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(54) Binary displays.

(57) Apparatus is disclosed for displaying a measure of time in binary notation. Various examples of the apparatus are disclosed, each example comprising arrays (100,102,104,106) of graphic symbols each of which can be switched between two states one of which is perceived as different from the other. Thus for example the graphic symbols may be switched from being visible to invisible; or otherwise altered. Further, in order to establish the place-value of a graphic symbol in an array, a graphic indicium may be provided or this may be established by the location of the graphic symbol in the apparatus as a whole. Similar apparatus with symbols other than visible symbols is suggested.

Table 2

LH			RH	
\	8		\	1
—	16		—	2
∩	24		∩	3
/	32		/	4
^	40		^	5
∠	48		∠	6
△	56		△	7

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"BINARY DISPLAYS"

This invention relates to binary numbers and has particular application to such numbers providing a measure of time. Such numbers include the time of day (i.e. seconds, minutes or hours), the day of the week, the day of the month, the month of the year, the season of the year and the year itself.

The development of electronic computers has brought to prominence in that field the binary system of expressing numbers. The nature of the binary system is well understood by those skilled in the art and will not be discussed in detail here. The binary system has, however, not yet come into wide use by the public for displaying numbers. One reason for this is probably that the general public lacks familiarity with the binary system. US patent #3750384 to Miller and Verbel discloses a clock displaying the time in binary notation by means of arrays of simple lights. Furthermore, in the apparatus of USP #3750384, each array of lights is identified by means of the words "hours", "minutes", etc. and also the figures "1", "2", etc. It is considered that the utility of this apparatus in assisting the learning of binary is considerably diminished by these characteristics.

It is thought that the apparatus of the present invention will help in educating the public to be more familiar with binary notation and it is one object of the invention to provide a clock or calendar which provides a measure of time in binary by means of a display which will be sufficiently attractive and interesting to induce a user to learn binary.

SUMMARY OF THE INVENTION

According to the invention there is provided apparatus for expressing a measure of time in binary notation, the apparatus including at least one array comprising at least three graphic displays perceivable each as having a place-value in the binary system, timing means for generating signals at regular time intervals and means responsive to the signals to alter or reorientate each graphic display or to cause each graphic display to move or disappear so that it is thereby perceived in one of two alternate states and hence the or each said array is caused to indicate a binary number representing one of the following namely seconds, minutes, hours, weekdays, monthdays, months, seasons or years.

In one form of the invention, each graphic display is elongate and the graphic displays in an array are disposed so as to make up at least one

geometrical figure. In one aspect at least three of the displays in an array are disposed so as to make up a triangle. In an alternative form of the invention, the graphic displays in each said array are similar one to the other but different to the graphic displays in the other said arrays. In one aspect the displays are of pictorial form. In another aspect, all of the graphic displays are substantially similar one to the other.

Further according to the invention, the apparatus includes means for marking the location of each graphic display in its array.

According to an important aspect of the invention each location in one array is aligned with a location another said array and the means for marking the aligned locations is common to the said arrays. Advantageously, the means for marking the said location comprises a graphic indicium of pictorial form.

In another form of the invention, the graphic displays in each said array are different one from the other. In one aspect the graphic displays in each array are also different from the displays in the other array.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further discussed with reference to the accompanying illustrations, in which

Figure 1 shows two groups of three graphic displays, each group forming what is seen as a triangle;

Figure 2 is a somewhat schematic view of the face of a watch incorporating groups of the graphic displays shown in Figure 1;

Figure 3 is a view of the face shown in Figure 2, with some of the graphic displays in the invisible state;

Figure 4 is a similarly schematic view of a clock face displaying more groups of graphic displays;

Figure 5 is a view of a clock incorporating yet another arrangement of graphic displays;

Figures 6 and 7, 8 to 12, 13 and 14, 15 and 16, 17, 18, 19, 20, 21 and 22 which all show groups of alternative graphic displays constituting clocks and/or calendars.

As used in this specification and the claims, the term 'graphic' includes such matter as can be perceived by the sense of touch in the case of, for example, a blind person.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS

Referring first to Figure 1 there are shown two groups of three symbols labelled 1, 2 and 4 (in the first or right hand group) and 8, 16 and 32 (in the second or left hand group). The symbols represent in the present case two groups of three LCD (liquid crystal display) elements, the elements in each group being arranged in the pattern of equilateral triangle. However, the symbols could represent a wide variety of alternative elements such as fluorescent light tubes or rib-like protuberances in a flat surface. Whatever form the elements take they should have the characteristic that they must be able to take two forms which can be distinguished one from another by one of the human senses. Thus in the case of LCDs, in the energised form each element can be seen but when not energised it cannot be seen. Other visible elements might, for example be a certain colour in one form and another colour in the second form. Where the elements are to be perceived by the sense of touch, they might in one form be raised above the surrounding surface and in the second form be retracted flush with the surface.

In the present example, each LCD element can be seen not only as being 'on' or 'off' but also as being disposed in one of three orientations in either triangle. Thus a person who is familiar with the array shown in Figure 1 can even though there is no other frame of reference, by its orientation, assign a value to any one of the LCD elements which is 'on' even though all the others may be 'off'.

Thus a person observing the LCD element labelled 1 switched 'on' with all the other switched 'off' will, initially by calculation and soon afterwards by rote, know that it represents the decimal number 1 and occupies the right-handmost column in a binary array. Similarly, each LCD element labelled 2, 4, 8, 16 and 32, switched 'on' with all the others 'off' will always represent the decimal numbers 2, 4, 8, 16 and 32 respectively and occupy the 2nd, 3rd, 4th, 5th and 6th from right hand columns in the binary array. Moreover, groups of the elements switched 'on' can be read as other decimal numbers. In the Table 1, all permutations for switching the six LCD element shown in Figure 1 are shown in the centre of each column; 'on' is indicated by a black line and 'off' is indicated by a blank. At the right of each column the decimal equivalent of each permutation and at the left of each column the equivalent thereof in conventional binary is given.

Missing from the above table are the permutations of elements representing the decimal numbers 61, 62 and 63. For the purposes of the

present examples, these are of no importance.

Simplified information from Table 1 is given in Table 2 in which in the right hand column the permutations of the LCD elements 1, 2 and 4 making up the group in right hand triangle are given together with the decimal value equivalent of each; and similarly in the left hand column the permutations of the elements 8, 16 and 32 are given together with the decimal value equivalents thereof. It will perhaps be somewhat clearer from Table 2 that any (decimal) number between 0 and 63 can be obtained by adding a decimal number from the left hand column to a number in the right hand column, it being assumed of course that the number 0 is represented by all of the elements in both triangles being 'off'. Any decimal number so arrived at is represented by placing together the equivalent permutation of LCDs in each column.

Figure 3 shows how four arrays of graphic displays of the type shown in Figure 1 can be grouped on the face of a wristwatch or clock. The upper array 100 in this example represents the hour of the day (in decimal from 0 to 24). The next array 102 represents the minute of the hour (in decimal from 0 to 59). The next array 104 represents the second of the minute (again from 0 to 59 in decimal). The lower array 106 represents the day of the month (in decimal from 1 to 31). It is necessary to provide a timing device (clock) and electronic circuitry to cause the LCD elements in the four arrays to switch on and off as appropriate. The design and construction of such circuitry (as indeed the circuitry for all the exemplary devices described herein) will be well within the capability of the skilled addressee and will not be described here.

Figure 3 shows, by way of example, what would be seen on the watch face when the watch registers the time to be 12.24 and 48 seconds on the 6th day of the month.

In Figure 4, a clock face is shown containing four arrays of graphic displays of the type illustrated in Figure 1 and one array comprising three LCD elements only. The arrays 110, 112 and 114 on the left hand side represent respectively the hour, minute and second of the day. The array 116 on the right hand side, comprising three elements only, represents the day of the week. The reason for this is that three elements are sufficient to cover the group of numbers from 1 to 7 inclusive. The second array 118 on the right hand side represents the day of the month.

In Figure 5, the clock face contains an upper array for the day of the week, a middle array for the month of the year and a lower array for the day of the month.

Figures 6 and 7 show a design for the face of a pictorial calendar clock. In this case the graphic

displays are again made up of LCD elements LCDs but these are shaped to represent simple objects being in the example clouds, birds, sailing boats and fishes. It will be observed that there are five clouds 120, six birds 122, four sailing boats 124 and six fishes 126. The position of the element in its row is in this case significant but since each element becomes invisible when it is 'off' thereby becoming ineffective as a frame or reference it is useful to provide another frame of reference or indicium. This other frame of reference is constituted by the illustration of waves. It will be noted that there are six wave crests 128. A fish is located below each crest and one sailing boat, bird and cloud are located above each crest. The waves are in permanent depiction. They may be painted on the screen forming the front of the clock or they may be in the form of an LCD element which is permanently 'on'. In any case the observer can easily judge from the waves the position of any of the elements in any of the rows. The clouds represent the day of the month, the birds represent the minute of the hour, the sailing boats represent the hour of the day and the fishes represent the second of the minute. In Figure 6 all of the elements are shown as being 'on', a situation which would not in practice occur. It is shown by way of explanation only. Figure 7 shows an example of a real time situation and according to the example it is thirty five minutes and three seconds past ten on the twentieth day of the month.

Figures 8 to 12 show a similar arrangement for a calendar where there are four cloud elements for the month of the year and five bird elements for the day of the month. The branch 140 with its thorns is in permanent depiction and is the frame of reference. In addition, there is a twig 142 depicted in LCD elements comprising (as can be seen in Figure 8) a blossom 144 (used to indicate the spring), two fresh leaves with a berry 146 (used to indicate the summer), and two dried leaves 148 (for the autumn). The winter is indicated by the twig without any leaves, the blossom or the berry. The calendar is intended for use in the northern hemisphere.

The entire set of LCD elements is shown in Figure 8 as being 'on', a situation which would not ordinarily occur. In Figure 9 the calendar shows that it is winter and the date is January 31. In Figure 10, it is summer and the date is July 18. It is spring and the date is May 2 in Figure 11; and in Figure 12 it is October 21 in the autumn.

Figures 13 and 14 show a calendar which might appeal to a child. Here there is an upper row of four candy jars 150 and a lower row of five candy jars 152. The jars, being in permanent depiction, are the frame of reference. The LCD elements representing the candies are present or ab-

sent to indicate numbers. The upper row represents the month of the year and the lower row represents the day of the month. In Figure 14 it is July 22.

5 In Figures 15 and 16 the wigwams 160 are in permanent depiction and provide the frame of reference. The trees 162 are merely for decoration. The smoke columns indicate the month of the year and the warriors indicate the day of the month. In 10 Figure 16 it is March 14.

Figure 17 depicts an alternative design for a watch face. The four LCD elements 170 in the column on the left indicate the hour of the day and the six elements 172 in the column on the right 15 indicate the minute of the hour. The frame of reference is the thin vertical line 174 between the columns intersected by the horizontal cross lines. The diamonds 176 below the left hand column would beat out the seconds.

20 Figure 18 shows an elongate clock with four arrays of squares separated by diamonds 180. The right hand array of six squares represents seconds; the second from right array, also of six squares, represents minutes; the second from left array of four squares represents hours; and the left hand 25 array of five squares represents the date. An optional indicium for identifying the place value of each square in an array is constituted by a dot in the centre of each square.

30 Figure 19 shows a clock with an elliptical face and having four arrays of squares arranged in similar fashion to those shown in the clock of Figure 17. There are four squares in row 184 (all being visible); six squares in row 186 (three of 35 which squares are visible); six squares in row 188 (three of which again are visible); and four squares in row 189 (one square being visible).

In yet another example, one or more arrays are provided, each array comprising a number of elements which are again perceived as graphic symbols distinguishable one from another by their form. Consider for example an array of six elements in the form of the letters I, F, O, Z, A and X. 40 If these letters were put together in the order given in an apparatus such as, for example, a time piece or calendar they would if they were all visible at the same time be seen as the word IFOZAX. A user could soon learn furthermore that the letter X always occupies the right hand position, the letter A 45 always occupies the second from right hand position, and so on the letter I always occupying the sixth from right hand (i.e. in fact the left hand) position. Also the user could soon learn that any group of letters seen together represents a specific number in binary and also in decimal. For example, 50 the letters AX seen by themselves represent 000011 in binary and thus 3 in decimal; the letters FZX seen by themselves represent 010101 in bi-

nary and thus 21 in decimal; and so on. It is important that the letters in the array are different from one another. It should also be clear that it is not necessary that letters be used; the widest variety of graphic symbols may be used as long as the symbols in any array are different from one another. Letters are however useful as any combination will come to be read as a quasi-word rather than as individual letters especially if they are carefully chosen. It is considered that the letters making up the array IFOZAX are for this reason a good combination especially as when read as a word they have an attractive quality.

It is contemplated that a clock will include, say, three or four arrays comprising the word IFOZAX, although the arrays representing hours and the date respectively might only comprise the words OZAX and FOXAX; i.e. subsets of the six letters. In this way users who have sufficient familiarity with the clock will cease to think of the time in decimal number terms but rather in terms of words and subwords in the same way as 12.00 o'clock is thought of as 'noon' or 'midnight'.

Figure 20 shows an example of a clock using the words IFOZAX, OZAX and FOXAX.

Other examples of arrays of letters are EZOPIA, OFZLIA, UFOZLI and SETOYA.

Figure 21 shows an example of a clock with two arrays of pictorial symbols, the upper array representing hours and the lower array representing minutes. In this case all of the symbols are different one from the other and the user will need to learn the place-value in each array which each symbol has.

In yet another example, the graphic displays could be arranged to be switched from a state in which they are still to a state in which they are perceived to be in motion. For example, the birds in Figures 6 and 7 could be arranged to be perceived as still or alternatively flapping their wings. This would have the advantage that the birds themselves would also serve as a frame of reference for establishing the place value of the other graphic displays.

The purpose of Figure 22 is to illustrate a modification to a clock incorporating the same principles as the clocks described above. In Figure 22 the house is provided with rows of windows at different levels which indicate the time and date in the same manner as described in the other examples. The windows at the lower level shown with the blinds drawn are merely the indicia for indicating the place-value of the windows thereabove. However the clock is provided with extra displays in the form of a bat and a ghost in the doorway, shown at 190 and 192 respectively. The electronic circuit is arranged to switch the displays 190 and 192 on and off at random times for short random

periods. It is thought that this will provide a feature of added interest and excitement especially for a child. Clearly more than one array would usually have to be provided for most time pieces or calendars.

Although the examples have been shown as incorporating LCDs it is emphasized that the invention may be used with any alternative suitable form of elements able to provide graphic displays. Fibre optics might be employed whether or not of the same colour; they might for example be mounted in a bracelet or a wand. As previously suggested herein, the elements might be constituted by protuberances which are mechanically arranged to stand proud, or be retracted flush with, a surface. In a very simply form, the elements might be constituted by discs or blocks manually inserted or withdrawn from holes in a box. This would be used, not for timing, but simply to learn to perceive numbers in binary notation although the holes in the box might be grouped so as to constitute a calendar. The elements could also be in the form of advertising symbols.

It is believed that in nearly all of the examples described above of the two states taken by the graphic displays one will be instinctively perceived as 'positive' or 'on' as opposed to the other being 'negative' or 'off'. It is conceivable that in order to avoid the possibility of the binary numbers being misread, there may be cases within the scope of the invention in which the user will require instruction as to which state is 'positive' (on) and which is 'negative' (off).

It is furthermore envisaged that the numbers displayed by any of the elements as described could be assigned other meanings such as letters, characters, symbols and words of spoken languages or computer or other technical languages.

Claims

1. Apparatus for expressing a measure of time in binary notation, the apparatus being characterised in including at least one array comprising at least three graphic displays perceivable each as having a place-value in the binary system, timing means for generating signals at regular time intervals and means responsive to the signals to alter or reorientate each graphic display or to cause each graphic display to move or disappear so that it is thereby perceived in one of two alternate states and hence the or each said array is caused to indicate a binary number representing one of the following namely seconds, minutes, hours, weekdays, monthdays, months, seasons or years.

2. Apparatus according to claim 1, characterised in that it includes at least two said arrays in each of which the graphic displays are substantially similar one to the other.

3. Apparatus according to claim 2, characterised in that the graphic displays in one said array are different to those in the other said array or arrays.

4. Apparatus according to claim 1, characterised in that it includes at least two said arrays in each of which the graphic displays are substantially different one from the other.

5. Apparatus according to claim 4, characterised in that the graphic displays in one said array are different to the graphic displays in the other said array or arrays.

6. Apparatus according to claim 4, characterised in that the graphic displays in one said array are substantially similar to those in the other said array or arrays.

7. Apparatus according to any one of the preceding claims, characterised in that the graphic displays are of pictorial form.

8. Apparatus according to any one of the preceding claims, characterised in that it includes means for marking the location of each graphic display in its array.

9. Apparatus according to claim 8, characterised in that each location in one said array is aligned with a location in another said array and the means for marking the aligned locations is common to the said arrays.

10. Apparatus according to claim 8 or claim 9, characterised in that the means for marking the said location comprises a graphic indicium.

11. Apparatus according to any one of claims 8 to 10, characterised in that the means for marking the said location is of pictorial form.

12. Apparatus according to claim 2, characterised in that the graphic displays in each array form the word IFOZAX.

13. Apparatus according to claim 1, characterised in that each graphic display is elongate and the graphic displays in an array are disposed so as to make up at least one geometrical figure.

14. Apparatus according to claim 14, characterised in that the graphic displays in an array are disposed so as to make up at least one triangle.

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Table 1

000001 \ = 1	010101 — ^ = 21	101001 ^ \ = 41
000010 — = 2	010110 — / = 22	101010 ^ — = 42
000011 / = 3	010111 — Δ = 23	101011 ^ / = 43
000100 / = 4	011000 Δ = 24	101100 ^ / = 44
000101 ^ = 5	011001 Δ \ = 25	101101 ^ ^ = 45
000110 / = 6	011010 Δ — = 26	101110 ^ / = 46
000111 Δ = 7	011011 Δ / = 27	101111 ^ Δ = 47
001000 \ = 8	011100 Δ / = 28	110000 / = 48
001001 \ \ = 9	011101 Δ ^ = 29	110001 / \ = 49
001010 \ — = 10	011110 Δ / = 30	110010 / — = 50
001011 \ / = 11	011111 Δ Δ = 31	110011 / / = 51
001100 \ / = 12	100000 / = 32	110100 / / = 52
001101 \ ^ = 13	100001 / \ = 33	110101 / ^ = 53
001110 \ / = 14	100010 / — = 34	110110 / / = 54
001111 \ Δ = 15	100011 / Δ = 35	110111 / Δ = 55
010000 — = 16	100100 / / = 36	111000 Δ = 56
010001 — \ = 17	100101 / ^ = 37	111001 Δ \ = 57
010010 — — = 18	100110 / / = 38	111010 Δ — = 58
010011 — Δ = 19	100111 / Δ = 39	111011 Δ / = 59
010100 — / = 20	101000 ^ = 40	000000 (60) = 0

Table 2

LH			RH	
\	8		\	1
—	16		—	2
∟	24		∟	3
/	32		/	4
∧	40		∧	5
∠	48		∠	6
△	56		△	7

FIG.1

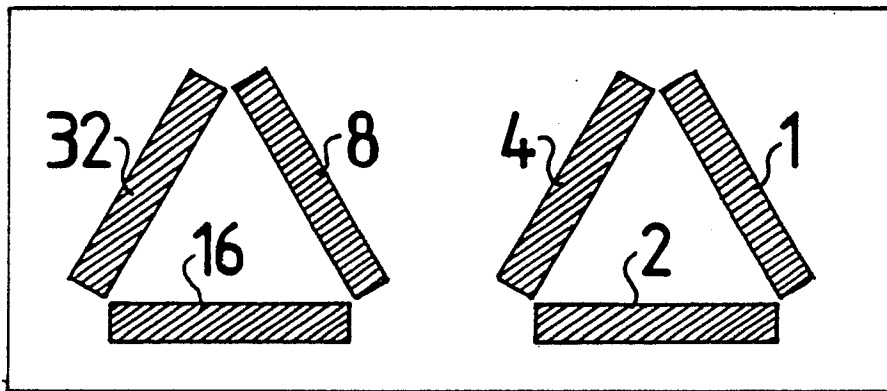


FIG.2

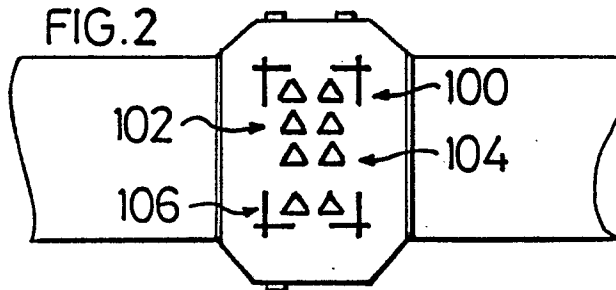


FIG.3

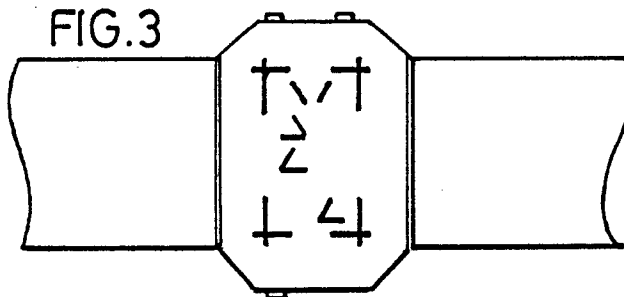


FIG.4

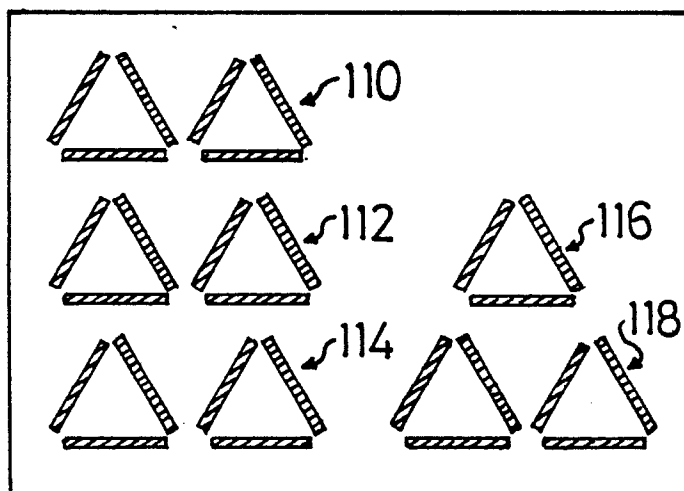


FIG. 5

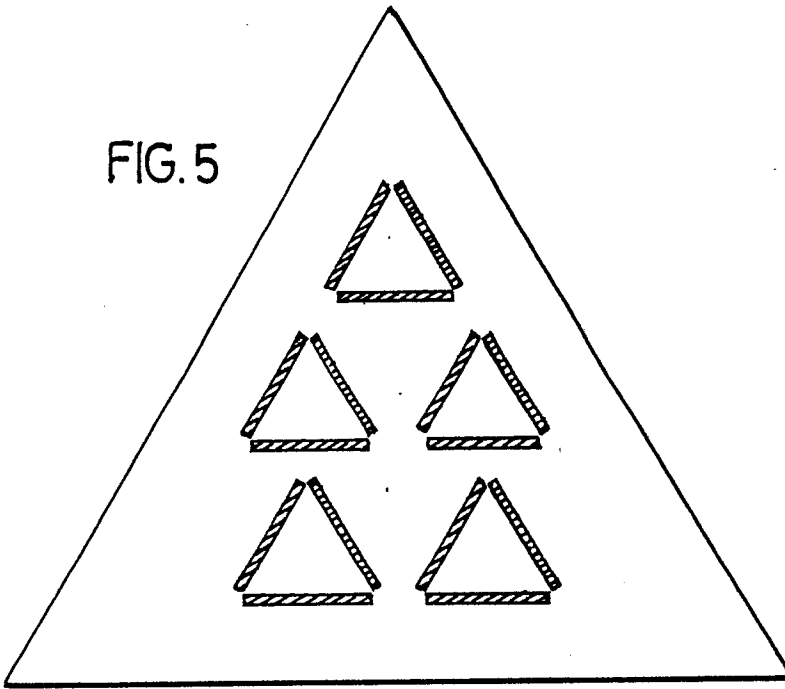


FIG. 6

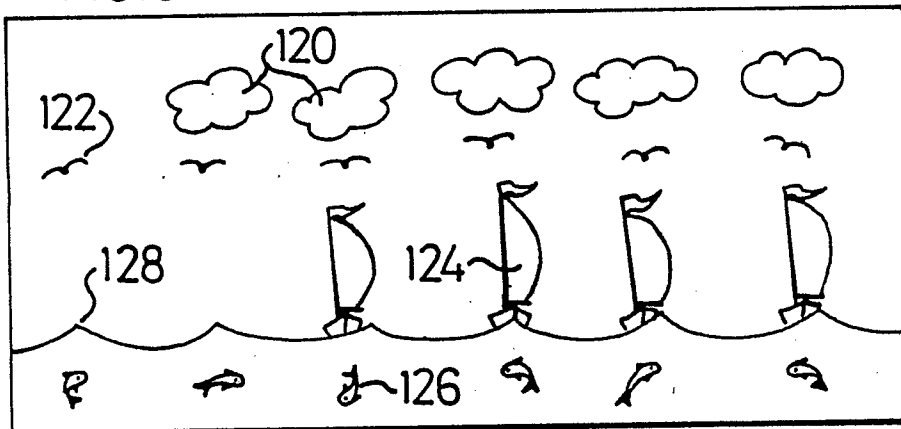


FIG. 7

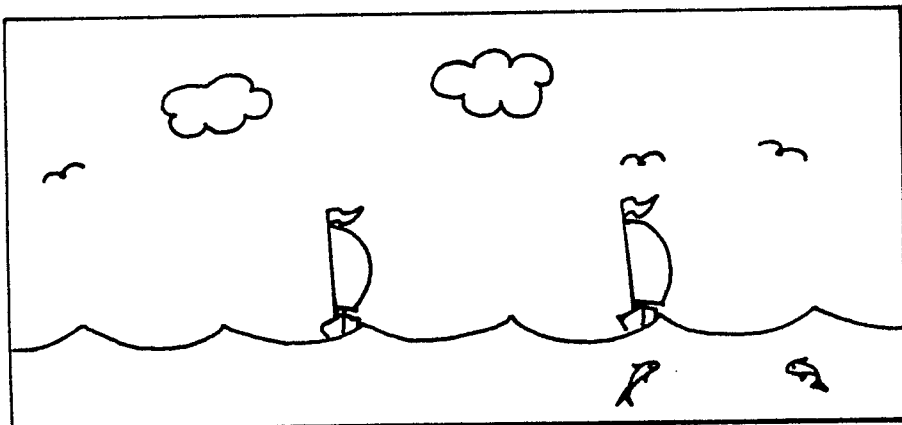


FIG.8

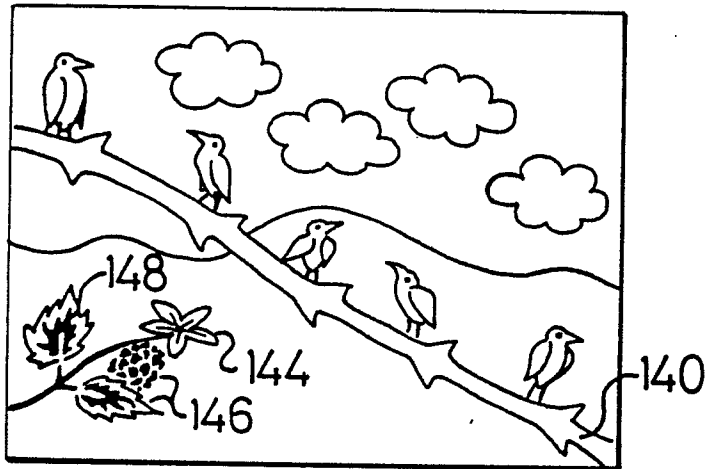


FIG.9

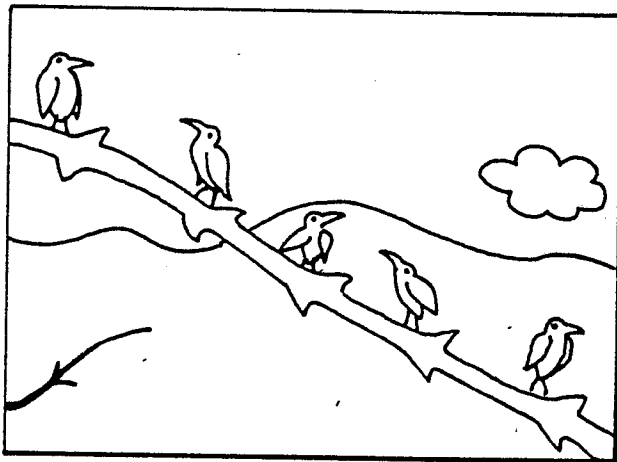


FIG.10

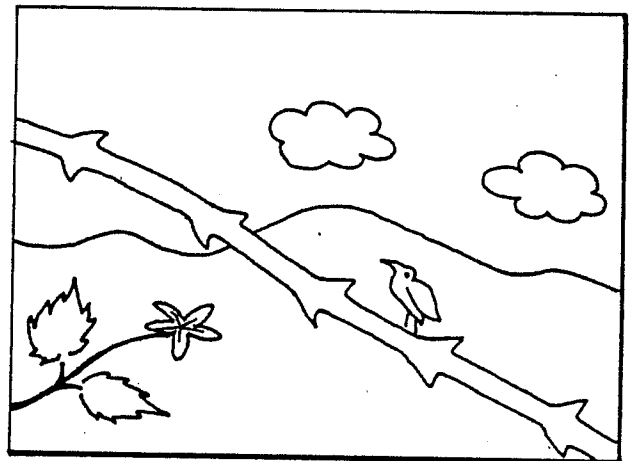


FIG.11

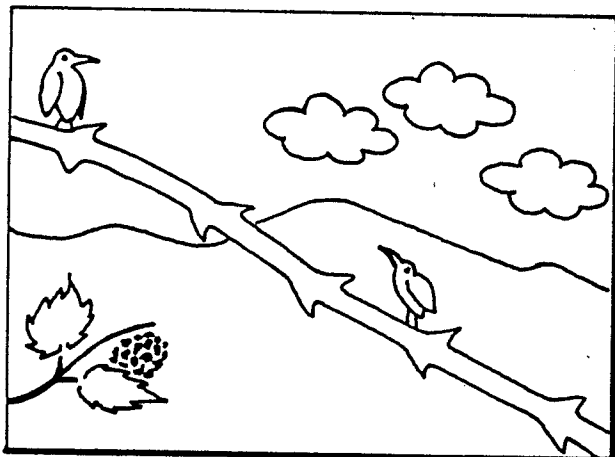


FIG.12

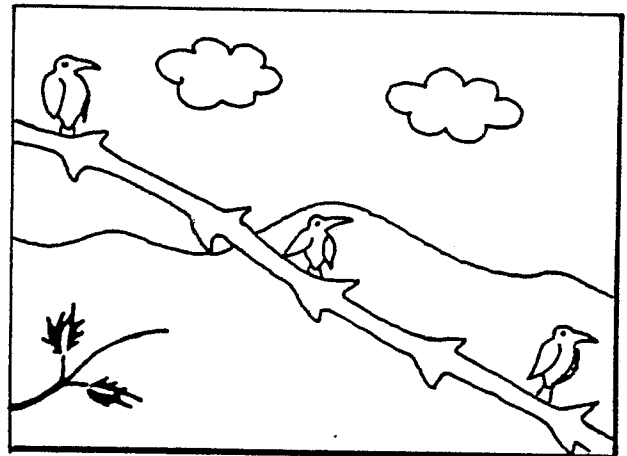


FIG. 13

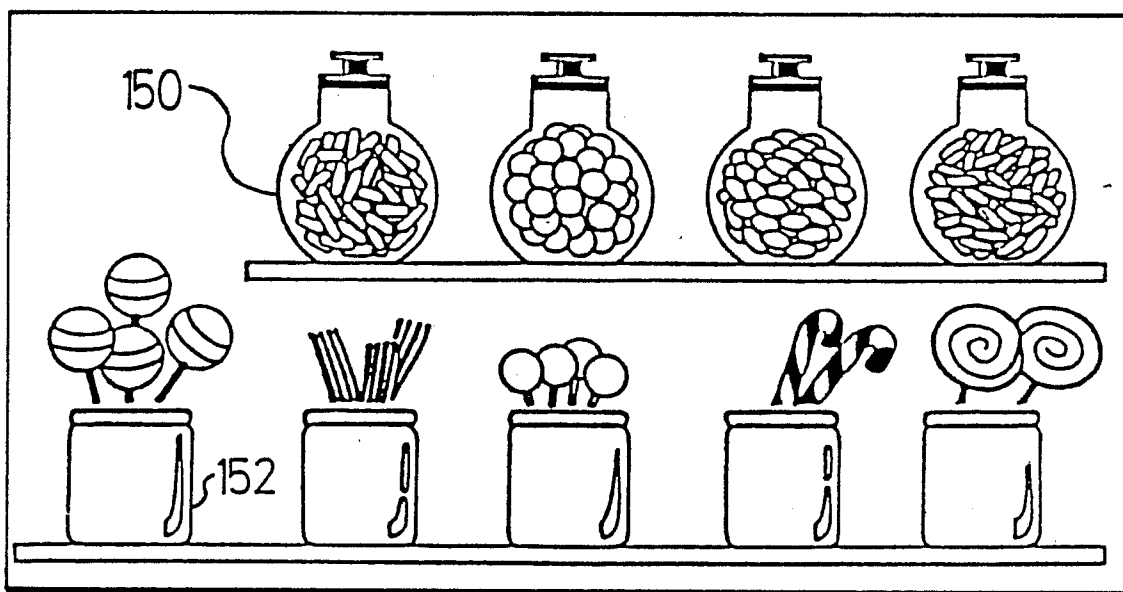


FIG. 14

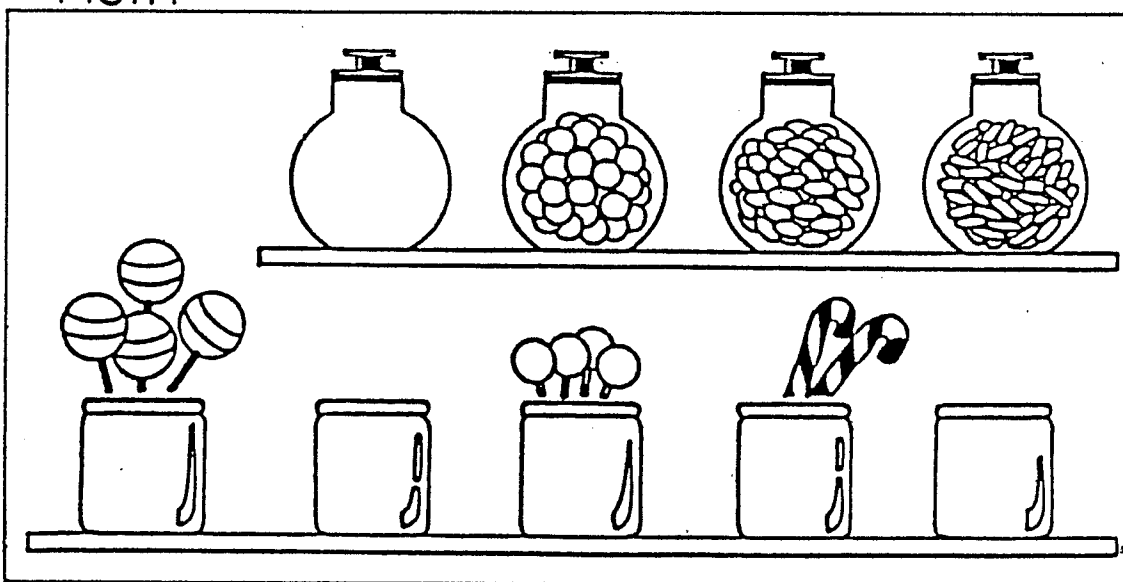


FIG. 15

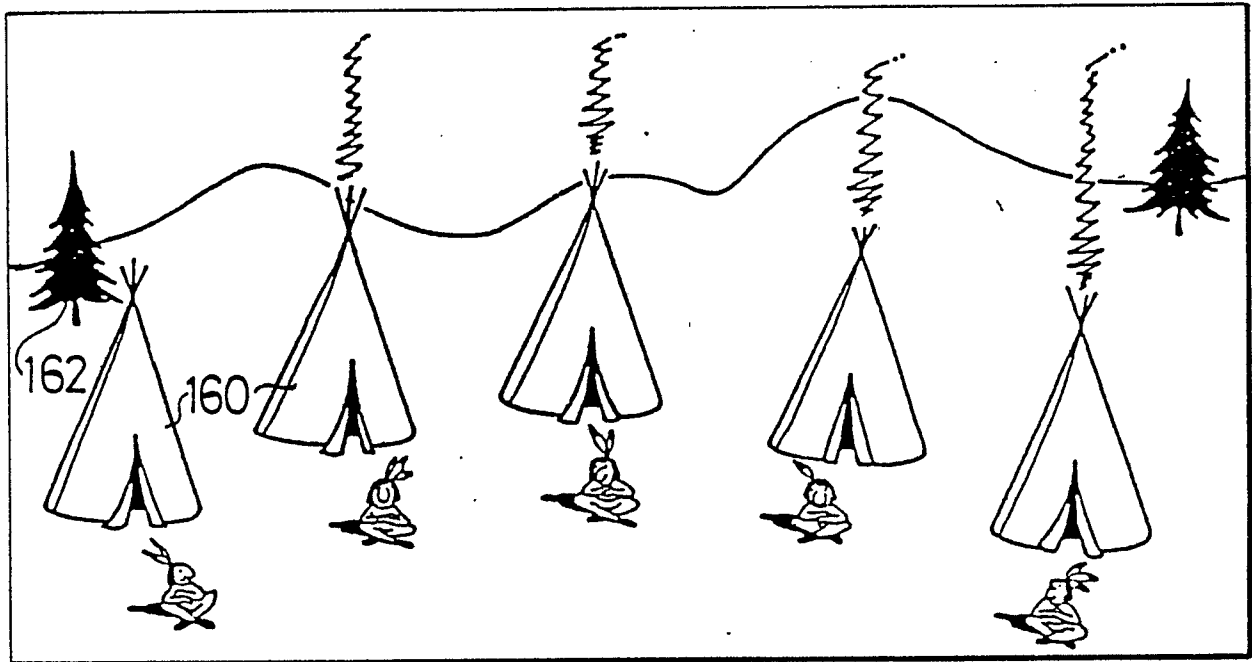


FIG. 16

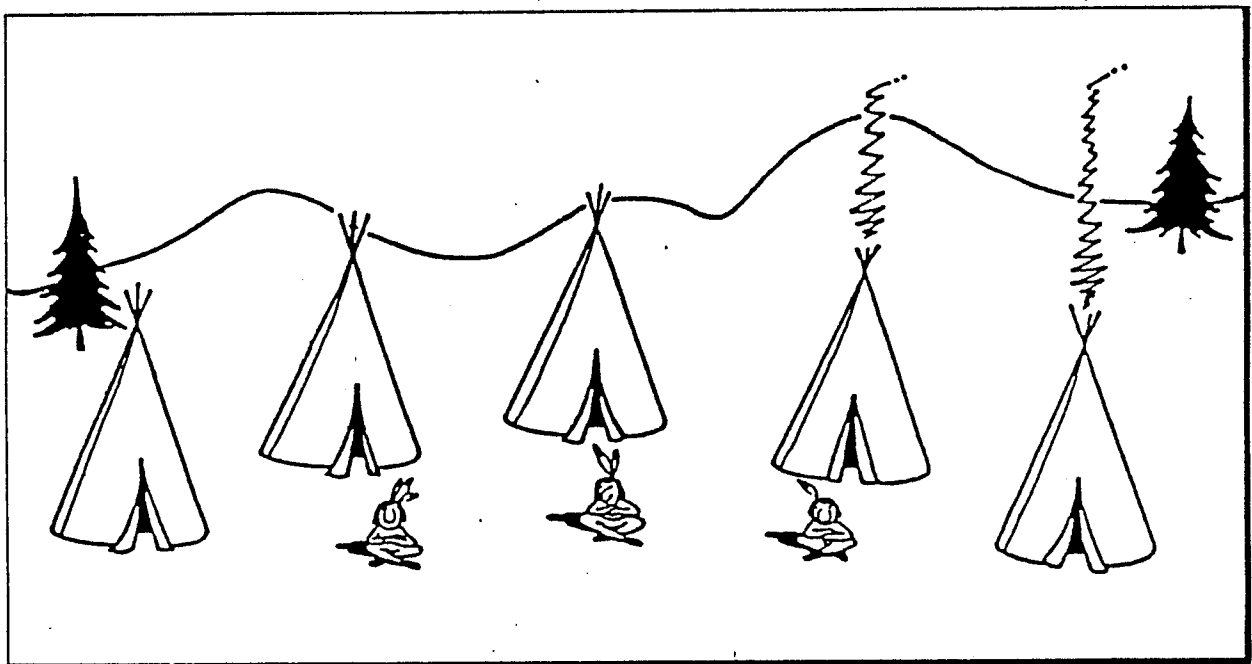


FIG. 17

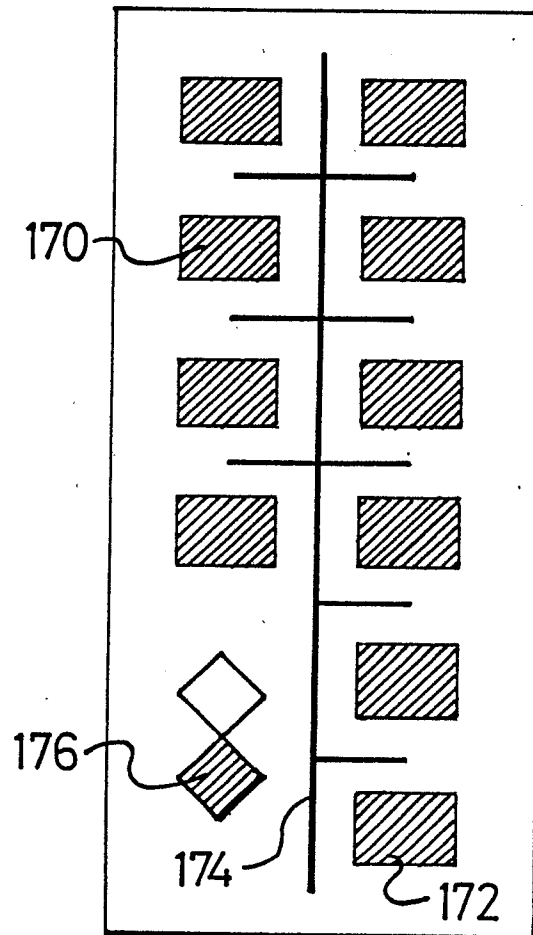


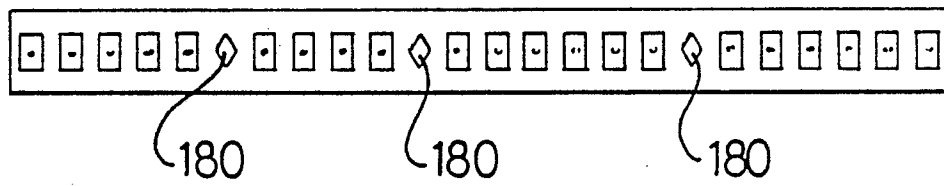
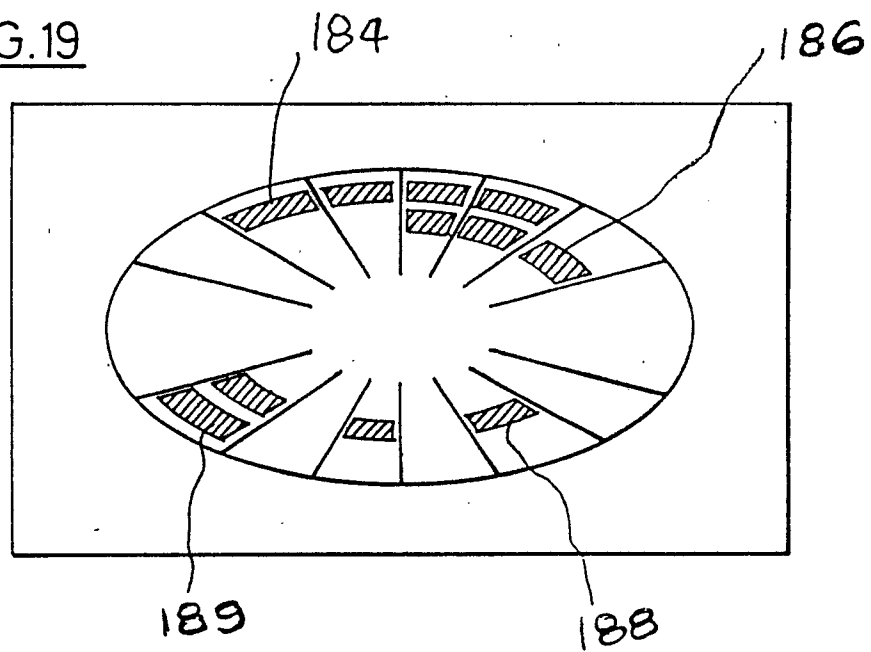
FIG. 18FIG. 19

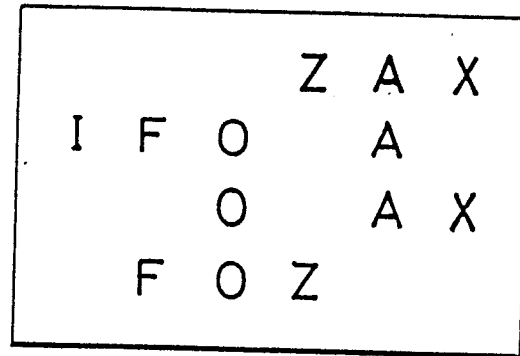
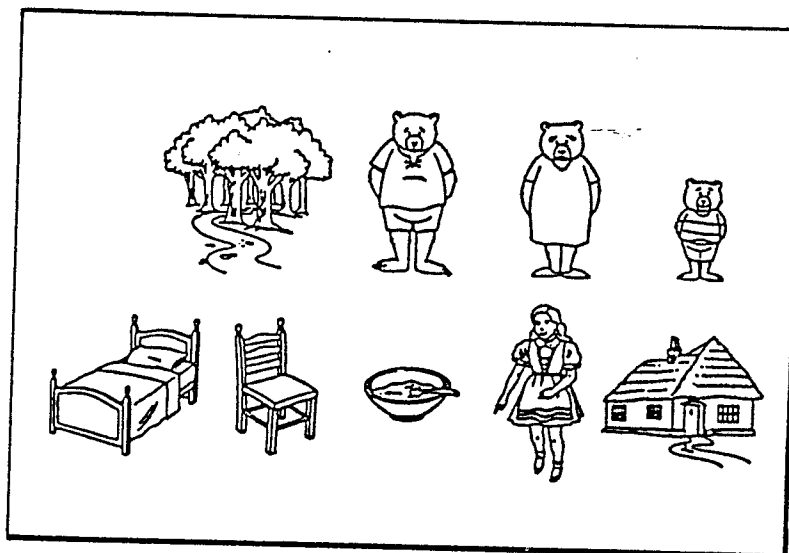
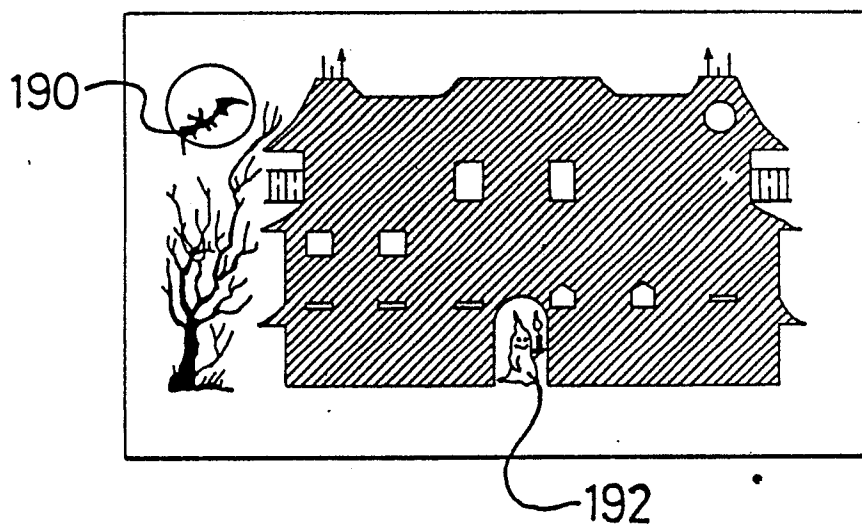
FIG. 20FIG. 21

FIG. 22





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	WIRELESS WORLD, vol. 86, no. 1535, August 1980, pages 65,66, Sussex, GB; J.M. OSBORNE: "Binary clock" * Figure 1 *	1-6,13	G 04 G 9/10 G 09 F 9/30
A	--- US-A-3 974 444 (R.O. WHITAKER) * Figures 2,6 *	1,6,14	
A	--- US-A-3 744 235 (S. KRATOMI) * Figures *	1,5,7	
D,A	--- US-A-3 750 384 (A.D. MILLER) * Figures *	1,8,9	
A	--- US-A-3 841 082 (J.W. CUEVAS et al.) -----	1	TECHNICAL FIELDS SEARCHED (Int. Cl.4) G 04 G G 09 F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17-09-1987	Examiner EXELMANS U.G.J.R.
CATEGORY OF CITED DOCUMENTS			
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