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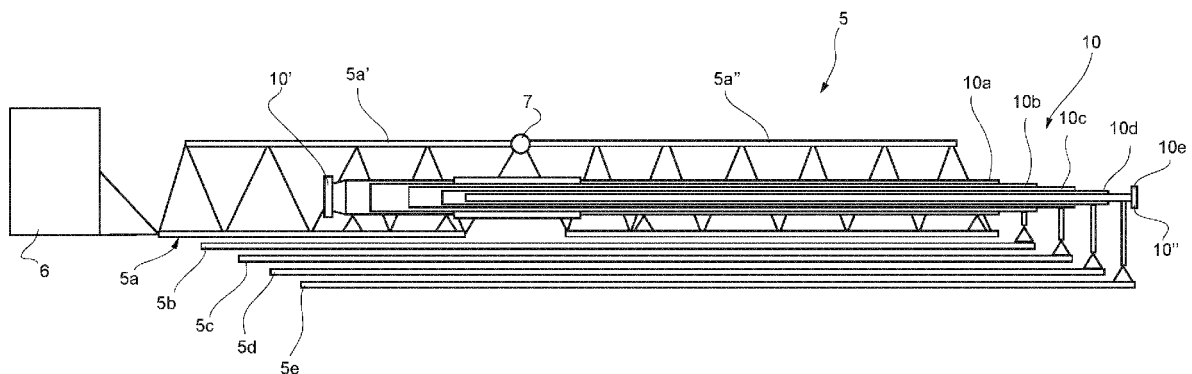
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(54) **IMPROVED LADDER ASSEMBLY FOR A FIREFIGHTING VEHICLE**

(57) Ladder assembly (5) for a rescue vehicle, said ladder assembly (5) comprising a plurality of segments (5a, 5b, 5c, 5d, 5e) carried one within the other in a telescopic manner, actuator means configured to allow retraction or extraction of ladder assembly (5) between a minimum and a maximum length and a hydraulic equipment (10) provided with a plurality of rigid segments (10a, 10b, 10c, 10d, 10e) each associated to a respective seg-

ments (5a, 5b, 5c, 5d, 5e), the first segment (5a) of the ladder assembly (5) comprising a terminal portion (5a') and a main portion (5a''), the first segment (10a) of the hydraulic equipment (10) comprising a first portion (10a') and a second portion (10a'') respectively carried by terminal and main portions (5a', 5a''), the first portion (10a') being connected to the second portion (10a'') via a flexible element (11).

FIG. 2



Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102022000010415 filed on May 19, 2022, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention concerns an improved ladder assembly, in particular an improved ladder assembly for a rescue vehicle.

[0003] The present invention finds its preferred, although not exclusive, application in firefighting vehicles. Reference will be made to this application by way of example below.

BACKGROUND OF THE INVENTION

[0004] Rescue vehicles such as firefighting vehicles are usually provided with an extendable ladder assembly. Such ladder assembly is configured to vary its longitudinal extension in order to reach high or distant rescue points.

[0005] A preferred use of such ladder assembly for firefighting vehicles is to provide firefighting mixture to buildings on fire or to allow a cage hosting rescuers to reach apartments in buildings. Accordingly, the preferred, but not exclusive use, of such extendable ladder assembly is to provide a suitable vertical elongation to reach needed portions of a rescue point.

[0006] As said, since the main use of ladder assembly is to provide firefighting mixtures, they are equipped with water pipes.

[0007] In such known arrangement, the ladder assembly comprises a plurality of segments that are placed one within the other and extends telescopically to vary the ladder length. In such configuration, the water pipes, that are made rigid, are themselves realized telescopically, i.e. in segments that are each carried by a respective segment of the ladder assembly.

[0008] However, according to an example of known ladder assembly arrangement shown in EP2182164 A1, the use of the aforementioned rigid tubes is impossible if it is requested to provide a further degree of freedom to the terminal portion of the ladder. Indeed, rigid water tubes would make impossible to move such terminal portion.

[0009] In view of the above, the need is felt to improve existing ladder system to allow the use of rigid water tubes in an extendable ladder assembly layout with a movable terminal portion.

[0010] An aim of the present invention is to satisfy the above mentioned needs in a cost-effective and optimized manner.

SUMMARY OF THE INVENTION

[0011] The aforementioned aim is reached by a ladder assembly and a rescue vehicle as claimed in the appended set of claims.

BRIEF DESCRIPTION OF DRAWINGS

[0012] For a better understanding of the present invention, a preferred embodiment is described in the following, by way of a non-limiting example, with reference to the attached drawings wherein:

- Figure 1 is a schematic representation of a rescue vehicle comprising a ladder assembly according to the invention;
- Figure 2 is a schematic representation of a ladder assembly according to the invention;
- Figures 3 and 4 are schematic representation of the ladder assembly of the rescue vehicle of figure 1 in two different operative conditions; and
- Figures 5A-5B are respectively a schematic lateral and lateral sectioned view of a portion of the ladder assembly according to a possible embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0013] The attached figures disclose a rescue vehicle 1, in particular a firefighting vehicle, comprising a body 2 movably on ground G via a plurality of wheels 3 or any other equivalent traction means.

[0014] The vehicle 1 is provided with a ladder assembly 5 that is coupled by a support structure 4 to the body 2 of the vehicle. In particular, the support structure 4 may comprise a base 4' rigidly carried by vehicle body, an intermediate portion 4'' carried in a turntable way by base 4' and a connection 4''' portion rigidly carried by ladder assembly 5 and coupled via a movable connection 4a to the intermediate portion 4''.

[0015] As visible in figure 1 and as schematized in figure 2, the ladder assembly 5 comprises a plurality of segments 5a, 5b, 5c, 5d, 5e that are telescopically coupled one with respect to the other, as described, for sake of example, in patent publication EP2182164 A1. In the described embodiment, without any limitative meaning, reference will be made to a five-segments ladder, however such number may vary according to the needs and typology of the rescue vehicle.

[0016] Therefore, the vehicle extends along a longitudinal axis A and the ladder assembly 5 extends along a longitudinal axis B that may vary its position (see figures 1 and 3, 4) in function of the movements of the support structure with respect to longitudinal axis A. In particular, when in rest position, longitudinal axis A, B are parallel one with respect to the other and to the ground G, while in operation the longitudinal axis B tends to be inclined of an angle with respect to the ground G, i.e. being inci-

dent to longitudinal axis A.

[0017] The aforementioned segments 5a, 5b, 5c, 5d, 5e are at least partially arranged one within the other so that the first can be totally extracted from the second, the second from the third and consequently till the fifth segment that is coupled to the connection portion 4''.

[0018] Such movement may be achieved by dedicated actuators, such as hydraulic actuators or ropes actuators as in the aforementioned patent publication.

[0019] In particular, the first segment 5a comprises a terminal portion 5a' and a main portion 5a'' wherein the main portion 5a'' cooperates with the second segment 5b and the terminal portion 5a' is connected to a rescue cab 6 in known manner, e.g. fixed or movable.

[0020] In particular, the terminal portion 5a' is hinged via a hinge connection 7 to the main portion 5a''. Accordingly, the terminal portion 5a' may vary the inclination of a longitudinal axis C thereof with respect to the longitudinal axis B of the ladder (see figure 4), e.g. varying the value of an inclination angle α between 180 and 105°.

[0021] Making reference to the schematic representation of figure 2, the ladder assembly 5 is provided with a hydraulic equipment 10 configured to allow to provide firefighting fluid to rescue cab 6 from a source of firefighting fluid of the vehicle 1.

[0022] The hydraulic equipment 10 is advantageously carried within ladder assembly 5, i.e. within ladder assembly segments. In detail, the hydraulic equipment 10 comprises a plurality of rigid segments 10a, 10b, 10c, 10d, 10e that are telescopically housed one within the other. In particular, the rigid segments 10a, 10b, 10c, 10d, 10e are in equal number of the segments 5a, 5b, 5c, 5d, 5e of the ladder assembly 5.

[0023] In particular, the first segment 10a is provided with an outlet 10' that is configured to be hydraulically connected to a hydraulic device (not shown) that may be used by a rescuer on the cab 6 and the fifth segment 10e is provided with an inlet 10'' that is configured to be hydraulically connected to the firefighting fluid source on the vehicle.

[0024] In detail, the first segment 10a of the hydraulic equipment 10 has a diameter greater than the diameter of the second segment 10b and so on so that the fifth segment 10e is the smallest and is inserted within all the other segments.

[0025] Each segment 10a, 10b, 10c, 10d, 10e of the hydraulic equipment 10 is fixedly carried by the respective segment 5a, 5b, 5c, 5d, 5e of the ladder assembly 5 so that the movement of each segment 5a, 5b, 5c, 5d, 5e carries the respective 10a, 10b, 10c, 10d, 10e of the hydraulic equipment 10.

[0026] In particular, the first segment 10a is divided into two separate portions 10a', 10a'', a first portion 10a' is fixedly carried by the terminal portion 5a' of the first segment 5a of the ladder and a second portion 10a'' is fixedly carried by the main portion 5a''. The first and second portions 10a', 10a'' are connected together via a flexible element 11.

[0027] The flexible element 11 may be realized as a hose or an accordion-shape element or as any suitable flexible piping typology and is connected to its extremities to the portions 10a', 10a'', as detailed in the following.

[0028] In particular, the flexible element 11 is configured to allow the relative movement via hinge 7 of portions 5a', 5a'' of an angle α of maximum about, e.g., 75°, 80°.

[0029] In particular the flexible element 11 is placed vertically above or below the hinge 7, in the disclosed embodiment vertically below the hinge 7.

[0030] Preferably, flexible element 11 is connected to the portions 10a', 10a'' via a length compensator 11'. Length compensator 11' allows a relative motion of at least an extremity of the flexible element 11 with respect to the first and/or second portions 10a', 10a''.

[0031] In the disclosed embodiment, only one extremity of the flexible element 11 is connected in a movable manner to the first and/or second portions 10a', 10a'', in particular to the main portion 10a''.

[0032] Accordingly, flexible portion 11 comprises a first extremity 12 that is rigidly coupled, e.g. bolted or welded to the first portion 10a' of the first segment 10a of the hydraulic equipment 10 and a second extremity 13 that is movably about external surface of the second portion 10a''. In particular, the second extremity 13 is fixed to an annular element 14 that is arranged between second portion 10a'' and slides in tight manner with respect to the external surface of the second portion 10a''.

[0033] The annular element 14 is operatively coupled via elastic means 15, e.g. a plurality of helicoidally springs, to a flange element 16 that is fixedly carried by the second portion 10a''.

[0034] The allowed movement along longitudinal axis B of flange element 16 depends on the rigidity of the elastic means 15 that may be set in function of the stiffness of the flexible element 11 and of the maximum allowed pressure of the firefighting fluid flowing in the flexible element 11.

[0035] The operation of the embodiment of the invention as described above is the following.

[0036] When the ladder assembly 5 is in its retracted configuration (figure 1) the segments 5a, 5b, 5c, 5d, 5e are placed one with respect to the other and the segments 10a, 10b, 10c, 10d, 10e are consequently compacted one within the other.

[0037] When the ladder assembly 5 starts to be extracted (see figure 3), after being inclined with respect to the ground to reach the needed inclination, then the first segment 5a is controlled to be extracted with respect to the second segment 5b thereby increasing the length of the ladder assembly along axis B. The first segment 10a follows the movement of the first segment 5a extracting from the respective second segment 10b.

[0038] When the correct position is reached, then a further degree of movement may be used by controlling the movement of terminal portion 10a' by varying its inclination, i.e. angle α with respect to main portion 10a''.

In particular, since the hinge point 7 is positioned vertically distanced with respect the flexible element 11 in order to allow the motion of the terminal portion 10a' with respect to the main portion 10a", the flexible element may bent in order to compensate the variation of length along the longitudinal axis B.

[0039] If present the length compensator system 11', the flexible element 11 is allowed to retract or expand with respect to one (or two) of its fixation points according to the variation of pressure therein according to the flow of firefighting fluid passing in the flexible portion 11. In such case, the force F exerted by the pressure variation in flexible portion 11 acts against or in favor of elastic means 15 thereby moving extremity 13 carried by element 14.

[0040] In view of the foregoing, the advantages of the ladder assembly and of the rescue vehicle according to the invention are apparent.

[0041] Thanks to the proposed ladder assembly, it is possible to use rigid segments on a ladder in which the first segment has a terminal portion that is movable.

[0042] Indeed, the flexible element may compensate the length variation due to the movement of such terminal portion with respect to the main portion.

[0043] The proposed solution is economic and can be applied to any typology of existing ladders.

[0044] Moreover, the possible presence of a length compensator allows to compensate the stresses due to the variation of pressure in the flexible element thereby providing a robust disposition.

[0045] It is clear that modifications can be made to the described ladder assembly and rescue vehicle which do not extend beyond the scope of protection defined by the claims.

[0046] For example, the number of segments of ladder and of hydraulic equipment may vary.

[0047] Moreover, the relative disposition of the segments of hydraulic equipment with respect to the segments of ladder or of the flexible element with respect to the hinge may vary.

[0048] Clearly, the typology of hinge and of cab described or the coupling between the ladder assembly and the vehicle or the typology of rescue vehicle may be of any kind.

Claims

1. Ladder assembly (5) for a rescue vehicle, said ladder assembly (5) comprising a plurality of segments (5a, 5b, 5c, 5d, 5e) carried one within the other in a telescopic manner, said ladder assembly (5) comprising actuator means configured to allow retraction or extraction of ladder assembly (5) between a minimum and a maximum length along said longitudinal axis (B), said ladder assembly (5) comprises a hydraulic equipment (10), said hydraulic equipment (10) comprising a plurality of rigid segments (10a,

10b, 10c, 10d, 10e) each associated to a respective segments (5a, 5b, 5c, 5d, 5e) of said ladder assembly (5), the first segment (5a) of said ladder assembly (5) comprising a terminal portion (5a') and a main portion (5a"), said terminal portion (5a') being carried in a movable manner by said main portion (5a"), said first segment (10a) of said hydraulic equipment (10) comprising a first portion (10a') and a second portion (10a") respectively carried by said terminal and main portions (5a', 5a"), said first portion (10a') being connected to said second portion (10a") via a flexible element (11).

2. Ladder assembly according to claim 1, wherein said terminal portion (5a') is coupled by a hinge connection (7) to said main portion (5a").

3. Ladder assembly according to claim 2, wherein said flexible portion (11) is placed vertically distanced to said hinge connection (7).

4. Ladder assembly according to any of the preceding claims, wherein said segments (10a, 10b, 10c, 10d, 10e) of said hydraulic equipment (10) are realized in metal.

5. Ladder assembly according to any of the preceding claims, wherein said segments (10a, 10b, 10c, 10d, 10e) of said hydraulic equipment (10) are one inserted with respect to the other and coupled in a sliding manner.

6. Ladder assembly according to any of the preceding claims, wherein said segments (10a, 10b, 10c, 10d, 10e) of said hydraulic equipment (10) are housed within the respective segment (5a, 5b, 5c, 5d, 5e) of said ladder assembly (5).

7. Ladder assembly according to any of the preceding claims, wherein the segments (5a, 5b, 5c, 5d, 5e) of said ladder assembly (5) are N, the first segment (10a) of said hydraulic equipment (10) being provided with an outlet (10') for connecting a hydraulic device to be used by rescuer and the N-th segment (10e) of said hydraulic equipment (10) being provided with an inlet (10") for connecting a source of fluid of said vehicle.

8. Ladder assembly according to any of the preceding claims, wherein said flexible element (11) is configured to vary its length via a length compensator (11').

9. Ladder assembly according to claim 8, wherein said length compensator (11') is configured to couple said flexible element (11) to said terminal portion (5a') and to said main portion (5a") so that at least one of the extremities (12, 13) of said flexible element (11) are carried in a movable manner with respect to said

terminal portion (5a') and to said main portion (5a").

10. Ladder assembly according to claim 8 or 9, wherein a first extremity (12) of said flexible element (11) is fixedly carried to one between said terminal portion (5a') and said main portion (5a") and a second extremity (13) of said flexible element (11) is movably carried to the other between said terminal portion (5a') and said main portion (5a").
11. Ladder assembly according to claim 10, wherein said second extremity (13) is fixedly carried to a first element (14) that is slidably carried by said other between said terminal portion (5a') and said main portion (5a").
12. Ladder assembly according to claim 11, wherein length compensator (11') comprises elastic means (15) operatively interposed between said first element (14) and a portion (16) fixed with respect to said other between said terminal portion (5a') and said main portion (5a").
13. Ladder assembly according to any of the preceding claims, comprising a cab (6) carried by said terminal portion (5a') .
14. Rescue vehicle (1) comprising a ladder assembly (5) according to any of the preceding claims.

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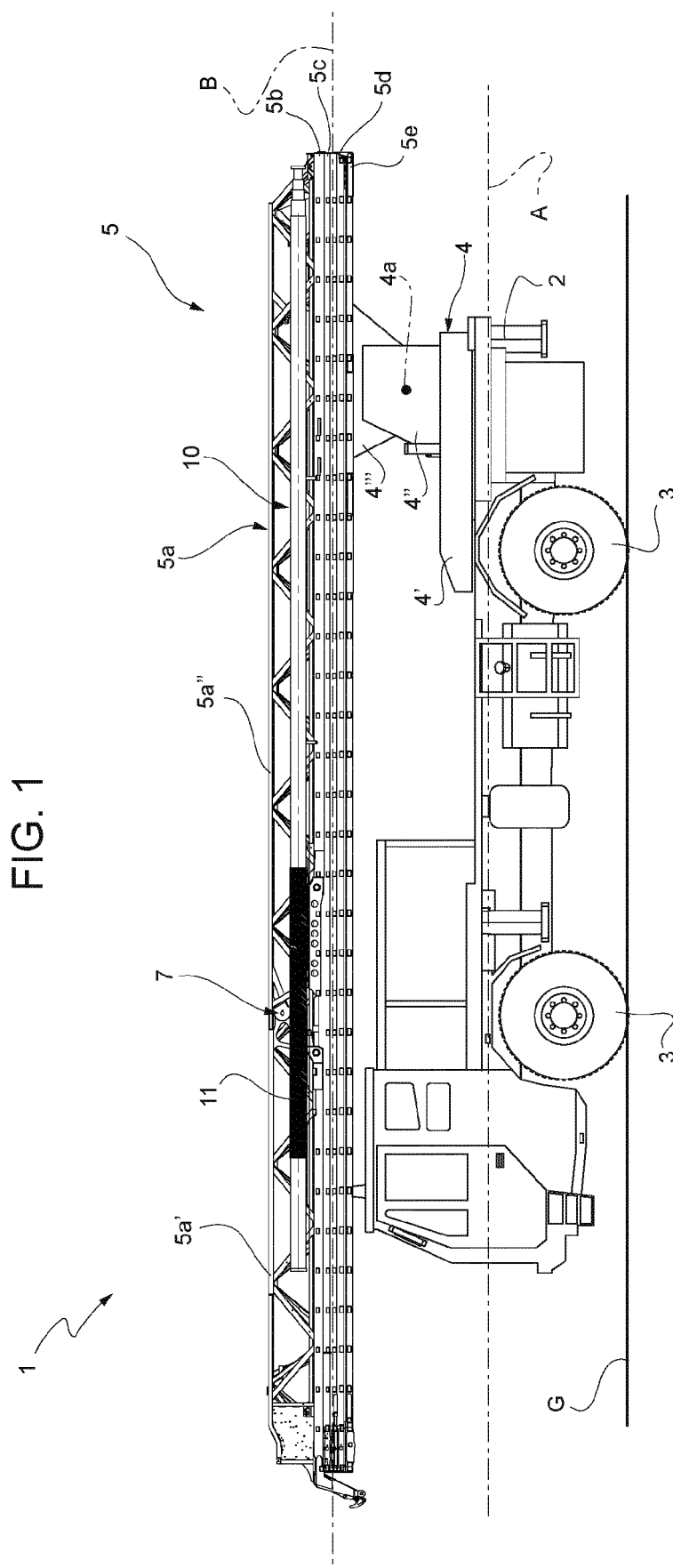


FIG. 2

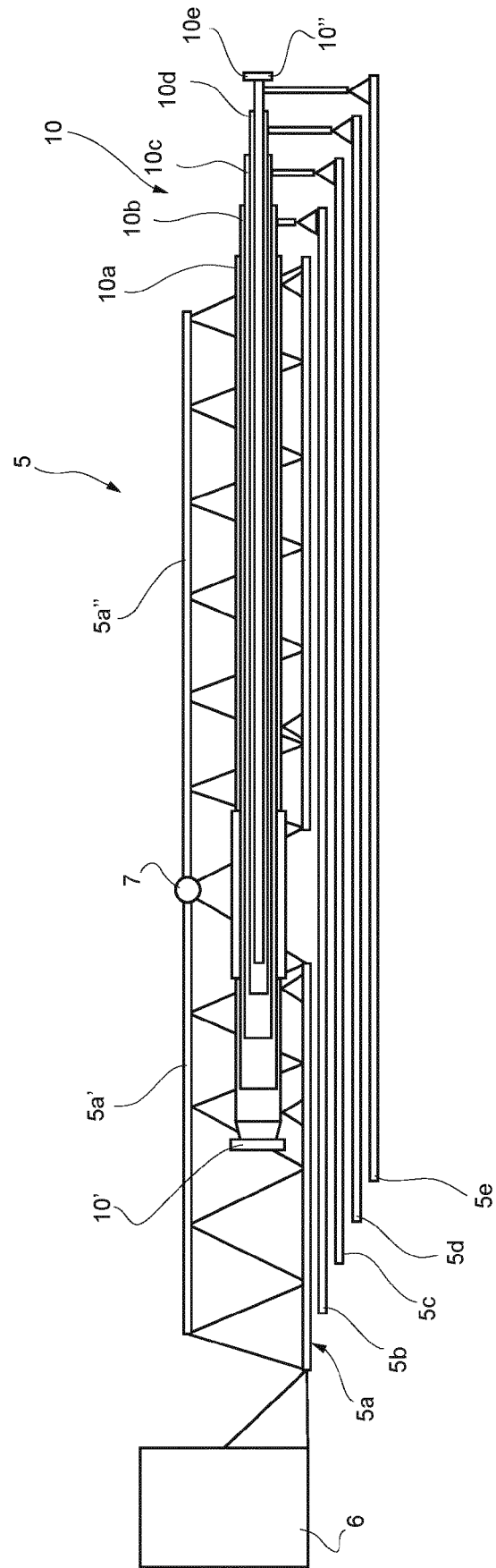


FIG. 3

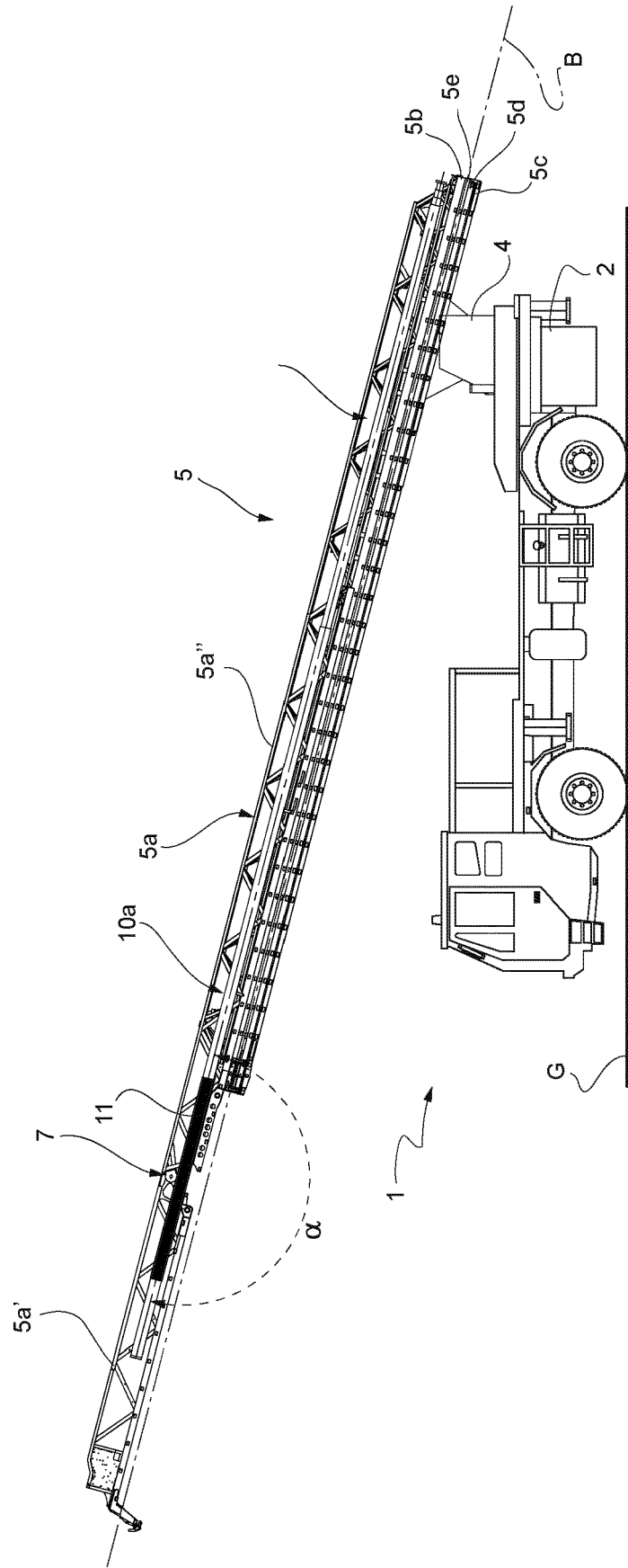


FIG. 4

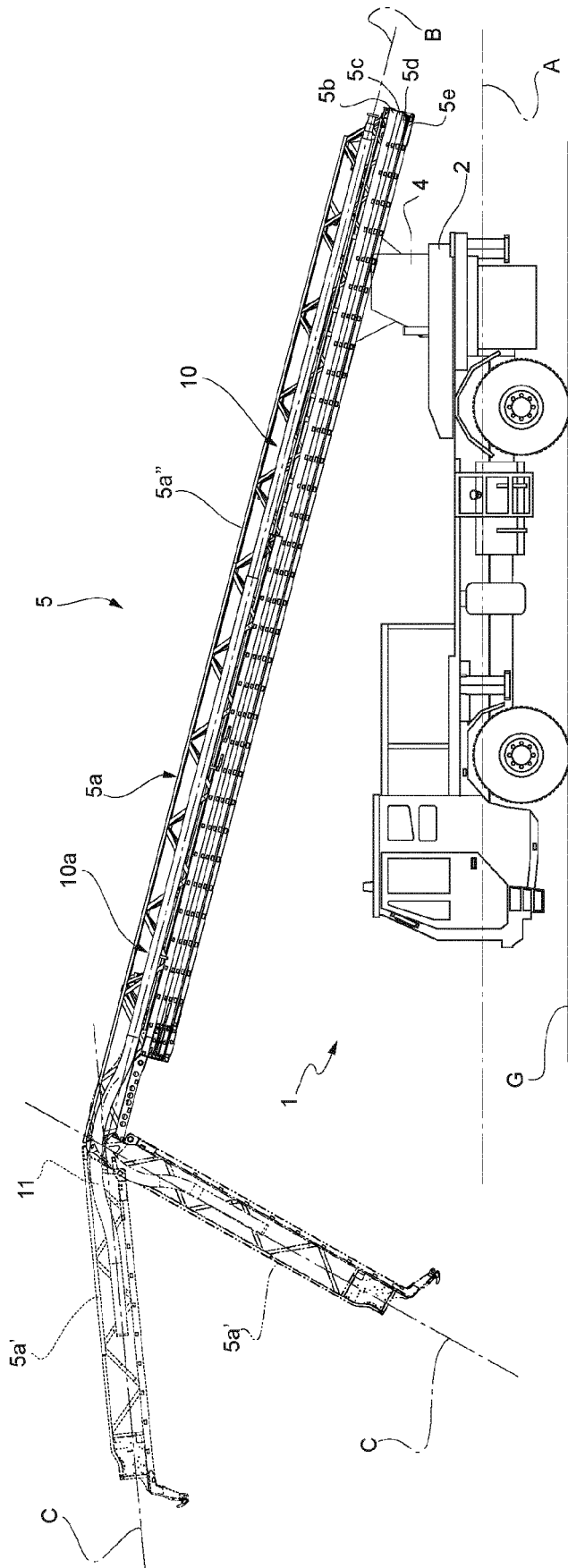


FIG. 5A

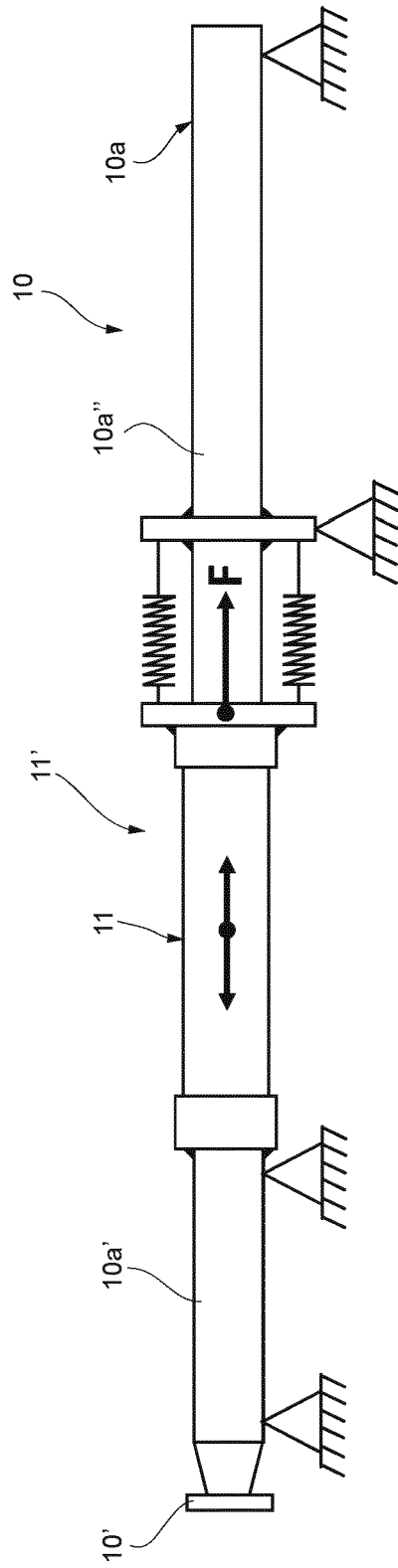
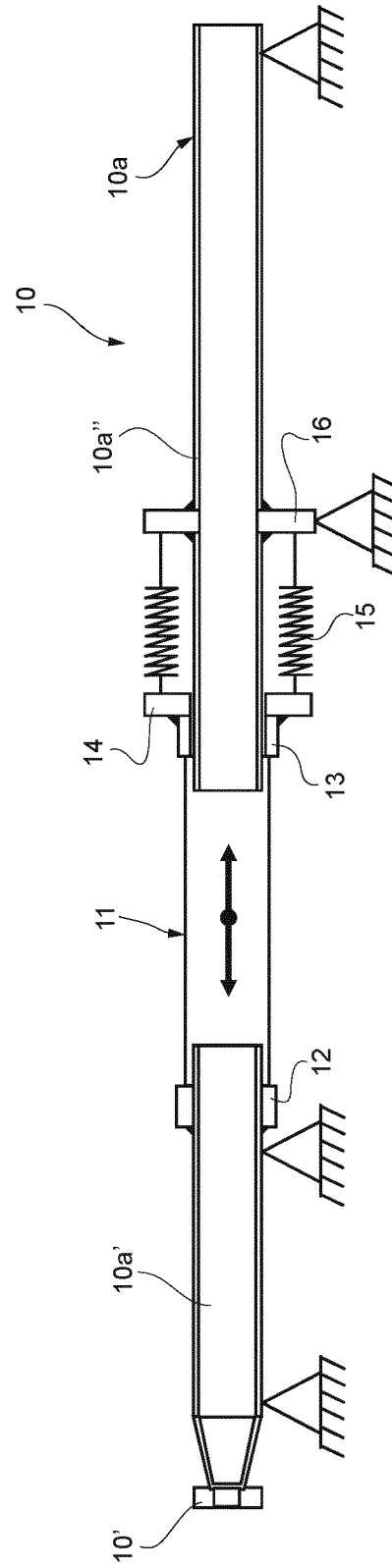


FIG. 5B





EUROPEAN SEARCH REPORT

Application Number

EP 23 17 4140

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EPO FORM 1503 03.82 (P04C01)

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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 August 2023	Examiner 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	

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

EP 23 17 4140

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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04-08-2023

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