United States Patent

[111] 3,618,952

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[21] Appl. No **856,061**
[22] Filed **Sept. 8, 1969**
[45] Patented **Nov. 9, 1971**

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[54] **GAME UTILIZING MATHEMATICAL BASE SYSTEMS**
23 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **273/135 B,** 35/31 A, 235/116
[51] **Int. Cl.** **A63f 3/00,** G09b 19/02, G06c 27/00
[50] **Field of Search** ..... 273/135 B, 135 BC

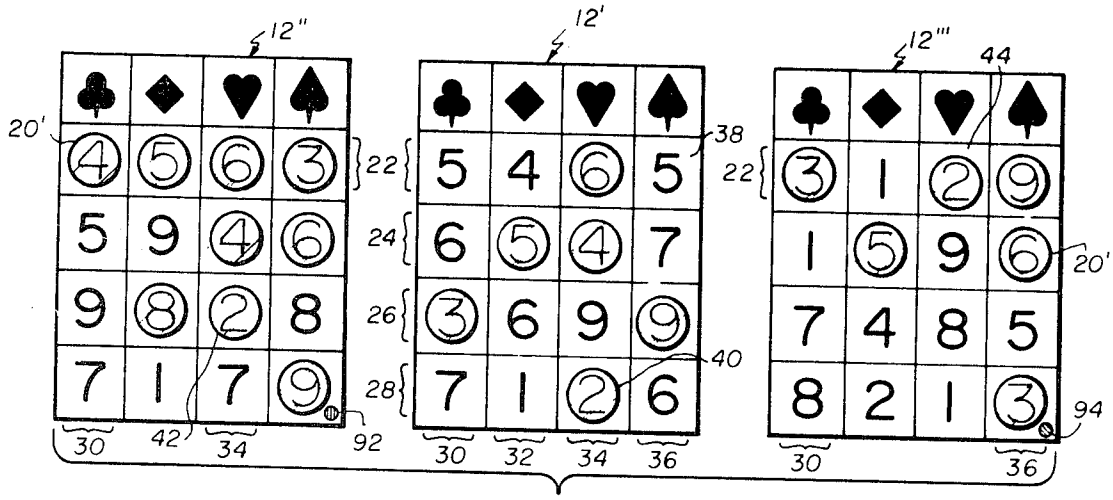
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ABSTRACT: A game apparatus having at least one playing board having an array of uniquely identifiable positions thereon with such positions having numerical values associated therewith, each position being identified by a playing card suit symbol and a numeral. A position selection system consisting of conventional playing cards is provided for sequentially identifying a plurality of said positions on the board and the numerical values associated therewith. When a preselected number of positions have been identified, further identification ceases; and a base selection card is chosen for selecting the particular mathematical base system on which continued play of the game is to be predicated. Once the base system is chosen, those identified numerical values which have mathematical significance in the particular base system chosen are converted to numerical values in another base system, preferably base 10, and the total of these converted numerical values is determined to represent the score of the player. A particular aspect of the apparatus resides in the disc-type converter which is of simple, compact construction and so designed to facilitate direct conversion of one numerical base system to another.



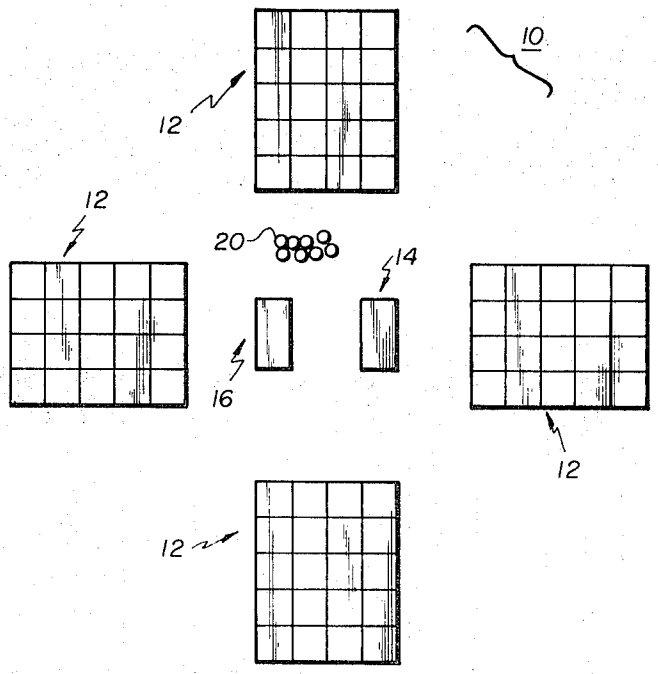


FIG. 1

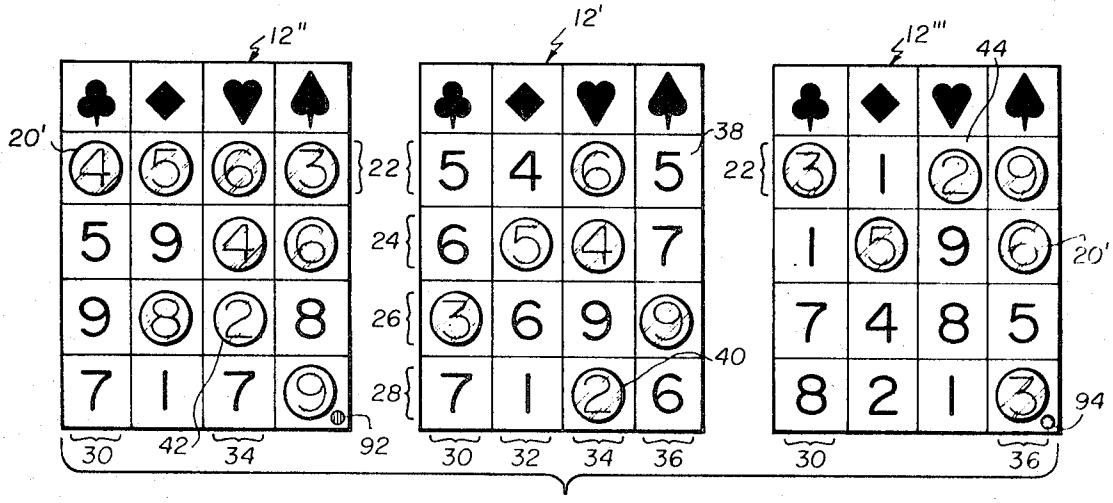


FIG. 2

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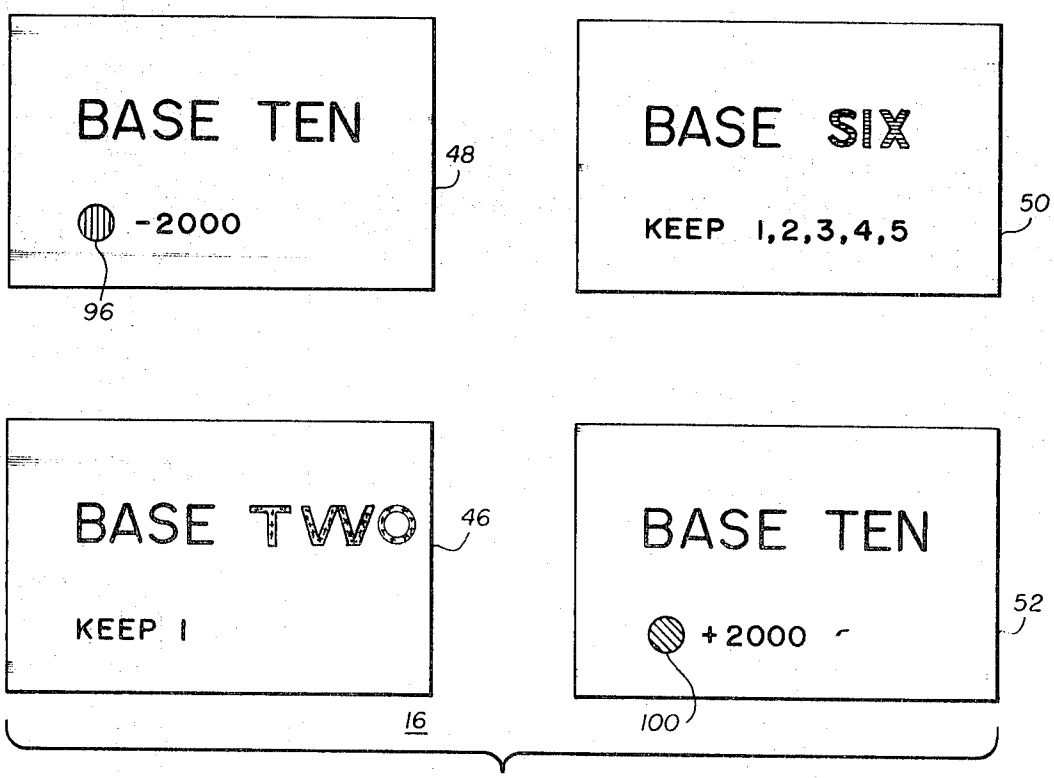


FIG. 3

SET 1

PLAYER	BONUS OR PENALTY	NUMERALS	MODIFIED NUMERICAL SEQUENCE	BASE	SCORE	TOTAL SCORE INCLUDING BONUS OR PENALTY
12'	45	6402	0402	6	54 146	146
12''	47	4563	4503	6	1047	1047
12'''	49	9603	0003	6	3	3

(53, 92)

SET 2

12'	98				
12''	-2000				
12'''					
	TOTAL			TOTAL	GRAND TOTAL

FIG. 6

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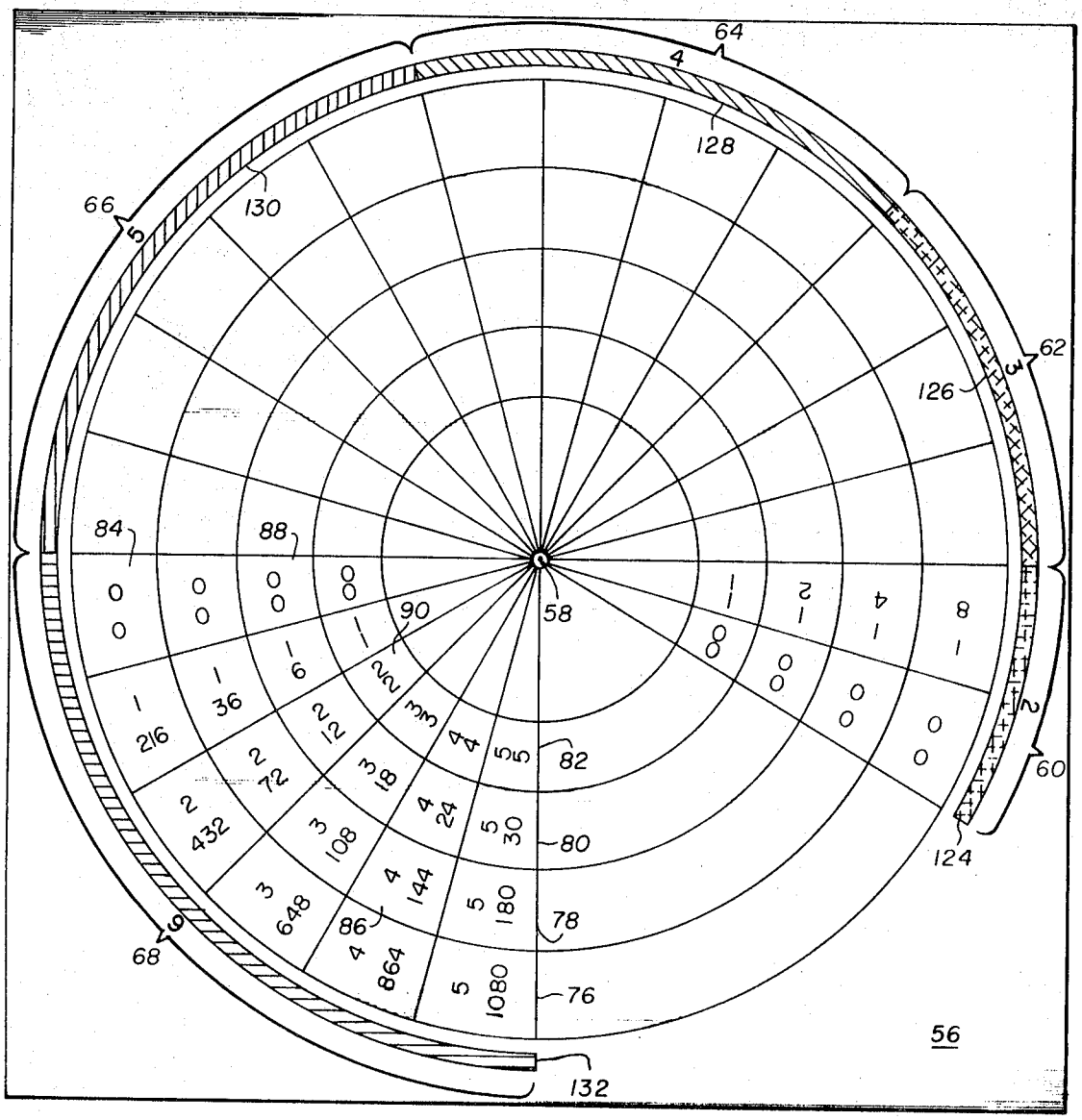


FIG. 4

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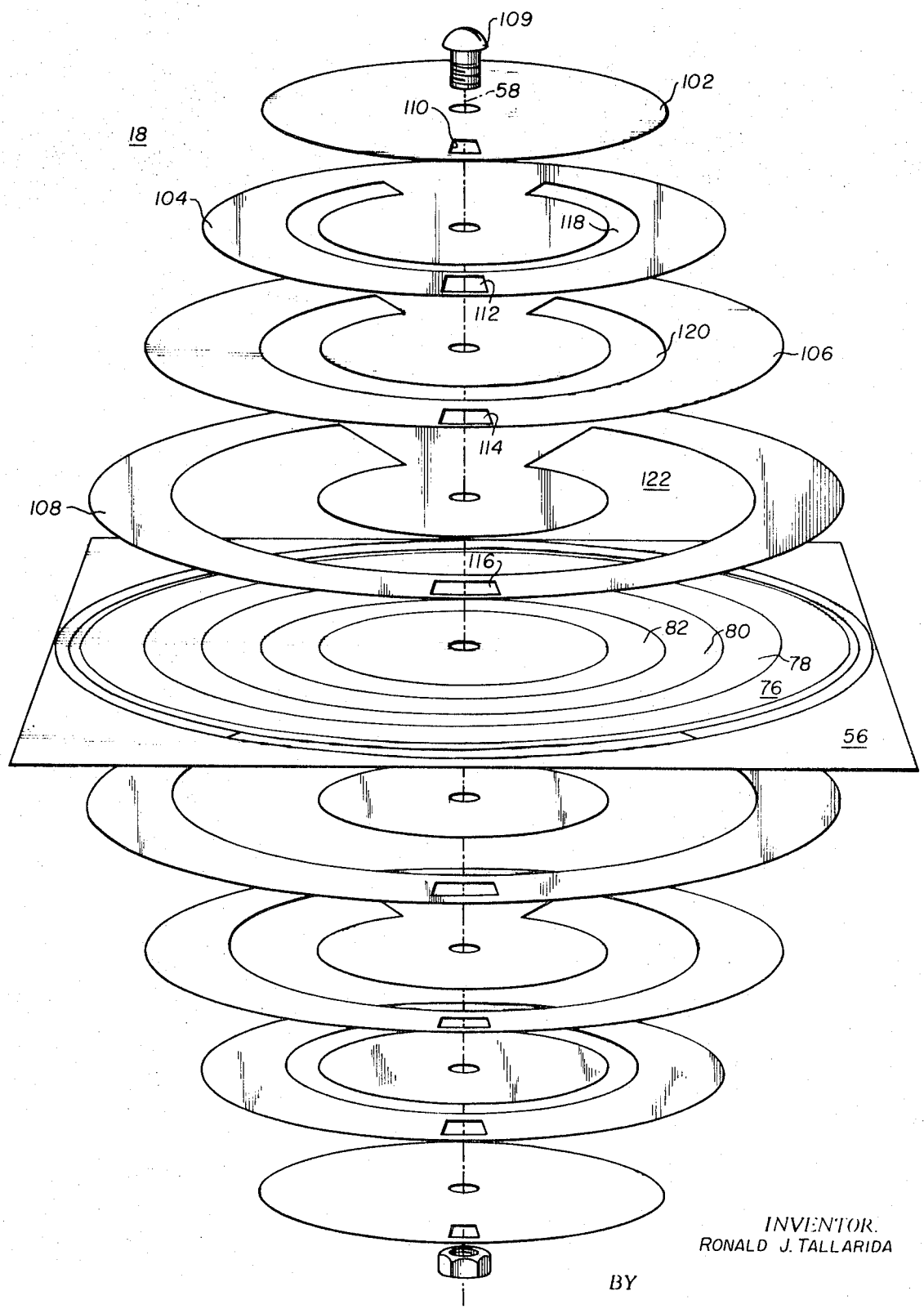


FIG. 5

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GAME UTILIZING MATHEMATICAL BASE SYSTEMS

BACKGROUND OF THE INVENTION

This invention relates to games which can be participated in by one or more players, and more particularly relates to such a game which is not only entertaining but which is also useful as a teaching device to instruct in the mathematical principles underlying various concepts of the "new math."

In the evolution of teaching mathematics, educators today tend to shy away from characterizing mathematics as a mental tool the rigors of which must be arbitrarily accepted and memorized without understanding the underlying principles thereof. For example, in the past, beginning students have been asked to accept the fact that the basic numbering system includes the digits 0–9 and that all higher numbers are based on various combinations of these digits which combinations are usually memorized without understanding the fundamental concepts of the base ten system upon which this numerical sequence is based. At the very most, these students subsequently learned to analyze a multidigit number in terms of a "ones" column, "tens" column, "hundreds" column, "thousands" column, etc., without appreciating the fact that each of the digits actually represents the particular digit times 10 to a prescribed exponent, i.e., 10^0, 10^1, 10^2, 10^3, etc. Today, not only are these underlying concepts of the base ten system taught to beginning students, but also, these students learn that mathematical systems can employ other bases and that such other base systems have utility in our own environment, e.g., the base "two" system as applied to computers. Hopefully, the end result is a keener understanding of the base ten system, an awareness of the existence and utility of other base systems, and an overall greater appreciation for mathematics in general.

With such emphasis on the "new math," designers of educational learning aids have been searching for new and improved methods and devices for teaching the fundamental concepts of the various base systems upon which mathematical computation may be predicated. An example of such an instructional aid is represented by the Neal U.S. Pat. No. 3,055,121 which discloses an educational device for converting numbers between one base system and any other. The Neal device is perhaps typical of the prior art over which the instant invention is intended to be an improvement, in the sense that Neal represents a tool for converting between one base system and another.

SUMMARY OF THE INVENTION

In contradistinction to such prior art devices and learning aids, the instant invention provides an enjoyable, exciting, competitive, but yet simple game which can be played by people of all ages quite independently of whether or not such people are interested in learning or in fact understand the fundamental mathematical principles upon which it is based. At the same time, however, continued play of the game of the instant invention stimulates those people who are interested to discover the underlying mathematical concepts involved.

As will be described in greater detail, the game of the instant invention includes at least one playing board having an array of uniquely identifiable positions thereon. Much like a "Bingo" card, a plurality of such positions have a numerical value associated therewith. Position selection means, in the preferred form an ordinary deck of playing cards, are provided for sequentially identifying a plurality of the positions and for identifying the numerical values associated therewith. In the practice of the game, the playing cards are sequentially uncovered, and the players employ markers to cover those positions on their boards which have been identified by the individual playing cards. Once any player has covered a row or column on his board, this portion of the play is halted; and, utilizing options which are available to them, the players select a particular row or column on their board with which they wish to continue the game.

After the players have selected and recorded their chosen sequence, base selection means, preferably in the form of a deck of base cards each of which identifies a particular base system, are employed to select a particular numerical base system upon which continued play of the game will be predicated. Once a particular base has been selected, the players are directed to retain (and record) only those numerals in their selected row or column which have mathematical significance in the base selected, and to treat all other nonmeaningful numerals as a zero. Finally, the numbers of the thus modified sequence of each player are converted from the particular base system which was selected to the numerical values which such modified sequence represents in another preselected base system, preferably base ten. These converted values are accumulated and represent the participants' score for that particular set of the game.

As a particularly advantageous feature of the instant invention, a degree of strategy and excitement is built into the game by employing the laws of probability and prearranging selected ones of the participants' playing boards such that (1) a player must make a strategic decision as to which type of playing board to employ and (2) given a particular board, which row or column the participant is going to choose for continued play.

As a further feature of the instant invention, a simple, compact, and novel converter is provided for directly converting numbers between the particular base system selected and the base ten system upon which the score is predicated. Conversely, the converter may be used to directly convert numbers in the base ten to their equivalent in any other base system. Since the converter of the instant invention provides a direct conversion between base systems it allows all participants to play the game regardless of their understanding of the mathematical processes involved. However, as the description hereof unfolds, it will become readily apparent that continued play of the game will inherently stimulate the participants to explore the mathematics upon which it is based.

Accordingly, it is an object of the instant invention to provide an exciting, enjoyable, competitive and stimulating game which can be employed as an instructional device for teaching mathematical principles of numerical base systems.

Another object of the instant invention is to provide such a game which can be enjoyably played by people of virtually all ages, regardless of the level of mathematical proficiency which they have achieved.

Still another object of the instant invention is to provide such a game which includes at least one playing board having an array of uniquely identifiable positions thereon, a plurality of such positions having numerical values associated therewith; position selection means for sequentially identifying a plurality of said uniquely identifiable positions and for identifying the numerical values associated therewith; base selection means for selecting a particular numerical base system on which continued play of the game is to be predicated; and conversion means for converting those identified numerical values which have mathematical significance in the particular numerical base system selected by said base selection means to numerical values in a preselected other base system.

Still another object of the instant invention is to provide a converter for converting between numerical base systems, which converter has independent application if so desired, and in its preferred form, is particularly adapted to use in the game of the instant invention.

Still another object of the instant invention is to provide such a converter which includes a planar member having a plurality of arcuately segmented distinguishable areas disposed thereon about a vertical axis thereof, each of said areas being associated with a particular numerical base system and being provided with indicia which equates numerical values in that particular base system with numerical values in another preselected base system; and selective viewing means rotatably mounted with respect to said vertical axis for viewing selected portions of said areas.

Another object of the instant invention is to provide such a game wherein a preselected number of base cards, having a preselected number of numerical base systems associated therewith, are utilized in the play of said game so as to establish a predetermined probability of retaining mathematically significant numbers for use in subsequent portions of the play.

Yet another object of the instant invention is to provide such a game wherein the mathematically most significant positions of the rows and columns of at least one of the playing boards are provided with preselected numerical values so as to predictably vary the value of said board.

Yet another object of the instant invention is to provide such a game wherein the players can be appropriately compensated for the fact that they may be employing a preselectively weighted playing card.

Other objects of the instant invention and a better understanding thereof may be had by referring to the following specification and drawings in which:

FIG. 1 is a plan view of most of the components of the game of the instant invention as they would be layed out for play;

FIG. 2 is a plan view of three playing boards utilized in the game of the instant invention;

FIG. 3 is a plan view of four of the base cards utilized in the game of the instant invention;

FIG. 4 is a plan view of a portion of the converting wheel of the instant invention;

FIG. 5 is an exploded perspective view of the converting wheel of the instant invention; and

FIG. 6 is a plan view of a portion of a score pad which may be employed in connection with the game of the instant invention.

Turning to the Figures and with particular reference to FIG. 1, there are illustrated most of the components of the game **10** of the instant invention. Broadly speaking, and as will be described in greater detail, the game includes a plurality of playing boards **12**; position selection means **14**, in the preferred form, preselected cards of an ordinary deck of regular playing cards; base selection means **16**, in the preferred form, a plurality of cards each bearing an indication of the particular base upon which continued play of the game is to be predicated; and a converter designated **18** in FIG. **5** utilized to convert numbers between one base system and another. Additionally, a plurality of transparent markers designated **20** in FIG. **1** are employed to cover the playing boards **12** in a manner to be described below.

Turning to FIG. **2**, there are illustrated in detail three of the playing boards **12** which for ease of identification have been individually identified as **12'**, **12''** and **12'''** respectively. Using the card **12'** as exemplary, it will be seen that each of the cards comprises an array of rows **22**, **24**, **26**, **28** and columns **30**, **32**, **34** and **36** so as to uniquely define, in the illustrated case, 16 positions such as **38** each of which has associated therewith a numerical value ranging from one through nine. As can be seen in FIG. **2**, each of the columns **30**, **32**, **34** and **36** is uniquely characterized, in the illustrated embodiment, by the symbols which are traditionally known as clubs, diamonds, hearts, and spades associated with the suits of an ordinary deck of playing cards. Thus column **30** may be thought of as the clubs column; **32** as the diamonds column; **34** is the hearts column; and **36** is the spades column. Thus it is possible to uniquely identify each of the 16 positions **38** established on the boards **12'**, **12''**, and **12'''** with a deck of ordinary playing cards. For example, if one turned over the two of hearts, that would correspond to the position **44** of the card **12'''**.

In fact, and as noted with respect to FIG. **1**, the position selection means **14** of the instant invention actually comprises a deck of ordinary playing cards (not shown in detail) from which have been withdrawn the "tens," "jacks," "queens," and "kings" of all suits, it being understood during the playing of the game that an "ace" is valued as one.

Thus it may be appreciated that the first part of play of the game of the instant invention is much like the popular game "Bingo" wherein some means is provided to sequentially identify a plurality of positions, and the individual participants search for, identify, and cover such positions if they are present on the boards with which they are playing. Similarly in the instant invention, each participant selects a board such as **12'**, **12''**, or **12'''** and is supplied with a plurality of markers such as **20** illustrated in FIG. **1**. Next, the individual playing cards of the position selection means **14** are sequentially revealed to identify the positions which the players should then search for on their boards. If the player's board contains the position called for by the playing card, he covers that position with one of the markers **20**. Much like "Bingo," this portion of the play is continued (that is the playing cards are sequentially revealed) until one player has covered an entire row or column of his card with the markers **20**.

In the illustration of FIG. **2**, and as illustrated by the phantom showing **20'** it has been assumed that playing cards of the position selection means **14** have been sequentially uncovered to reveal the three of clubs, the four of clubs, the five of diamonds, the eight of diamonds, the two of hearts, the four of hearts, the six of hearts, the three of spades, the six of spades, and the nine of spades. At this point this portion of the play will be terminated, since the player having card **12''** will have completely covered the row designated **22**.

Before going further into the description of the play and the other components required therefor, it should be pointed out that the four-by-four array illustrated on the playing boards **12** of FIGS. **1** and **2** has been chosen primarily because of its compatibility with the playing cards of an ordinary deck of cards. That is the four columns **30**, **32**, **34**, and **36** can be conveniently designated with the suits of an ordinary deck of cards. If desired, however, a larger array, such as five by five or six by six, can be utilized so long as (1) there is unique identifying information for each of the columns; (2) the position selection means is designed to permit the identification of the selected number of columns; and (3) the converting wheel, to be described in further detail, is appropriately modified to take into account the extra columns. As an example, a five-by-five array could be used for the boards **12** and the familiar "Bingo" letters could be used to identify each of the columns.

Assuming that play has stopped because the player utilizing the board **12''** has completed his row **22**, the players must next select the particular row or column upon which they wish to continue play. In the present game, the players have two options as to which row or column they wish to choose. The strategy involved in selecting the options will be explained in greater detail. In the first option each player may select any row or column on his board which contains at least three markers **20**, with the uncovered numeral in such a row or column being treated as a zero. In the second option, each player may select the row or column of his board corresponding to the row or column which has been completed by the participant who halted the play (again, treating any uncovered number in that row or column as a zero). For example, in the assumed game, the player employing board **12'** could select column **34** (because it has three markers **20**), or, using the second option, he could select row **22** (because it corresponds to the completed row of the participant employing board **12''**).

For the sake of illustration, let it be assumed that the player employing playing board **12'** selects column **34**. He then records the numeral sequence of this column (treating the uncovered "9" as zero) in the block **45** of the score pad of FIG. **6** which block **45** is located under the column marked "numerals" and in the row corresponding to his name (in this case simply designated **12'** for the participant). In FIG. **6** the numeral sequence 6402 has been appropriately entered in the block **45** of the score pad.

For the participant employing board **12''** let it be assumed that he chooses the numeral sequence of the completed row **22**. He therefore records the numeral sequence 4563 in the block designated **47** of the score pad of FIG. **6**.

Finally, let it be assumed that the participant employing board 12''' chooses column 36 and therefore records the numeral sequence thereof, 9603 (recall, he must treat the uncovered "5" as a zero), in the block designated 49 of the score pad of FIG. 6.

Each player having now determined and preferably recorded the numerical sequence which he will employ, the next step is to determine upon which base system the remainder of play will be predicated. This is accomplished by using the base selection means broadly designated 16 in FIG. 1 which in the preferred embodiment comprises a plurality of base cards such as those illustrated at 46, 48, 50 and 52 of FIG. 3. As shown, each of these base cards comprises a card upon which is designated a particular base system, cards 46 through 52 designating base two, ten, six and ten respectively. It will also be noted that the cards 46 and 50 also direct the participant to "keep" those particular numerals which have mathematical significance in the particular base system indicated by the respective card. For example, on card 46 which designates that the game shall continue in the base two system; since only zero and one have meaning in a base two system, the card directs the participants to "keep" only the "1's" in the mathematical sequence they have chosen. Similarly, on the base card 50, wherein the base six system has been selected, the card directs that the participants "keep" the numerals 1, 2, 3, 4 and 5, since these are the only numerals which have significance in a base six system. It will be appreciated that in the familiar base ten system (for instance selected by the cards 48 and 52) all the numerals 1 through 9 are retained and therefore there is no specific direction to keep only a prescribed group of numbers. With respect to the cards 48 and 52, the designations "−2000" and "+2000" will be subsequently explained. Also it will become apparent that the dots 96 and 100 on the base cards 48 and 52 correspond to the dots 92 and 94 on the boards 12'' and 12'''.

It will be appreciated that once the players have selected their row or column as explained above, only one base card of the base selection means 16 is turned over to reveal on which base continued play of the game is predicated. For the sake of illustration, let it be assumed that at this point in the game the base card 50 has been revealed such that the game will be based on base six from this point on.

Once the card 50 has been overturned revealing the base six as the system, the participants review their previously selected rows or columns and modify the numerical sequence thereof by doing just as the base card instructed, that is, keeping the numerals 1 through 5 and discarding (treating as zero) any of the numbers of their sequence which have no mathematical significance in the base six. For example, and dealing with the participant employing playing board 12', who has previously selected the numeral sequence 6402, his modified numerical sequence will become 0402 since the 6 has no mathematical significance in a base six system. This modified sequence 0402 has been appropriately placed in the block 53 of the score pad of FIG. 6. Additionally the base six has been written into the small box 54 located beneath the column designated "base."

For the participant employing playing board 12'', his numerical sequence 4563 becomes a modified numerical sequence of 4503 since the "6" thereof has no significance in the base six system. Similarly for the participant employing playing card 12''' his numerical sequence 9603 becomes 0003 since the "9" and "6" thereof have no significance in the base six system.

The final step in the game of the instant invention is to convert the modified numerical sequences of the individual participants to a total score. This is accomplished by converting the modified numerical sequence in the particular base selected to its numerical value in some other preselected base system. In the instant invention, the conversion is always to the base ten system such that to determine the score of each player it is necessary to convert modified numerical sequences in the base six to their equivalent value in the base ten. This is accomplished by utilizing the converting wheel 18 of FIGS. 4 and 5 hereof.

Without going into great detail at the present time as to the converter 18, it will be pointed out that such converter includes a planar member 56 which is divided into a plurality of arcuately segmented distinguishable areas disposed about a vertical axis 58 thereof. Each of these areas sequentially designated 60 through 68 in FIG. 4 corresponds to one particular base system, in this case base two through base six respectively; it being understood that on the undersurface of the planar member 56 are the remaining segmented areas 70 through 74 corresponding to the base systems seven through nine.

Dealing with the segmented area 68 for example, each of these areas contains the necessary indicia for converting a 4-digit number from the particular base system (base six) to numerical values in the base ten system. Thus in the segmented area 68, there are four partial rings of information 76, 78, 80 and 82 which contain the necessary equivalents for converting a four place number in the base six to the values of these digits in the base ten. For example, the number 4444 in the base six equals the sum of 864+144+24+4=1,036. In other words, 4444 in the base six equals 1,036 in the base ten. It should be noted that in the converter of the instant invention, the pairs of numerals provided in the partial rings of information such as 76 to 82 are full equivalents in the respective mathematical base systems, there being no intermediate step necessary in the conversion process (such as multiplying 4 times 6^2 which is the fundamental mathematical operation involved in converting the third most significant digit in 4444 to the 144 equivalent in the base ten system). Thus the converter table on the member 56 of FIG. 4 provides a direct, explicit conversion from one base system to another.

Returning now to the hypothetical game, it can be seen from the segmented area 68 of FIG. 4 that the modified numerical sequence 0402 of the participant employing playing board 12' would equal the sum of "0" (from the conversion pair 84 of the partial ring 76); 144 (from the conversion pair 86 of the partial ring 78); zero (from the conversion pair 88 of the partial ring 80) and 2 (from the pair 90 of the partial ring 82) for a total score of 146 recorded in the block 92 of the score pad of FIG. 6. Similarly, the modified numeral sequence 4503 in the base six for the participant employing playing board 12'' would, from the segmented area 68 of FIG. 4, equal the total of 864, 180, 0 and 3 or a total score of 1,047. Finally the modified numerical sequence 0003 in the base six for the participant employing playing board 12''' would equal a total score of 0+0+0+3 or 3. Thus, and at least for the present time, the winner of this particular set would be the participant employing playing board 12'' who had a total score of 1,047.

It is important to note throughout the above description that although the conversion process involved transferring between two different base systems, the participants, in using the conversion tables on the planar member 56 of FIG. 4, did not have to be aware of the mathematical principles therebehind. For example, it was not necessary for the participant of playing board 12' to understand why in the second most significant position 86 of partial ring 78, the number 4 in the base six was equal to 144. That is he did not have to multiply 4 times 6^2 to understand either exponents or bases to obtain the conversion. All he had to understand was addition to get his aggregate score.

As noted previously, a certain degree of strategy and excitement is added to the game of the instant invention by preselectively arranging certain of the playing boards 12 such that some of the boards are potentially more valuable than other boards. As a matter of fact, of the three playing boards illustrated in FIG. 2, board 12' is what may be designated as an average board, board 12'' is a good playing board, while board 12''' is a poor playing board. This fact is fairly well represented by the scores achieved in the hypothetical game described above. The manner of weighting the particular arrays will now be explained.

To begin with, it should be apparent that, roughly speaking, the most important numbers on the playing boards, so far as potential score is concerned, are those numbers residing in

rows 22 and columns 30. This is inherently so because the numbers in these rows and columns are mathematically most significant, i.e., they represent the fourth place of a 4-digit number and accordingly, are always multiplied by some base to the third power. Therefore, in order to make some of the playing boards 12 of greater or lesser value than others, it is only necessary to concentrate on the distribution of numbers in the rows 22 and columns 30 thereof.

To illustrate the system chosen, consider a deck of base cards (base selection means 16) having 20 base cards of the type illustrated in FIG. 3; and that of these 20 base cards, there are two each calling for bases two through nine and four base cards calling for base ten. Once having established the number and type of base cards it is possible to determine the probability of retaining a particular digit as the base cards are uncovered. For example, the probability of retaining the digit one is 20 out of 20 since all bases from two through ten employ a "1." Another way of saying this is that the probability of retaining a "1" is 20/20=1. At the other extreme, the probability of retaining a 9 in the game is only 4 out of 20 since only 4 of the 20 base cards call for base ten which is the only base system which has use for the number 9. Thus the probability of retaining a 9 is 4/20=0.2.

The probability for each of the numbers 1 through 9 is set forth below as follows:

P (1)=20/20=1
P (2)=18/20=0.9
P (3)=16/20=0.8
P (4)=14/20=0.7
P (5)=12/20=0.6
P (6)=10/20=0.5
P (7) 8/20=0.4
P (8)=6/20=0.3
P (9)=4/20=0.2

where P is the probability of retention of a particular digit.

Having assigned a probability of retention to the individual numbers 1 through 9, it is then possible to establish an expectation value for the digits 1 through 9 by multiplying the probability of retaining the individual digit by its value. For example, the expectation value which can be assigned to the number 2 equals 0.9×2=1.8. Similarly, expectation values for the remaining digits are set forth below:

e (1)=1×1=1
e (2)=0.9×2=1.8
e (3)=0.8×3=2.4
e (4)=0.7×4=2.8
e (5)=0.6×5=3.0
e (6)=0.5×6=3.0
e (7)=0.4×7=2.8
e (8)=0.3×8=2.
e (9)=0.2×9=1.8

where "*e*" may be said to be the expectation value associated with the digits 1 through 9.

Knowing the expectation values of each of the digits, it is possible to assign a total expectation value for the playing boards 12 simply by adding the expectation values of each of the numbers in the rows and columns corresponding to 22 and 30 in FIG. 2. Without bothering to total up the expectation value for each of the cards of FIG. 2, it can be noted from the expectation values listed above that, as a rough estimate, those playing boards 12 whose rows 22 and columns 30 include the most "5's" and "6's" will have the greatest likelihood of producing a high score in the play of the game (note that 5's and 6's have the highest expectation value of 3.0). Thus by selectively distributing 5's and 6's (and the other numbers as well) in the first row and first column of the playing boards, it is possible to preselectively vary the potential of a given playing board.

Of course, as the participants continue to play the game, they will begin to realize that certain cards produce more winning scores than others. Eventually they may appreciate or they can be told that for quick assessment a card that has the most "5's" and "6's" in the first row and column thereof is potentially, based on the laws of probability, the better card with which to play. Alternatively, and in fact in the preferred embodiment of the instant invention, weighted cards are so indicated by color coding. For example, a red dot 92 on the board 12'' of FIG. 2 indicates that the board 12'' is a "better" board. Similarly, a green dot 94 on the playing board 12''' indicates that this board is a "poor" board with which to play. Thus, the participants know before they choose that particular boards are better or worse than others. Of course, at first blush it would appear that the participants would always choose those boards having the red dot 92.

However, in accordance with the invention, certain ones of the base cards, for instance 48 and 52 of FIG. 3, include instructional information which will compensate the players for their choice of boards should that particular base card be uncovered during the play of the game. For example, should the base card 48 be uncovered during the base selection process; not only does that card indicate that play will continue in the base ten system, but the red dot 96 thereon also directs that all players employing a red dotted playing board 12 must subtract 2,000 from their score. For example, in FIG. 6 a "−2,000" has been placed in the block 98 under the appropriate column entitled "bonus or penalty" and in the row designated 12'', representing the fact that during the second set, base card 48 was selected such that the participant employing board 12'' was penalized. Similarly, should a base card such as 52 be turned over during the base selection operation, the green dot 100 thereon directs all players using a green dotted board such as 12''' to add 2,000 to their score. If desired, certain situation cards indicating penalty and bonus signals, but not naming a base, may be distributed throughout the deck of base cards.

Thus when a participant initially makes his choice of playing boards 12, he has to make a decision as to whether (1) he will select a better playing board, in which case it is possible to be penalized if a card such as 48 of FIG. 3 turns up in the base selection process; (2) to choose a poor board such as 12''', with the hope that a bonus base card such as 52 of FIG. 3 comes up during the base selection process; or (3) to choose just an average card in which there is no possibility of either penalty or bonus. This is a strategic decision on his part and would depend to a great extent on his total score relative to the other players as a new set gets under way, and also on which base cards have been uncovered in previous sets.

A second degree of strategy introduced by the laws of probability and expectation valves worked out for the instant invention has to do with the options which are available to the players when they have to pick a particular row or column upon which to continue the game. It will be recalled that the boards are covered (by turning the playing cards one at a time) until some player covers a row or column of four numbers. At that time, every player has the option of choosing any row or column on his playing board which has at least three markers thereon or choosing the row or column of his board which corresponds to the completed row or column of another participant's board.

Considering the play outlined before, it was assumed that the participant employing board 12'' had stopped the play at this point by virtue of having covered his row 22. At that time, it was assumed that the participant employing board 12''' had selected column 36 (this was permitted since it had three markers 20 thereon) with which to continue play. Actually the participant employing board 12''' had the option of using row 22 for two separate reasons: (1) this row also had three markers 20 thereon and (2) it additionally corresponded to the row 22 covered by the participant employing board 2''. From previous discussion, it was pointed out that the expectation value of a nine (the first digit in column 36 of board 12''') was 1.8 whereas the expectation value of a three (the first digit in row 22 of the board 12''') is 2.4. Therefore, strategy would have dictated, at least during the first set of the game, that the player employing board 12''' should have selected row 22 rather than column 36. If he had done so, he would have achieved a higher score (660 to be exact).

Preferably, the game is practiced by playing a plurality of sets each one identical to the set which has been described thus far. If the player is informed that there are only 20 base cards having two base cards for each of the numbers 2 through 9 and four cards for the base ten (as in the example), he can to a certain extent gear his strategy by recalling which base cards have been unturned during previous sets. For example, if the participant employing board 12''' was aware that all of the base ten cards had been used during previous sets (and recall that there are only four in the illustrated example), he most certainly would not choose column 36 in the example given since he would know that there would be no possibility of using the 9 which is the most significant digit thereof. On the other hand, if no base ten card had been used in previous sets, he might take a calculated gamble that a base ten card would come up during this particular base selection operation, with the hope of making a large score in that set.

It should be noted that if, in a particular set, a base ten card such as 48 or 52 of FIG. 3 is turned over during the base selection process, there is no need to use the conversion wheel of FIGS. 4 and 5 since by definition the 4-digit number utilized is already in the base ten.

Turning now to FIG. 5, and the details of the converter wheel 18, it was previously described, with respect to FIG. 4, that the converter wheel includes the planar surface 56 on opposite sides of which are disposed the distinguishable segmented areas 60 through 74 corresponding to the base systems two through nine with each one of such areas containing the necessary indicia to directly convert the numbers utilized in the respective base system to their equivalent value in the base ten system.

For instance, the segment 68, drawn in detail to illustrate conversion from base six to base ten, includes the partial rings 76 through 82, each being divided into six pairs of numbers necessary to make the direct conversion required from a 4-digit number in the base six to values in the base ten Likewise, the segment designated 60 in FIG. 4 contains four partial rings of information each ring having two pairs of numbers necessary to convert a 4-digit number in the base two system to the equivalent in the base ten system. It should be noted that, for the sake of drawing simplicity, the detailed indicia of the segments 62 through 66, and the total undersurface of the planar surface 56 have been eliminated.

Turning to FIG. 5, and dealing only with the upper half thereof (it being understood that the lower half is identical) to facilitate the conversion process, there are provided a plurality of disclike members 102, 104, 106 and 108 each of which is individually rotatably mounted about the axis 58, for example by means of a threaded pin 109 being inserted through the entire assembly along the axis 58. The disclike member 102 includes a viewing aperture 110 which is radially spaced from the axis 58 so as to overlie the ring of information defined by the partial rings 82 disposed on the planar surface 56 therebeneath. Similarly the disclike member 104 includes a viewing aperture 112 radially disposed from the axis 58 so as to overlie the ring of information defined by the partial rings 80. In like manner, the disclike member 106 includes a viewing aperture 114 radially spaced from the axis 58 so as to overlie the ring defined by the partial rings 78, and the disclike member 108 includes a viewing aperture 116 radially spaced from the axis 58 so as to overlie the ring of information defined by the partial rings 76 on the planar surface 56. Furthermore, in order to make sure that the lower disclike members do not block the viewing apertures of the disclike members thereabove, the lower disclike members 104, 106 and 108 include arcuate cutout sections 118, 120 and 122 respectively.

In operation, and working with the previous example, let it be assumed that it is desirable to convert 0402 (the modified numerical sequence of the participant employing board 12') to its value in the base ten system. The user simply rotates the disclike members 102 through 108 such that the viewing aperture 116 overlies the position identified as 84 in FIG. 4; the viewing aperture 114 overlies the position 86 in FIG. 4; the viewing aperture 112 overlies the position 88 of FIG. 4; and the viewing aperture 110 overlies the position 90 of FIG. 4. In this manner, the user can simply read off the equivalent values in the base ten and need only add the individual values to achieve his score of 146. As noted previously, the converter wheel 18 provides the necessary conversion directly, i.e., each pair gives the equivalent numerical values, such that the user need not understand the mathematical concepts involved to utilize the converter.

Finally when a converter employing the above-described inventive concepts is specifically designed for use in the game of the instant invention, it can be tailored to facilitate play. Thus, and with reference to FIG. 4, along the outer periphery of the segmented areas of the planar surface 56, there are provided distinguishable color-coded arcuate segments 124, 126, 128, 130 and 132 which by predesign have the same colors as the ink utilized with respect to base numbers on the base cards of FIG. 3. For example, for the base card 50 of FIG. 3, the base "six" would be printed in blue ink, and similarly the arcuate segment 132 of FIG. 4 would be coded with a blue coloring. In this manner, when a base six card comes up the user quickly knows to rotate all of the disclike members 102, 104, 106 and 108 to that section of the planar surface 56 which is defined by the blue arcuate segment 132 imprinted thereon before he individually rotates the discs to find out his modified sequence.

Additionally, and with respect to the converter per se, those numbers of the pairs in the segment 68 which represent base six values are colored blue also. This helps the user to identify which numeral of each pair relates to base six, the remaining (black) numeral being the equivalent in base ten.

Although the converter 18 of FIG. 5 is illustrated in exploded perspective view, it will be appreciated that in its assembled condition all discs are closely stacked one upon another such that the overall thickness of the converter may be in the order of a quarter inch. This compact, easy-to-use converter wheel is simple to manufacture, simple to assemble and therefore in and of itself presents a significant improvement over similar converter wheels presently available.

It will be appreciated that the converter 18 of FIG. 5 can be used for the converse operation, i.e., to determine the equivalent of a base ten number in any other base. As will be shown, by virtue of the instant invention, this conversion can be performed with relative ease employing only addition and subtraction and does not require multiplication, division or a knowledge of exponents.

For example, suppose it is desired to convert 128 in the base ten system to its equivalent number in the base six system. One simply rotates the disc-type members 102 through 108 over the "base six" area 68 until he finds the largest numeral less than 128. It can be seen in FIG. 4 that this would be 108 which would appear adjacent the numeral 3 through the viewing aperture 114 of the disclike member 106. The difference between 128 and 108 is 20. Therefore, one next examines the numbers in area 68 and finds the largest number less than 20. This is the number 18 of the pair 3, 18 and would appear through the viewing aperture 112 of disclike member 104. Next one takes the difference between 20 and 18 which is 2. He would find on area 68 that the equivalent of 2 in the base ten is 2 in the base six. This pair of numbers 2, 2 would be seen when the viewing aperture 100 of disclike member 102 was rotated over the portion 90 indicated in FIG. 4. Thus; $128_{ten}=332_{six}$ or in other words, 128 in the base ten may be expressed as 332 in the base six.

From the above it will be seen that the entire game of the instant invention can be played without the participants understanding the underlying mathematical concepts. However, it should be apparent that continued play will stimulate the minds of the participants into attempting to apply the laws of probability and additionally should stimulate some participants to inquire further into the fundamentals of the various base systems. The additional information necessary for understanding the base systems and the laws of probability can

be provided in an appropriate portion of the instruction booklet which accompanies the game or it can be provided by an instructor.

Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be limited, not by the specific disclosure herein, but only by the appended claims.

I claim:

1. A game apparatus comprising:

a playing board having an array of uniquely identifiable positions thereon, a plurality of said positions having numerical values associated therewith;

position selection means for sequentially selecting a plurality of said uniquely identifiable positions;

base selection means for selecting a particular numerical base system on which continued play of the game is to be predicated; and

conversion means for converting those selected numerical values which have mathematical significance in the particular numerical base system selected by said base selection means to numerical values in a preselected other base system.

2. The game apparatus of claim 1 wherein there are at least two criteria for uniquely identifying said uniquely identifiable positions and wherein said numerical values associated with said uniquely identifiable positions constitute one of said criteria.

3. The game apparatus of claim 2 wherein said array includes a preselected number of rows and columns defining a number of said positions equal to the product of said number of rows and number of columns, and wherein each of said columns is identified by a different characteristic which establishes the second criterion for uniquely identifying said positions.

4. The game apparatus of claim 3 wherein there are four rows and four columns, and said characteristics are the four suit symbols of a deck of regular playing cards.

5. The game apparatus of claim 4 wherein said position selection means comprises those cards of a regular deck of playing cards ranging in value from "ace" through nine; whereby, as the individual ones of said playing cards are uncovered, the suit and numerical value thereof will identify corresponding ones of said uniquely identifiable positions in said array.

6. The game apparatus of claim 5 and further including marker means positionable on said playing board for recording the fact that certain ones of said positions have been identified by said playing cards.

7. The game apparatus of claim 1 and further including marker means positionable on said playing board for recording the fact that certain ones of said uniquely identifiable positions have been selected by said position selection means.

8. The game apparatus of claim 1 wherein said base selection means further includes indicia constituting instructional information for directing the retention of only those numerical values which have mathematical significance in the particular numerical base system selected by said base selection means.

9. The game apparatus of claim 1 and further including a second playing board having an array of uniquely identifiable positions thereon, a plurality of said positions of said second board having numerical values associated therewith; said position selection means including means for sequentially selecting a plurality of said positions of said second board.

10. The game apparatus of claim 9 and further including marker means positionable on said first and second playing boards for recording the fact that certain ones of said positions of said first and second boards have been selected by said position selection means.

11. The game apparatus of claim 9 wherein the numerical values on at least one of said first and second boards consist predominantly of numerals 5 and/or numerals 6, whereby to provide a weighted distribution of numerical values so as to predictively vary the probability of retaining mathematically significant numbers in the numerical base system selected by said base selection means.

12. The game apparatus of claim 11 wherein said base selection means includes indicia constituting instructional scoring information for compensating for the fact that said one of said first and second boards includes said weighted distribution of numerical values.

13. The game apparatus of claim 9 wherein said base selection means comprises a plurality of cards each bearing indicia identifying a particular numerical base system.

14. The game apparatus of claim 13 wherein as preselected number of said cards designating base systems consisting predominantly of base ten is utilized in the play of said game so as to establish a predetermined probability of retaining mathematically significant numbers in the particular numerical base system selected when one of said cards is uncovered.

15. The game apparatus 14 wherein there are at least two criteria for uniquely identifying said uniquely identifiable positions and wherein said numerical values associated with said uniquely identifiable positions constitute one of said criteria; and

wherein each of said arrays includes at least a preselected number of rows and columns defining a number of said positions equal to the product of said number of rows and number of columns, and wherein each of said columns is identified by a different characteristic which establishes the second criterion for uniquely identifying said positions.

16. The game apparatus of claim 15 wherein the mathematically most significant positions of the rows and columns of at least one of said boards are provided with numerical values consisting predominantly of numerals 5 and/or numerals 6 so as to predictively vary the numerical value which will be established by said conversion means.

17. The game apparatus of claim 16 wherein selected ones of said base cards are provided with indicia constituting instructional scoring information for compensating for the fact that the mathematically most significant positions of the rows and columns of the array of said one of said boards have been provided with said predominant numerical values.

18. The game apparatus of claim 1 wherein said conversion means comprises:

a planar member having a plurality of arcuately segmented distinguishable areas disposed thereon about a vertical axis thereof;

each one of said areas being associated with a particular numerical base system and being provided with indicia which equates numerical values in that particular base system with the numerical value of said numerical values in another preselected base system; and

selective viewing means rotatably mounted with respect to said vertical axis for viewing selected portions of the indicia of said areas.

19. The game apparatus of claim 18 wherein said planar member is provided with identifying indicia for identifying the numerical base system associated with each of said areas; wherein said base selection means comprises a plurality of cards, each bearing indicia identifying a particular numerical base system; and

wherein said identifying indicia on said planar member and the indicia on said base cards are coded so as to more easily identify that area of said planar member which corresponds to the base system selected by one of said base cards.

20. The game apparatus of claim 18 wherein there are at least two criteria for uniquely identifying said uniquely identifiable positions and wherein said numerical values associated with said uniquely identifiable positions constitute one of said criteria; wherein said array includes a preselected number of rows and columns defining a number of said positions equal to the product of said number of rows and number

of columns, and wherein each of said columns is identified by a different characteristic which establishes the second criterion for uniquely identifying said positions; and

wherein the indicia in each of said areas includes a plurality of partial rings of information corresponding in number to said preselected number of rows and columns.

21. The game apparatus of claim 20 wherein each of said partial rings of information includes a plurality of pairs of numbers equating a numerical value in the respective base system to a numerical value in said other preselected base systems; the number of pairs of numbers in each partial ring being equal to the number which designates the particular base system to which the respective area corresponds.

22. The game apparatus of claim 21 wherein said selective viewing means comprises a plurality of disclike members stacked one above the other on said planar member, each of said disclike members having an aperture radially located from said axis to rotatively overlie a respective one of the total rings of information defined by the sum of said partial rings of information each of said apertures being dimensioned to reveal one of said pairs of numbers.

23. The game apparatus of claim 22 wherein successive lower ones of said disclike members include annular removed portions so as to noninterruptingly permit pairs of numbers on said planar member to be viewed by the aperture in successively higher ones of said disclike members.

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