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(54) **ARTICULATED DEVICE FOR SUPPORTING AND/OR HANDLING LOADS**

(57) The device (11) comprises a first outer element (14') extending along a longitudinal axis (b) and a second outer element (16') hinged to the first outer element (14') for rotation relative to the latter about a first transverse axis (c) in a first operating condition of the device (11). The first and the second outer elements (14', 16') have longitudinal internal cavities (12) accommodating first and second inner elements (14'', 16'') which are hinged to each other for rotation relative to each other about a second transverse axis (c'') parallel to, or coinciding with, the first transverse axis (c) when the device (11) is in the first operating condition. The device (11) further compris-

es locking means (34a, 34b) arranged to prevent relative rotation of the first and second outer elements (14', 16') and of the first and second inner elements (14'', 16''), respectively, when said elements (14', 16', 14'', 16'') are aligned with each other along the longitudinal axis (b) and when the device (11) is in a second operating condition rotated 180° about the longitudinal axis (b) relative to the first operating condition. The first and second inner elements (14'', 16'') are slidable along the longitudinal axis (b) relative to the first and second outer elements (14', 16') when the device (11) is in the second operating condition.

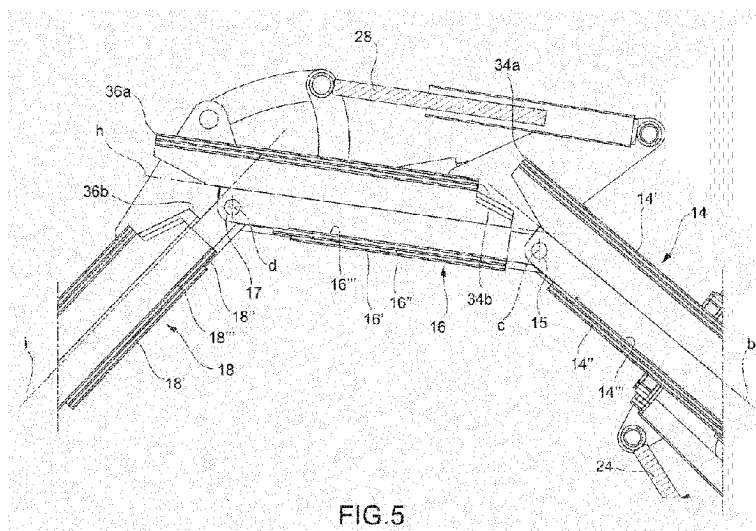


FIG. 5

## Description

**[0001]** The present invention relates in general to a device for supporting and/or handling loads, such as for example an arm intended to be mounted on work vehicles and/or earth-moving equipment.

**[0002]** Such a device is known for example from US 5 625 967.

**[0003]** In the construction industry, there is a need of supporting and/or handling loads of various type by using the least possible number of devices and equipment, in order to reduce the operating costs of the construction activity and the required expertise to accomplish the goals set out. Said activities may cover a wide range, from excavation to earth-moving, support (either temporary or not) of mechanical and building structures, scaffolding and various constructions.

**[0004]** For example, earth-moving machines, in particular those used in the building and construction industries, conventionally have to balance the requirements of robustness and reliability with the need of providing versatile and small-sized machines.

**[0005]** In order to increase the operating flexibility of the machines used in the construction industry, the prior art provides for a plurality of solutions, for example the so-called backhoe loaders, which allow a same machine to carry out, alternatively, several functions. Nevertheless, some operations, which are important or necessary in the construction field, are still precluded to conventional excavators, and require, instead, special equipment. For example, access for the operators to working areas positioned at a certain height and handling of materials from/to such working areas require the use of aerial platforms or telescopic boom lifts, in order to avoid the mounting of scaffolds or scaffolding dollies.

**[0006]** The difficulties in combining in an efficient way, both in terms of structure and in terms of sizes, the function of excavation and the function of lifting of goods and people on the same vehicle, results not only in higher costs, because of the duplication of the equipment used in the construction site and of the operators dedicated to the use and maintenance of such equipment, but also in a greater complexity in managing the construction site.

**[0007]** On the other hand, in the prior art there are no solutions quickly and easily to use, that are suitable for supporting and handling loads with extremely variable sizes and that are also easy to pack, transport and store.

**[0008]** It is an object of the present invention to increase the versatility and efficiency of the construction machines, allowing to provide a machine having both the features of a conventional earth-moving equipment and the features of a telescopic boom lift.

**[0009]** A further object of the present invention is to provide a structural supporting element that is suitable for supporting loads positioned at variable distances, and that is also easy to use and transport.

**[0010]** These and other objects are fully achieved according to the present invention by virtue of an articulated

device having the features set forth in independent claim 1.

**[0011]** Advantageous embodiments of the invention are defined in the dependent claims, the subject-matter of which is to be considered as forming an integral part of the following description.

**[0012]** In short, the invention is based on the idea of providing an articulated device, such as for example an articulated arm, comprising a plurality of parts articulated one to the other and locking means configured to allow the device to work in two different modes, namely a first mode, in which the locking means allow relative rotation of the parts about the respective articulation axis, and a second mode, in which the locking means prevent relative rotation of the parts about the respective articulation axis and further keep the parts aligned one with the other along a given longitudinal axis, so as to allow a telescopic extension/retraction movement of the parts along said direction.

**[0013]** Preferably, the parts of the articulated device are hinged to each other at joints that comprise the locking means. The joints are made in such a way as to allow free relative rotation of the parts when the locking means are in a non-operating condition, and to ensure alignment of the parts, preventing relative rotation, when the locking means are in an operating condition.

**[0014]** The articulated device according to the invention may, for example, be an arm of a work vehicle or of an earth-moving equipment, in which case in said first operating mode it may work as an articulated arm, while in said second operating mode it may work as a telescopic arm.

**[0015]** The articulated device according to the invention can also be used, nevertheless, as a structural supporting element, as will be clear from the following description.

**[0016]** The functional and structural features of some preferred embodiments of an articulated device according to the invention will now be described, with reference to the appended drawings, wherein:

Figure 1 is a lateral view showing schematically a vehicle comprising an articulated device according to an embodiment of the invention, the device being configured in this case as a arm;

Figure 2 is a perspective view of the articulated device of the vehicle of Figure 1;

Figure 3 is a lateral, partially sectioned, view of the articulated device of Figure 2;

Figure 4 shows a detail of the articulated device of Figure 2;

Figure 5 is a lateral section view of the articulated device of Figure 2, in a first operating mode;

Figure 6 is a lateral section view of the articulated device of Figure 2, in a second operating mode;

Figures 7 and 8 are a perspective view and a lateral view, respectively, of the articulated device of Figure 2, in the second operating mode;

Figure 9 is a section view of the articulated device of Figure 2, taken along section line IX-IX of Figure 8; Figure 10 is a schematic lateral view of a further example of a vehicle provided with an articulated device according to the invention, the articulated device being shown in the second operating mode; Figure 11 is a schematic lateral view of an articulated device according to a further embodiment of the invention; Figure 12 is a perspective view of the articulated device of Figure 11; Figure 13 shows a detail of the articulated device of Figure 12; and Figures 14A and 14B are schematic lateral views showing the articulated device of Figure 11 in two different operating modes.

**[0017]** Before explaining in detail a plurality of embodiments of the invention, it shall be made clear that the invention is not limited to the constructional details and to the configuration of the components as illustrated in the following description or shown in the appended drawings. The invention may be carried out according to further embodiments, in addition to those described herein.

**[0018]** With reference first to Figure 1, an articulated device for handling loads according to a first embodiment of the present invention, wherein the articulated device is used as an arm for a machine 9, for example an earth-moving equipment or a work vehicle, is generally indicated with 11. For ease of reference, therefore, in the description of this first embodiment the articulated device will be referred to as "arm".

**[0019]** In the embodiment illustrated herein, the arm 11 comprises three arm parts 14, 16 and 18, namely a first arm part 14, a second arm part 16 hinged to the first arm part 14 at a first joint 15, and a third arm part 18 hinged to the second arm part 16 at a second joint 17. It is however clear that the arm according to the invention may comprise a different number of arm parts, with a minimum of two.

**[0020]** The arm 11 may work according to two different operating modes: a first operating mode, as shown in Figures 1 to 5, wherein the arm works as a conventional articulated arm of an excavator, and a second operating mode, as shown in Figures 6 to 9, wherein the arm is able to extend telescopically.

**[0021]** The arm 11 is provided, at its distal end (in the illustrated example, the distal end of the third arm part 18), with one or more tools, such as for example a shovel 22, for performing the functions the machine is intended to perform. At its proximal end, the arm 11, or, more precisely, the first arm part 14, is supported by a support element 32 so as to be able to rotate about an axis coinciding with the longitudinal axis (indicated with b) of the first arm part 14. The support element 32 is in turn rotatable about a transverse axis a. According to an embodiment, the support element 32 is mounted on a frame 10 of the machine 9 through guiding means (not shown) so

that it can slide, along with the whole arm 11, longitudinally (that is, along the forward direction of the machine) between two end positions, namely a fore one and a rear one. In further embodiments (not illustrated), the arm may be truck-mounted, self-propelled or supported by means of tripods or other fixed supporting devices.

**[0022]** The first joint 15 allows relative rotation of the second arm part 16 with respect to the first arm part 14 about a transverse axis c parallel to the transverse axis a. Said rotation is defined by the angle, indicated with  $\alpha$  in Figure 1, between the longitudinal axis b of the first arm part 14 and the longitudinal axis (indicated with h) of the second arm part 16. The angle  $\alpha$ , that is herein defined as positive in the clockwise direction of rotation of the second arm part 16 relative to the first arm part 14, is comprised between a given minimum angle (preferably lesser than  $90^\circ$ ), corresponding to the condition of interference between the bodies of the two adjacent arm parts 14 and 16, and a maximum angle of  $180^\circ$ , corresponding to the condition of alignment of the longitudinal axes b and h of the first arm part 14 and the second arm part 16, respectively.

**[0023]** Likewise, the second joint 17 allows relative rotation of the third arm part 18 with respect to the second arm part 16 about a transverse axis d parallel to the transverse axes a and b. Said rotation is defined by the angle, indicated with  $\beta$  in Figure 1, comprised between the longitudinal axis h of the second arm part 16 and the longitudinal axis (indicated with i) of the third arm part 18. The angle  $\beta$ , which is herein defined as positive in the clockwise direction of rotation of the third arm part 18 relative to the second arm part 16, is comprised between a given minimum angle (preferably lesser than  $90^\circ$ ), corresponding to the condition of interference between the bodies of the two adjacent arm parts 16 and 18, and a maximum angle of  $180^\circ$ , corresponding to the condition of alignment of the longitudinal axes h and i of the second arm part 16 and the third arm part 18, respectively. Actuating means 24, 26 and 28 of per-se-known type, such as for example hydraulic cylinders, control the rotary movements of the arm parts 14, 16 and 18, respectively, about the respective transverse axes a, c and d.

**[0024]** As shown in particular in Figures 4 to 6, each arm part 14, 16 and 18 has a telescopic structure, with a plurality of elements (indicated with 14', 14'' and 14''' for the first arm part 14, with 16', 16'' and 16''' for the second arm part 16, and with 18', 18'' and 18''' for the third arm part 18) that are slidably arranged one inside the other along the longitudinal axes b, h and i of the respective arm parts.

**[0025]** In the embodiment proposed herein, each arm part comprises three elements (an outer one, an inner one and an intermediate one), but of course the number of elements may be different.

**[0026]** The outer elements 14', 16' and 18' of the three arm parts 14, 16 and 18 are hinged two by two about the above-mentioned transverse axes c and d. The intermediate elements 14'', 16'' and 18'' of the three arm parts

14, 16 and 18 are hinged two by two about the transverse axes c" and d" (shown in Figure 10) parallel to the transverse axes c and d. The inner elements 14"', 16"' and 18"' of the three arm parts 14, 16 and 18 are hinged two by two about the transverse axes c'" and d'" (shown in Figure 10) parallel to the transverse axes c and d. In the operating mode of the arm 11 shown in Figure 3, in which the arm works as an articulated arm, the transverse axes c" and c'" coincide with the transverse axis c, while the transverse axes d" and d'" coincide with the transverse axis d.

**[0027]** According to the invention, the arm 11 further comprises locking means associated to each one of the joints 15 and 17, said locking means connecting the three arm parts 14, 16 and 18 one to the other so as to keep said joints locked in the condition of alignment of the longitudinal axes b, h and i of the three arm parts 14, 16 and 18.

**[0028]** In the embodiment proposed herein, the locking means are made as form-fit coupling means and comprise, for each joint, a protrusion protruding from an end of one of the parts connected by said joint, and a seat provided on an end of the other part connected by said joint, the protrusion and the seat being shaped so as to engage by form-fit with each other in the condition of alignment of the longitudinal axes of the arm parts connected by said joint. Said protrusions and seats are provided in all the elements forming the various arm parts, but, for simplicity, will be hereinafter described in detail with reference only to the outer elements 14', 16' and 18' of the three arm parts 14, 16 and 18.

**[0029]** Near the first joint 15 a protrusion 34a at the end of the outer element 14' of the first arm part 14 has an abutment profile that mates with the corresponding abutment profile of the seat 34b provided at the proximal end of the outer element 16' of the second arm part 16. Likewise, near the second joint 17 the protrusion 36a at the end of the outer element 16' of the second arm part 16 has an abutment profile that mates with the corresponding abutment profile of the seat 36b provided at the proximal end of the outer element 18' of the third arm part 18. The same applies, as already said, for the other outer elements 14", 14"', 16", 16"', 18" and 18"' of the arm parts 14, 16 and 18.

**[0030]** Alternatively to what has been described and illustrated above, the locking means may be made as mechanisms (for example, knuckle-joint mechanisms) or stop devices (for example, oleo-dynamic stop devices) of various type, instead of being made as form-fit means.

**[0031]** In the second operating mode of the arm 11, as shown in Figure 6, the abutment profiles of the locking means, interposed between adjacent parts of the articulated arm, overlap on each other. The protrusions 34a, 36a and the seats 34b, 36b of the adjacent arm parts reciprocally create a fixed coupling that prevents further rotation of the arm parts about the respective transverse axes c and d. It is thus ensured that the longitudinal axes b, h and i of the three arm parts 14, 16 and 18 are aligned

with each other.

**[0032]** In the illustrated example, the engagement between the protrusions and the seats of the adjacent arm parts, and hence the alignment of the arm parts, is ensured by the weight of the arm parts themselves, which tends to generate a rotation of the arm parts about the transverse axes c and d in the positive direction of the angles of oscillation  $\alpha$ ,  $\beta$ , which rotation is however prevented by the resistance generated by the protrusions of the arm parts. In order to achieve such an effect, during shifting from the first operating mode to the second operating mode the whole arm 11 is rotated by 180° about the longitudinal axis b of the first arm part 14.

**[0033]** Once the arm 11 is in the second operating mode, i.e. in the operating mode where the longitudinal axes of all the arm parts are aligned with each other, the inner elements of the arm parts are slidable relative to the outer elements. The longitudinal extension of the intermediate elements relative to the outer elements, as well as the longitudinal extension of the inner elements relative to the intermediate elements, allows to extend the arm 11 telescopically. The extension and retraction movements of the arm 11 in the second operating mode are controlled by actuators and transmission mechanisms that are known per se and therefore will not be described and illustrated herein.

**[0034]** Figure 11 and the following ones show an embodiment of the articulated device according to the invention which is arranged to allow application of the device as a structural supporting element (for example, a tie beam for supporting the struts of a truss). In the illustrated example, the device 11 lacks those components that are used for load handling (the shovel 22, the actuators 24, 26, 28 and the supporting device 32), and comprises, instead, only the arm parts 14, 16, 18 (with the respective extractable elements) connected to each other by hinges 38, 40. Said hinges, as in the preceding case, allows relative rotation of each arm part with respect to the adjacent arm part about the respective transverse axis (in the illustrated example only the transverse axes c and d are shown, but the explanations regarding the arm described above with reference to Figures 1 to 10 still apply).

**[0035]** Figures 14A and 14B show two possible operating modes of the articulated device 11, namely a longitudinal alignment mode (that is, an alignment mode along the longitudinal axis b) wherein the locking elements of the device 11 are oriented as in Figure 5, and a longitudinal alignment mode wherein the device 11 is rotated 180° relative to Figure 14A.

**[0036]** In the configuration of Figure 14A, the device 11 is supported at both its opposite ends and acts like a beam able to bear a load P weighing on any point between the two ends. In the configuration of Figure 14B, instead, only one of the two ends of the device 11 is restrained and the device is able to bear the load P when the latter acts on the opposite free end.

**[0037]** In both the above-mentioned configurations the

inner elements can be extracted telescopically to extend the device 11 and provide beams of different lengths.

[0038] Naturally, the principle of the invention remaining unchanged, the embodiments and the constructional details may vary widely from those described and illustrated purely by way of non-limiting example, without thereby departing from the scope of the invention as defined in the appended claims.

## Claims

1. Articulated device (11) for supporting and/or handling loads, comprising a first outer element (14') extending along a longitudinal axis (b) and a second outer element (16') hinged to the first outer element (14') by means of a first joint (15) for rotation relative to the first outer element (14') about a first transverse axis (c) in a first operating condition of the device (11),

### characterized

**in that** the first and the second outer elements (14', 16') have longitudinal internal cavities (12) where at least one first inner element (14'') and at least one second inner element (16'') are accommodated, said at least one first and second inner elements (14'', 16'') being hinged to each other by means of a second joint for rotation relative to each other about a second transverse axis (c'') parallel to, or coinciding with, the first transverse axis (c) when the device (11) is in the first operating condition,

**in that** the first joint (15) and the second joint are provided with respective locking means (34a, 34b) arranged to prevent relative rotation of the first and second outer elements (14', 16') and of the first and second inner elements (14'', 16''), respectively, when the first joint (15) and the second joint are arranged in a maximum angular position, in which the respective first and second inner and outer elements (14', 16', 14'', 16'') are aligned with each other along said longitudinal axis (b), and when the device (11) is in a second operating condition rotated 180° about said longitudinal axis (b) relative to the first operating condition, and

**in that** in said maximum angular position the first and second inner elements (14'', 16'') are slidable along said longitudinal axis (b) relative to the first and second outer elements (14', 16').

2. Device according to claim 1, wherein said locking means (34a, 34b) have abutment profiles mating with each other, said abutment profiles being overlapped with each other in the maximum angular position of the first and second joints (15), whereby the respective first and second inner and outer elements (14', 16', 14'', 16'') are aligned with each other along said longitudinal axis (b) and relative rotation of said first and second inner and outer elements (14', 16',

14'', 16'') is prevented.

3. Device according to claim 1 or claim 2, further comprising actuating means (26, 28) for controlling relative rotation of the first and second outer elements (14', 16') about the first transverse axis (c).

4. Machine (9) comprising a device (11) according to any of the preceding claims, the device (11) being mounted on the machine so that the first outer element (14') is rotatable about said longitudinal axis (b) to be moved between the first and the second operating conditions.

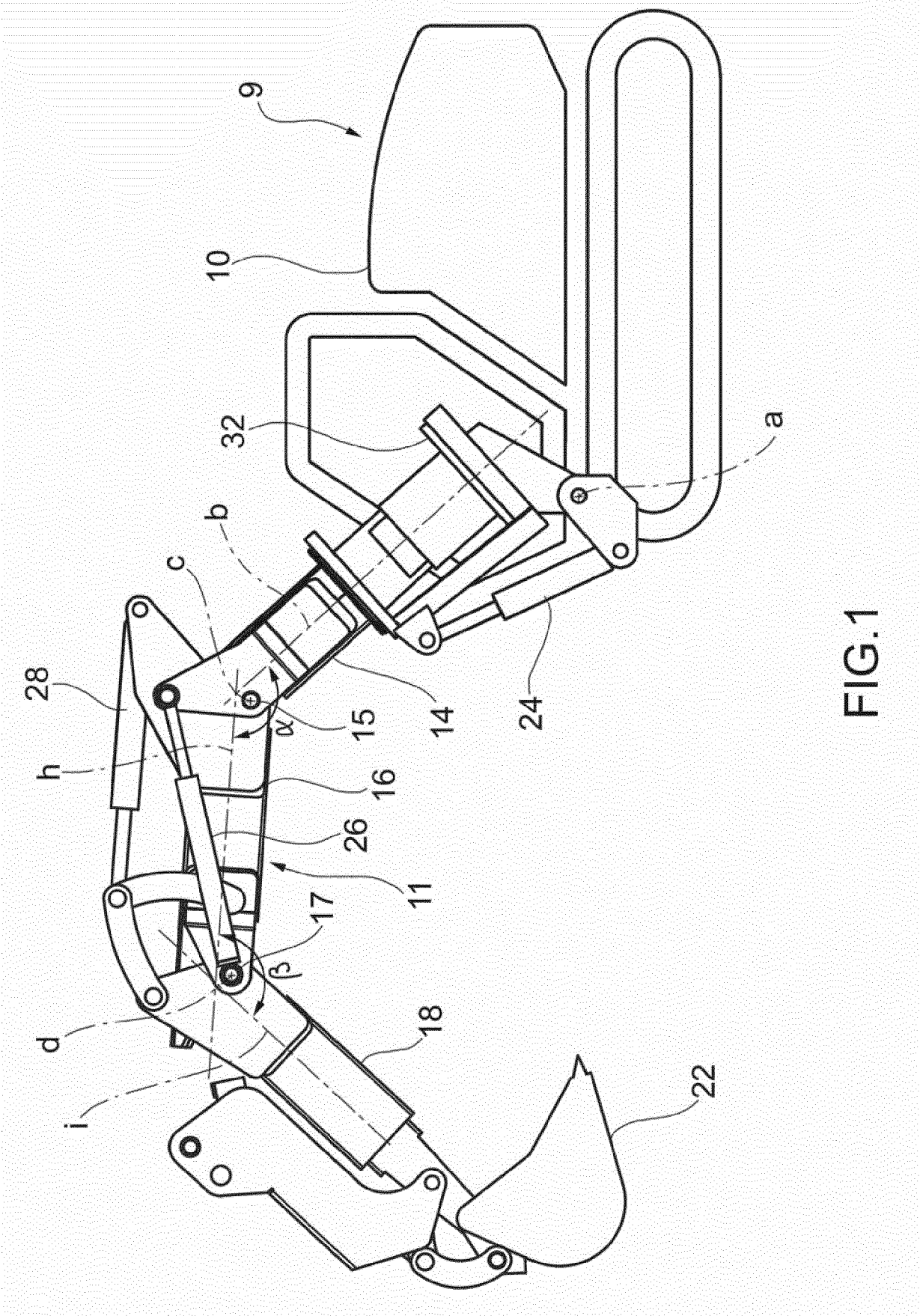
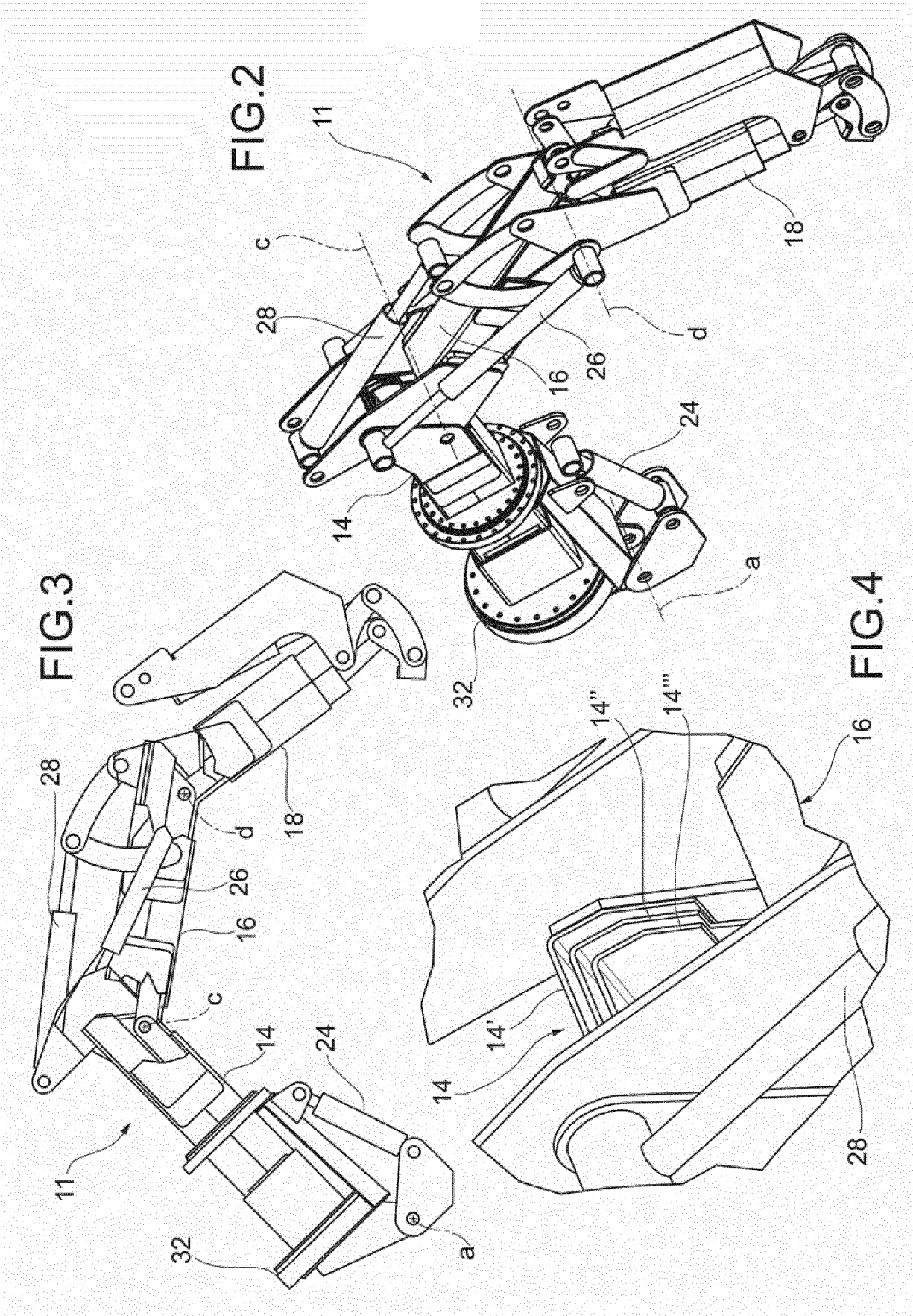


FIG.1



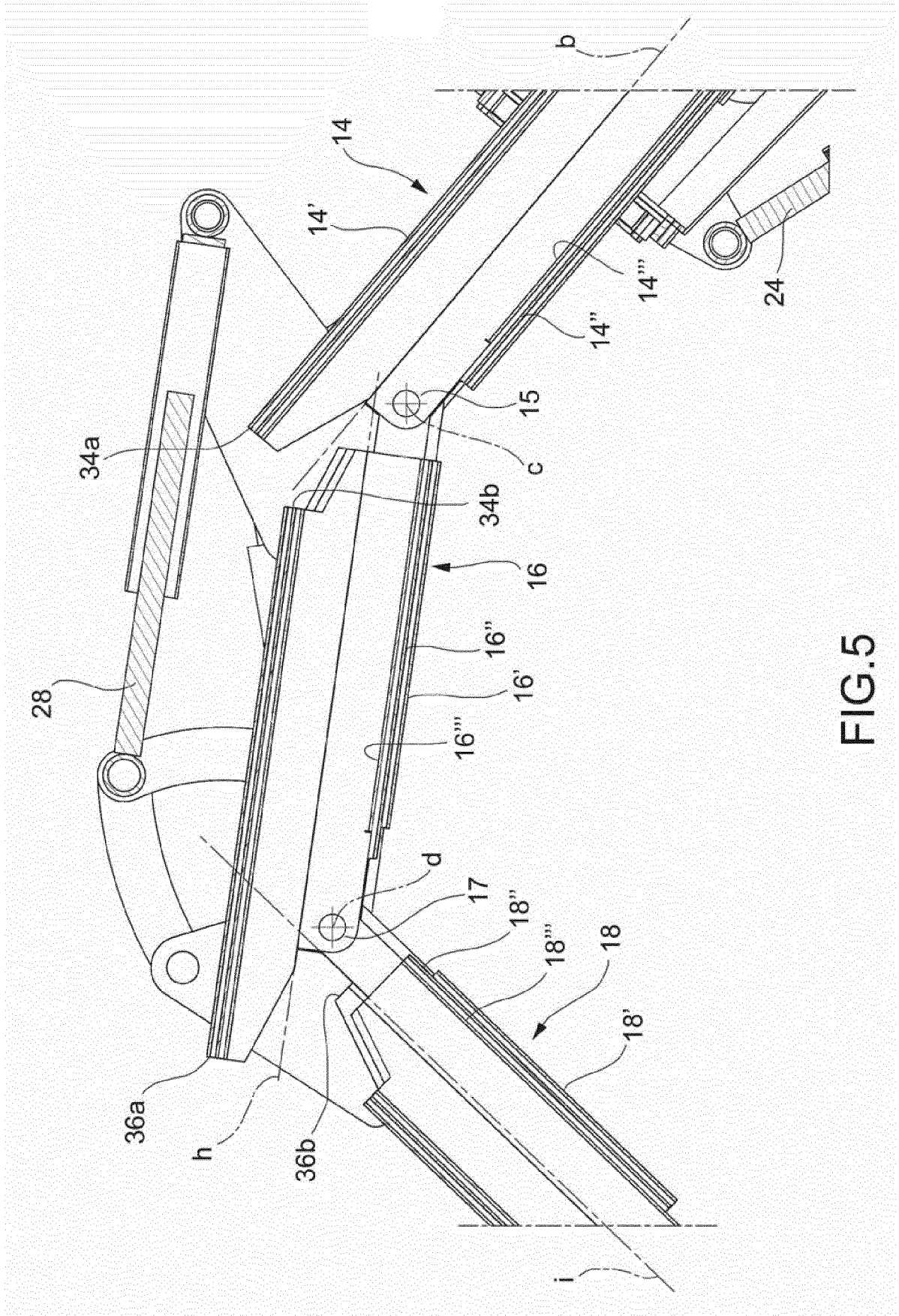


FIG.5

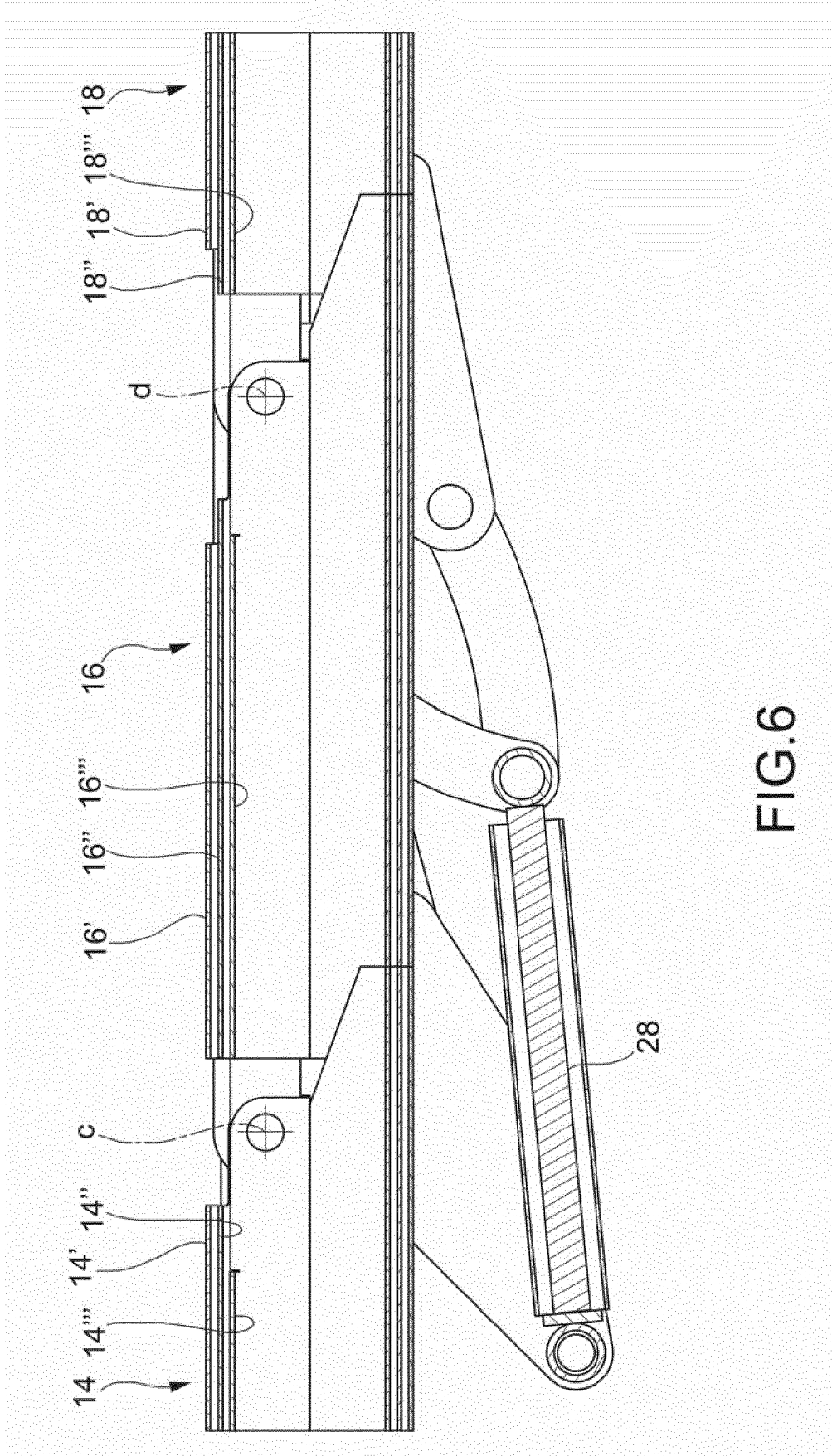


FIG.6

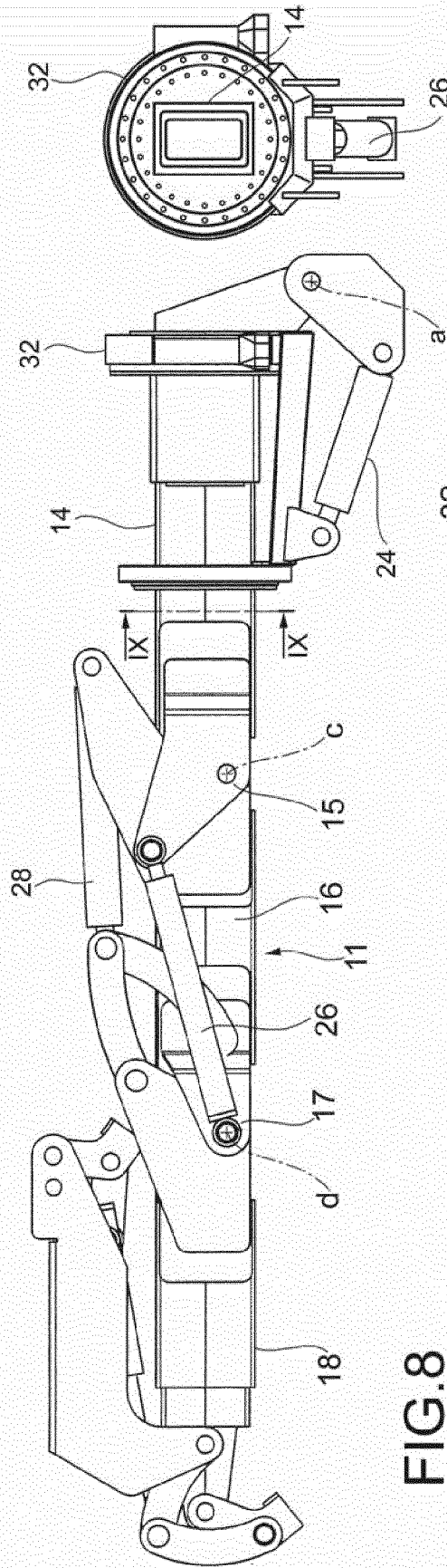


FIG. 8

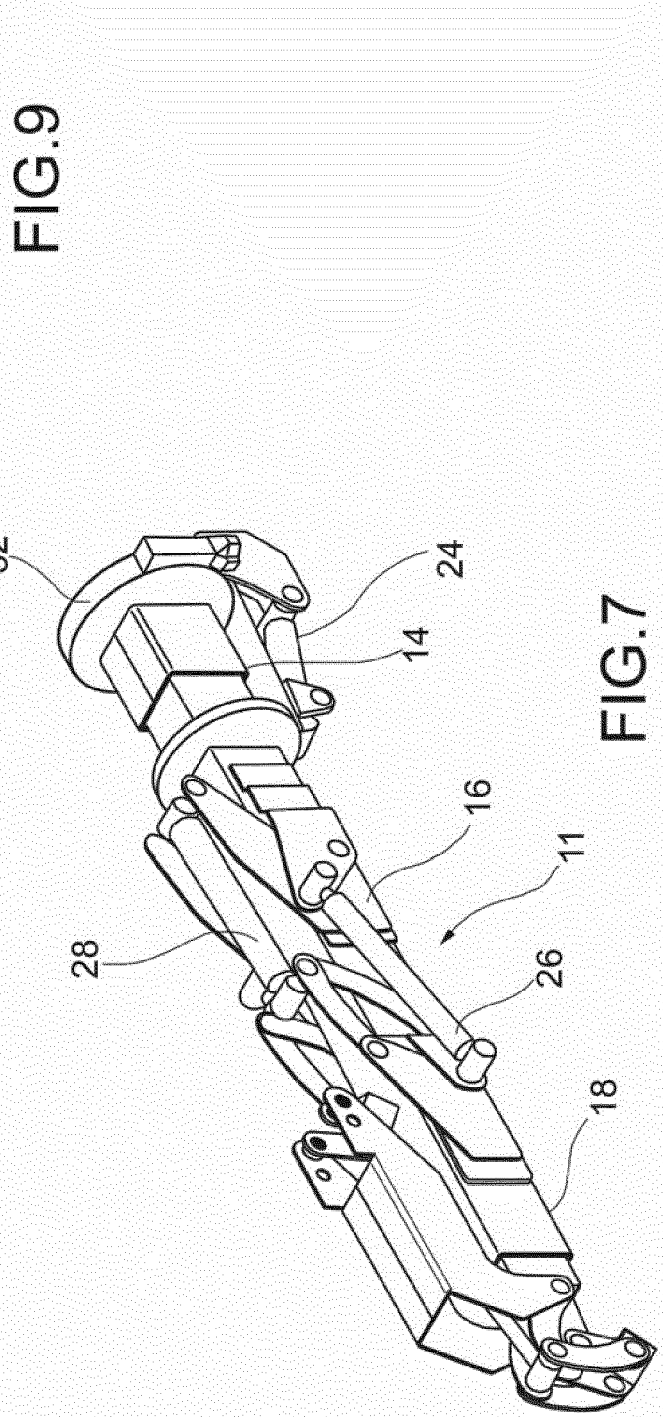


FIG. 7

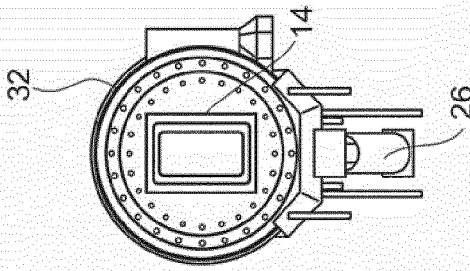


FIG. 9

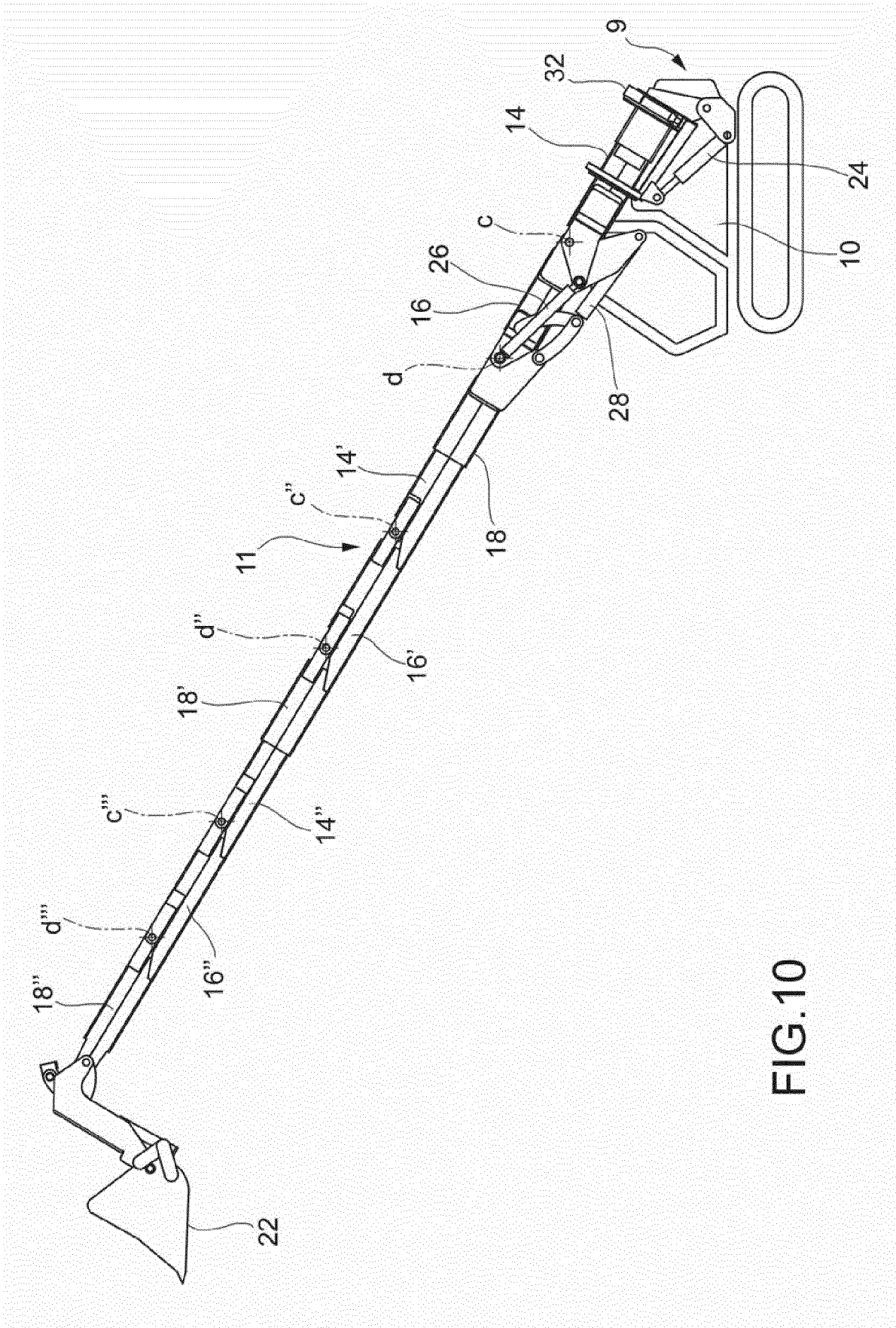
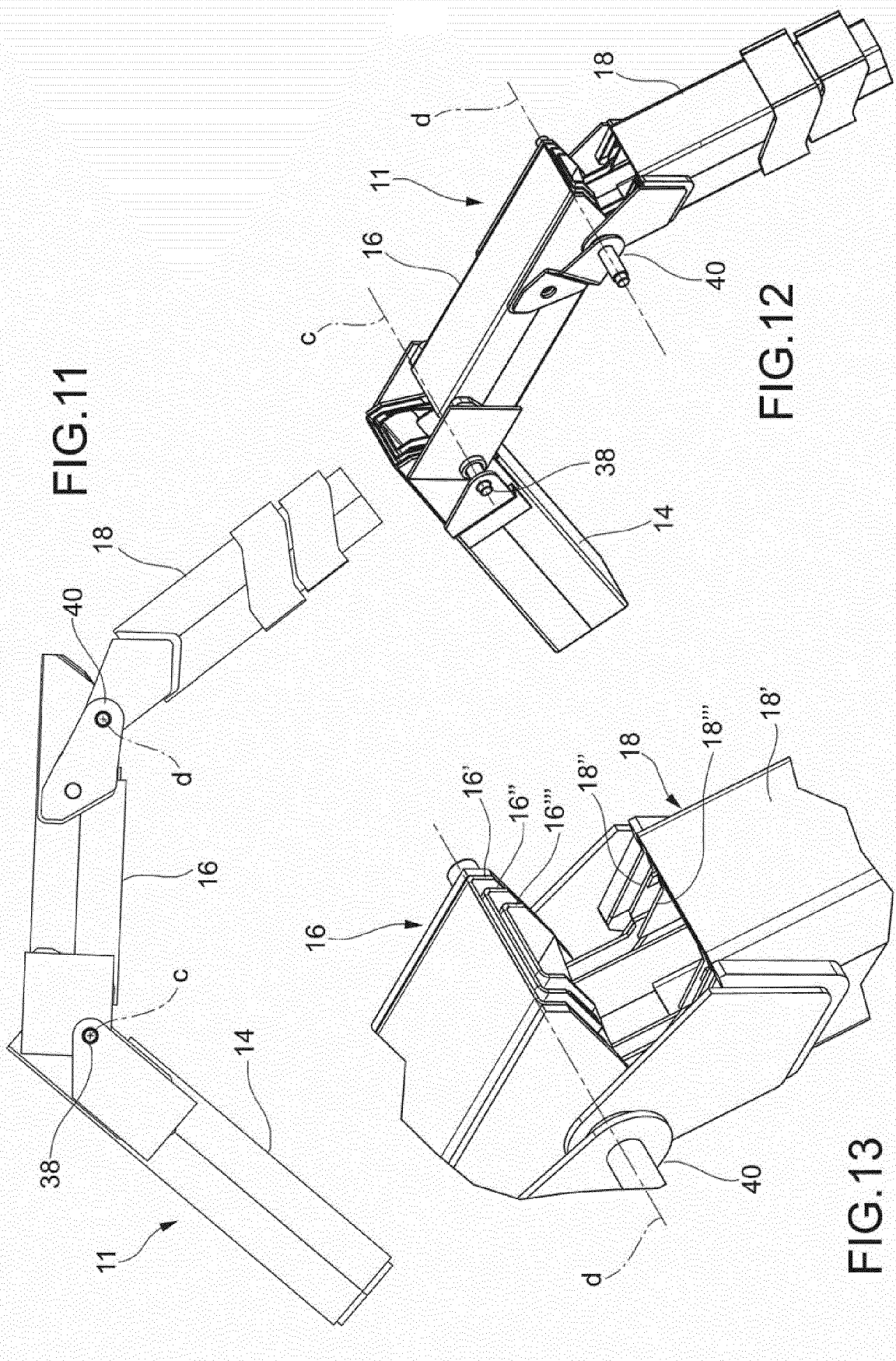


FIG.10



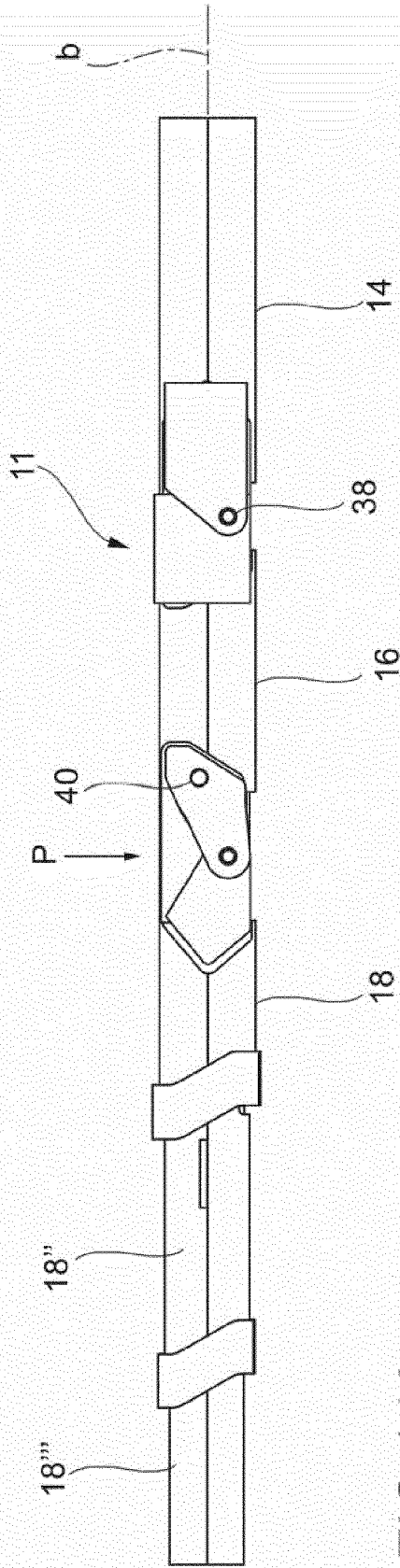


FIG. 14A

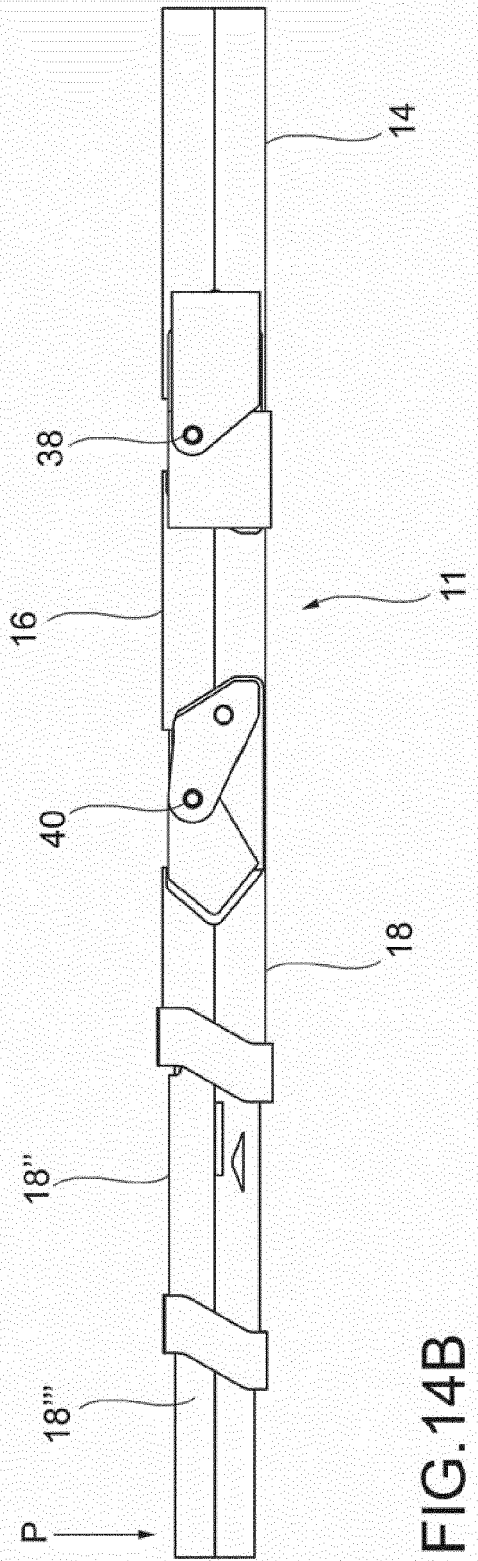


FIG. 14B



ANNEX TO THE EUROPEAN SEARCH REPORT  
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