



(12)

EUROPEAN PATENT APPLICATION

- (43)

Date of publication:
24.07.2024 Bulletin 2024/30
- (51)

International Patent Classification (IPC):
B25F 5/00 (2006.01) F01C 13/02 (2006.01)
F01C 21/18 (2006.01)
- (21)

Application number: 23215100.1
- (52)

Cooperative Patent Classification (CPC):
B25F 5/00; F01C 13/02; F01C 21/18
- (22)

Date of filing: 07.12.2023

- (84)

Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN
- (71)

Applicant: KS TOOLS Werkzeuge-Maschinen
GmbH
63150 Heusenstamm (DE)

(72)

Inventor: Altin, Orhan
63150 Heusenstamm (DE)

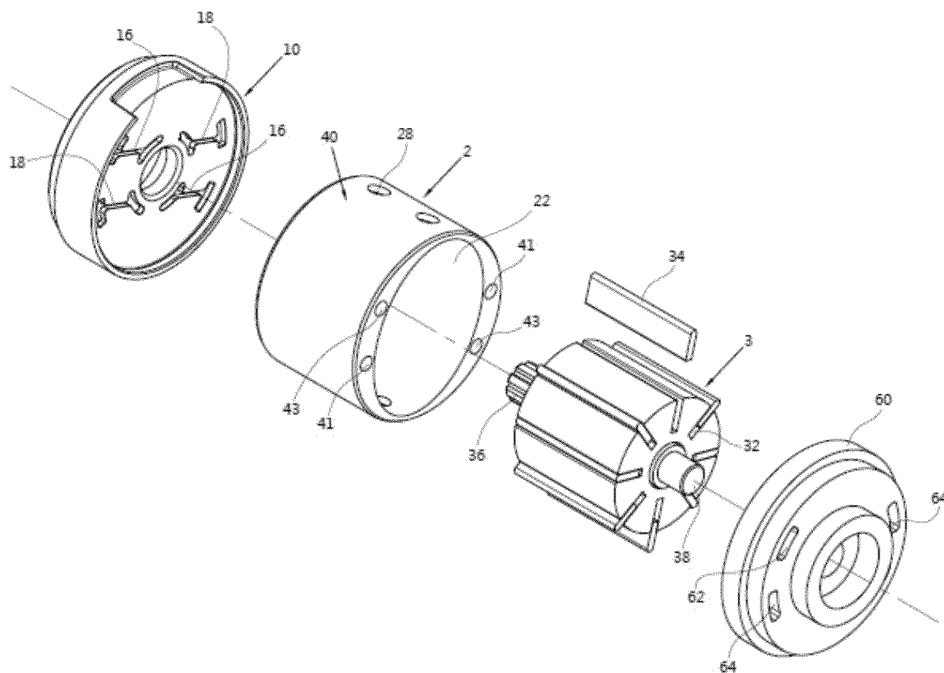
(74)

Representative: Schwerbrock, Florian
Hagenauer Strasse 1
10435 Berlin (DE)

(30)

Priority: 19.01.2023 TW 112102877
- (54)

PNEUMATIC TOOL MOTOR INCLUDING SIDE COVER WITH AIRFLOW-GUIDING STRUCTURE
- (57)

A pneumatic tool motor (10) comprises a cylinder (2), a side cover (10) disposed on a front end of the cylinder (2), and a rear cover (60) disposed on a rear end of the cylinder (2). The side cover (10) includes two first gas accumulation grooves (12) and two second gas accumulation grooves (14). Each of the first and second gas accumulation grooves (12, 14) includes a gas accumulation portion (121, 141) aligned with an associated discharge passage (43) or inlet passage (41) and a gas guiding portion (122, 142) shallower than the gas accumulation portion (121, 141). Each of two exhaust ports (64) and two inlet ports (62) of the rear cover (60) includes a gas accumulation portion (641, 621) aligned with an associated discharge passage (43) or inlet passage (41) and a gas guiding portion (642, 622) shallower than the gas accumulation portion (641, 621).
- 
- FIG 2
- Processed by Luminess, 75001 PARIS (FR)
- EP 4 403 311 A1

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a pneumatic tool motor including a side cover with an airflow-guiding structure and, more particularly, to an airflow-guiding structure for a side cover of a pneumatic tool motor cylinder, which reduces the wear caused by operation of the vanes of the rotor and increases the airtight effect through disposition of air accumulation grooves.

[0002] In operation of a pneumatic tool motor, high pressure air is introduced into a pneumatic tool body and passes through air guiding holes to drive vanes of a rotor in the pneumatic tool body, thereby generating a rotational power transmitted to a driving end of the pneumatic tool for driving a tool. With continuous developments of the products, designers try to obtain the maximum force for driving the rotor at a fixed input air pressure. Namely, the vanes of the rotor can withstand the maximum air pressure by providing a better air supply condition for the introduced high pressure air, thereby enhancing the output power of the rotor. This is the major issue in the design of pneumatic tool motors for a long time, and the design pattern of increasing the rotor output power by increasing the air input can be analyzed through analysis of historic patent applications for pneumatic tool motors.

[0003] After introducing the high pressure air into the pneumatic tool body, the high pressure air is filled through air guiding holes into a cylinder chamber receiving the rotor. However, in a case that the diameters of the outlets of the air guiding holes are not changed, it is difficult to instantly fill a large amount of high pressure air into the cylinder chamber to drive the vanes for high-torque rotation. To this end, U.S. Patent No. 2,424, 638 ('638 patent) filed Nov. 8, 1994 discloses secondary ports 48 which are radially outside of the through-ports 52 and in the form of grooves with larger volumes. The '638 patent clearly discloses the air current from the through-ports 52 flows out of the secondary ports 48 and into the pneumatic tool body. Thus, high pressure air is guided by the through-ports 52 and is filled into the cylinder chamber for driving the rotor received in the cylinder chamber. Although the '638 patent does not clearly teach the operation of the secondary ports 48, a person skilled in the art may easily understand its purposes of generating a higher air pressure through filling a larger airflow into the secondary ports 48.

[0004] U.S. Patent No. 3,472,323 ('323 patent) filed Oct. 24, 1967 also discloses an exhaust passage 12 in FIGS. 5 and 6 and teaches that the gas passing through the exhaust passage 121 flows out of a port 118 of a groove which widens outward at an outer side of the exhaust passage 121 and is then guided into the pneumatic tool body. Thus, the high pressure air can be filled through the exhaust passage 121 into the exhaust chamber 54 to rotate the rotor 50 received in the exhaust chamber 54. It can be seen that providing a gas groove which

widens outward at the edge of the exhaust hole of the pneumatic tool cylinder body is a known design for increasing the air pressure operation.

[0005] Furthermore, Swedish Patent No. SE 515533 C2 ('533 patent) discloses four air inlets 32, 33, 35, and 36 in FIGS. 2 and 3 to permit operations in reverse directions, and gas grooves which widen outward are also provided at edges of the air inlets 32, 33, 35, and 36 to increase the inlet amount of air.

[0006] U.S. Patent No. 6,250,399 B1 ('399 patent) filed Sep. 13, 1999 discloses two first ports 35, 37 and two second ports 36, 38 (FIG. 9) to permit operations in reverse directions. FIG. 11 illustrates the inner housing 30 having a plurality of openings 31-34 which allow pressurized air to pass from the valve housing 12 into the ports 35-38. The first ports 35, 37, either alone or in combination, drive the rotor in a first direction when pressurized air is directed through the openings 31 and/or 33. Similarly, the second ports 36, 38 drive the rotor in a second direction, either alone or in combination, when pressurized air is directed through the openings 32 and/or 34. When two ports are receiving pressurized air, the tool will be in an overdrive state. Namely, in '399 patent, the first and second ports 35-38 intercommunicate with inner grooves in the body of a side cover, such that pressurized air can be guided to drive the rotor to thereby generate a high-speed driving force. Although '399 patent does not clearly illustrate enlarged guiding grooves extending from the inlet ports, the difference is merely a measure combining a conventional technique.

[0007] U.S. Patent Publication No. 2004/0197218 A1 ('218 application) filed Mar. 8, 2004 discloses a pneumatic tool body in the form of a cylinder including air inlets 11 and back pressure air outlets 12, which are disposed at a side wall of the cylinder, and an air outlet 13 is formed on another side of the cylinder opposite to the air inlets 11 and the back pressure air outlets 12. When the rotor 2 spins a half cycle in the clockwise direction, the pressurized air within each air room C is expelled from the air outlet 13 when the rotor reaches to the air outlet 13. When the rotor 2 spins to a full cycle, the back pressure air in each air room C is expelled from the back pressure air outlets 12. When the rotor 2 spins in the counterclockwise direction, the pressurized air is sucked in via the back pressure air outlets 12 and is expelled via the air outlet 13 and the air inlets 11 subsequently. As can be seen from the figures of '218 application, gas grooves which widen outward are disposed on outer edges of the air inlets 11 and the back pressure air outlets 12 to increase the inlet amount of air. Thus, '218 application can be deemed as a derivative design of the conventional technique.

[0008] FIG. 1 shows a pneumatic motor with dual air intake disclosed in Taiwan Utility Model No. M541520 ('520 patent) which is a counterpart patent application of EP 3,351,723 B1. The '520 patent discloses a pneumatic cylinder 2 and a rotor 3. The pneumatic cylinder 2 includes a cylinder body 20 and an accommodating room

22 located in the cylinder body 20. The cylinder body 20 has two air inletting paths 24, two air venting paths 26, four air venting holes 28 and a front axial hole 29. The cylinder body 20 includes a middle pipe 40, a front cover 50 disposed on a front end 40a of the middle pipe 40, and a rear cover 60 disposed on a rear end 40b of the middle pipe 40. The front axial hole 29 is provided on the front cover 50. The four venting holes 28 are provided on the top and bottom sides of the middle pipe 40. The rear cover 60 has two air inlets 62 spaced from each other by 180 degrees, two air outlets 64 spaced from each other by 180 degrees, two rear air inletting grooves 66 provided on a front wall of the rear cover 60 and connected with the two air inlets 62 respectively, two rear air venting grooves 68 provided on the front wall of the rear cover 60 and connected with the two air outlets 64 respectively, and a rear axial hole 69.

[0009] The middle pipe 40 is provided on the rear end 40b thereof with two rear air inletting recesses located correspondingly to the two air inlets 62 and communicating with the accommodating room 22, and two rear air venting recesses 44 located correspondingly to the two air outlets 64 and communicating with the accommodating room 22. The middle pipe 40 further has two air inletting channels 41 penetrating through the middle pipe 40 along an axis X of the cylinder 20 and connected with the two rear air inletting recesses 42 respectively, two air venting channels 43 penetrating through the middle pipe 40 along the axis X and connected with the two rear air venting recesses 42 respectively, two front air inletting recesses 46 provided on the front end 40a of the middle pipe 40 and connected with the two air inletting channels 41 respectively, and two front air venting recesses 48 provided on the front end 40a of the middle pipe 40 and connected with the two air venting channels 43 respectively. The two front air inletting recesses 46 and the two front air venting recesses 48 all communicate with the accommodating room 22.

[0010] The front cover 50 has two front air inletting grooves 56 provided on a rear wall of the front cover 50 and communicating with the two air inletting channels 41 respectively, and two front air venting grooves 58 provided on the rear wall of the front cover 50 and communicating with the two air venting channels 43 respectively. Each of the air inletting paths 24 is composed of one of the air inlets 62, one of the rear air inletting grooves 66, one of the rear air inletting recesses 42, one of the air inletting channels 41, one of the front air inletting recesses 46, and one of the front air inletting grooves 56. Each of the air venting paths 26 is composed of one of the air outlets 64, one of the rear air venting grooves 68, one of the rear air venting recesses 44, one of the air venting channels 43, one of the front air venting recesses 48, and one of the front air venting grooves 58. In other potential embodiments, the front cover 50 and the middle pipe 40 may be formed integrally.

[0011] The air firstly passes through the two air inlets 62, and then divided into three parts. A first part of the

air flows into the accommodating room 22 through the two rear air inletting recesses 42. A second part of the air enters the two rear air inletting grooves 66 and then flows into the accommodating room 22. A third part of the air passes through the two air inletting channels 41 and is divided into two parts. One part of the air flows into the accommodating room 22 through the two front air inletting recesses 46. The other part of the air enters the two front air inletting grooves 56 and then flows into the accommodating room 22. The air entering the accommodating room 22 blows the vanes 34 to move, causing the vanes 34 to move out from the grooves 32 and abut against the inner wall of the accommodating room 22. At this time, another portion of the air pushes the extended-out vanes 34 to move, thereby driving the rotor 3 to rotate in the accommodating room 22.

[0012] The following is the detailed process that the air leaves the accommodating room 22 through the two air venting paths 26. Firstly, the air is partially vented through the air venting hole 28 in the first air venting process. Then, a part of the air directly enters the rear air venting recess 44 and vented from the air outlet 64, another part of the air enters the rear air venting groove 68 and vented from the air outlet 64, and the remaining part of the air enters the air venting channel 43 through the front air venting recess 48 and the front air venting groove 58 and then vented from the air outlet 64, so that the second air venting process is accomplished.

[0013] However, the '520 patent has the following disadvantages. When the rotor 3 rotates in the accommodating room 22 at a high speed and a high torque, the vanes 34 move outward from the grooves 32 and abut against the inner wall of the accommodating room 22 at a high speed and a high pressure. At this time, the extended-out vanes 34 will pass through the two rear air inletting recesses 42 and two rear air venting recesses 44 and reach the notches formed in the inner wall of the accommodating room 22. After long-term operation, the notches formed in the inner wall of the accommodating room 22 will cause abrasion of corners at the top edges of the vanes 34 under stress. The output of the rotor 3 is related to the airtight extent between the rotating vanes 34 and the inner wall of the accommodating room 22. The higher the airtightness, the better the driving efficiency of the pressurized air. When the airtightness is reduced, the speed and the torque of the rotor will be reduced significantly, shortening the service life of the product.

[0014] Thus, a need exists for a novel pneumatic tool motor which mitigates and/or obviates the above drawbacks.

BRIEF SUMMARY OF THE INVENTION

[0015] To solve the disadvantages of the prior art, an objective of the present invention is to provide a pneumatic tool motor comprising: a cylinder including a chamber, two inlet passages, two discharge passages, and

two exhaust holes; a rotor received in the chamber and including a plurality of channels receiving a plurality of vanes; a side cover disposed on a front end of the cylinder and configured for guiding airflow, with two front inlet guiding grooves provided on a rear wall of the side cover and respectively intercommunicating with the two inlet passages, with two front discharge guiding grooves provided on the rear wall of the side cover and respectively intercommunicating with the two discharge passages; and a rear cover disposed on a rear end of the cylinder, with the rear cover including two inlet ports and two exhaust ports, with two rear input guiding grooves provided on a front wall of the rear cover and respectively intercommunicating with the two inlet passages, with two rear output guiding grooves provided on the front wall of the rear cover and respectively intercommunicating with the two discharge passages.

[0016] The side cover includes two first gas accumulation grooves associated with the two front inlet guiding grooves respectively and aligned with the two discharge passages. Each of the two first gas accumulation grooves includes a gas accumulation portion aligned with an associated discharge passage and a gas guiding portion which intercommunicates with an associated front inlet guiding groove and which is shallower than the gas accumulation portion of the first gas accumulation groove.

[0017] The side cover further includes two second gas accumulation grooves associated with the two front discharge guiding grooves respectively and aligned with the two inlet passages respectively. Each of the two second gas accumulation grooves includes a gas accumulation portion aligned with an associated inlet passage and a gas guiding portion which intercommunicates with an associated front discharge guiding groove and which is shallower than the gas accumulation portion of the second gas accumulation groove.

[0018] Each of the two exhaust ports includes a gas accumulation portion aligned with an associated discharge passage and a gas guiding portion which intercommunicates with an associated rear output guiding groove and which is shallower than the gas accumulation portion of the exhaust port.

[0019] Each of the two inlet ports includes a gas accumulation portion aligned with an associated inlet passage and a gas guiding portion which intercommunicates with an associated rear input guiding groove and which is shallower than the gas accumulation portion of the inlet port.

[0020] In an example, each of the two first gas accumulation grooves) has an area greater than an associated discharge passage. Each of the two second gas accumulation grooves has an area greater than an associated inlet passage. The gas guiding portion of each of the two first gas accumulation grooves is within an extent of an associated gas accumulation groove. The gas guiding portion of each of the two second gas accumulation grooves is within an extent of an associated gas accumulation groove. Each gas guiding portion of the rear

cover is within an extent of an associated gas accumulation groove.

[0021] The present invention will become clearer in light of the following detailed description of illustrative embodiments of this invention described in connection with the drawings.

DESCRIPTION OF THE DRAWINGS

10 **[0022]**

FIG. 1 is an exploded, perspective view corresponding to FIG. 2 of Taiwan Utility Model No. M541520.

FIG. 2 is a partial, exploded, perspective view of a pneumatic tool motor of a preferred embodiment according to the present invention.

FIG. 3 is a perspective view of the pneumatic tool motor of FIG. 2 after assembly.

FIG. 4 is a perspective view of an airflow-guiding side cover of FIG. 2.

FIG. 5 is a plan view of the airflow-guiding side cover of FIG. 4.

FIG. 6 is another exploded, perspective view of the pneumatic tool motor of FIG. 2.

FIG. 7 is a plan view of a rear cover of the pneumatic tool motor of FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

30 **[0023]** With reference to FIGS. 2, 3, and 6, a pneumatic tool motor according to the present invention comprises a cylinder 20 having a chamber 20, four exhaust ports 28, and a middle tube 40. A side cover 10 for guiding airflow is disposed on a front end of the middle tube 40. 35 A rear cover 60 is disposed on a rear end of the middle tube 40. Two of the four exhaust ports 28 are disposed on a side of the middle tube 40, and another two exhaust ports 28 are disposed on another side of the middle tube 40 opposite to the side of the middle tube 40 and aligned with the two of the four exhaust ports 28 respectively. 40 The rear cover 60 includes two diametrically disposed inlet ports 62 and two diametrically disposed outlet ports 64. With reference to FIGS. 6 and 7, the rear cover 60 further includes a front side having two rear input guiding grooves 66 intercommunicating with the two inlet ports 62 respectively. The front side of the rear cover 60 further includes two rear output guiding grooves 68 intercommunicating with the two exhaust ports 64 respectively. 45 The rear end of the middle tube 40 intercommunicates with the chamber 22. The middle tube 40 further includes two diametrically disposed inlet passages 41 each extending through the middle tube 40 along an axis parallel to a central axis X of the middle tube 40. The two inlet passages 41 intercommunicate with the two exhaust ports 64 respectively. The middle tube 40 further includes two diametrically disposed discharge passages 43 each extending through the middle tube 40 along an axis parallel to the central axis X of the middle tube 40. The two

discharge passages 43 intercommunicate with the two inlet ports 62 respectively.

[0024] With reference to FIGS. 4-7, the side cover 10 includes two front inlet guiding grooves 16 disposed on a side wall of the side cover 10 and respectively intercommunicating with the two inlet passages 41 of the middle tube 40. The side wall of the side cover 10 further includes two front discharge guiding grooves 18 respectively intercommunicating with the two discharge passages 43 of the middle tube 40.

[0025] Thus, the pneumatic tool motor includes two inlet passageways and two discharge passageways. Each of the two inlet passageways is comprised of one of the inlet ports 62, one of the two rear input guiding grooves 66, one of the two inlet passages 41, and one of the front inlet guiding grooves 16. Each of the two discharge passageways is comprised of one of the two exhaust ports 64, one of the two rear output guiding grooves 68, one of the two discharge passages 43, and one of the front discharge guiding grooves 18.

[0026] The side cover 10 includes two first gas accumulation grooves 12 associated with the two front inlet guiding grooves 16 respectively and aligned with the two discharge passages 43 of the middle tube 40 respectively. Each of the two first gas accumulation grooves 12 has an area covering an associated discharge passage 43 of the middle tube 40. Each of the two first gas accumulation grooves 12 includes a gas accumulation portion 121 aligned with the associated discharge passage 43 of the middle tube 40 and a gas guiding portion 122 which intercommunicates with an associated front inlet guiding groove 16 and which is shallower than the gas accumulation portion 121 of the first gas accumulation groove 12.

[0027] Furthermore, the side cover 10 includes two second gas accumulation grooves 14 associated with the two front discharge guiding grooves 18 respectively and aligned with the two inlet passages 41 of the middle tube 40 respectively. Each of the two second gas accumulation grooves 14 has an area covering an associated inlet passage 41 of the middle tube 40. Each of the two second gas accumulation grooves 14 includes a gas accumulation portion 141 aligned with the associated inlet passage 41 of the middle tube 40 and a gas guiding portion 142 which intercommunicates with an associated front discharge guiding groove 18 and which is shallower than the gas accumulation portion 141 of the second gas accumulation groove 14.

[0028] Each of the two exhaust ports 64 is aligned with an associated discharge passage 43 of the middle tube 40 and has an area covering the associated discharge passage 43. Each of the two exhaust ports 64 includes a gas accumulation portion 641 aligned with the associated discharge passage 43 of the middle tube 40 and a gas guiding portion 642 which intercommunicates with an associated rear output guiding groove 68 and which is shallower than the gas accumulation portion 641 of the exhaust port 64.

[0029] Each of the two inlet ports 62 is aligned with an

associated inlet passage 41 of the middle tube 40 and has an area covering the associated inlet passage 41. Each of the two inlet ports 62 includes a gas accumulation portion 621 aligned with the associated inlet passage 41 of the middle tube 40 and a gas guiding portion 622 which intercommunicates with an associated rear input guiding groove 66 and which is shallower than the gas accumulation portion 621 of the inlet port 62.

[0030] In the preferred embodiment of the present invention, each gas guiding portion 122, 142, 622, 642 is within the extent of an associated gas accumulation groove 121, 141, 621, 641.

[0031] The rotor 3 is rotatably received in the chamber 22 of the cylinder 2 and includes a plurality of channels 32 receiving a plurality of vanes 34 respectively. A front axle 36 extends forward from the rotor 3 and extends beyond the cylinder 2 to abut against the front cover 50. A rear axle 38 extends outward from the rotor 3 and extends beyond the cylinder 2 to abut against the rear cover 60.

[0032] By the provision of the first and second gas accumulation grooves 12, 14 on the side cover 10 and the gas accumulation portions 621, 641 on the rear cover 60, high pressure air currents can be filled into the chamber 22 via the gas accumulation portions 122, 142, 621, 641 to actuate the vanes 34 of the rotor 3. Furthermore, a portion of the air currents is guided by the gas guiding portions 122, 142, 622, 642 into a central portion of the chamber 22 to generate back pressure acceleration for outward movement of the vanes 34 to abut against the inner wall of the chamber 22, thereby enhancing the airtightness.

[0033] Due to provision of the gas accumulation grooves 12, 14 of the side cover 10 and the gas accumulation portions 621, 641 on the rear cover 60, the chamber 22 is free of notches contacting with the vanes 34. This reduces rotational loss of the rotor 34 and maintains excellent airtightness, which is more durable and provides enhanced effect.

[0034] Thus since the invention disclosed herein may be embodied in other specific forms without departing from the spirit or general characteristics thereof, some of which forms have been indicated, the embodiments described herein are to be considered in all respects illustrative and not restrictive. The scope of the invention is to be indicated by the appended claims, rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

Claims

1. A pneumatic tool motor comprising: a cylinder (2) including a chamber (22), two inlet passages (41), two discharge passages (43), and two exhaust holes (28); a rotor (3) received in the chamber (22) and including a plurality of channels (32) receiving a plu-

rality of vanes (34); a side cover (10) disposed on a front end of the cylinder (2) and configured for guiding airflow, with two front inlet guiding grooves (16) provided on a rear wall of the side cover (10) and respectively intercommunicating with the two inlet passages (41), with two front discharge guiding grooves (18) provided on the rear wall of the side cover (10) and respectively intercommunicating with the two discharge passages (43); and a rear cover (60) disposed on a rear end of the cylinder (2), with the rear cover (60) including two inlet ports (62) and two exhaust ports (64), with two rear input guiding grooves (66) provided on a front wall of the rear cover (60) and respectively intercommunicating with the two inlet passages (41), with two rear output guiding grooves (68) provided on the front wall of the rear cover (60) and respectively intercommunicating with the two discharge passages (43), **characterized in that:**

the side cover (10) includes two first gas accumulation grooves (12) associated with the two front inlet guiding grooves (16) respectively and aligned with the two discharge passages (43), each of the two first gas accumulation grooves (12) includes a gas accumulation portion (121) aligned with an associated discharge passage (43) and a gas guiding portion (122) which intercommunicates with an associated front inlet guiding groove (16) and which is shallower than the gas accumulation portion (121) of the first gas accumulation groove (12),

the side cover (10) further includes two second gas accumulation grooves (14) associated with the two front discharge guiding grooves (18) respectively and aligned with the two inlet passages (41) respectively, each of the two second gas accumulation grooves (14) includes a gas accumulation portion (141) aligned with an associated inlet passage (41) and a gas guiding portion (142) which intercommunicates with an associated front discharge guiding groove (18) and which is shallower than the gas accumulation portion (141) of the second gas accumulation groove (14),

each of the two exhaust ports (64) includes a gas accumulation portion (641) aligned with an associated discharge passage (43) and a gas guiding portion (642) which intercommunicates with an associated rear output guiding groove (68) and which is shallower than the gas accumulation portion (641) of the exhaust port (64), each of the two inlet ports (62) includes a gas accumulation portion (621) aligned with an associated inlet passage (41) and a gas guiding portion (622) which intercommunicates with an associated rear input guiding groove (66) and which is shallower than the gas accumulation

portion (621) of the inlet port (62).

2. The pneumatic tool motor as claimed in claim 1, **characterized in that:** each of the two first gas accumulation grooves (12) has an area greater than an associated discharge passage (43), and each of the two second gas accumulation grooves (14) has an area greater than an associated inlet passage (41).
3. The pneumatic tool motor as claimed in claim 1, **characterized in that:** the gas guiding portion (122) of each of the two first gas accumulation grooves (12) is within an extent of an associated gas accumulation groove (121), the gas guiding portion (142) of each of the two second gas accumulation grooves (14) is within an extent of an associated gas accumulation groove (141), and each gas guiding portion (622, 642) of the rear cover (60) is within an extent of an associated gas accumulation groove (621, 641).

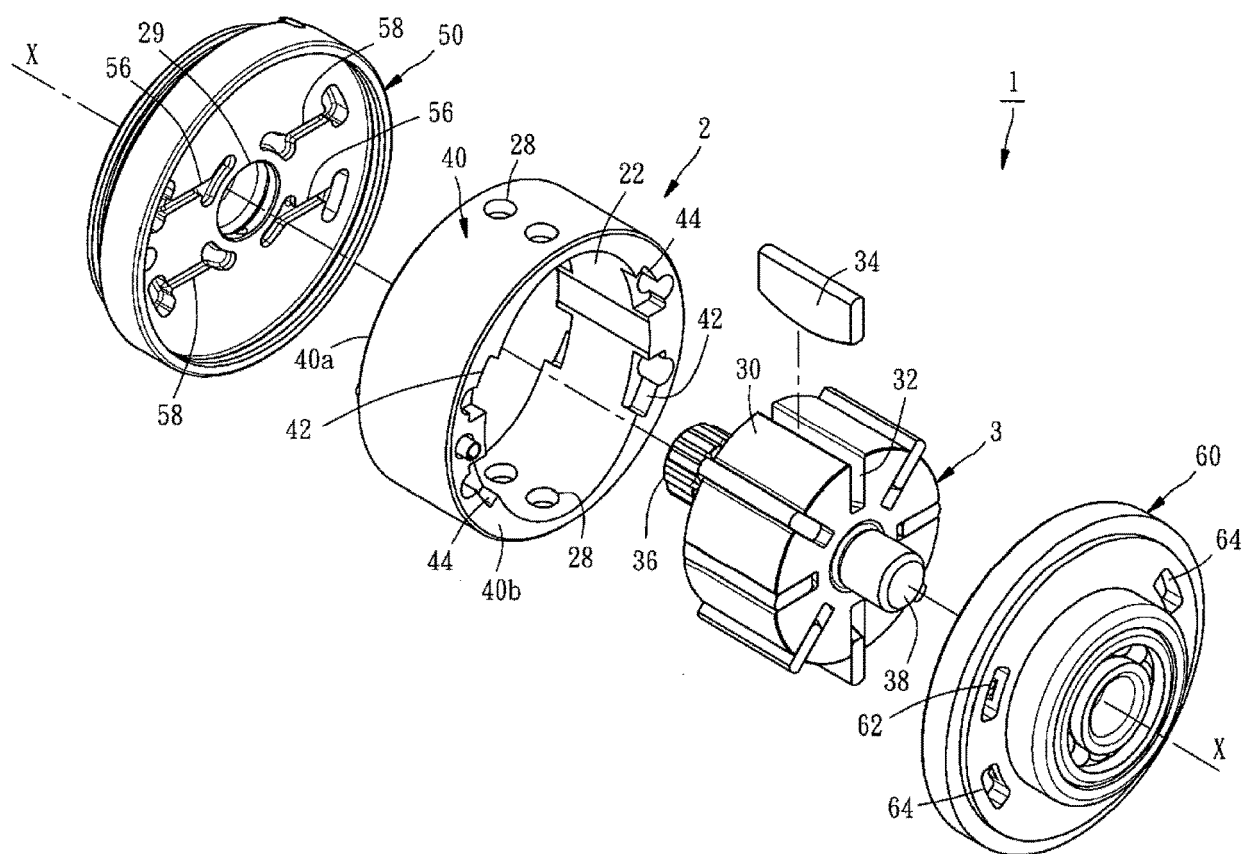


FIG 1

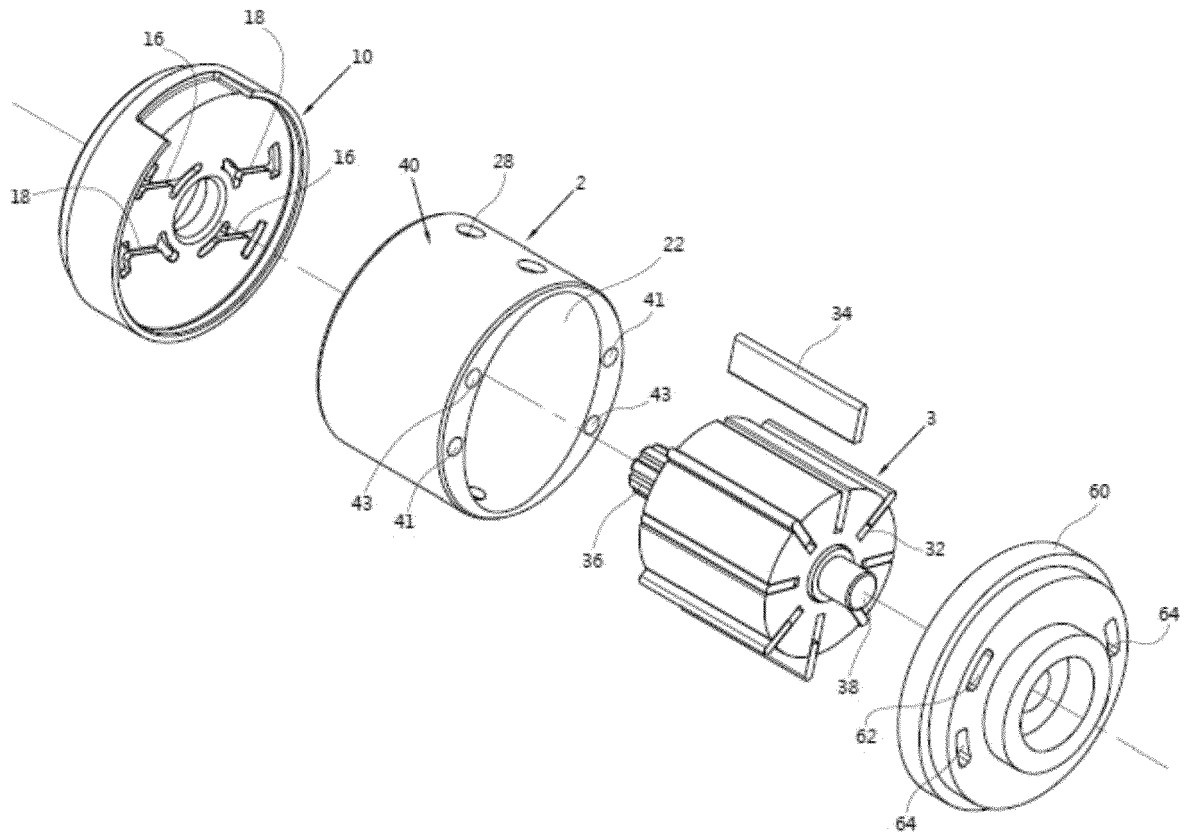


FIG 2

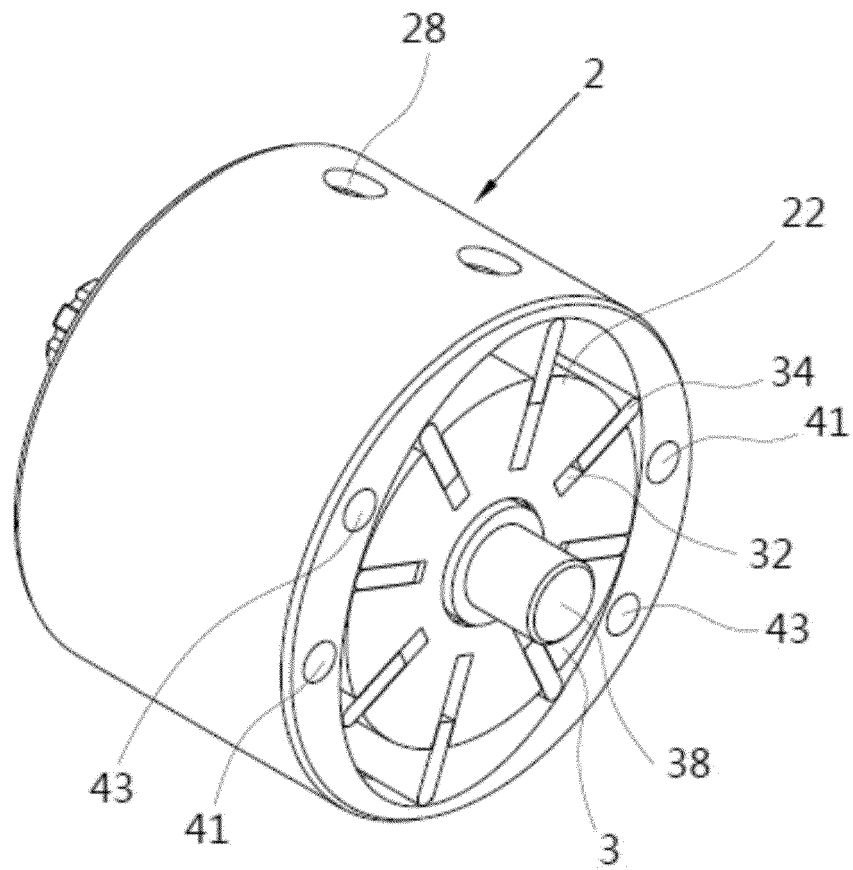


FIG 3

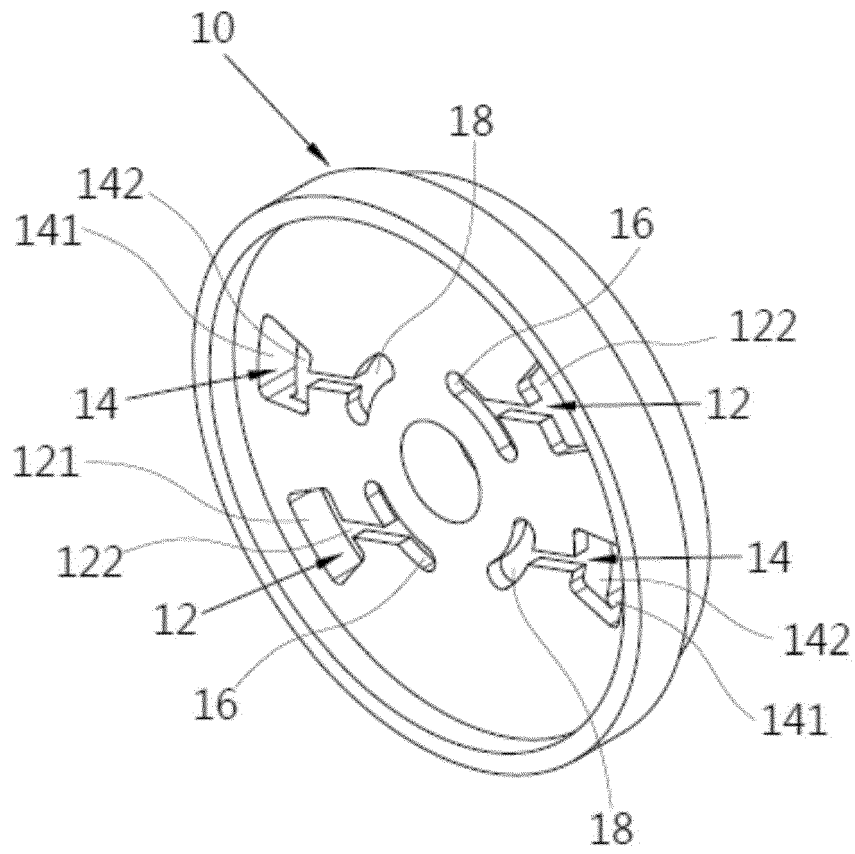


FIG 4

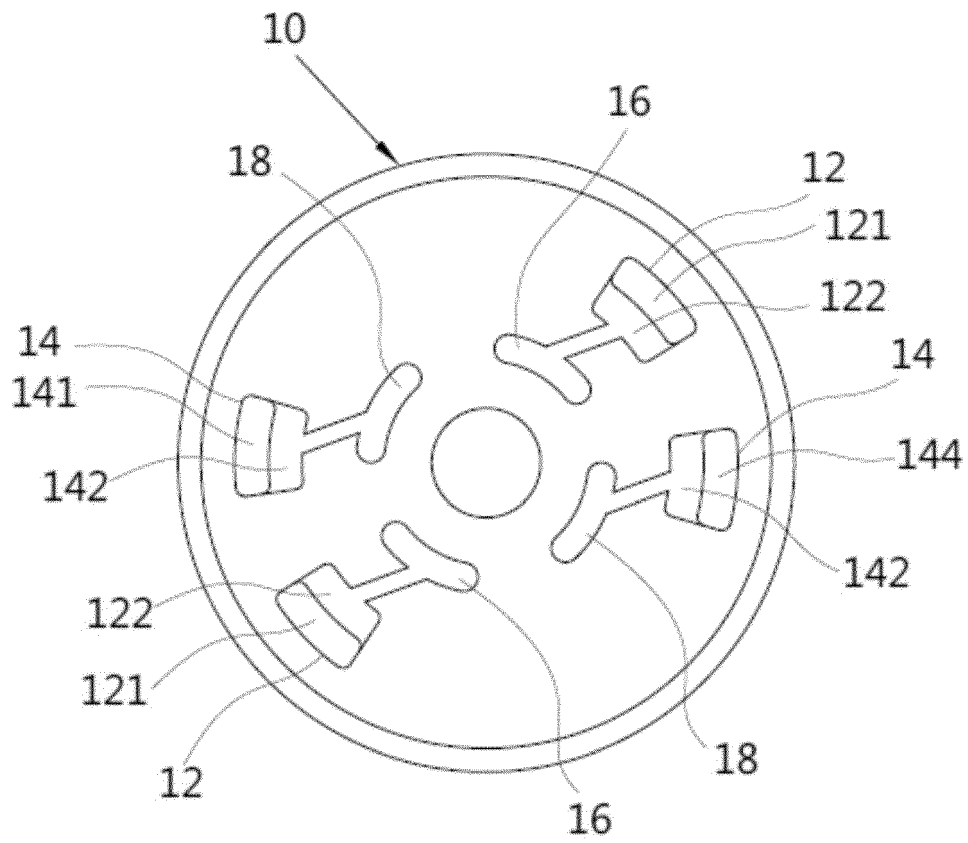


FIG 5

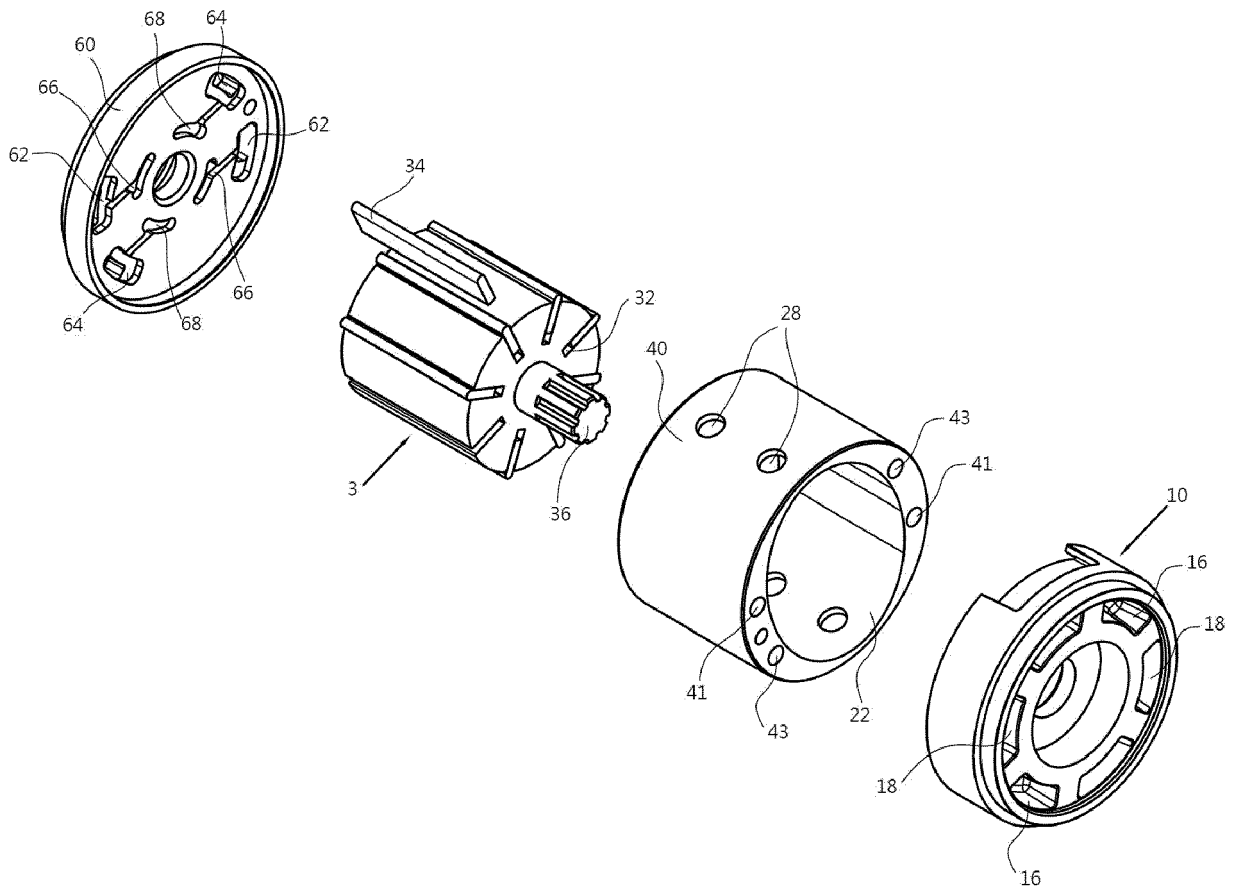


FIG 6

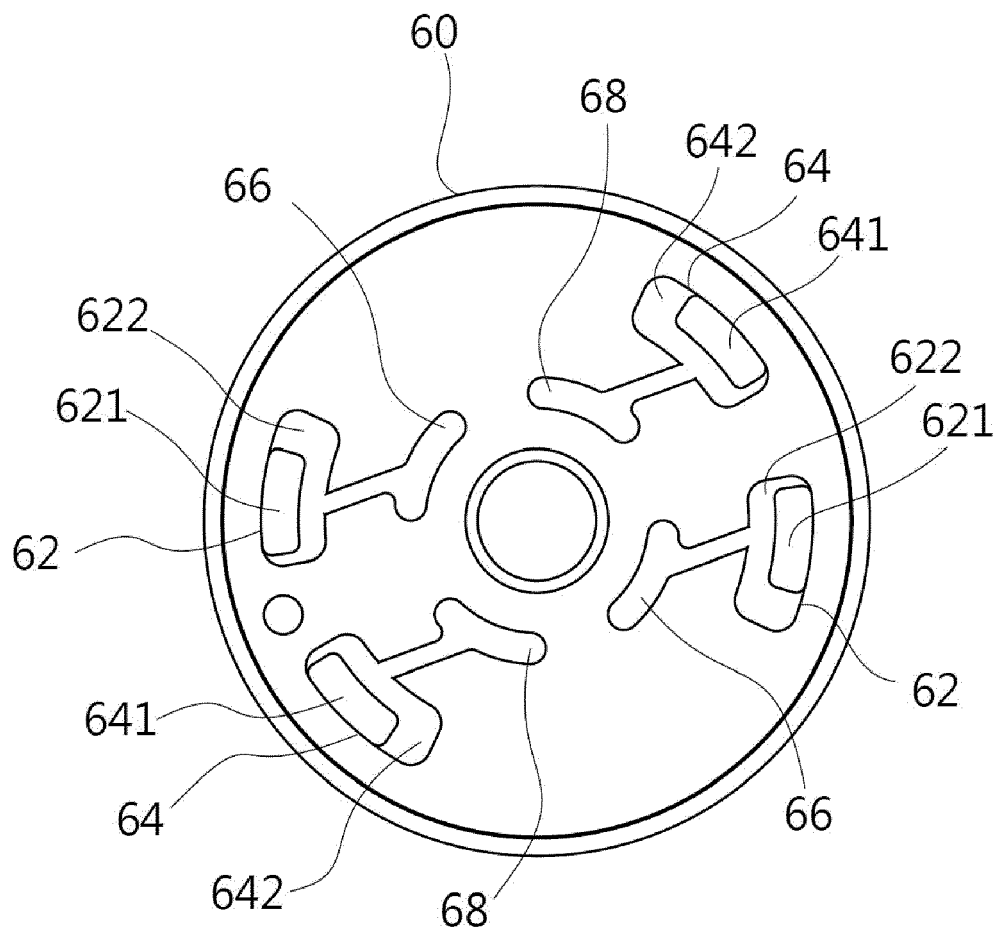


FIG 7



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 5100

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03:82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 3 351 723 B1 (WU YU JEN [TW]) 2 December 2020 (2020-12-02) * paragraphs [0009] - [0017] * * figures 1-7 *	1-3	INV. B25F5/00 F01C13/02 F01C21/18
A	US 2006/113099 A1 (LIVINGSTON PATRICK S [US] ET AL) 1 June 2006 (2006-06-01) * paragraphs [0018], [0021], [0022], [0024] * * figures 1-5 *	1-3	
A	US 2007/151075 A1 (IZUMISAWA OSAMU [JP] ET AL) 5 July 2007 (2007-07-05) * paragraphs [0049], [0050], [0054], [0059] * * figures 3,22-24 *	1-3	
A	US 6 059 049 A (LIN CHEN-YANG [TW]) 9 May 2000 (2000-05-09) * column 2, lines 7-20 * * column 3, lines 1-16 * * figures 2,3 *	1-3	
			TECHNICAL FIELDS SEARCHED (IPC)
			B25F F01C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 24 April 2024	Examiner Bonnin, David
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			

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

EP 23 21 5100

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

24 - 04 - 2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3351723 B1	02-12-2020	EP 3351723 A1	25-07-2018
		TW M541520 U	11-05-2017
		US 2018209272 A1	26-07-2018
US 2006113099 A1	01-06-2006	CA 2527177 A1	01-06-2006
		EP 1666214 A1	07-06-2006
		US 2006113099 A1	01-06-2006
		US 2007137873 A1	21-06-2007
US 2007151075 A1	05-07-2007	AT E329732 T1	15-07-2006
		CN 1396855 A	12-02-2003
		DE 60120636 T2	19-10-2006
		DK 1250217 T3	23-10-2006
		EP 1250217 A2	23-10-2002
		ES 2262625 T3	01-12-2006
		JP 2003520695 A	08-07-2003
		TW 553810 B	21-09-2003
		US 2003121680 A1	03-07-2003
		US 2007151075 A1	05-07-2007
		WO 0154865 A2	02-08-2001
US 6059049 A	09-05-2000	TW 417558 U	01-01-2001
		US 6059049 A	09-05-2000

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- US 2424638 A [0003]
- US 3472323 A [0004]
- SE 515533 C2 [0005]
- US 6250399 B1 [0006]
- US 20040197218 A1 [0007]
- TW M541520 [0008] [0022]
- EP 3351723 B1 [0008]