A belt drive apparatus having a take-up for varying the tension in the belt including a driven rotatable member, belt engaging means which includes a pulley for receiving and driving a belt and which is driven through a first cylinder-piston which is in fluid communication with a second cylinder-piston operatively connected with displaceable belt engaging means for displacing the belt in conformity with the relative movement of the members of the first cylinder-piston relative to each other to vary the tension on the endless belt in accordance with the amount of torque on the belt driving pulley. The second cylinder-piston is secured coaxially to the driven rotatable member for rotation therewith and with the first cylinder-piston to eliminate problems in fluid communication between the first and second cylinder-piston devices.

6 Claims, 4 Drawing Figures
BELT DRIVE APPARATUS HAVING IMPROVED TAKE-UP

The present invention relates to a belt drive apparatus having an improved take-up means for varying the tension in the belt.

In previously utilized belt drives for various machines including textile yarn processing machines, such as twisters, spinning frames or the like, various types of take-up mechanisms have been utilized for varying the tension on and tautness of the drive belt in accordance with the operating conditions of the machine. U.S. Pat. No. 3,413,865, issued Dec. 3, 1968, assigned to the assignee of the present application, disclosed a belt drive with a take-up mechanism which was far superior to previous take-up devices. The previous take-up devices were controlled, for example, in dependence on the driving speed or motor speed of the belt drive. In textile yarn processing machines, for example, where the driving belt is utilized for driving yarn processing spindles, the spindle mass and the air resistance vary constantly with constant circumferential belt speed because of the winding of the bobbins, so that the belt tension must undergo corresponding variations. The torque to be extended by the belt driving pulley, whose value remains unconsidered in a belt tension which depends only on motor speed, thus varies in one or the other directions.

In the belt take-up mechanism described in the aforementioned U.S. Pat. No. 3,413,865, an arrangement was provided which operated on torque-dependent control of the belt tension. This belt drive and take-up device included a driven rotatable member, an endless belt, belt engaging devices including a pulley for receiving and driving the belt which was coaxially arranged with and rotatable relative to the rotatable member, and devices displaceable with respect to the belt to vary the tension on and tautness of the belt. A first fluid operable cylinder-piston device was interposed between and drivenly connected the rotatable member and the pulley and comprised a first and a second member movable relative to each other. The first member was pivotally connected to a portion of the pulley eccentrically located with regard to the axis of rotation of the pulley and the second member was pivotally connected to and carried by a part of the rotatable member which was eccentrically located with regard to the axis of rotation of the pulley. Second fluid operable cylinder-piston means were operatively connected with the displaceable belt engaging means and were in fluid communication with the first cylinder-piston means for displacing the belt means in conformity with the movement of the first and second members of the first cylinder-piston means relative to each other to vary the tension of the endless belt in accordance with the amount of torque on the belt driving pulley.

In the specific arrangements disclosed in the prior U.S. Pat. No. 3,413,865, the first cylinder-piston device rotated with the rotatable member of the drive belt and the second cylinder-piston device was non-rotating. The fluid communication between the first and second cylinder-piston devices was by means of relatively movable conduits joined at a rotating joint. This arrangement has produced problems in sealing and packing of the relatively movable parts of the connecting joint.

Accordingly, it is the object of this invention to overcome the above problems in the belt drive apparatus and take-up mechanisms of the prior patent of the assignee of this invention and to provide a belt drive apparatus having improved take-up means.

By this invention, it has been found that these problems may be overcome by mounting the second fluid operable cylinder-piston device coaxially to the driven rotatable member for rotation therewith and with the first fluid operable cylinder-piston means. Additionally, positively operating mechanisms are controlled by the second cylinder-piston device for operating the displaceable belt engaging means for varying the tension on the belt.

Some of the objects and advantages of this invention having been stated, other objects and advantages will appear as the description proceeds when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of one form of a belt driving apparatus having take-up means in accordance with this invention;

FIG. 2 is a sectional view taken generally along the line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view through another embodiment of a belt drive apparatus having a take-up means in accordance with this invention; and

FIG. 4 is a schematic plan view of the belt drive apparatus having take-up means in accordance with FIG. 3 and illustrating how this mechanism operates with belt take-up rollers.

Referring now to the drawings, FIGS. 1 and 2 illustrate a first embodiment of a belt drive mechanism with take-up devices in accordance with this invention and FIGS. 3 and 4 illustrate a second embodiment of a belt drive mechanism with take-up devices in accordance with this invention. Many of the basic features of this embodiment of FIGS. 1 and 2 and the embodiment of FIGS. 3 and 4 are the same and will be given like reference numerals for like parts.

Referring first to the basic features common to both the embodiment of FIGS. 1 and 2 and the embodiment of FIGS. 3 and 4, the belt drive mechanism with take-up devices includes a belt driving pulley 10 which is rotatably mounted by means of roller bearings 11 on a journal 12 which is mounted on a frame 13. An endless belt 15 is received around the belt driving pulley 10 and may also pass around an idler pulley 16 (shown only in FIG. 4) at the other end of the endless belt 10 for providing an endless belt drive.

A rotatable member in the form of a V-belt pulley 17 is rotatably mounted on the hub of belt driving pulley 10 for relative rotation with respect thereto. The V-belt pulley 17 receives a plurality of V-belts 18 which also pass around a pulley 20 secured to the end of a shaft 21 leading from a motor or other suitable driving means 22. Thus, the V-belt pulley 17 is rotatably driven by the V-belts 18 and driving means 20, 21 and 22. The V-belt pulley 17 is secured against axial displacement by a snap ring 25 secured to the hub of the belt driving pulley 10.

Drivingly connecting the rotatable member 17 and the belt driving pulley 10 is a fluid operable cylinder-piston which comprises a cylinder 30 and piston 31. The end of the piston 31 which is in the form of a ball 32 is pivotally connected to the inside of the belt driving pulley 10 eccentrically with respect to the axis of rotation of the pulley 10 by being received within a ball socket 35. The other end of the cylinder 30 includes a fluid conducting conduit 36 which passes through an aperture in the rotatable member or V-belt pulley 17.
so that the cylinder 30 is pivotally connected to the rotatable member 17 at a position eccentrically located with regard to the axis of rotation of the rotatable member 17 and the belt driving pulley 10. The distance between the pivotal connection of the piston 31 and the belt driving pulley 10 from the axis of rotation of the pulley 10 is greater than the distance between the pivotal connection of the cylinder 30 and feed pipe 36 with the rotatable member or V-belt pulley 17 from the axis of rotation of the pulley 10.

Thus, as the rotatable member 17 is rotated by the above-described driving mechanisms, the cylinder 30 and piston 31 will be rotated therewith and the piston 31 will cause rotation of the belt engaging pulley 10. However, due to the resistance of the belt engaging pulley 10 to rotate, the piston 31 and cylinder 30 will move relative to each other forcing fluid out of the cylinder 30 and through the conduit 36. The conduit 36 leads to a further fluid operable cylinder piston comprising a cylinder 40 and piston 41 which are mounted coaxially to the driven rotatable member 17 and the belt engaging pulley 10. The cylinder 40 is secured to a disc 43 which is mounted on the rotatable member 17 for rotation therewith so that the cylinder 40 and piston 41 rotate with the rotatable member 17.

Thus, as fluid is forced from the cylinder-piston device 30, 31 through conduit 36, the fluid will be received by the cylinder 40 forcing the piston 41 outwardly therefrom. The piston 41 is operatively connected with control mechanisms for belt engaging devices for engaging the belt 40 to increase the tension or tauntess therein. These belt engaging devices will be described more fully below in connection with the two embodiments of this invention illustrated in the drawings. As the belt 15 is continuously rotated by the above-described belt driving mechanisms, the amount of torque on the belt driving pulley 10 may decrease allowing a reversal of the above-described action to decrease the amount of tension or tautness on the belt 15.

Referring now to the specific embodiment specified in FIGS. 1 and 2, the frame portion 13 carrying the journal 12, rotatable member 17 and belt driving pulley 10, comprises a movable frame portion which is mounted for linear movement in a fixed frame portion 50. Thus, the movable frame portion 13 and fixed frame portion 50 form a carriage for allowing linear movement of all of the above-described belt driving mechanisms.

Mounted on the movable frame portion 13 is an upright L-shaped arm member 51 which carries a fluid operable cylinder-piston device comprising a cylinder 53 and piston 54. The cylinder-piston device 53, 54 is mounted in axial alignment with the cylinder-piston device 40, 41 so that as the piston 41 moves upwardly from the cylinder 40, as described above, it will contact the piston 54 and cause it to move upwardly within the cylinder 53. This forces fluid out of the cylinder 53 which passes through a fluid conducting conduit 56 and into a further cylinder-piston device comprising a cylinder 60 and piston 61. The cylinder 60 is secured to the front of movable frame portion 13 and the piston 61 is secured to a portion of the fixed frame 50.

Accordingly, as fluid is forced into the cylinder 60 from the line 56, the piston 61 will be forced outwardly causing the movable frame 13, belt driving pulley 10, etc. to move linearly with respect to the fixed frame 50 or to the left as viewed in FIG. 1. This increases the distance between the belt driving pulley 10 and the idler pulley on the other end of the belt 15, thus increasing the tension or tautness in the belt 15. In this embodiment of FIGS. 1 and 2, the means displaceable with respect to the belt to vary the tension and tautness on the belt comprises, inter alia, the belt driving pulley and does not require the use of additional tension rollers or the like.

Referring now to the embodiment of FIGS. 3 and 4, the piston 41 extends downwardly through a bore in the journal 12 and into an enclosed cylindrical housing and is attached at its lower end to a coupling member 71 carrying one end of a control cable 72 which passes out of the housing 70 and around an idler pulley 73 mounted on an extension of the frame portion 13, which in this embodiment is stationary.

The cable 72 leads to and is connected with the ends of lever mechanisms 74 which are pivotally mounted on any stationary frame portion of the machine and carry on the other ends thereof tension rollers 75 which are positioned for movement toward and away from the drive belt 15 for increasing or decreasing the tension or tautness on the drive belt 15.

Thus, as fluid is forced into the cylinder 40, the piston 41 will move upwardly causing movement of the cable 72 from right to left, as viewed in FIGS. 3 and 4 and thus cause movement of the tension rollers 75 into tighter engagement with the belt 15 to increase the tension or tautness of the belt. Stationary guide rollers 80 may be suitably positioned on the outside of the belt 15 to cooperate with the tension rollers 75. Accordingly, in this embodiment of FIGS. 3 and 4, the means displaceable with respect to the belt comprise tension rollers 75.

As may be clearly seen from the above descriptions of the embodiments of FIGS. 1, 2 and 3, 4, the problems present with the prior take-up device of the above-described U.S. patent have been overcome inasmuch as no fluid conduits between cylinder-piston devices utilize rotary joints or connections and the control devices for the take-up means utilized with the belt driving mechanism have been simplified and made more direct.

In the drawings and specification, there have been set forth preferred embodiments of this invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. In a belt drive apparatus having a take-up means for varying the tension in the belt including a driven rotatable member, endless belt means, belt engaging means including a pulley for receiving and driving said belt means which is coaxially arranged with and rotatable relative to said rotatable member and means displaceable with respect to said belt means to vary the tension on and tautness of said belt means, first fluid operable cylinder-piston means interposed between and drivingly connecting said rotatable member and said pulley and comprising a first and a second member movable relative to each other, said first member being pivotally connected to a portion of said pulley eccentrically located with regard to the axis of rotation of said pulley, said second member being pivotally connected to and carried by a part of said rotatable member which is eccentrically located with regard to the axis of rotation of said pulley, and second fluid operable cylinder-
piston means in fluid communication with said first cylinder-piston means and operatively connected with said displaceable belt engaging means for displacing said belt means in conformity with the movement of said first and second members of said first cylinder-piston means relative to each other to vary the tension of said endless belt means in accordance with the amount of torque on said belt driving pulley; the improvement of:

said second fluid operable cylinder-piston means being secured coaxially to said driven rotatable member for rotation therewith and with said first fluid operable cylinder-piston means to eliminate problems in fluid communication between said first and second cylinder-piston means.

2. In a belt drive apparatus having a take-up means, as set forth in claim 1, in which the distance between the pivotal connection of said first member of said first cylinder-piston means from the axis of rotation of said pulley is greater than the distance between the pivotal connection of said second member from the axis of rotation of said pulley.

3. In a belt drive apparatus having a take-up means, as set forth in claim 1, in which said means displaceable with respect to said belt means for varying the tension on and tautness of said belt means comprises said belt engaging and belt driving pulley.

4. In a belt drive apparatus having a take-up means, as set forth in claim 1, in which said means displaceable with respect to said belt means to vary the tension on and tautness of said belt means comprises tension roller means positioned along said belt for displaceable movement with respect to said belt.

5. In a belt drive apparatus, as set forth in claim 1, in which said apparatus further comprises movable frame means carrying said rotatable member, said pulley and said first and second cylinder-piston means, a fixed frame means carrying said movable frame means for allowing linear movement of said movable frame means and said components carried thereby, and third fluid operable cylinder-piston means comprising a first and second member movable relative to each other in which said first member is connected with said movable frame means and said second member is connected with said fixed frame means, said third cylinder-piston means being in fluid communication with said second cylinder-piston so that said first and second members of said third cylinder-piston means will move relative to each other upon reception of fluid from said second cylinder-piston means to move said movable frame and said pulley for varying the tension and tautness in said belt means.

6. In a belt drive apparatus having a take-up means, as set forth in claim 1, in which said second fluid operable cylinder-piston means comprises a first and second member movable relative to each other, said means displaceable with respect to said belt means to vary the tension on and tautness of said belt means comprises tension roller means positioned along said belt means for movement into and out of engagement with said belt means for varying the tension thereon, said second cylinder-piston means being operatively connected to said tension roller means to move said tension roller means into and out of engagement with said belt means for varying the tension of said belt means in accordance with the relative movement between said first and second members of said second cylinder-piston means.

* * * * *