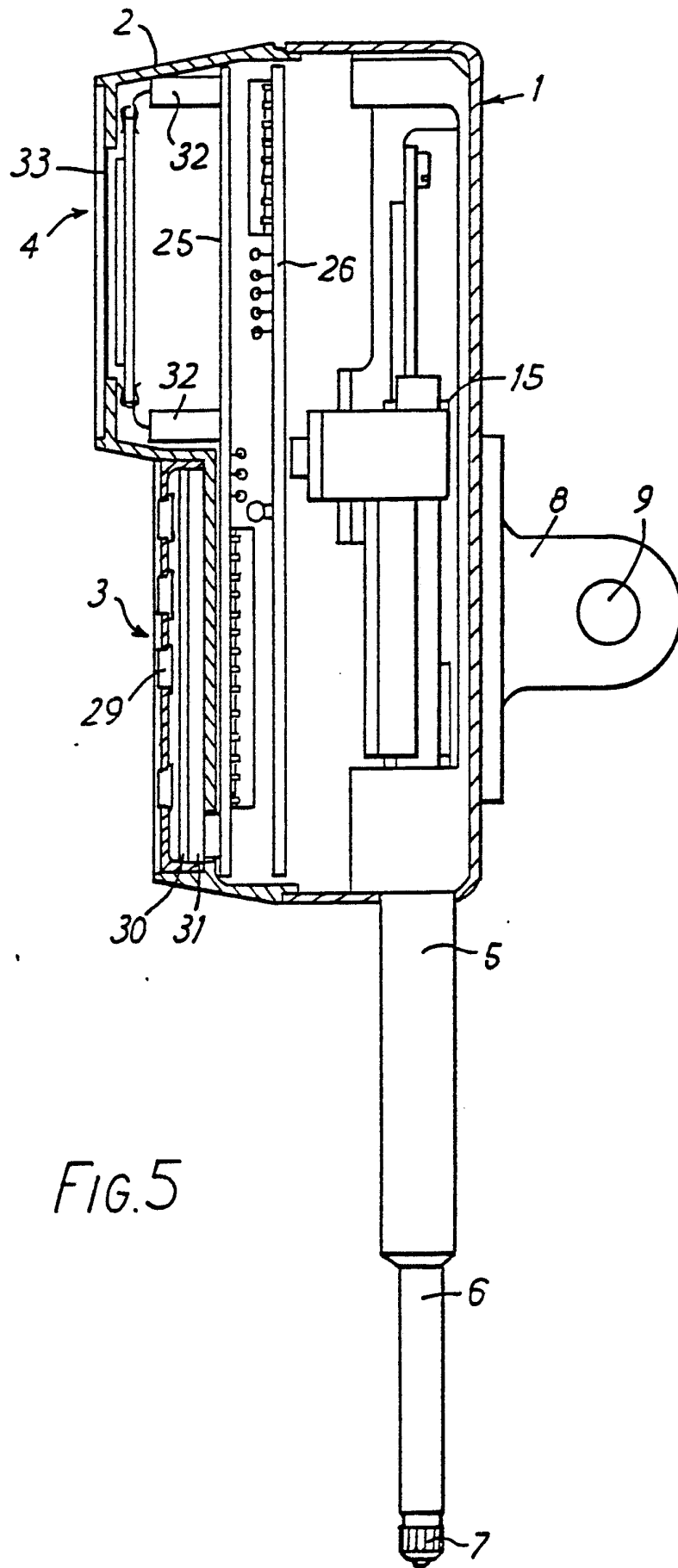
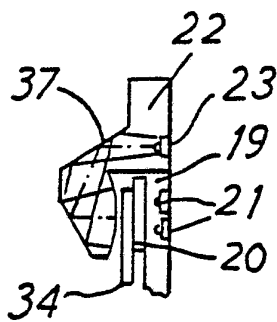
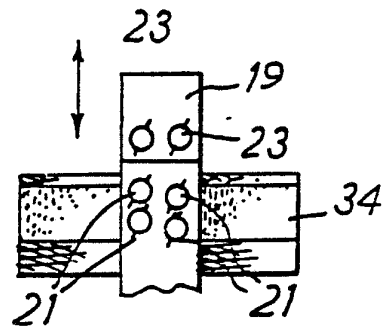
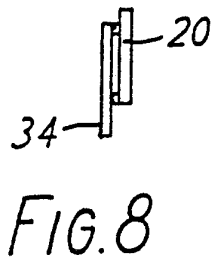
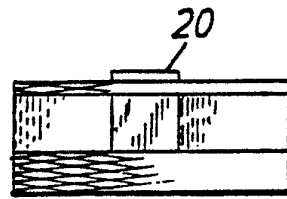
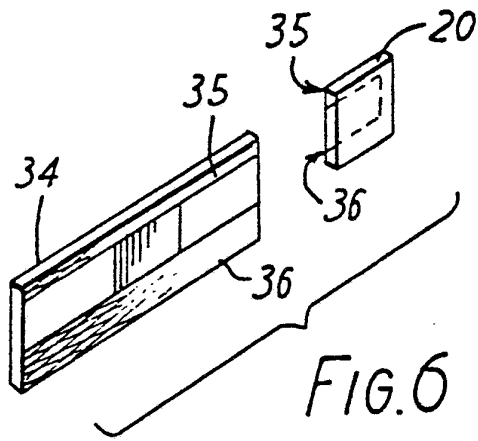


FIG. 5



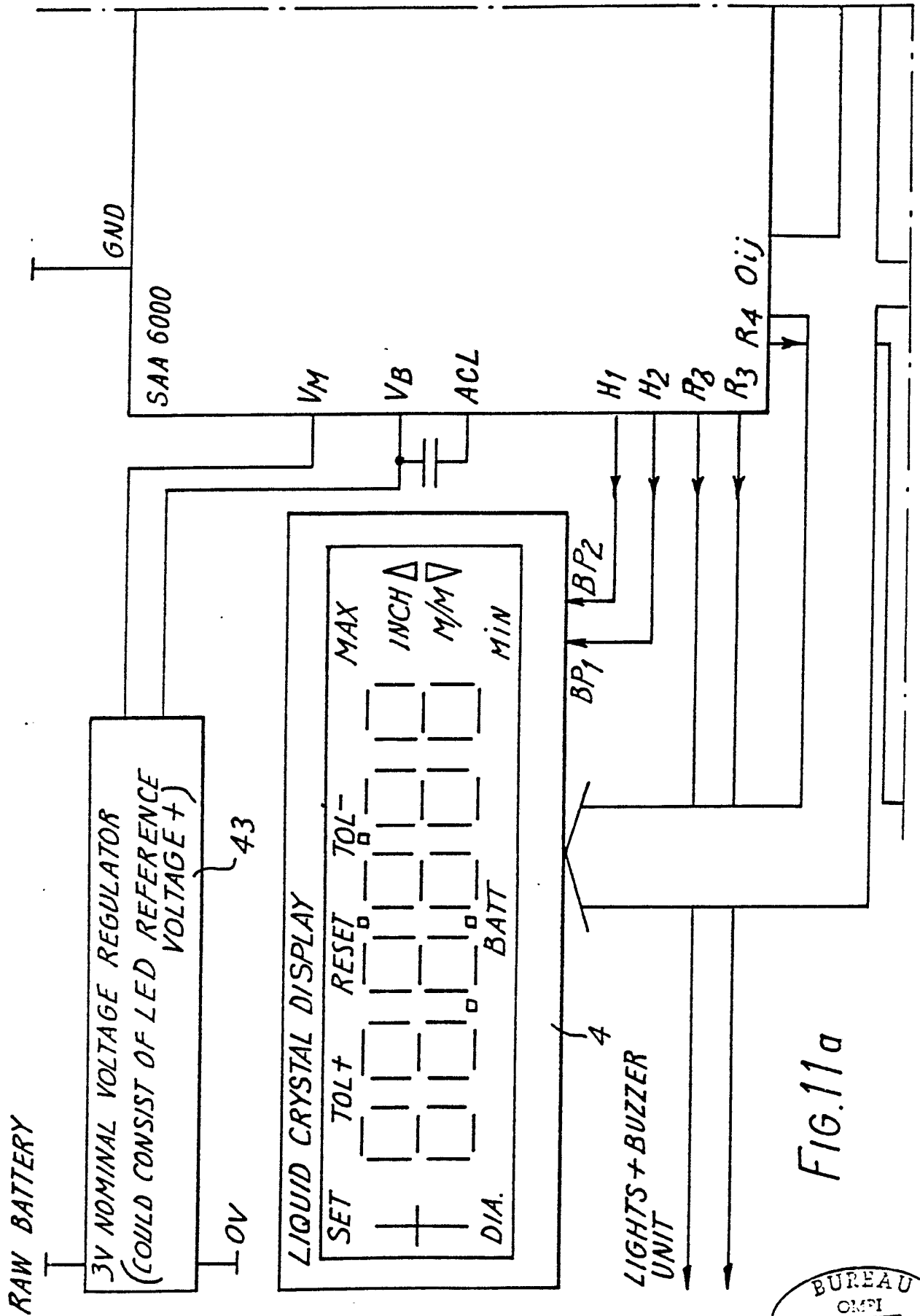


FIG.11a



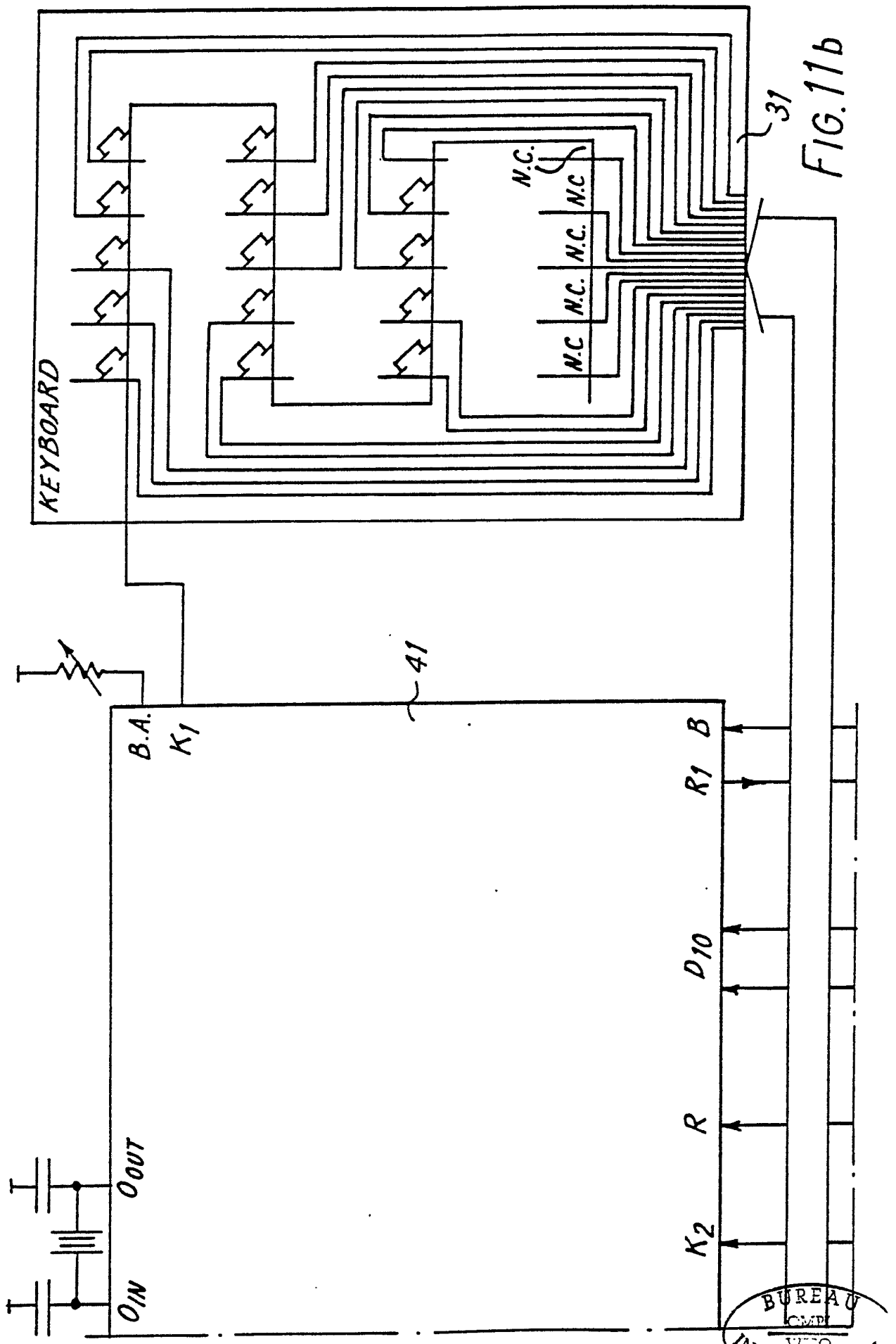


FIG. 11b

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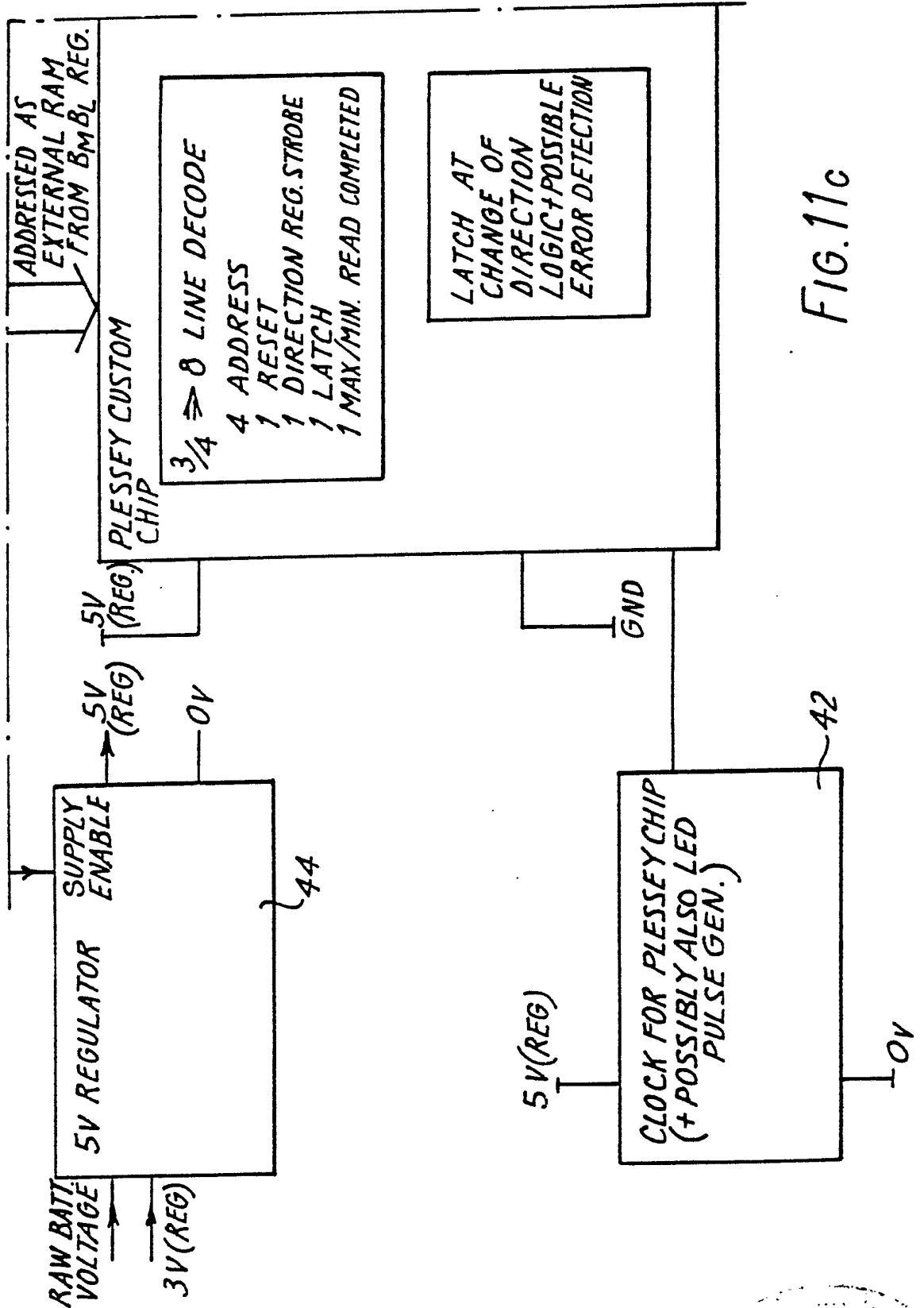
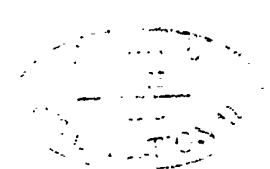


FIG. 11c



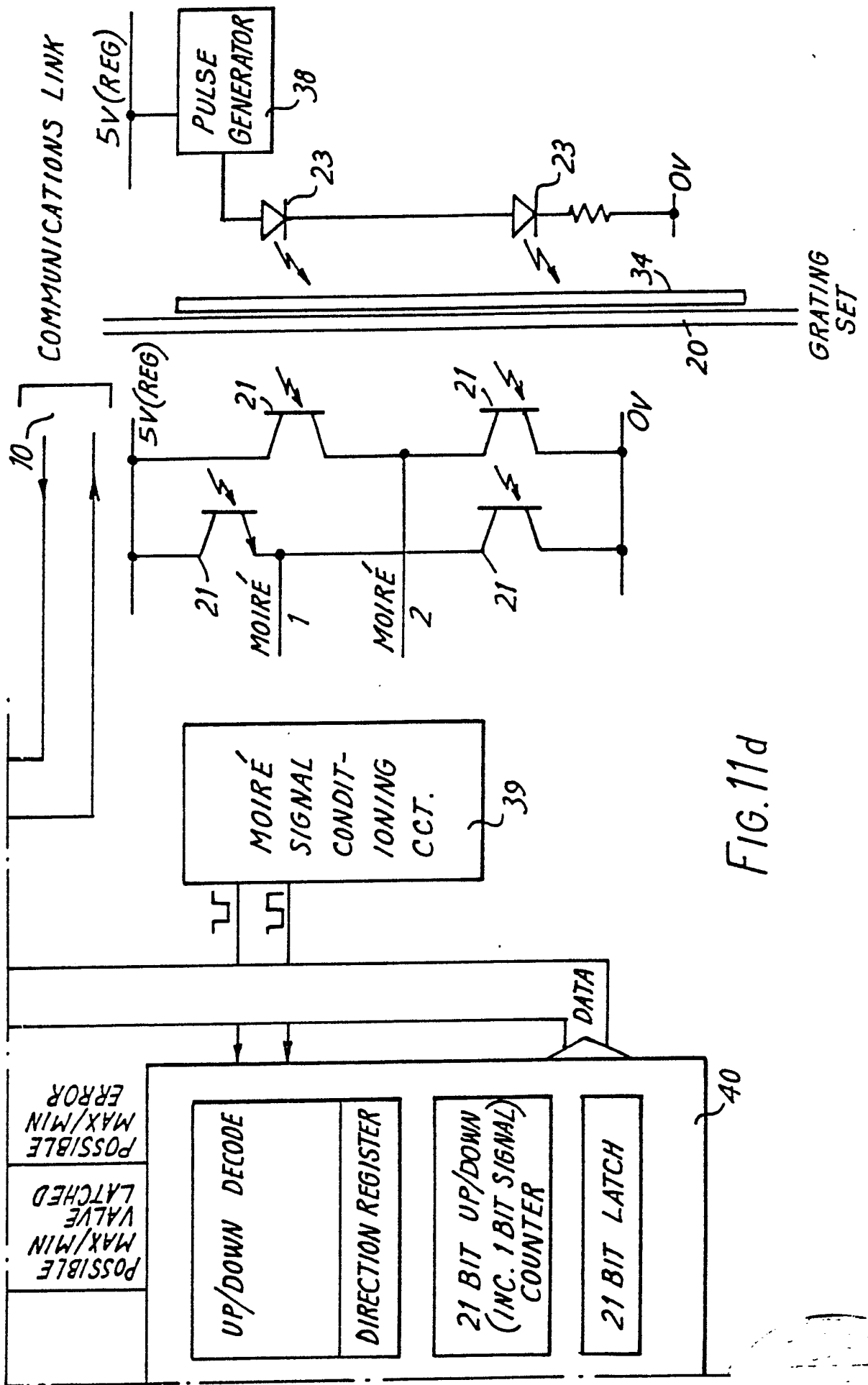
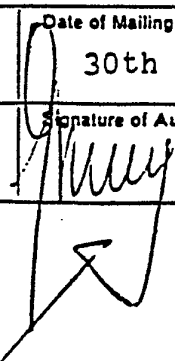


FIG. 11d

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 81/00196

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ¹				
According to International Patent Classification (IPC) or to both National Classification and IPC				
Int.Cl. ³ : G 01 B 11/00; G 01 B 3/22				
II. FIELDS SEARCHED				
Minimum Documentation Searched ⁴				
Classification System	Classification Symbols			
Int.Cl. ³ :	G 01 B 3/22; G 01 B 3/18; G 01 B 3/20; G 01 B 7/00; G 01 B 11/00; G 01 B 21/00			
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵				
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴				
Category ⁶	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸		
X	VDI-Zeitschrift, volume 122, no. 9, published May 1980 (Düsseldorf, DE), H. Becher: "Microtecnic 80", pages 347-354, see page 348, second column; figure 2 --	1,2		
X	Machinery and Production Engineering, volume 123, no. 3187, published December 19/26 1973 (Burgess Hill, GB), "Some aspects of Inspex '73", pages 812-818, see page 812, left-hand column, line 8 to right-hand column, line 9 --	1,2		
	US, A, 4114280, published September 19, 1978 see column 2, lines 15-59, D.W. Rucinski --	1,4		
	FR, A, 2390706, published December 8, 1978 see page 7, line 6 to page 8, line 32; Team-Technik Gesellschaft für Entwicklung und Vertrieb von Maschinen und Anlagen m.b.H. --	1		
	US, A, 4181959, published January 1, 1980 see page 1, abstract and figures, I. Tateishi -----	1		
<p>¹⁵ Special categories of cited documents:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> </td> <td style="width: 50%; border: none;"> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p> </td> </tr> </table>			<p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p>	<p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p>
<p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p>	<p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p>			
IV. CERTIFICATION				
Date of the Actual Completion of the International Search ¹⁹	Date of Mailing of this International Search Report ²⁰			
9th December 1981	30th December 1981			
International Searching Authority ¹ EUROPEAN PATENT OFFICE Branch at The Hague P.O.Box 5818 Patentlaan, 2 2280 HV RIJSWIJK (ZH) The Netherlands	Signature of Authorized Officer ²⁰  G.L.M. Kruidenberg			