April 7, 1964 F. W. SINDEN 3,128,100

PUZZLE WITH CHANGEABLE INDICATORS ARRANGED IN DISTINCT BUT INTERRELATED GROUPS

Filed April 28, 1960

FIG. 1

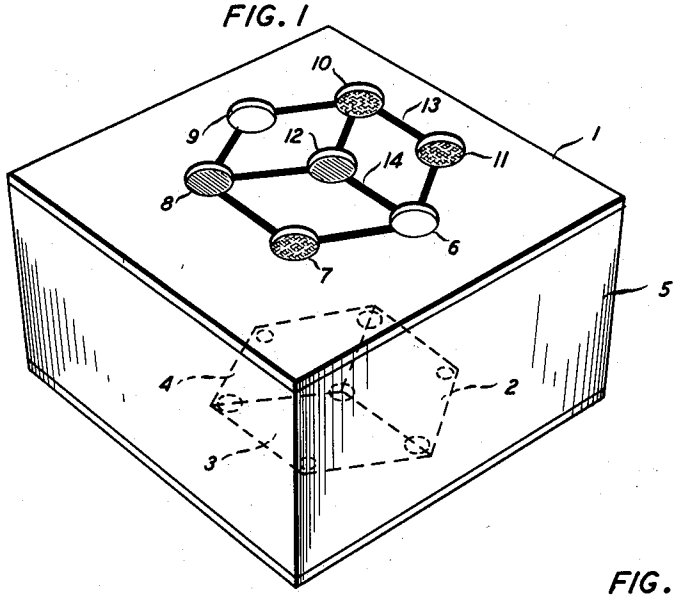


FIG. 2

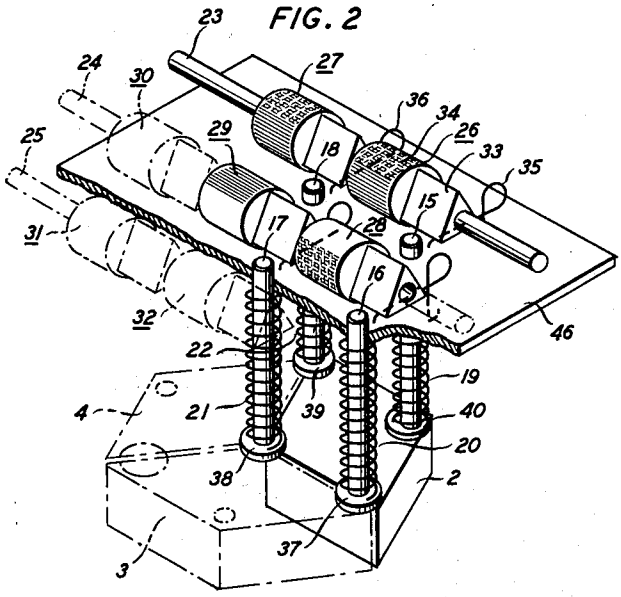


FIG. 3A

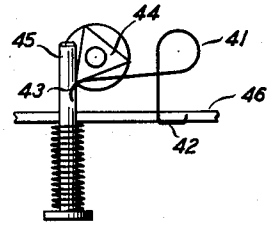
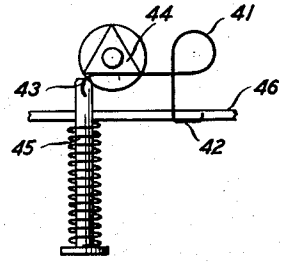


FIG. 3B



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PUZZLE WITH CHANGEABLE INDICATORS ARRANGED IN DISTINCT BUT INTERRELATED GROUPS

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This invention relates to puzzles and more particularly to puzzles which present the operator with the problem of determining the specific unique program of operations required for a plurality of actuating members in order to attain a preselected relationship or pattern among a plurality of responsive indicating members.

Puzzles of the variety indicated which are known in the prior art generally employ some type of random programming which requires the operator to determine by means of trial and error the particular sequence or program of operations of the buttons, switches or other actuating members necessary to produce the desired patterns of indications. Alternatively, such puzzles may employ programming which, while based on a mathematically determinable arrangement, is so complex as to make the solution extremely obscure, thereby severely limiting the attractiveness of the device to the average user. Other disadvantages of prior art devices include the employment of cumbersome mechanical arrangements which increase the cost of manufacture. Still other devices have inconvenient operating restrictions imposed by a requirement for a source of electric power.

Accordingly, a broad object of my invention is to provide an improved puzzle of the general type indicated.

A more specific object of my invention is to provide a puzzle which may be solved, alternatively, by the application of mathematical techniques, by the employment of trial and error methods, or by the application of the intuitive logic possessed by a reasonably intelligent user.

A further object of my invention is to provide a puzzle of the type indicated comprising simple mechanical structures which are conducive to both simplicity and economy of manufacture.

An additional object of my invention is to provide a simple mechanical puzzle which has a plurality of solutions each associated with a respective one of a plurality of preselectable problems.

The principles of the invention stem in part from the realization that certain basic mathematical concepts, such as Euclidean three-space geometry, modular arithmetic and the theory of groups may be turned to account in providing a programming scheme for a puzzle that is both intriguing and challenging to an operator, irrespective of his mathematical skill.

In accordance with one aspect of the invention, each of a plurality of actuating members is arranged to operate a respective unique plurality of indicating members, and each of the indicating members is capable of assuming any one of a plurality of indicating states. Further, the combined operation of each possible set of actuating members also effects a change in the indicating state of a respective unique plurality of indicating members. In accordance with another aspect of the invention, the operator may preselect the particular problem to be solved by choosing a desired pattern of indications for the indicating members. For example, the selection may be to have all indicating members driven to a common indicating state. The solution to the puzzle then lies in determining the program which must be followed in the operation of the actuating members to step all of the indicating members to the selected common state.

One approach to the solution of the puzzle is mathematical in nature and, as indicated above, is available to operators familiar with the concepts of Euclidian three-space geometry and modular arithmetic. The solution may also be arrived at, however, by a succession of relatively simple common sense conclusions. For example, the operator may determine first, after a period of observation, the relationship between each actuating member and its associated indicating members. Next the operator should determine, by observation, the effect of simultaneous operation of various sets or groups of the actuating members. Based on these observations, the thoughtful operator is able to deduce a simple rule which gives the particular combination of operating steps required for the solution. Random solution, while more time-consuming than the methods indicated, is also possible.

The objects of the invention are achieved in a specific illustrative embodiment comprising a small box, substantially cubic in form, which houses the various mechanical elements of the puzzle. Protruding from the bottom of the box are three rhomboid blocks fitted together to form a hexagonal perimeter. Each of the blocks may be depressed inwardly against spring pressure to impart an upward motion to a respective group of four vertically aligned rods. Each of the three groups of four rods has a respective pair of rods in common with each of the other two groups. Additionally, one rod is common to all three groups, and one rod in each group is unique to that group making a total of seven rods in all.

Also mounted in the box are seven cylindrical counters or indicating members, each corresponding to a respective one of the rods. Each counter has three stable states or positions of rotation determined by a cam and a spring. The state of each counter is indicated by one of three colors which is visible through a corresponding window or hole in the top of the box. Each rod in its upward movement engages one of the cams and changes the state of its associated indicator by one step.

Inscribed or otherwise marked on the cover of the puzzle box is a hexagonal figure and each of its six vertices marks the location of one of the indicator windows. The seventh window is located at the center of the hexagon and lines extend from it to each of three non-adjacent vertices. As a result, the markings on the cover of the puzzle assume the configuration of a cube, seen in perspective, with two of its diametrically opposed corners superimposed. Alternatively, the figure may be viewed as a combination of three rhombuses, which together form a hexagon, and each rhombus corresponds to a respective one of the rhomboid blocks at the bottom of the box. This correspondence between the figure formed by the operating buttons and that formed by the windows immediately provides a clue to persons familiar with Euclidian three-space geometry since the coordinates of each window, using the center window as the origin, serve to indicate the relationship of the indicators to the operating buttons. Operators who are mathematically inclined may readily express these relationships in terms of a set of simultaneous equations, employing modular arithmetic, and the solution of such equations also solves the puzzle.

Accordingly, one feature of the invention is a mechanical puzzle utilizing a unique combination of mechanical features to make preselected overlapping groups of indicating members responsive to the operation of preselected ones of a plurality of actuating members.

A further feature of the invention is the employment, in a puzzle, of n actuating members and 2^n-1 indicating members, each having m possible indicating states, where each of the actuating members may be operated to change the state of a respective group of the indicating members, where particular ones of the indicating mem-

bers are common to two or more of the respective groups and where one indicating member is common to all of the groups.

An additional feature of the invention is a puzzle box which employs cam-operated multi-state counters, the state of each counter being indicated by a color showing through a window, and the change of state of unique groups of the counters being responsive to the operation of pushbuttons.

The principles of the invention together with additional objects and features thereof will be fully apprehended when considered in connection with the following drawings in which:

FIG. 1 is a perspective view of the outside of a puzzle-box in accordance with the invention;

FIG. 2 is a perspective view of a portion of the interior mechanism of the puzzle box of FIG. 1; and

FIGS. 3A and 3B are sketches of the counter-positioning elements of the mechanism shown in FIG. 2.

Referring now to FIG. 1 of the drawing, the illustrative embodiment comprises a substantially cubic box 5. The top 1 has a hexagonal figure inscribed or otherwise marked on its outer surface. Each vertex of the hexagon marks the position of one of the small circular holes or windows 6 through 11. The center of the hexagon marks the position of an additional window 12. Markings such as the line 14 connect the center window 12 with each of the windows 6, 8, and 10. As a result, the over-all configuration on the cover 1 may be regarded as that of a cube, seen in perspective, with a window marking seven of its eight corners, the corner marked by the hole 12 being superimposed over the position of the hidden or eighth corner. Also shown in FIG. 1 is the position of the three operating pushbuttons or actuating members 2, 3, and 4 which are positioned in the bottom of the box 5.

FIG. 2 shows the position of the three rhomboid shaped pushbuttons 2, 3, and 4 in relation to the interior mechanism of the device.

This mechanism includes a total of seven operating rods, four of which, 15, 16, 17, and 18, are shown. Each of the rods is spring loaded by a respective one of the springs 19, 20, 21, and 22. The free end of each spring bears against a shelf member 46 which is positioned in a plane parallel to the cover of the box 5 and which has a suitable accommodating hole as a guide for each of the operating rods.

Above the free ends of the rods 15, 16, 17, and 18 are three shafts 23, 24, and 25 mounted in a co-planar array, which is perpendicular to the axes of the rods 15, 16, 17, and 18. The mountings for the shafts 23, 24, and 25, which are not shown, may comprise any suitable arrangement such as small accommodating holes on the inside of each of two sides of the box 5.

Rotatably mounted on the shaft 23 are two counters or indicating members 26 and 27, each of which may rotate independently of the other. Similarly, counters 28, 29, and 30 are mounted on the shaft 24 and counters 31 and 32 are mounted on the shaft 25. Each of the indicating members such as 26 is an integral structure comprising an indicating end 34, which is cylindrical, and a cam end 33. Each of the indicating ends, such as 34, is marked longitudinally on its surface so that the lateral area is divided into three equal areas, each subtending an angle of 120 degrees. Each of these three equal divisions of area is suitably marked by a distinguishing color which may be, for example, white, yellow, or red. To illustrate the principle of employing color identification for the operating states or rotational positions of the indicating members, each of the windows, such as 6, 12, 10, and 11, is hatched in the same manner as its corresponding indicating member 28, 29, 27, and 26, respectively.

When the mechanism shown in FIG. 2 is properly in place in the box 5 of FIG. 1, each of the cylindrical ends such as 34 of each indicating member such as 26 is placed immediately under and shows through a corresponding one of the holes 6 through 12. Indicating members 26 and 27 correspond to the holes 11 and 10, respectively; indicating members 28, 29, and 30 correspond to the holes 6, 12, and 9, respectively; and indicating members 31 and 32 correspond to the holes 8 and 7, respectively.

Turning now to a consideration of the operation of the mechanism, when the button 2 is pushed against the flanges 37, 38, 39, and 40, each of the rods 15, 16, 17, and 18 is moved upward thereby compressing each of the springs 19, 20, 21, and 22. As each rod moves upward, it engages the edge of the bottom face of a respective one of the triangular prisms which constitutes the driving or cam end of a corresponding indicating member, thereby causing each of the four indicating members 26, 27, 28, and 29 to rotate through an arc of approximately 90 degrees.

The rotating action is more readily understood when considered in connection with FIGS. 3A and 3B. FIG. 3A shows an illustrative operating rod 45 in the fully raised position after it has rotated the indicating member 44 through 90 degrees. The loop spring 41 has one end 42 suitably secured to the shelf 46. The opposite end 43 of the spring 41 bears against but is not affixed to the bottom face of the cam of the indicating member 44. As the indicating member 44 is rotated, it forces the end 43 of the spring 41 downward so that when the rod 45 is released, assuming its neutral position as shown in FIG. 3B, the spring end 43 drives the indicating member 44 through an additional 30 degrees of rotation—a total rotation of 120 degrees, the extent of one indicating area on the cylindrical end.

Accordingly, the end result of the depression and release of the pushbutton 2 is that the color showing through each of the holes 10, 11, 12, and 6 is changed. If initially each hole showed a common color, such as white, for example, the effect would be to advance each indicator to the yellow section. Or, if one or more of the windows indicated initially showed red, the operation of the corresponding counter would effect a change to white.

The effect of operating each of the buttons 3 and 4 is substantially identical to that described for button 2. Significantly, however, the operation of each button has the effect of changing the color showing through at a unique group of four of the windows. Additionally, the operation of each button changes the indications at two windows which are also changed by the operation of each respective adjacent button. Specifically, the operation of either or both of the buttons 2 and 3 effects a change in the indications showing at windows 6 and 12. Further, it will be observed that the operation of any or all of the buttons effects a change of indication at the center window 12.

A puzzle in accordance with the invention may be operated in a variety of ways. For example, initially all the indicators showing through the windows may be yellow and the problem may be to operate the pushbuttons a minimal number of times to change all of the indicators to show red. Or, initially, the indicators may be mixed, some being red, others white and others yellow. The problem selected might then be to change all of the indicators to a common color, white, for example, with the least possible number of pushbutton operations. Or, instead, initially, all of the indicators may be of a common color or of a random combination of colors and the problem may then be to change the indicators to show a particular preselected pattern of colors. In each case, as previously described, the problem may be solved mathematically, by careful observation of how the device operates or by trial and error.

The principles of the invention may readily be adapted to a wide variety of arrangements, the embodiment disclosed herein being intended as merely illustrative. For example, there may be n buttons or actuating members,

in which case there are 2^n-1 windows and corresponding indicators, and each of the indicators may have m indicating states. Further, the operation of each button changes the state of 2^{n-1} of the indicators. In the illustrative embodiment m and n both equal 3. This selection is arbitrary and, within the scope of the invention, may of course be varied. While the basic number of independent indicating members is designated as 2^n-1, this number may be reduced by having one or more blank or inoperative indicators or it may be increased by additional indicators which merely parallel the basic indicators.

Although the disclosed embodiment shows mechanical means implementing the principles of the invention, it is apparent that, alternatively, electrical means such as switches and indicating lights may be employed. These and a wide variety of other modifications may be effected without departing from the scope and spirit of the invention.

I claim:

1. A puzzle comprising, in combination, n actuating means, n being not less than 3, 2^n-1 indicating means including a plurality of unique combinations thereof each having 2^{n-1} of said indicating means therein, each of said indicating means being capable of assuming any one of a plurality of m indicating states, m being not less than 3, means responsive to each of said actuating means for changing the indicating state of each of said indicating means in a respective one of said unique combinations of said indicating means, each of said unique combinations including at least one of said indicating means from at least one other of said unique combinations, at least one of said indicating means being common to all of said unique combinations, whereby the indicating states of said indicating means may be changed to form a preselected pattern of indicating states by the operation of said actuating means in accordance with a mathematically determinable number of operations of selected sets of said actuating means.

2. A puzzle in accordance with claim 1 wherein said indicating means comprise a plurality of mechanically rotatable elements, each of said elements having m indications thereon, each indication being representative of a respective one of said m states, and a box member having a plurality of co-planar windows therein, the state of each of said indicating means being visible through a respective one of said windows.

3. A puzzle in accordance with claim 2 wherein said actuating means comprise pushbuttons mounted for depressible operation into said box, said means for changing the indicating state of said indicating means comprising 2^n-1 rods mounted in said box, whereby the depression of each of said pushbuttons imparts an axial movement to a respective unique combination of 2^{n-1} of said rods, and means for translating the axial movements of said rods into rotary movements of a corresponding number of said indicating means.

4. Apparatus in accordance with claim 3 wherein said translating means comprises a plurality of cams each integrally mounted with a respective one of said rotatable indicating elements.

5. A puzzle comprising, in combination, n actuating means, 2^n-1 indicating means including a plurality of unique combinations thereof each having 2^{n-1} of said indicating means therein, each of said indicating means being capable of assuming any one of a plurality of m indicating states, means responsive to each of said actuating means for changing the indicating state of each of the indicating means in a respective one of said unique combinations of said indicating means, each of said unique combinations including at least two of said indicating means which are in common with one other of said unique combinations, each one of said unique combinations including at least one of said indicating means which is unique to said one combination, and at least one of said indicating means being common to all of said unique combinations, whereby the indicating states of said indicating means may be changed to conform to a preselected pattern of indicating states by the successive operation of determinable sets of said actuating means.

6. A puzzle comprising, in combination, a housing box including a top and a bottom, a plurality of windows in said top each marking a respective vertex of a hexagon and an additional window marking the approximate center of said hexagon, a plurality of indicating members mounted in said box including a plurality of unique sets of four of said indicating members, each of said indicating members corresponding to a respective one of said windows, each of said indicating members being capable of assuming any one of a plurality of indicating states, the indicating state of each being visually determinable through a respective one of said windows, three pushbuttons mounted on the bottom of said box, means responsive to the operation of each of said pushbuttons for changing the state of one of said unique sets of four of said indicating members, each of said unique sets comprising a first respective pair of said indicating members which is common to a first other one of said sets and a second respective pair of said indicating members which is common to a second other one of said sets, the indicating member corresponding to the window marking the center of said hexagon being common to all of said sets, whereby any preselected pattern of said indicating states may be made visible through said windows by operating groups of said buttons, simultaneously, a respective mathematically determinable number of times and all of said buttons, simultaneously, a respective mathematically determinable number of times.

7. Apparatus in accordance with claim 6 wherein said state changing means comprises a plurality of rods mounted in said box, each corresponding to a respective one of said indicating members.

8. Apparatus in accordance with claim 7 wherein each of said indicating members comprises a respective rotatable cylindrical member with its lateral surface distinctly marked to denote each respective one of said operating states, the particular operating state of each of said cylindrical members being dependent on its rotational position, a respective one of said distinct marks being visible through each respective one of said windows.

9. Apparatus in accordance with claim 8 including a plurality of cams each integrally related with a respective one of said cylindrical members, whereby axial movement of each of said rods is translated into a rotating movement of a respective one of said cylindrical members.

10. A puzzle comprising, in combination, three actuating members, seven indicating members comprising a plurality of unique overlapping groups of four of said indicating members, each of said indicating members being capable of assuming any one of three operating states, means responsive to each of said actuating members for changing the indicating state of a respective one of said unique groups of four indicating members, each of said unique groups including two indicating members common to one other of said groups and two indicating members common to a second other of said groups, one of said indicating members being common to all of said groups, and each of three of said indicating members being unique to a respective one of said groups, whereby, the indicating states of said indicating members may be changed to form a preselected pattern of indicating states by the operation of said actuating members in accordance with a mathematically determinable number of operations of selected sets of said actuating members.

11. Apparatus as defined in claim 10 including a box member housing said puzzle, said box having a cover member with seven windows therein, said actuating members comprising spring loaded pushbuttons, said indicating members comprising seven rotatable cylindrical members each having three markings thereon indicative of

said three operating states, the particular operating state of each of said indicating members being visible through a respective one of said windows.

12. Apparatus as defined in claim 11 wherein said indicating state changing means comprises seven rod members three of which being axially movable in response to the operation of either of a single unique, respective pair of said pushbuttons, one rod member being axially movable in response to the operation of any one of said pushbuttons, and the remaining three each being axially movable in response to the operation of an associated single one of said pushbuttons, seven cam members each affixed to a corresponding one of said cylindrical members and responsive to the axial advance and impingement thereon of a corresponding one of said rod members for rotating a respective one of said cylindrical members through approximately 90 degrees, seven spring members each being loaded by the axial advance of a respective one of said rods, each spring member being in contact with a respective one of said cams, and each spring member, when loaded, being responsive to the axial withdrawal of its respective rod for rotating a respective one of said cylindrical members through approximately 30 degrees, whereby each actuation and release of said pushbuttons rotates said cylindrical members through approximately 120 degrees, a different indicating state of said cylindrical members being made visible thereby through said windows.

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