The Two-Piece Clamping Shaft Collar

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Introduction

The shaft collar, though simple, is a very important component in many competitive robotics systems. When placed along a shaft, a shaft collar acts to hold the shaft, or the components along it, in place, so that the system may continue to function. Therefore, it is desirable for a shaft collar to have great holding power, and to be able to maintain its position despite the various shocks and stresses encountered in a robotics match. It is also desirable that the part does not damage the shaft and is easy to assemble, so that no time is wasted on such issues. The current VEX shaft collars, however, fail to meet these goals. Note, for example, the Set Screw Shaft Collar, shown below in ***Figure 1***.

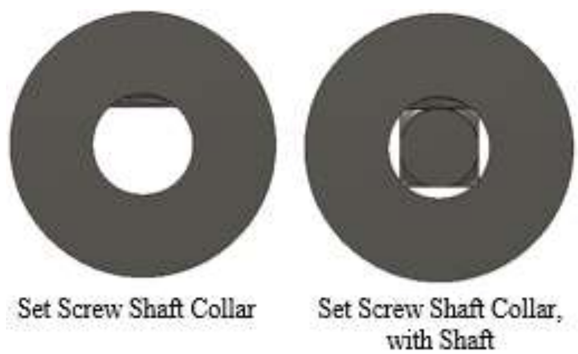

Figure 1

This design relies on the clamping force of the set screw against the shaft in order to provide holding power. This, however, results in shaft damage and a flair-up of material at the set screw’s point of contact with the shaft, making it rather difficult to adjust the position of the shaft collar and hindering assembly efforts. This shaft collar is also rather ineffective, as the flat-tipped set screw prevents proper shaft penetration, resulting in a decrease in holding power.

VEX also produces a Clamping Shaft Collar, shown below in ***Figure 2***. This design relies not on a shaft-penetrating set screw, but on a single clamping screw, which compresses the shaft collar around the shaft. Note that this design is still ineffective and lacks holding power, because some of the clamping ability of the screw must be sacrificed to bend the shaft collar around the shaft. This inability of the current VEX products to meet the requirements of an effective shaft collar means that an alternative design is needed.

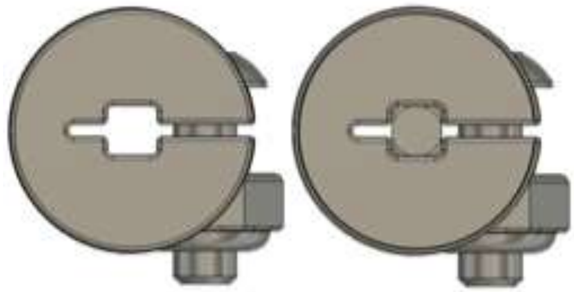

Figure 2

This need can be met with the Two-Piece Clamping Shaft Collar, a part of my own design, shown below in ***Figure 3***. This simple design consists of an upper half, a lower half, and two #8-32×½" screws, which serve to hold the part together. Ideally, both halves would be made of steel, due to the high holding power of that material. Both halves of the part may simply be assembled on a shaft in place of an existing shaft collar, and be joined together by the two screws. Despite the apparent simplicity of this design, it possesses many advantages over the current VEX products. For example, the part's use of two clamping screws results in an increase in holding power, as the full seating torque of each screw may be used to hold the collar in place. Furthermore, the part's two piece design allows it to be easily assembled anywhere along the shaft, regardless of the presence of other components. In contrast, all of the current VEX products must be slid over the end of the shaft, which may necessitate the removal of other components to ensure proper assembly. Assembly is also made easy by the "flat-top" design of the upper half of the part, which provides room for screw heads. This allows for screws of any type to be used, providing teams with greater design freedom and allowing them to consider the advantages and disadvantages of each screw type.

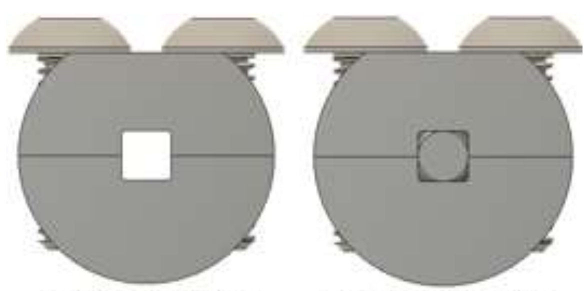

Figure 3

Design Process

This design process of the Two-Piece Clamping Shaft Collar was heavily reliant on the Fusion 360 Version 2.0.6670 CAD software. The software was first used to analyze the CAD files of the shaft collars currently produced by VEX, so that the weaknesses of those products could be determined. This analysis, as well as the design goals outlined in the introductory paragraph of this report, was used to inform the development of the basic design of the Two-Piece Clamping Shaft Collar. From this basic design, the part was gradually modelled in Fusion 360. This modelling process focused on the use of parametric sketches, each of which outlined a small element of the larger design. This use of properly dimensioned parametric sketches allowed for each element of the part to be easily visualized, and led to the creation of a more organized model overall.

Conclusion

This project can be considered to be my first real experience with CAD. My relative inexperience with Fusion 360 meant that I tried to break the project down into smaller, more approachable parts. This led to my discovery of parametric modelling, a design technique which fit rather well with my chosen approach to problem solving. Thus, this project has taught me much about not just CAD software, but about the technique of parametric modelling, and of the use of proper dimensioning and constraining tools. I still do hope, however, to continue to learn about these tools and techniques. In addition, my breaking down of the project into simplified parts has allowed me to refine my techniques when approaching problems in general, so that I may be better prepared when encountering engineering problems in the future.

CAD software is an incredibly valuable tool to both those in competitive robotics teams, and in my desired future career field of engineering. The ability of CAD software to create easy to understand models, for example, allows for the easy visualization and communication of ideas, and leads to greater collaboration between designers. Furthermore, the relative simplicity of CAD software allows for the rapid prototyping of designs, so that many different designs may be built, tested, and improved upon within a relatively short period of time. This process of iterative design is further benefitted by the ability of some CAD programs to run simulations, which allows for the relatively efficient testing and improvement of existing designs. CAD software is therefore incredibly useful to engineers and robot-builders that desire a fast, efficient, and collaborative design process. For these reasons, I hope to become more experienced with CAD software in the future, and to continue use it for the purposes of collaboration and iterative design in the fields of competitive robotics and engineering.