(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 096 075 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.09.2009 Bulletin 2009/36

(51) Int Cl.:
B66C 23/70 *(2006.01)*

(21) Application number: **08152042.1**

(22) Date of filing: **28.02.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(71) Applicant: **Cargotec Patenter AB**
SE 341-81 Ljungby (SE)

(72) Inventor: **TOLBOOM, COR**
NL-8424 SJ, ELSLOO (NL)

(74) Representative: **Löfgren, Jonas et al**
Bjerkéns Patentbyrå KB
Box 1274
801 37 Gävle (SE)

(54) **Telescopic boom**

(57) A boom (1') comprising at least three telescopic boom sections, a first transmission member (10) and a second transmission member (20). The respective transmission member is arranged inside the boom sections and has a first point fixed in relation to an inner boom section and a second point fixed in relation to an outer boom section. A first pulley (13) is arranged to act on the first transmission member so as to displace the outer boom section outwards in relation to an intermediate boom section when the intermediate boom section is displaced outwards in relation to the inner boom section under the effect of an actuating member (6). A second pulley (23) is arranged to act on the second transmission member so as to displace the outer boom section inwards in relation to the intermediate boom section when the intermediate boom section is displaced inwards in relation to the inner boom section under the effect of the actuating member.

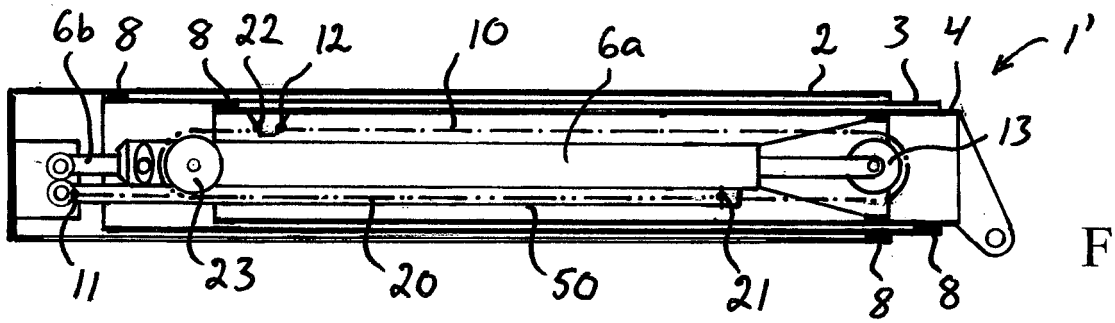


Fig 4

EP 2 096 075 A1

Description

FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention relates to a telescopic boom according to the preamble of claim 1.

[0002] Telescopically extendable and retractable booms are frequently used for instance on different types of cranes and are known in various configurations. In a telescopic boom having two or more displaceable boom sections, every displaceable boom section may be provided with its own hydraulic cylinder in order to control the extension and retraction of the boom section. It is also known to use a hydraulic cylinder for displacing a first displaceable boom section in relation to a fixed support or fixed boom section and a flexible transmission member, e.g. in the form of a belt or chain, for displacing a second displaceable boom section in relation to the first displaceable boom section, as disclosed in US 4 193 505 A and FR 2 708 584 A1.

SUMMARY OF THE INVENTION

[0003] The object of the present invention is to provide a telescopic boom of new and advantageous design.

[0004] According to the invention, this object is achieved by a telescopic boom having the features defined in claim 1.

[0005] The telescopic boom of the present invention comprises:

- a first boom section;
- a second boom section mounted to the first boom section so as to be axially displaceable in relation to the first boom section;
- a third boom section mounted to the second boom section so as to be axially displaceable in relation to the second boom section;
- an actuating member acting on the second boom section for displacing the second boom section axially in relation to the first boom section;
- an elongated, flexible first transmission member, which is arranged inside the boom sections and has a first point fixed in relation to the first boom section and a second point fixed in relation to the third boom section; and
- an elongated, flexible second transmission member, which is arranged inside the boom sections and has a first point fixed in relation to the first boom section and a second point fixed in relation to the third boom section.

The first transmission member extends inside the boom sections between its first and second points over a first pulley, which is fixed in axial position in relation to the second boom section, the first pulley being arranged to act on the first transmission member so as to displace said second point of the first transmission member and thereby the third boom section axially outwards in relation to the second boom section when the second boom section is displaced axially outwards in relation to the first boom section under the effect of the actuating member. The second transmission member extends inside the boom sections between its first and second points over a second pulley, which is fixed in axial position in relation to the second boom section, the second pulley being arranged to act on the second transmission member so as to displace said second point of the second transmission member and thereby the third boom section axially inwards in relation to the second boom section when the second boom section is displaced axially inwards in relation to the first boom section under the effect of the actuating member.

[0006] Thus, the transmission members and the pulleys will force the third boom section to move axially in relation to the second boom section when the second boom section is moved axially in relation to the first boom section and will thereby cause a synchronization of the axial movements of the individual boom sections when the boom is extended and retracted. With the solution according to the invention, the transmission members extend only inside the boom sections and do no pass through any area between two adjacent boom sections. Thus, the transmission members and their pulleys are all located inside the boom sections and are thereby well protected against weather influences and dirt and protected against collisions with outside elements. A further advantage with this internal location of the transmission members and their pulleys is that no parts other than sliding elements need to be located in the areas between the boom sections. Hereby, the dimensions of the sliding elements can be optimized to reduce normal stress on the boom sections.

[0007] According to an embodiment of the invention, the first pulley and the second pulley are mounted to an elongated support unit, which is fixed to the second boom section at the inner end thereof and extends axially inside the second and third boom sections, the first pulley being mounted at the outer end of the support unit and the second pulley being mounted at the inner end of the support unit. Hereby, the pulleys can be mounted inside the boom sections in a simple manner.

[0008] Another embodiment is **characterized in:**

- **that** the boom comprises an elongated, flexible third transmission member extending in parallel to the second transmission member;
- that the third transmission member is arranged inside the boom sections and has a first point fixed in relation to the first boom section and a second point fixed in relation to the third boom section;
- that the third transmission member extends inside the boom sections between its first and second points over a third pulley, which is fixed in axial position in relation to the second boom section, the third pulley being arranged to act on the third transmission

member so as to displace said second point of the third transmission member and thereby the third boom section axially inwards in relation to the second boom section when the second boom section is displaced axially inwards in relation to the first boom section under the effect of the actuating member;

- that the second pulley and the third pulley are mutually concentric and mounted to the support unit on opposite sides thereof symmetrically in relation to the centre axis of the support unit; and
- that the first pulley is mounted in a plane which extends through the centre axis of the support unit and forms the plane of symmetry for the second and third pulleys. Hereby, the forces acting on the support unit in connection with mutual displacements of the boom sections will be well balanced.

[0009] According to another embodiment of the invention, the actuating member comprises:

- a cylinder part, which is fixed in axial position in relation to the second boom section and which constitutes a body part of the support unit,
- a piston, which is mounted inside the cylinder part so as to be axially displaceable in relation to the cylinder part, and
- a piston rod, which is secured to the piston and fixed in axial position in relation to the first boom section. In this case, the cylinder part functions as a vital part of the actuating member as well as the support unit, which will make it possible to achieve a very compact construction of these appliances and facilitate the mounting thereof inside the boom sections.

[0010] According to another embodiment of the invention, the boom comprises at least one flexible conduit in the form of a hose or cable, which is arranged inside the boom sections and has a first point fixed in relation to the first boom section and a second point fixed in relation to the third boom section, said conduit extending inside the boom sections between its first and second points over a pulley, which is fixed in axial position in relation to the second boom section and arranged to act on the conduit so as to keep the conduit stretched out and prevent it from slackening when the boom sections are axially displaced in relation to each other.

[0011] Further advantageous features of the boom according to the invention will appear from the dependent claims and the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] With reference to the appended drawings, a specific description of preferred embodiments of the invention cited as examples follows below. In the drawings:

Fig 1	is a schematic illustration of a telescopic boom according to a first embodiment of the present invention, as seen in a cut lateral view and with the boom sections of the boom in an extended position,
Fig 2	shows the boom of Fig 1 with the boom sections in a retracted position,
Fig 3	is a schematic illustration of a telescopic boom according to a second embodiment of the invention, as seen in a cut lateral view and with the boom sections of the boom in an extended position,
Fig 4	shows the boom of Fig 3 with the boom sections in a retracted position,
Figs 5 and 6	illustrate the arrangement of flexible conduits in the boom of Figs 3 and 4,
Figs 7-11	are perspective views illustrating different stages in a process of assembling a boom of the type illustrated in Figs 3-6, and
Fig 12	is an illustration corresponding to Fig 10, with the boom sections shown in a cut planar view from above.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0013] Telescopic booms 1, 1' according to two different embodiments of the present invention are illustrated in Figs 1-4. In the illustrated embodiments, the respective boom 1, 1' comprises three boom sections 2, 3, 4. A first boom section 2 constitutes an innermost base section of the boom. A second boom section 3 constitutes an intermediate section of the boom and is mounted to the first boom section 2 so as to be axially displaceable in relation thereto. A third boom section 4 constitutes an outermost section of the boom and is mounted to the second boom section 3 so as to be axially displaceable in relation thereto. The boom sections 2, 3, 4 are tubular and together they delimit an inner space 5 of the boom. The third boom section 4 is slidingly received in the second boom section 3, which in its turn is slidingly received in the first boom section 2. The boom 1, 1' is telescopically extendable by displacement of the second and third boom sections 3, 4 outwards in relation to the first boom section 2 and telescopically retractable by displacement of the second and third boom sections 3, 4 inwards in relation to the first boom section 2.

[0014] The boom sections 2, 3, 4 are in a conventional manner provided with sliding elements 8 so as to allow the third boom section 4 to be slidingly supported against the second boom section 3 and the second boom section 3 to be slidingly supported against the first boom section 2, as illustrated in Figs 1-4.

[0015] The boom 1, 1' comprises an actuating member 6 acting on the second boom section 3 for displacing the second boom section 3 axially in relation to the first boom section 2. The actuating member 6 is with advantage a hydraulic cylinder comprising a cylinder part 6a, a piston (not shown) mounted inside the cylinder part 6a so as to be axially displaceable in relation to the cylinder part, and a piston rod 6b secured to the piston. However, any other suitable type of actuating member capable of displacing the second boom section 3 axially in relation to the first boom section 2 could be used.

[0016] In the embodiment illustrated in Figs 1 and 2, the actuating member 6 is a hydraulic cylinder with the cylinder part 6a fixed in axial position in relation to the first boom section 2 and with the piston rod 6b fixed in axial position in relation to the second boom section 3. The piston rod 6b could alternatively by fixed in axial position in relation to the first boom section 2 and the cylinder part 6a fixed in axial position in relation to the second boom section 3, if so desired. In the example illustrated in Figs 1 and 2, the actuating member 6 is mounted on the outside of the first and second boom sections 2, 3, but it could alternatively be mounted inside the boom sections in the above-mentioned inner space 5.

[0017] In the embodiment illustrated in Figs 3-12, the actuating member 6 is a hydraulic cylinder mounted in the inner space 5 of the boom sections with the cylinder part 6a fixed in axial position in relation to the second boom section 3 and with the piston rod 6b fixed in axial position in relation to the first boom section 2.

[0018] The boom 1, 1' comprises an elongated, flexible first transmission member 10 in the form of a belt or cable or chain or the like, which is arranged in the inner space 5 of the boom sections. This transmission member 10 has a first point 11 fixed in relation to the first boom section 2 and a second point 12 fixed in relation to the third boom section 3. The transmission member 10 extends inside the boom sections between said first and second points 11, 12 over a pulley 13, in the following denominated first pulley, which is fixed in axial position in relation to the second boom section 3. The first pulley 13 is arranged to act on the first transmission member 10 so as to displace said second point 12 of the first transmission member and thereby the third boom section 4 axially outwards in relation to the second boom section 3 when the second boom section is displaced axially outwards in relation to the first boom section 2 under the effect of the actuating member 6. Thus, when the second boom section 3 is moved outwards by the actuating member 6, the first pulley 13 will be moved together with the second boom section away from said first point 11 so that said second point 12 is forced to move outwards, thereby driving also the third boom section 4 outwards. The first pulley 13 is located closer to the outer end of the boom as compared to said first and second points 11, 12 of the first transmission member 10. Thus, the first transmission member 10 extends forwards from the first point 11 in the direction towards the outer end of the boom, around the first pulley 13 and then backwards from the first pulley 13 to the second point 12 in the direction towards the inner end of the boom.

[0019] The boom 1, 1' also comprises an elongated, flexible second transmission member 20 in the form of a belt or cable or chain or the like, which is arranged in the inner space 5 of the boom sections. This transmission member 20 has a first point 21 fixed in relation to the first boom section 2 and a second point 22 fixed in relation to the third boom section 4. The transmission member 20 extends inside the boom sections between said first and second points 21, 22 over a pulley 23, in the following denominated second pulley, which is fixed in axial position in relation to the second boom section 3. The second pulley 23 is arranged to act on the second transmission member 20 so as to displace said second point 22 of the second transmission member and thereby the third boom section 4 axially inwards in relation to the second boom section 3 when the second boom section is displaced axially inwards in relation to the first boom section 2 under the effect of the actuating member 6. Thus, when the second boom section 3 is moved inwards by the actuating member 6, the second pulley 23 will be moved together with the second boom section away from said first point 21 so that said second point 22 is forced to move inwards, thereby driving also the third boom section 4 inwards. The second pulley 23 is located closer to the inner end of the boom as compared to said first and second points 21, 22 of the second transmission member 20. Thus, the second transmission member 20 extends backwards from the first point 21 in the direction towards the inner end of the boom, around the second pulley 23 and then forwards from the second pulley 23 to the second point 22 in the direction towards the outer end of the boom. The first pulley 13 is suitably located close to the outer end of the second boom section 3 and the second pulley 23 close to the inner end of the second boom section.

[0020] In the illustrated embodiments, the first and second transmission members 10, 20 are designed as separate parts. However, the first and second transmission members could alternatively constitute different sections of one and the same belt or cable or chain or the like.

[0021] The boom 1, 1' comprises a rigid elongated element 50, for instance in the form of a rod, which extends axially in the inner space 5 of the boom sections and is fixed in axial position in relation to the first boom section 2. The elongated element 50 is secured to the first boom section 2 at the inner end thereof. The above-mentioned first point 21 of the second transmission member 20 is fixed to the elongated element 50 at the outer end thereof. In the embodiment illustrated in Figs 1 and 2, also the above-mentioned first point 11 of the first transmission member 10 is fixed to the elongated element 50 at the outer end thereof. The first point 11 of the first transmission member 10 may however alternatively be fixed directly to the first boom section 2 at the inner end thereof, as illustrated in Figs 3 and 4. In the latter case, the first point 11 of the first transmission member 10 is easily

accessible at the inner end of the boom 1', which makes it easy to adjust the tension of the first transmission member 10 and thereby facilitates the installation and maintenance of the inner drive system of the boom.

[0022] The first and second pulleys 13, 23 are with advantage rotatably mounted to an elongated support unit 40, 40', which is fixed to the rear part of the second boom section 3, i.e. at the inner end thereof, and which extends axially in the inner space 5 of the boom sections. The first pulley 13 is mounted at the outer end of the support unit 40, 40' and the second pulley 23 is mounted at the inner end thereof. The support unit 40, 40' is suitably provided with one or several sliding elements 41 at its outer end, each sliding element 41 abutting against an inner sliding surface of the third boom section 4 so as support the outer end of the support unit slidingly against the third boom section 4.

[0023] In the embodiment illustrated in Figs 1 and 2, the support unit 40 is secured to the second boom section 3 by means of an attachment 9 and it is arranged to move along the elongated element 50 when the second boom section 3 is displaced axially in relation to the first boom section 2. The elongated element 50 may be supported by the support unit 40 via a first bracket 42 arranged at the inner end of the support unit and rest against this bracket 42 via a sliding element 43 arranged on the bracket 42, as illustrated in Figs 1 and 2. In the example illustrated in Figs 1 and 2, the sliding element 41 provided at the outer end of the support unit 40 is mounted to a second bracket 44, which is arranged at the outer end of the support unit 40. The elongated element 50 extends through a cavity in the first bracket 42 and will also extend through a cavity in the second bracket 44 when the boom is in the retracted position.

[0024] In the embodiment illustrated in Figs 1 and 2, the above-mentioned first points 11, 21 of the first and second transmission members 10, 20 are fixed to a holder 51 secured to the elongated element 50 at the outer end thereof. The holder 51 may abut against the support unit 40 via sliding elements 52 arranged on the holder 51. The above-mentioned second points 12, 22 of the first and second transmission members 10, 20 are fixed to another holder 53 secured to the third boom section 4 at the inner end thereof. The holder 53 may abut against the support unit 40 via sliding elements 54 arranged on the holder 53.

[0025] In the embodiment illustrated in Figs 3-12, the boom 1' comprises an elongated, flexible third transmission member 30 (see Figs 7 and 12) in the form of a belt or cable or chain or the like, which is arranged in the inner space 5 of the boom sections in parallel to the second transmission member 20. This third transmission member 30 has a first point (not shown) fixed in relation to the first boom section 2 and a second point 32 fixed in relation to the third boom section 3. The transmission member 30 extends inside the boom sections between its first and second points over a pulley 33, in the following denominated third pulley, which is fixed in axial position in relation to the second boom section 3. The third pulley 33 is arranged to act on the third transmission member 30 so as to displace said second point 32 of the third transmission member and thereby the third boom section 4 axially inwards in relation to the second boom section 3 when the second boom section is displaced axially inwards in relation to the first boom section 2 under the effect of the actuating member 6. The second pulley 23 and the third pulley 33 are mutually concentric and rotatably mounted to the support unit 40' on opposite sides thereof symmetrically in relation to the centre axis of the support unit, as illustrated in Fig 12. In this case, the first pulley 13 is mounted in a plane which extends through the centre axis of the support unit and forms the plane of symmetry for the second and third pulleys 23, 33. Said first point of the third transmission member 30 is fixed to the elongated element 50 at the outer end thereof at the same axial position along the elongated element as the first point 21 of the second transmission member 20.

[0026] In the embodiment illustrated in Figs 3-12, the support unit 40' comprises a body part formed by the cylinder part 6a of the actuating member. The second and third pulleys 23, 33 are rotatably mounted to this cylinder part 6a on opposite sides thereof, as illustrated in Figs 7-9 and 12. At its inner end, the cylinder part 6a is provided with two projections 45, which extend from the cylinder part on opposite sides thereof. These projections 45 are received in seats 7 provided on the inner wall of the second boom section 3, as illustrated in Fig 12, so as to thereby secure the cylinder part 6a to the second boom section 3. The support unit 40' further comprises a bracket 46 secured to the outer end of the cylinder part 6a, the first pulley 13 being rotatably mounted to this bracket 46. Sliding elements 41 are mounted on the outside of a frame 47 secured to the bracket 46 so as to allow the bracket to be slidingly supported in relation to the inner wall of the third boom section 4.

[0027] The boom may comprise one or several flexible conduits 60 in the form of hoses or cables arranged in the inner space 5 of the boom sections. Such a conduit 60 could for instance be a hose for supplying compressed air or hydraulic fluid to a tool carried by the boom at the outer end thereof and for return of hydraulic fluid from such a tool. Such a conduit 60 could also be an electric or optical cable. In the embodiment illustrated in Figs 3-12, the respective conduit 60 has a first point 61 fixed in relation to the first boom section 2 and a second point 62 fixed in relation to the third boom section 4. The conduit 60 extends inside the boom sections between said first and second points 61, 62 over a pulley 63 which is fixed in axial position in relation to the second boom section 3. The pulley 63 is arranged to act on the conduit 60 so as to keep the conduit stretched out and prevent it from slackening when the boom sections are axially displaced in relation to each. The pulley 63 is located closer to the outer end of the boom as compared to said first and second points 61, 62 of the conduit 60. Thus, the conduit 60 extends forwards from the first point 61 in the direction

towards the outer end of the boom, around its pulley 63 and then backwards from the pulley 63 to the second point 62 in the direction towards the inner end of the boom. The pulley 63 is mounted to the bracket 46 at the outer end of the support unit 40' and is suitably concentric with the first pulley 13, as illustrated in Figs 7 and 12. In the example illustrated in Figs 7-12, the boom comprises two pulleys 63 for conduits arranged on opposite sides of the first pulley 13. The respective conduit 60 may be connected to a rigid pipe 64, which is mounted to the third boom section 4 so as to extend from the second point 62 of the conduit to the outer end of the third boom section.

[0028] All the pulleys 13, 23, 33, 63 are with advantage carried by the support unit 40' so as to allow the pulleys and the support unit to be jointly mounted to the second boom section 3 as a preassembled assembly. Fig 7 shows such a preassembled assembly 70 comprising:

- a base 71;
- a combined actuating member and support unit comprising a piston rod 6b and a cylinder part 6a;
- the above-mentioned mounting projections 45 protruding from opposite sides of the cylinder part 6a;
- the above-mentioned rigid elongated element 50 secured to the base 71;
- the above-mentioned first transmission member 10 secured at one end to the base 71 and at the other end to a slide member 73 slidingly arranged on top of the cylinder part 6a;
- the above-mentioned second and third transmission members 20, 30, each of which being secured at one end to the elongated element 50 via an attachment 72 provided at the outer end of the elongated element and at the other end to the slide member 73;
- the above-mentioned second and third pulleys 23, 33 rotatably mounted to the cylinder part 6a on opposite sides thereof;
- the above-mentioned bracket 46 provided at the outer end of the cylinder part 6a;
- the above-mentioned frame 47 with sliding elements 41 provided at the outer end of the bracket 46; and
- the above-mentioned first pulley 13 rotatably mounted to the bracket 46.

[0029] The preassembled assembly 70 may also be provided with one or several flexible conduits 60, as illustrated in Fig 8. In the illustrated example, each conduit 60 is secured at one end to a holder 74 mounted to the above-mentioned slide member 73 and at the other end to the base 71. Each conduit 60 extends over a pulley 63 rotatably mounted to the bracket 46 and is connected to a pipe 64, which is secured at one end to the holder 74 and at the other end is to be secured to the outer end of the third boom section 4.

[0030] The assembly 70 is mounted to an outer boom section 4 by being inserted with the frame 47 first into the inner cavity of the boom section via the open inner end of the boom section 4, as illustrated in Fig 9. The slide member 73 is then secured to this boom section 4. Thereafter, the assembly 70 and the outer boom section 4 are together mounted to an intermediate boom section 3 by being inserted with the base 71 first into the inner cavity of the intermediate boom section 3 via the open outer end of the boom section 3, as illustrated in Fig 10. The cylinder part 6a is then secured to the intermediate boom section 3 via the mounting projections 45. Finally, the assembly 70, the outer boom section 4 and the intermediate boom section 3 are together mounted to an inner boom section 2 by being inserted with the base 71 first into the inner cavity of the inner boom section 2 via the open outer end of the boom section 2, as illustrated in Fig 11. The base 71 and the piston rod 6b are then secured to the inner boom section 2. Thus, this boom 1' can be assembled and disassembled in a very simple and convenient manner, which will facilitate the installation of the drive system of the boom and the maintenance of the boom and its drive system.

[0031] The telescopic boom according to the present invention may constitute a crane boom, in which case the first boom section 2 could be pivotally mounted to a part of a crane, for instance a vehicle crane, so as to be pivotable about a horizontal axis in relation to that crane part. In this case, the third boom section 4 may be designed to carry a load in a load suspension point located at its outer end. The telescopic boom according to the invention may alternatively constitute an extension boom for positioning a support leg in the horizontal direction in relation to the chassis of a trailer or a vehicle in the form of a lorry or the similar. In this case, the first boom section 2 is mounted to the chassis of the trailer/vehicle and a vertically extendable support leg is secured to the outer end of the third boom section 4.

[0032] The invention is of course not in any way restricted to the embodiments described above. On the contrary, many possibilities to modifications thereof will be apparent to a person with ordinary skill in the art without departing from the basic idea of the invention as defined in the appended claims. The boom may for instance comprise more than three boom sections if so desired.

Claims

1. A telescopic boom (1; 1') comprising:

- a first boom section (2);
- a second boom section (3) mounted to the first boom section (2) so as to be axially displaceable in relation to the first boom section;
- a third boom section (4) mounted to the second boom section (3) so as to be axially displaceable in relation to the second boom section; and
- an actuating member (6) acting on the second boom section (3) for displacing the second boom section axially in relation to the first boom section

(2),

characterized in:

- **that** the boom (1; 1') comprises an elongated, flexible first transmission member (10), which is arranged inside the boom sections (2, 3, 4) and has a first point (11) fixed in relation to the first boom section (2) and a second point (12) fixed in relation to the third boom section (4);
- **that** the first transmission member (10) extends inside the boom sections between its first and second points (11, 12) over a first pulley (13), which is fixed in axial position in relation to the second boom section (3), the first pulley (13) being arranged to act on the first transmission member (10) so as to displace said second point (12) of the first transmission member (10) and thereby the third boom section (4) axially outwards in relation to the second boom section (3) when the second boom section (3) is displaced axially outwards in relation to the first boom section (2) under the effect of the actuating member (6);
- **that** the boom (1; 1') comprises an elongated, flexible second transmission member (20), which is arranged inside the boom sections (2, 3, 4) and has a first point (21) fixed in relation to the first boom section (2) and a second point (22) fixed in relation to the third boom section (4); and
- **that** the second transmission member (20) extends inside the boom sections between its first and second points (21, 22) over a second pulley (23), which is fixed in axial position in relation to the second boom section (3), the second pulley (23) being arranged to act on the second transmission member (20) so as to displace said second point (22) of the second transmission member (20) and thereby the third boom section (4) axially inwards in relation to the second boom section (3) when the second boom section (3) is displaced axially inwards in relation to the first boom section (2) under the effect of the actuating member (6).

2. A telescopic boom according to claim 1, **characterized in that** the first pulley (13) and the second pulley (23) are mounted to an elongated support unit (40: 40'), which is fixed to the second boom section (3) at the inner end thereof and extends axially inside the second and third boom sections (3, 4), the first pulley (13) being mounted at the outer end of the support unit (40: 40') and the second pulley (23) being mounted at the inner end of the support unit (40: 40').

3. A telescopic boom according to claim 2, **characterized in that** the support unit (40: 40') is provided with one or several sliding elements (41) at its outer end, each sliding element (41) abutting against an inner sliding surface of the third boom section (4) so as support the outer end of the support unit (40: 40') slidingly against the third boom section (4).

4. A telescopic boom according to claim 2 or 3, **characterized in:**

- **that** the boom (1') comprises an elongated, flexible third transmission member (30) extending in parallel to the second transmission member;
- **that** the third transmission member (30) is arranged inside the boom sections (2, 3, 4) and has a first point fixed in relation to the first boom section (2) and a second point (32) fixed in relation to the third boom section (4);
- **that** the third transmission member (30) extends inside the boom sections between its first and second points over a third pulley (33), which is fixed in axial position in relation to the second boom section (3), the third pulley (33) being arranged to act on the third transmission member (30) so as to displace said second point (32) of the third transmission member (30) and thereby the third boom section (4) axially inwards in relation to the second boom section (3) when the second boom section (3) is displaced axially inwards in relation to the first boom section (2) under the effect of the actuating member (6);
- **that** the second pulley (23) and the third pulley (33) are mutually concentric and mounted to the support unit (40') on opposite sides thereof symmetrically in relation to the centre axis of the support unit; and
- **that** the first pulley (13) is mounted in a plane which extends through the centre axis of the support unit (40') and forms the plane of symmetry for the second and third pulleys (23, 33).

5. A telescopic boom according to any of claims 2-4, **characterized in that** the actuating member (6) comprises:

- a cylinder part (6a), which is fixed in axial position in relation to the second boom section (3) and which constitutes a body part of the support unit (40'),
- a piston, which is mounted inside the cylinder part (6a) so as to be axially displaceable in relation to the cylinder part, and
- a piston rod (6b), which is secured to the piston and fixed in axial position in relation to the first boom section (2).

6. A telescopic boom according to claim 5 in combina-

tion with claim 4, **characterized in that** the second pulley (23) and the third pulley (33) are mounted to said cylinder part (6a) on opposite sides thereof.

7. A telescopic boom according to claim 6, **characterized in that** the support unit (40') comprises a bracket (46) secured to the outer end of said cylinder part (6a), the first pulley (13) being mounted to this bracket (46).

8. A telescopic boom according to any of claims 1-7, **characterized in:**

- **that** the boom (1') comprises at least one flexible conduit (60) in the form of a hose or cable, which is arranged inside the boom sections (2, 3, 4) and has a first point (61) fixed in relation to the first boom section (2) and a second point (62) fixed in relation to the third boom section (4); and
- **that** said conduit (60) extends inside the boom sections between its first and second points (61, 62) over a pulley (63), which is fixed in axial position in relation to the second boom section (3) and arranged to act on the conduit (60) so as to keep the conduit stretched out and prevent it from slackening when the boom sections are axially displaced in relation to each other.

9. A telescopic boom according to claim 8 in combination with claim 2, **characterized in that** the pulley (63) for said conduit (60) is mounted to the support unit (40') at the outer end thereof.

10. A telescopic boom according to claim 9, **characterized in that** the pulley (63) for said conduit (60) is concentric with the first pulley (13).

11. A telescopic boom according to any of claims 1-10, **characterized in:**

- **that** the boom comprises a rigid elongated element (50), which extends axially inside the boom sections (2, 3, 4) and is fixed in axial position in relation to the first boom section (2); and
- **that** said first point (21) of the second transmission member (20) is fixed to said elongated element (50) at the outer end thereof.

12. A telescopic boom according to claim 11 in combination with claim 4, **characterized in that** said first point of the third transmission member (30) is fixed to said elongated element (50) at the outer end thereof.

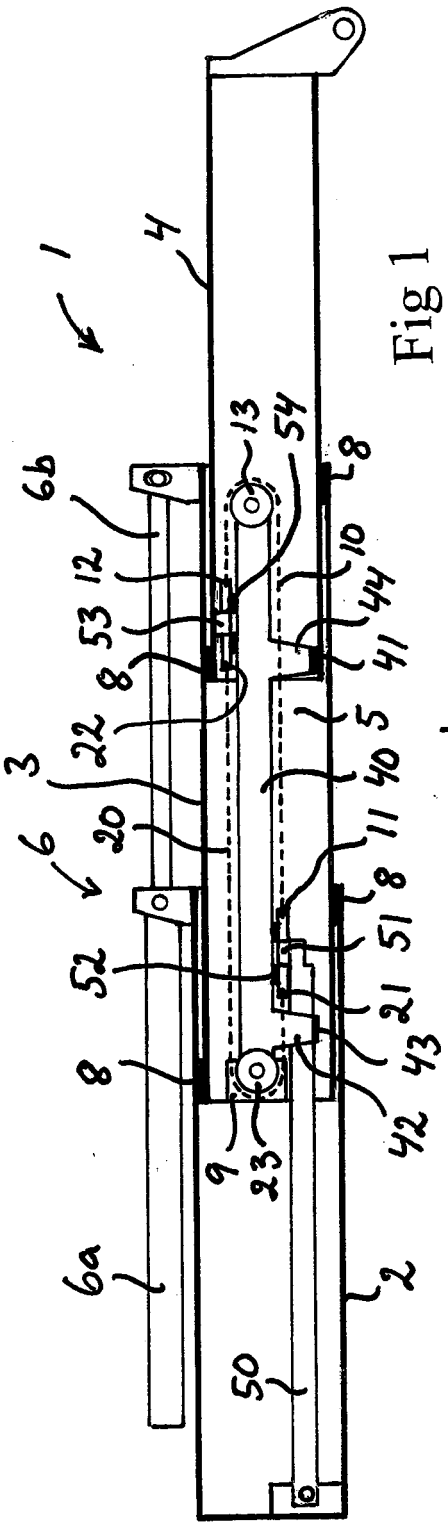

1
4
13
54
8
6b
12
10
53
44
8
41
22
5
3
40
20
11
6
8
52
51
21
8
43
42
9
23
6a
2
50

Fig 1

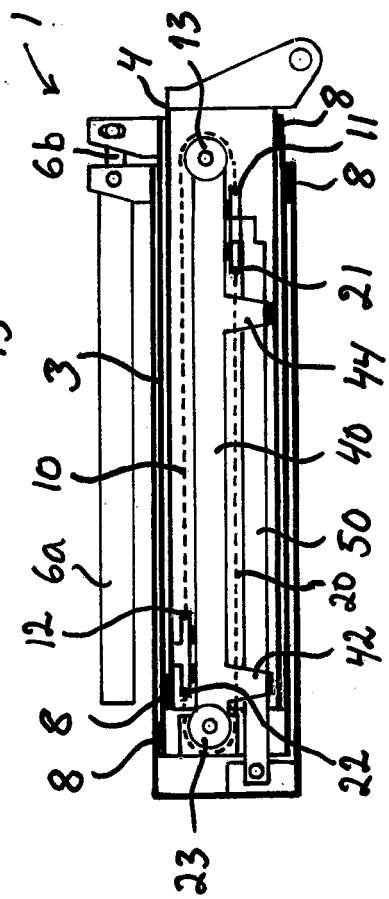

1
4
13
6b
8
11
8
21
3
44
10
46
6a
50
12
20
42
8
8
22
23

Fig 2

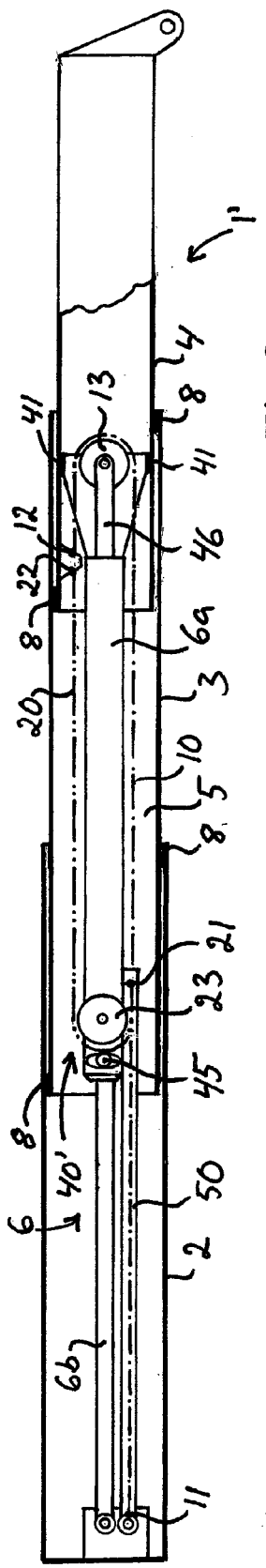


Fig 3

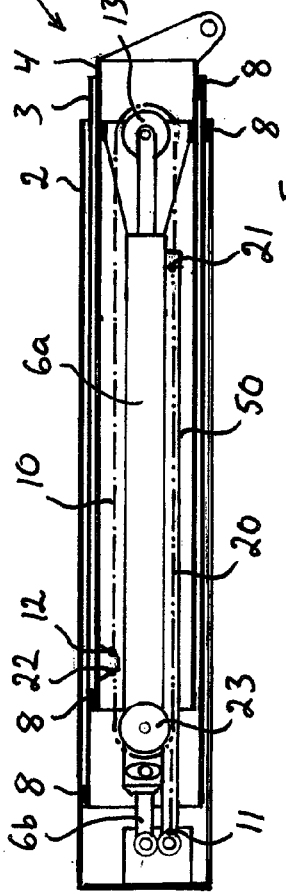


Fig 4

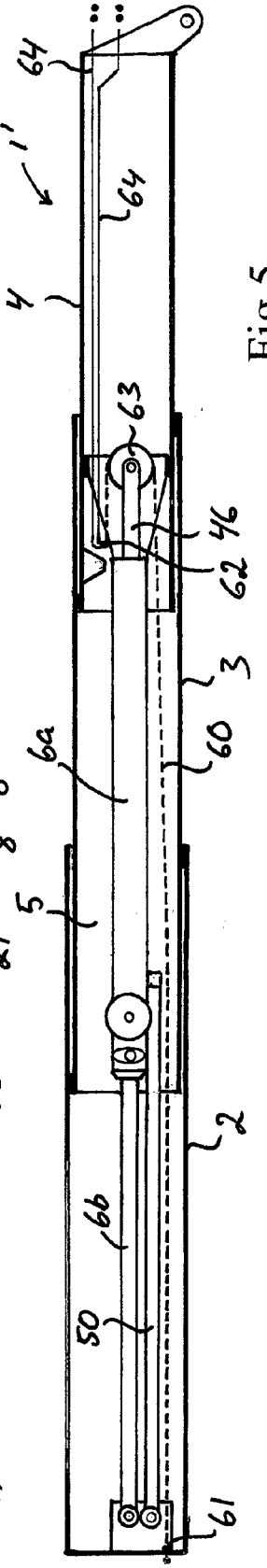


Fig 5

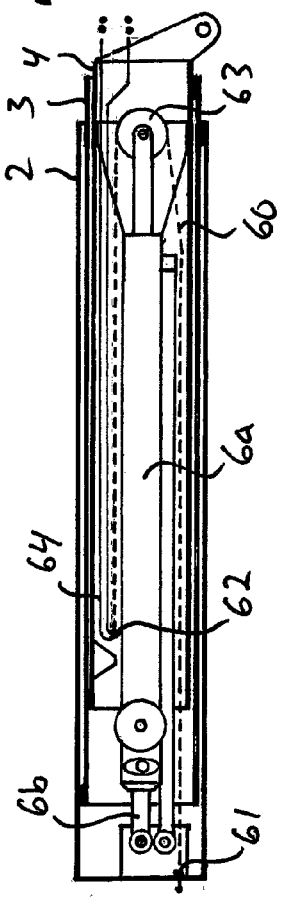


Fig 6

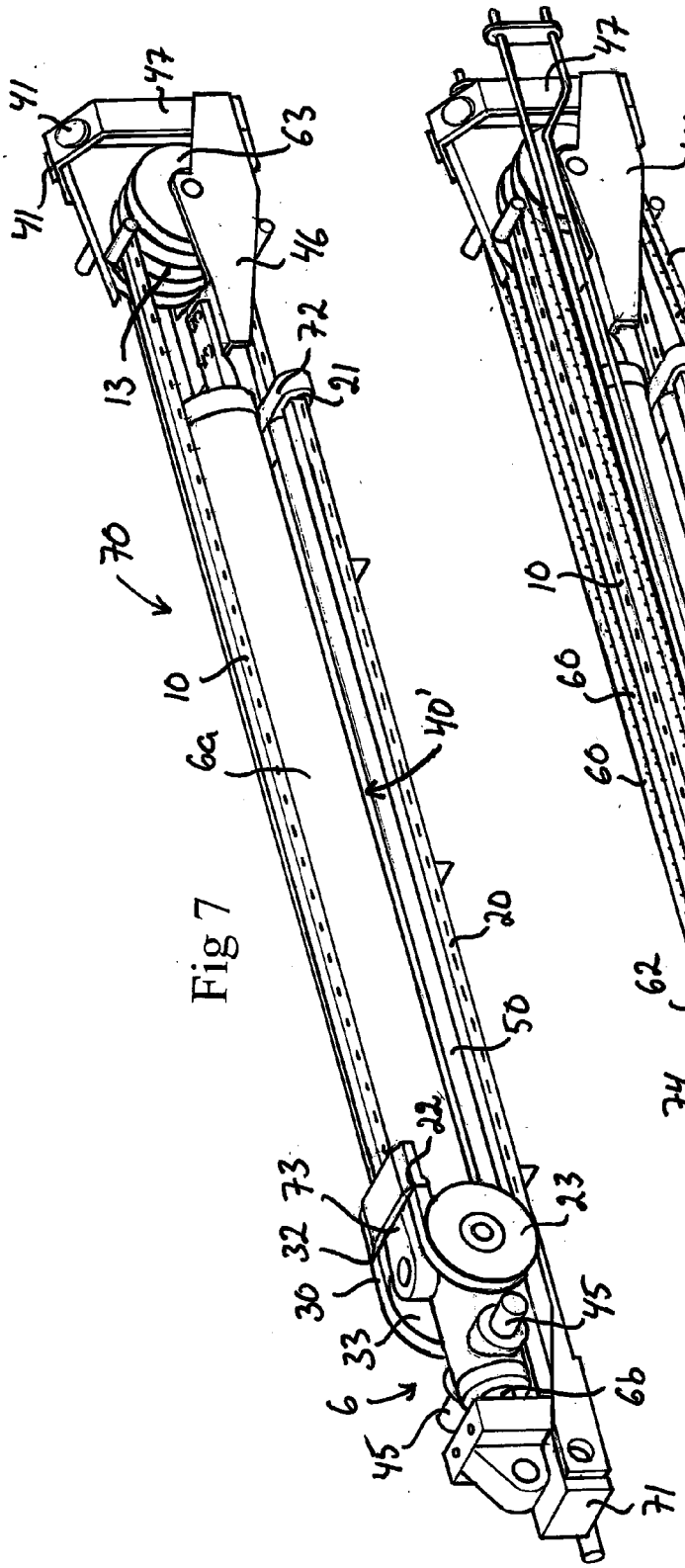

41
47
63
46
72
21
13
70
10
6a
40'
20
50
22
73
32
30
33
6
45
23
66
71

Fig 7

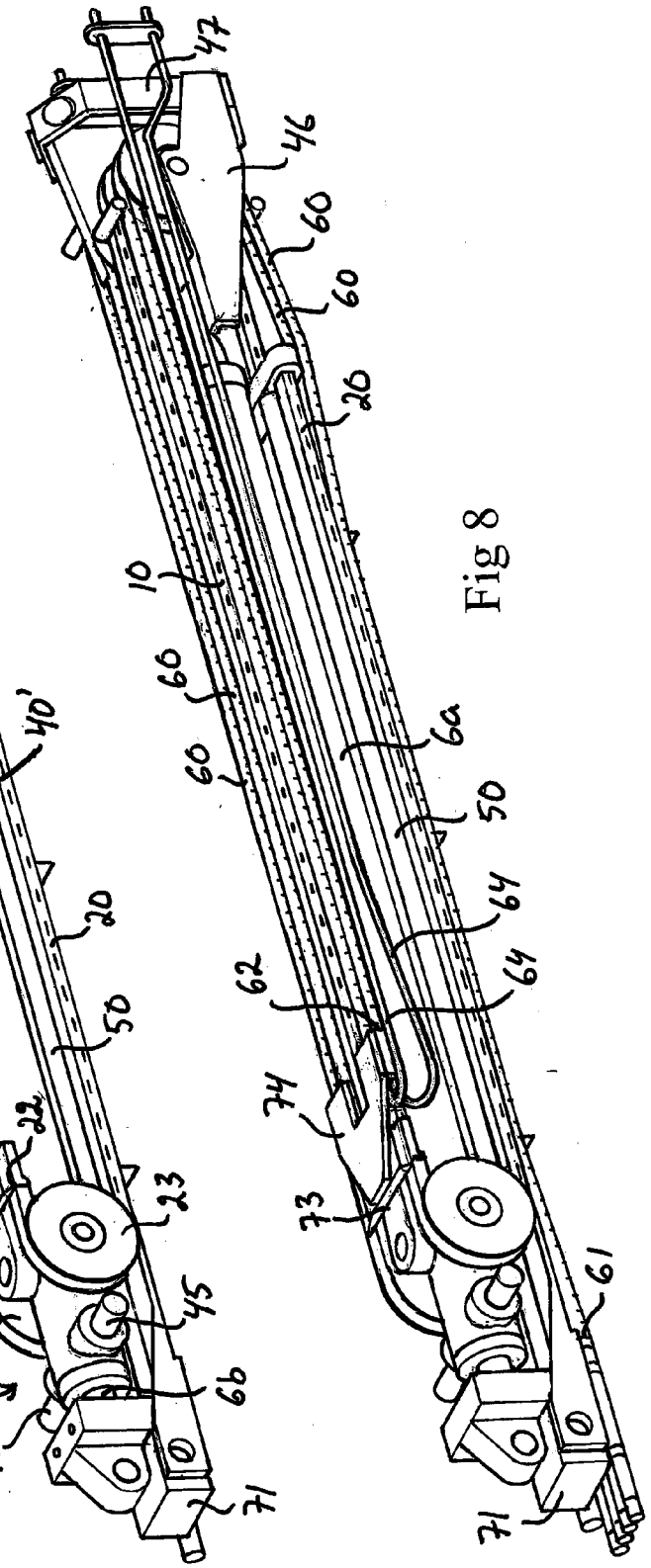

47
46
60
20
10
66
6a
50
64
62
74
73
61
71

Fig 8

Fig 9

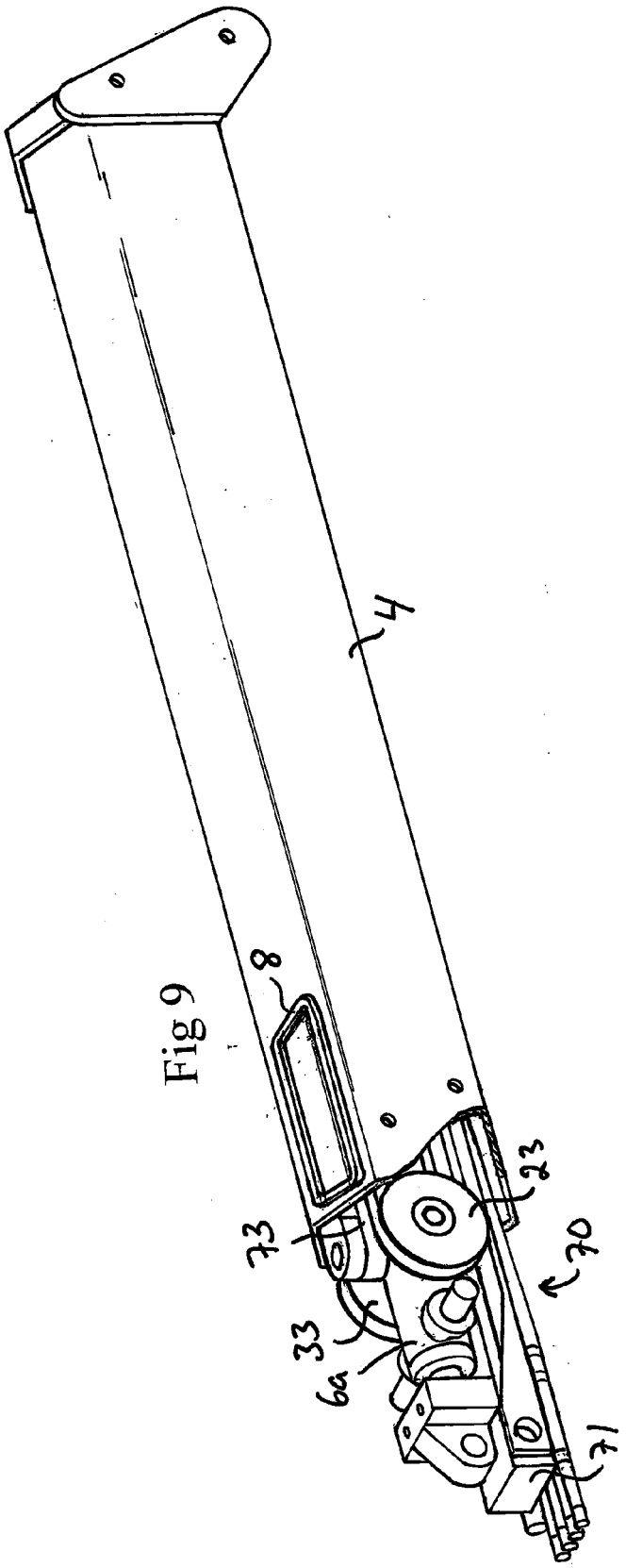
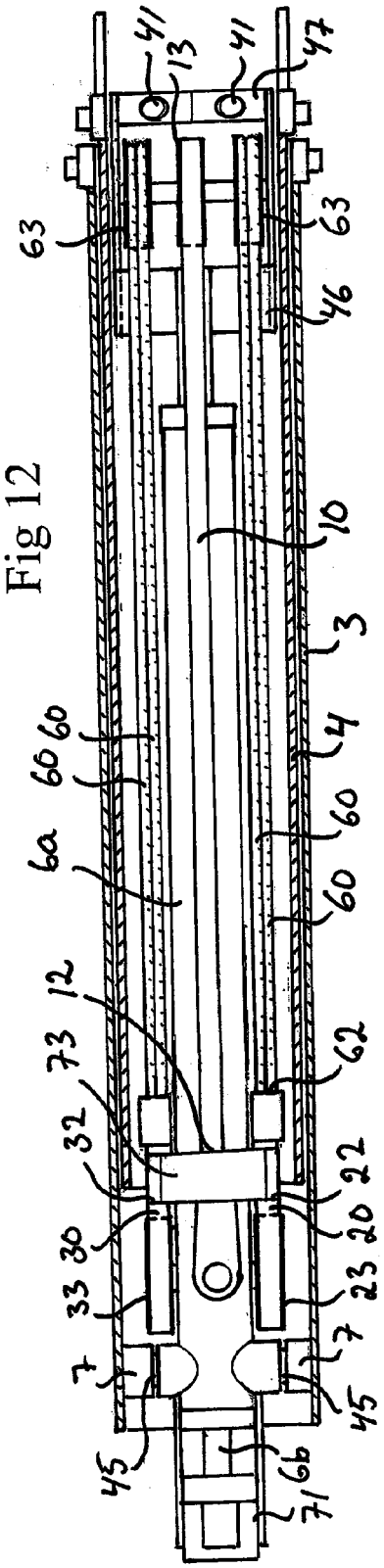

4
8
73
23
70
33
6a
71

Fig 12


41
13
41
47
63
63
46
10
3
4
60
6a
60
60
60
12
73
62
32
22
30
20
33
23
7
7
45
45
71
6b

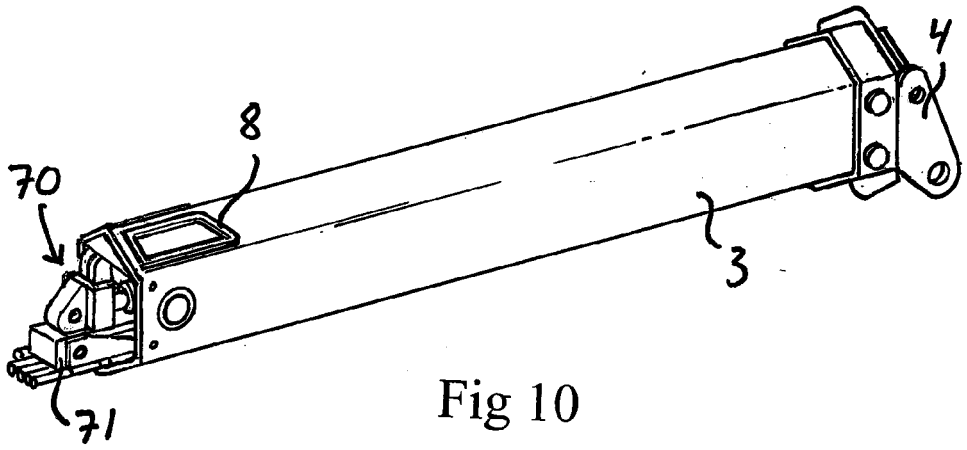


Fig 10

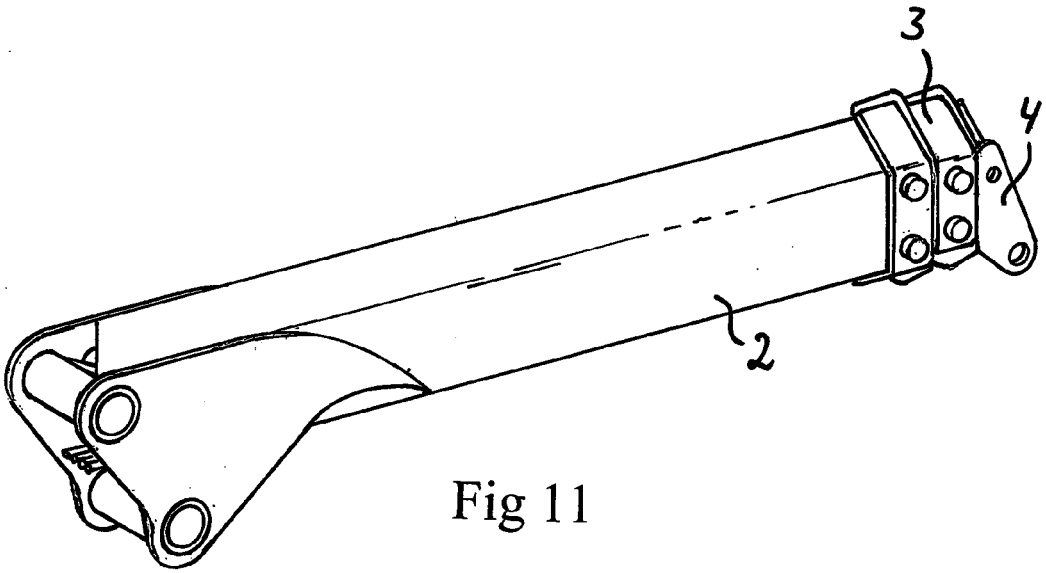


Fig 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 2042

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2001 130871 A (AICHI CORP KK) 15 May 2001 (2001-05-15) * abstract * * figures 1-4 *	1,2,4-12	INV. B66C23/70
Y		3	

Y	JP 11 011891 A (AICHI CORP KK) 19 January 1999 (1999-01-19) * abstract * * figures 1-3,5,6 *	3	
A		2,5	

X	US 4 258 853 A (GILL STEPHEN H ET AL) 31 March 1981 (1981-03-31) * column 2, line 25 - column 3, line 22 * * figures 1-3,6 *	1,2,4-10	

X	JP 2002 128470 A (FURUKAWA CO LTD) 9 May 2002 (2002-05-09) * abstract * * figures *	1,2,5,11	
	-----		TECHNICAL FIELDS SEARCHED (IPC)
X	US 5 060 427 A (BERNABE JR VINCENT [US]) 29 October 1991 (1991-10-29) * column 1, line 38 - column 3, line 21 * * figures 2,10 *	1	B66C E04H B66F

X	DE 28 54 034 A1 (PORSCHE AG) 3 July 1980 (1980-07-03) * page 3, paragraph 4 - page 5, paragraph 3 * * figures 1,2 *	1	
A		5	

A	JP 11 335079 A (AICHI CORP KK) 7 December 1999 (1999-12-07) * abstract * * figures 1-3 *	2,4-7,9	

	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 September 2008	Özsoy, Sevda

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

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 2042

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,A	US 4 193 505 A (ELIASSON HANS [SE] ET AL) 18 March 1980 (1980-03-18) * the whole document * -----	1,8	
D,A	FR 2 708 584 A (PPM [FR]) 10 February 1995 (1995-02-10) * the whole document * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 September 2008	Özsoy, Sevda

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

3

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 15 2042

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-09-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2001130871 A	15-05-2001	JP 3735497 B2	18-01-2006
JP 11011891 A	19-01-1999	NONE	
US 4258853 A	31-03-1981	NONE	
JP 2002128470 A	09-05-2002	NONE	
US 5060427 A	29-10-1991	CA 2035194 A1	02-08-1991
DE 2854034 A1	03-07-1980	NONE	
JP 11335079 A	07-12-1999	JP 3631371 B2	23-03-2005
US 4193505 A	18-03-1980	AT 360202 B	29-12-1980
		CA 1067863 A1	11-12-1979
		DE 2812177 A1	05-10-1978
		FI 780863 A	22-09-1978
		FR 2384705 A1	20-10-1978
		SE 402753 B	17-07-1978
FR 2708584 A	10-02-1995	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4193505 A **[0002]**
- FR 2708584 A1 **[0002]**