21 MAY 2002

166166

G00002

Description:

Lift Drive Pulley with rotating oscillation damping

The invention concerns a lift drive pulley with rotating oscillation damping consisting of a mass which is rotatable about its axis of rotation by means of spring elements.

A drive pulley, in which the external rim is supported on a bearing arranged at a hub of a drive shaft for the avoidance of oscillations, has become known from patent specification DE 3 532 624. Freely supporting support arms with rubber elements, which are received by a housing of the outer rim, are arranged at a flange arranged firmly at the hub. The outer rim, the annular rubber elements and the freely supporting support arms form an arrangement which is rotatably supported at the bearing. A turning moment acting at the outer rim is transmitted by way of the rubber elements, the freely supporting support arms and the flange to the hub and then to the drive shaft. The bearing of the outer rim enables a slight tangential movement of the drive pulley. The inertia of the drive pulley can be varied by increasing or reducing the mass of the outer rim.

A disadvantage of the known equipment lies in that rubber elements are used for the avoidance of oscillations. The spring properties of the rubber elements change due to ageing and fatigue and thus the damping behaviour of the drive pulley. Expensive replacement of the rubber elements and new adjustment of the drive pulley are disadvantageous consequences thereof.

Here, the invention is to create a remedy. The invention as characterised in the claims solves the task of avoiding the disadvantages of the known equipment and of creating a damping equipment, the damping behaviour of which is easily settable and does not change in the course of time.

The advantages achieved by the invention are to be seen substantially in that a build-up of the drive pulley is possible independently of the damping equipment. It is furthermore advantageous that drive pulleys already in operation can be

subsequently equipped with the damping equipment according to the invention and adjusted to specific damping properties.

The invention is explained more closely in the following with reference to drawings illustrating merely one manner of embodiment. There:

Fig.1 shows a schematic illustration of a unit consisting of a gear, a drive pulley arranged at a drive shaft with free end, and an oscillation damper acting as damping equipment;

Fig.2 shows an equipment according to Fig.1 with an external bearing;

Fig.2a shows an oscillation damper arranged at the gear-side end face of the drive pulley;

Fig.3 shows a frequency response of the tangential acceleration at the drive pulley with and without oscillation damper;

Fig.4 shows an oscillation damper with a spoke-shaped torsion spring;

Fig.5 shows details of the oscillation damper according to Fig.4;

Fig.6 shows an oscillation damper with a tubular torsion spring; and

Figs.7 and 8 show details of the torsion spring according to Fig.6.

Oscillations excited by a lift gear often lead to disturbing noises in the lift cage. The frequency of the tooth engagement in the case of two-start and three-start worm gears is particularly disturbing. The disturbing frequency amounts to about 50 hertz or 75 hertz. An oscillation damper operating as damping equipment consists of a mass and a spring with the natural frequency

$f_t = 1/2\pi \cdot (c/m)^{1/2}$,

wherein c (Newtons per metre) is the spring rate and m (kilograms) is the mass of the oscillation damper. One end of the spring is connected with the mass. When the other end, denoted as foot point, is excited at the natural frequency the damper oscillates in opposite phase and endeavours to keep the foot point quiet. The force in the spring then compensates for the exciting force. With increasing mass, the width of the frequency band increases with reducing amplitude. As rule of thumb, the damper mass is to amount to about 10 percent of the mass to be kept quiet.

In the case of geared lifts, a rotating oscillation damper is used, which has about the same diameter as the drive pulley and is connected with this by means of a torsion spring.

In Figs.1 to 6 a gear of a lift, for example a worm wheel gear, is denoted by 1 and stands in connection with a drive shaft 2. According to Fig.1, the drive shaft 2 has a free shaft end, at which a drive pulley 3 and oscillation damper 4 are arranged. According to Fig.2, the free shaft end is supported at an external bearing 5. In this case, the drive pulley 3 is arranged between the gear 1 and the external bearing 5 and the oscillation damper 4 is arranged externally of the external bearing 5.

The shaft part between the drive pulley 3 and the oscillation damper 4 acts as a spring, which must also be taken into consideration as part of the damper spring in the computation of the oscillation damper. Regarded mathematically, the drive shaft 2 ends in every case at the drive pulley 3, wherein the oscillation damper 4 is arranged coaxially with the drive shaft 2 at the shaft end.

As shown in Fig.2a, the oscillation damper 4 can also be arranged coaxially with the drive shaft 2 at the gear-side end face of the drive pulley 3. The oscillation damper 4 can also be arranged coaxially with the drive shaft 2 at the shaft-end-side end face of the drive pulley 3.

Fig.3 shows a frequency response of the tangential acceleration at the drive pulley with and without oscillation damper 4. In the shown diagram, the amplitude as amplification in db is entered on the ordinate and the oscillation frequency in hertz is entered on the abscissa. The rolling defect in the gear toothing acts as excitation. The oscillation damper 4 causes a strong lowering of the amplitude at, for example, 73.5 hertz.

An example of embodiment of a rotating oscillation damper 4 with a spoke-shaped torsion spring 11 is illustrated in Fig.4 and Fig.5. Fig.4 shows a section along the line A - A of Fig.5. A shaft end 6 of the drive shaft 2 is supported by the external bearing 5, which is retained by a bearing block 7. The shaft end 6 has a bore 8, into which a threaded bolt 9 is screwed, at one end face 6.1. The bore is usually already formed during the manufacture of the drive shaft 2 independently of

whether the drive unit 2 is equipped with an oscillation damper 4 or not. The threaded bolt 9 carries a disc 10, which acts as mass, with a spoke-shaped torsion spring 11, which is machined out of the disc 10 and which enables a slight movement of the disc about the axis of the threaded bolt 9. The spring hardness is co-determinative for the natural frequency of the oscillation damper 4. The disc 10 is pressed by means of a first nut 12 onto a spacer member 13 and this onto the end face 6.1 of the shaft end 6. A cap 14 covers the first nut 12 in order that no body parts and objects can be seized by the rotating first nut 12. For fine adjustment, an additional mass in the form of a trimming ring 15 is necessary, which is arranged at the disc 10 by means of first screws 16.

According to Fig.5, the spoke-shaped torsion spring 11 comprises spokes 17, which are formed by recesses 18 in the disc 10. A recess 18 extends, for example, circularly over almost 120 degrees and comprises prolongations in radial direction at the ends. The disc 10 remaining between two prolongations is the spoke 17 with its spring effect. The first screws 16 of the trimming ring 15 engage into threads 19 arranged at the disc 10.

Fig.6 shows a further variant of embodiment of the rotating oscillation damper 4, in which the oscillation frequency, also called damping frequency, is settable to, for example, between 46 hertz and 90 hertz. The first nut 12 urges a tubular torsion spring 20, which is arranged on the threaded bolt 9, against the end face 6.1 of the shaft end 6. The torsion spring 20 enables a slight movement of the disc 10 about the axis of the threaded bolt 9. A thread, which is not illustrated, of the disc 10 engages into an external thread 21 of the tubular torsion spring 20, whereby the disc 10 is adjustable axially to a specific spacing B from the end face 6.1 according to the desired oscillation frequency. The oscillation frequency reduces as the spacing B increases. For securing the disc 10, a clamping nut 22 is placed onto the tubular torsion spring 20 so that an air gap C of, for example, 2 to 3 millimetres from the disc 10 is present. The disc 10 and the clamping nut 22 are tightened against each other by means of second screws 23 and clamped fast on the torsion spring 20. A hood 24 covers the clamping nut 22 in order that no body parts and objects are seized by the rotating clamping nut 22 and second screws 23. In this variant of embodiment, the low production costs and the simple and accurate setting of the damping frequency are of advantage.

Fig.7 shows details of the torsion spring 20 and Fig.8 shows a section along the line A - A of Fig.7. The torsion spring 20 consists of a tubular spring element 25 with external thread 21 and bore 26 as well as a spring foot 27, which is urged against the end face 6.1 of the shaft end 6 by means of the nut 12 and the threaded bolt 9. At least one longitudinal slot 28 is arranged, for example in axial direction, at the spring element 25. In the example of embodiment, three longitudinal slots 28 are arranged, wherein each two radial axes 29 form an angle 30 of 120 degrees. The longitudinal slots 28 can, for example, also be arranged in spiral shape at the spring element 25. The longitudinal slots 28 reduce the torsional stiffness of the torsion spring 20 and increase the range of adjustment of the damper frequency.

Patent Claims:

1. Lift drive pulley with an oscillation damper (4) consisting of a mass (10) and spring elements (11,20), whereas the mass (10) and the spring elements (11,20) are arranged coaxially with a drive shaft (2) at the end face of the lift drive pulley (3) and whereas the spring elements (11,20) enable a rotational movement relative to the drive pulley (3) of the mass (10) about the coaxial axle.

2. Lift drive pulley with rotating oscillation damping according to claim 1, characterised in that the mass is a disc (10), which is connected with the end face (6.1) of the drive shaft (2) by means of a torsion spring (11, 20).

3. Lift drive pulley with rotating oscillation damping according to claim 2, characterised in that the disc (10) comprises spokes (17) which act as torsion spring (11).

4. Lift drive pulley with rotating oscillation damping according to claim 3, characterised in that recesses (18), which form the spokes (17), are provided at the disc (10).

5. Lift drive pulley with rotating oscillation damping according to claims 2 to 4, characterised in that an additional mass in the form of a trimming ring (15) arranged on the disc (10) is provided for fine adjustment.

6. Lift drive pulley with rotating oscillation damping according to claim 1, characterised in that a tubular torsion spring (2), on which the disc (10) is arranged to be axially displaceable, is provided.

7. Lift drive pulley with rotating oscillation damping according to claim 6, characterised in that an external thread (21) is provided at the tubular torsion spring (20) for the axial displacement of the disc (10) and that an axially displaceable clamping nut (22) is provided on the external thread (21) for the securing of the disc (10).

8. Lift drive pulley with rotating oscillation damping according to claims 6 and 7, characterised in that the torsion spring (20) comprises a tubular spring element (25) and a spring foot (27), wherein at least one longitudinal slot (28) is arranged at the spring element (25).