

PATENT SPECIFICATION

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(72) Inventor MANFRED HARIG



(54) HOISTING DEVICE

(71) We, N.V. WESTERN GEAR EUROPE S.A., a body corporate organized and existing under the laws of Belgium, of 2630, Aartselaar, Belgium, do hereby declare the invention for which we pray that a patene may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

10 This invention relates to a hoisting device of the type which is more particularly intended for the vertical displacement of loads and which consists of a housing containing amongst others a rotatable driving pulley 15 for a cable, whereby means are provided in order to obtain a good co-operation between aforesaid driving pulley and cable.

In a first well known hoisting device, the cable is wound several times around the 20 pulley for this purpose, but this gives rise to considerable and well known disadvantages such as the difficulty of maintaining the cable in the correct location, the wear produced thereby and the relatively elaborate 25 construction.

It has already been suggested, in order considerably to simplify the construction, only to wind the cable once around aforesaid driving pulley, whereby means are provided for pressing this cable against the driving pulley, or respectively in a circumferential groove of this driving pulley in order thus to increase the friction between cable and pulley. Such a known hoisting device 30 consists of a split driving pulley of which both halves are permanently pressed towards each other, thus firmly gripping and driving the cable, and whereby means are provided for appropriately pulling the pulley 40 halves apart in order to facilitate the entering and removing of the cable, respectively into and out of the pulley.

Such known devices have the disadvantage that the pressure exerted on the cable 45 is far from being regularly distributed.

According to the present invention there is provided a hoisting device, comprising a housing, a driving pulley mounted in said housing and a cable by which the load is suspended engaged with the driving pulley, 50 said driving pulley being provided with means forming part of the pulley which grip the cable with a uniform force over a substantial part of the circumference of the pulley and with means also forming part of the 55 pulley which urge said gripping means apart at the locations where the cable enters and leaves the pulley, in such a way that no friction occurs when the cable enters or leaves the pulley and said urging part of 60 the gripping means is performed in such a manner that no or practically no increase of pressure occurs on the cable on the opposite side of the pulley.

In an embodiment of hoisting device 65 according to the invention the driving pulley consists of two pulley halves, at least one of which is formed of a flexible or elastically deformable material, it being understood that such deformation shall be only slight 70 and local, or in other words is successively displaced along the circumference of the pulley, and whereby the deformation is such as to never exceed the limit of elasticity of the materials used. 75

One thus obtains on the one hand, that the cable is gripped, or respectively driven, uniformly or practically uniformly over a large arc, by the means which press the pulley halves with a predetermined pressure 80 towards each other, whereas on the other hand, the spreading of the pulley halves on one side is such, that no or practically no pressure increase occurs on the cable at the other side of the pulley halves. 85

Another feature of an embodiment of the invention is that the means which keep the pulley halves apart are displaced towards the centre of the pulley in such a manner, that the local circumferential velocity of the 90

driving pulley are practically equal to each other, so that the friction and consequently also the generation of heat remain as small as possible, so that the hoisting device can be maintained in continuous use.

5 A feature of another embodiment of the invention is that said means which maintain the pulley halves apart are displaced towards the outer circumference of the pulleys in such a manner that there is no difference in circumferential velocity between these means and the driving pulley, so that similarly in this case no detrimental friction or heat generation is caused.

10 Another feature of an embodiment of the invention is that the groove of the split driving pulley increases in width progressively towards the axis in such a manner that the cable is always pressed towards the bottom of the groove, due to the lateral pressure of the pulley halves.

15 Some embodiments of the invention will now be described, by way of examples, with reference to the accompanying drawings, in which:

25 Figure 1 shows a schematic and partially cutaway front view of a device according to the invention;

30 Figure 2 shows a cross-section taken along the line II-II indicated in Figure 1;

Figure 3 is a view similar to that of Figure 1, of an alternative embodiment.

Figure 4 is a cross-section taken along the line IV-IV indicated in Figure 3;

35 Figure 5 shows on a larger scale that area of Figure 4 enclosed within the rectangle indicated by F5;

Figure 6 is a view similar to that of Figure 1, of yet a further alternative embodiment;

40 Figures 7, 8 and 9 show cross-sections respectively taken along the lines VII-VII, VIII-VIII IX-IX indicated in Figure 6.

In the embodiment illustrated in Figures 1 and 2 the hoisting device mainly consists of a housing 1 which is shown schematically. In this housing shafts are fitted, which are driven by appropriate means, such as for instance a motor, attached to the housing 1, but not shown.

50 The hoisting mechanism itself consists of a driving pulley 2 with a dovetail shaped groove, the pulley 2 consisting of two elements or pulley halves, respectively 3 and 4, of which element 3 is suitably fixed to a shaft 5, whereas element 4 is attached to element 3 by means of screw-threaded bolts 6. The bolts 6 each co-operate with a screw-threaded bore 7 which is provided in element 3 of the pulley 2 and pass freely through a hole 8 in element 4 of the driving pulley 2. Finally, a spring 10 is fitted between the head 9 of each bolt 6 of the element 4, which in the present case consist of dished springs.

65 It is clear, that the force with which the

two pulley halves 3 and 4 are pressed towards each other is adjustable by the screwing in or out of the bolts 6, whereby this force shall be such that the cable 13 is gripped without slippage between elements 3 and 4 and without any harmful distortion being caused to the cable.

70 The pulley halves 3 and 4 are provided on the opposing surfaces and over the entire circumference with a bevelled surface, respectively 11 and 12, with which the cable 13 can co-operate. As is most apparent in Figure 5, these surfaces 11, 12 have been provided in such a manner that they form a conical groove which widens towards the inside in dovetail cross-sectional shape, in such a manner that in consequence of the lateral pressure of the two pulley halves 3 and 4 on the cable 13, the cable 13 is permanently urged towards the bottom of the groove, so that any possibility of the cable 13 jumping out of the groove is totally eliminated. Between the elements 3 and 4 of driving pulley 2 a space 14 is formed which is defined for the major part between parallel surfaces of the elements 3 and 4, and these surfaces are provided, towards the outer periphery of said elements 3 and 4, in the present case with conical surfaces, respectively 15 and 16. Each element 3 and 4 is thus provided as it were on its side which forces the other element with a dished shape.

In this embodiment a ball bearing or suchlike 18 is fitted on the shaft 5, or respectively on the hub 17 of element 3, and carries an eccentric disc 19. The latter is attached by means of a pin, rod, or suchlike 20 to the housing 1 of the hoisting device in some manner not shown, in such a manner that disc 19 is immovable with respect to the housing 1. The disc 19 also runs on a ball bearing or suchlike 21, which is fitted in a ring 22, provided at its circumference with conical surfaces, respectively 23 and 24.

105 Eccentric disc 19 is provided in such a manner, that ring 22, which is rotatable on bearing 21, engages the conical surfaces 15 and 16 of the driving pulley 2 in the course of the rotation of the latter, and such precisely between the locations where cable 13 enters and respectively leaves the driving pulley. One thus obtains, that at the locations where the cable 13 enters and leaves the pulley 2, both elements 3 and 4 are pressed away from each other in order to permit the cable 13 to enter and to leave the pulley freely without friction, whereas at the other side of the driving pulley, due to the presence of bolts 6 and of springs 10, cable 13 is firmly gripped between the surfaces 11 and 12 and such over a very large arc and with a uniform or practically uniform pressure.

120 Due to the fact that the ring 22 is of relatively large diameter with respect to the dia- 130

meter of aforesaid space 14, one simultaneously obtains that the difference in circumferential velocity of surfaces 23 and 24 with respect to surfaces 15 and 16 of elements 3 and 4 is so small, that only a very slight and permissible generation of heat occurs between ring 22 and elements 3 and 4.

In this case surfaces 15-16 and 23-24 pass ideally over each other so that friction, heat and wear are reduced to a bare minimum.

In Figures 3 and 4, a different embodiment is shown, with which similar results are obtained as those described with reference to Figures 1 and 2, but in which case the ring 22 is supported by rollers, respectively 25, 26 and 27, which rotate freely around respective shafts 28, 29 and 30, which are attached in an appropriate but not shown manner to the casing 1 of the hoisting device.

In these two embodiments we thus obtain that the actual driving pulley rotates around an axis A-A, whereas the ring 22 rotates jointly around an axis B-B either on the eccentric disc 19, or respectively on the eccentrically located rollers 25-26-27.

It is obvious that the closer axes A-A and B-B lie together, the slighter the friction that will be present between ring 22 and elements 3 and 4. The half pulleys 3 and 4 are moved over ring 22, in order that these half pulleys should thus be opened in successive locations and permit the entry and the leaving of the cable in and out of the driving pulley to occur without friction.

At least one of the half pulleys, for instance half pulley 4, is made of a flexible or elastically deformable material, whereby this deformation shall however be so slight that the limit of elasticity of the material used will never be exceeded.

It is obvious that the half pulley which is made of such deformable material shall always be subjected to such deformation at successive locations of the circumference, due to the local influence of ring 22.

It has thus been obtained, on the one hand, that by means of springs 10 the cable 13 is gripped over a large arc with uniform or practically uniform pressure, whereby this pressure which is exerted by the half pulleys 3 and 4 upon the cable has been determined in advance, by the screwing in or out of the bolts 9, in such a manner that a slippage free drive of the cable 13 is obtained without distortion of the latter, whereas on the other hand, the spreading of the half pulleys 3, 4 on one side by means of aforesaid ring 22 and by local deformation of one half pulley, is such that no or practically no pressure increase occurs on the cable at the other side of the pulley.

It is obvious that the second half pulley may be made undeformable, or that both

half pulleys may be made of some flexible or elastically deformable material.

In the examples of Figures 1 to 5, ring 22 on the one hand, and elements 3 and 4 on the other hand, are provided with bevelled surfaces which are in contact with each other. It is however obvious, that instead of such a ring 22 with bevelled surfaces, a completely cylindrical ring could be used, in which case surfaces 15 and 16 should of course also be at right angles with respect to the axis A-A of shaft 5.

In Figures 6 to 9 a further alternative embodiment is finally shown, whereby the cable pulley is of integral construction and whereby spring elements are used around the entire circumference which firmly press the cable into the groove with uniform or practically uniform pressure, and whereby these spring elements are opened at the locations where the cable leaves the pulley or comes into contact therewith, for instance by means of cams, so that this opening has no influence upon the pressure exerted by said spring elements upon the cable.

In these Figures, the spring elements are made up of pairs of blocks 31-32 which are provided with bevelled surfaces, respectively 33 and 34, which can engage with the cable 13 in order to force it tightly into the groove of the pulley, whereby these small blocks 33, 34 are each fitted in a movable manner upon the body of screws 35-36 and 37-38 which are screwed into the pulley 2 itself and whereby these screws can also be used for the fixing of leaf springs, respectively 39-40, which, as can clearly be seen from the drawing, supply the required pressure on the blocks 33, 34 for forcing the cable into the groove.

In this case, each block is further provided with rollers, respectively 41-42, 43-44 and 45-46, 47-48, which can co-operate with guides or cams, respectively 49-50.

In this case, the cable 13 is pressed by means of the springs 39 and 40 into the groove of the driving pulley 2, so as to be driven without slippage by the latter, whereas the entrance and the leaving of the cable can also take place without friction by the pressing apart of the blocks 31 and 32 at the locations where the cable enters the driving pulley, or respectively leaves the latter. The pairs of blocks 31-32 are separated circumferentially from adjacent blocks only by small distances and therefor the cable is gripped with uniform force over a substantial part of the circumference of the pulley.

WHAT WE CLAIM IS:—

1. A hoisting device, comprising a housing, a driving pulley mounted in said housing and a cable by which the load is suspended engaged with the driving pulley,



meter of aforesaid space 14, one simultaneously obtains that the difference in circumferential velocity of surfaces 23 and 24 with respect to surfaces 15 and 16 of elements 3 and 4 is so small, that only a very slight and permissible generation of heat occurs between ring 22 and elements 3 and 4.

In this case surfaces 15-16 and 23-24 pass ideally over each other so that friction, heat and wear are reduced to a bare minimum.

In Figures 3 and 4, a different embodiment is shown, with which similar results are obtained as those described with reference to Figures 1 and 2, but in which case the ring 22 is supported by rollers, respectively 25, 26 and 27, which rotate freely around respective shafts 28, 29 and 30, which are attached in an appropriate but not shown manner to the casing 1 of the hoisting device.

In these two embodiments we thus obtain that the actual driving pulley rotates around an axis A-A, whereas the ring 22 rotates jointly around an axis B-B either on the eccentric disc 19, or respectively on the eccentrically located rollers 25-26-27.

It is obvious that the closer axes A-A and B-B lie together, the slighter the friction that will be present between ring 22 and elements 3 and 4. The half pulleys 3 and 4 are moved over ring 22, in order that these half pulleys should thus be opened in successive locations and permit the entry and the leaving of the cable in and out of the driving pulley to occur without friction.

At least one of the half pulleys, for instance half pulley 4, is made of a flexible or elastically deformable material, whereby this deformation shall however be so slight that the limit of elasticity of the material used will never be exceeded.

It is obvious that the half pulley which is made of such deformable material shall always be subjected to such deformation at successive locations of the circumference, due to the local influence of ring 22.

It has thus been obtained, on the one hand, that by means of springs 10 the cable 13 is gripped over a large arc with uniform or practically uniform pressure, whereby this pressure which is exerted by the half pulleys 3 and 4 upon the cable has been determined in advance, by the screwing in or out of the bolts 9, in such a manner that a slippage free drive of the cable 13 is obtained without distortion of the latter, whereas on the other hand, the spreading of the half pulleys 3, 4 on one side by means of aforesaid ring 22 and by local deformation of one half pulley, is such that no or practically no pressure increase occurs on the cable at the other side of the pulley.

It is obvious that the second half pulley may be made undeformable, or that both

half pulleys may be made of some flexible or elastically deformable material.

In the examples of Figures 1 to 5, ring 22 on the one hand, and elements 3 and 4 on the other hand, are provided with bevelled surfaces which are in contact with each other. It is however obvious, that instead of such a ring 22 with bevelled surfaces, a completely cylindrical ring could be used, in which case surfaces 15 and 16 should of course also be at right angles with respect to the axis A-A of shaft 5.

In Figures 6 to 9 a further alternative embodiment is finally shown, whereby the cable pulley is of integral construction and whereby spring elements are used around the entire circumference which firmly press the cable into the groove with uniform or practically uniform pressure, and whereby these spring elements are opened at the locations where the cable leaves the pulley or comes into contact therewith, for instance by means of cams, so that this opening has no influence upon the pressure exerted by said spring elements upon the cable.

In these Figures, the spring elements are made up of pairs of blocks 31-32 which are provided with bevelled surfaces, respectively 33 and 34, which can engage with the cable 13 in order to force it tightly into the groove of the pulley, whereby these small blocks 33, 34 are each fitted in a movable manner upon the body of screws 35-36 and 37-38 which are screwed into the pulley 2 itself and whereby these screws can also be used for the fixing of leaf springs, respectively 39-40, which, as can clearly be seen from the drawing, supply the required pressure on the blocks 33, 34 for forcing the cable into the groove.

In this case, each block is further provided with rollers, respectively 41-42, 43-44 and 45-46, 47-48, which can co-operate with guides or cams, respectively 49-50.

In this case, the cable 13 is pressed by means of the springs 39 and 40 into the groove of the driving pulley 2, so as to be driven without slippage by the latter, whereas the entrance and the leaving of the cable can also take place without friction by the pressing apart of the blocks 31 and 32 at the locations where the cable enters the driving pulley, or respectively leaves the latter. The pairs of blocks 31-32 are separated circumferentially from adjacent blocks only by small distances and therefor the cable is gripped with uniform force over a substantial part of the circumference of the pulley.

WHAT WE CLAIM IS:—

1. A hoisting device, comprising a housing, a driving pulley mounted in said housing and a cable by which the load is suspended engaged with the driving pulley,



- said driving pulley being provided with means forming part of the pulley which grip the cable with a uniform force over a substantial part of the circumference of the pulley and with means also forming part of the pulley which urge said gripping means apart at the locations where the cable enters and leaves the pulley, in such a way that no friction occurs when the cable enters or leaves the pulley and said urging apart of the gripping means is performed in such a manner that no or practically no increase of pressure occurs on the cable on the opposite side of the pulley.
2. A hoisting device as claimed in claim 1, in which the driving pulley consists of two pulley halves, at least one of said pulley halves being formed of a flexible or elastically deformable material.
3. A hoisting device as claimed in claim 2, in which one half pulley is formed of a flexible or elastically deformable material, and the other half pulley is formed of a rigid non-deformable material.
4. A hoisting device as claimed in claim 2, in which both half pulleys are formed of a flexible or elastically deformable material.
5. A hoisting device as claimed in any one of claims 2 to 4, in which the or each deformable half pulley is formed in one piece.
6. A hoisting device as claimed in any one of claims 2 to 4, in which the or each deformable half pulley is formed of at least two parts.
7. A hoisting device as claimed in any one of claims 2 to 6, in which the means for pressing said half pulleys apart consist of a roller of ring which is provided between the half pulleys and inside the outer circumference thereof.
8. A hoisting device as claimed in claim 7, in which said roller or ring is located within a space which is formed between said half pulleys.
9. A hoisting device as claimed in claim 8, in which each half pulley is dished, with the dished side of the pulleys directed towards each other to form said space.
10. A hoisting device as claimed in any one of claims 7 to 9, in which said roller or ring is of cylindrical shape.
11. A hoisting device as claimed in any one of claims 7 to 9, in which said roller or ring is provided along its circumference with bevelled surfaces which correspond to the shape of said space, or respectively with the bevel of the borders of the dish.
12. A hoisting device as claimed in any one of claims 6 to 11, in which said roller or ring is fitted on a bearing around a disc which is eccentric with respect to the axis of a drive shaft of the drive pulley, but which itself is mounted on a bearing provided on the driving pulley or on the drive shaft of the driving pulley.
13. A hoisting device as claimed in claim 12, in which said eccentric disc is maintained fixed with respect to the housing of the hoisting device.
14. A hoisting device as claimed in any one of claims 6 to 11, in which said roller or ring rests on three rollers which are eccentrically located with respect to the axis of the driving pulley.
15. A hoisting device as claimed in claim 14, in which said rollers are mounted so as to rotate freely around shafts which are attached to the housing of the hoisting device.
16. A hoisting device as claimed in any one of claims 6 to 15, in which the two half pulleys are connected together by means of bolts located on a circle and which are fixed in one half pulley and along which the other half pulley is free to move axially, spring means being provided between each bolt head and the adjacent half pulley, the arrangement being such that the pulley halves act on the cable, along the largest part of their circumference, in parallel direction and with a substantially constant pressure, the deflection imparted by said roll or ring occurring only at the place of entry and exit of the cable.
17. A hoisting device as claimed in any one of claims 2 to 16, in which the groove of the pulley is defined between an inclined surface on the side wall of each half pulley which faces the other half pulley.
18. A hoisting device as claimed in claim 17, in which said inclined surfaces form a groove which progressively widens from the outer peripheral edge of the pulley towards the axis.
19. A hoisting device as claimed in claim 18, in which said groove is of dovetail shape.
20. A hoisting device, comprising a housing, a driving pulley mounted in the housing and a cable by which the load is suspended engaged with the driving pulley, said driving pulley consisting of two half pulleys, at least one of which is made so as to be deformable, said half pulleys being connected together by means of bolts located along a circle and which are fixed to one half pulley, and along which the other half pulley is free to move axially, spring means being provided between each bolt head and the adjacent half pulley so that the half pulleys are continuously urged towards each other by a constant adjustable and uniform or almost uniform pressure, a roller or ring being provided between and within the outer circumference of said half pulleys, said roller or ring being located eccentrically and urging the half pulleys away from each other at the locations of entry and exit of the cable, in such a manner that on the one hand, the cable which is received in a dovetail shaped groove around the pulley is gripped over a



- substantial part of the circumference of the pulley with a uniform or almost uniform pressure, and that on the other hand, by local and temporary distortion of one or of
- 5 both half pulleys the cable can enter and leave the driving pulley without friction and without or practically without alteration of the pressure exerted by aforementioned springs upon the cable.
- 10 21. A hoisting device as claimed in claim 1, in which the pulley is provided with pairs of spring-loaded gripping elements distributed around the circumference of the pulley for firmly pressing the cables uniformly over
- 15 a large arc of the periphery of the pulley into a groove of the pulley, and means which urge said gripping elements of each pair of elements away from each other at the locations where the cable enters and leaves the
- 20 pulley.
22. A hoisting device as claimed in claim 21, in which gripping elements of each pair each consist of an L-shaped block which is mounted so as to be free to move on one
- 25 side of the pulley and which reaches over the cable.
23. A hoisting device as claimed in claim 22, in which each block is provided, at the location of the cable, with a bevelled surface.
- 30 24. A hoisting device as claimed in claim 22 or claim 23, in which each block is provided with a leaf spring which constantly pressures the block towards the cable.
25. A hoisting device as claimed in any 35 one of claims 22 to 24, in which said blocks are each provided with rollers which can co-operate with means which locally press the pairs of blocks away from each other.
26. A hoisting device as claimed in claim 40 25, in which said means consist of two guides or cams.
27. A hoisting device, substantially as hereinbefore described with reference to and as illustrated in Figures 1, 2 and 5 or Figures 45 3 to 5, or Figures 6 to 9 of the accompanying drawings.

For the Applicants
D. Young & Co.
Chartered Patent Agents
9 & 10 Staple Inn
London WC1V 7RD