

K'Nex Ball Amusement Machine - The Ball Unit

Introduction



This is an amusement machine which is made almost entirely from K'Nex. The non-K'Nex components are the balls (which are made of bouncy rubber), the signs and the column labels.

There are two slots; one is for children's use and is low down, and the other (near the top of the machine) is for adults' use. When a ball is inserted in the lower slot, a chain hoist raises it to the level of the higher slot – it's powered by a 12-volt K'Nex motor.

Each inserted ball runs down a channel near the top of the machine and bounces down an array of pins. It then lands in one of 14 columns.

Each column can hold up to seven balls. A full column is indicated by a pink flag (in the picture on the left, columns 4, 9 and 10 are full). When an eighth ball enters a column, the seven balls are released into a winnings tray. The winning ball ends up in a box at the base of the machine.

If one of the three columns at the far left or far right of the machine is filled, all three columns get emptied into the tray.

There are some 'blockers' between some of the pins so that the balls end up fairly evenly distributed through columns 4 to 11. The three columns at each end are visited less frequently.

The part of the development which was most time-consuming was the design of the ball unit (there are 14 of these - it's the part which holds up to seven balls and then releases them when an eighth ball enters it). It was important that no ball was left in the column after a win, and that the bottom of the column was always closed afterwards. There would have been a lot of time wasted if, after the assembly of the machine, a flaw was found.

The centres of the ball units are 75mm apart.

The Balls

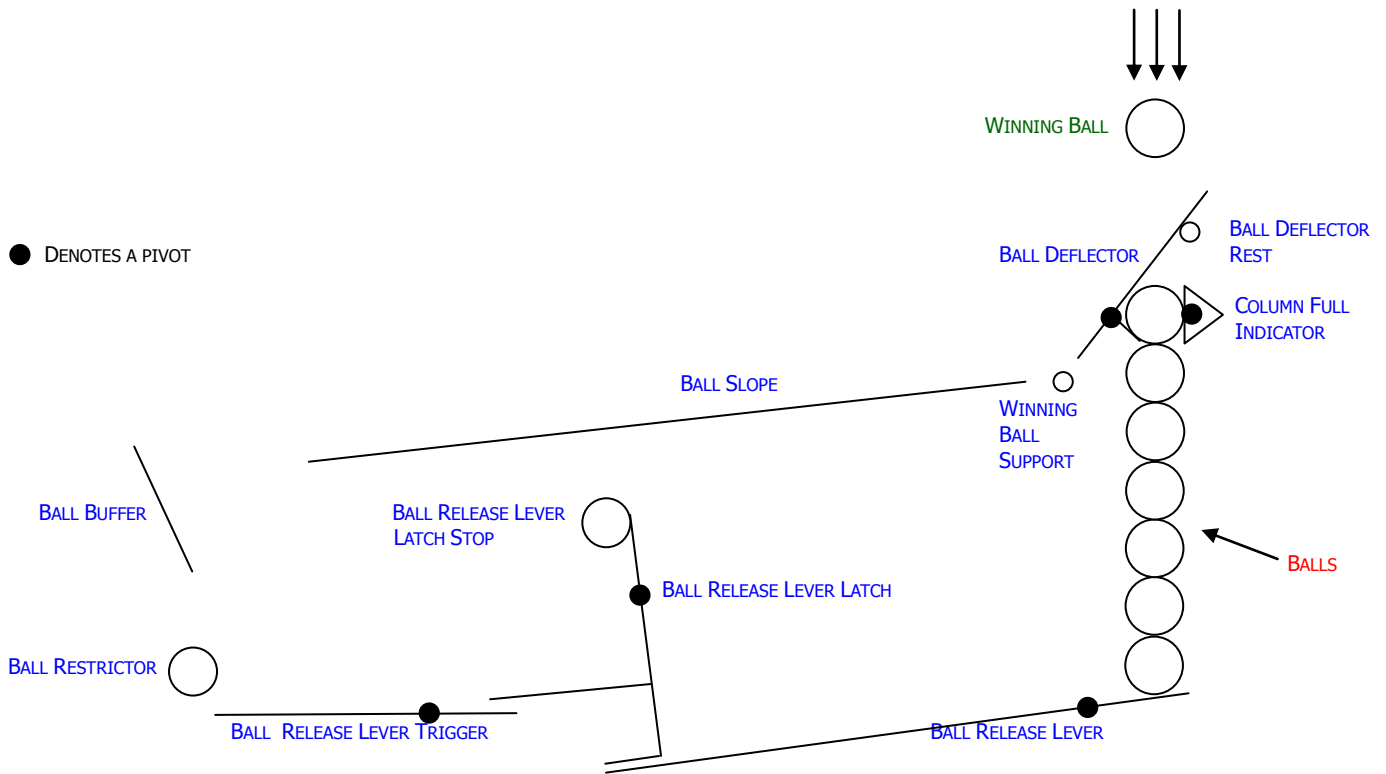
The balls are made of some kind of bouncy rubber (K'Nex balls are far too light for the mechanism to work). A box of new 400 balls was bought from an eBay seller. There were four different types of ball, about the same number of each. A quarter of them were slightly larger but about 20% lighter than the ones which were used and they didn't work very well. Another quarter felt slightly tacky, and the increased friction meant that they didn't work well either. The last quarter had a surface which was more like fabric than rubber, and they tended to slide down the pins instead of bouncing on them.

The balls used are pictured on the right. Each one weighs between 47 and 55 grams and no problems have been encountered (the weight is the same for identical designs, but some designs are heavier than others for some reason). Each ball has a diameter of 44mm, but they are not perfectly spherical: some diameters are as low as 43mm, and some are up to 45mm. These variations do not matter, because the ball unit has been tweaked so that all the balls work.



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Schematic Representation of the Mechanism (Not to Scale)



Summary of the Method of Operation

This is to be read in conjunction with the photos which follow.

The seventh ball in a column activates the Column Full Indicator (FIG. 1). An eighth ball is deflected by the Ball Deflector (FIG. 2) which is resting on the Ball Deflector Rest (FIG. 3) so that it passes over the Winning Ball Support (FIG. 4) and then runs down the Ball Slope (FIG. 5). The ball then hits the Ball Buffer (FIG. 6), from which it is thrown into the cradle of the Ball Release Lever Trigger (FIG. 7). This trigger then lifts the Ball Release Lever Latch (FIG. 8) which is kept upright by the Ball Release Lever Latch Stop (FIG. 9). This in turn unlocks the Ball Release Lever (FIG. 10) on which the balls are piled up. The seven balls in the column are then released into the winnings tray. The winning ball rolls past the Ball Restrictor (FIG. 11) which maximises its time on the Ball Release Lever Trigger, and then falls out at the back of the unit. It is then redirected so that it ends up in the 'cash box'.

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The Internal Ball Unit Components

These components are shown in the order in which they are visited by a ball.



COLUMN FULL INDICATOR
FIG. 1



BALL DEFLECTOR
FIG. 2



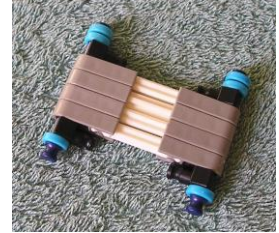
BALL DEFLECTOR REST
FIG. 3



WINNING BALL SUPPORT
FIG. 4



BALL SLOPE
FIG. 5



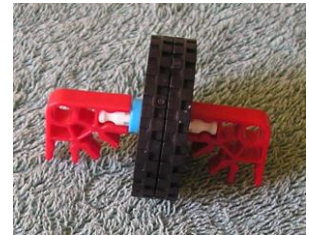
BALL BUFFER
FIG. 6



BALL RELEASE LEVER TRIGGER
FIG. 7



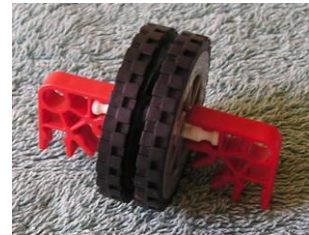
BALL RELEASE LEVER LATCH
FIG. 8



BALL RELEASE LEVER LATCH STOP
FIG. 9



BALL RELEASE LEVER
FIG. 10

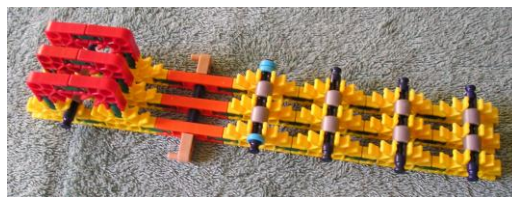


BALL RESTRICTOR
FIG. 11

Here are some extra photos for clarification purposes:



BALL DEFLECTOR (UNDERSIDE)
FIG. 12

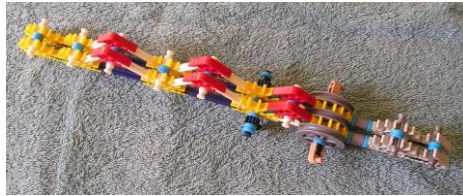


BALL SLOPE (UNDERSIDE)
FIG. 13



BALL RELEASE LEVER TRIGGER (UNDERSIDE)
FIG. 14

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BALL RELEASE LEVER (UNDERSIDE)
FIG. 15

How the Components are Placed

The pivoting rod through most of the components has one blue spacer at one end and two blue spacers at the other. For consistency, in the ball unit all the double blue spacers are on the right-hand side (when looking from the front).

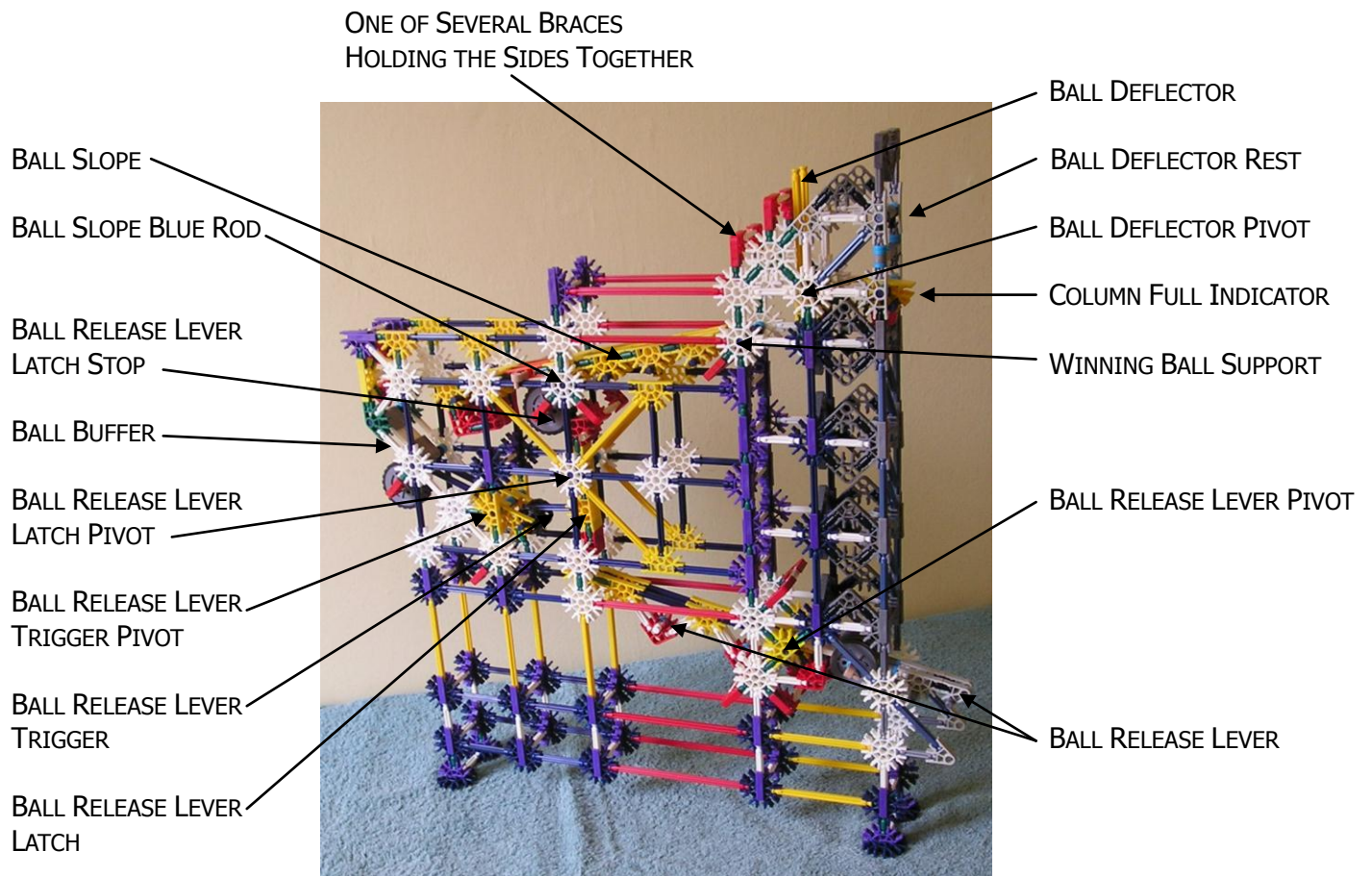
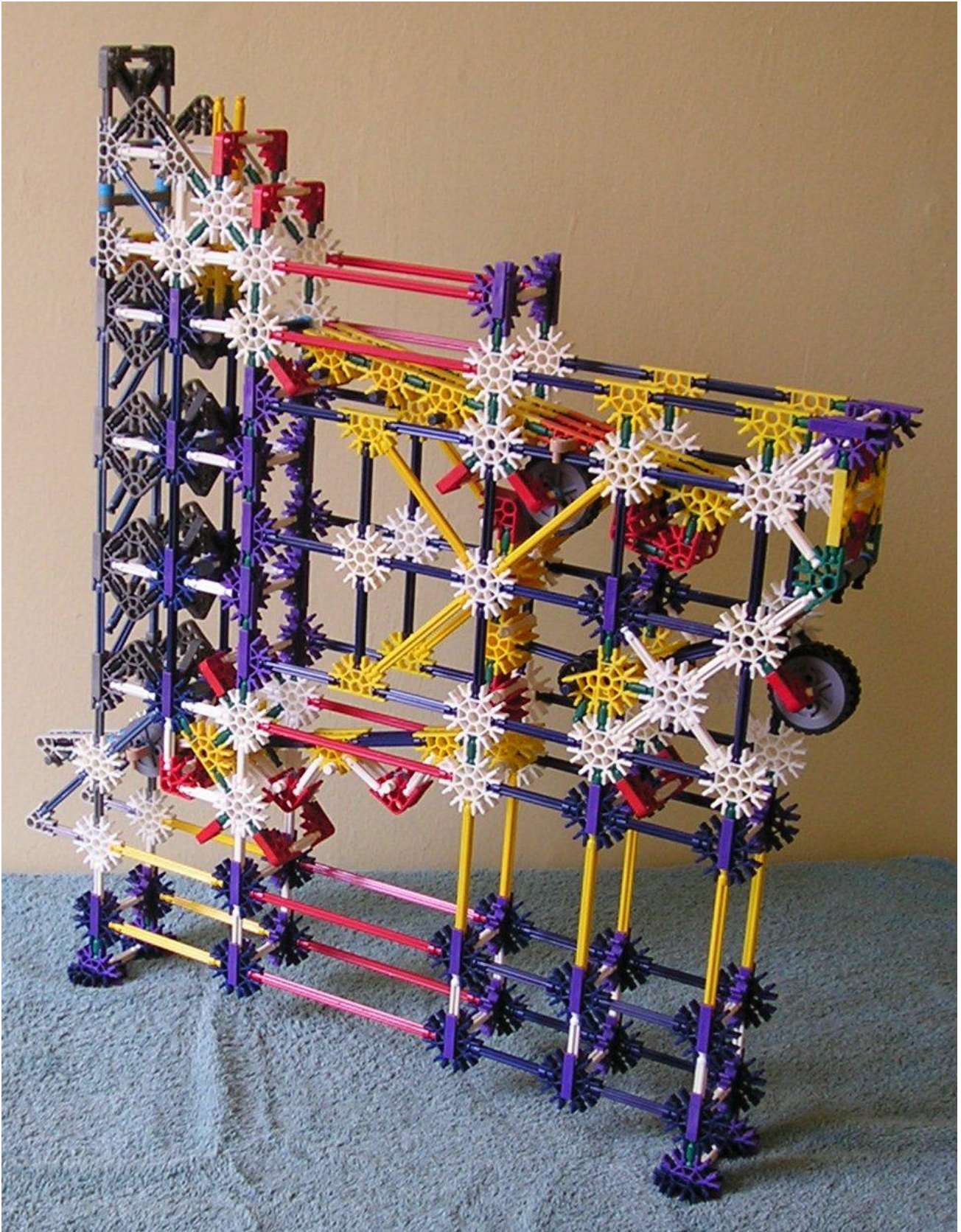


FIG. 16

K'Nex Ball Amusement Machine - The Ball Unit

Some More Photos



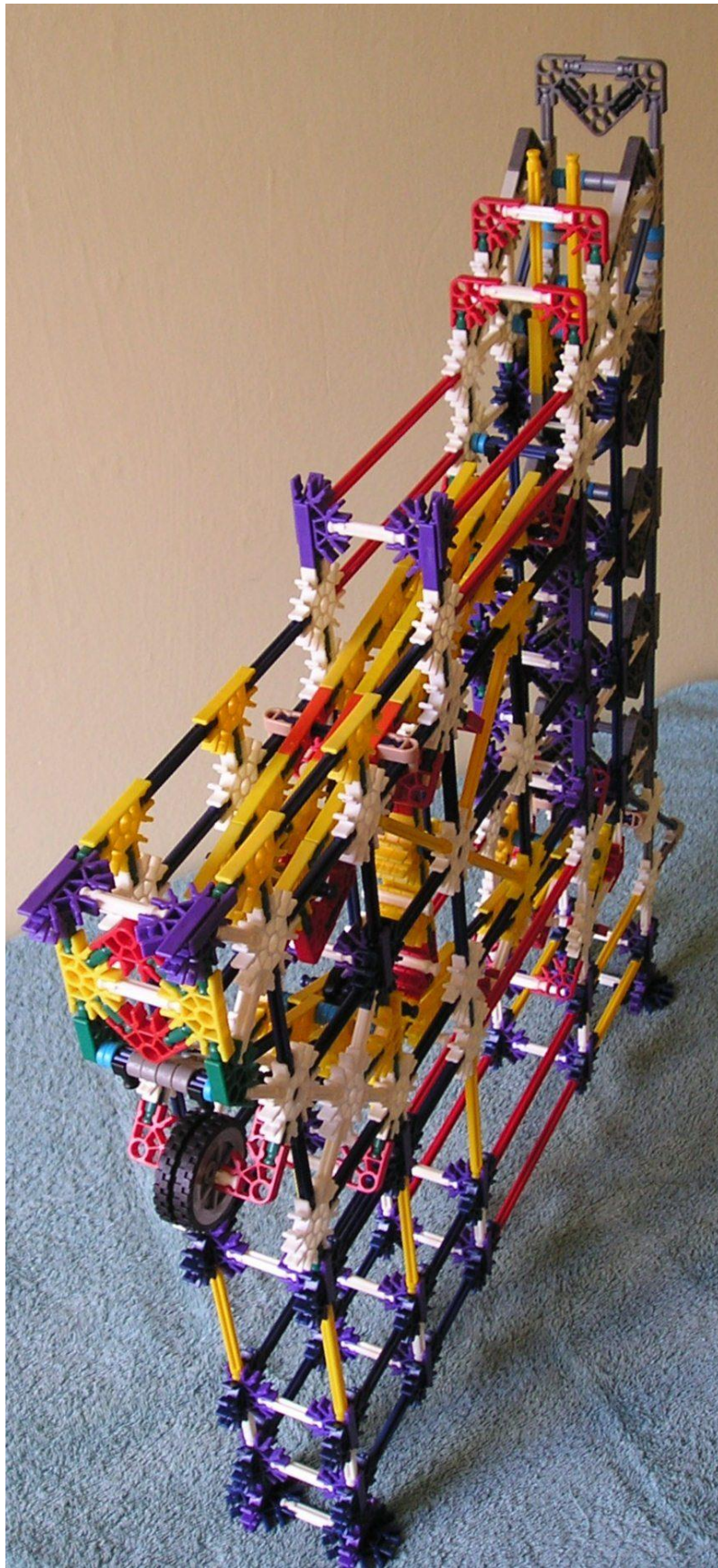
A VIEW FROM THE OTHER SIDE
FIG. 17

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A VIEW FROM THE BACK
FIG. 18

K'Nex Ball Amusement Machine - The Ball Unit



A VIEW FROM THE TOP
FIG. 19

K'Nex Ball Amusement Machine - The Ball Unit



FRONT VIEW
FIG. 20

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Where the Pivots Holes Are

This picture shows the right-hand side of the ball unit (looking from the front) together with the locations of the pivot and other holes.

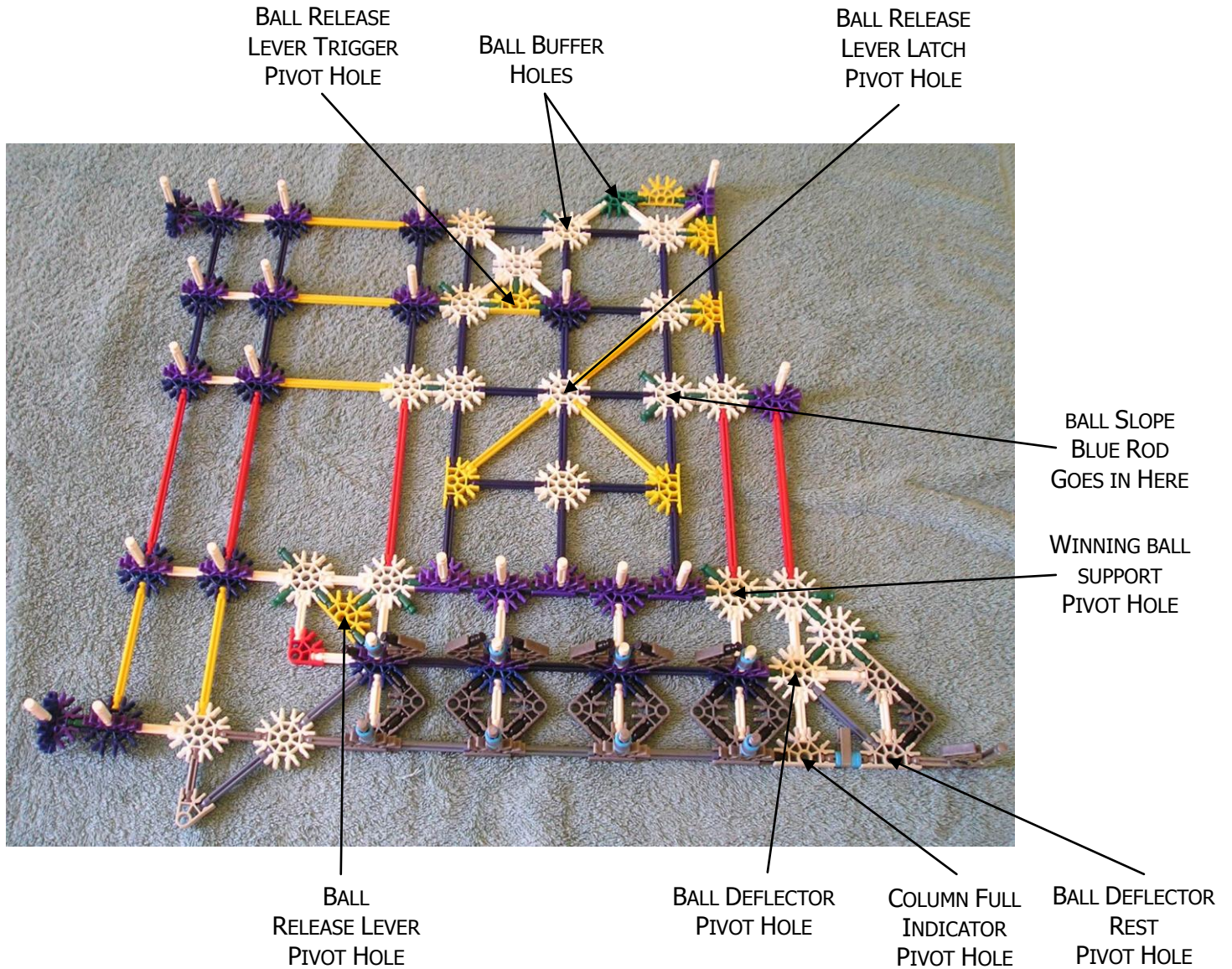


FIG. 21

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The Matching Left-hand Side

This is a mirror image of the right-hand side, but there is a very important area in between the sides that has to be just right – this is shown by the second picture. Its function is to prevent balls getting stuck.

It is much easier to add this left-hand side if it is split into several pieces first, starting with the bottom section in the photo and working upwards.

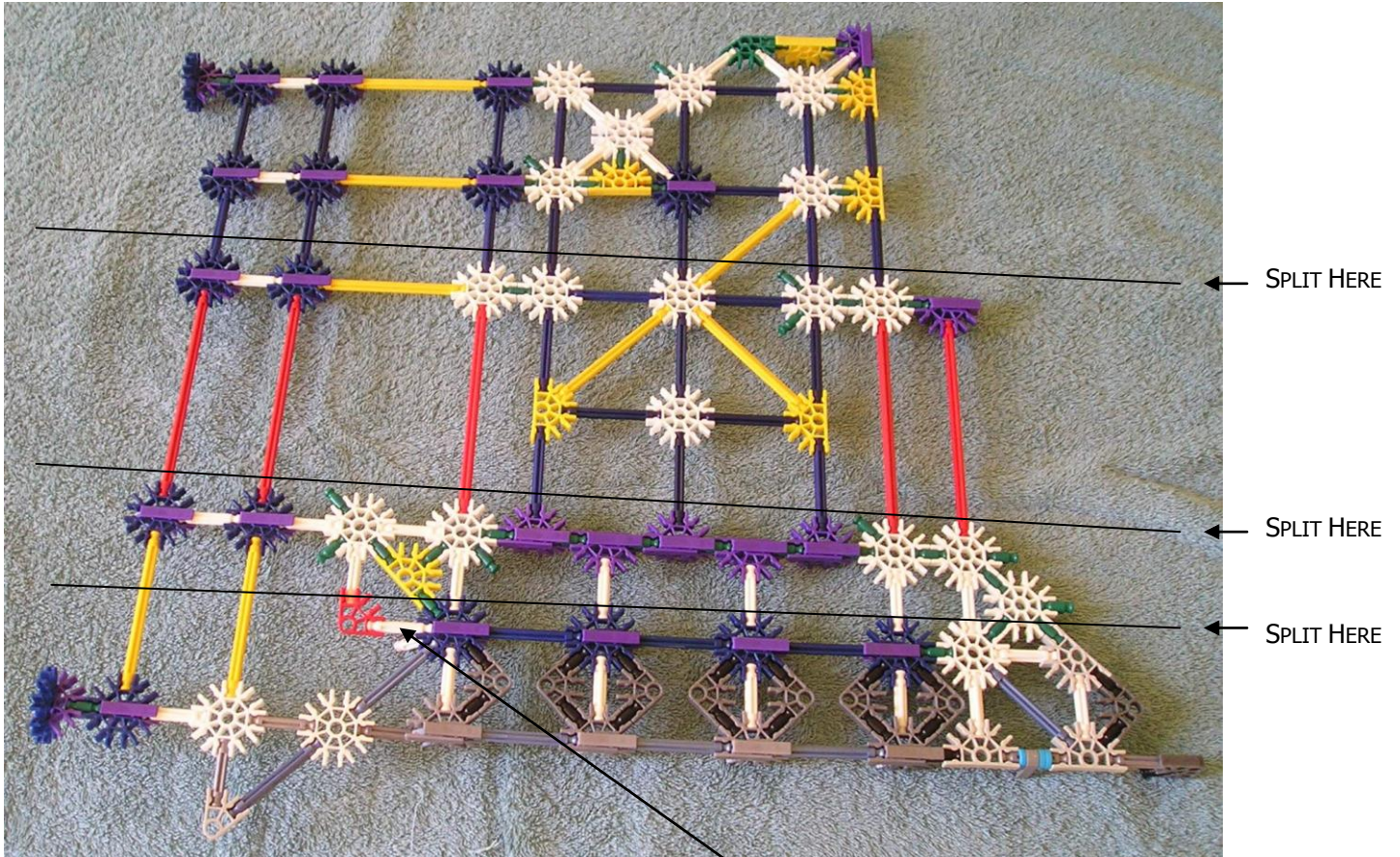
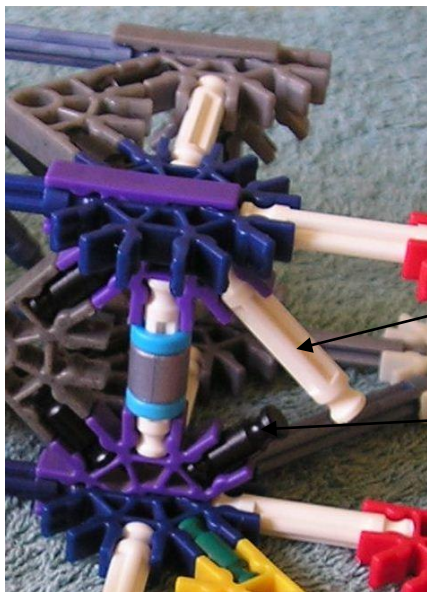


FIG. 22



This white rod is this one viewed from the other side

This black rod is essential

FIG. 23