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(54) **LENGHTENING HANDLE OF A RATCHET WRENCH**

(57) The application relates to a ratchet wrench lengthening handle (100) according to one embodiment, which comprises a working head (102), a shaft member (154), a pulling head (122) and a roller chain (166). The working head is capable of having a ratchet wrench releasably attached thereto. The shaft member lies between the working and pulling heads. The pulling head is provided with a socket gear (142) capable of having a

threaded fastener releasably attached thereto. The socket gear rotates (L3) upon being turned with a ratchet wrench attached to the working head. Rotation of the socket gear is brought about by a pulling motion (L7) of the roller chain occurring towards the working head co-directionally with the shaft member and resulting from turning the ratchet wrench.

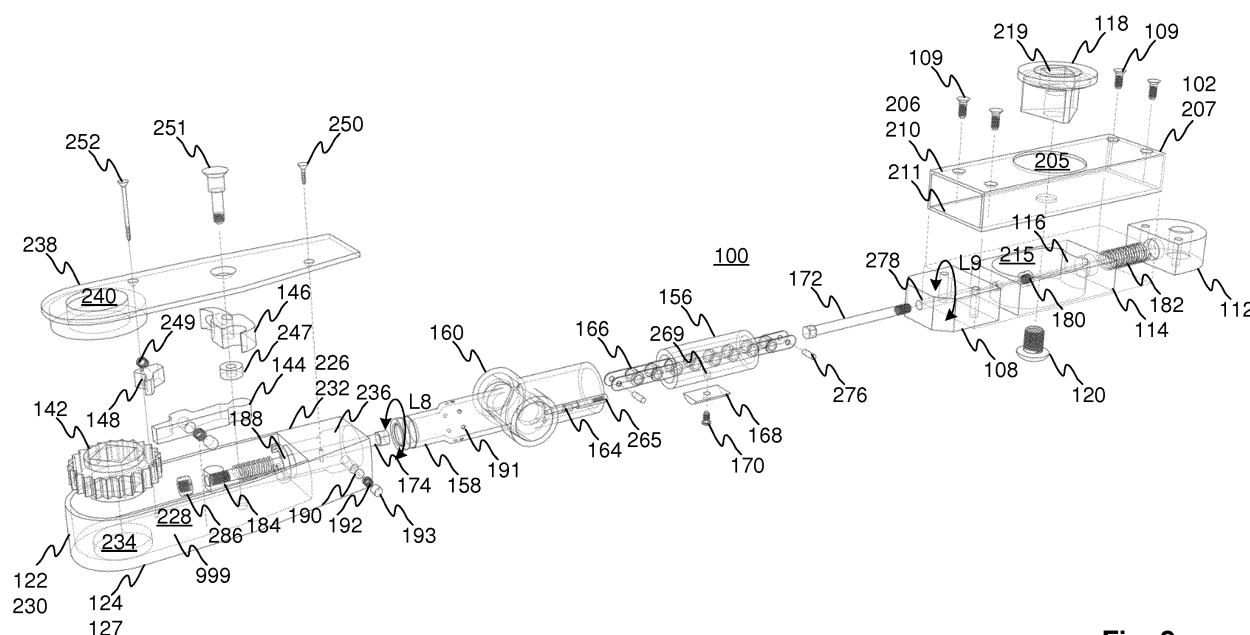


Fig. 2

Description

Technical field

[0001] The application relates generally to a ratchet wrench lengthening handle.

Background

[0002] Traditionally, the loosening and tightening of threaded fasteners, such as bolts and nuts, has been performed by using fork spanners, socket wrenches, and extension handle-equipped socket wrenches.

[0003] A problem with prior known tools is the space required by rotational motion conducted in releasing or securing the same in a confined working space, e.g. in a vehicle's engine compartment or within building structures.

[0004] In addition, it is difficult with prior known tools to generate a sufficient force for overcoming the thread friction in a confined working space once the fastener has been secured or has stuck too tightly to a mounting plate due to rust or dirt.

[0005] Furthermore, in view of occupational safety, it is inconvenient to work in the proximity of vehicles' exhaust manifolds, catalytic converters, etc. while the latter are hot.

Summary

[0006] It is one objective of the invention to solve the prior art problems with a ratchet wrench lengthening handle, which enables the use of a ratchet wrench for releasing and securing a threaded fastener from afar and safely in such a way that the fingers need not be brought to the proximity of the fastener into a working space which is tight, hot or comprises sharp objects.

[0007] The one objective of the invention is attained with a ratchet wrench lengthening handle as defined in the independent claim.

[0008] According to one embodiment of the invention, the ratchet wrench lengthening handle comprises a working head, a shaft member, a pulling head, and a roller chain. To the working head can be releasably attached a ratchet wrench. The shaft member lies between the working and pulling heads. The pulling head is provided with a socket gear to which can be releasably attached a threaded fastener. The socket gear rotates by being driven with a ratchet wrench attached to the working head. Rotation of the socket gear is achieved by a pulling motion of the roller chain occurring towards the working head, co-directionally with the shaft member and caused by turning the ratchet wrench

[0009] Other embodiments of the invention are presented in the dependent claims.

Brief description of the figures

[0010] Some exemplary embodiments of the invention will now be described more precisely with reference to the accompanying figures:

fig. 1a shows a wrench lengthening handle in a plan view
fig. 1b shows the lengthening handle in a side view
fig. 2 shows the lengthening handle in an exploded view

Detailed description of the figures

[0011] Figs. 1a-1b and 2 illustrate a lengthening handle 100 for a wrench (not shown in the figures), which enables use of the wrench to loosen and tighten a threaded fastener (not shown in the figures) afar from the attachment point.

[0012] The wrench can be a male driver-equipped ratchet wrench or a T-wrench.

[0013] The threaded fastener can be e.g. a threaded bolt (a flat head machine screw) or its counterpart nut.

[0014] The fastener attachment point can be in any setting difficult to work with a ratchet wrench, e.g. in the engine compartment of a vehicle, train, airplane or the like means of transport or a working machine, or within building structures.

[0015] The lengthening handle 100 can be e.g. 590, 595, 600, 605 or 610 mm in length.

[0016] The lengthening handle 100 comprises a working head 102 capable of having a wrench attached thereto in a removable manner.

[0017] The working head 102 may comprise its enclosure element 104, having its first end 206 closed with a shaft socket member 108 which can be attached with fastening screws 109 to the enclosure 104 through the latter's top surface 210.

[0018] The manufacturing material for the enclosure 104 can be profile steel.

[0019] A second end 207 of the enclosure 104 is closed with a plug member 112, which can also be attached with screws 109 to enclosure 104 through the latter's top surface 210.

[0020] Alternatively, the socket 108 and/or the plug 112 can be attached through a bottom surface 111 or both surfaces 210, 211 of the enclosure 104.

[0021] The enclosure 104 may be formed with an opening 205 in its top surface 210.

[0022] Inside the enclosure 104 can be a sliding plate 114, designed to have in its middle an opening 215 extending therethrough and having its area confined by a surface 116.

[0023] The sliding plate 114 can be designed e.g. in such a way that the opening 215 therein is in the shape of an oval or rectangle, which is co-directional with the sliding plate 114 and at whose second end, adjacent to the plug 112, the surface 116 is designed as a convex

curved surface 116 converging towards the middle as presented in the figures.

[0024] The sliding plate 114 is installed inside the enclosure 104 so as to enable the sliding plate 114 to move in a longitudinal direction of the enclosure 104 between the ends 206, 207 within a space defined by the top and bottom surfaces 210, 211, the socket 108 and the plug 112.

[0025] The working head 102 may further comprise an eccentric cam spindle 118, which is fitted into the enclosure 104 by way of its opening 205 and attached through the bottom surface 211 with a nut 120 so as to enable the spindle 118 to swivel in a rotational motion L1 around its center axis through 360°.

[0026] The spindle 118 provided with a female driver 219 capable of having the wrench's male driver mated therewith for attaching the wrench to the lengthening handle 100, whereby it is possible with the attached wrench to rotate the spindle around its center axis as indicated by the rotational motion L1.

[0027] The driver 219 can be e.g. 1/2" or 3/8".

[0028] In addition, the spindle 118 may include three cams 117 which enable, jointly with the surface 116, the sliding plate 114 to push itself inside the enclosure 104 in a longitudinal direction towards the plug 112.

[0029] The number of cams 117 can be at least three, e.g. 3, 4 or 5 exemplars.

[0030] The manufacturing material for the socket 108, the plug 112 and the spindle 118 can be chromium-vanadium steel.

[0031] The working head 102 can be constructed so as to enable its rotation (turning) relative to a shaft member 154, functioning as the axis of a rotational motion L9 and included in the lengthening handle 100, in both directions through 360°, thus enabling use of the lengthening handle 100 to loosen and tighten a fastener regardless of the position to which the pulling head 122 included in the lengthening handle 100 has been turned.

[0032] The working head 102 may further comprise a support grip (not shown in the figures) mounted on the socket 108, by means of which the working head 102 can be releasably locked in place after being rotated to a desired position. It is further by means of the support grip that the user operating a ratchet wrench by means of the lengthening handle 100 is enabled to obtain a firm grip on the lengthening handle 100.

[0033] The lengthening handle 100 may additionally comprise the aforesaid pulling head 122, to which a loosenable and/or tightenable fastener can be attached (fitted) in a releasable manner.

[0034] The pulling head 122 may comprise a housing 124 therefor, whose top surface 226 can be formed with a recess (space) 228 so as to be delimited by a side portion 230, an end face 232 and a bottom surface 227 of the housing 124.

[0035] The recess 228 may have its bottom formed with an opening 234 through the bottom surface 227 of the housing 124.

[0036] The housing 124 may have its end face 232 formed with an opening 236 therethrough.

[0037] The space constituted by the recess 228 can be closed with a cover member 238.

5 **[0038]** The cover 238 may be formed with an opening 240 therethrough.

[0039] Inside the housing 124, in the recess 228, can be a socket gear 142 of the pulling head 122, to which is releasably attachable a threaded fastener.

10 **[0040]** The fastener can be attached in a releasable manner directly to the gear 142 into its opening 141 or by way of an adapter matching the fastener in size and fixed releasably in the opening 141.

[0041] The opening 141 can be e.g. square as depicted in the figures, hexagonal or Torx-shaped.

15 **[0042]** The opening (socket) 141 of the gear 142 can be e.g. 1/4", 3/8" or 1/2".

[0043] The gear 142 can be fitted in the recess 228 in a manner to be in alignment with the openings 234, 240.

20 **[0044]** In addition, the recess 228 may contain a push latch 144, it being by virtue of the latter's pushing movement L2 that the gear 142 is forced to turn in the direction of a rotational motion L3.

25 **[0045]** The latch 144 can be provided with a sliding pin 143 pushing itself against an inner surface of the recess 228, and with a return spring 145, both enabling the latch 144 to be pressed into tooth gaps of the gear 142.

30 **[0046]** The recess 228 may further contain a rocker arm 146, it being by virtue of the latter's swinging movement (rotational motion) L4 that the latch 144 is forced to perform the pushing movement L2 which generates a rotational motion L3.

35 **[0047]** The recess 228 may additionally contain a locking latch 148 by means of which the gear 142 is locked in place so as to prevent rotation of the gear 142 against its rotational motion L3.

[0048] The latch 148 may perform a rotational motion L5 and a rotational motion opposite thereto.

40 **[0049]** In addition, the recess 228 may contain a return spring 249 for the latch 148, by means of which the latch 148, during and/or after the pushing movement L2, presses itself, as indicated by the rotational motion L5, against a tooth gap of the gear 142 once the latch 148 has risen in the direction of a movement opposite to the rotational motion L5, as a result of the pushing movement L2, from the preceding tooth gap.

[0050] The cover 238 can be fastened with cover screws 250, 251, 252 to the housing 124.

50 **[0051]** The screw 250 can be fastened through the cover 238 to the end face 232.

[0052] The screw 251 can be fastened through the cover 238 to the bottom of the recess 228 so as to simultaneously secure the rocker arm 146 and the mounting plate 247. The screw 251 enables a movement L4 of the rocker arm 146 and a rotational motion opposite thereto. In addition, the screw 251 functions as an axle so as to allow the rocker arm 146 to rotate in the direction of and against the movement L4 around the screw 251.

[0053] It is a function of the mounting plate 247 to enable a movement L4 and its opposing movement for the rocker arm 146, and to hold the rocker arm 146 stationary even though the rocker arm 146 is fastened with the screw 251.

[0054] The screw 252 can be fastened through the cover 238 to the bottom of the recess 228 so as to simultaneously secure the latch 148. The screw 252 enables a movement L5 and its opposing movement for the latch 148 and functions as an axle so as to enable the latch 148 to rotate in the direction of and against the movement L5 around the screw 252.

[0055] The strength of all the screws 109, 170, 250, 251, 252 included in the lengthening handle 100 may be in the order of 12.9.

[0056] The manufacturing material for the pulling head 122 can be e.g. chromium-vanadium steel.

[0057] The measurements for the working and pulling heads 102, 122 can be e.g. height 19, 20 or 21 mm, width 39, 40 or 41 mm, and length 124, 125 or 126 mm.

[0058] In addition, the lengthening handle 100 may comprise the aforesaid shaft 154, which lies between the working and pulling heads 102, 122.

[0059] The shaft 154 may comprise an elongated hydraulic tube 156, which is e.g. 17, 18 or 19 mm in diameter.

[0060] The shaft 154 may further comprise a joint sleeve 158, which may include a joint 160 that divides the shaft 154 into a section 162 proximal to its pulling head 122 and a section 163 proximal to its working head 102 which may include the tube 156.

[0061] The joint 160 pivots back and forth as indicated by a rotational motion L6 so as to enable the section 162 proximal to pulling head 122 to be pivoted to an angle α of 135°-180° relative to the section 163 proximal to the working head 102.

[0062] The angle α can be e.g. 135°, 145°, 150°, 157,5°, 165°, 170°, or 180° as indicated in the figure.

[0063] This signifies that by virtue the joint 160 it is possible to deflect the shaft member 154 in such a way that the pulling head 122 is at some angle α other than a 180° angle relative to the working head 102, whereby it is by means of the lengthening handle 100 that the turning of a fastener is made possible in a cramped and difficult-to-access space.

[0064] In addition, the shaft 154 may comprise a joint locking latch 164 and a spring 265 therefor.

[0065] It is by means of the latch 164 and the spring 265 that the joint 160 is capable of being locked in some specific position such that the section 162 is at any angle α of 135-180° with respect to the section 163. It is further by means of the same that the joint 160 is releasable from locking so as to enable unimpeded pivoting of the joint 160.

[0066] The joint 160 included in the joint sleeve 158 can be e.g. 34, 35 or 36 mm in width and 26, 27 or 28 mm in height.

[0067] The joint sleeve 158 can have a total length of

e.g. 58, 60 or 62 mm.

[0068] The manufacturing material for components of the joint sleeve 158 can be chromium-vanadium steel.

[0069] The shaft 154 may further comprise a single-row roller chain 166, which is installed inside the shaft 154 so as to be capable of performing a movement L7 and a movement opposite thereto (reciprocating motion) inside the shaft 154 co-directionally therewith between the working and pulling heads 102, 122.

[0070] It is the movement L7 of the roller chain 166, proceeding towards the working head 102 and caused by turning the wrench, which brings about rotation of the gear 142.

[0071] The roller chain 166 is able to travel inside the shaft 154, i.e. the tube 156 and the joint sleeve 158, in keeping with the movement L7 and the movement opposite thereto even with the shaft 154 deflected at the joint 160 to some angle α .

[0072] In addition, the shaft 154 may comprise a guide plate 168, which is installed inside the tube 156. It is by means of the guide plate 168 that the roller chain 166 is held in a steady position inside the shaft 154 so as to be continuously capable of performing its reciprocating motion.

[0073] The guide plate 168 can be fastened onto an inner surface of the tube 156 by means of a screw 170 through an opening 269 in the tube 156.

[0074] The shaft 154 may further comprise a spindle (push rod) 172 for the working head 102, by means of which the movement L7 and its opposite movement of the roller chain 166 are transmitted to the sliding plate 114, and a spindle (push rod) 174 for the pulling head 122, whose movement L7 and its opposite movement are transmitted to the rocker arm 146.

[0075] Each spindle 172, 174 can be attached to the roller chain 166 with a chain pin 276.

[0076] At the working head 102, the spindle 172 is able to work its way through an opening 278 in the socket 108 into an interior of the enclosure 104 and to move in the opening 278. The spindle 172 may attach to the sliding plate 114 by means of a screw 180.

[0077] The machine bolt strength of the spindles 172, 174 can be e.g. in the order of 10.9.

[0078] The plug 112 may include a spring 182, by means of which the sliding plate 114 that has pushed itself towards the plug 112 is returned back towards the socket 108.

[0079] At the pulling head 122, the joint sleeve 158, and at the same time the spindle 174 inside the same, are able to work their way through an opening 236 in the housing 124 into an interior of the housing 124 and to move in the opening 236.

[0080] The spindle 174 may push itself into a space in the recess 228, wherein its end can be fitted with the rocker arm 146 by means of a socket 184 and a nut 286 mounted on the spindle 174.

[0081] The socket 184 enables a movement L4 of the rocker arm 146 and its opposite movement as the spindle

174 is moving co-directionally with the movement L7 or its opposite movement, and the nut 286 secures the socket 184 fixedly to the spindle 174.

[0082] The joint sleeve 158 can be locked to the housing 124 with a retaining ring 188, which secures the joint sleeve 158 to the housing 124 yet enables the housing 124 (pulling head 122) to be rotated in both directions relative to the shaft 154 functioning as an axis of the rotational motion L8, whereby the lengthening handle 100 can be used for loosening and tightening a fastener depending on which way the pulling head 122 has been pivoted.

[0083] The housing 124 can be locked in place, such that the pulling head 122 is not able to pivot relative to the shaft 154, by means of a lock ball 190, which works its way through an opening 189 in the end face 232 of the housing 124 and which is pressed against an appropriate locking groove 191 of the joint sleeve 158 with a lock screw 193 by way of a spring 192. Respectively, the screw 193 also enables the ball 190 to be released from the groove 191, whereby the pulling head 122 is again capable of pivoting relative to the shaft 154.

[0084] The grooves 191 and the locking components 190, 192, 193 provide at least four locking positions. The number of locking positions can be e.g. 4, 6 or 8.

[0085] The grooves 189 can be implemented in such a way that the pulling head 122 can be pivoted e.g. with 45° staging.

[0086] The spindle 174 may further comprise a chain returning spring 194 between the rocker arm 146 and the retaining ring 188. The spring 194 has a function of returning the chain 166 and the spindle 174 back towards the fixedly locked pulling head 122 should the latter have earlier traveled towards the working head 102.

[0087] The working head 102 and the pulling head 122 of the lengthening handle 100 can have a gear ratio of e.g. 1:4 relative to each other.

[0088] The loosening of a tightened fastener by means of a wrench and the lengthening handle 100 begins by fitting the opening 141 of the gear 142 present in the pulling head 122, or an adapter present therein, on the fastener so as to enable its rotation in the loosening direction, and by attaching the male driver of the wrench to the female driver 219 of the spindle 118 included in the working head 102.

[0089] Being turned with the wrench, the spindle 118 rotates according to the movement L1 so as to push, with one of its cams 117 by virtue of the sliding plate's 114 curved surface 116, the sliding plate 114 towards the plug 112, whereby the sliding plate 114 works its way from a basic position, in which none of the spindle's 118 cams 117 is in contact with the curved surface 116, to its extreme position as one of the spindle's 118 cams 117 rises along the curved surface 116 to its top.

[0090] While pushing itself towards the extreme position, the sliding plate 114 also pulls, in keeping with the movement L7, the roller chain 166 attached thereto with the spindle 172, whereby the socket 184 attached to the

roller chain's 166 spindle 174 proximal to the pulling head 122 retreats against an attachment end of the rocker arm 146 pivotable upon the screw 251 towards the working head 102 (end face 232), generating at the same time the rotational motion L5 of the rocker arm 146 in such a way that its other end pivots towards the gear 142. At the same time, the rocker arm 146 pushes the latch 144 forward towards the gear 142 co-directionally with the movement L2, such that the socket gear 142 turns according to the rotational motion L3 one tooth gap forward.

[0091] The latch 148 locks a rotational position of the gear 42 in a way to prevent the socket gear 142 from rotating back against the movement L3.

[0092] As the gear 142 is rotating as indicated by the movement L3, the fastener attached thereto directly or by means of an adapter rotates over some specific distance in its loosening direction.

[0093] As the spindle 118 continues its rotation co-directionally with the movement L1 away from top of the curved surface 116 and before the next cam 117 makes contact with the curved surface 116, the sliding plate 114 starts to move towards its basic position and the socket 108.

[0094] When retreating towards the basic position, the sliding plate 114 also pushes the roller chain 166 against the movement L7, whereby the socket 184, attached to the roller chain's 166 spindle 174, pushes itself, along with the rocker arm's 146 attachment end, towards the gear 142, setting at the same time the rocker arm 146 in a rotational motion against the movement L5 in such a way that the other end of that rocker arm 146 rotates towards the working head 102 (end face 232). At the same time, the rocker arm 146 pulls the latch 144 rearward towards the end face 232 in a direction opposite to the movement L2, the latch 144 having thereby its end pressed, by means of both the pulling motion and the sliding pin 143 and the return spring 145, down into the next tooth gap without turning the gear 142.

[0095] As the turning of a wrench is continued at the working head 102, it is the next cam 117 of the spindle 118 which starts to push, as described above, the sliding plate 114 towards the plug 112, ultimately inducing, by way of the chain 166, rotation of the gear 142 as indicated by the movement L5 and concurrently rotation of the fastener again in its loosening direction.

[0096] Therefore, the repeated turning of the spindle 118 with a wrench produces a reciprocating motion, which is a result of the regularly repeated movement L7 and opposite movements of the roller chain 166 and components connected thereto, and by virtue of which the socket gear 142 rotates to thereby loosen a tightened fastener.

[0097] Tightening of a fastener begins by releasing the pulling head 122 locked in place with the lock screw 193, by turning the pulling head 180° with respect to the shaft 154 and by re-locking it in place.

[0098] This is lowed by fitting the gear 142 included in the pulling head 122, or an adapter present therein, onto

a fastener so as to enable its rotation in the tightening direction, and by fixing a possibly disconnected wrench to the working head 102.

[0099] The lengthening handle 100 transmits rotation of the wrench to the gear 142 in a manner similar to the loosening process, but this time the gear 142, having been rotated by 180°, turns the fastener in its tightening direction which is opposite to its loosening direction.

[0100] By continuing the turning of the spindle 118 with a wrench there is generated a reciprocating motion, which is a result of the regularly repeated movement L7 and opposite movements of the roller chain 166 and components connected thereto, and by virtue of which the gear 142 rotates to thereby secure the fastener to a mounting plate.

[0101] Those described above are just exemplary embodiments of the invention. The principle according to the invention can naturally be varied within the scope of protection defined by the claims, regarding e.g. implementation details as well as fields of use.

Claims

1. A ratchet wrench lengthening handle (100), comprising
a working head (102),
a shaft member (154),
a pulling head (122), and
a roller chain (166),
said working head being capable of having a ratchet wrench releasably attached thereto,
said shaft member being present between the working and pulling heads,
said pulling head being provided with a socket gear (142) capable of having a threaded fastener releasably attached thereto, and
said socket gear rotating (L3) upon being turned with a ratchet wrench attached to the working head,
characterized in that
rotation of the socket gear is brought about by a pulling motion (L7) of the roller chain occurring towards the working head co-directionally with the shaft member and resulting from turning the ratchet wrench.
2. A lengthening handle according to the preceding claim, wherein the roller chain is placed inside the shaft member in a manner to allow its movement inside the shaft member back and forth between the working and pulling heads.
3. A lengthening handle according to either of the preceding claims, wherein the ratchet wrench is attachable to an eccentric spindle (118), which is present at the working head and, by rotating (L1) the same with the ratchet wrench, the roller chain travels towards the pulling head.
4. A lengthening handle according to claim 3, wherein the rotational motion (L1) of the spindle moves a sliding plate (114) at the working head by virtue of its design in such a way that the roller chain is enabled to perform a reciprocating movement co-directional with the shaft member, the movement thereof occurring away from the working head not rotating the socket gear.
5. A lengthening handle according to any of the preceding claims, wherein it is by virtue of the roller chain's pulling motion that a rocker arm (146) present at the pulling head pushes (L4) a push latch (144), whose pushing motion (L2) rotates (L3) the socket gear.
6. A lengthening handle according to any of the preceding claims, wherein the socket gear, which has rotated as a result of the pushing motion, is locked in such a way by a latch (148) present at the pulling head that its reverse rotation is denied.
7. A lengthening handle according to any of the preceding claims, wherein the shaft member includes a joint (160), by means of which it is possible to deflect (L6) the shaft member in such a way that the pulling head is at some angle (α) with respect to the working head.
8. A lengthening handle according to any of the preceding claims, wherein the pulling head is capable of being rotated (L8) relative to the shaft member.
9. A lengthening handle according to any of the preceding claims 2-8, wherein the shaft member includes a guide plate (168), by means of which the roller chain is held in a steady position inside the shaft member so as to be continuously capable of performing its reciprocating motion.
10. A lengthening handle according to any of the preceding claims 5-9, wherein the roller chain's motion is transmitted to the sliding plate and to the rocker arm by way of spindles (172, 174) which are attached to the roller chain.
11. A lengthening handle according to any of the preceding claims, wherein the working head is capable of being rotated (L9) relative to the shaft member.
12. A lengthening handle according to claim 11, wherein the working head is provided with a support grip, by means of which the rotated working head is locked releasably in place.

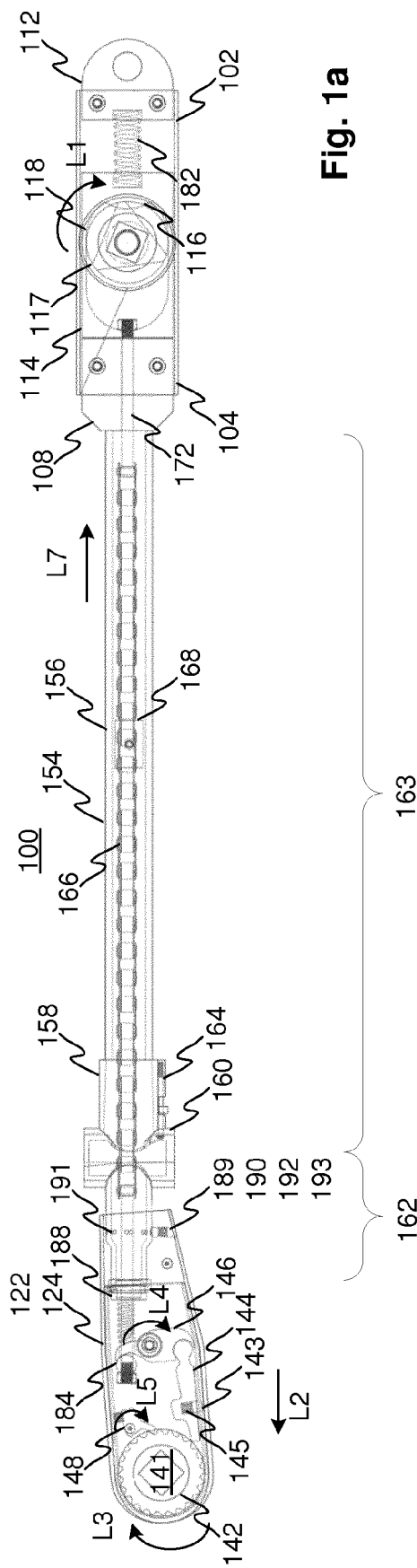


Fig. 1a

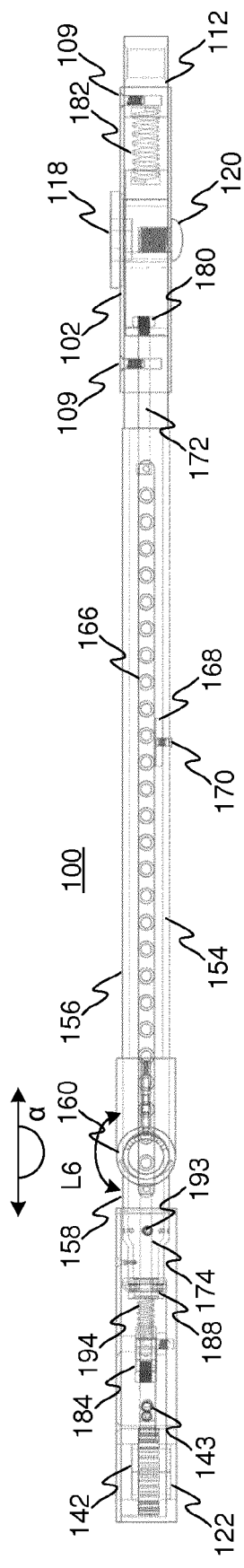


Fig. 1b

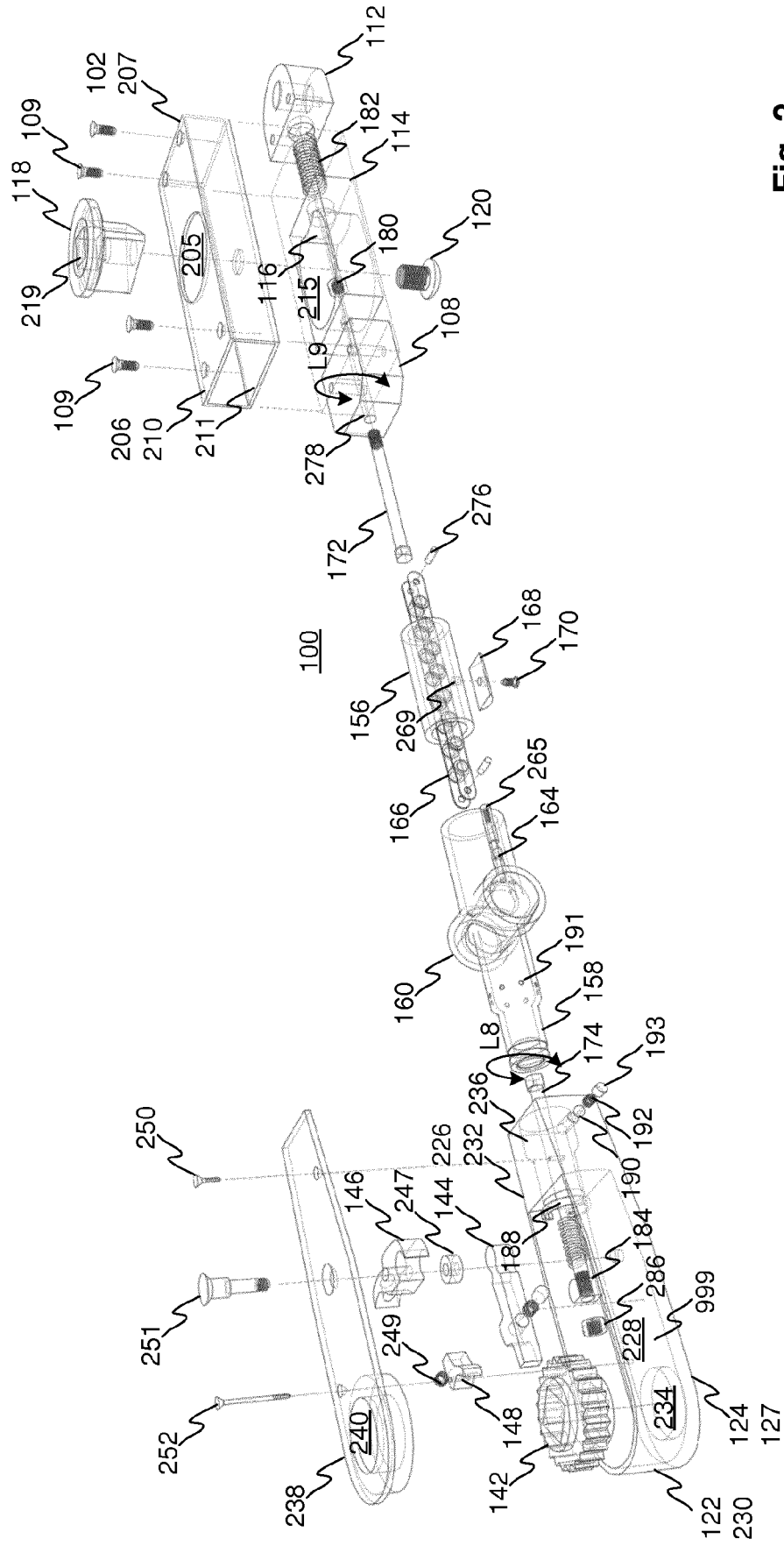


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 19 16 9380

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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Y	* figures 1-13 *	6	B25B17/02
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Y	* figures 1-5 *		
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			TECHNICAL FIELDS SEARCHED (IPC)
			B25B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		21 October 2019	Hartnack, Kai
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)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 16 9380

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82