United States Patent [19]

Lou

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[54] **DYNAMICALLY INTERACTING TOY BLOCKS**

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[73] Assignee: **Lotus Games, Inc.**, St. Paul, Minn.

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[52] **U.S. Cl.** ..... **35/69**, 46/1 R, 46/24, 273/137 B

[51] **Int. Cl.** **A63h 33/04**

[58] **Field of Search** ..... 35/22 A, 69; 46/1 R, 24, 46/25, 26; 273/137 AC, 137 AD, 137 B, 137 C, 137 D, 137 W

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Attorney, Agent, or Firm—Neil B. Schulte

[57] **ABSTRACT**

A toy block of specially chosen dimensions, construction, shape, and weight so as to be ideally suited for stacking, balancing, and tumbling in such a way as to teach concepts of weight, counterweight, balance, friction, levers, inertia, and momentum. Additional concepts in the field of electronics may be taught through analogies drawn between the block constructions and various electronic components.

2 Claims, 19 Drawing Figures

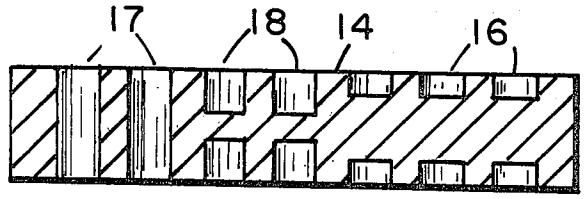


FIG. 1

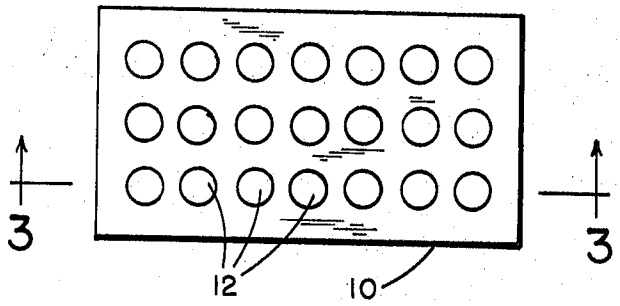
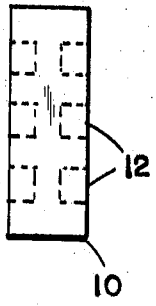


FIG. 2



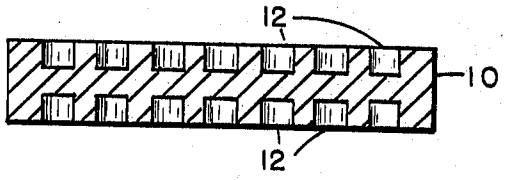


FIG. 3

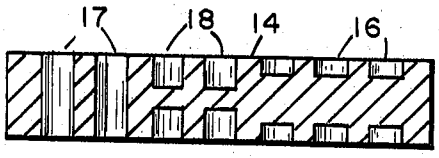


FIG. 4

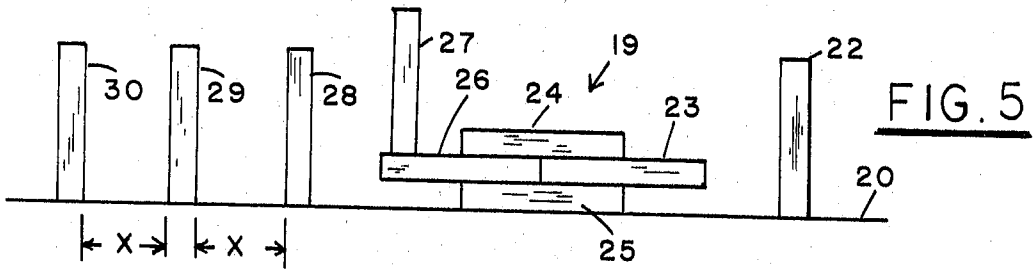


FIG. 5

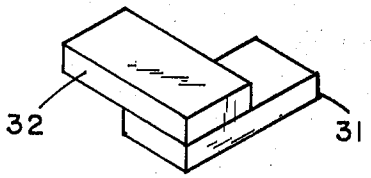


FIG. 6

FIG. 7

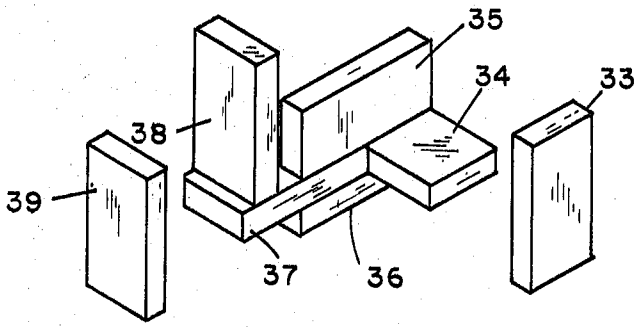


FIG. 8

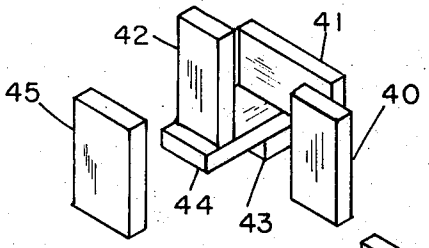


FIG. 9

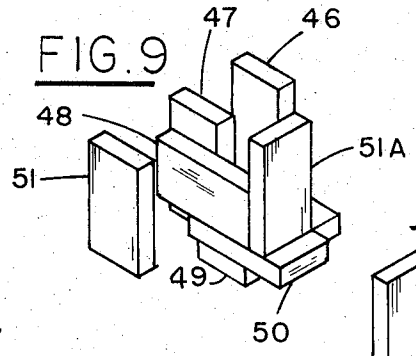
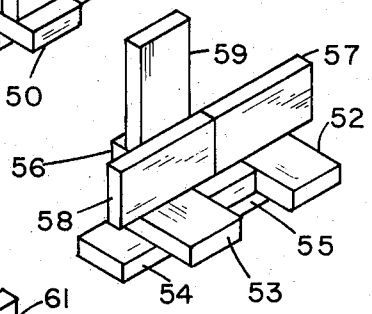


FIG. 10



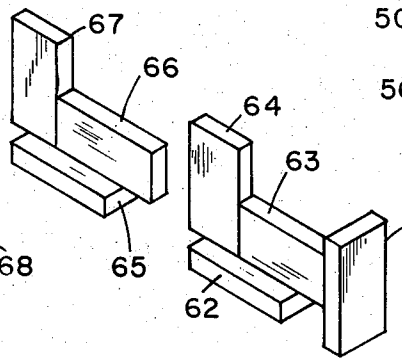
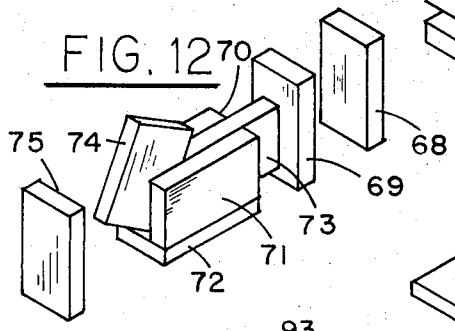


FIG. 11

FIG. 12



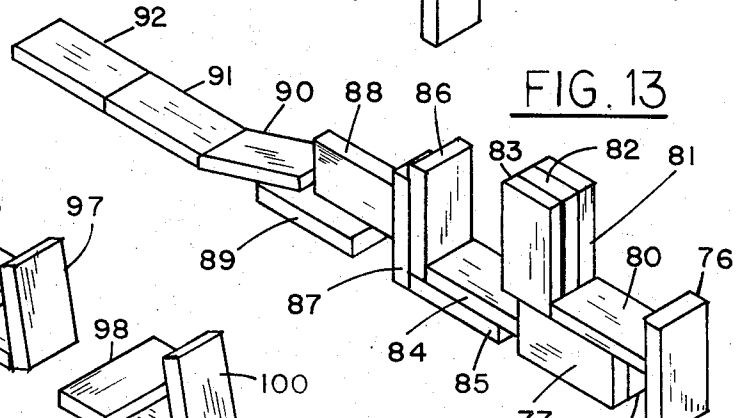
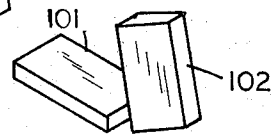


FIG. 13

FIG. 14



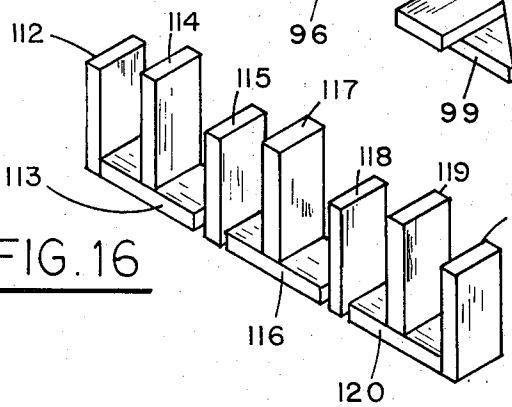
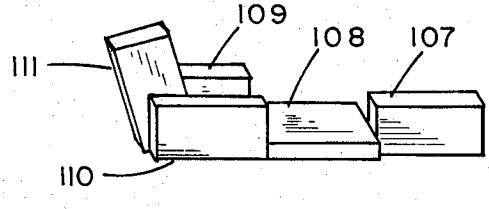
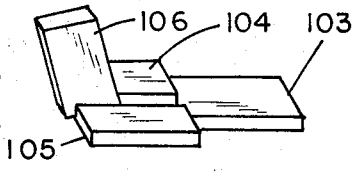


FIG. 16

FIG. 15





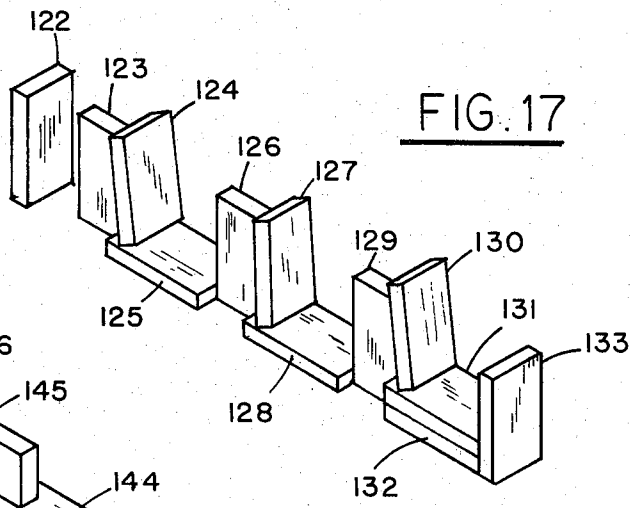


FIG. 17

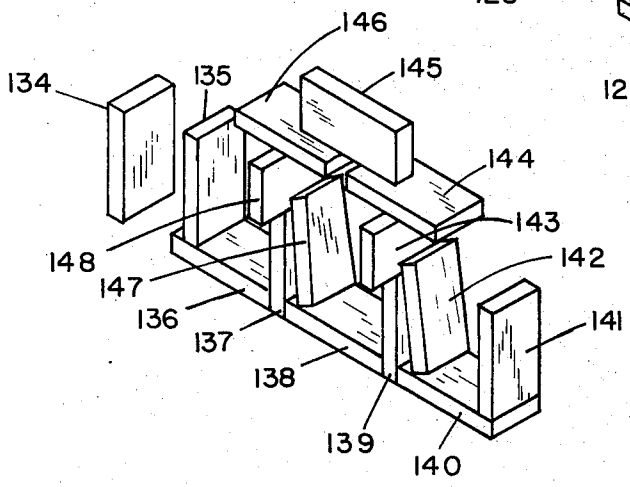


FIG. 18

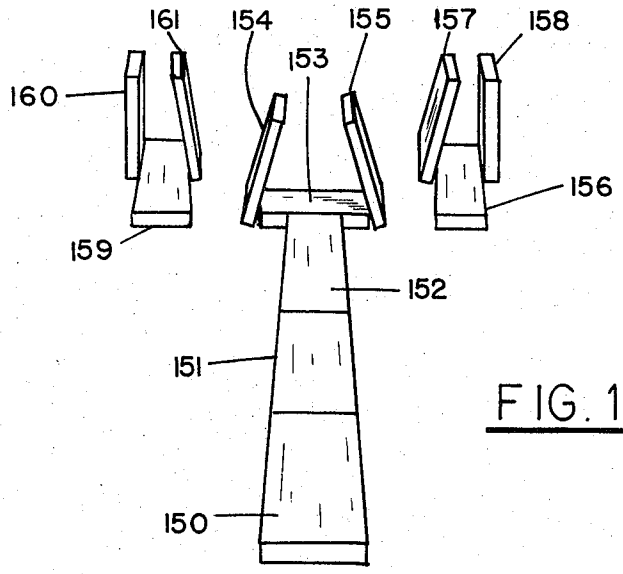


FIG. 19

DYNAMICALLY INTERACTING TOY BLOCKS

BACKGROUND OF THE INVENTION

In the prior art it is not uncommon to see blocks which can be placed in a row so that as one block begins to fall it strikes another block which in turn strikes a third block and so on to produce a chain reaction. As a play activity this has been done most frequently with the small blocks known as dominoes. In fact, the activity is so well known as to give rise to the now common phrase "domino effect" suggesting any type of chain reaction. However, the blocks employed in the prior art are not generally intended for this purpose and do not accomplish the chain reaction result as well as might be desired. The domino-type blocks are formed with various irregularities which interfere with the tumbling action and the size and weight of the blocks are not standardized. In order to better demonstrate the principles of balance, friction, momentum, and leverage it is necessary that the blocks be more carefully designed. My invention accomplishes this end by providing a very specialized block specifically designed for the purpose as will be described below.

SUMMARY OF THE INVENTION

Briefly, my invention contemplates a rectangular toy block which is provided with faces of the proper smoothness so as to provide a slight amount of friction. The block is twice as long as it is wide and three times as wide as it is thick. The utility of these dimensions is discussed at length later. A series of indentations is provided in each of the large faces of the block which indentations assist in the molding process. The blocks are made from plastic and the indentations insure that during the cooling of the plastic the block does not significantly change size from its predetermined dimensions. In a second embodiment of the invention these holes are caused to have different depths at one end of the block than the other end so as to make the block heavier at one end. This intentional unbalance assists in stacking the blocks and also assists in the tumbling action. It may therefore be seen that it is an object of my invention to provide a plurality of toy blocks especially designed with the proper weighting, dimensions, size, and surface characteristics to lend themselves well to complicated dynamic interactions. Further objects and advantages will become apparent upon consideration of the following descriptions and drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a view of the large face of the block showing the molding indentations therein.

FIG. **2** is an end view of the block of FIG. **1.**

FIG. **3** is a first sectional view of the side of the block of FIG. **1** showing the indentations arranged according to the first embodiment.

FIG. **4** is a second sectional view of the side of the block of FIG. **1** showing a second embodiment with different depth indentations at the two ends of the block so as to provide preferential weighting at one end of the block.

FIG. **5** shows a first arrangement of the blocks which may be employed to achieve dynamic interactions.

FIG. **6** demonstrates how the weighting of the blocks assists in their stacking.

FIG. **7** shows another way of dynamically interacting the blocks while turning a corner.

FIG. **8** shows a construction of the blocks in which the direction of tumbling is reversed.

FIG. **9** shows a combination of blocks referred to as a splitter since the input energy can be directed into different outputs.

FIG. **10** shows a combination of blocks called an and-gate requiring two inputs to trigger the output.

FIG. **11** shows a combination referred to as a diode since energy is transfered in one direction only.

FIG. **12** shows a combination referred to as a toggle which demonstrates principles of friction and momentum.

FIG. **13** shows a combination of blocks called an amplifier since the energy input is amplified during the tumbling process.

FIG. **14** shows a combination of blocks referred to as a tensor which utilizes blocks balanced carefully on their ends.

FIG. **15** shows another combination in which balanced blocks are stabilized by frictional contact with blocks positioned beside them.

FIG. **16** shows a combination of blocks which may be compared to an electronic delay line since the transmittal of energy through the blocks is slowed.

FIG. **17** shows another combination of blocks in which the transfer of energy is slower than normal.

FIG. **18** is a more complicated combination of blocks in which momentum is transferred without disturbing the blocks balanced above the transmitting blocks.

FIG. **19** shows a random output configuration wherein the blocks are combined in such a way that the direction of the flow of energy is unpredictable.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. **1** and **2,** front and end views of the block of the present invention are shown. As can be seen, the block **10** is provided with a number of cylindrical indentations **12.** These indentations are produced when the block is molded from plastic. By providing indentations **12,** heat setting plastics may be used to form the blocks without danger of the block changing appreciably in size during cooling.

The block is precisely twice as long as it is wide. This ratio is chosen so that the blocks may be placed with half of one block resting on top of half of another block such as shown in FIG. **5** or FIG. **6.** Whether the blocks are at right angles or directly in line, one half of the top block rests directly above one half of the lower block with the sides in flush alignment. When the blocks are positioned directly above one another in this way they rest in exactly neutral balance. In the first embodiment this neutral balance is important to the tumbling action of the blocks.

The indentation pattern chosen for the first embodiment is shown in the sectional drawing of FIG. **3** which comprises a section on line **3—3** of FIG. **1.** It can be seen that the depth of the indentations is constant across the length of the block. A second embodiment is shown in FIG. **4** wherein the holes **18** at one end of the block are made deeper than the holes **16** at the other end of the block. This second embodiment provides a block which is heavier at one end so that a non-neutral balance condition can be effected. With a non-neutral balance the arrangement shown in FIG. **6** is sta-

ble wherein a block **32** can be rested on top of a block **31** with the edges exactly coinciding with no danger of block **32** tipping downward. Even greater unbalance can be had by forming some indentations into complete holes **17** through the block. In one embodiment using holes passing through the block the balance point was shifted about 1 millimeter.

Returning to FIG. **2** it may be seen that the third dimension of the block, the thickness, is chosen to be exactly one third the width of the block. Although it is also possible to build blocks which have a thickness ranging from one half to one fifth of the width it has been found most preferably to provide a block which is exactly one third the width. In the numerous examples of dynamic interaction that follow the usefulness of this one third dimension will be discussed at greater length. Although the absolute size of the block may vary over a substantial range the preferred embodiment has been constructed with blocks having a thickness of 7 millimeters, a width of 21 millimeters, and a length of 42 millimeters. This size block has been found to be convenient to handle and ideal for building the various constructions shown in FIGS. **7** through **19** without exceeding the area of a typical table top. The smaller cylindrical indentations shown in FIG. **4** are approximately 1 ½ millimeters deep whereas the deeper indentations are approximately 3 millimeters deep. The holes are roughly 4 millimeters in diameter. These dimensions are exemplary only.

It is essential that a substantial portion of the surface of the block be relatively smooth and planar so that the blocks can readily slide upon each other. If desired, the indentations may be omitted entirely, thus, ensuring a completely smooth and planar surface.

In the various constructions shown in FIGS. **7** through **19** the blocks are balanced and stacked so that as an input block is caused to fall against the next successive block, a chain reaction is initiated involving a number of different mechanical effects demonstrating principles of levers, transfer of momentum, balance, friction, and inertia. Since each block transfers its energy to the next block the entire construction may be thought of as incorporating a flow of energy. This flow can be made to turn abruptly or reverse direction. It can be caused to jump to a higher level, hesitate, appear to act at a distance, or provide random and unexpected actions. Because of these effects electrical circuit analogies and terminology are adopted for descriptive purposes. This terminology has been found to add to the teaching capabilities of the blocks by introducing some electronic concepts into the play activity.

The simplest interaction of the blocks is accomplished by simply standing them on edge in a row and tipping one over into the next block which then continues on into the next block providing a chain reaction of tumbling. Such an arrangement is shown on the left in FIG. **5** along with the first type of construction to be shown herein. This block construction **19** is termed a relay and is formed on a surface **20** by a base block **25** supporting a key **23,** a tongue **26,** and a cap **24.** When using a neutral balance block of the type shown in FIG. **3,** key block **23** and tongue **26** must be held in place while cap **24** is positioned. The use of an unbalanced block, such as shown in FIG. **4,** however, is easier since the weighted ends can be placed inward over block **25** and they will support themselves. After cap **24** is in position an output block **27** is balanced on tongue **26** as shown. Block **22** is referred to as the input block and blocks **28, 29,** and **30** comprise a series of follower blocks spaced apart by a distance *x*. In all simple chains such as the one shown in FIG. **5** by blocks **28, 29** and **30,** the distance *x* can vary over a small range. In the preferred embodiment it has been found most desirable to make this distance approximately 28 millimeters or approximately four times the thickness of the block. Varying this distance varies the speed of the chain reaction.

In FIG. **5** the flow of energy is initiated by tipping block **22** onto key **23.** The weight of block **22** against block **23** levers cap **24** upwards allowing tongue **26** to tip downwards. Output block **27** falls against block **28** which in turn falls against block **29** and so on. The relay of FIG. **5** is a simple straight forward one demonstrating simple concepts of balance and levering. In FIG. **7** a relay is shown in which the transfer can be made to turn a corner. Block **33** falls onto key **34** upsetting vertically positioned cap **35.** The tongue **37** tips off the end of base **36** allowing block **38** to fall into block **39** and so on.

A still more complicated relay is shown in FIG. **8** wherein the flow of energy is reversed in direction. Block **40,** which may be at the end of another series of relays, falls into block **41.** Block **41** is positioned somewhat differently here and referred to as a wing. Wing block **41** falls backwards off block **44** which then tips downward on base **43** allowing block **42** to fall into block **45.** The advantage of having a block weighted at one end for use as wing **41** is here apparent where the heavier end could be positioned over block **44** so that the maximum portion of wing **41** may be extended out into the path of input block **40.** It should be noted that the embodiment of FIG. **8** can be worked backwards while eliminating block **42.** The input action of block **45** falling on block **44** would tilt wing **41** forwards into block **40** initiating a transfer of energy in the opposite direction.

A more complicated relay is shown in FIG. **9** wherein the energy flow can be split into two paths by a single input from block **46.** Block **46** falls onto block **47** and block **47** continues the momentum transfer into block **51** while at the same time pivoting a wing cap **48** off a tongue **50.** With the weight of wing **48** removed the weight of output block **51***a* tilts tongue **50** downwards so that block **51***a* falls to the right in second direction. Thus, two output blocks **51** and **51***a* are provided. The constructions shown to this point have been termed relays in accordance with their analogous behavior to electronic relays. In FIG. **10** a construction is shown which continues the electronic analogy by simulating an and gate.

The construction of FIG. **10** provides an output from two inputs. Blocks falling on key **52** or key **53** upset the caps **57** or **58.** But either cap **57** or **58** will hold down the end of tongue **56** resting upon base blocks **54** and **55.** If both of these caps **57** or **58** are removed tongue **56** falls allowing output block **59** to continue the transfer of energy.

Still another electrical analogy construction is shown in FIG. **11** wherein a diode is constructed. In FIG. **11** the transfer of energy from block **60** falling against block **61** is transferred through a block **63** resting on a base **62.** This jars vertical output block **64** sufficiently to tilt off the end of base block **62** into a second bar **66** resting on a base **65.** Bar **66** repeats the action by tilting

vertical output block **67** into another chain of blocks. Since the transfer of energy can take place in one direction only in these constructions the analogy to electronic diodes is evident.

FIG. **12** shows another one way energy transfer device which is termed a toggle. The output block **74** is balanced on one corner between a pair of blocks **70** and **71** on top of a base **72.** Here the utility and symmetry of using blocks which have a thickness one third the width is evident since the blocks conveniently provide side panels for output block **74** which do not extend beyond the edges of base block **72.** The input of energy comes from block **68** falling against block **69** which drives block **73** against block **74** causing it to tilt outwards follower block **75.**

The construction of FIG. **13** is useful in teaching concepts of amplification. The input is directed against block **76** which forces a block **80** against three blocks **81, 82** and **83** all resting on top of a group of three blocks **77, 78** and **79.** As the three blocks fall against blocks **86** and **87** a considerable amplification is produced due to the increased weight of the three blocks being toppled. This effect can be enhanced even more by using unbalanced blocks with the heavy ends at the top. On the contrary, the effect can be lessened and the amplifier made more stable by positioning the blocks with the heavy ends downward. Either way amplification is achieved and the impact is transmitted through a vertically positioned block **88** on top of a base block **89** to a series of directly contacting blocks **90, 91,** and **92.** The transfer of energy through the series of blocks **90** through **92** is helpful in teaching the concepts of momentum and can be extended for quite a distance along a relatively smooth surface by adding more blocks.

In FIG. **14** a construction is shown which is reffered to as a tensor. Input block **93** falls against transfer block **94** nudging base block **96.** The delicately balanced output block **97** falls backwards onto block **95** and, in the process, slides forward into base block **99.** The action is repeated, block **100** falling onto block **98** and sliding forward into block **101.** Edgewise balanced block **102** tilts forward continuing the transfer of energy.

In FIG. **15** a construction is shown which is named a tactil. Two versions are shown. In the first version an output block **106** is delicately balanced but held in position by means of sideways frictional contact with guide blocks **104** and **105.** In the second version an output block **111** is more securely held by additional surface area contact with guide blocks **109** and **110.** Using uneven weight blocks with the heavy end down greatly facilitates balancing blocks **106** and **111.** As the input momentum is tranferred through block **103** the frictional balance is disturbed causing output block **106** to fall against block **107.** The transfer of energy through inertial contact with block **108** upsets output block **111** in a similar fashion.

In FIG. **16** a delayed action chain reaction is shown. An input from ether end initiates a slow chain reaction down the line of blocks. For example, the reaction may proceed through blocks **112, 114, 115, 117, 118, 119** and out through **121.** However blocks **115** and **118** must do work before they can fall, that is, they must move the base of blocks **113, 116** or **120.** This takes time and slows the transfer of energy. The amount of slowing is dependent upon the spacing between base blocks **113, 116** and **120.**

Another variation is shown in FIG. **17.** Input block **122** falls against block **123** and the direct transfer of energy through block **123** causes block **124** to tilt over into block **126.** The action continues with block **127** tilting into block **129** and block **130** tilting into output block **133.** In FIG. **17** it may also be seen how the transfer of energy can be continued while gaining height. Base blocks **125** and **128** raise the height one block thickness while base blocks **131** and **132** raise the height of action by two thicknesses of blocks. The height may be increased indefinitely by adding additional blocks underneath the vertical transfer blocks as well.

A similar type of energy transfer is shown in FIG. **18.** Block **134** falls against block **135** which falls against transfer block **148.** The energy is carried through to tilt block **147** into transfer block **143.** Block **142** is then tilted into output block **141.** Although energy is transferred through this construction blocks **143** and **148** remain in position on top of vertical support blocks **137** and **139** so that the balanced blocks **144, 145** and **146** remain undisturbed.

Finally, in FIG. **19,** a construction is provided wherein a random output is produced. The input energy is inertially transferred down blocks **150, 151** and **152** so as to disturb base block **153.** Carefully balanced blocks **154** and **155** are upset and they fall. However, one of the blocks **154** and **155** falls first. The second block lands on top of it and slides outward striking either block **156** or block **159.** This impact in turn causes either block **157** or block **161** to fall into blocks **158** or **160** producing an output in one of two directions. The other direction is undisturbed and predicting the outcome is virtually impossible.

In the constructions that have been shown only a small fraction of the number of possibilities have been covered. A representative variety of dynamic interactions have been shown and suggested which demonstrate various principles of mechanics. All of these principles can be reliably and repeatedly demonstrated due to the unique design configuration of the blocks of the present invention.

I claim:

1. A dynamically active rectilinear toy block having first, second, and third pairs of faces, said faces being planar and substantially smooth over a substantial portion of their surfaces and the planar portions of each pair of faces comprising rectangular parallel surfaces, the first, second, and third orthogonal dimensions of the block having predetermined ratios with the first dimensions being about three times the second dimension and the third dimension being about twice the first dimension and in which both of the faces defined by said first and third dimensions include a plurality of holes of similar diameters therein which vary in depth and are deeper at one end of the block to make that end of the block lighter.

2. The block of claim **1** in which some of said holes at the lighter end of the block pass through the block to make that end of the block still lighter.

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