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BI-DIRECTIONAL FLOATING BELT TENSIONER

HP INC

Bi -directional Floating Belt Tensioner

Abstract

A low cost, bi-directional, compact, low tension belt tensioner was needed for a material supply station. This design allows for maximum pulley wrap angle that is consistent between clockwise and counter clockwise operation. This design is compact and low cost. It allows for maximum torque transmission from the drive motor to the belt while adding minimal tension to the drive belt above the load that is being rotated. This allows for the key advantages of a smaller drive motor and least wear and tear on the system.

Paper

During development of a supply system a need was realized for rotational movement of the supply container. This container holds the powdered material. Rotation direction of the container (clockwise or counter clockwise) selects the movement of material into or out of the supply container. To use the supply in this way, a holder with rotational capability is provided. The inner portion of the supply holder rotates with the needed direction and at the desired rate to dispense or return material from or to the supply.

To drive the needed movement on the supply holder, a motor is used. A belt couples the motor to the inner, rotating section of the supply holder. Initially in the design process, a single tensioner pulley resting on the drive belt was used to provide enough frictional coupling of motion from the motor to the belt and in turn from the belt to the rotating section of supply holder. While testing this configuration some significant issues were found that impacted both reliability and cost.

The single tensioner design performed well in one direction and not in another, clockwise vs. counter clockwise. The tensioner wheel would provide stronger frictional coupling to both motor and supply holder in one direction than the opposite direction. This caused the motor drive to tend to slip in one rotational direction.

A first method explored for fixing this was to simply increase the belt tension. This worked functionally, however, there was an issue with wear on the belt from the high forces needed to provide needed friction in the weaker direction. Additionally, the motor was impacted by a higher loading, due to the added friction present from this higher loading.

The added belt wear was unacceptable, as this would reduce the life and reliability of the belt to unacceptably low levels. As well, extra motor loading would have meant that the motor and motor driver used both would have to have been upgraded to more expensive, higher power units. This motor, as with most of the components in the system, has limitations in cost and also, due to the nature of the product, has high reliability requirements, making the needed motor upgrade additionally expensive.

To solve both issues, a low cost, bi-directional, compact, low force belt tensioner was created. This design provides for a maximum wrap angle of the drive belt around the motor pulley, this wrap angle is consistent between clockwise and counter clockwise operation of the motor. Additional favorable factors are that this design is compact and low cost. The design allows for maximum torque transmission to the belt while adding minimal tension to the drive belt above the load that is being rotated. This allows for the smallest possible drive motor and minimum wear and tear on the system. This design reduces overall cost thru motor cost reduction net of the cost of the added pulley. System reliability is enhanced significantly due to the minimal belt tension, thereby belt wear is reduced, and thus reliability is enhanced.

The figures 1 thru 4 below show details of the design. Figure 1 shows the supply system holder for the rotatable containers (supply canisters) to provide material. Note the opening in which supply canisters are loaded. The interior surface of this holder rotates under motor control as noted above. The motor used to provide the rotation is shown in the expanded section of the figure, along with the belt and tensioner design.

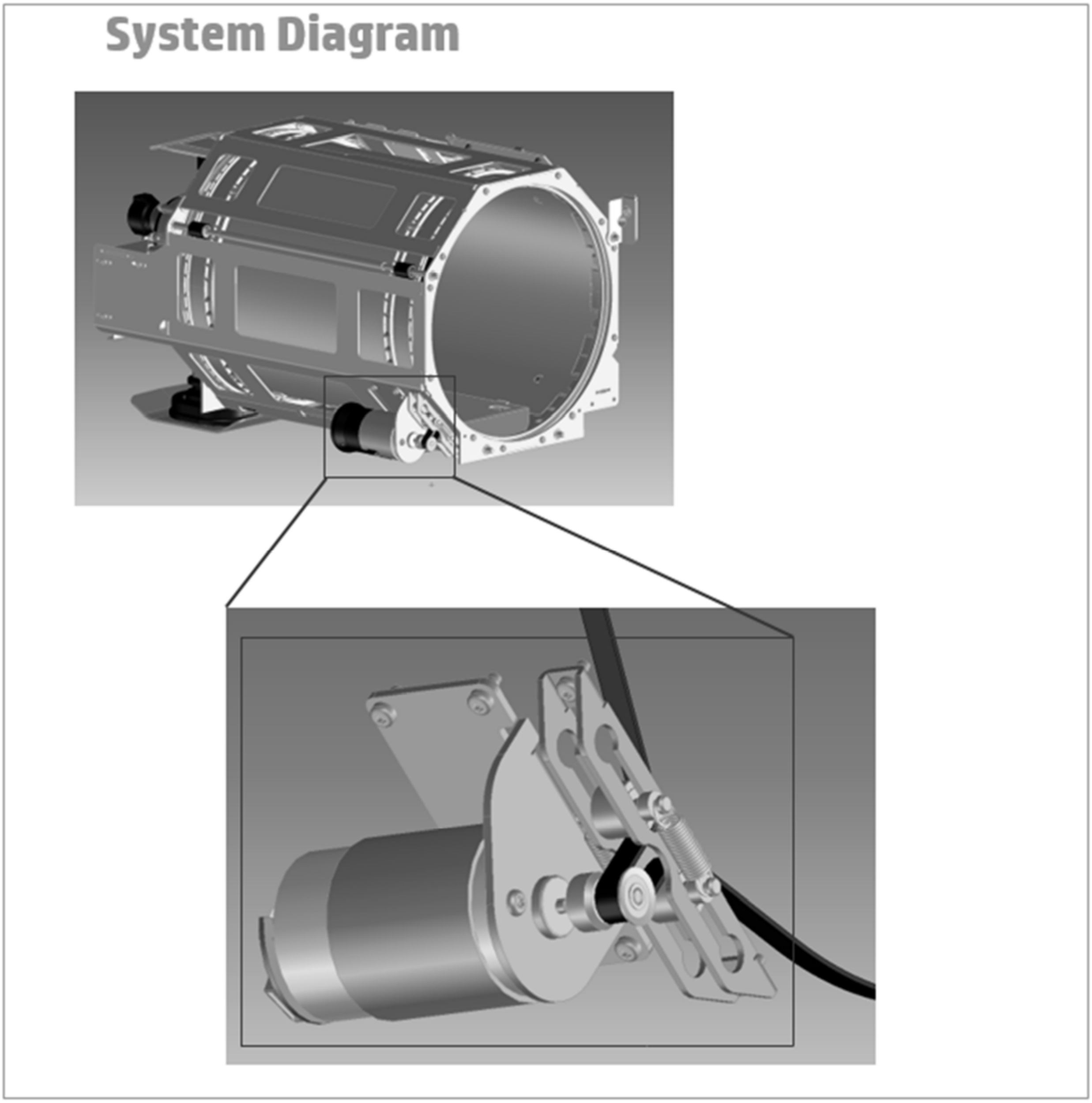

Figure 1 - System view of belt tensioner

Figure 2 below shows the belt tensioner and motor during an idle state. Note that the tensioner pulleys are equidistant from the motor pulley. This is because there is no motor driven force on the belt, only tensioner spring force during motor idle, thus the pulleys sit equally on the belt, on each side of the motor pulley.

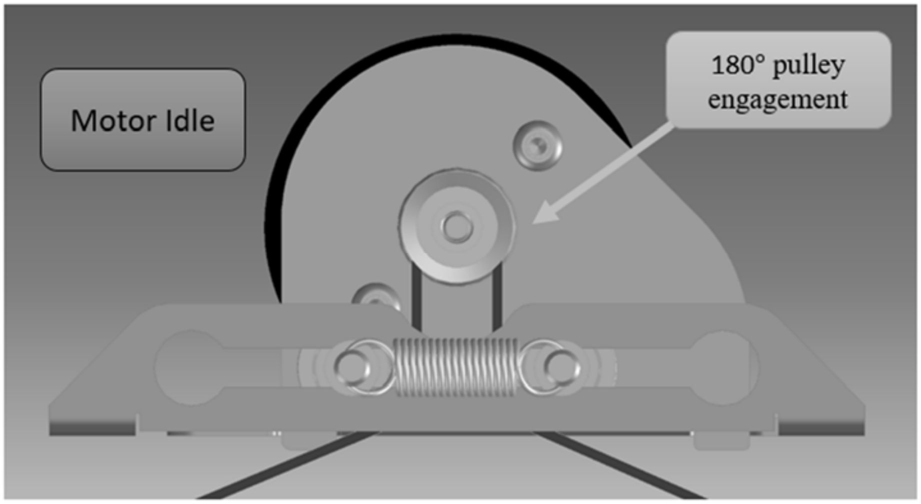

Figure 2 - Belt tensioner with motor idle

In figure 3 below, the motor is rotating clockwise, and both tensioner pulleys have shifted towards the left. The belt section on the left is under higher force, as the motor is pulling the flexible belt towards it. Thus, the belt angle around the pulley is reduced. The belt section on the right is under lower force, and the belt angle around the pulley is increased. Most significantly, note that the pulley retains its nearly 180-degree engagement around the pulley. This is highly significant, as this keeps the requirement for overall belt tension low because a greater proportion of belt area is available for the motor drive pulley to exert force on it.

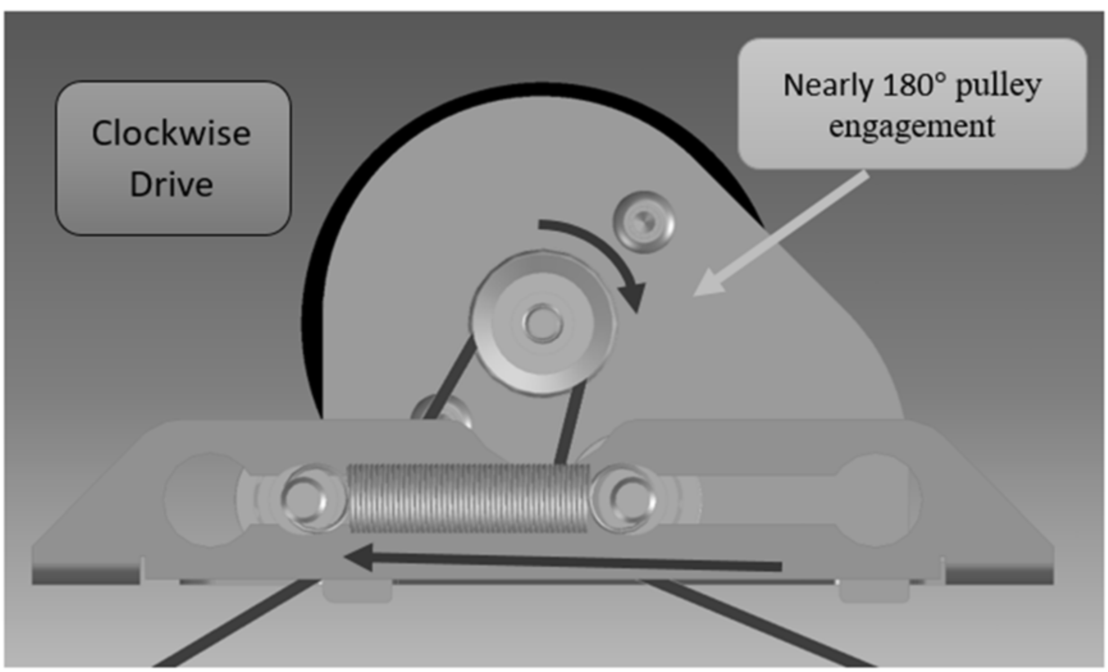

Figure 3 - Belt tensioner with motor driving clockwise

In figure 4 below, the motor is rotating counter-clockwise, and both tensioner pulleys have shifted towards the right. The belt section on the right is under higher force, as the motor is pulling the flexible belt towards it. Thus, the belt angle around the pulley is reduced. The belt section on the left is under lower force, and the belt angle around the pulley is increased. Most significantly, note that the pulley retains its nearly 180-degree engagement around the pulley. This, again, is highly significant, as this keeps the requirement for overall belt tension low in this direction as well as the opposite direction illustrated above.

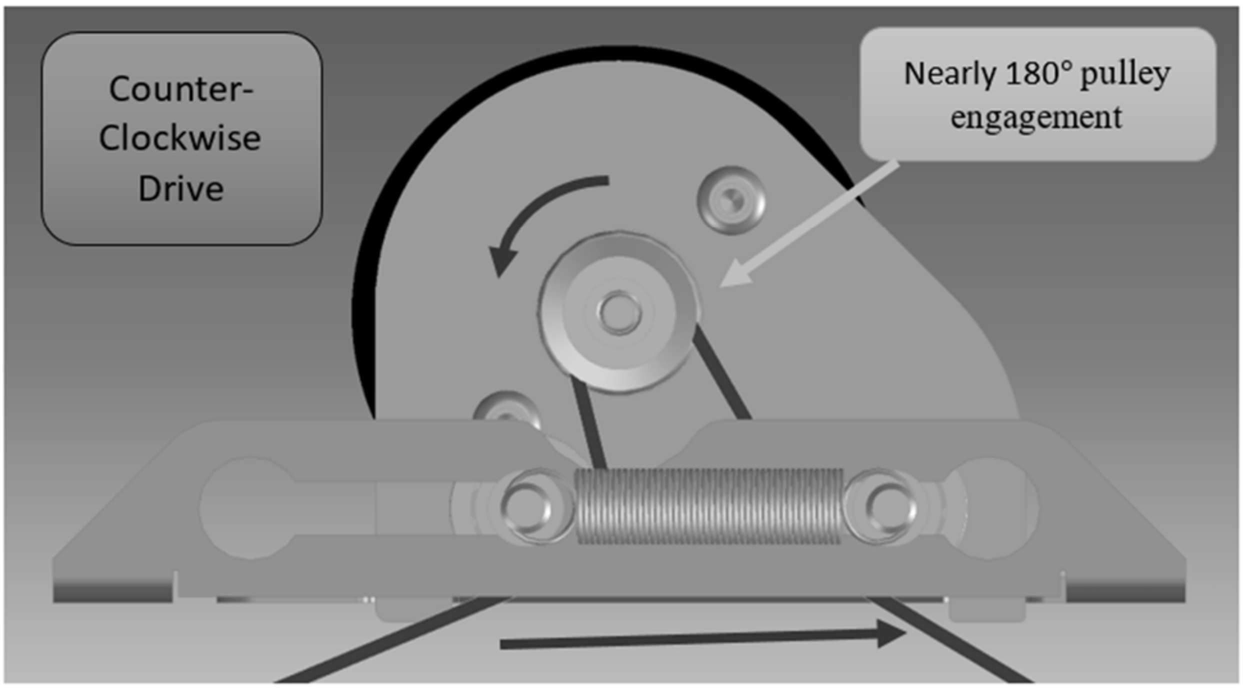

Figure 4 - Belt tensioner with motor driving counter clockwise

In summary, the key/differentiating features of this design are:

1. Floating tensioner dual pulley design allowing consistent wrap angle on pulley.
2. Low added belt loading from tensioner.
3. High load transmission without belt skipping.
4. Low cost.
5. Compact.

Disclosed by Kevin E Swier, HP Inc.