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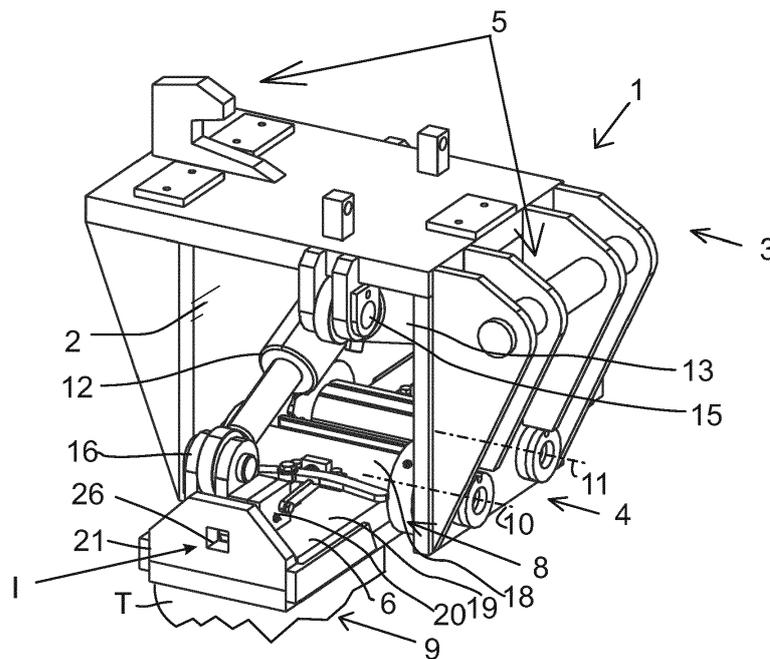
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(54) **COUPLING SYSTEM FOR COUPLING OF TOOLS TO AN EXCAVATOR ARM AND USES OF THE COUPLING SYSTEM**

(57) A coupling system for coupling of tools (T) to an excavator arm. The coupling system comprises an adapter device (1), the adapter device comprising a frame (2) and first quick coupling elements (5) being adapted for coupling to a quick coupler of the excavator arm. The adapter device comprises at least one coupling arm (6, 7) which can be turned by a hydraulic cylinder (12, 13) about a pivot axis (10, 11). The coupling arm (6, 7) comprises second quick coupling elements (18, 19, 20) for releasable attachment of a tool (T) to the coupling arm

(6, 7). The coupling system further comprises an attachment member (21) which is fixedly connected to the tool (T), the attachment member (21) comprising third quick coupling elements (22, 23, 24, 25, 26) adapted for coupling to the second quick coupling elements (18, 19, 20) of the coupling arm (6, 7) for securely attaching the tool (T) to the coupling arm (6, 7). When in use, a tool (T) coupled to the adapter device (1), which is coupled to the excavator arm, is turnable by using the hydraulic cylinder (12, 13) of the adapter device (1).



**Fig. 1**

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention relates to a coupling system for coupling of tools to an excavator arm. Further, the invention relates to uses of the coupling system.

### SUMMARY OF THE INVENTION

**[0002]** According to a first aspect, the present invention provides a coupling system for coupling of tools to an excavator arm. The coupling system comprises an adapter device, the adapter device comprising a frame having an upper part and a lower part. The adapter device comprises first quick coupling elements arranged at the upper part of the frame. The first quick coupling elements are adapted for coupling to a quick coupler of the excavator arm. The adapter device further comprises at least one coupling arm, having a first end and a second end, the first end being pivoted about a pivot axis, at the lower part of the frame. The adapter device further comprises a hydraulic cylinder for turning the coupling arm, about the pivot axis. The hydraulic cylinder has a first pivot point at the upper part of the frame and a second pivot point at the coupling arm. The second pivot point is at a distance from the pivot axis. The hydraulic cylinder has a hydraulic connection connectable to an external hydraulic system of the excavator. The coupling arm comprises second quick coupling elements for releasable attachment of a tool to the coupling arm. The coupling system further comprises an attachment member fixedly connected to the tool. The attachment member comprises third quick coupling elements adapted for coupling to the second quick coupling elements of the coupling arm for securely attaching the tool to the coupling arm. When in use, a tool coupled to the adapter device, which is coupled to the excavator arm, is turnable by using the hydraulic cylinder of the adapter device.

**[0003]** The technical effect of the invention is that the hydraulic cylinder for moving and implementing the tool need only be disposed in the adapter device and the various tools adapted to be coupled with the attachment member to the adapter device need not be equipped with a hydraulic cylinder for moving the tool. Consequently, a variety of tools may be designed to be very simple in structure and thus inexpensive. The second quick coupling elements of the adapter device and the third quick coupling elements of the attachment member enable quick coupling and changing of the tools to the adapter device.

**[0004]** In one embodiment of the coupling system the adapter device comprises a first coupling arm and a second coupling arm having their pivot axes, arranged in parallel and at a distance from each other, the first and second coupling arms extending from the pivot axes at opposite directions in relation to each other.

**[0005]** In one embodiment of the coupling system the

adapter device comprises a first hydraulic cylinder for turning the first coupling arm and a second hydraulic cylinder for turning the second coupling arm.

**[0006]** In one embodiment of the coupling system first hydraulic cylinder and the second hydraulic cylinder are arranged side by side with each other and in an cross-shaped X-formation, so that the first pivot point of the first hydraulic cylinder on the frame is disposed on the other side of the frame in relation to the first coupling arm, while the first pivot point of the second hydraulic cylinder on the frame is disposed on the other side of the frame in relation to the second coupling arm. This arrangement of hydraulic cylinders makes it possible to design a low structure for the adapter device while having relatively long strokes for the hydraulic cylinders so that a wide turning angle of coupling arms can be obtained.

**[0007]** In one embodiment of the coupling system the first coupling arm and the second coupling arm are connected to each other by toothed gear segments for synchronizing the turning movements of the coupling arms. With this arrangement the turning movements of the coupling arms are synchronized and the forces exerted on the coupling arms are evenly distributed.

**[0008]** In one embodiment of the coupling system the coupling arm comprises a cylindrical part arranged at a first end of the coupling arm. The cylindrical part has a cylindrical outer face having a radius and a longitudinal axis coinciding with the pivot axis. The coupling arm further comprises a plate fixedly connected to the cylindrical part. The plate has an upper face at the upper side to which the second pivot point of the hydraulic cylinder is connected. The plate has a first abutment face at a lower side. The coupling arm further comprises a latching mechanism connected to the plate for releasable locking the attachment member to the coupling arm. The latching mechanism has a latch pin which is movable between a release position and a locking position. The cylindrical part, plate and the latching mechanism together form said second quick coupling elements of the adapter device.

**[0009]** In one embodiment of the coupling system the attachment member comprises a flat portion having a planar second abutment face at the upper side of the flat portion which second abutment face can be abutted against the first abutment face. The flat portion has a first end and a second end and side edges extending between the first end and the second end. The attachment member further comprises first retaining wall members extending perpendicularly in relation to the flat portion on side edges of the flat portion. The first retaining wall members are for holding edges of the plate of the coupling arm to prevent lateral movement of the attachment member in relation to the coupling arm. The attachment member further comprises a curved hook portion at a first end of the flat portion. The curved hook portion has a cylindrical inner face curving with a radius matching with the radius of the outer face of the cylindrical part of the coupling arm for hooking engagement with the coupling arm. The attachment member further comprises a second re-

taining wall member extending perpendicularly at the second end of the flat portion in relation to the flat portion. The second retaining wall member has a hole adapted for receiving the latch pin into the hole at the locking position II of the latch pin.

**[0010]** In one embodiment of the coupling system the latching mechanism comprises a handle for moving the latch pin between the release position and the locking position.

**[0011]** In one embodiment of the coupling system the hole is a through hole. The latch pin has a safety colored free end which can be visually detected by the operator when the latch pin is in the locking position to ensure secure attachment of the attachment member of the tool to the coupling arm.

**[0012]** In one embodiment of the coupling system the latching mechanism comprises a compression spring for urging the latch pin towards the locking position.

**[0013]** In one embodiment of the coupling system the latching mechanism comprises a holder which can be placed to hold the handle in the release position of the latch pin against the spring force of the compression spring.

**[0014]** In one embodiment of the coupling system the attachment member is fixedly connected to a tool, a pair of which tools together, when being coupled to the first coupling arm and the second coupling arm, form

- a grapple or
- a timber grapple or
- a sleeper grapple or
- a rail grapple or
- a rail handling device or
- a rail guiding device or
- a sleeper laying distributor or
- a clamshell bucket or
- a demolition device or
- a cutting device or
- a breaking device

or any combination thereof.

**[0015]** In one embodiment of the coupling system the first quick coupling elements are configured to be compatible to NTP10 or NTP20 or NTP30 or S1 or S2 or S3 excavator quick coupler.

**[0016]** The coupling system as above described can be used for coupling tools of a series of tools which are configured for railway maintenance and/or railway building.

**[0017]** The coupling system as above described can be used for coupling tools of a series of tools which are configured for excavating work and/or lumbering work and/or construction work.

**[0018]** It is to be understood that the aspects and embodiments of the invention described above may be used in any combination with each other. Several of the aspects and embodiments may be combined together to form a further embodiment of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

5 Figure 1 shows an axonometric view of an adapter device of the coupling system according to one embodiment of the invention,

10 Figure 2 shows the adapter device of Fig. 1 seen from opposite direction of Fig. 1,

15 Figure 3 shows an axonometric view of a coupling arm of the adapter device of Fig. 1,

20 Figure 4 shows an axonometric view of an attachment member adapted for coupling to the coupling arm, of Figure 3,

25 Figure 5 shows an axonometric view of an adapter device of Figure 1 the attachment member being partly detached from the coupling arm,

30 Figure 6 shows a side view of the adapter device of Fig. 1 in a situation where the coupling arms are turned to their extreme lowest position,

35 Figure 7 shows a side view of the adapter device of Fig. 1 in a situation where the coupling arms are turned to their extreme uppermost position,

40 Figure 8 shows an axonometric view of an embodiment of a tool attached to the attachment member, the tool being a combined rail grabbing jaw and a rail transfer roller,

45 Figure 9 is the apparatus of Figure 8 seen from below,

50 Figure 10 shows the tool of Figures 8 and 9 being coupled to the adapter device of Fig. 1, the tool on the right being detached from the coupling arm,

55 Figures 11 and 12 show the combination of railway handling tools in action,

Fig. 13 shows bucket parts of a clamshell bucket as tools being attached to the attachment members of the coupling system of the invention, and

Fig. 14 shows timber grapple jaws as tools being attached to the attachment members of the coupling system of the invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0020]** Figures 1, 2, 5, 6 and 7 show a coupling system for coupling of multiple tools T to an excavator arm (not shown).

**[0021]** The coupling system comprises an adapter device 1. The adapter device 1 comprises a frame 2 having an upper part 3 and a lower part 4. The adapter device 1 comprises first quick coupling elements 5 arranged at the upper part 3 of the frame 2. The first quick coupling elements 5 are adapted for coupling to a matching quick coupler of the excavator arm (not shown). The first quick coupling elements 5 may be configured to be compatible to NTP10 or NTP20 or NTP30 or S1 or S2 or S3 excavator quick coupler.

**[0022]** The adapter device 1 further comprises at least one coupling arm 6, 7. In the shown example the adapter device comprises two coupling arms 6 and 7.

**[0023]** Each coupling arm 6, 7 has a first end 8 and a second end 9. The first ends 8 of the coupling arms 6, 7 are pivoted to be turnable about pivot axes 10, 11 at the lower part 4 of the frame 2.

**[0024]** The adapter device 1 further comprises a hydraulic cylinder 12, 13 for turning each of the two coupling arms 6, 7 about the respective pivot axis 10, 11. The hydraulic cylinder 12, 13 has a first pivot point 14, 15 at the upper part 3 of the frame 2 and a second pivot point 16, 17 at the coupling arm 6, 7.

**[0025]** The second pivot point 16, 17 is at a distance from the pivot axis 10, 11 of the coupling arm 6, 7. The hydraulic cylinder 12, 13 has a hydraulic connection which is connectable to an external hydraulic system of the excavator.

**[0026]** Referring also to Figure 3, the coupling arm 6, 7 comprises second quick coupling elements 18, 19, 20 for releasable attachment of a tool T to the coupling arm 6, 7. The coupling system further comprises an attachment member 21 fixedly connected to the tool T.

**[0027]** The attachment member 21 is shown also in Figure 4. The attachment member 21 is similar for every tool T of a variety of different kinds of tools. The tool T is fixedly attached to the underside of the attachment member 21.

**[0028]** The attachment member 21 comprises third quick coupling elements 22, 23, 24, 25, 26 adapted for coupling to the second quick coupling elements 18, 19, 20 of the coupling arm 6, 7 for securely attaching the tool T to the coupling arm 6, 7. When in use, one or two tools T coupled to the adapter device 1, which is coupled to the excavator arm, is/are turnable by using the one or two hydraulic cylinders 12, 13 of the adapter device 1.

**[0029]** Referring again to Figures 1, 2, 5, 6 and 7, the adapter device 1 comprises a first coupling arm 6 and a second coupling arm 7 having their pivot axes 10, 11 arranged in parallel and at a distance from each other. The first and second coupling arms extend from the pivot axes 10, 11 at opposite directions in relation to each other. The adapter device 1 comprises a first hydraulic cyl-

inder 12 for turning the first coupling arm 6 and a second hydraulic cylinder 13 for turning the second coupling arm 7. The first hydraulic cylinder 12 and the second hydraulic cylinder 13 are arranged side by side with each other and in an cross-shaped X-formation, so that the first pivot point 14 of the first hydraulic cylinder 12 on the frame 2 is disposed on the other side of the frame 2 in relation to the first coupling arm 6, while the first pivot point 15 of the second hydraulic cylinder 13 on the frame 2 is disposed on the other side of the frame 2 in relation to the second coupling arm 7. The first coupling arm 6 and the second coupling arm 7 are connected to each other by toothed gear segments 27 (see Figures 3, 6 and 7) for synchronizing the turning movements of the coupling arms 6, 7.

**[0030]** Reference is made to Figure 3 which shows the first coupling arm 6. The structure of the second coupling arm 7 is similar. The coupling arm 6 comprises a cylindrical part 18. The cylindrical part 18 is arranged at a first end 8 of the coupling arm 6. The cylindrical part 18 has a cylindrical outer face F1 having a radius. The cylindrical part 18 has a longitudinal axis coinciding with the first pivot axis 10. The coupling arm 6 further comprises a plate 19 fixedly connected to the cylindrical part 18. The plate 19 has an upper face 28 at the upper side to which the second pivot point 16 of the hydraulic cylinder 12 is connectable, and a first abutment face 29 at a lower side. A latching mechanism 20 / (shown in Figures 1, 2, and 5) is connected to the plate 19 for releasable locking the attachment member 21 to the coupling arm 6. The latching mechanism 20 has a latch pin 30 which is movable between a release position I (see Figure 1) and a locking position II (see Figure 2). The cylindrical part, plate and the latching mechanism together form the second quick coupling elements of the coupling arm 6.

**[0031]** As shown in Figure 4, the attachment member 21 comprises a flat portion 31 having a planar second abutment face 32 at the upper side of the flat portion. The second abutment face 32 can be abutted against the first abutment face 29 of the coupling arm 6, 7. The flat portion 31 has a first end 33 and a second end 34 and side edges 35 extending between the first end 33 and the second end 34. First retaining wall members 23 extends perpendicularly in relation to the flat portion 31 on side edges 35 of the flat portion 31. The first retaining wall members 23 are intended for holding edges of the plate 19 of the coupling arm 6, 7 to prevent lateral movement of the attachment member 21 in relation to the coupling arm 6, 7. A curved hook portion 24 is at a first end 33 of the flat portion 31. The curved hook portion 24 has a cylindrical inner face Fi curving with a radius which matches with the radius of the outer face Fo of the cylindrical part 18 of the coupling arm 6, 7 for hooking engagement with the coupling arm 6, 7. A second retaining wall member 25 extends perpendicularly at the second end 34 of the flat portion 31 and extends perpendicularly in relation to the flat portion 31. The second retaining wall member 25 has a hole 26 adapted for receiving the latch

pin 30 into the hole at the locking position II of the latch pin.

**[0032]** As illustrated in Figure 5, the latching mechanism 20 comprises a handle 36 for moving the latch pin 30 between the release position I and the locking position II. The hole 26 is a through hole, and the latch pin 30 has a safety colored free end which can be visually detected by the operator when the latch pin is in the locking position II to ensure secure attachment of the attachment member 21 of the tool T to the coupling arm 6, 7. The latching mechanism 20 further comprises a compression spring 37 for urging the latch pin 30 towards the locking position II. The latching mechanism 20 further comprises a holder 38 which can be placed to hold the handle 36 in the release position I of the latch pin 30 against the spring force of the compression spring 37.

**[0033]** As shown in Figures 6 and 7, a pair of tools T together, when being coupled to the first coupling arm 6 and the second coupling arm 7, can be turned by the first hydraulic cylinder 12 and the second hydraulic cylinder 13 of the adapter device 1 so that grapping can be implemented. As an example, Figures 6 and 7 show the tools forming a sleeper grapple which can be used to change sleepers in railway maintenance work.

**[0034]** Figures 8 to 12 illustrate a special combination tool for rail handling. The combination tool T comprising a rail grapping jaw J and a rail transfer roller R has been fixedly attached to the attachment member 21 to be coupled to the adapter device 1 as shown in Figure 10. In Figure 11 a rail has been grapped by the rail grapping jaws J. In Figure 12 rail has been grapped by transfer rollers R.

**[0035]** Figures 13 and 14 illustrate different tools attached to the attachment members 21.

**[0036]** The tools T may be designed to form a grapple or a timber grapple or a sleeper grapple or a rail grapple or a rail handling device or a rail guiding device or a sleeper laying distributor or a clamshell bucket or a demolition device or a cutting device or a breaking device, or any combination thereof.

**[0037]** The coupling system as described can be used for coupling tools of a series of tools which are configured for railway maintenance and/or railway building and/or excavating work and/or lumbering work and/or construction work.

**[0038]** Although the invention has been described in conjunction with a certain type of coupling system, it should be understood that the invention is not limited to any certain type of coupling system. While the present inventions have been described in connection with a number of exemplary embodiments, and implementations, the present inventions are not so limited, but rather cover various modifications, and equivalent arrangements, which fall within the purview of prospective claims.

## Claims

1. A coupling system for coupling of tools (T) to an ex-

cavator arm, the coupling system comprising

- an adapter device (1), the adapter device comprising a frame (2) having an upper part (3) and a lower part (4), the adapter device comprising:

+ first quick coupling elements (5) arranged at the upper part (3) of the frame (2), the first quick coupling elements (5) being adapted for coupling to a quick coupler of the excavator arm,

+ at least one coupling arm (6, 7) having a first end (8) and a second end (9), the first end (8) being pivoted about a pivot axis (10, 11) at the lower part (4) of the frame, and

+ a hydraulic cylinder (12, 13) for turning the coupling arm (6, 7) about the pivot axis (10, 11), the hydraulic cylinder (12, 13) having a first pivot point (14, 15) at the upper part (3) of the frame (2) and a second pivot point (16, 17) at the coupling arm (6, 7), the second pivot point (16, 17) being at a distance from the pivot axis (10, 11), and the hydraulic cylinder (12, 13) having a hydraulic connection connectable to an external hydraulic system of the excavator,

wherein the coupling arm (6, 7) comprises second quick coupling elements (18, 19, 20) for releasable attachment of a tool (T) to the coupling arm (6, 7); and the coupling system further comprises an attachment member (21) fixedly connected to the tool (T), the attachment member (21) comprising third quick coupling elements (22, 23, 24, 25, 26) adapted for coupling to the second quick coupling elements (18, 19, 20) of the coupling arm (6, 7) for securely attaching the tool (T) to the coupling arm (6, 7), whereby, when in use, a tool (T) coupled to the adapter device (1), which is coupled to the excavator arm, is turnable by using the hydraulic cylinder (12, 13) of the adapter device (1).

2. The coupling system according to claim 1, **characterized in that** the adapter device (1) comprises a first coupling arm (6) and a second coupling arm (7) having their pivot axes (10, 11) arranged in parallel and at a distance from each other, the first and second coupling arms extending from the pivot axes at opposite directions in relation to each other.

3. The coupling system according to claim 2, **characterized in that** the adapter device (1) comprises a first hydraulic cylinder (12) for turning the first coupling arm (6) and a second hydraulic cylinder (13) for turning the second coupling arm (7).

4. The coupling system according to claim 3, **characterized in that** first hydraulic cylinder (12) and the

second hydraulic cylinder (13) are arranged side by side with each other and in an cross-shaped X-formation, so that the first pivot point (14) of the first hydraulic cylinder (12) on the frame (2) is disposed on the other side of the frame (2) in relation to the first coupling arm (6), while the first pivot point (15) of the second hydraulic cylinder (13) on the frame (2) is disposed on the other side of the frame (2) in relation to the second coupling arm (7).

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5. The coupling system according to any one of the claims 1 to 4, **characterized in that** the first coupling arm (6) and the second coupling arm (7) are connected to each other by toothed gear segments (27) for synchronizing the turning movements of the coupling arms.

6. The coupling system according to any one of the claims 1 to 5, **characterized in that** the coupling arm (6, 7) comprises

- a cylindrical part (18) arranged at a first end (8) of the coupling arm (6, 7), the cylindrical part having a cylindrical outer face (F1) having a radius, the cylindrical part (18) having a longitudinal axis coinciding with the pivot axis (10, 11),
- a plate (19) fixedly connected to the cylindrical part (18), the plate having an upper face (28) at the upper side to which the second pivot point (16, 17) of the hydraulic cylinder (12, 13) is connected, and a first abutment face (29) at a lower side, and
- a latching mechanism (20) connected to the plate (19) for releasable locking the attachment member (21) to the coupling arm (6, 7), the latching mechanism (20) having a latch pin (30) which is movable between a release position (I) and a locking position (II),

whereby the cylindrical part, plate and the latching mechanism together form said second quick coupling elements.

7. The coupling system according to claim 6, **characterized in that** the attachment member (21) comprises

- a flat portion (31) having a planar second abutment face (32) at the upper side of the flat portion which second abutment face (32) can be abutted against the first abutment face (29), the flat portion (31) having a first end (33) and a second end (34) and side edges (35) extending between the first end (33) and the second end (34),
- first retaining wall members (23) extending perpendicularly in relation to the flat portion (31) on side edges (35) of the flat portion (31), the first retaining wall members (23) being for holding

edges of the plate (19) of the coupling arm (6, 7) to prevent lateral movement of the attachment member (21) in relation to the coupling arm (6, 7),

- a curved hook portion (24) at a first end (33) of the flat portion (31), the curved hook portion having a cylindrical inner face (Fi) curving with a radius matching with the radius of the outer face (Fo) of the cylindrical part (18) of the coupling arm (6, 7) for hooking engagement with the coupling arm, and

- a second retaining wall member (25) extending perpendicularly at the second end of the flat portion in relation to the flat portion (31), the second retaining wall member (25) having a hole (26) adapted for receiving the latch pin (30) into the hole at the locking position (II) of the latch pin.

8. The coupling system according to claim 6 or 7, **characterized in that** the latching mechanism (20) comprises a handle (36) for moving the latch pin (30) between the release position (I) and the locking position (II).

9. The coupling system according to claim 7 or 8, **characterized in that** the hole (26) is a through hole, and the latch pin (30) has a safety colored free end which can be visually detected by the operator when the latch pin is in the locking position (II) to ensure secure attachment of the attachment member (21) of the tool (T) to the coupling arm (6, 7).

10. The coupling system according to any one of the claims 6 to 9, **characterized in that** the latching mechanism (20) comprises a compression spring (37) for urging the latch pin (30) towards the locking position (II).

11. The coupling system according to any one of the claims 6 to 9, **characterized in that** the latching mechanism (20) comprises a holder (38) which can be placed to hold the handle (36) in the release position (I) of the latch pin (30) against the spring force of the compression spring (37).

12. The coupling system according to any one of the claims 2 to 11, **characterized in that** the attachment member (21) is fixedly connected to a tool (T), a pair of which tools (T) together, when being coupled to the first coupling arm (6) and the second coupling arm (7), form

- a grapple or
- a timber grapple or
- a sleeper grapple or
- a rail grapple or
- a rail handling device or
- a rail guiding device or

- a sleeper laying distributor or
- a clamshell bucket or
- a demolition device or
- a cutting device or
- a breaking device

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or any combination thereof.

13. The coupling system according to any one of the claims 1 to 12, **characterized in that** the first quick coupling elements (5) are configured to be compatible to NTP10 or NTP20 or NTP30 or S1 or S2 or S3 excavator quick coupler. 10

14. Use of the coupling system of any one of the claims 1 to 12 for coupling tools of a series of tools which are configured for railway maintenance and/or railway building. 15

15. Use of the coupling system of any one of the claims 1 to 12 for coupling tools of a series of tools which are configured for excavating or lumbering or construction. 20

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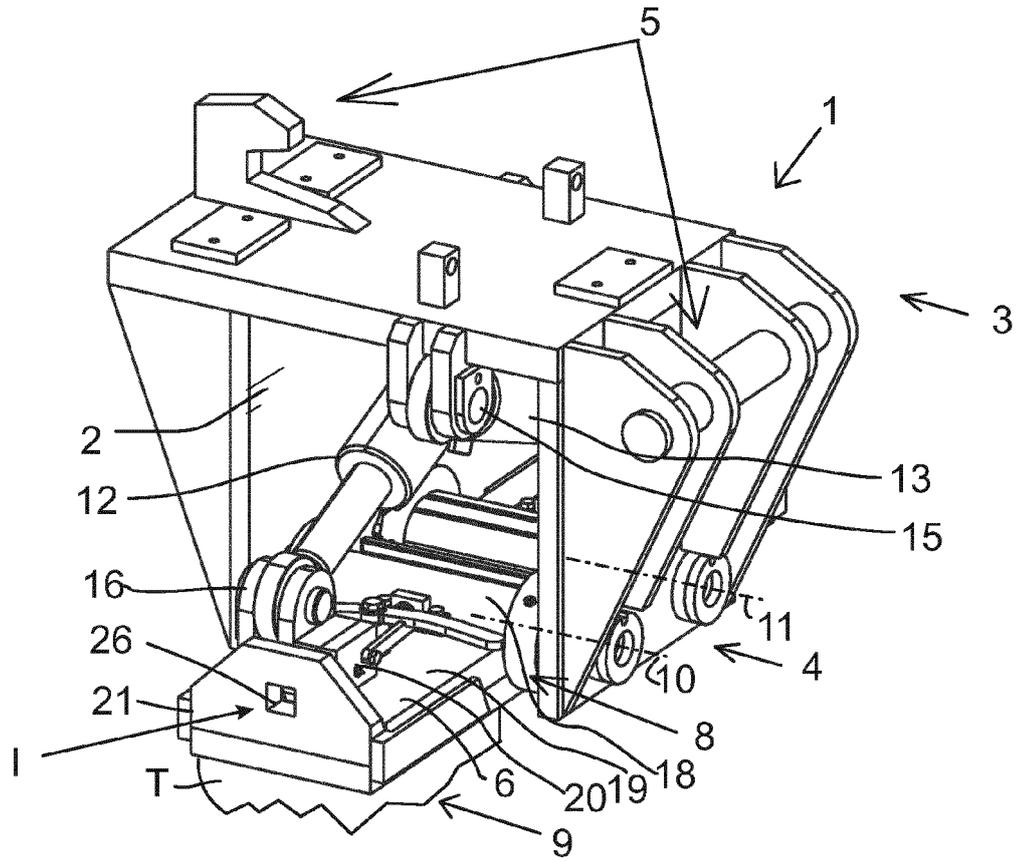


Fig. 1

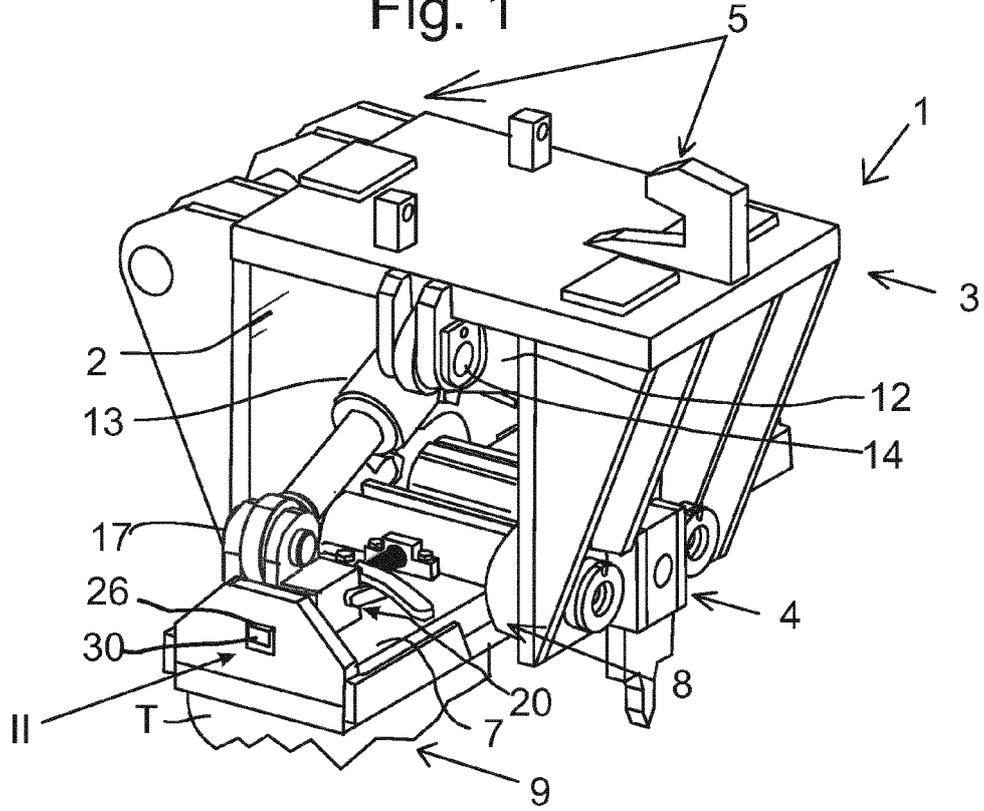


Fig. 2

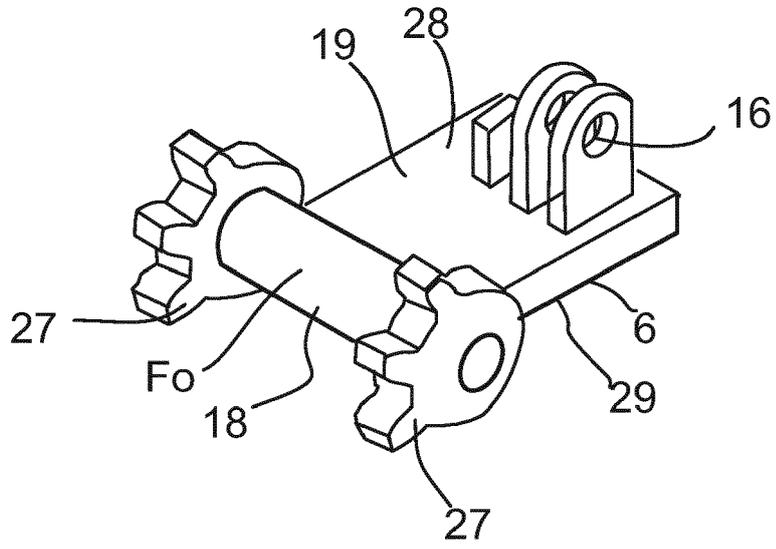


Fig. 3

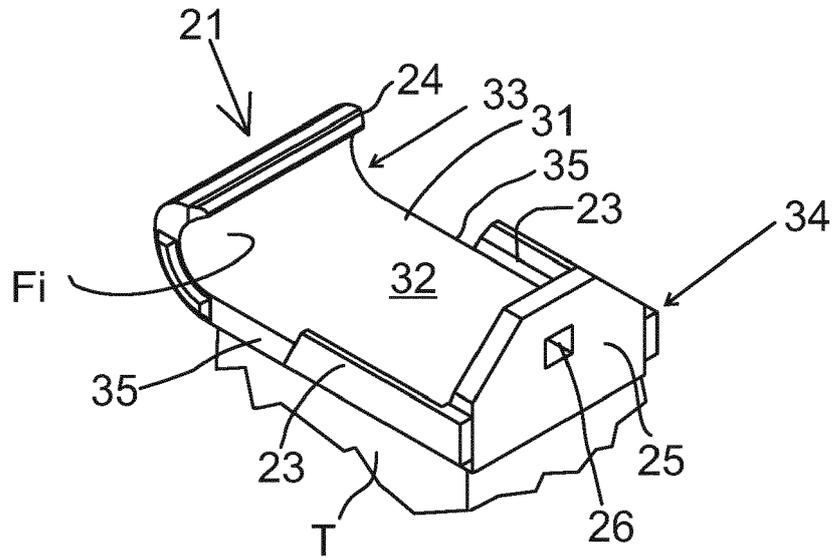


Fig. 4

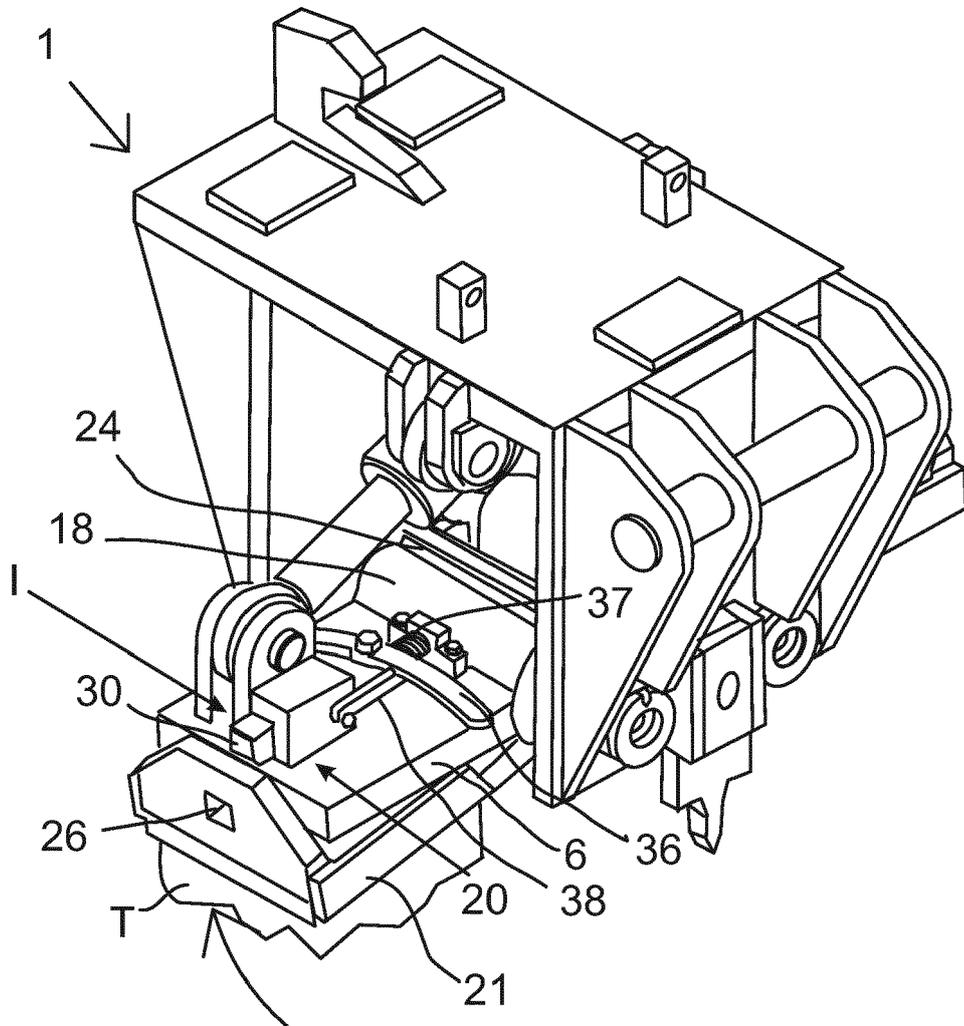


Fig. 5

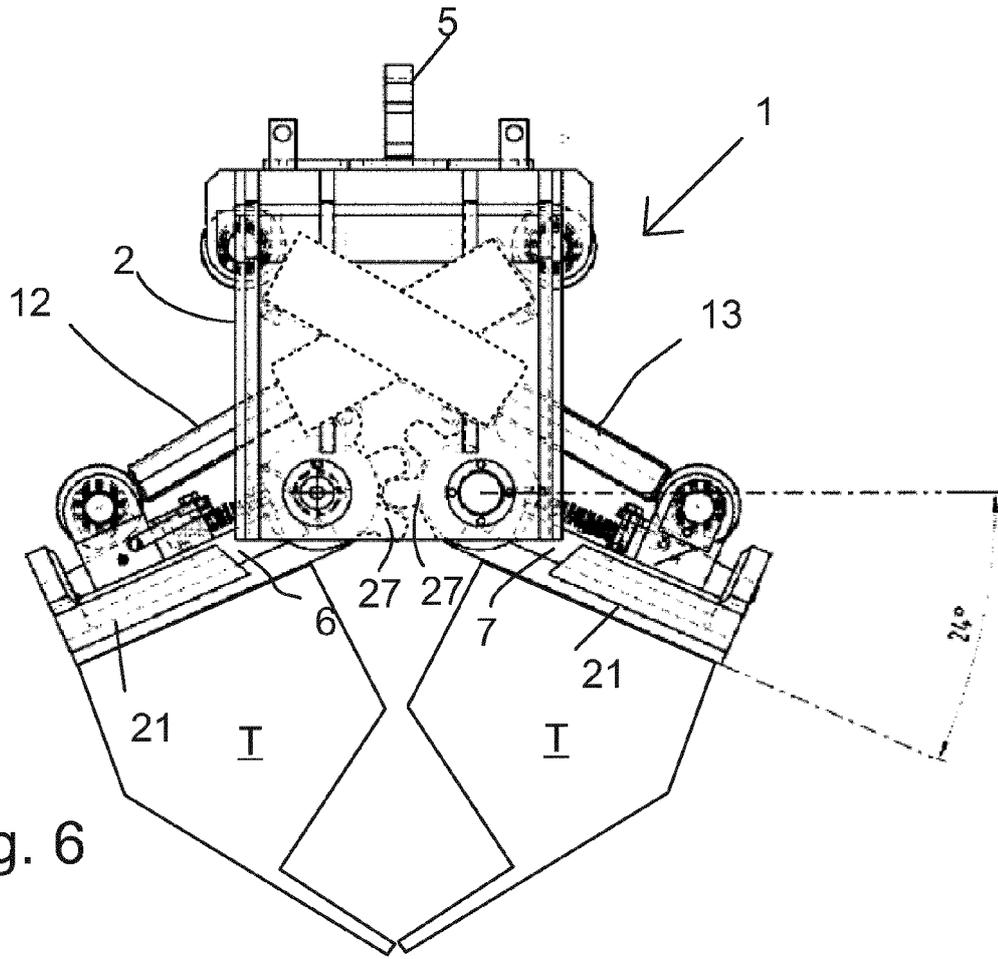


Fig. 6

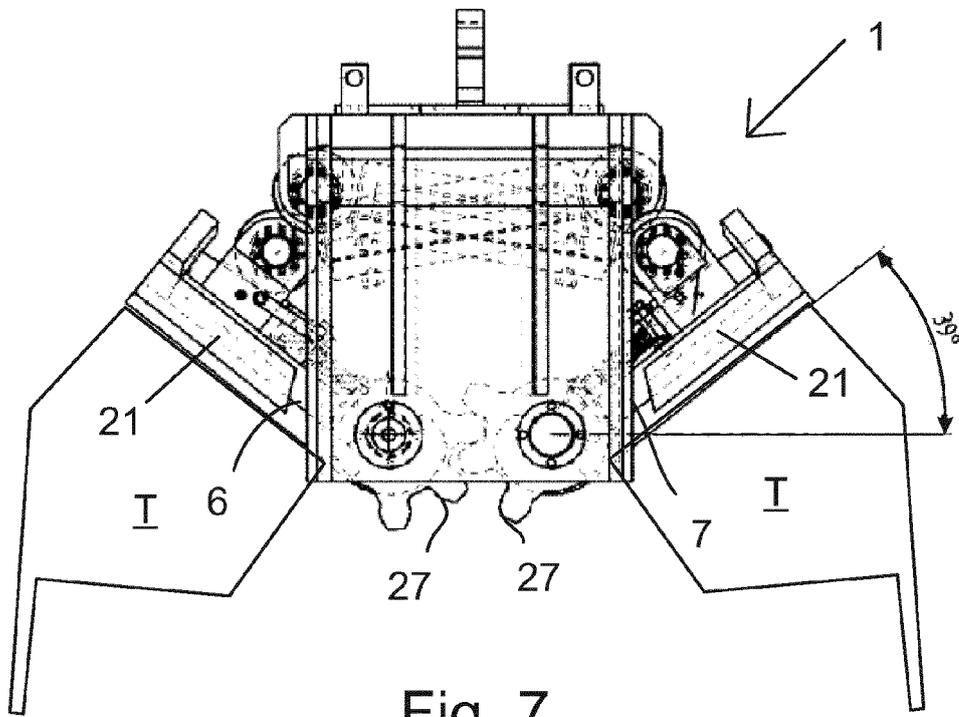
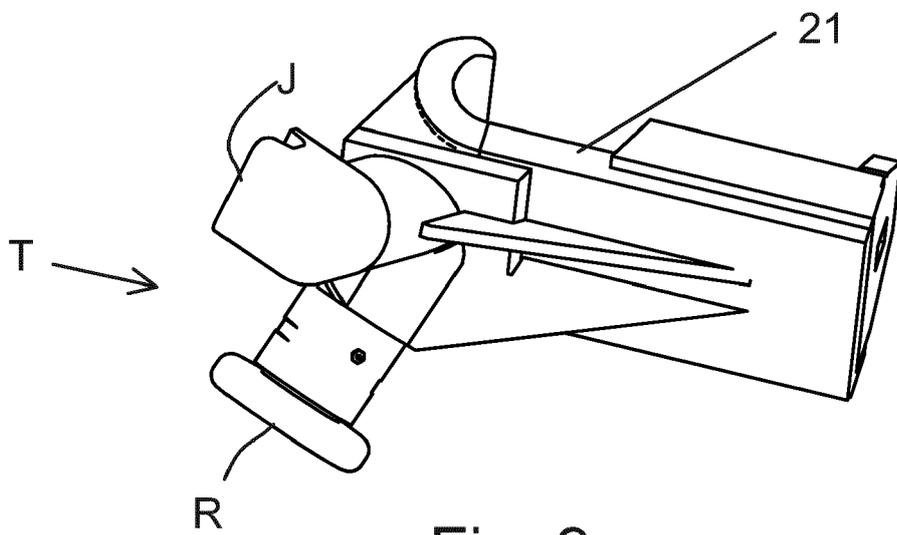
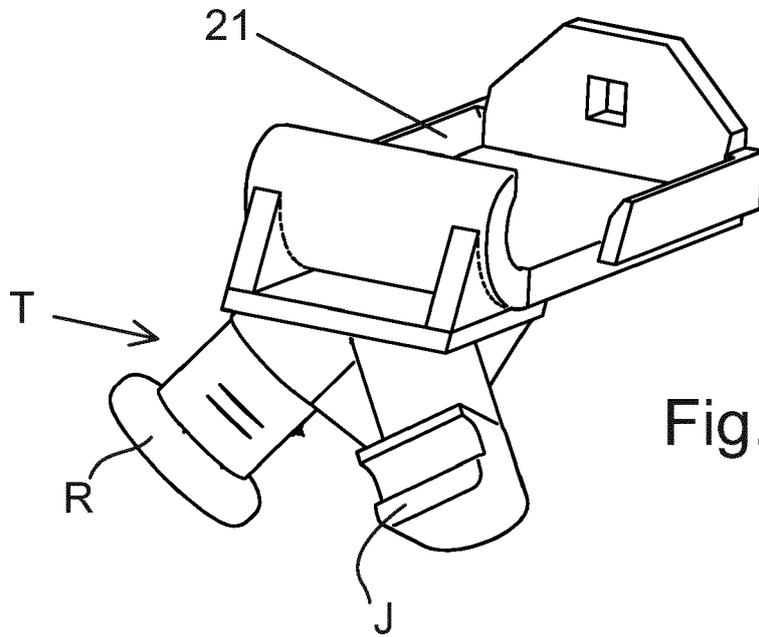


Fig. 7



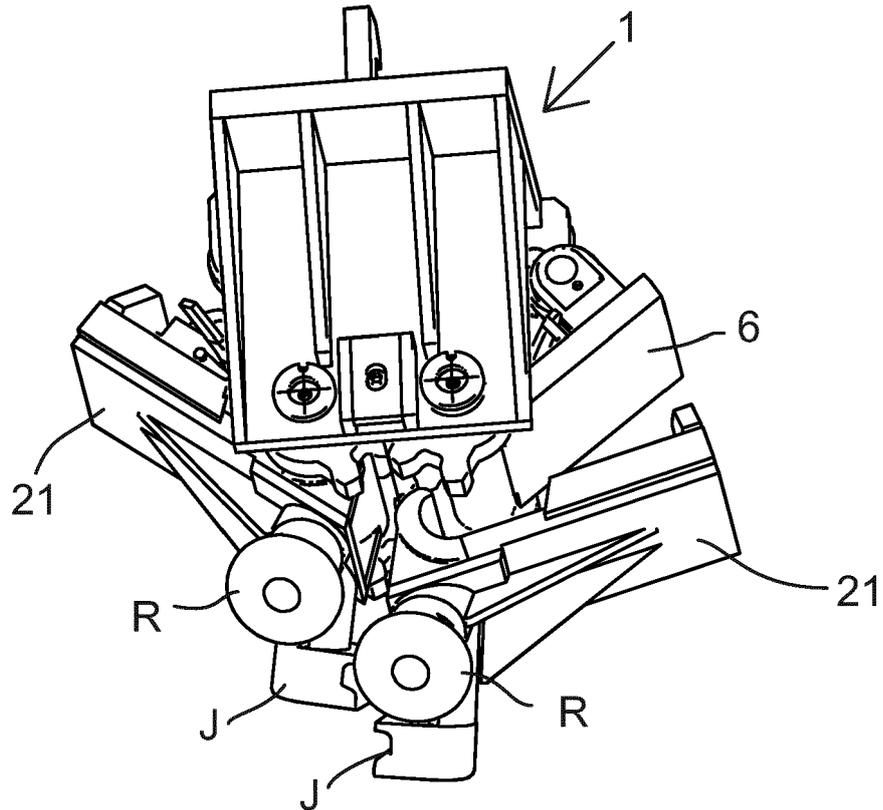


Fig. 10

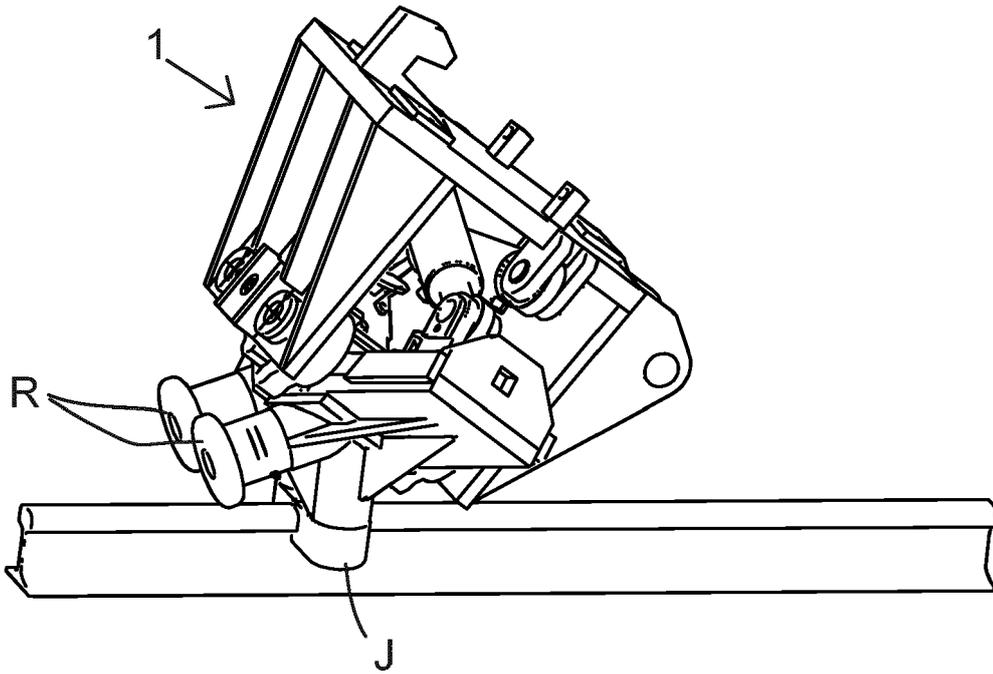


Fig. 11

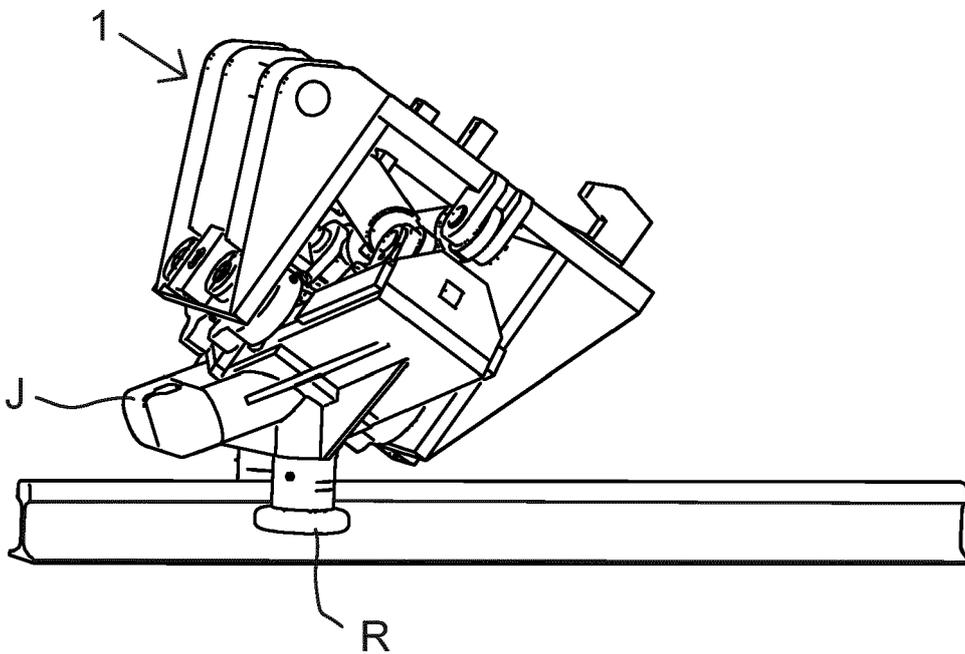


Fig. 12

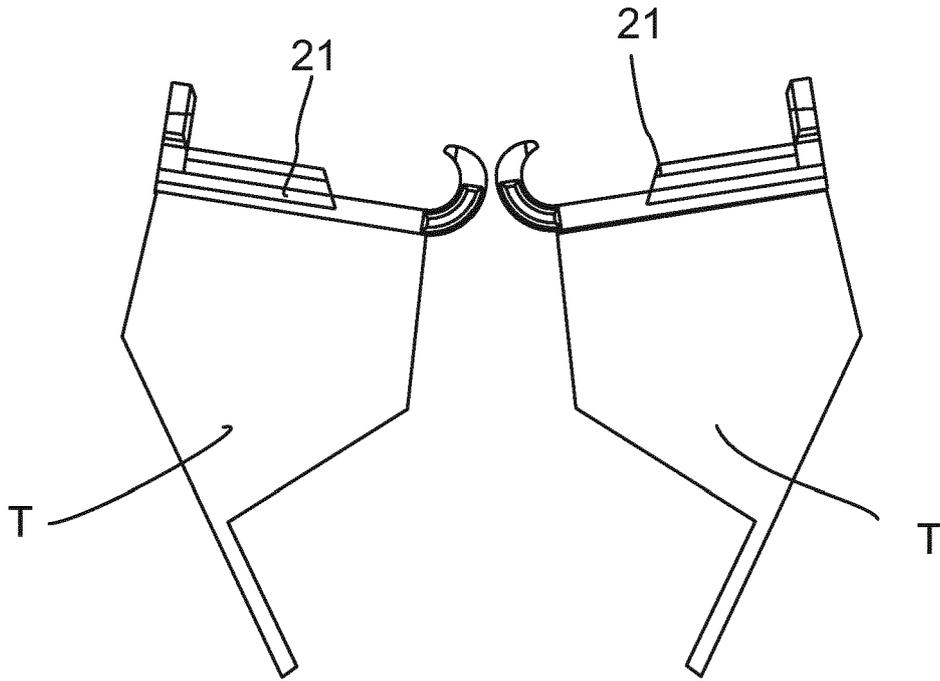


Fig. 13

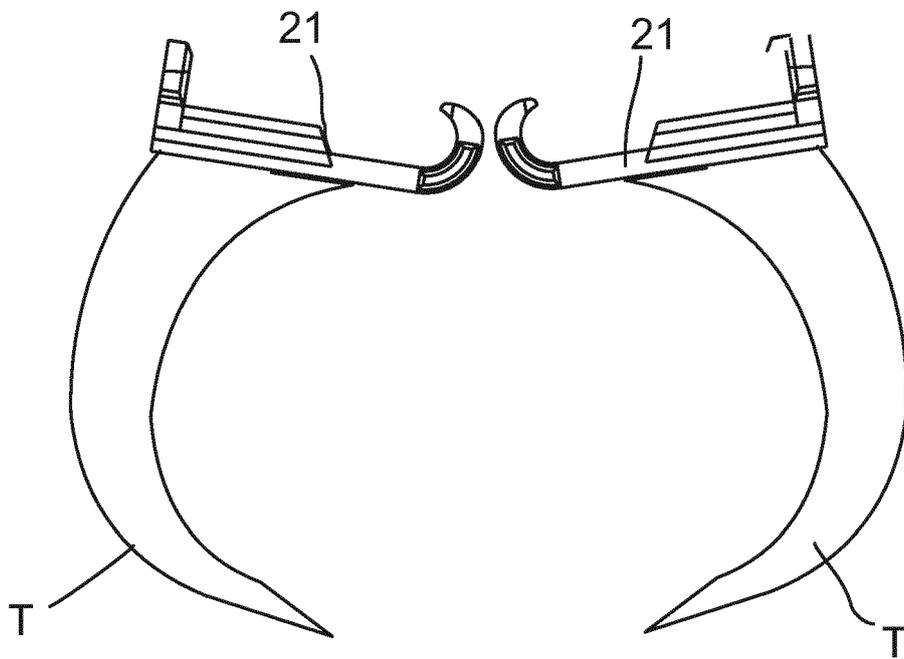


Fig. 14



EUROPEAN SEARCH REPORT

Application Number  
EP 19 16 8123

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			TECHNICAL FIELDS SEARCHED (IPC)
			E02F
The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>13 September 2019</b>	Examiner <b>Clarke, Alister</b>
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			

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