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BACKGROUND OF THE INVENTION

This invention relates to a traction elevator apparatus, and more particularly to enhancement in the traction ability thereof.

In recent years, conservation of resources and
5 the reduction of cost have been applied also to the elevator industry. It has accordingly been proposed to lighten the weight of elevator cages and to make the diameter of elevator sheaves smaller. With this measure, however, slip between the driving sheave and the rope
10 connecting the cage and a balance weight is likely to occur. It is accordingly desired to enhance the traction ability thereof.

Figure 1 illustrates the roping system of a single lap type traction elevator of a prior art. Numeral
15 1 designates the driving sheave of an elevator hoist, and numeral 2 the deflecting wheel thereof. A rope 3 is extended over the sheave 1 and the deflector wheel 2. A cage 4 and a balance weight 5 are respectively connected to the ends of the rope 3.

20 In such a system, the angle θ over which the rope 3 is wound on the driving sheave 1 becomes less than 180° . The rope winding angle θ for the case where the deflector wheel 2 is not utilized, becomes 180° .

The is, with the prior art roping system as shown
25 in Figure 1, the rope winding angle θ is not more than 180° which makes it very difficult to yield high traction

characteristics, and in turn, to lighten the weight of the cage itself for the purposes of saving materials and reducing the cost thereof.

This invention has been made in order to solve the disadvantages of the prior art, and has for its object to provide a traction elevator apparatus having a structure in which the winding angle of a rope with respect to a driving sheave can be made greater than 180°, consequently enhancing the traction ability thereof, thereby facilitating the use of lighter weight cages as well as allowing the use of smaller diameter sheaves.

The invention provides a traction elevator comprising a driving sheave, at least one deflector wheel, and a rope interconnecting a cage and a counterweight, the rope path extending from the cage to the counterweight by way of two portions in contact with the deflector wheel(s) and a portion wound on the sheave, the deflector wheel(s) and the sheave being at different levels and the rope being crossed over itself between the sheave and the deflector wheel(s), wherein the two portions in contact with the deflector wheel(s) lie outside the respective vertical tangents to both sides of the sheave with a sufficient distance therefrom so that the distance between parallel parts of the cage side and balance weight side rope parts is such as to prevent the cage and the balance weight from interfering with each other.

This brings forth the effect that the winding angle θ of the rope with respect to the driving sheave can be made greater than 180°, thereby enhancing the traction ability thereof. In turn the weight of the cage itself can be reduced and the diameter of the sheave can be decreased resulting in the reduction of construction material as well as the reduction in cost.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic arrangement diagram of a prior art traction elevator apparatus;

Figure 2 is a schematic arrangement diagram showing an embodiment of a traction elevator apparatus according to the present invention;

Figure 3 is a schematic arrangement diagram showing another embodiment of the traction elevator apparatus according to the present invention; and

Figures 4 and 5 are plan views showing the positions of grooves formed in deflector wheels, and corresponding to the embodiments of Figures 2 and 3, respectively.

Figure 2 shows an embodiment of a single lap type traction elevator apparatus according to the present invention.

Positioned underneath the driving sheave 1 of an elevator hoist (not shown) is disposed a deflecting wheel 6 which has a diameter larger than that of the driving sheave 1, for illustrative purposes. A rope 3 is wound around the driving sheave 1 having a cage side rope part 3a and balance weight side rope part 3b wound on the deflecting wheel 6 in a manner so that the said parts cross each other in the space between the driving sheave 1

and the deflecting wheel 6. The rope part 3a on the side of the driving sheave 1 closer to a balance weight 5 is wound around the cage side of the deflector wheel 6, while the rope part 3b on the side of the driving sheave 1 closer to the cage 4 is wound on the balance weight side of the wheel 6. The cage 4 and the balance weight 5 are attached to the suspending ends of the respective rope parts 3a and 3b. Thus, the winding angle θ of the rope 3 with respect to the driving sheave 1 can be made greater than 180° .

The "traction ability" as a function of the rope tension ratio T_1/T_2 between the rope and the driving sheave can be defined by the following expression:

$$T_1/T_2 = e^{\mu\theta} \quad (1)$$

where T_1 : rope tension on the cage side,
 T_2 : rope tension on the balance weight side,
 e : base of the natural logarithm,
 μ : apparent friction factor between the groove of the driving sheave and the rope, and
 θ : winding angle of the rope of the driving sheave.

The winding angle θ of the rope 3, which can be made greater than 180° as described above, signifies that the traction ability can be increased as is apparent from Expression (1) mentioned above. Consequently, a lighter weight cage 4 and a smaller diameter sheave 1 can be utilized.

With the embodiment of this invention shown in Figure 2, when the elevator becomes large in size, the deflector wheel 6 also becomes large resulting in very large deflector wheel which is not desirable from an economic view point. Another embodiment overcoming the above mentioned drawback is shown in Figure 3 according to the present invention.

In the embodiment of Figure 3, a deflector wheel 6a for a cage 4 and a deflector wheel 6b for a balance weight 5 are disposed below and on opposite sides of a driving sheave 1. The rope 3 is wound around the driving sheave 1. The cage side rope part 3a of the rope 3 on the side of the driving sheave 1 closer to the balance weight 5 extends over the cage side deflector wheel 6a, while the balance weight side rope part 3b, on the side of the driving sheave 1 closer to the cage 4 extends over the balance weight side deflector wheel 6b. Thus, the rope parts 3a and 3b cross each other on the lower side of the driving sheave 1 thereby yielding a winding angle θ of the rope 3 on the driving sheave 1 which is greater than 180° .

In this manner, the traction ability can be increased allowing for the usage of smaller diameter deflector wheels.

As thus far described, according to the present invention, at least one deflector wheel is arranged below a sheave in such a manner that the part of the circumferential surface of the deflector wheel in contact with the rope lies outside a vertical tangent with respect to the sheave surface. Further, a rope is wound on the sheave and the deflector wheel in a manner so that parts of the rope cross under the sheave. Therefore, the angle θ over which the rope is wound on the sheave can be made greater than 180° , and accordingly the traction ability can be increased.

This is especially so when utilized with single lap type traction elevators.

While the foregoing embodiments have exemplified the construction in which the driving sheave is disposed above the cage, this invention is also applicable to a construction in which a sheave is installed below the cage, that is, in the lowest part of a shaft.

In addition, the distance L between the parallel parts of the cage side rope part 3a and the balance weight side rope part 3b is set so as to prevent the cage and the balance weight from interfering with each other, by properly selecting the diameter and installation position of the deflector wheel.

In the systems illustrated in the foregoing embodiments, it is feared that the rope parts 3a and 3b may interfere at the crossing parts thereof. To eliminate the above mentioned fear, a groove with which the cage side rope part 3a is held in engagement and a groove with which the balance weight side rope part 3b is held in engagement may be individually formed in the deflector wheel or wheels so as to establish a safe distance between the crossing parts of both the rope parts owing to the grooves.

Such embodiments corresponding to the foregoing embodiments of Figures 2 and 3 are respectively shown in Figures 4 and 5.

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Claims:

1. A traction elevator comprising a driving sheave, at least one deflector wheel, and a rope interconnecting a cage and a counterweight, the rope path extending from the cage to the counterweight by way of two portions ~~portion~~ in contact with the deflector wheel(s) and a portion wound on the sheave, the deflector wheel(s) and the sheave being at different levels and the rope being crossed over itself between the sheave and the deflector wheel(s), wherein the two portions in contact with the deflector wheel(s) lie outside the respective vertical tangents to both sides of the sheave with a sufficient distance therefrom so that the distance between parallel parts of the cage side and balance weight side rope parts is such as to prevent the cage and the balance weight from interfering with each other.

2. A traction elevator as claimed in claim 1, wherein the angle of wrap of the rope on the driving sheave is greater than 180°.

3. A traction elevator as claimed in claim 1 or 2, being a single lap type traction elevator.



4. A traction elevator as claimed in any preceding claim, wherein the deflector wheel or wheels is or are formed with at least one groove in which the rope portions for connection to the cage and the counterweight respectively are held in engagement, the groove or grooves being formed in different positions with respect to each other, thereby preventing the said rope portions from interfering with each other.

5. A traction elevator as claimed in any preceding claim, wherein the portion of the rope wound on the driving sheave which is on the circumferential part of the driving sheave closer to the balance weight is connected to the cage, while the rope portion which is on the circumferential part of the driving sheave furthest from the balance weight is connected to said balance weight, the rope portions extending towards the cage and the counterweight respectively crossing each other at some point along their length.

6. A traction elevator as claimed in any preceding claim, wherein a single deflector wheel is provided, having a diameter larger than that of the driving sheave.



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7. A traction elevator as claimed in any of claims 1 to 5, wherein respective defector wheels for the cage side and the counterweight side are disposed on respective sides of the driving sheave.

- 5 8. A traction elevator substantially as herein described with reference to Figure 2 or 3 of the accompanying drawings.
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