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(71) Applicant (for all designated States except US): **GEBR. MEIJER ST. JABIK B.V.** [NL/NL]; Oudebildtdijk 894, NL-9079 NG Sint Jacobiparochie (NL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MEIJER, Sjoerd** [NL/NL]; Oudebildtdijk 894, NL-9079 NG Sint Jacobiparochie (NL). **MEIJER, Hendrik** [NL/NL]; Gijsbert van Swietenstraat 15, NL-9079 LV Sint Jacobiparochie (NL).

(74) Agent: **GROOTSCHOLTEN, Johannes, Antonius, Maria**; Arnold & Siedsma, Sweelinckplein 1, NL-2517 GK The Hague (NL).

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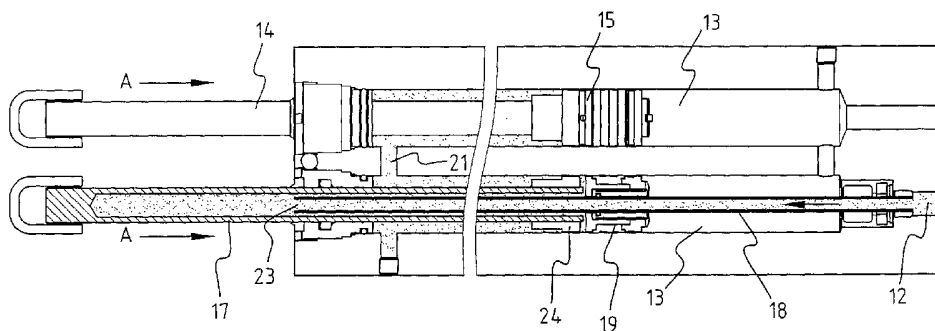
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(54) Title: FORK-LIFT TRUCK AND FORK FOR A FORK-LIFT TRUCK



(57) Abstract: The present invention relates to a fork (6) of a fork-lift truck. This comprises a suspension (7) for connecting or connected to a fork beam (5) of the fork-lift truck (1), and at least one fork carrier (8). This fork carrier (8) is associated with the suspension (7) and is extendable and retractable relative thereto in a common longitudinal direction. The suspension (7) comprises at least one cylinder (13) oriented in the longitudinal direction and having a piston (19) and a piston rod (17) coupled to the fork carrier (8) for driving movements of the fork carrier along the suspension (7), and also at least one channel (12) through the suspension to the cylinder (13). A tube (18) connected to the channel (12) is arranged in the cylinder (13), wherein the piston (19) with the piston rod (17) is hollow and movable round the tube (18).

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FORK-LIFT TRUCK AND FORK FOR A FORK-LIFT TRUCK

The present invention relates to a fork-lift truck and a fork for such a fork-lift truck. Such a fork of a fork-lift truck comprises a suspension for connecting or connected to a fork beam of the fork-lift truck, and at
5 least one fork carrier. The fork carrier is associated with the suspension and is extendable and retractable relative thereto in a common longitudinal direction.

Such a fork can be telescopically extendable and retractable with the suspension.

10 The suspension herein comprises at least one cylinder oriented in the longitudinal direction and having a piston and a piston rod coupled to the fork carrier. This serves to drive the movements of the fork carrier along the suspension. For feed to the cylinder
15 at least one channel runs through the suspension to the cylinder. Oil or another fluid can be carried through the channel to the cylinder.

In the known art two channels normally run through the suspension to the cylinder to enable provision of a
20 double-action cylinder. In the case of a construction with two cylinders per suspension four channels run through the suspension to the two cylinders. Technically it is not a great problem to drill large numbers of channels through the suspension, which is usually
25 manufactured from steel or metal. However, the production process is adversely affected in terms of cost and possibly also time, while forks with such a construction have the particular drawback that they are voluminous, particularly because of the channels, which
30 must extend along the cylinders through the suspension to be able to realize the double-action function.

The present invention has for its object to obviate or at least alleviate the drawbacks of the above mentioned known forks, for which purpose the forks according to the invention, just as a fork-lift truck according to the invention, is distinguished by the feature that a tube connected to the channel is arranged in the cylinder and the piston and the piston rod are hollow and movable round the tube. The function of a channel extending along the cylinder can thus be fulfilled by the tube, which results in space being saved and a simplification of the production process because fewer cylinder holes and channel holes need to be drilled. The space-saving can result in narrower, more elegant forks, and the space that comes available can also be applied and utilized for additional components, measures and features, such as measuring equipment in the fork and so on.

In the dependent claims of the appended set of claims are described preferred embodiments of forks which fall within the scope of the invention defined in the main claim. Claim 2 thus relates to the feature that the outer end of the tube directed toward the fork carrier is open in order to bring about a connection to the space in the cylinder on the side of the piston rod relative to the piston. The tube does not have to be open per se for this purpose but can also comprise holes or passages.

Claim 3 relates to the feature that the tube extends substantially over the full length of the cylinder. The range of movement of the piston rod in the cylinder can thus be maximized.

Claim 4 relates to the measure that the piston is arranged sealingly and the piston rod with clearance round the tube. An effective centring is thus provided, while an option for throughfeed of oil or other fluid is

provided between the tube and the piston rod. Claim 5 subsequently relates to the measure that the piston rod comprises a passage between the spaces in and around the piston rod. Oil can thus be carried from the tube
5 through the hollow piston rod into the space in the cylinder around the piston rod. This will normally correspond with retraction of the fork. In a configuration with the measures of claims 2, 4 and 5 it is advantageous when the passage in the piston rod is
10 arranged in close proximity to the piston. A maximum range of movement of the fork carrier is also provided herewith. This is associated with a maximum stroke of the cylinder without leakage of oil or other fluid. Claims 7 relates to the measure that the channel
15 comprises two parts, of which a first part is connected to the tube and a second part is connected to the space in the cylinder opposite the piston rod relative to the piston. The two-part channel preferably comprises two concentric channel parts, which also results in a
20 considerable space-saving. Additionally or alternatively, the two-part channel can comprise separate channel parts which are arranged adjacently of each other and which then each lead to one of at least two substantially synchronous cylinders arranged
25 adjacently of each other, wherein the at least two cylinders are connected close to the outer ends thereof. It is thus not necessary to drill four channels, two channels for each of the at least two cylinders, through the suspension, which in turn produces a further
30 simplification.

As already noted, the present invention also relates to a fork-lift truck with all per se known elements, such as a displaceable frame, a mast on the frame, a carriage movable along the mast and a fork beam

on the carriage, but also having at least one fork according to the present invention on the fork beam.

The present invention will be further elucidated hereinbelow on the basis of a description of a number of
5 embodiments shown in the drawings, wherein the same or similar components are designated with the same reference numerals, and in which:

fig. 1 is a perspective view of a fork-lift truck according to the present invention;

10 fig. 2 is a perspective, exploded view of a fork of a fork-lift truck of fig. 1 according to the present invention;

fig. 3 is a cut-away perspective view of a suspension of a fork according to the present invention;

15 fig. 4 and fig. 5 each show a detail of the view of fig. 3;

fig. 6A and fig. 6B show different operating positions in a cut-away or cross-sectional view of the fork according to fig. 2, 3, 4 and 5;

20 fig. 7 is a perspective, cut-away view of a fork in an alternative embodiment of the present invention;

fig. 8 and fig. 9 each show a view of a detail of the embodiment of a fork according to the invention shown in fig. 7; and

25 fig. 10A and fig. 10B each show an operating position of the fork of fig. 7, 8 and 9.

Fig. 1 shows a fork-lift truck 1. The fork-lift truck comprises a displaceable frame 2 having a mast 3 thereon. A carriage 4 is displaceable along mast 3 and a
30 fork beam 5 is arranged on carriage 4. Fork beam 5 thus moves up and downward with carriage 4 along mast 3. Arranged on fork beam 5 are two forks 6 which are extendable and retractable. Full lines show the forks 6 in a retracted position, while broken lines show an
35 extended position of forks 6.

Fig. 2 shows that each of the forks 6 comprises a suspension 7 and a fork carrier 8. Fork carrier 8 is an extendable and retractable component which fits over the part 9 of suspension 7 which extends substantially in horizontal direction. The part 10 of suspension 7 which extends substantially in upward direction can be coupled or is fixed to fork beam 5 by means of fixing means (not further shown). The channels run through the upward extending part 10 to the parts 9 extending substantially in horizontal direction, in which in the embodiment shown here two cylinders are arranged, as will be described below in more detail.

Fig. 3 shows a perspective view in cross-section of suspension 7, wherein channels 12 are drilled in the upward part 10 and wider cylinders 13 are drilled in horizontal part 9. A combination of a piston rod 14 with a piston 15 is placed in the left-hand cylinder 13 and the drilled hole forming the left-hand cylinder 13 is closed with a plug 16.

The right-hand cylinder 13 is also closed with a plug 16, but piston rod 17 is hollow and a tube 18 is placed therein which runs through piston 19, wherein piston 19 connects sealingly to tube 18, while piston rod 17 fits round the tube with clearance. Tube 18 is further connected to the right-hand channel 12 in the upward part 10 of suspension 7. The left-hand cylinder 13 is connected directly onto the left-hand channel 12.

The spaces in the two cylinders 13 opposite piston rods 14, 17 relative to pistons 15, 19 communicate with each other via a passage 20. This passage 20 is therefore situated close to the outer end of cylinders 13 that is directed toward the upward part 10 of suspension 7. At the other end of cylinders 13 there is also arranged a passage 21, and passages 20 and 21 in particular are shown in the detail view of fig. 5 and

fig. 4 respectively. These connections or passages 20, 21 are formed by a laterally arranged drilled hole sealed with plugs 22.

The operation of the thus formed configuration of particularly the suspension 7 of a fork 6 according to the present invention is shown in fig. 6A and 6B. Fig. 6A shows how oil under pressure is carried into tube 18. This oil introduced under pressure flows via the open end 23 of tube 18 into the hollow piston rod 17 and then
5 along a coupling piece 24, while pressure is herein applied to piston 19. Coupling piece 24 is open, so that via passage 21 the oil also acts on piston 15 in the other of the two cylinders 13 in order to bring about a substantially synchronous movement of the two piston
10 rods 14, 17 in the direction of arrow A.

It is conversely the case, as shown in fig. 6B, that when oil under pressure is carried into the other of the channels 12, this oil spreads via passage 20 over the two cylinders 13, and thus causes pistons 15, 19 to
20 move in the other direction so as to bring about a displacement of piston rods 14, 17 in the direction of arrow B.

Fig. 7-10 show an alternative embodiment, in particular of a suspension 7 of a fork 6 according to the present invention. In the embodiment shown here,
25 suspension 7 comprises a single cylinder 13 which in general and in detail is the same as cylinder 13 of fig. 3-6 with the hollow piston rod 17 therein. In the embodiment shown here however, tube 18 is extended into
30 channel 12, as shown most clearly in fig. 9. A concentric embodiment of a two-part channel is thus provided, wherein tube 18 forms part of this two-part configuration of channel 12. Because tube 18 extends in a drilled hole 25, which is a single drilled hole 25,

this is a concentric, two-part construction of channel 12.

A T-shaped coupling piece 26 is arranged on the top side of the upward extending part 10 of suspension 7.

5 This coupling piece 26 has two inlets 27 and 28 which are connected, each with a separate valve (not shown), for introducing oil under pressure therethrough through either drilled hole 25 or tube 18.

The view of fig. 8 is not essentially different
10 from the view of fig. 4 in respect of the cylinder 13 with the hollow piston rod 17 therein. The difference between fig. 4 and 8 lies in the presence of respectively two cylinders and one cylinder.

The operation of the configuration shown in fig. 7-
15 9 is represented schematically in fig. 10A and fig. 10B. When oil is forced under pressure through tube 18, as shown in fig. 10A, it enters the interior of hollow piston rod 17. The hollow piston rod 17 in turn forms a unit with piston 19 via a coupling piece 24, along which
20 the oil can flow out of the interior of hollow piston rod 17 to the space in the cylinder 13 therearound so as to exert a pressure on piston 19 and thus bring about a movement in the direction of arrow A.

If, on the other hand, oil under pressure passes
25 through the channel 12 formed by a drilled hole 25, around tube 18, piston 19 will then be pressed in the other direction of arrow B so as to extend piston rod 17.

After perusal of the foregoing many alternative and
30 additional embodiments will occur to the skilled person, which must all be deemed as being part of the group of embodiments falling within the scope of the invention defined in the appended claims, in particular the main claims. It is thus possible to use a single channel with
35 two concentric parts for a configuration with two

cylinders. The tube 18 applied in each case does not have to be open at the end thereof, but can also comprise radially oriented passages. The fork carrier 8 is shown in fig. 2 as a telescopically slidable component which fits round the substantially horizontally oriented part 9 of the suspension 7. In an alternative embodiment the fork carrier 8 can also be slidable along this part 9. Channels 12 and cylinders 13 are formed substantially as drilled holes, but alternative embodiments thereof are likewise possible. Laser techniques and other methods can for instance be used to realize the desired passages, channels and cylinder holes.

CLAIMS

1. Fork of a fork-lift truck, comprising
- a suspension for connecting or connected to a fork
5 beam of the fork-lift truck; and
- at least one fork carrier, which is associated with
the suspension and is extendable and retractable
relative thereto in a common longitudinal direction,
wherein the suspension comprises: at least one cylinder
10 oriented in the longitudinal direction and having a
piston, and a piston rod coupled to the fork carrier for
driving movements of the fork carrier along the
suspension; and at least one channel through the
suspension to the cylinder,
15 wherein a tube connected to the channel is arranged in
the cylinder and the piston and the piston rod are
hollow and movable round the tube.

2. Fork as claimed in claim 1, wherein the outer
end of the tube directed toward the fork carrier is
20 open.

3. Fork as claimed in claim 1 or 2, wherein the
tube extends substantially over the length of the
cylinder.

4. Fork as claimed in claim 1, 2 or 3, wherein the
25 piston is arranged sealingly and the piston rod with
clearance round the tube.

5. Fork as claimed in at least one of the foregoing
claims, wherein the piston rod comprises a passage
between the spaces in and around the piston rod.

30 6. Fork as claimed in claims 2, 4 and 5, wherein
the passage in the piston rod is arranged in close
proximity to the piston.

7. Fork as claimed in at least one of the foregoing
claims, wherein the channel comprises two parts, of
35 which a first part is connected to the tube and a second

part is connected to the space in the cylinder opposite the piston rod relative to the piston.

8. Fork as claimed in claim 7, wherein the two-part channel comprises two concentric channel parts.

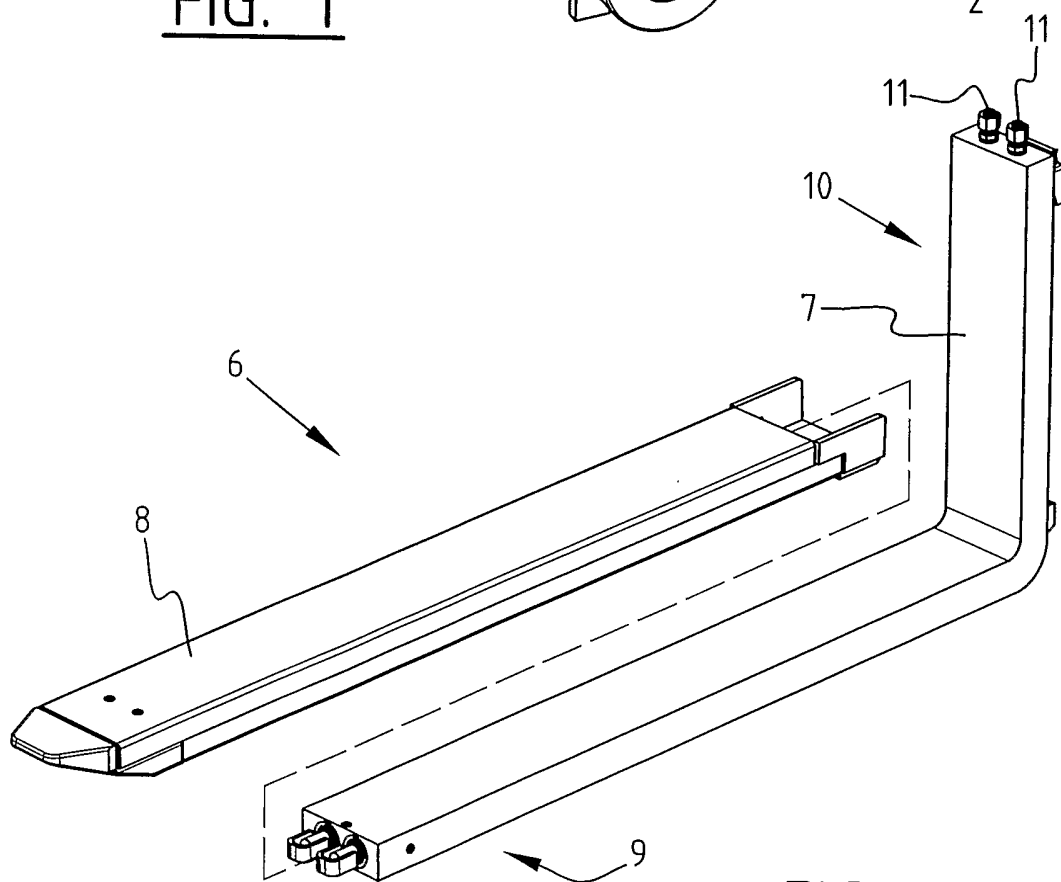
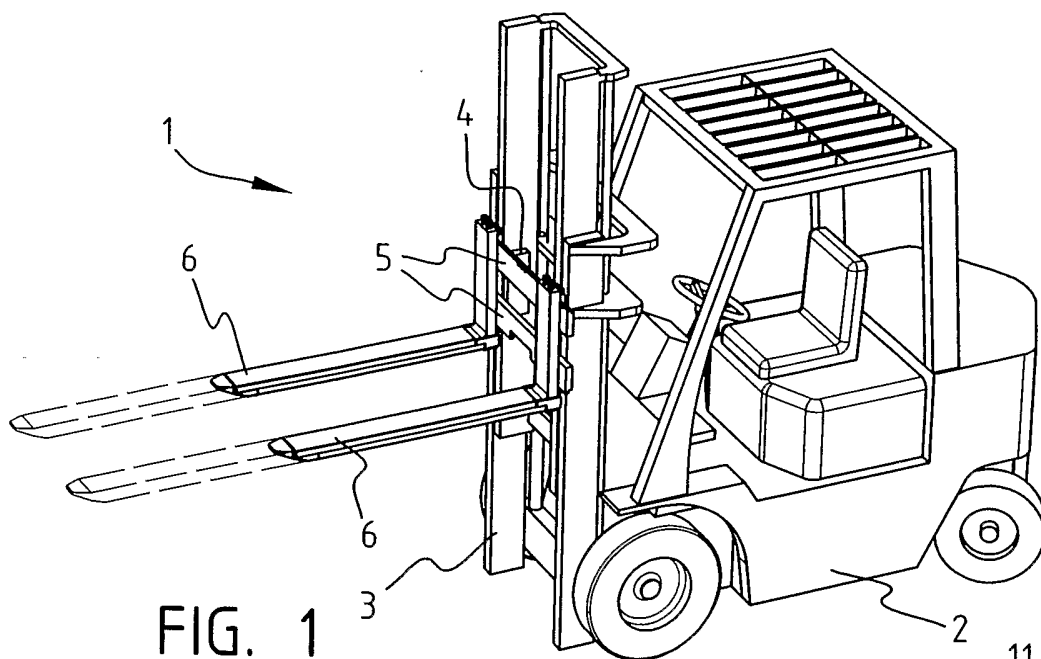
5 9. Fork as claimed in claim 7 or 8, wherein the two-part channel comprises separate channel parts arranged adjacently of each other.

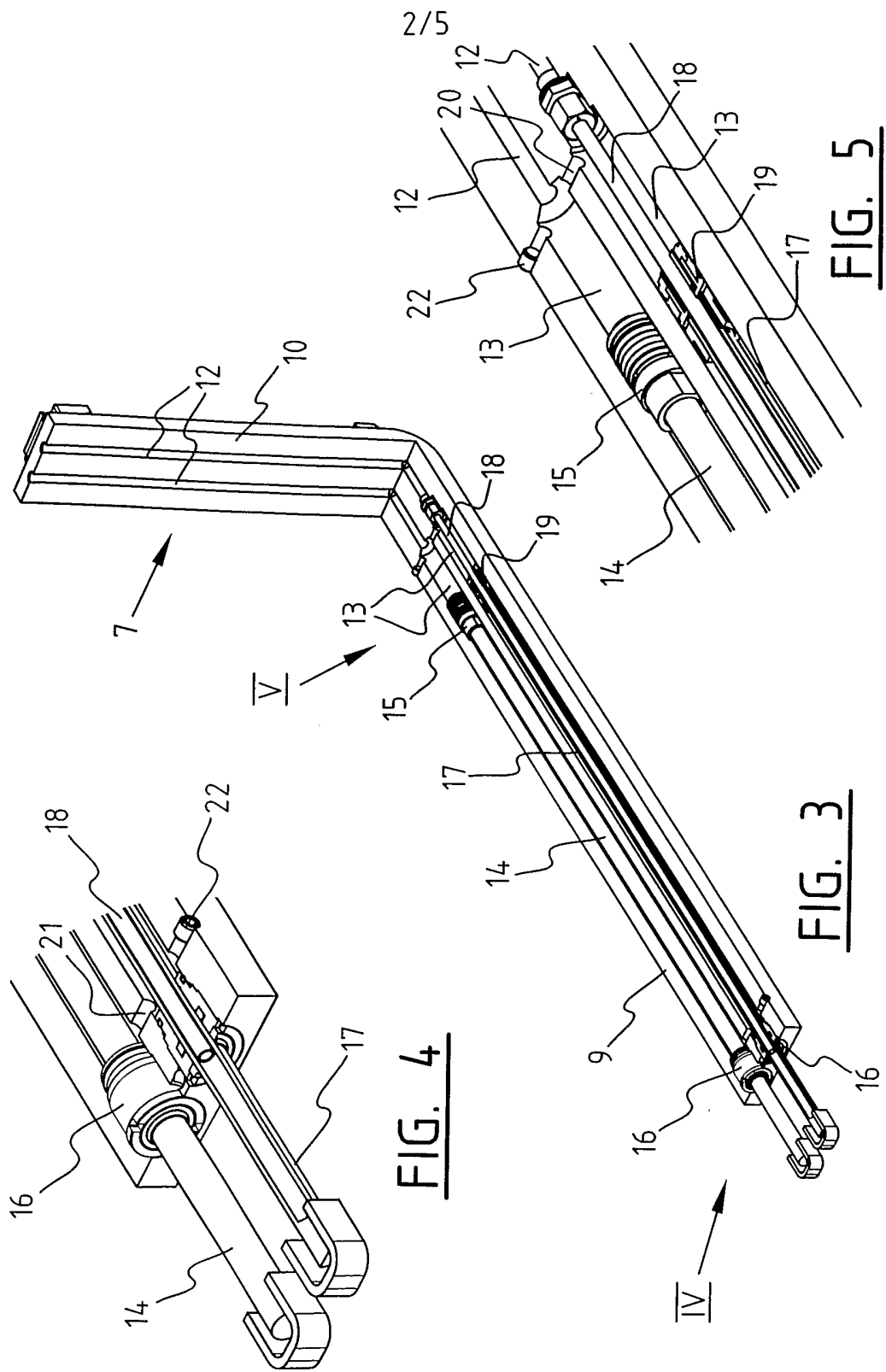
10 10. Fork as claimed in claim 9, wherein the suspension comprises at least two cylinders arranged adjacently of each other and substantially parallel.

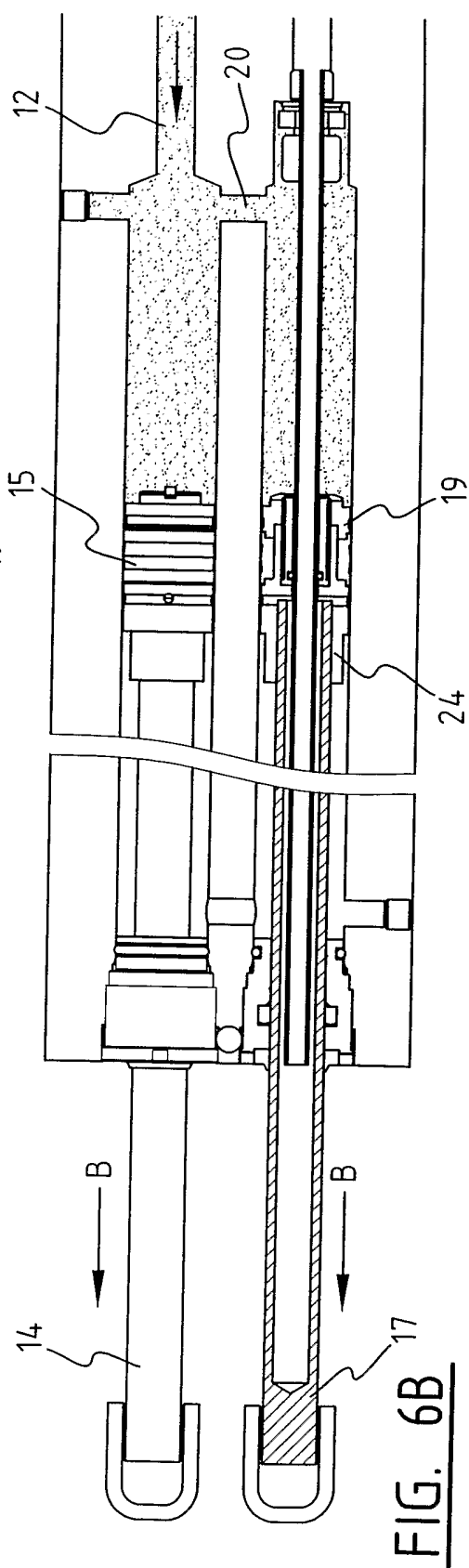
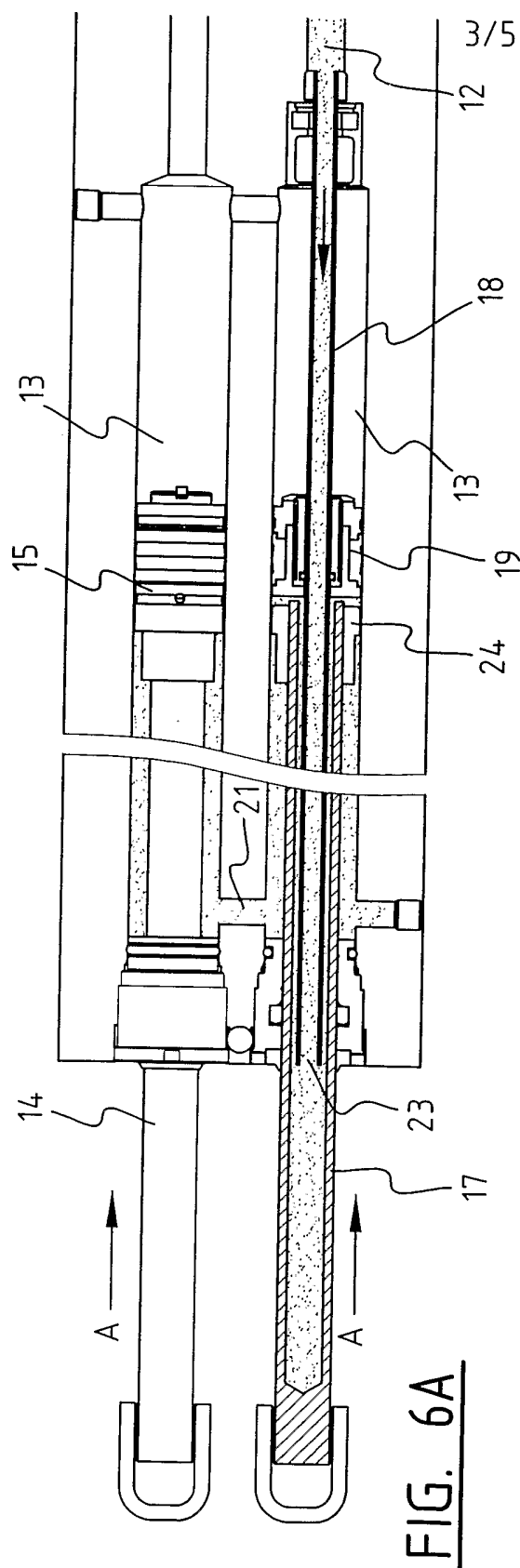
11. Fork as claimed in claim 10, wherein the at least two cylinders are connected close to the outer ends thereof.

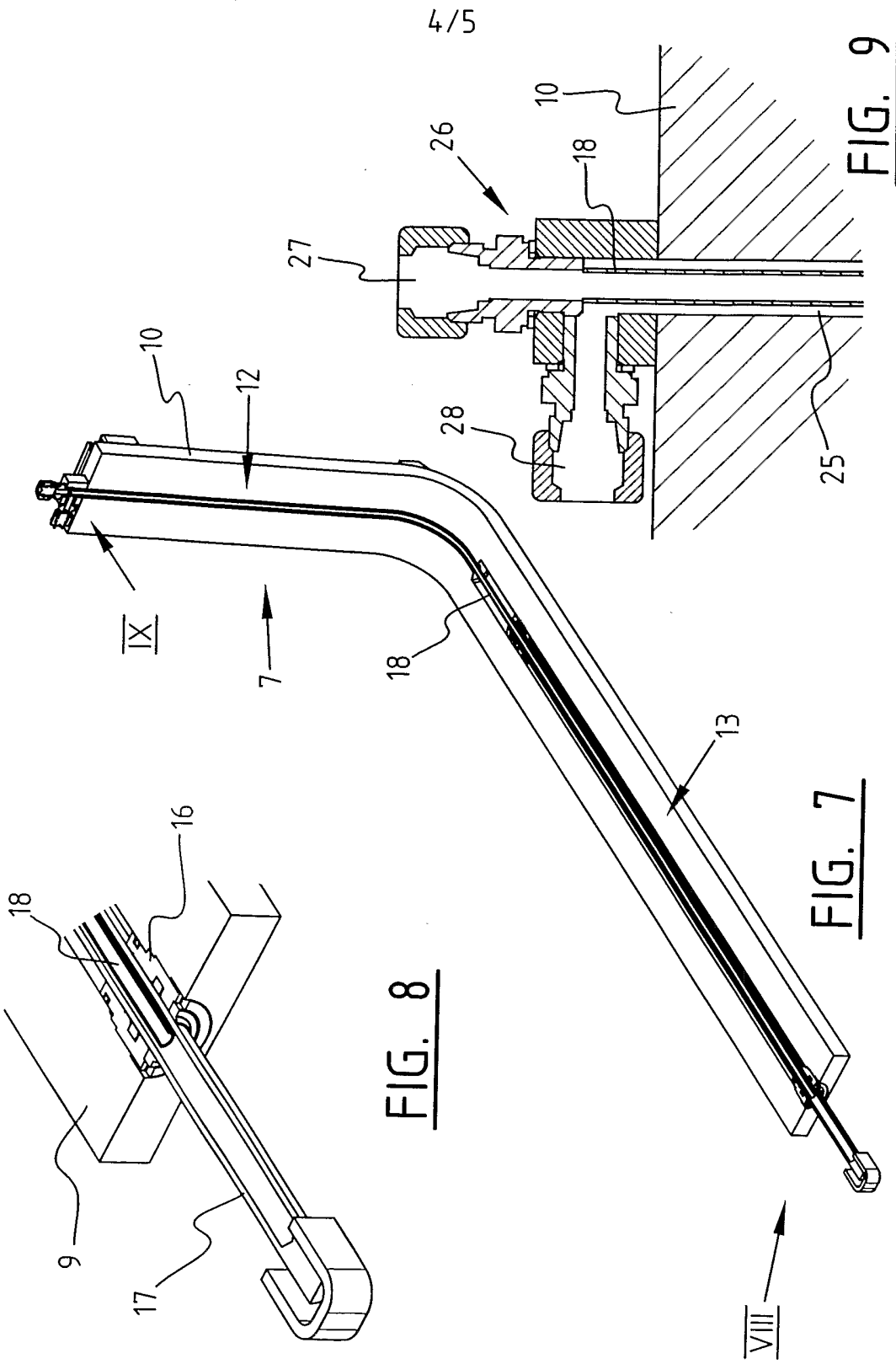
15 12. Fork-lift truck, comprising a displaceable frame, a mast on the frame, a carriage movable along the mast and a fork beam on the carriage, wherein at least one fork as claimed in at least one of the foregoing claims is arranged on the fork beam.

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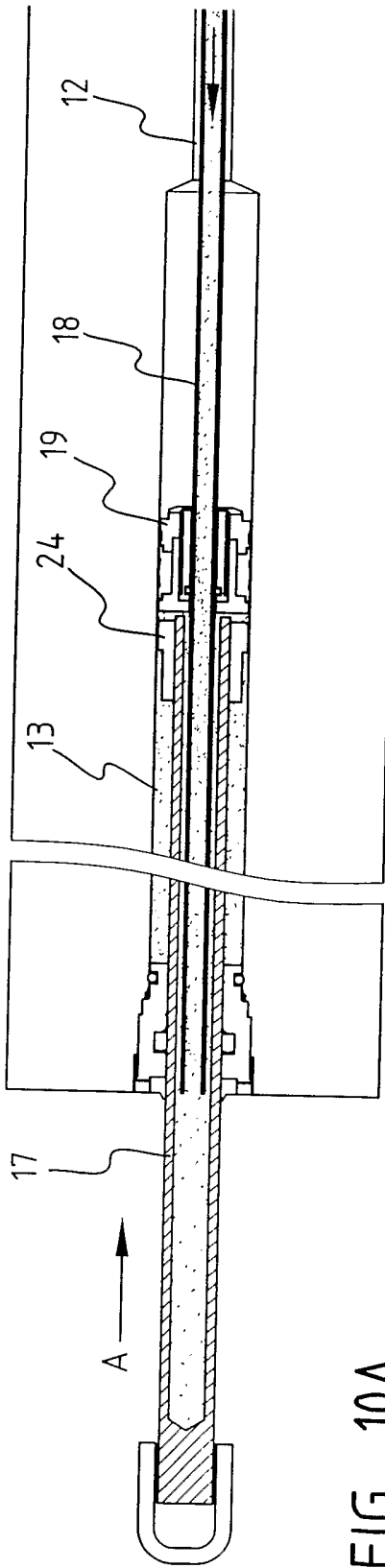


FIG. 10A

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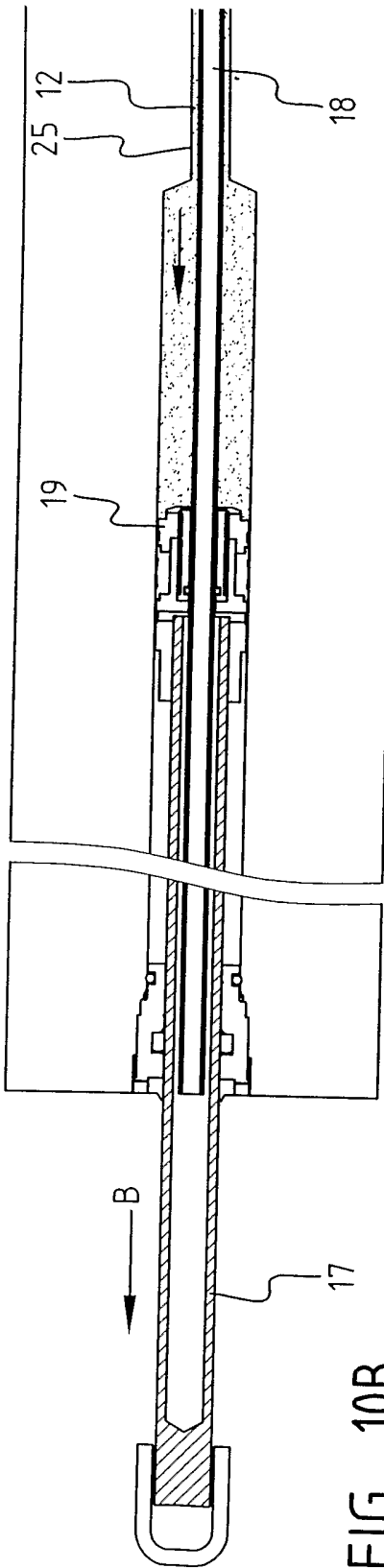


FIG. 10B

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B66F9/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B66F B62B F15B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Guthmuller, J

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