

Elevator Roping Arrangement

This invention relates to traction elevator systems, in particular, improving traction between the rope and the drive.

5 In one common type of elevator roping configuration ropes are wrapped for about 180° around a drive sheave that is rotated by the motor. The available traction is obviously dependent on the surface area of the sheave contacted by the rope and the
10 downward force, while the required traction is dependent on the weight of the car and the counterweight and the acceleration. If the downward load is reduced (as it would be if the elevator car and the counterweight weighed less), the required traction
15 (determined by the ratio of the rope loads on each side of the sheave) would increase, and, when it exceeded the available traction, it would give rise to slip, which diminishes efficiency and cable life.

20 Another arrangement, sometimes known as the double wrap, uses a secondary sheave, also known as a deflection sheave, as part of a rope arrangement in which the ropes are fed from the counterweight over the deflection sheave to the drive sheave,
25 back to the deflection sheave, back to the drive sheave and then down to the car, thus doubling the arc of the ropes on each sheave and thus proportionally increasing the available traction. However, the load on each sheave is also increased because the
30 sum of the rope forces (it determines that load) is also doubled. The arrangement may, by increasing the number of ropes on each sheave, actually increase the loading on the drive sheave, significantly enough to decrease the service life of the bearing
35 components that support the drive sheave and the secondary sheave, and also the life of the rope. Furthermore, the double wrap arrangement is neither

(13)

- 2 -

compact, nor inexpensive, mainly because the sheaves have to be made twice as large, and because they have to be strong enough to withstand the increased loading that they sustain.

5 Another arrangement for improving traction is shown in Finnish Patent No. 56813. There, the ropes are wrapped less than 251° around the main drive after passing over a deflection sheave. A problem is, however, that the deflection sheave
10 and the drive sheave are not coplanar, leading to noise and excessive sheave and cable wear.

According to the present invention there is provided an elevator system comprising a car, a counterweight, a drive unit and at least one
15 rope extending from the counterweight to the car through the drive unit which drives the rope to move the car within an elevator shaft, wherein the drive unit comprises a motor; a drive sheave; and a deflection sheave;

20 the drive sheave being driven by the motor, and the rotational plane thereof being oriented at a vertical angle relative to the rotational plane of the deflection sheave;

the or each rope, in passing through the
25 drive unit, extends from the counterweight to the deflection sheave and from the deflection sheave to the drive sheave at a horizontal angle relative to the plane of each sheave, then around the drive sheave, and then to the car, the portion of the
30 or each rope passing from the deflection sheave to the drive sheave being adjacent the portion leaving the drive sheave and extending to the car; and

the drive sheave and deflection sheave containing
35 a nonmetallic insert for supporting and guiding the or each rope.

Preferably, the or each rope is routed around the drive sheave for more than 250° .

This arrangement significantly improves available traction without enlarging the size of the sheaves, or increasing the number of wraps. Noise and rope wear are significantly reduced and more rope wrap -
5 hence more traction - is available with a small drive sheave.

An embodiment of the invention will now be described by way of example only and with reference to the accompanying drawing which is a perspective
10 view of a geared AC elevator drive embodying the present invention. It shows multiple ropes which extend into an elevator shaft to connect to a counterweight and a car; however, neither the car, the shaft, nor the counterweight are shown specifically in
15 the drawing.

The geared AC elevator drive shown in the drawing includes an AC worm gear motor 10 and a drive sheave 12 that the motor rotates in order to raise and lower the car. This motor 10 is mounted
20 on a rather straightforward frame arrangement to a pair of beams 14 which span the elevator shaft above the car and counterweight. (The car, counterweight, and the shaft are not specifically shown in the drawing.)

25 A deflection sheave 16 on the beams 14 rotates about a rotational axis 16a which lies basically in the horizontal plane of the beams. On the other hand, the drive sheave 12 rotates about an axis 12a which is oriented at some vertical angle X
30 with respect to the horizontal plane and axis 16a. The drive sheave 12, in other words, is oriented at an angle relative to the rotational plane of the deflection sheave 16 (their rotational planes are not parallel). This offset may be established
35 simply by using tapered support blocks 17 below the motor 10. The drive sheave and the deflection sheave contain a nonmetallic (e.g. polyurethane) insert INS, like the insert shown in U.S. patents

(15)

- 4 -

3,279,762 and 4,198,196. These inserts are cleated to improve traction. The insert here, however, need not be cleated to attain satisfactory traction (due to the wrap of more than 250°).

5 Four ropes 20 extend upward from the counterweight into corresponding grooves on the deflection sheave 16. From the deflection sheave 16 these ropes enter grooves on the bottom of the drive sheave 12. They then pass around the drive sheave for
10 an angular distance (approximately 252° minimum) and from there drop down to the car.

The drive sheave 12 is not only offset with respect to the rotational axis 16a, but is also not coplanar with the rotational plane of the deflection
15 sheave 16, so that the ropes leaving the drive sheave can drop down between the beams 14. As a result of the location of the drive sheave 12 relative to the deflection sheave 16, and as a result of the offset angle X, the incoming portions
20 20a of the rope are horizontally displaced from the departing portions 20b that drop down to the car, and it is the offset angle X that permits the portions 20a and 20b to clear each other, thus giving rise to an "interleaved" rope pattern (at
25 IX) where the portions 20a and 20b cross. The angle (horizontal draw angle) between the rope and the deflection sheave and the drive sheave as measured in the horizontal plane is about 1.5° . (In the prior art this is typically 0.7° . This
30 limits the maximum permissible wrap because adjacent ropes must clear each other.) The vertical angle (vertical draw angle) between the planes of rotation of the drive sheave and the deflection sheave is also about 1.5° . The inserts permit these greater
35 draw angles - however, without increased wear, which would otherwise occur.

The drive shown in the drawing provides a wrap angle Δ of approximately 252° (minimum).

That wrap angle could be increased somewhat by raising the deflection sheave vertically, but, so that the portions 20a and 20b will clear, that may require increasing the offset angle X, and
5 so the vertical draw angle. But, this is not practical, if required, because the inserts minimize the wear the higher draw produces. There is a disadvantage, however, in increasing the angle X unnecessarily: it increases the side thrust on the drive shaft,
10 and it increases the side loading and friction on the grooves, which may significantly reduce rope life. Obviously, the offset angle X is a function of the size of the drive sheave; a smaller drive sheave will require a larger offset angle,
15 if the portions 20a, 20b are to clear each other in the area IX. The selection of the offset angle thus must take into account the size of the drive sheave, the permissible thrust on the drive shaft, and the permissible side loading on the drive sheave
20 grooves. The grooves in the drive sheave and the deflection sheave, of course, may contain polyurethane insert material to increase traction and decrease wear.

This particular roping arrangement may, of
25 course, be used in other types of motor drives where it is desired to increase the surface area between the ropes and the drive sheave without increasing the number of wraps. Similarly, the number of ropes which are shown is not particularly significant,
30 and more or less could be used, depending on the system load (counterweight and car).

Other modifications and variations may be made, in whole or in part, to the drive which has been shown, without departing from the scope of
35 the invention it embodies.

(17)



- 6 -

CLAIMS:

1. An elevator system comprising, a car, a counterweight,
a drive unit and at least one rope extending from
the counterweight to the car through the drive
unit which drives the rope to move the car within
an elevator shaft, wherein
the drive unit comprises a motor; a drive
sheave; and a deflection sheave;
the drive sheave being driven by the motor,
and the rotational plane thereof being oriented
at a vertical angle relative to the rotational
plane of the deflection sheave;
the or each rope, in passing through the
drive unit, extends from the counterweight to the
deflection sheave and from the deflection sheave
to the drive sheave at a horizontal angle relative
to the plane of each sheave, then around the drive
sheave, and then to the car, the portion of the
or each rope passing from the deflection sheave
to the drive sheave being adjacent the portion
leaving the drive sheave and extending to the car;
and
the drive sheave and deflection sheave containing
a nonmetallic insert for supporting and guiding
the or each rope.
2. An elevator system as claimed in claim 1,
wherein said vertical and horizontal angles are
each about 1.5°.
3. An elevator system as claimed in claim 1
or claim 2 wherein the wrap angle of the or each
rope in passing around the drive sheave is greater
than 250°.
4. An elevator system as claimed in any preceding
claim having more than one rope, said non-metallic
insert being cleated.
5. An elevator system substantially as herein
described with reference to the accompanying drawings.