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(54) **Falling safety device for a telescopic ladder set**

(57) The present invention relates to a falling safety device for a telescopic ladder set comprising a plurality of ladder segments, including at least a bottom ladder segment and a top ladder segment being telescopically extractable from the bottom ladder segment. This falling safety device comprises a rope running along the extension direction of said telescopic ladder set at least between a lower point near the bottom of the telescopic ladder set and an upper point located at one of the ladder segments. According to the present invention, a rope guiding means comprises a deflection pulley suspended at the upper point located at the top end of said top ladder segment, and a tackle arrangement disposed between said bottom ladder segment and said top ladder segment. Said tackle arrangement comprises a lower group of tackle pulleys suspended near the bottom end of said top ladder segment and an upper group of tackle pulleys suspended near the top end of said bottom ladder segment. The rope runs from a lower fixing point at the bottom of the telescopic ladder set up to said deflection pulley and further down via said tackle arrangement to an upper fixing point at said bottom ladder segment. When passing said tackle arrangement, the rope is subsequently deflected alternately by tackle pulleys of the lower and upper groups.

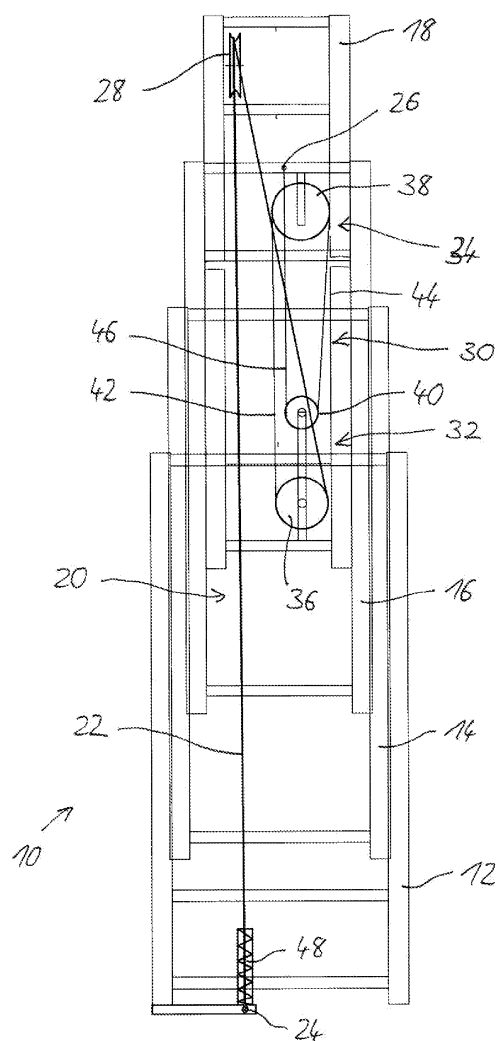


Fig. 1

Description

[0001] The present invention relates to a falling safety device for a telescopic ladder set, according to the preamble of claim 1.

[0002] Telescopic ladder sets of fire fighting vehicles are often equipped with falling safety devices to prevent fire workers entering the ladder from falling down in a rescue situation. Such falling safety devices comprise a rope that runs along the extension direction of the ladder and is tensioned between a lower point at the bottom of the ladder set and an upper point located at one of the ladder segments, which may be the top most extractable ladder segment. A person climbing the ladder can engage the rope by means of an engaging unit that is part of the personal equipment of the fire worker. This engaging unit follows the person's position on the ladder by sliding along the rope. It may also comprise an absorbing means to dampen the impact of the load when the person falls down from the ladder and is stopped in this falling movement by the engaging unit that clinches into the rope.

[0003] To adapt the rope length between the bottom and the top of the ladder set to the extension state, a rope guiding means further comprise means for tensioning the rope between an upper and a lower tensioning point between which the absorber unit can be engaged and run along the length of the ladder. In conventional telescopic ladder sets, the rope is deflected at the lower tensioning point at the bottom of the ladder by deflection pulleys and wound onto a spring drum that provides a predetermined tension on the rope. When the ladder is extracted, a corresponding section of the rope is wound from the spring drum.

[0004] Although this system works to adjust the rope length and keep a certain tension in any extension state of the ladder, it has the severe disadvantage that it does not keep a person safe from falling from the ladder. For example, when a person falls from the ladder at a point that is still in a large distance from the top of the ladder, i. e. the upper fastening point of the rope, the engaging unit engages safe with the rope, but the rope itself can be wound from the spring role against the tensioning force, with the effect that the person hanging at the rope may swing down from the declined ladder and may become hurt when interfering with objects located under or adjacent to the ladder. For example, the person can collide with the face of a building in front of which the ladder is located. For this reason the device as described above comprising a spring drum is not considered to be entirely safe.

[0005] Moreover, it is desired to strain the rope with a very high tension. For this reason a steel rope is used for this purpose. However, in the known design of falling safety devices using spring drums, a steel rope causes friction with other ladder components, leading to excessive wear of the rope as well as of the constructional elements.

[0006] Another aspect of the spring drum tensioning system is that the spring drum itself consumes a lot of space at the mounting of the telescopic ladder, and the system is generally expensive.

5 **[0007]** It is therefore an object of the present invention to provide a falling safety device for a telescopic ladder set that keeps a person engaged with the rope safe from falling from the ladder even at full load on the rope at any extension state of the telescopic ladder. Another object is to provide a falling safety device of the above kind that allows the use of a steel rope without damaging other constructional elements and that is less expensive and space consuming in the ladder construction.

10 **[0008]** These objects are achieved by a falling safety device comprising the features of claim 1.

15 **[0009]** The rope guiding means of the falling safety device according to the present invention comprises a deflection pulley suspended at the top end of a top ladder segment, and a tackle arrangement disposed between this top ladder segment and a bottom ladder segment from which the top ladder segment is telescopically extractable. This tackle arrangement comprises two groups of tackle pulleys, namely a lower group of tackle pulleys suspended near the bottom end of the top ladder segment and an upper group of tackle pulleys suspended near the top end of the bottom ladder segment.

20 **[0010]** The rope runs from a lower fixing point at the bottom of the telescopic ladder set up to the deflection pulley, is deflected there downwards and runs further over the tackle pulleys of the tackle arrangement to an upper fixing point at the bottom ladder segment. That is, between its lower fixing point and its upper fixing point, the rope is repeatedly deflected by the deflection pulley and the tackle pulleys. When the rope passes the tackle arrangement, it is subsequently deflected alternately by the tackle pulleys of the lower and upper groups. For example, after passing the deflection pulley, the rope may run down to a first tackle pulley belonging to the lower group (and being fixed near the bottom end of the top ladder segment), then up to a second tackle pulley belonging to the upper group (being fixed near the top end of the bottom ladder segment), again down to a third tackle pulley belonging to the lower group, and so on. Because the distance between the tackle pulleys belonging to the different groups changes with the extension state of the top ladder segment with respect to the bottom ladder segment, the length of the rope sections connecting tackle pulleys that are subsequently passed by the rope also changes. Because a plurality of tackle pulleys is passed subsequently when the rope runs through the tackle arrangement, this change can compensate for the change of the extension length of the ladder. The total number of tackle pulleys necessary for compensating the change can be chosen suitably.

25 **[0011]** Although the change of extension length of the ladder can be fully compensated by this falling safety device, the rope is always biased between its fixing points without the need of any spring drum mechanism. There

is no danger that the person guided by the rope can fall from the ladder and unwind the rope so that she or he falls down against an interfering object. Another advantage is that the tackle pulley arrangement can be received space consuming between the top and the bottom ladder segment. The construction according to the present invention is less expensive than the conventional spring drum mechanism.

[0012] According to a preferred embodiment of the present invention, the total number of tackle pulleys deflecting said rope when it passes said tackle arrangement is equal to the number of extractable ladder segments of the telescopic ladder set.

[0013] For example, the telescopic ladder set comprises four segments in total, namely one segment fixed to the turning/inclining suspension on the fire fighting vehicle carrying the ladder set and three further ladder segments arranged telescopically extractable from this ladder segment. In this case the number of extractable ladder segments is equal to three. According to this preferred embodiment, the number of tackle pulleys comprised within the tackle arrangement is also equal to three. For example, in this case the lower group of tackle pulleys can comprise two tackle pulleys suspended at the bottom end of the top ladder segment, and the upper group of tackle pulleys comprises only one tackle pulley fixed near the top end of the bottom ladder segment. After being deflected by the deflection pulley, the rope runs down to the lowest tackle pulley of the lower group of tackle pulleys, up to the tackle pulley of the upper group, again down to the second tackle pulley of the lower group and finally up to its upper fixing point at the bottom ladder segment. Then there are three rope sections that shorten when the top ladder segment is extracted from the bottom ladder segment, namely one rope section between the lowest tackle pulley of the lower group and the tackle pulley of the upper group, a subsequent rope section between the tackle pulley and the upper group and a second tackle pulley of the lower group and a final rope section between this last tackle pulley of the tackle arrangement and the upper fixing point. By shortening these three rope sections, the extension of the length between the lower fixing point and the deflection pulley at the top end of the top ladder segment can be fully compensated.

[0014] When one further ladder segment is added to the ladder set described above, one further tackle pulley should be added to the tackle arrangement to compensate the elongated extension length of the ladder. In this case the upper group of tackle pulleys can comprise this additional fourth tackle pulley. Preferably the rotation axis of the deflection pulley stands perpendicular to the rotation axis of the tackle pulleys. Typically the rotation axis of the tackle pulleys stands generally vertical to the plane of the rungs of the ladder segments so that they can be received between the ladder segments without consuming too much mounting space. However, the deflection pulley may stand vertically in this case, i. e. its rotation

axis lying within the plane of the rungs of the ladder set.

[0015] According to another preferred embodiment, the top ladder segment represents the top most extractable ladder segments of the telescopic ladder set, and it is slidably mounted on top of the bottom ladder segment.

[0016] Preferably the rope is connected to the lower fixing point by a tension spring.

[0017] This tension spring is arranged to compensate length changes of the rope due to temperature and unpreciseness of the rope guiding means.

[0018] Further objects, features and advantages of the present invention will become apparent from the following description with respect to the accompanying drawings, wherein:

Fig. 1 is a schematic top view on a telescopic ladder set comprising a first embodiment of a falling safety device according to the present invention; and

Fig. 2 is a top schematic view on another telescopic ladder set, comprising a falling safety device according to a second embodiment of the present invention.

[0019] The telescopic ladder set 10 in Fig. 1 comprises four ladder segments in total, namely a first ladder section 12, a second ladder section 14, a third ladder section 16 and a fourth ladder section 18. The first ladder section 12 is mounted turnably to be inclined upwards and downwards on top of a fire fighting vehicle. The other three ladder segments 14, 16 and 18 are telescopically extractable from the first ladder segment 12. This means that a subsequent ladder segment, for example, the second ladder segment 14, is extractable from a foregoing ladder segment (like the first ladder segment 12 in this example) by a sliding movement on the foregoing ladder segment that is actuated by a respective drive (not shown). In the following the top most ladder segment, which is the fourth ladder segment 18, will be designated as the "top ladder segment" 18, while the foregoing third ladder segment 16, on which the fourth ladder segment 18 is supported, will be designated as a "bottom ladder segment" 16 with respect to the top ladder segment 18.

[0020] The telescopic ladder set 10 comprises a falling safety device 20 comprising a rope 22 that runs along the extension direction of the telescopic ladder set 10 between a lower fixing point 24 at the bottom of the first ladder segment 12 to an upper fixing point 26 at the top end of the bottom ladder segment 16. It is noted that the terms "top" and "bottom" refer to the extension movement of the telescopic ladder set 10, so that any "bottom" part is located on the side closer to the general suspension of the whole ladder set 10, while the term "top" refers to the free end of the ladder set 10 (disposed on the top side in Fig. 1). Between its lower fixing point 24 in its upper fixing point 26, the rope 22 is guided and tensioned via guiding means that will be explained in the following. These guiding means also compensate the change of the extraction length of the rope 22 between the bottom of the ladder set 10 and its top end.

[0021] The rope guiding means comprise a deflection pulley 28 suspended at the top end of the top ladder segment 18, and a tackle arrangement 30 disposed between the bottom ladder segment 16 and the top ladder segment 18. The pulleys of this tackle arrangement, that will be described in more detail in the following, are received directly under the top ladder segment 18 and over the bottom ladder segment 16 within the rungs of the two ladder segments so that the mounting space needed for the tackle arrangement 30 is very small. While the rotation axis of the deflection pulley 28 stands horizontal within in the plane of the rungs of the top ladder segment 18, the rotation axis of the pulleys of the tackle arrangement 30 stands perpendicular to the rungs of the ladder segments 16, 18. This means that the pulleys of the tackle arrangement 30 lie flat between the ladder segments 16 and 18.

[0022] The tackle arrangement 30 comprises two groups of tackle pulleys, namely a lower group 32 of tackle pulleys suspended near the bottom end of the top ladder segment 18, and an upper group 34 of tackle pulleys suspended near the top end of the bottom ladder segment 16. That is, the respective tackle pulleys of the lower group 32 and the upper group 34 are suspended at different ladder segments 16 and 18 that are extractable from each other. When the top ladder segment 18 is extracted from the bottom ladder segment 16, the lower group 32 moves towards the upper group 34, shortening the distance between the two opposed groups 32 and 34 of tackle pulleys of the tackle arrangement 30. However, by this extraction movement the distance between the deflection pulley 28 and the lower group 32 of tackle pulleys is not changed, because the deflection pulley 28 and the lower group 32 are located at opposite ends of one and the same ladder segment 18.

[0023] The tackle arrangement 30 comprises three tackle pulleys in total, namely a first tackle pulley 36 belonging to the lower group 32 and being suspended at the bottom end of the top ladder set 18, a second tackle pulley 38 suspended at the top end of the bottom ladder segment 16, and a third tackle pulley 40 mounted in the bottom region of the top ladder segment 18 but more towards its top end than the first tackle pulley 36. That is, the first tackle pulley 36 and the third tackle pulley 40 belong to the lower group 32, while the upper group 34 only comprises the second tackle pulley 38. Starting from its lower fixing point 24, the rope 22 extends along the extension length of the ladder set 10 up to the deflection pulley 28 and is deflected there to run downwards into the tackle arrangement 30. Within the tackle arrangement 30, the rope 22 first passes the first tackle pulley 36, is deflected by it to run up to the second tackle pulley 38, runs down again to the third tackle pulley 40 and is there deflected to run up to its upper fixing point 26. This means that the rope 22 is subsequently deflected, when passing the tackle arrangement 30, alternately by tackle pulleys of the lower group 32 and the upper group 34. In this embodiment it first passes the first tackle pulley 36 as a

member of a lower group 32, then passes the second pulley 38 as a member of the upper group 34, then passes again a tackle pulley 40 as a member of the lower group 32. After each deflection by a tackle pulley, the rope 22 runs in an opposite direction.

[0024] On the run of the rope 22 between the first tackle pulley 36 of the tackle arrangement 30 and the upper fix point 26, there are three rope sections that are shortened by the extraction movement of the upper ladder segment 18 with regard to the bottom ladder segment 16, namely a first rope section 42 between the first tackle pulley 36 and the second tackle pulley 38, a second rope section 44 between the second tackle pulley 38 and the third tackle pulley 40 and a third rope section 46 between the third tackle pulley 40 and the upper fixed point 26. The shortening of these rope sections 42, 44 and 46 in total corresponds to the elongation of the rope section between the lower fixing point 24 and the deflection pulley 28 so that the full compensation of the increasing distance between the lower fixing point 24 and the deflection pulley 28 is achieved. It is to be understood that when the ladder segments 12, 14, 16, 18 are retracted again, the length of the first, second and third rope section 42, 44 and 46 increases correspondingly, so that the rope is always tensioned along its changing extraction/retraction length. The lower end of the rope 22 is connected to the lower fixing point 24 by a tension spring 48. This tension spring 48 is not necessary for the principle of compensating the extraction/retraction length of the ladder set 10 but helps to compensate changes of the rope length because of temperature effects and an unpreciseness of the mounting of the elements of the rope guiding means.

[0025] At the section of the rope 22 between its lower fixing point 24 and the deflection pulley 28 on top of the ladder set 10, an engaging unit as part of the personal equipment of a person climbing the ladder set 10 can be engaged so that this person is safely connected to the rope 22. When the person falls from the ladder set 10, it is safely held by the engagement of the engaging unit that the rope 22. This engaging unit can run freely on the rope 22 between the lower fixing point 24 and the deflection pulley 28. This engaging unit can also comprise an absorber unit to absorb a shock due to the load when a person falls into the rope 22. Also in this emergency case of catching a falling person, the rope 22 keeps its tension as described above.

[0026] Fig. 2 shows another embodiment of a falling safety device 50 in a ladder set 52. The telescopic ladder set 52 comprises one more ladder segment than the telescopic ladder set 10 described before in connection with Fig. 1 so that there are four extractable ladder segments to be extracted from one fixed ladder segment at the bottom suspension of the telescopic ladder set 52. This ladder segment 54 can be inclined and turned around a suspension (not shown) of the whole telescopic ladder set 52, while a second ladder segment 56, a third ladder segment 58, a fourth ladder segment 60 and a fifth ladder segment 62 are subsequently mounted slidably onto

each other to represent the extractable ladder segments 56,58,60,62.

[0027] The basic construction of the falling safety device 50 is the same as that of the falling safety device 20 described before, that is, it comprises a rope 22 being fixed at a lower fixing point at the bottom of the ladder set 52 and is deflected by rope guiding means and is fixed, on the other hand, at an upper fixing point 26. In this embodiment, the "top ladder segment" is represented by the fifth ladder segment 62, and the "bottom ladder segment" is represented by the fourth ladder segment 60 carrying the fifth ladder segment 62 so that the fifth ladder segment 62 is extractable and mounted slidable on the fourth ladder segment 60.

[0028] At the top end of the top ladder segment 62, the deflection role 28 is mounted in the same way as in the foregoing embodiment. Between the bottom ladder segment 60 and the top ladder segment 62, the tackle arrangement 30 is disposed. However, in this case the tackle arrangement 30 comprises an additional tackle pulley 64 belonging to the upper group 34 of tackle pulleys and being rotatably fixed near the top end of the bottom ladder segment 60. That is, in this embodiment the tackle arrangement 30 comprises four tackle pulleys in total, namely the first tackle pulley 36, the second tackle pulley 38, the third tackle pulley 40 and the additional fourth tackle pulley 64.

[0029] After having passed the third tackle pulley 40 of the lower group 32, the rope 22 is deflected to pass the fourth tackle pulley 64 to be deflected again and to run down to the upper fixing point 26 that is located, in this case, at the bottom end of the bottom ladder segment 60. By this arrangement with an additional tackle pulley 64 there is also an additional rope segment 66 between the fourth tackle pulley 64 and the upper fixing point 26 to be shortened or elongated when the telescopic ladder set 52 is extracted or retracted. This compensates the additional extension length due to the provision of the fifth ladder segment 52 with regard to the foregoing embodiment of the telescopic ladder set 10. It can be stated that with each additional ladder segment of the telescopic ladder set, one additional tackle pulley can be provided so that the rope 22 is deflected one more time, and there is an additional extended/shortened rope section. Generally the number of tackle pulleys within the tackle arrangement 30 can correspond to the number of extractable ladder segments. While in the foregoing embodiment, the number of tackle pulleys (three) within the tackle arrangement 30 corresponds to a number of extractable ladder segments 14,16,18, this number has been increased by one in the present embodiment of the telescopic ladder set 52, showing four tackle pulleys within the tackle arrangement 30, corresponding to the number of four extractable ladder segments 56,58,60,62.

Claims

1. Falling safety device (20,50) for a telescopic ladder set (10,52) comprising a plurality of ladder segments (12,14,16,18; 54,56,58,60,62), including at least a bottom ladder segment (16,60) and a top ladder segment (18,62) being telescopically extractable from the bottom ladder segment (16,60), said falling safety device (20,50) comprising a rope (22) running along the extension direction of said telescopic ladder set (10,52) at least between a lower point near the bottom of the telescopic ladder set and an upper point located at one of the ladder segments, and rope guiding means for guiding said rope (10,52), **characterized in that** said rope guiding means comprises a deflection pulley (28) suspended at the upper point located at the top end of said top ladder segment (18,62), and a tackle arrangement (30) disposed between said bottom ladder segment (16,60) and said top ladder segment (18,62), said tackle arrangement (30) comprising a lower group (32) of tackle pulleys (36,40) suspended near the bottom end of said top ladder segment (18,62) and an upper group (34) of tackle pulleys (38,64) suspended near the top end of said bottom ladder segment (16,60), said rope (22) running from a lower fixing point (24) at the bottom of the telescopic ladder set up to said deflection pulley (28) and further down via said tackle arrangement (30) to an upper fixing point (26) at said bottom ladder segment (16,60), wherein said rope (22) is subsequently deflected, when passing said tackle arrangement (30), alternately by tackle pulleys (36,38,40,64) of the lower and upper groups (32,34).
2. Falling safety device according to claim 1, **characterized in that** the total number of tackle pulleys (36,38,40,64) deflecting said rope (22) when it passes said tackle arrangement (30) is equal to the number of extractable ladder segments (14,16,18; 56,58,60,62) of said telescopic ladder set (10,52).
3. Falling safety device according to one of claims 1 or 2, **characterized in that** the rotation axis of said deflection pulley (28) stands perpendicular to the rotation axis of the tackle pulleys (36,38,40,64).
4. Falling safety device according to one of claims 1 to 3, **characterized in that** said top ladder segment (18,62) represents the topmost extractable ladder segment of said telescopic ladder set (10,52), and that it is slidably mounted on top of said bottom ladder segment (16,60).
5. Falling safety device according to one of claims 1 to 4, **characterized in that** said rope (22) is connected to said lower fixing point (24) by a tension spring (48).

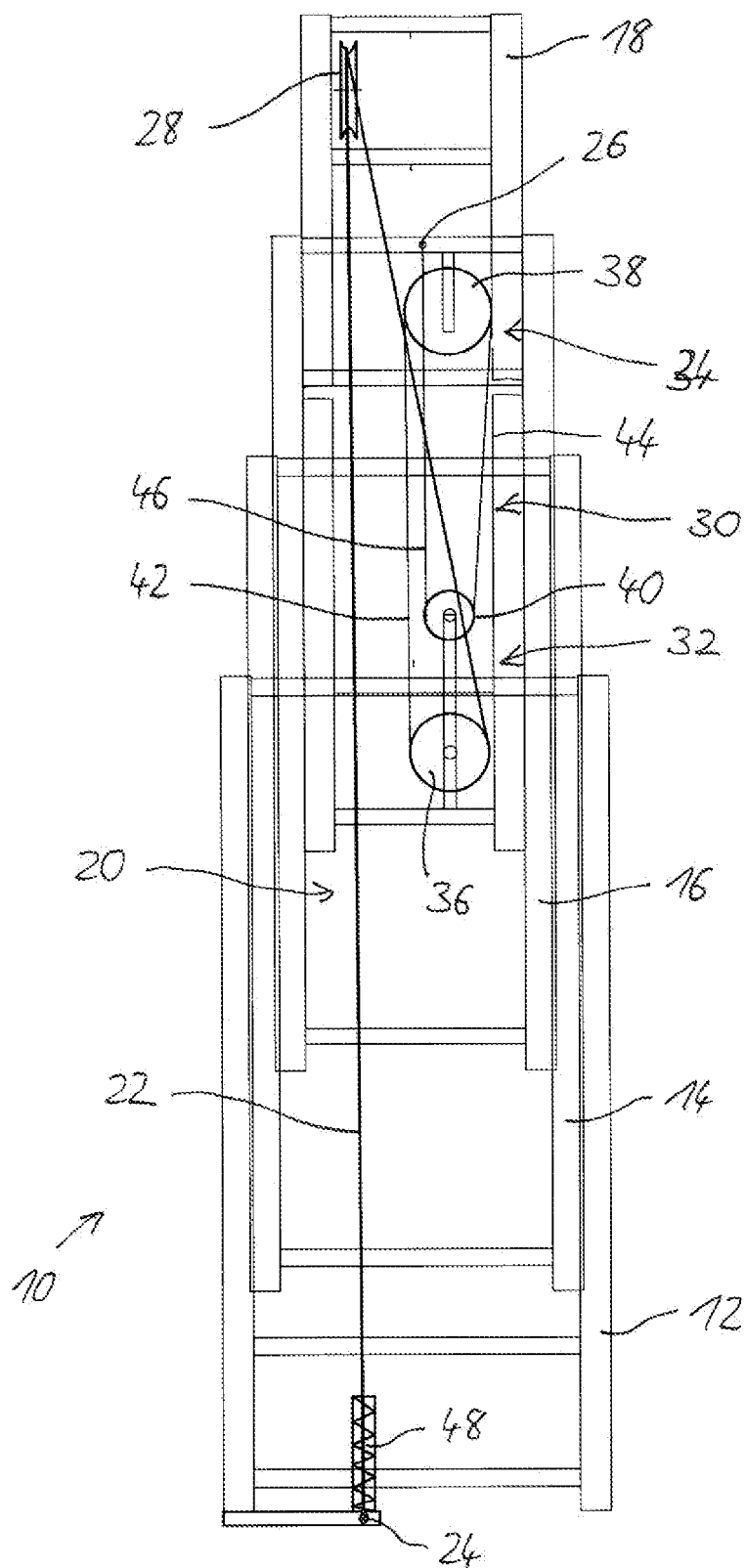


Fig. 1

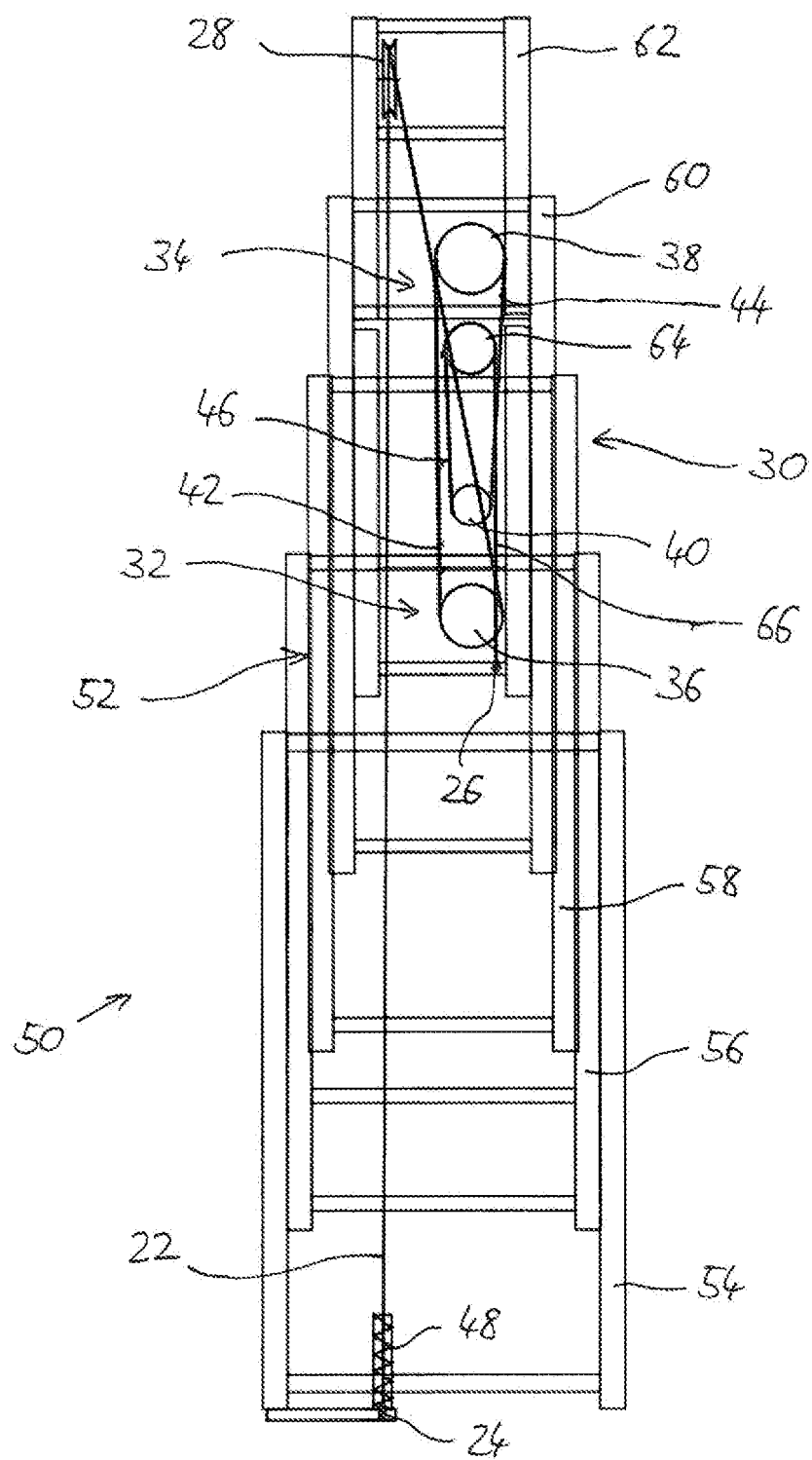


Fig. 2



EUROPEAN SEARCH REPORT

 Application Number
 EP 10 15 9593

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2009 001995 A (NAKAO KIMIYO) 8 January 2009 (2009-01-08) * figures 9-12 *	1-5	INV. E06C1/12 E06C7/18
A	CA 2 181 858 A1 (WILLIAMSON RICHARD [CA]) 24 January 1998 (1998-01-24) * figure 3 *	1-5	
A	FR 2 712 916 A1 (MOUNIER ALAIN [FR]) 2 June 1995 (1995-06-02) * figures 1-3 *	5	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E06C
Place of search		Date of completion of the search	Examiner
The Hague		31 August 2010	Bauer, Josef
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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 EPO FORM 1503 03.82 (P04/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 15 9593

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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31-08-2010

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2009001995	A	08-01-2009	NONE	
CA 2181858	A1	24-01-1998	NONE	
FR 2712916	A1	02-06-1995	NONE	