

[54] **GAME WITH POLYHEDRAL PLAYING
PIECES**

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273/155, 273/157 R

[51] Int. Cl.A63f 9/20

[58] Field of Search.....273/137, 155, 157, 136, 130,
273/135

[56] **References Cited**

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Primary Examiner—Delbert B. Lowe
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[57] **ABSTRACT**

This game comprises a group of identical polyhedron playing pieces, for example, cubes, tetrahedrons, right prisms, or rectangular parallelepipeds. The polyhedrons are formed of a transparent or translucent material which may be slightly tinted. The apices of the pieces are provided with indicia each designating one of a certain number of values. The values may be designated by colored portions disposed in the vicinity of the apices or by arcuate lines disposed about the apices varying in radius or in number. The number of playing pieces is such that each combination of values is produced once and only once in the group of playing pieces. An additional playing element may be added to the said group in order that the resultant number of playing pieces, including the additional piece, is divisible by a greater number of factors. This construction enables the verification of the values of juxtaposed apices of adjacent pieces in position without displacement.

16 Claims, 9 Drawing Figures

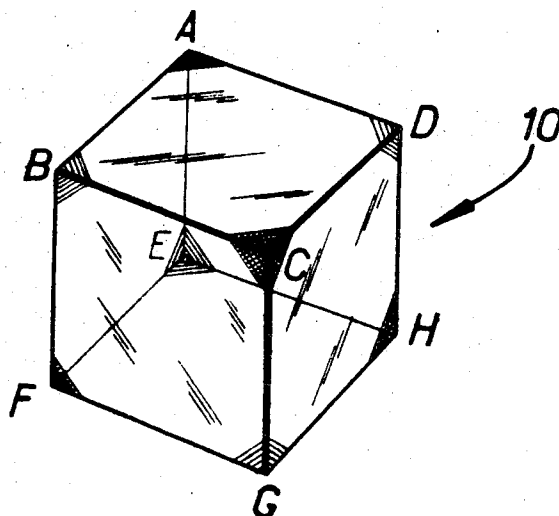


FIG. 1

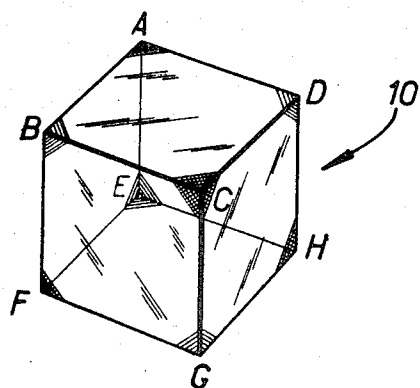


FIG. 2

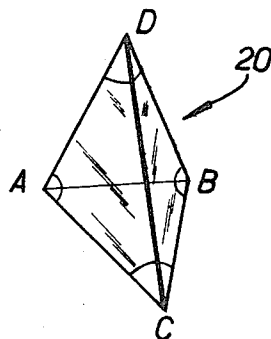


FIG. 3

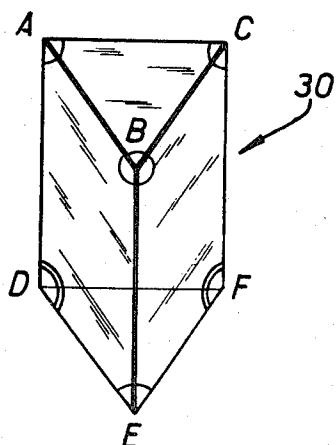


FIG. 4

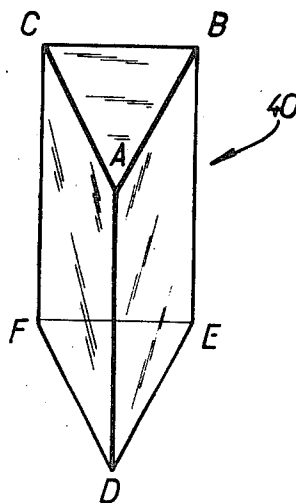
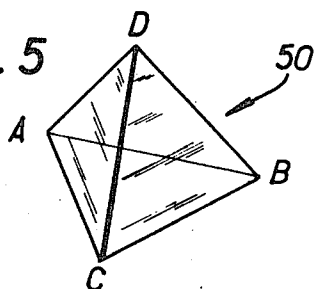


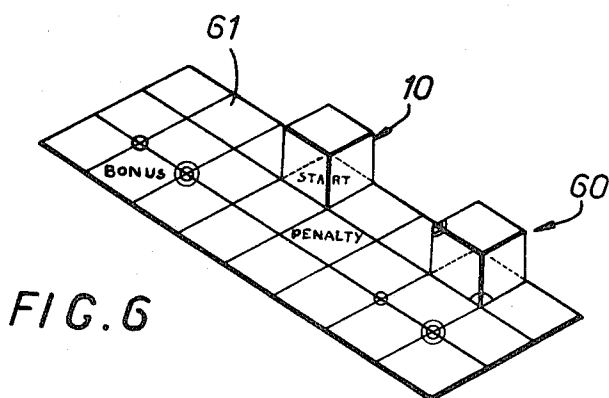
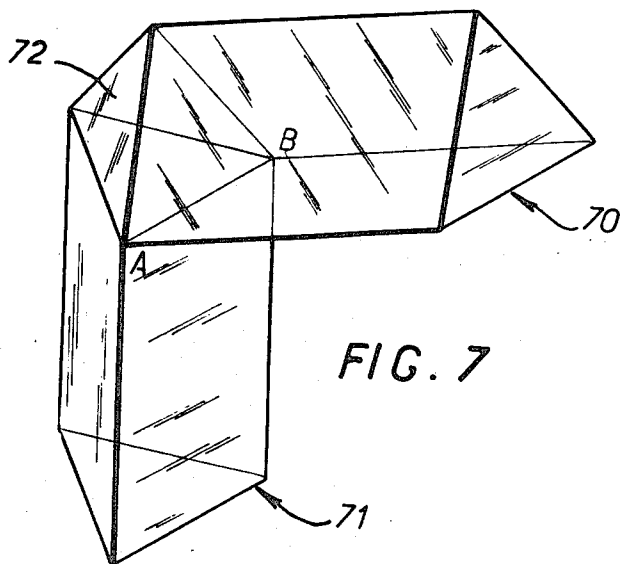
FIG. 5



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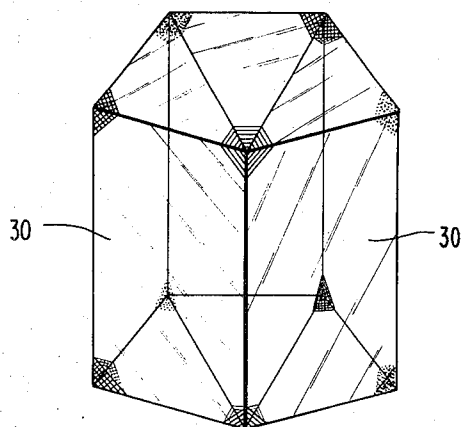
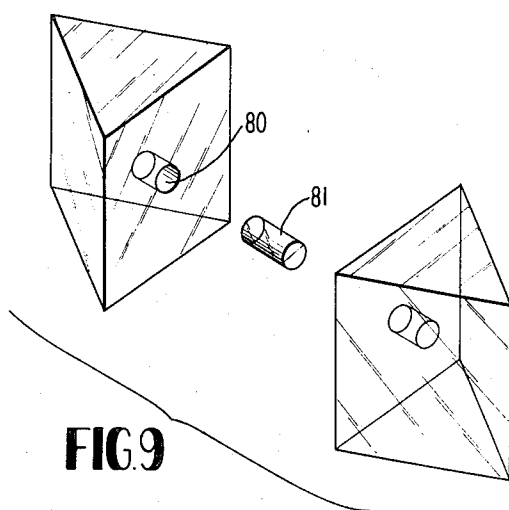


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FIG.8



GAME WITH POLYHEDRAL PLAYING PIECES

BACKGROUND OF THE INVENTION

The present invention relates to a game employing polyhedron playing pieces. The present invention is a further development of the game theory presented in my U.S. Pat. application Ser. No. 787,162, filed Dec. 26, 1968 and my U.S. Pat. No. 3,608,906, Sept. 28, 1971.

According to the games and the puzzles of my previous application and patent, as well as the instant application, each of the N apices of each of the playing pieces is provided with a value from a certain number of values M and the number of pieces is such that all the combinations of M values taken N by N is produced once and only once in a group. The preferred rules of the game require all juxtaposed apices of juxtaposed playing pieces to carry the same value.

The present game extends the theory presented in the above-mentioned application and patent from planar playing pieces to polyhedron playing pieces.

It will be appreciated that such a polyhedral construction of playing pieces further requires the use of logical skills in solving the various combinatorial problems faced in the playing of this game.

SUMMARY OF THE INVENTION

The present invention consists in a game comprising at least one group of identical polyhedron playing pieces, each playing piece having N apices and being substantially transparent, each apex of each piece carrying a value taken from M possible values, and means for designating the values being visible through the playing pieces so that the values of the apices of juxtaposed playing pieces can be verified in position.

Preferably, the number of pieces of said group is such that all the combinations of M values taken N by N are produced once and only once.

The polyhedron playing pieces may be cubes, right prisms with isosceles or equilateral triangular cross sections, parallelepipeds or the like.

The game may be provided with a playing board or panel which can include spaces corresponding to the shape of the particular playing pieces with which it is going to be used.

A supplementary playing element may be provided which is to effectively increase the number of factors by which the number of playing pieces in the group is divisible.

The values are preferably designated in the vicinity of the apices by colored portions, each color representing a particular one of the M values, or by arcuate portions which may vary in radius or in number representing the M values.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a perspective view of a cube playing piece for the game according to the invention;

FIG. 2 shows a perspective view of a tetrahedron playing piece having two equilateral triangular faces and two isosceles triangular faces;

FIG. 3 shows a perspective view of a right prism playing piece having an equilateral triangular cross section;

FIG. 4 shows a perspective view of a right prism playing piece having an isosceles triangular cross section;

FIG. 5 shows a perspective view of a regular tetrahedron playing piece;

FIG. 6 shows a perspective view of a game board or panel having an additional playing element with a cube playing piece such as shown in FIG. 1 in position thereon;

FIG. 7 shows a perspective view of right prism playing pieces such as shown in FIG. 3 juxtaposed to a tetrahedron playing piece such as shown in FIG. 5;

FIG. 8 shows the juxtaposition of a group of identical playing pieces; and

FIG. 9 shows the detachable assembly of a pair of playing pieces.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a cube playing piece 10 according to the invention. The walls of the cube are preferably formed of transparent or translucent plastic, which may be tinted if desired, by injection moulding or by assembling the walls. The cube playing piece 10 includes apices A,B,C,D,E,F,G,H and each of these apices is associated with one of the possible values. In this example the values are indicated by coloring the portions of the adjacent walls forming each of the apices, and FIG. 1 is correspondingly lined for color. Each color corresponds to one of the possible values M. Further, in this embodiment the possible values $M = 2$, though M could be any other number desired. The value of the apices A,C,F, and H is designated by a first color and the value of each of the apices B,D,E and G is designated by a second color. Accordingly, each of the corners of the cube 10 is of the first or second color. It is understood that instead of two different colors only one color is necessary, the other value being represented by an apex of no color, i.e. the color of the walls. Preferably the colored portions are colored so that the color of the adjacent colored portions of an adjacent playing piece is visible therethrough. The transparency of the walls of the playing pieces is very advantageous as it allows the player or players to see the value of each apex whether or not it is hidden from view, for example, as the apex E of the cube 10 is hidden from view in FIG. 1. In this way the pieces do not have to be moved during the playing of the game in order to verify that a particular piece is properly juxtaposed to another piece in that all pieces including their apices are visible to all the players at any given moment from any position.

In order to designate the value sequence of a particular polyhedron playing piece a series of conventions will be observed as follows. Each of the colors will be designated by a numerical value 0, 1, 2, etc ... As the number of possible values M of the cube 10 is equal to 2, the numerical values 0 and 1 will suffice for this example. Next, the reading order observed is such that the first four values represent the upper apices A,B,C,D and the second four values the lower four apices E,F,G,H. within each of these groups of four values the first will be the lowest value, i.e. 0, and the rest of the apices of each of the groups of four apices are then read in the counterclockwise direction. Accordingly, cube 10 shown in FIG. 1 is represented by the value sequence (0101 0101). Further, the cube having the second color at each one of its apices is represented by

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the value sequence (1111 1111) and the cube having a single apex of the second color is represented by the value sequence (0000 0001). (It is noted that the sole apex carrying the value 1 can be differently oriented during the game without affecting the value sequence).

The value sequences of the playing pieces which comprise the group of cubes wherein the possible values $M = 2$ and each possible combination of value sequences is represented once and only once are as follows:

	ABCD	EFGH
8 apices 0	0000	0000
7 apices 0	0000	0001
6 apices 0	0000	0011
	0000	0101
	0001	0100
5 apices 0	0000	0111
	0001	0110
	0001	1010
4 apices 0	0000	1111
	0001	0111
	0001	1011
	0001	1101
	0001	1110
	0101	1010
3 apices 0	0001	1111
	0011	1101
	0101	1011
2 apices 0	0011	1111
	0101	1111
	0111	1101
1 apex 0	0111	1111
0 apices 0	1111	1111

Accordingly the number of pieces in this group is 23.

The game according to the invention is preferably played as follows: a first piece is put into any arbitrary position and a second piece must then be put into position juxtaposed thereto so that each of the values of each of the juxtaposed apices is the same. Accordingly, a cube having all its apices of a first color can only be put into juxtaposed relative position to a second cube having four apices of the same first color on one of its faces.

According to a further embodiment, the playing piece is formed as a tetrahedron by a pair of equilateral triangles and a pair of isosceles triangles. Such a playing piece 20 is shown in FIG. 2 and comprises a pair of equilateral triangles A-C-D and C-B-D sharing the common side C-D and a pair of isosceles triangles A-B-D and A-C-B sharing the common side A-B which is shorter than any of the other edges of the tetrahedron 20. In the case where such a tetrahedron is provided with one of two values at each of its apices, $M = 2$, there are 10 possible pieces included in the group containing all the combinations of values once and only once. These possible pieces are as follows, employing the same convention as used hereinabove:

	ABCD	
4 apices 0	0000	
3 apices 0	0001	
	0100	
2 apices 0	0011	60
	0101	
	0110	
	1100	
1 apex 0	0111	
	1101	
0 apices 0	1111	65

In the case where the tetrahedron 20 is provided with one of three values at each one of its apices, $M = 3$,

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there are 45 possible pieces included in the group of playing pieces containing all of the combinations of values produced once and only once. These pieces are as follows:

	ABCD	ABCD	ABCD
	0000	0200	1200
	0001	0201	1201
	0002	0202	1202
	0011	0210	1210
	0012	0211	1211
10	0022	0212	1212
	0100	0220	1220
	0101	0221	1221
	0102	0222	1222
	0110	1100	2200
	0111	1101	2201
	0112	1102	2202
15	0120	1111	2211
	0121	1112	2212
	0122	1122	2222

According to a further embodiment the polyhedron playing pieces are formed as right prisms having equilateral triangular cross sections.

Such a playing piece is shown in FIG. 3 wherein a right prism 30 includes six apices A,B,C,D,E,F, each one of which being designated by one of two possible values, i.e., $M = 2$; according to the invention, the group containing all the combinations of such playing pieces once and only once includes 16 playing pieces. The list of the possible pieces for this group of playing pieces is as follows:

	ABC	DEF
6 apices 0	000	000
5 apices 0	000	001
4 apices 0	000	011
	001	001
	001	010
	001	100
3 apices 0	000	111
	001	011
	001	101
	001	110
2 apices 0	001	111
	011	011
	011	101
	011	110
1 apex 0	011	111
0 apices 0	111	111

FIG. 4 shows a further embodiment of the playing piece formed as a right prism having an isosceles triangular cross-section and including apices A,B,C,D,E,F. Taking again the case in which there are two possible values, $M = 2$, with respect to this embodiment the following list enumerates the group of 36 possible playing pieces produced once and only once:

	ABC	DEF
6 apices 0	000	000
5 apices 0	000	001
	000	010
	000	100
4 apices 0	000	011
	000	101
	000	110
	001	001
	001	010
	001	100
	010	001
	010	100
	100	100
3 apices 0	000	111
	001	011
	001	101
	001	110
	010	011
	010	101
	010	110
	011	100
	100	101

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2 apices

1 apex 0

0 apices 0

100	110
111	100
111	010
111	001
110	110
110	101
110	011
101	110
101	011
011	011
111	110
111	101
111	011
111	111

According to a final alternative embodiment the playing pieces are formed as regular tetrahedrons such as the playing piece 50 shown in FIG. 5. The tetrahedron 50 has apices ABCD and in the case where the number of possible values $M = 2$, there are five possible playing pieces included in the group containing all the combinations of values once and only once, as follows:

A	B	C	D
0	0	0	0
0	0	0	1
0	0	1	1
0	1	1	1
1	1	1	1

Preferably, the means designating the value carried by a particular apex comprises a colored portion surrounding the apex which is transparent or translucent in order that no portion of the next adjacent playing piece is blocked from vision, in particular, this is most helpful in enabling players to verify whether a particular piece has been properly positioned according to the preferred rules of the game, i.e., adjacent values of adjacent apices being the same value. It is of course understood that the values need not be designated by colored portions in the vicinity of the apices but could be designated by other appropriate markings such as an arc of a circle on each of the walls forming a particular apex. Such markings are shown in FIGS. 2 and 3 in which an arc having a relatively small radius designates the value 1 and an arc having a relatively large radius designates the value 2, the value 0 being designated by an apex portion (not shown) having no arc. Such a configuration of value designation is considered to be highly advantageous in the case such as the tetrahedron 20 of FIG. 2 where M is 3 or greater.

Considering the group of playing pieces comprising cubes such as shown in FIG. 1, i.e. cubes wherein $M = 2$, the total number of pieces containing all the value sequences according to the invention is 23.

In the case where the number of pieces of such a group is a primary number (23) it is preferable to add a certain number of elements to such a group in order to form an effective group having a larger number of factors such as 24.

Such an additional playing element could for example include one or more apices carrying a value which within the rules of the game can be placed in juxtaposed position relative to either of the other two particular values.

This difficulty of the group of 23 playing pieces can be overcome in another manner by the use of a game panel or board 60 as shown in FIG. 6 including eight rows of three playing squares or spaces, one of these playing squares being occupied by a supplementary cubic element which may or not may be fixed to the

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panel, the other squares being the 23 playing squares onto which the remaining 23 playing pieces are adapted to be positioned in accordance with the rules of the game. With the use of such a game panel and supplementary cubic element, one or more of the apices of any panel square or any cubic elements may be provided with an indication for the playing of the game such as "start", "Bonus", "Penalty." Such indications are intended to enhance the enjoyment of such a panel especially for a group of competing players. Other types of panels are also possible, either planar or polyhedral or a combination thereof, in order to form specific figures or designs by juxtaposition of some or all of the playing pieces of the group.

Preferably, a type of polyhedron is chosen in which the symmetry thereof enables the completing of a group of playing pieces according to the invention with a relatively small number of pieces. When the number of pieces is a number having several factors, such as the group of 16 right prisms with an equilateral triangular cross section shown in FIG. 3, it is not necessary to add an additional piece to the group to make up a group of playing pieces for the game. However, in the case where the number of playing pieces according to the group of the invention is without factors other than 1, such as in the case with the cube playing pieces of FIG. 1, a supplementary element having the same dimensions as the playing pieces preferably completes the group of pieces defining the game.

Depending on the form of polyhedron which is chosen for the game, one or more game panels or boards of planar or polyhedral construction are provided, being adapted to the particular shape and dimensions of the playing pieces.

In the case where a group of playing pieces according to the invention is formed by a small number of pieces, for example in the case of the group of 10 tetrahedral pieces 20 such as shown in FIG. 2, a further group or groups of identical pieces may be provided for playing the game by oneself, with other players or for certain logic studies. Such additional groups could be distinguished from the principal group by tinting the plastic of the additional group of playing pieces.

Instead of using an additional group or groups having the same shape and dimensions as the principal group each such group could be formed as a different polyhedron wherein each such polyhedron has a dimension in common with the polyhedrons of the other groups. An example of such a combined group of playing pieces comprises the group of tetrahedron playing pieces shown in the embodiment of FIG. 5 in combination with the 16 right prismatic playing pieces shown in the embodiment of FIG. 3.

FIG. 7 shows the juxtapositioning of the right prism pieces 70 and 71 relative to the tetrahedron playing piece 72. The equilateral triangular faces of the tetrahedron playing piece 72 are in engagement with the equilateral triangular faces of the two prism playing pieces 70 and 71. Though the values have not been illustrated in this Figure, in order that such juxtapositioning falls within the rules of the game, as set forth hereinabove, all of the juxtaposed apices must be of the same value. In this regard it should be noted that at the points A and B the values of apices of all three of the playing pieces illustrated must be the same.

FIG. 8 shows the juxtaposition of a plurality of playing pieces 30.

The actual juxtapositioning of pieces can be facilitated by simple means for joining or assembling the pieces to one another. Such means are shown in my abovementioned U.S. Pat. No. 3,608,906. Each of the sides of the playing pieces according to the present invention can be provided with a hole 80. Each of these holes is adapted to receive by tight fit a pin 81 extending from another playing piece next to which the first piece is to be juxtaposed. Such means provide certain advantages enabling the manipulation of the pieces already juxtaposed as a unit without worrying whether certain pieces will move out of position. The playing pieces can be taken apart at the will of the players.

The present invention is not intended to be limited to the various examples described hereinabove but it extends to all variations, in particular with respect to the shape of the polyhedron playing pieces, the number of these pieces and the means for assembling such playing pieces.

What I claim is:

1. A game comprising a group of polyhedral playing pieces of identical shape, each playing piece being substantially transparent, each apex of each piece carrying an indicium taken from M possible indicia, the indicia being visible through the playing pieces so that the indicia of juxtaposed apices can be verified in position, and the arrangement of said indicia on each piece being produced once and only once by the pieces of said group.

2. A game as claimed in claim 1, wherein the polyhedral playing pieces are formed as cubes, the number of possible indicia $M = 2$, and the number of pieces in said group is 23.

3. A game as claimed in claim 1, wherein the polyhedral playing pieces are formed as right prisms having isosceles triangular cross sections, the number of possible indicia $M = 2$, and the number of pieces in said group is 36.

4. A game as claimed in claim 1, wherein the polyhedral playing pieces are formed as tetrahedrons having two equilateral triangular faces and two isosceles triangular faces, the number of possible indicia $M = 2$, and the number of playing pieces in the said group is 10.

5. A game as claimed in claim 1, wherein the

polyhedral playing pieces are formed as tetrahedrons having two equilateral triangular faces and two isosceles triangular faces, the number of possible indicia $M = 3$, and the number of playing pieces in said group is 45.

6. A game as claimed in claim 1, wherein the polyhedral playing pieces are formed as regular tetrahedrons, the number of possible indicia $M = 2$, and the number of playing pieces in said group is five.

7. A game as claimed in claim 1, wherein the polyhedral playing pieces are rectangular parallelepipeds.

8. A game as claimed in claim 1, further comprising a playing board or panel, the panel including spaces corresponding to the shape of a face of the polyhedral playing pieces.

9. A game as claimed in claim 1, wherein a supplementary identical polyhedral playing piece is provided in order to increase the number of factors by which the number of playing pieces in the group is divisible.

10. A game as claimed in claim 9, wherein the polyhedral playing pieces are cubes and the number of playing pieces in the said group is 23 plus said supplementary playing piece.

11. A game as claimed in claim 1, wherein the transparent material of the playing pieces is slightly tinted.

12. A game as claimed in claim 1, wherein the said indicia comprise colored portions in the vicinity of the apices of the pieces, a different color constituting each one of the M possible indicia.

13. A game as claimed in claim 1, further comprising means for detachably interconnecting playing pieces according to a desired orientation.

14. A game as claimed in claim 1, wherein said indicia comprise arcs disposed in the vicinity of the apices of the playing pieces, a predetermined number of arcs designating each one of the M possible indicia.

15. A game as claimed in claim 1, wherein said indicia comprise arcs disposed in the vicinity of the apices of the playing pieces, said arcs having different radii to designate each of the M possible indicia.

16. A game as claimed in claim 1, wherein the polyhedral playing pieces are formed as right prisms having equilateral triangular cross sections, the number of possible indicia $M = 2$, and the number of playing pieces in said group is 16.

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