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(54) **Telescopic arm for a crane moving an attachment member**

(57) In a crane (1) moving an attachment member (14), a telescopic arm (7) has an attachment portion (8) to a support body (4), at least one intermediate portion (11) and an end portion (12) movable with respect to each other under the bias of a linear actuator (16), and a feeding circuit (22) housed in the intermediate (11) and end (12) attachment portions to control the attachment member (14); the feeding circuit (22) comprises a first telescopic tube circuit (24) surrounding the linear actuator (16), a second rigid tube circuit (25) inside and integral with the end portion (12), and a guided flexible tube circuit (26) interposed between the two rigid tube hydraulic circuits (24)(25).

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Description

[0001] The present invention relates to a telescopic arm for a crane moving an attachment member.

[0002] The use of a clamp member coupled to a free end of a crane mounted either on the ground or on board of a respective vehicle, e.g. a truck, is known in the field of product handling/collection in general, and of waste products handling/collection in particular, to which reference will be made in the following description without therefore losing in generality.

[0003] The known cranes generally comprise a column, a first arm of fixed length overhangingly coupled to an upper end of the column and a telescopic arm, commonly known as "derricking arm" overhangingly extending from the mentioned fixed length arm.

[0004] The telescopic arm comprises, in turn, an attachment portion hinged to the fixed length arm, an intermediate portion and an end portion, both axially or longitudinally sliding with respect to each other and with respect to the attachment portion.

[0005] The end portion carries a clamp member hanging from a free end thereof, the hydraulic actuators of which are hydraulically coupled to a hydraulic attachment joint fixed onto the end portion of the arm itself.

[0006] The hydraulic attachment joint is connected to a further hydraulic joint fixed onto the attachment portion by means of a flexible hydraulic circuit comprising a plurality of flexible tubes arranged side-by-side. The flexible tubes, which is several meters long, slide in use within the telescopic arm adapting themselves as a function of the per se small space available within the arm and have segments either bent or folded in a loop to allow the relative translation of both sliding portions.

[0007] As a consequence, the flexible tubes slide not only in contact with each other but also against the inner surface of the portions during operation by effect of oil pressure, thus wearing relatively quickly. Furthermore, wear is more accentuated the longer and stiffer are the flexible tubes. For these reasons, quick change devices, adapted to allow the rapid replacement of the flexible tubes in order to contain machine downtime as much as possible, are provided in some solutions.

[0008] The already rapid wear of flexible tubes is then, in some cases, further aggravated by the fact that the flexible tubes themselves are excessively bent due to the narrow curvature radii of the followed paths. The presence of tubing segments with narrow curvature radius limits increasing the diameter of the tubes, which limits the maximum oil flow at the clamp member inlet and/or requires the use of reinforced tubes with inevitable increase of costs.

[0009] It is the object of the present invention to make a telescopic arm, the construction features of which allow to simply and cost-effectively solve the problems disclosed above.

[0010] According to the present invention, a telescopic arm of a crane moving an attachment member is made, the arm comprising an attachment tubular portion for a support body; an intermediate tubular portion; an end tubular portion, to which said attachment member is coupled; driving means housed in said tubular portions to translate said intermediate and end tubular portions one with respect to the other and with respect to said attachment tubular portion, and a hydraulic feeding circuit housed within said attachment, intermediate and end tubular portions to feed pressurized fluid to said attachment member; **characterized in that** said driving means comprise a linear actuator interposed between said attachment tubular portion and said intermediate tubular portion, and in that said hydraulic feeding circuit comprises a first variable length telescopic tube circuit surrounding said linear actuator, a second rigid tube circuit extending within said tubular end portion and integrally connected to the end tubular portion, and a flexible tube circuit interposed between said first and second hydraulic circuit.

[0011] Preferably, the arm defined above also comprises guide means to guide said flexible tube circuit along a predetermined path which varies as a function of the relative positions of said attachment, intermediate and end tubular portions.

[0012] Furthermore, said guide means preferably comprise a resilient guide having an end integrally connected to said linear actuator and an opposite end integrally connected to said end tubular portion.

[0013] The invention will now be described with reference to the accompanying drawings that illustrate a non-limitative embodiment thereof, in which:

figure 1 schematically shows a side elevation view of a crane provided with a first preferred embodiment of the telescopic arm according to the present invention;

figure 2 shows a section of the telescopic arm in figure 1;

figure 3 is a perspective, enlarged scale view, with parts removed for clarity, of the arm in figure 2;

figure 4 is a perspective view of a detail of figures 2 and 3;

figure 5 shows a detail of figure 4 on enlarged scale; and

figure 6 is a figure similar to figure 1 and schematically shows a side elevation view of a crane provided with a second preferred embodiment of the telescopic arm according to the present invention.

[0014] In figure 1, numeral 1 indicates a crane as a whole adapted to be positioned on a fixed base 2 or installed on board of a vehicle, e.g. a truck (not shown).

[0015] Again with reference to figure 1, crane 1 comprises an upright or column 3, an arm 4 (per se known and not described in detail), hinged to an upper free end of column 3, and mobile with respect to column 3 itself under the bias of its own hydraulic jack 5. Crane 1 then comprises a telescopic arm 7, commonly known as derricking arm and, in turn, comprises an attachment tubular

portion 8 hinged in a known manner to a front end of the arm 4 to turn with respect to the arm 4 itself about a horizontal axis 9 under the bias of a hydraulic linear actuator, indicated by numeral 10.

[0016] The telescopic arm 7 further comprises, in addition to the attachment tubular portion 8, an intermediate tubular portion 11 and an end tubular portion 12 sliding with respect to the attachment tubular portion 8 and, respectively, to the intermediate tubular portion 11 itself in a rectilinear longitudinal direction 13; an attachment member 14 (figure 1), selected from a plurality of attachment members with different functions and/or movements, in the specific case a hydraulic clamping member of the grab type (known in itself and not described in detail) is coupled to the end portion 12 (in a known manner).

[0017] The intermediate 11 and end 12 tubular portions are axially mobile with respect to each other and with respect to attachment portion 8 under the bias of an actuating assembly 15 comprising a hydraulic actuator 16 housed within the telescopic arm 7 and comprising a liner 18 connected in fixed position to the intermediate portion 11 and a rod 19 connected to the attachment portion 8.

[0018] Then, the assembly 15 comprises a strap or belt transmission 20 (known in itself and not described in detail) to move the end portion 12 in opposite senses with respect to the intermediate portion 11 in direction 13.

[0019] Still with reference to figures from 2 to 5, the telescopic arm 7 completely houses a hydraulic circuit 22 to feed a pressurized fluid to the hydraulic cylinders of the clamping member 14.

[0020] The hydraulic circuit 22 is completely housed in the telescopic arm regardless of the relative position of the portions 8, 11 and 12, and comprises a rigid tube circuit 24 of variable length which surrounds the hydraulic actuator 16, and a further rigid, fixed length tube circuit 25 arranged within the end portion 12 and integrally connected to the end portion 12 itself, and a flexible tube circuit 26 arranged between the hydraulic circuits 24 and 25.

[0021] With specific reference to figures 4 and 5, the circuit 24 comprises, in the particular example described, four telescopic conduits 27 distributed about the actuator 16 parallel to the actuator 16 itself. Each of the telescopic conduits 27 comprises two respective rectilinear rigid tubes, indicated by 27a and 27b, which are fluid-tightly connected to each other by means of a respective telescopic joint 28 (figure 4), and of which tube 27b extends externally and parallel to the liner 18 of the actuator 16 and is integrally connected to a bottom plate 30 integral with the liner itself 18. The segment 27a extends instead parallel and externally to the rod 19 and comprises an end portion facing the arm 8 integrally connected to an interface plate 31 connected to rod 19 and a pressurized oil feeding conduit (not shown).

[0022] Again with reference to figures 4 and 5, the flexible tube circuit 26 comprises, for each tube 27b, a respective flexible tube 33, which has a length variable from 1200 to 1300 millimeters, and an end segment of which is fluid-tightly connected to the tube 27b itself at plate 30. The flexible tubes 33 have respective intermediate segments 34 arranged in reciprocally parallel portions, arranged side-by-side and coplanar within a jointed tube guide channel 35. The channel 35 extends substantially for the entire length of the tubes 33 and defines a tubular housing, which houses and envelops all the tubes 33.

[0023] The channel 35 ends, on the side facing the plate 30, with a respective bracket 36 integrally connected to the plate 30, and on the opposite side with an attachment bracket 37 integrally connected to the end portion 12 to move at the same time with the end portion 12 itself. Channel 35 guides tubes 33 along a predetermined path P as the portions of the intermediate 11 and end portions 12 and has, regardless of the extension of the telescopic arm 7, a U-shaped segment 38 having an average curvature radius wider than 75 millimeters so as to avoid sudden or free bending of the flexible tubes 33 during the movement of the portions 11 and 12.

[0024] The flexible tubes 33 then comprise respective end terminals 40, which protrude outside channel 35 and end on a plate 41 of bracket 37, at which they are fluid-tightly connected to circuit 25.

[0025] Circuit 25 comprises a respective fixed length rigid tube 43 for each flexible tube 33. Tubes 43 are divided so as to form two pairs 43a of tubes transversally spaced apart and arranged on opposite sides of the channel 35 along respective substantially parallel paths. Again with reference to figures 4 and 5, tubes 43 have, starting from the plate 41, respective U-shaped folded segments 44 and respective substantially z-shaped segments 45 integrally connected to the end portion 12 by means of respective brackets 46. Each of the tubes 43 has a respective end segment fluid-tightly connected to a hydraulic connector 47 integral with the end portion 12 and adapted to allow the connection of the hydraulic tubes of the member 14 to the tubes 43 themselves.

[0026] The embodiment shown in figure 6 relates to a crane 50, similar to crane 1, the constituent parts of which are indicated by the same reference numerals as the corresponding parts of the crane 1.

[0027] Crane 1 comprises a telescopic arm 51, which differs from the telescopic arm 7 in that it comprises, in addition to the intermediate tubular portion 11, a further intermediate tubular portion 53 sliding within the intermediate tubular portion 11 in rectilinear longitudinal direction 13 and housing the end portion 12, again in longitudinally sliding manner. The intermediate tubular portions 11 and 53 are axially movable within each other and with respect to the attachment portion 8 under the bias of a driving assembly 15, which comprises, in addition to the hydraulic actuator 16 and the strap or belt transmission 20, a further transmission 55 again of the strap or rope type, also known in itself and not described in detail.

[0028] As the telescopic arm 7, the telescopic arm 51 houses a hydraulic circuit for feeding a pressurized fluid to the hydraulic cylinders of the clamping member 14.

The hydraulic circuit housed in the telescopic arm 51 differs from the flexible tube hydraulic circuit 22 solely in that its flexible tubes are longer than those of the hydraulic circuit 22, but guided exactly as the flexible tubes of the hydraulic circuit 22 itself. Consequently, also in the hydraulic circuit of the telescopic arm 51, the flexible tubes move along predetermined paths defined as a function of the longitudinal position of the tubular portions 11,12 and 53.

[0029] From the above it is apparent that the constructive features of the hydraulic circuits 22 provided in the telescopic arms 7 and 51 firstly allow, with respect to the known solutions, to considerably reduce the length of the flexible tubing but above all prevent the flexible tubes themselves from moving arbitrarily within the telescopic arms 7 and 51 sliding against each other and against the inner walls of the arm 7 itself.

[0030] This is essentially due to the fact that the hydraulic circuit 22 is substantially divided into three parts, the two end parts of which only use rigid tubes, i.e. tubes which cannot move in transversal directions with respect to the longitudinal direction of extension of the arms 7 and 51 and only the intermediate one is of the flexible tube type.

[0031] Such flexible tubing in addition to displaying an extremely short length with respect to the flexible tubing used in the known solutions is in all cases always guided along a predetermined path, therefore the flexible tubes 33 cannot slide in any manner against the inner walls of the arm 7 nor follow arbitrary paths, and thus cannot slide against each other and/or form loops with any curvature radius and, in particular, smaller than those required by the manufacturers of the flexible tubing itself.

[0032] In addition to this, the fact of defining the minimum curvature radius of the path set by the features of the conduit 35 and of maintaining such a curvature unchanged regardless of the operating condition of the telescopic arms 7 and 51 allows to increase the diameter of the flexible tubing itself and thus increase the oil flow towards the actuator member without the need to use special or dedicated tubing.

[0033] The particular configuration of the hydraulic circuit 22 then allows to make traditional telescopic arms, i.e. a single intermediate portion, but makes it possible to make telescopic arms with two or more mobile intermediate portions and thus cranes with high range in maximum extension conditions and particularly contained dimensions in maximum closing conditions and in extremely simple manner.

[0034] From the above, it is apparent that the different attachment devices may be coupled to the end portion 12 of crane 1 and 50 other than grab 14 described by way of example, in particular non-hydraulic driving accessories (for example, pneumatic or hydraulic). In such a case, the various hydraulic tubes of the circuit 22 may be simply replaced by pneumatic tubes or electric cables to define a pneumatic feeding circuit and an electric supply circuit to the attachment member, respectively.

Claims

1. A telescopic arm of a crane moving an attachment member, the arm comprising an attachment tubular portion for attaching to a support body; at least one intermediate tubular portion; an end tubular portion, to which said attachment member is coupled; driving means to translate said intermediate and end tubular portions one with respect to the other and with respect said attachment tubular portion; and a hydraulic feeding circuit housed within said attachment, intermediate and end tubular portions to control said attachment member; **characterized in that** said driving means comprise a linear actuator interposed between said attachment tubular portion and said intermediate tubular portion, and **in that** said feeding circuit comprises a first variable length tube circuit surrounding said linear actuator, a second rigid tube circuit extending within said tubular end portion and integrally connected to the end tubular portion, and a flexible tube circuit interposed between said first and second hydraulic circuit.

2. The arm according to claim 1, **characterized by** also comprising guide means to guide said flexible tube circuit along a predetermined path which varies as a function of the relative positions of said attachment, intermediate and end tubular portions.

3. The arm according to claim 2, **characterized in that** said guide means comprise a resilient guide having an end integrally connected to said linear actuator and an opposite end integrally connected to said end tubular portion.

4. The arm according to claim 3, **characterized in that** said guide extends substantially along its whole length of the flexible tube circuit and defines a tubular housing which houses and envelops said flexible tube circuit.

5. The arm according to any of the preceding claims, **characterized in that** said first variable length tube circuit comprises a plurality of telescopic joints arranged in the area of said linear actuator.

6. The arm according to claim 5, **characterized in that** each of said telescopic joints sealingly connects a first rectilinear tubing integrally connected to a fixed part of said linear actuator, and a second rectilinear tubing opposite to said first tubing and integrally connected to a mobile part of said linear actuator to translate together with said mobile part; said flexible tube circuit being directly connected to said second rectilinear tubing.

7. The arm according to any of the preceding claims, **characterized in that** said second rigid tube circuit

comprises at least one rigid tubing having a substantially Z-like shape.

8. The arm according to claim 7 when dependent on claim 2, **characterized in that** said second rigid tube circuit comprises two pairs of rigid tubes spaced transversally to one another and arranged on opposite parts of said guide means.

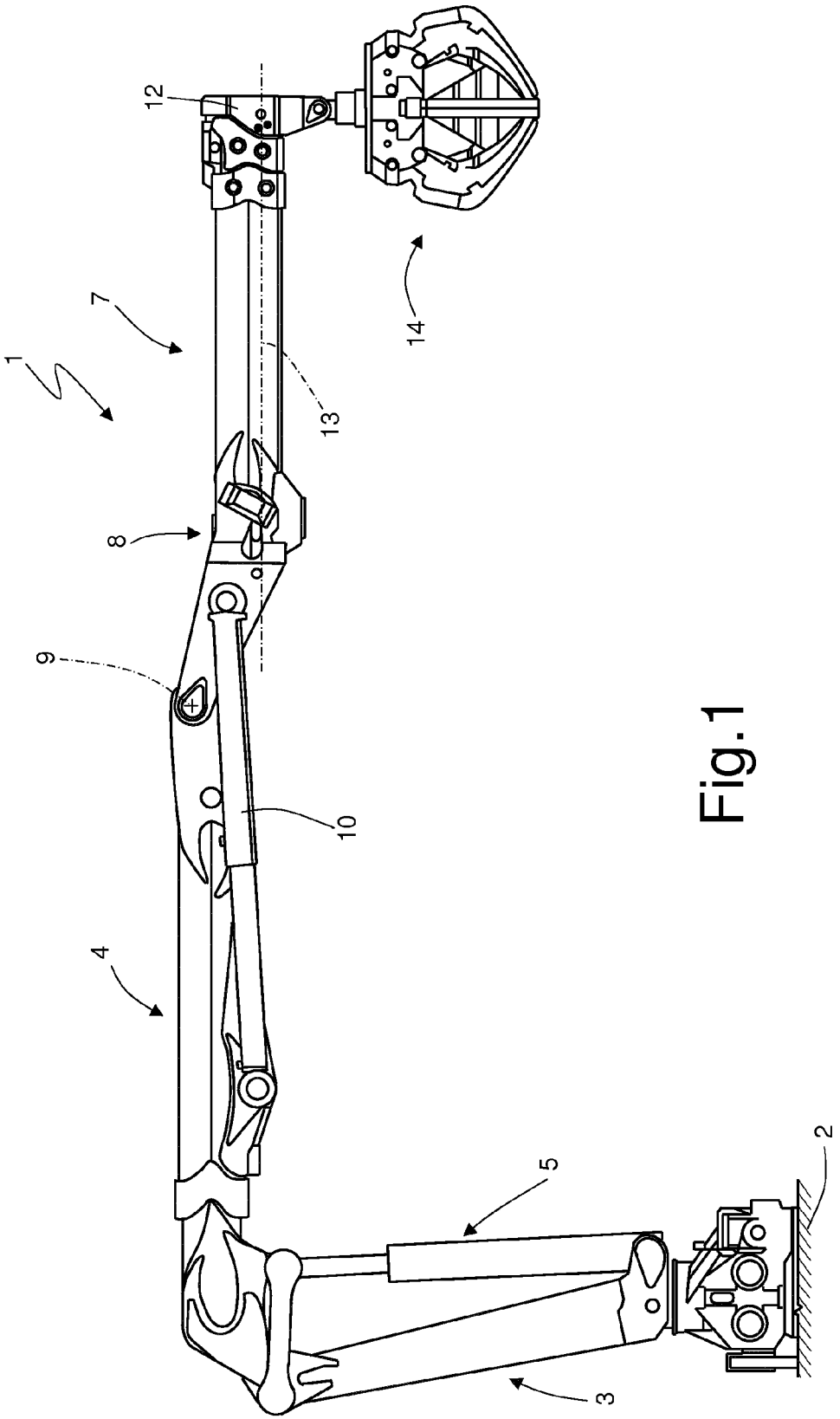

Fig.1

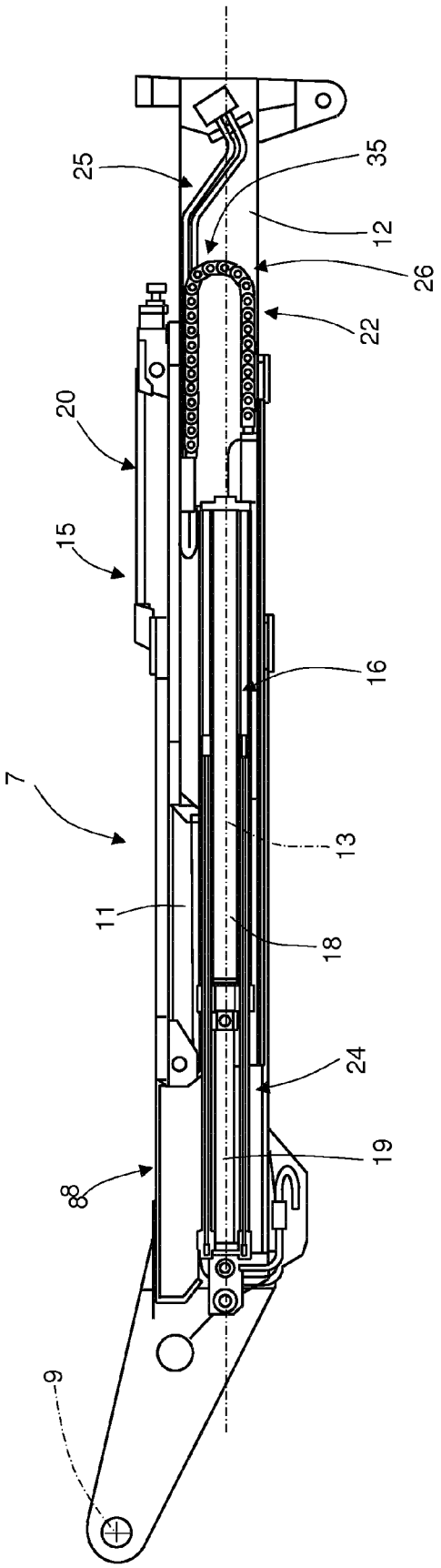

Fig.2

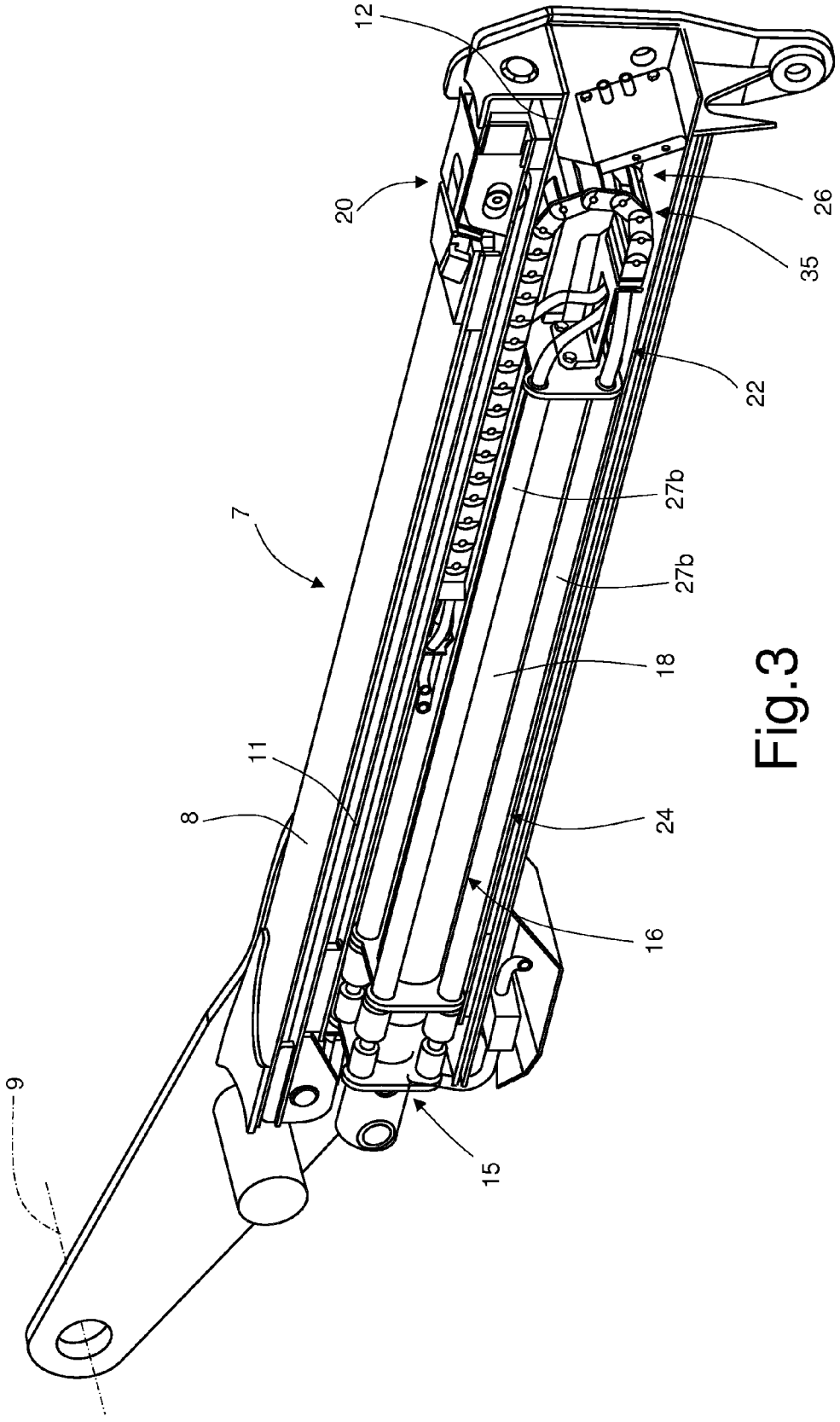

Fig.3

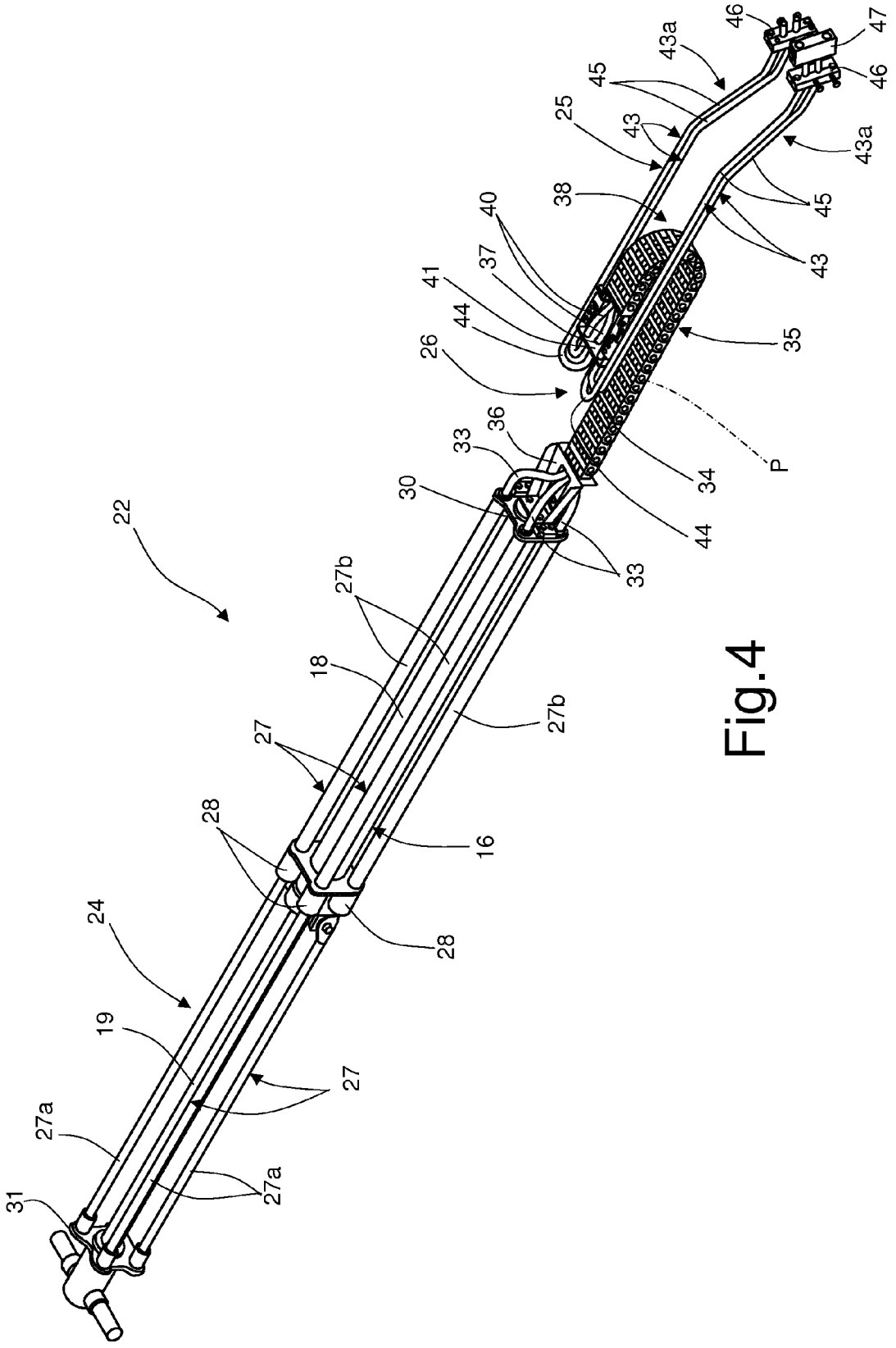
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Fig.4

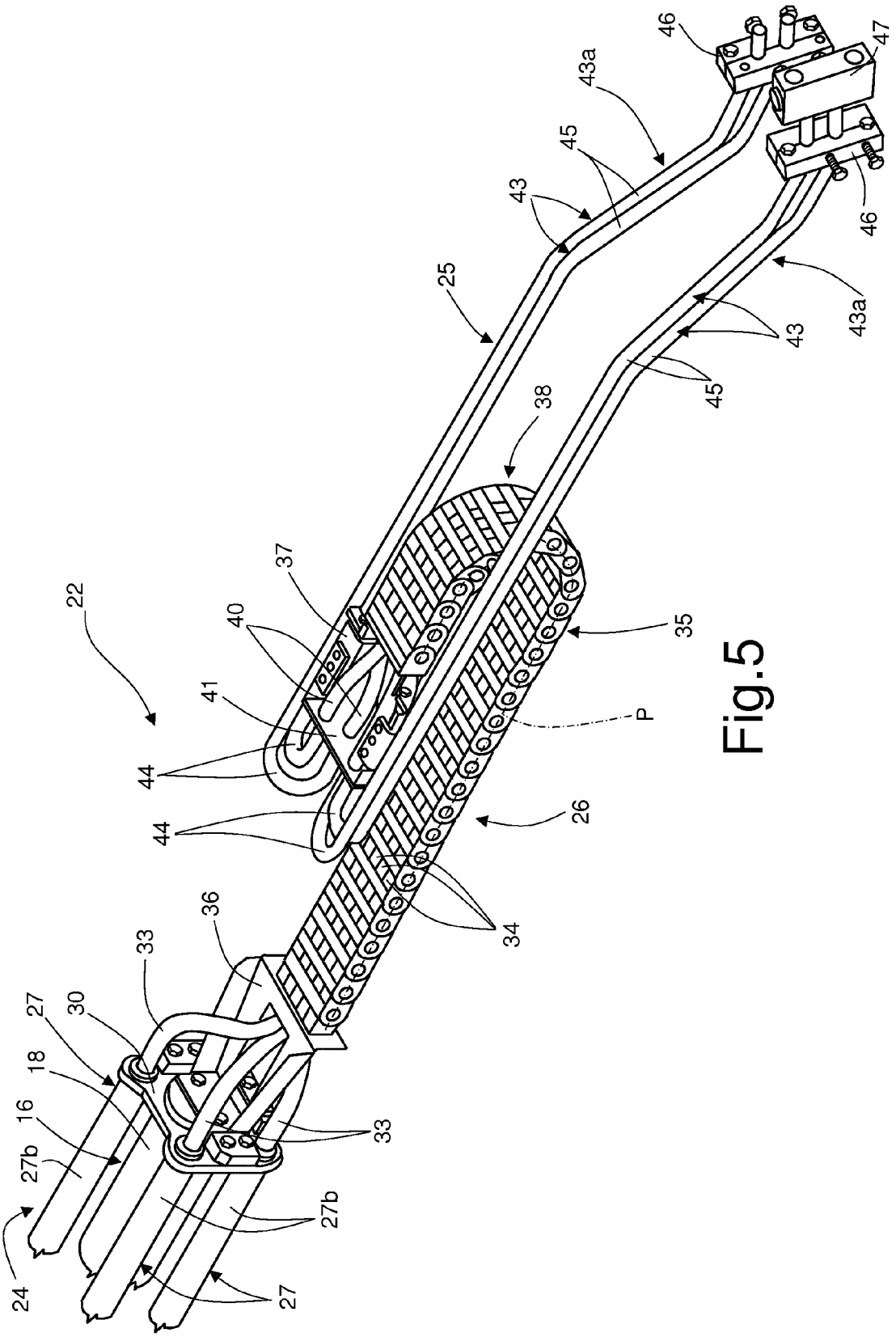
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Fig.5

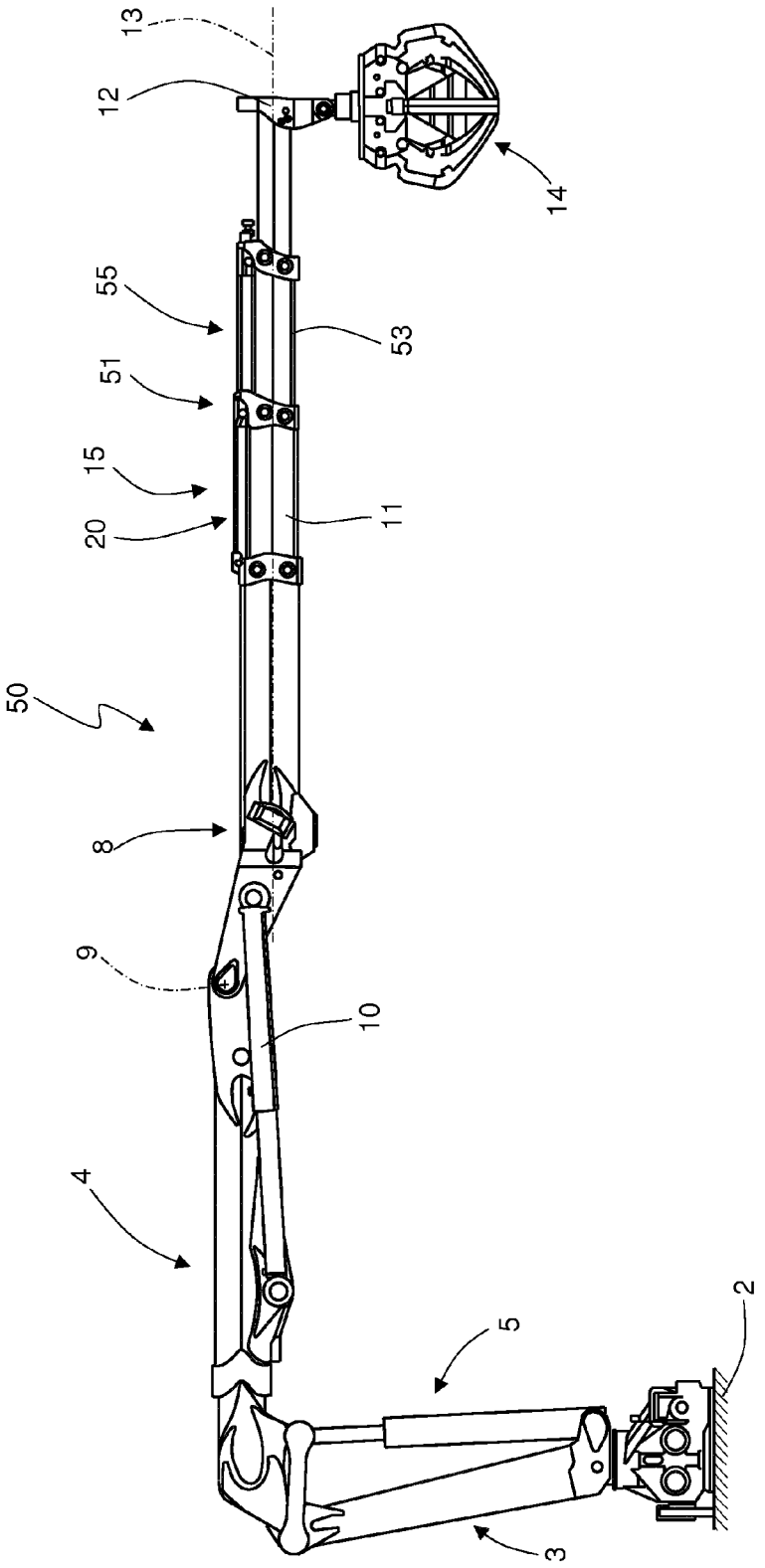

Fig.6

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EUROPEAN SEARCH REPORT

Application Number
EP 12 16 7031

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B66C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 July 2012	Rupcic, Zoran

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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