The Improved Balloon-Powered Hover Disk

Herbert Hover (pen name)

Goal

The goal of this project was to design a miniature hovercraft powered by a balloon. The specific requirements of the design were that the structure be robust and the balloon be easily inflated without damage. Low cost construction was also a consideration.

Explore

To begin this project, the internet was searched for toy hovercrafts. Several commercially available models were found that used battery-powered fans (e.g., [1], [2]). Although these hovercrafts were very cool, they were expensive and did not use a balloon. An inexpensive, home-made hovercraft powered by a balloon mounted on a CD (Hover Disk) was found on two websites [3], [4]. A diagram of this version appears in Figure 1. This version seemed to be a good starting point. However, in both cases, it was awkward to remove the balloon for inflation and no acceptable solution was provided to inflate it while it was mounted on the base (inflation by blowing into the bottom side of the base was not considered a sanitary solution).

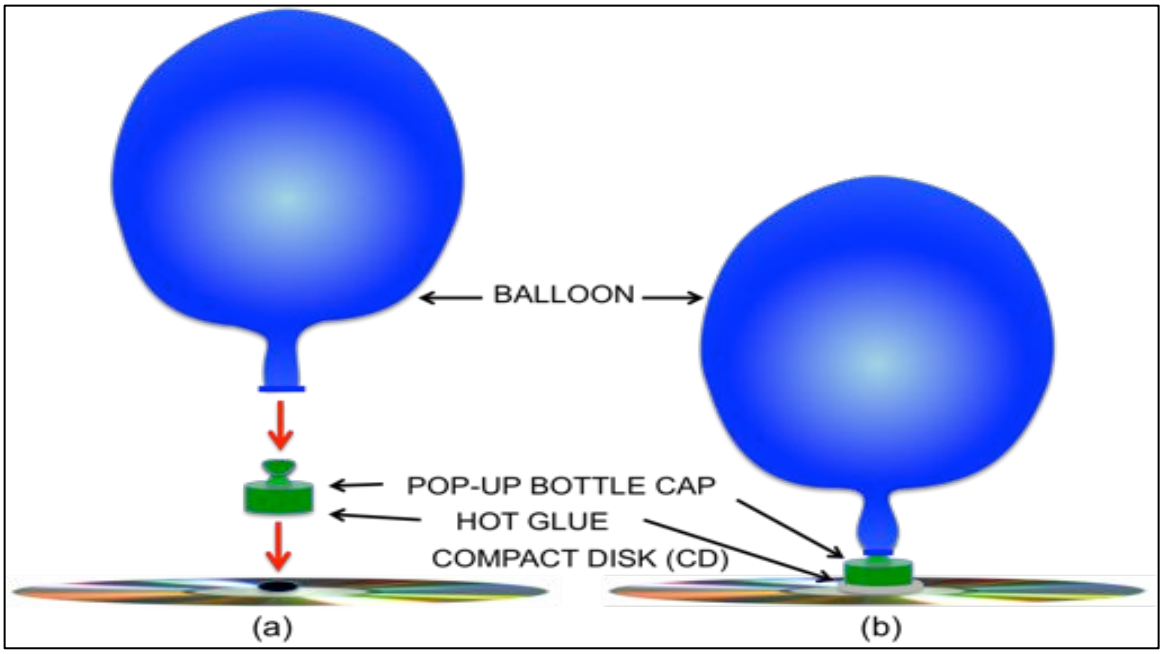

Figure 1 Balloon-powered Hover Disk (a) assembly and (b) completed.

Brainstorm

A brainstorming session yielded three design options that would allow the balloon to be easily inflated. Diagrams of Design A and Design B are are shown in Figure 2.

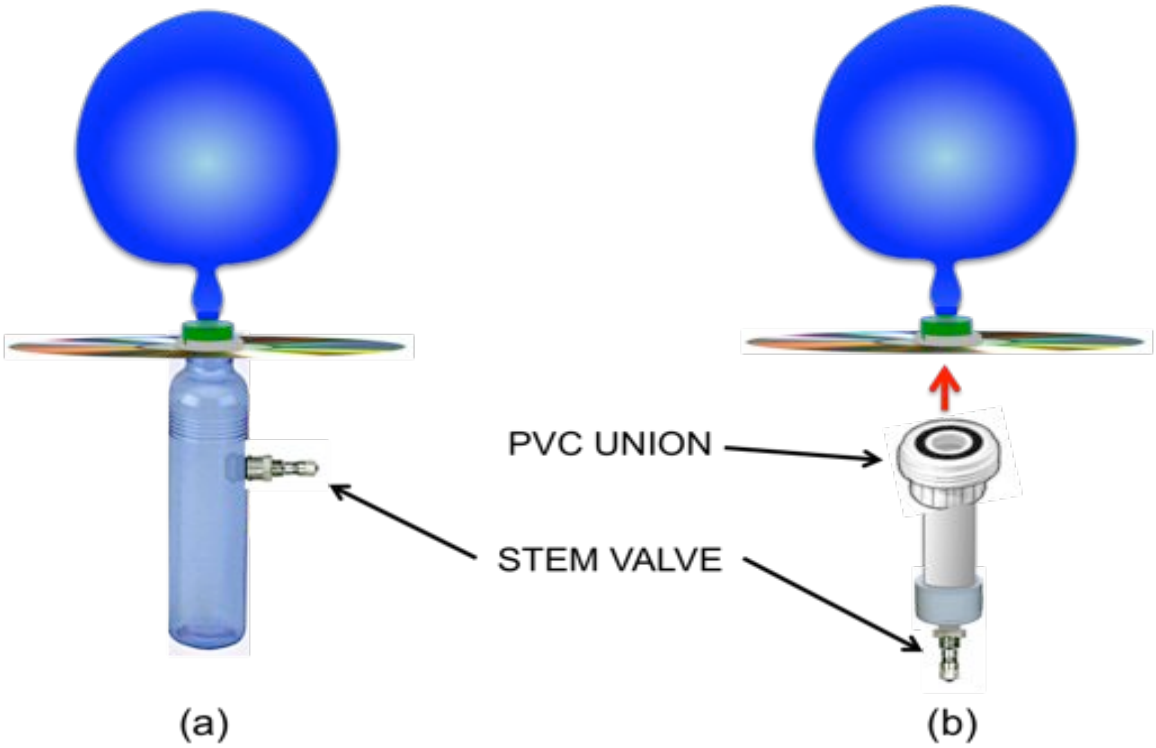

Figure 2 Diagrams of (a) Design A and (b) Design B

Design A required the hole in the CD to be enlarged and the pop-up bottle cap glued to the disk so that the entire hovercraft could be screwed on to the original bottle. A bike tire stem valve would then be mounted to the bottle with an o-ring seal. The balloon could then be inflated with a bicycle pump, the cap closed, and the Hover Disk could be removed from the bottle, ready for use. Although simple in concept, this design was judged to be difficult to build. CD disks are difficult to drill without breaking and gluing the cap on so that the hovercraft would screw on to a bottle would require exact measurements and careful alignment. In addition, it would require the purchase of a stem valve, which would be an extra cost.

In Design B, The Hover Disk itself would be unchanged, but a novel inflation device would be added. The inflation device would require a short PVC pipe with a special o-ring fitting on one end and a bike stem valve attached to a pipe cap on the other end. The balloon would be inflated with a bicycle pump attached to the stem valve with the opening on the base of the Hover Disk pressed against the o-ring fitting. This design was considered the simplest solution, but also the highest cost option. A cost reduction might be possible by simply eliminating the stem valve fitting and blowing into the pipe to inflate the balloon.

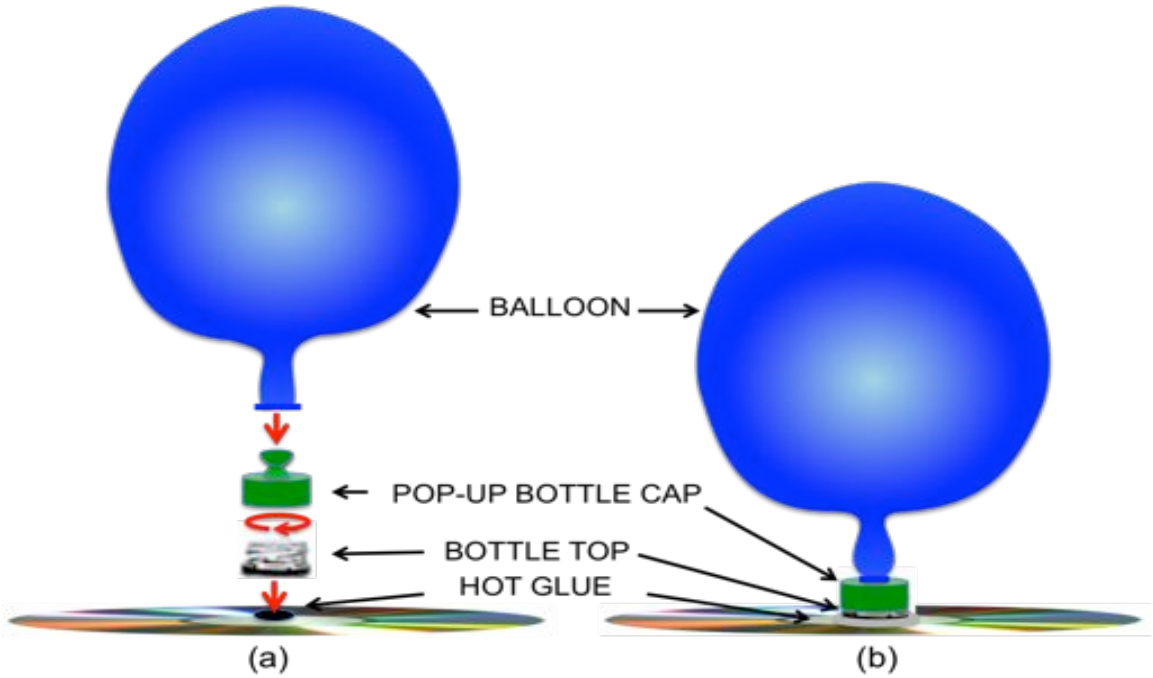

Figure 3 (a) Assembly Diagram and (a) completed form of Design C

Design C required a minor modification to the design. The top of the bottle would be cut off just below the cap fitting. The bottom surface of the bottle top would be sanded or filed to be flat and then glued over the hole in the CD. The balloon would be mounted to the bottle cap and the cap screwed on to the Hover Disk. Unscrewing the cap and blowing into it with the valve open could inflate the balloon. The valve could then be closed and the cap screwed back onto the Hover Disk. For Hover Disk operation, the valve could be opened. This design also had the flexibility

of being compatible with either of the bicycle pump inflation devices described for Designs A or B.

Plan

Design C was chosen for the prototype, since it could easily built without extra expense. In addition, the wider gluing surface formed by the bottle top would create a more robust structure. It also had the advantage that it could use either of the special inflation devices.

The materials needed for construction of the design were:

(1) A CD disk and
(2) A plastic bottle with a pop-up cap.

The tools required were:

(1) A hacksaw or a bandsaw for cutting off the bottle top,
(2) A flat file or a sander to flatten the cut surface,
(3) A hot glue gun and glue sticks to attach the bottle top to the CD.

Prototype

The prototype design was constructed following the procedure outlined in the brainstorming session. A bandsaw and a disk sander were used to prepare the bottle top and it was attached with hot glue to the disk. The Hover Disk was found to be very robust and inflation of the balloon worked as planned.

Build

As no problems were encountered with the prototype, 200 improved Hover Disk kits were prepared for a one-day hands-on science event. The construction techniques were identical to those for the prototype. A photo of the finished unit appears in Figure 4.

Test

Repeated testing of the Hover Disk further demonstrated the robustness of the design. The only difficulty encountered was that the bottom edges of some of the caps were somewhat sharp, so that inflating the balloon by blowing into them was uncomfortable.

Figure 4 Design C , with the inflated balloon attached to the closed pop-up cap on the left and the bottle top hot glued to CD on the right

Analyze

To reduce the discomfort when blowing directly into the sharp caps, the top of another bottle was cut off and sanded smooth. The cap was then twisted onto the bottle top, which reduced the discomfort during balloon inflation by creating a wider surface to blow against.

The average age of the children expected at the hands-on science event was 8 years old. As a result, many of them would not be able to blow up the balloons themselves. Therefore, the bicycle pump device described for Design A in the Brainstorming section was constructed so that the

kids could inflate the balloons. This also alleviated the need for adding additional bottle tops to all of the kits.

Conclusion

The improved design was found to be very successful with either inflation method and was well received by the attendees of the hands-on science event.

Future Plans

A possible enhancement to the improved Hover Disk might be the addition of non-pump version of the inflation device described for Design B in the Brainstorming section. Therefore, construction of such a device is planned as a future activity.

Thanks

Thanks are due to Karen, who donated all the bottles for the Hover Disks, Kendra and Amy for preparing the kits, and Mary for running the Hover Disk station at the hands-on science event.

References

[1] Young Explorers, R/C Racing Hovercraft, http://www.youngexplorers.com/itemdy00.aspx?T1=Y820021, 8/29/14.

[2] Amazon, "4M Hovercraft Kit", http://www.amazon.com/4M-3780-Hovercraft-Kit/dp/B003GY5HA0, 8/29/14.

[3] Museum of Science, Traveling Programs, "Make Your Own Toy Hovercraft," http://www.mos.org/sites/dev-elvis.mos.org/files/docs/education/mos_observing-air-flight_make-your-own-toy-hovercraft.pdf, 8/29/14.

[4] Supercharged Science, "Hovercraft," http://www.superchargedscience.com/aric/Hovercraft.htm , 8/29/14.