



(51) International Patent Classification:

G01L 25/00 (2006.01) F16B 5/02 (2006.01)
B25B 23/14 (2006.01)

(21) International Application Number:

PCT/IB2024/062957

(22) International Filing Date:

20 December 2024 (20.12.2024)

(25) Filing Language:

Italian

(26) Publication Language:

English

(30) Priority Data:

102023000027369 20 December 2023 (20.12.2023) IT

(71) Applicant: **ATLAS COPCO INDUSTRIAL TECHNIQUE AB** [SE/SE]; SICKLA INDUSTRIVÄG 19, 105 23 STOCKHOLM (SE).

(72) Inventor: **GIGLIOTTI, Francesco**; Via Lamarmora, 4, 21049 Tradate (VA) (IT).

(74) Agent: **DI GENNARO, Sergio** et al.; c/o BARZANO' & ZANARDO MILANO S.p.A., Via Borgonuovo, 10, 20121 Milan (IT).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: CONNECTION DEVICE BETWEEN A TIGHTENING TOOL AND A ROTARY TRANSDUCER

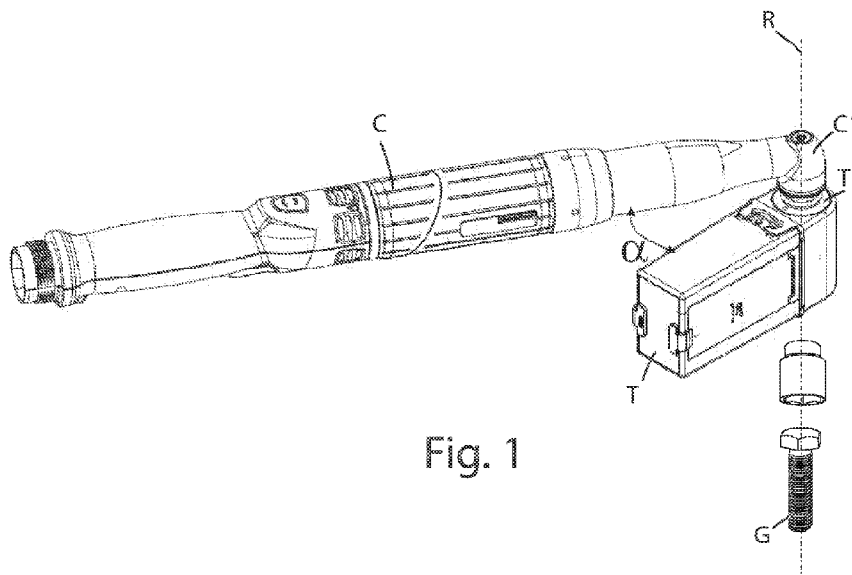


Fig. 1

(57) Abstract: Connection device between a tightening tool (C) and a rotary transducer (T), said tool having an elongated body at the end of which there is a rotating tightening head (CI), capable of being inserted into a seat (TI) located on the upper surface of the transducer (T). Said device includes a lower part or base (2) suitable for being fixed to the upper surface of the transducer (T) and an upper part (3) suitable for being fixed to the elongated body of the tightening tool (C). The lower and upper parts slide longitudinally to each other, i.e. along the longitudinal axis of the tool, while they are locked to each other transversely so as to prevent any relative rotation between transducer and tool around the rotation axis (R) of the tightening head.

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
- *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

Connection device between a tightening tool and a rotary transducer

The present invention relates to a connection device between a tightening tool, for example, a motorized tightening tool, and a rotary transducer.

Through the measurement of the torque exerted and the rotation angle imparted by the tool during screwing, the quality of the tool itself which performed the operation can be determined.

The assessment of the quality of a tightening is a well-recognized issue; for this purpose, electronic transducers are made to measure the features of tools such as industrial screwdrivers or torque wrenches, which include sensors suitable for measuring parameters such as torque, force, angle, and combinations of the above parameters. One application field of said devices is checking the tightening behaviour through the measure of the rotating and/or braking torque of the rotating shaft. Indeed, testing a tightening tool is a procedure which involves performing a tightening sequence, for which torque and angle are measured through such a type of transducer.

The tightening is exerted directly on the joint to be clamped, and the transducer is interposed between the tightening tool and the joint. Such rotary transducers are referred to as «in line» because they are precisely interposed between the joint and the tool to be checked.

European Patent EP4076848 describes a transducer of said type.

During the screwing process, the transducer measures the torque and angle features, which are acquired by a data collector. In particular, for certain transducers, the acquiring function can be integrated in the transducer itself. For the angle, it is important to detect only the absolute rotation angle of the head of the joint, which, along with the torque measure, provides an indication of the preload developed in the joint, i.e. the effectiveness itself of the

tightening process. The angle measure performed by the rotary transducer is generally based on an encoder which detects the rotation of the shaft with respect to the body of the transducer itself. The tightening tool is also provided with an encoder which detects
5 the rotation angle imparted by the torque to the joint.

The applicant has observed that, in order to perform an accurate and reliable comparison between the values detected by the tool and those detected by the transducer, no relative angular offset should be created between the two, such as for example the situation
10 illustrated in Figure 1 (angle α).

When the body of the tool is maintained in a stable position during tightening, constrained by an external reaction, the rotary transducer could be left unconstrained and the body free to rotate, as long as a gyroscopic compensation function is activated. The compensation
15 of the angle of the transducer detects any rotation of the body of the transducer and eliminates its influence from the encoder reading, maintaining the effective angle. However, in this case, the compensated angle reading would have greater uncertainty than the angle measured solely by the encoder, since gyroscope technology
20 typically has greater uncertainty than the encoder. The finding in question prevents the body of the transducer from rotating in said situation and thus makes the compensation null (the function can be disabled), and the angle reading maintained to the minimum uncertainty allowed by the encoder.

Furthermore, certain typologies of tightening tools allow the tightening angle result to be obtained, by compensating for any counter-rotations due to the reaction. In these cases, the tool itself is typically equipped with gyroscopic-type devices which compensate for the relative rotation of the arm. In these cases, if the angle
30 measure provided by the tool is to be checked through an in-line rotating reference transducer, any compensation introduced by the gyroscope of the tool should also be considered. To this end, it is

essential that the transducer accurately measures the same compensation on its side, activating its own gyroscope and performing a rotation of the body of the transducer exactly corresponding to the rotation of the arm of the tool due to the reaction. This is possible with the finding in question, which
5 constrains the body of the transducer to the head of the tool, aligning the readings of the two encoders and, simultaneously, of the two gyroscopes if a rotation of the tool-transducer bodies occurs.

10 Thus, the solution provided by the present invention allows a constraint between tool and transducer to be created, such that the angle measured by the two always has the same reference and there are no offsets.

One aspect of the present invention relates to a connection device
15 between a tightening tool and a tightening rotary transducer having the features of claim 1.

Further objects and advantages of the present invention will be apparent from the following description and the attached drawings, provided purely as an explanatory and non-limiting example,
20 wherein:

- Figure 1 illustrates a tightening tool associated with a transducer in a condition misaligned to each other;
- Figure 2 illustrates a tightening tool associated with a transducer using the device of the present invention;
- 25 - Figure 3 illustrates an exploded view of the device of the present invention associated with a transducer;
- Figure 4 illustrates an exploded perspective view of the device of the present invention.

With reference to the cited figures, the connection device according
30 to the present invention is interposed between a tightening tool C and a rotary transducer T. Said instrument has an elongated body at the end of which there is a rotating tightening head C1, which is

inserted into a seat T1 located on the upper surface of the transducer T. Said seat rotates in the body of the transducer and transfers the rotation imparted by the head of the tool C to the joint G located below the transducer.

5 Said device includes a lower part or base 2 suitable for being fixed to the upper surface of the transducer T and an upper part 3 suitable for being fixed to the elongated body of the tightening tool C. The lower and upper parts can slide longitudinally to each other (X-axis), i.e., along the longitudinal axis of the tool, so as to adapt the
10 shape of different tool models to the upper part and to make the tool head C1 of the tightening tool correspond with the seat T1 of the transducer, while they are locked to each other transversely (Y-axis), so as to prevent any relative rotation between transducer and tool around the rotation axis (R) of the tightening head.

15 Said upper part is substantially U-shaped so as to form a housing for the elongated body of the tightening tool. The side walls 31 of the U can either be fixed or translate transversely with respect to the longitudinal direction corresponding to the Y-axis so as to adapt to the diameter of the elongated body of the tool and securely
20 constrain it.

Furthermore, said walls have differentiated heights, particularly a higher first portion 311 which matches the elongated body, and a lower one 312 which allows the device to be easily handled by the operator which performs the tightening tests.

25 Furthermore, said upper portion includes on its horizontal part 32 at least one longitudinal groove elongated 33 in the longitudinal direction, which corresponds to at least one hole 22 obtained on the lower part. Screws or equivalent means allow to constrain the lower part to the upper one, and the grooves allow the two parts to slide
30 longitudinally, so as to assume a plurality of relative positions with respect to each other.

Preferably, there are two grooves parallel to each other, which

correspond to two pairs of holes on the lower part.

Said lower part 2 includes a pair of fins 21 which extend below the sides of the base so as to accommodate the upper surface of the transducer. Furthermore, said lower part includes a cantilevered
5 front protuberance 23 on which openings 24 used for fastening means (i.e. screws) with the transducer are obtained.

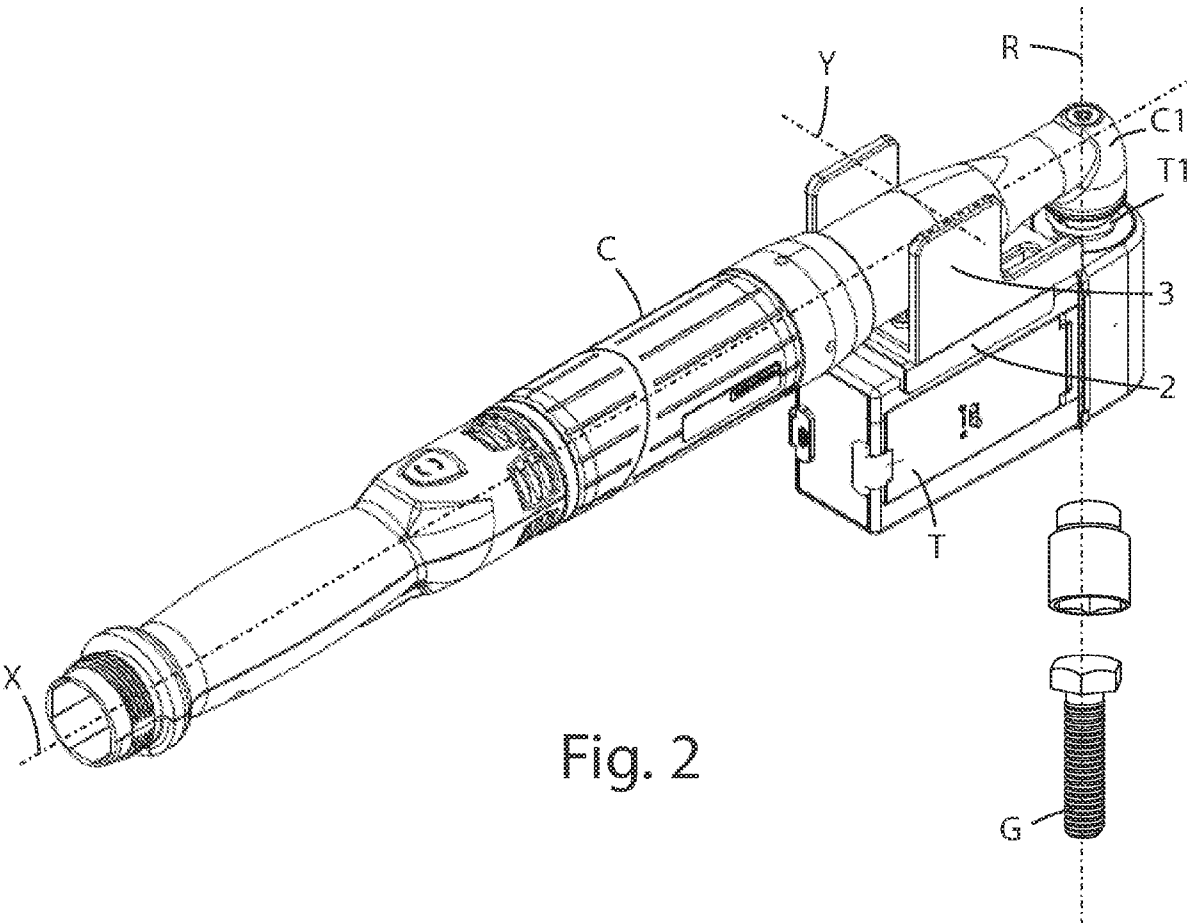
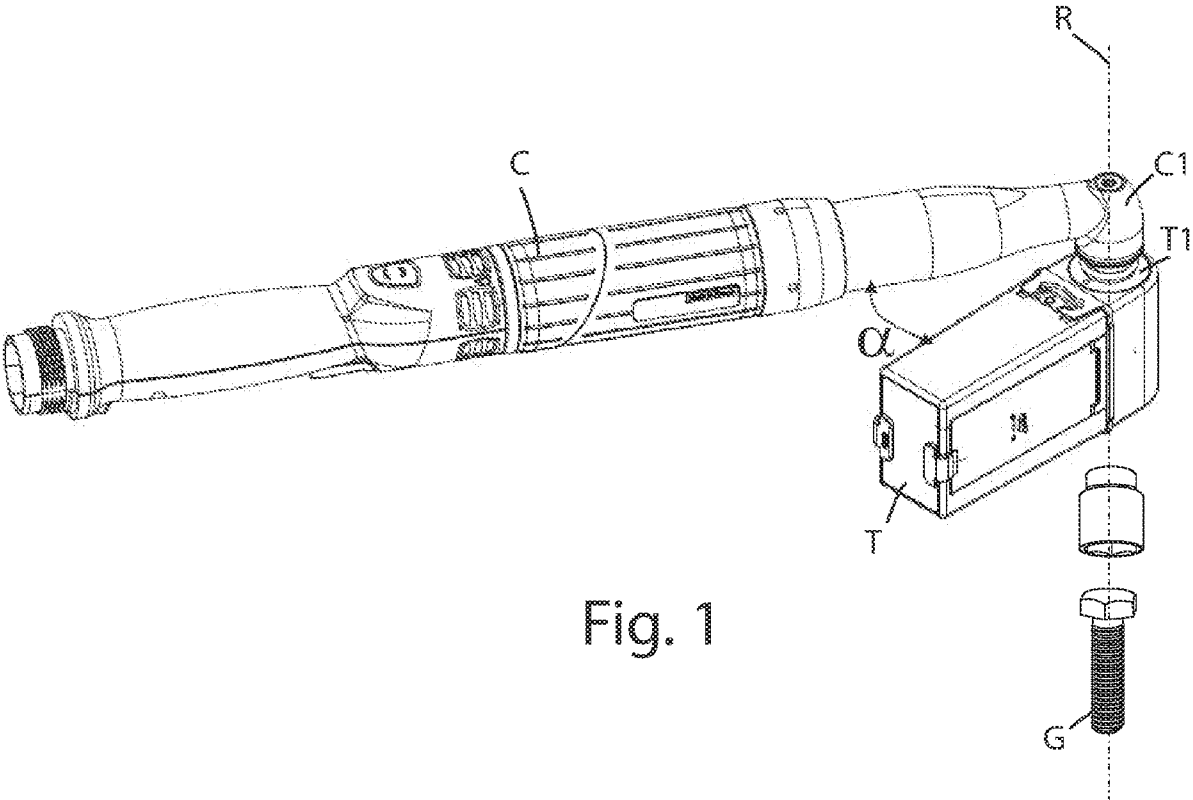
Preferably, both the upper and lower parts are made of a plastic material.

CLAIMS

1. Connection device between a tightening tool (C) and a rotary transducer (T),
said instrument having an elongated body at the end of which there
5 is a rotating tightening head (C1) capable of being inserted into a
seat (T1) located on the upper surface of the transducer (T),
said device includes a lower part or base (2) suitable for being fixed
to the upper surface of the transducer (T) and an upper part (3) suit-
able for being fixed to the elongated body of the tightening tool (C),
10 the lower and upper parts slide longitudinally to each other, i.e.
along the longitudinal axis of the instrument, while they are locked
to each other transversely so as to prevent any relative rotation
between transducer and instrument around the rotation axis (R) of
the tightening head.
- 15 2. Device according to claim 1, wherein said upper part is
substantially U-shaped so as to form a housing for the elongated
body of the tightening tool.
3. Device according to claim 2, wherein the side walls (31) of
the U can be fixed or can translate transversely so as to adapt to the
20 diameter of the elongated body of the instrument and securely
constrain it.
4. Device according to claim 1, in which said upper portion
includes on its horizontal part (32) at least one groove elongated
(33) in the longitudinal direction which corresponds to at least one
25 hole (22) obtained on the lower part, screws or equivalent means
allowing to constrain the lower part to the upper one and the
grooves allow the two parts to slide longitudinally so as to assume a
plurality of relative positions with respect to each other.
5. Device according to claim 1, wherein this lower part (2)
30 includes a pair of fins (21) which extend below the sides of the base
so as to accommodate the upper surface of the transducer.
6. Device according to claim 1, in which this lower part

comprises a cantilevered front protuberance (23) on which openings (24) used for fastening means with the transducer are obtained.

7. Device according to claim 1, wherein both the upper and lower parts are made of a plastic material.



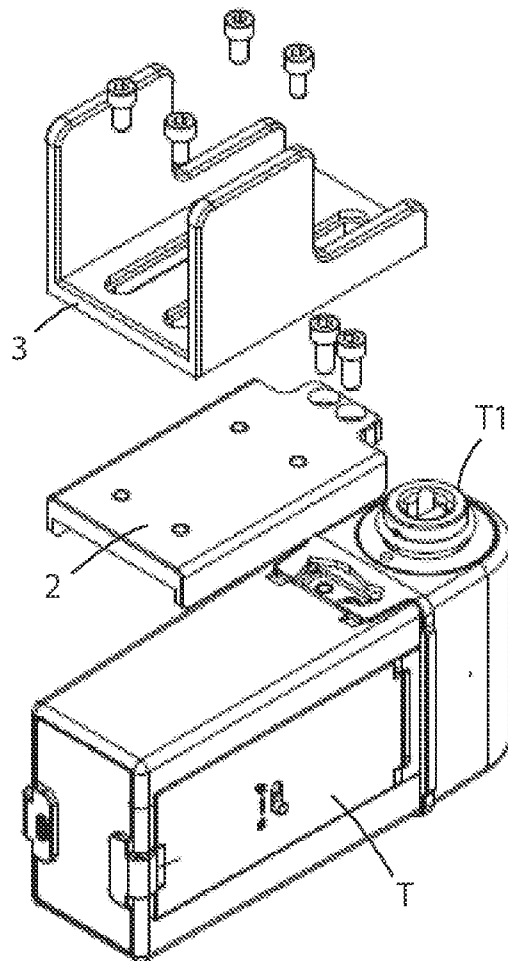


Fig. 3

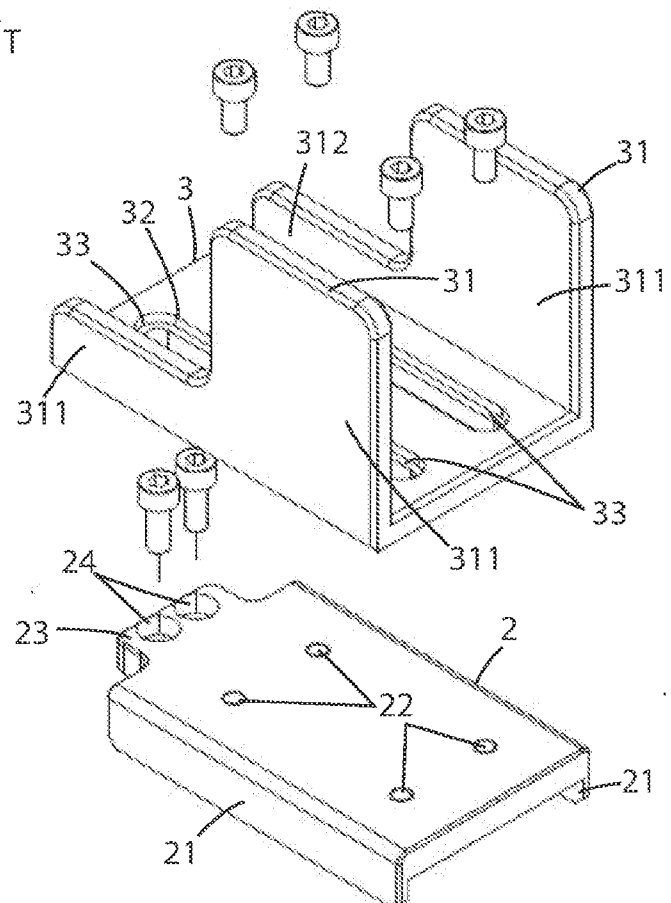


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/062957

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01L25/00 B25B23/14 F16B5/02
ADD.

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)

G01L B25B F16B

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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/122614 A1 (SHOWA SHELL SEKIYU [JP]; AKIBA TOSHIROU [JP]; OOMOTO SEIJI [JP]) 6 October 2011 (2011-10-06) paragraph [0008]; figures 2,3 -----	1 - 7
A	US 2023/070284 A1 (SANDY MICHAEL ROBERT [US]) 9 March 2023 (2023-03-09) paragraphs [0005], [0023]; figure 1 -----	1 - 7
A	WO 2021/124185 A1 (ATLAS COPCO IND TECHNIQUE AB [SE]) 24 June 2021 (2021-06-24) cited in the application abstract -----	1 - 7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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

15 April 2025

Date of mailing of the international search report

29/04/2025

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Keita, Mamadou

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2024/062957

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011122614 A1	06-10-2011	JP 4943528 B2 JP 2011208654 A WO 2011122614 A1	30-05-2012 20-10-2011 06-10-2011
US 2023070284 A1	09-03-2023	CN 115151381 A EP 4100209 A1 US 2023070284 A1 WO 2021167668 A1	04-10-2022 14-12-2022 09-03-2023 26-08-2021
WO 2021124185 A1	24-06-2021	EP 4076848 A1 IT 201900024721 A1 US 2022373410 A1 WO 2021124185 A1	26-10-2022 19-06-2021 24-11-2022 24-06-2021