

PATENT SPECIFICATION

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(54) A CABLEWAY ARRANGEMENT FOR MOVING A PAYLOAD

(71) I, GERHARD MULLER, a Swiss citizen, of Zipfelwiesenstrasse 7, Dietlikon, Switzerland, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed to be particularly described in and by the following statement:—

This present invention relates to cableway arrangements for moving payloads and to methods of constructing the same e.g. for overhead traffic systems.

In the prior art cableway arrangements known to us in Switzerland, loads, for example, gondolas or cabins (sometimes also referred to as payloads) carried by a driveway cause a considerable increase in the sagging of a support cable supporting the driveway since equilibrium conditions are brought about *via* saddles on the pylon carrying the support cable. If the load travels through a number of spans each bounded by two pylons then the sag of the support cable in the span increases markedly with increasing distance of the load from the anchored end of the support cable. After only three or four span zones from an anchored end of the cableway arrangement, depending upon the span length and the support pressures, equilibrium is achieved by the support cable sagging in the span zone in which the payload is situated whilst in the neighbouring span zones the sag is decreased correspondingly. Thus, the span zone containing the load takes up cable from the neighbouring span zones. This, in turn, causes a continuous feeding of the cable from one span zone to the next across the saddles or support shoes of the pylons and therefore leads to a bending load on the cables which can lead to their rupture. Apart from this the pronounced sagging of the support cable in the span zone in which the load is situated reduces the travelling speeds possible for the payload.

The present invention seeks to avoid the drawbacks of the known cableway arrangements.

According to one aspect of the present invention there is provided a cableway arrangement for moving a payload, comprising: a cable forming a driveway, said cable being pretensioned between spaced apart support means, forming at least one span, a support cable, said driveway and said support cable extending between said support means and bearing at the ends of the or each span upon said support means and connection elements interposed between said driveway and said support cable for suspending said driveway on said support cable, said connection elements being tensioned for producing stressing of said support cable and additional stressing of said driveway such that under no load condition said driveway has a negative sag along the or each span, said additional stressing of said driveway by said connection elements generating under the no load condition negative bearing forces at said support means, said cable forming the driveway being loaded under a tension which is at least twice that of said support cable.

According to another aspect of the present invention there is provided a transport system including a cableway arrangement as recited above.

According to a still further aspect of the present invention there is provided a method of constructing a cableway arrangement for moving a payload, the cableway arrangement comprising a cable forming a driveway extending between spaced apart support means forming at least one span, said driveway cable bearing at the ends of the or each span upon said support means, and a support cable also extending between said support means and being attached at the ends of said span or spans to said support means, said method comprising the steps of: pre-tensioning said driveway between said spaced support means, suspending said driveway from the support cable by connection elements, and tensioning said connection elements for

producing a stressing of said support cable and an additional stressing of said driveway such that under no load condition said driveway has a negative sag along the or
5 each span, said additional stressing of said driveway by said connection elements generating under the no load condition negative bearing forces at said support means, said cable forming said driveway
10 being loaded under a tension which is at least twice that of said support cable.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:

15 Figure 1 schematically illustrates the principal stress or tension conditions in a support cable and a driveway;

20 Figure 2 schematically illustrates the stress or tension conditions which prevail in a support cable and a driveway of a known cableway arrangement constructed on the principle of one form of a suspension bridge; and

25 Figure 3 illustrates a cableway arrangement according to the present invention.

In the drawings like parts have been designated by the same reference numerals.

30 Referring now to the drawings, initially there will be considered, in conjunction with Figure 1, the principal stress or tension conditions prevailing at a support cable 1 and at a driveway 2 in the form of a carrying cable. The support cable 1 and the driveway 2 are fixedly anchored at their terminal
35 points and throughout their extent are supported at a number of locations by supports or pylons 3. The regions between each terminal point and the adjacent pylon 3 and between each pair of pylons are designated herein as the span zones. In the no load or unloaded condition (i.e. no load is carried by the driveway 2) no prestress or pretension prevails at the support cable 1, so
40 that the support cable 1 will be seen to exhibit a large sag in each span zone. On the other hand, in the unloaded condition, the driveway 2 exhibits a very small sag, yet, however, is subjected to a very high stress or tension. Apart from this stress, both the weight of the driveway as well as the weight of the support cable are completely taken up by the pylons 3.

45 In Figure 2, there is illustrated a cableway arrangement constructed on the principle of one form of a suspension bridge. The driveway 2 is suspended by connection elements 4 to the support cable 1. By virtue of this arrangement, in the unloaded condition the driveway does not bear directly on the pylons 3. This principle of construction is used not only in connection with suspension bridges but also in connection with aerial ropeways or cableways.
50 A traffic load or payload 5 situated in a

given span zone produces in that span zone a sagging of the support cable 1 and a corresponding sagging of the driveway 2, and this sagging is clearly shown in Figure 2. The weight of the payload 5 is taken up
70 directly by the pylons 3' bounding that span zone. Additionally, due to the increased sag of the support cable, it will be recognized that cable is drawn or fed from the neighbouring span zones which, as previously considered heretofore, can result in considerable damage to the cable.

75 Figure 3 illustrates a cableway arrangement according to the present invention. The driveway 2 is under a stress or tensile load and is additionally pre-stressed by the support cable 1 by means of the connection elements 4 in such a manner that a negative sag or camber is produced in the driveway 2 in the unloaded condition; in other words, the driveway is upwardly arched. Consequently, the support cable 1 is overloaded. The basic difference of this cable arrangement in comparison to the cableway arrangement illustrated in Figure 2 resides in the fact that the driveway 2 is more strongly pre-stressed or tensioned and possesses approximately twice the tensile load of the support cable 1, and the support cable 1 is pre-loaded by the driveway 2. The additional stressing of the driveway 2 generates under no load condition negative bearing forces at the pylons 3'.
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In so doing, it has been found to be advantageous if the forces exerted upon pylons 3' by the driveway 2 in the unloaded condition corresponds to the average designed payload of the cableway arrangement.

When the payload 5 is situated in a given span zone then, due to the slight increase in tension caused thereby in the support cable 1, the camber of the driveway 2 is reduced. In the unloaded condition, the driveway exerts a force directly on the pylons 3', but this force is reduced in the loaded condition of the driveway. Now if the payload is directly beneath a pylon 3', then, in the ideal situation, the force at this pylon drops to zero so that, in contrast to the known constructions, a passenger in a cabin or gondola travelling over the driveway would not experience any physical sensation when it passed over the pylons 3'.
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Since the payload 5 seldom possesses a predetermined constant value, especially when the payload is a cabin or gondola where the payload varies between the empty or dead weight and the full weight of the cabin or gondola, the calculation should be based upon an average value of the payload, e.g. approximately the weight of a half occupied cabin or gondola. In such a case, the pre-loading of the driveway 2 which produces the camber is chosen such that the payload which is guided along the driveway
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follows a path of travel which approximates a straight line.

The deviations from such ideal case are relatively slight, since the dead weight, of, for example a self-propelled transport means generally make up more than 50% of the full weight. If one bases one's calculation on the average load, then 75% of the full weight can be compensated.

An empty transport means as it moves from pylon to pylon thus will pass through a slight raised or cambered path of travel; a fully loaded carriage, on the other hand, will move through a path of travel which corresponds to a very flat catenary curve. By the same token, an empty carriage upon passing through the supports or pylons 3' will not completely bring to zero the force directly exerted by the driveway thereon, whereas a completely occupied cabin will cause a force to be exerted which is opposite in direction to the force exerted by the driveway in the unloaded condition.

With the selection of the basic stresses in the driveway and support cable in the manner previously described, there is little change in these basic stresses between the loaded and unloaded conditions and so the pylons take a substantially fixed stress. The dangerous feeding of the support cable upon the saddles or support shoes is effectively eliminated. Furthermore, the payload tends to reduce the stress or tension in the driveway and only a very slight increase of the load in the support cable.

In summary, it should be mentioned that with the cableway arrangement of the present invention described above there is achieved a substantially rectilinear path for the payload, because on the one hand the payload follows a substantially straight line between pylons and, on the other hand, follows a substantially co-linear path as the payload crosses the pylons. Thus, the cableway arrangement in a transport system permits high traffic speeds. Furthermore, since the payload does not produce any appreciable change in stress or tension in either the support cable or the driveway there may be optimum utilization of material from which the cableway arrangement is constructed.

The above described cableway arrangement used in connection with a transport system is extremely reliable and safe in operation.

Since in the cableway arrangement there is no feeding of cable from one span zone to another there is no necessity to use cable tensioning weights. This allows the support cable to be clamped at the pylons. As a practical matter, this not only results in a

very great constructional simplification of the saddles or support shoes and pylons, but also additionally reduces the beanding loads in the cable wires.

WHAT I CLAIM IS:—

1 A cableway arrangement for moving a payload, comprising: a cable forming a driveway, said cable being pretensioned between spaced apart support means, forming at least one span, a support cable, said driveway and said support cable extending between said support means and bearing at the ends of the or each span upon said support means, and connection elements interposed between said driveway and said support cable for suspending said driveway on said support cable, said connection elements being tensioned for producing stressing of said support cable and additional stressing of said driveway such that under no load condition said driveway has a negative sag along the or each span, said additional stressing of said driveway by said connection elements generating under the no load condition negative bearing forces at said support means, said cable forming the driveway being loaded under a tension which is at least twice that of said support cable.

2. A cableway arrangement for moving a payload substantially as herein described with reference to and as shown in Figure 3 of the accompanying drawings.

3. A transport system including a cableway arrangement as claimed in claim 1 or 2.

4. A method of constructing a cableway arrangement for moving a payload, the cableway arrangement comprising a cable forming a driveway extending between spaced apart support means forming at least one span, said driveway cable bearing at the ends of the or each span upon said support means, and a support cable also extending between said support means and being attached at the ends of the said span or spans to said support means, said method comprising the steps of: pre-tensioning said driveway between said spaced support means, suspending said driveway from the support cable by connection elements, and tensioning said connection elements for producing a stressing of said support cable and an additional stressing of said driveway such that under no load condition said driveway has a negative sag along the or each span, said additional stressing of said driveway by said connection elements generating under the no load condition negative bearing forces at said support means, said cable forming said driveway being loaded under a tension which is at least twice that of said support cable.



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50 The above described cableway arrangement used in connection with a transport system is extremely reliable and safe in operation.

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2. A cableway arrangement for moving a payload substantially as herein described with reference to and as shown in Figure 3 of the accompanying drawings.

3. A transport system including a cableway arrangement as claimed in claim 1 or 2.

4. A method of constructing a cableway arrangement for moving a payload, the cableway arrangement comprising a cable forming a driveway extending between spaced apart support means forming at least one span, said driveway cable bearing at the ends of the or each span upon said support means, and a support cable also extending between said support means and being attached at the ends of the said span or spans to said support means, said method comprising the steps of: pre-tensioning said driveway between said spaced support means, suspending said driveway from the support cable by connection elements, and tensioning said connection elements for producing a stressing of said support cable and an additional stressing of said driveway such that under no load condition said driveway has a negative sag along the or each span, said additional stressing of said driveway by said connection elements generating under the no load condition negative bearing forces at said support means, said cable forming said driveway being loaded under a tension which is at least twice that of said support cable.

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