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(54) **Title:** TOOL HOLDER HAVING ANTI-VIBRATION ARRANGEMENT AND COOLANT CHANNEL, AND CUTTING TOOL PROVIDED WITH TOOL HOLDER

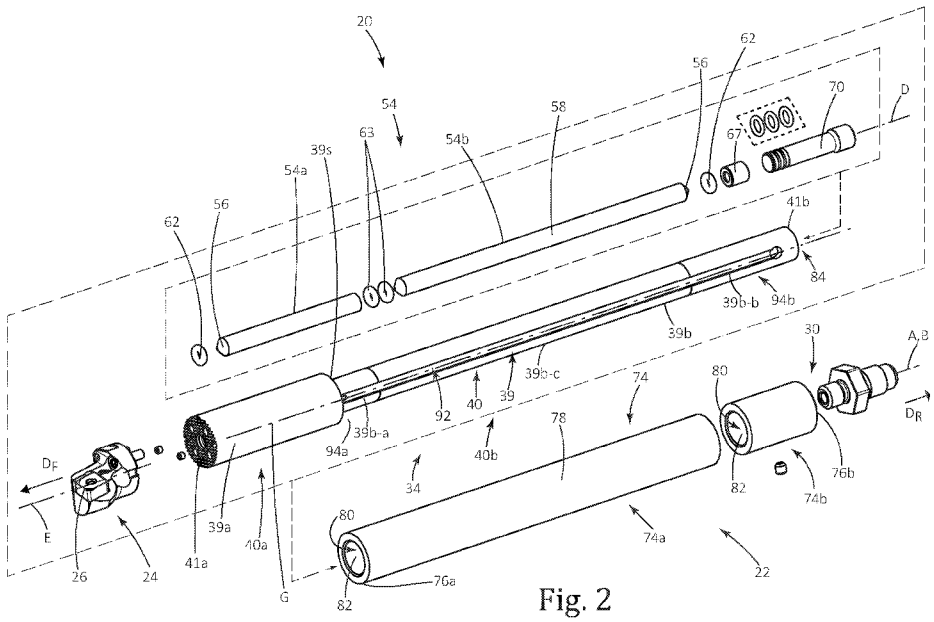


Fig. 2

(57) **Abstract:** An elongated tool holder (22) includes a mass housing portion (40) having a housing peripheral surface, an outer sleeve having a sleeve hole wall surface, and an anti-vibration arrangement (34). An elongated groove (92) is formed in one of the housing peripheral surface and the sleeve hole wall surface. In an assembled state of the tool holder, the groove, which is located at a common interface of the housing peripheral surface and the sleeve hole wall surface, forms a groove coolant channel. The groove coolant channel forms part of an overall tool holder coolant channel which is spaced apart from the anti-vibration arrangement, and thus isolates the coolant from the anti-vibration arrangement. A cutting tool (20) incorporates the tool holder.

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TOOL HOLDER HAVING ANTI-VIBRATION ARRANGEMENT AND COOLANT CHANNEL, AND CUTTING TOOL PROVIDED WITH TOOL HOLDER

FIELD OF THE INVENTION

The subject matter of the present application relates to tool holders, in general, and to such tool holders having an anti-vibration arrangement, in particular, and to such tool holders having a coolant channel, further in particular.

BACKGROUND OF THE INVENTION

Tool holders can be provided with an anti-vibration arrangement for suppressing vibration of the tool holder during metal cutting operations. Typically, the anti-vibration arrangement is a spring-mass system that includes a cavity and a vibration absorbing mass suspended therein by elastic supporting members. The cavity can be filled with a viscous fluid.

In some such anti-vibration arrangements an additional coolant channel is provided for providing cooling fluid to the cutting region. An example of such a tool holding system, is disclosed in, for example, US 7,681,869 B2. US 7,681,869 B2 discloses, in its Fig. 2, a damping body 1 provided with an axial boring 6 going therethrough. Inside the boring bar, there is an axially extending longitudinal tube 3 that generally is adapted to be rigidly secured at its outer ends inside a boring bar or to the object that is to be damped. The tube 3 is adapted to lead a cooling fluid through itself in communication with a channel extending further into the boring bar.

It is an object of the subject matter of the present application to provide a new and improved tool holder having an anti-vibration arrangement and a coolant channel.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the subject matter of the present application there is provided a tool holder elongated along a holder longitudinal axis thereof which defines opposite forward and rearward directions, the tool holder configured to have a cutting portion affixed at a forward end thereof, the tool holder comprising:

an outer sleeve comprising:

opposite forward and rearward sleeve end surfaces and a sleeve peripheral surface extending therebetween; and

a sleeve hole having a sleeve hole wall surface which opens out to the forward and rearward sleeve end surfaces;

a mass housing portion comprising:

opposite forward and rearward housing end surfaces and a housing peripheral surface extending therebetween; and

an interior holder cavity having an inwardly facing cavity wall surface; and

an anti-vibration arrangement comprising:

a vibration absorbing mass comprising two opposite mass end surfaces and a mass peripheral surface extending therebetween; and

two resilient suspension members, wherein:

an elongated groove is formed in one of the housing peripheral surface and the sleeve hole wall surface; and

the tool holder is adjustable between an unassembled state and an assembled state, and in the assembled state:

the vibration absorbing mass is disposed in the interior holder cavity and is elastically suspended therein by the two suspension members contacting the inwardly facing cavity wall surface;

the mass housing portion is at least partially located in the sleeve hole, such that at least a portion of the sleeve hole wall surface surrounds at least a portion of the housing peripheral surface about the holder longitudinal axis, thereby defining a common interface;

the groove is located at the common interface, thereby forming a groove coolant channel; and

the groove coolant channel is part of a tool holder coolant channel having an external coolant inlet and an external coolant outlet in fluid communication with each other.

In accordance with a second aspect of the subject matter of the present application there is provided a cutting tool comprising:

a tool holder of the type described above; and

a cutting portion located at a forward end of the tool holder, the cutting portion comprising at least one cutting insert.

It is understood that the above-said is a summary, and that features described hereinafter may be applicable in any combination to the subject matter of the present application, for example, any of the following features may be applicable to the tool holder or cutting tool:

The groove can be formed in the housing peripheral surface.

The sleeve hole wall surface can open out to the rearward sleeve end surface.

The groove can extend linearly along a groove axis. In the assembled state of the tool holder, the groove axis can be parallel to the holder longitudinal axis.

The mass housing portion can comprise a forward housing portion and a rearward housing portion, the forward housing portion being forward of, and having a greater radial dimension than, the rearward housing portion. In the assembled state of the tool holder, only the rearward housing portion can be located in the sleeve hole.

The housing peripheral surface can comprise a forward housing peripheral surface at the forward housing portion, a rearward housing peripheral surface at the rearward housing portion and a housing step surface connecting the forward housing peripheral surface and the rearward housing peripheral surface. The forward housing portion can comprise a forward housing coolant through channel opening out, at a rearward end thereof, to the housing step surface. In the assembled state of the tool holder, the groove coolant channel can extend to the forward housing coolant through channel. The forward housing coolant through channel can be part of the tool holder coolant channel.

The forward housing coolant through channel can further open out, at a forward end of the forward housing portion, to the housing peripheral surface to form the coolant outlet.

The mass housing portion can comprise a housing recess comprising an inwardly facing recess wall surface opening out to the rearward housing end surface. The tool holder can comprise a cavity axial sealing member. In the assembled state of the tool holder, the cavity axial sealing member can be located in the housing recess, delimiting the holder cavity in the rearward direction, so that a forward portion of the housing recess forms the interior holder cavity. The rearward housing portion can comprise a rearward housing coolant through channel opening out to the recess wall surface and the rearward housing peripheral surface. In the

assembled state of the tool holder, the rearward housing coolant through channel can be rearward of the cavity axial sealing member, and the rearward housing coolant through channel can be part of the tool holder coolant channel.

The outer sleeve can comprise a forward outer sleeve component and a rearward outer sleeve component. The forward and rearward outer sleeve components can be fixedly engaged with each other, the forward outer sleeve component being forward of the rearward outer sleeve component.

In the assembled state of the tool holder, the forward sleeve end surface and the housing step surface can abut each other.

The rearward housing peripheral surface can comprise axially spaced apart front and back rearward housing peripheral surfaces and a middle rearward housing peripheral surface extending therebetween, the front rearward housing peripheral surface being closer to the forward housing portion than the back rearward housing peripheral surface. In the assembled state of the tool holder, at least the front and back rearward housing peripheral surfaces can abut the sleeve hole wall surface, respectively.

The groove can be formed in the housing peripheral surface. The groove can comprise two groove ends. The front rearward housing peripheral surface can intersect the housing step surface. One of the two groove ends can be located at the back rearward housing peripheral surfaces. The other one of the two groove ends can be located at the intersection of the front rearward housing peripheral surface and the housing step surface.

The middle rearward housing peripheral surface can be radially recessed with respect to the front and back rearward housing peripheral surfaces. In the assembled state of the tool holder, the middle rearward housing peripheral surface can be spaced apart from the sleeve hole wall surface.

The mass housing portion can comprise a housing recess comprising an inwardly facing recess wall surface opening out to the rearward housing end surface. The tool holder can comprise a cavity axial sealing member. In the assembled state of the tool holder, the cavity axial sealing member can be located in the housing recess, delimiting the holder cavity in the rearward direction, so that a forward portion of the housing recess forms the interior holder cavity.

In the assembled state of the tool holder, the recess wall surface can open out to the rearward housing end surface to form the coolant inlet. A portion of the housing recess extending from the coolant inlet can be part of the tool holder coolant channel.

The outer sleeve can comprise a sleeve material. The mass housing portion can comprise a housing body material. The sleeve material can be denser than the housing body material.

The sleeve material can be carbide.

The cutting portion can be releasably attached to the tool holder.

The coolant outlet can be rotationally aligned with the cutting insert about the holder longitudinal axis.

BRIEF DESCRIPTION OF THE FIGURES

For a better understanding of the present application and to show how the same may be carried out in practice, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a perspective view of a cutting tool in accordance with the present application, showing an anti-vibration arrangement;

Fig. 2 is an exploded perspective view of the cutting tool in Fig. 1, in accordance with the present application;

Fig. 3 is an axial cross-sectional view of the cutting tool in Fig. 1;

Fig. 4 is a radial cross-sectional view of the cutting tool in Fig. 1 taken along line IV-IV in Fig. 3;

Fig. 5 is a radial cross-sectional view of the tool holder taken along line V-V in Fig. 3;

Fig. 5a is a detail of Fig. 5;

Fig. 6 is a first detail of Fig. 3; and

Fig. 7 is a second detail of Fig. 3.

It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity, or several physical components may be included in one functional block or element. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF THE INVENTION

In the following description, various aspects of the subject matter of the present application will be described. For purposes of explanation, specific configurations and details are set forth in sufficient detail to provide a thorough understanding of the subject matter of the present application. However, it will also be apparent to one skilled in the art that the subject matter of the present application can be practiced without the specific configurations and details presented herein.

Attention is first drawn to Fig. 1 showing a cutting tool **20**, for chip removal, depicting an aspect of the present application. The cutting tool **20** has a tool longitudinal axis **A**. In accordance with some embodiments of the subject matter of the present application, the cutting tool **20** can be a fixed cutting tool. That is to say, the cutting tool **20** is not designed to rotate about a rotational axis. In this non-limiting example shown in the drawings, the cutting tool **20** is a boring bar. However, the subject matter of the present application is not restricted only to boring bars and could also be applicable to, for example but not limited to, turning tools in general. The subject matter of the present application may also be applicable to rotary cutting tools, such as milling cutters and drills. For such rotary cutting tools, the cutting tool **20** is designed to be rotatable in a direction of rotation about the tool longitudinal axis **A**.

The cutting tool **20** includes a tool holder **22**. The cutting tool **20** also includes a cutting portion **24** that can include at least one cutting insert **26**. The at least one cutting insert **26** is designed to perform metal cutting operations and has a cutting edge for that purpose. In accordance with some embodiments of the subject matter of the present application, the at least one cutting insert **26** can be releasably attached to the cutting portion **24**. The cutting portion **24** can be integrally formed with the tool holder **22**. Alternatively, as seen in the non-limiting example shown in the drawings, the cutting portion **24** can be releasably attached to the tool holder **22**. The cutting portion **24** can be disposed at a forward end of the tool holder **22**. The rear end of the tool holder **22** is configured to be secured by a holding device.

Reference is now made to Fig. 2, showing an exploded view of the tool holder **22**, depicting another aspect of the present application. The tool holder **22** has a holder longitudinal axis **B**, that defines opposite forward and rear directions $\mathbf{D_F}$, $\mathbf{D_R}$. The tool holder **22** is elongated along the holder longitudinal axis **B**. In accordance with some embodiments of the subject

matter of the present application, the cutting tool **20** and the tool holder **22** can be co-axial with each other. It should be noted that two elements (e.g. the cutting tool **20** and the tool holder **22** in the present case) are co-axial with each other when their longitudinal axes are co-incident (aligned with other).

It should further be noted that use of the terms "forward" and "rearward" throughout the description and claims refer to a relative position in a direction of the holder longitudinal axis **B** towards the left and right, respectively, in Fig. 3. Generally speaking, the forward direction is the direction towards the cutting portion **24**.

Referring to Fig. 3, the tool holder **22** includes a tool holder coolant channel **28** having an external coolant inlet **30** and an external coolant outlet **32**. The coolant inlet and outlet **30, 32** are in fluid communication with each other. Coolant travels through the tool holder **22** via the tool holder coolant channel **28** along a coolant flow path, **F** (indicated by the arrows in the figures). It should be noted that use of the term "external inlet/outlet" throughout the description and claims refer to an opening that is located at the periphery of the tool holder **22.** Moreover, use of the term "internal inlet/outlet" throughout the description and claims refer to an opening that is located inside of the tool holder **22**.

As best seen in Figs. 1 and 2, the tool holder **22** includes an outer sleeve **74**. The outer sleeve **74** includes opposite forward and rearward sleeve end surfaces **76a, 76b** and a sleeve peripheral surface **78** which extends therebetween. The outer sleeve **74** further includes a sleeve hole **80**. The sleeve hole **80** has a sleeve hole wall surface **82** which opens out to the forward sleeve end surface **76a**. In accordance with some embodiments of the subject matter of the present application, the sleeve hole wall surface **82** can open out to the rearward sleeve end surface **76b**. In such a configuration, the sleeve hole **80** forms a through hole. In accordance with some other embodiments of the subject matter of the present application, the sleeve hole wall surface **82** may not open out to the rearward sleeve end surface **76**. In such a configuration, the sleeve hole **80** forms a blind hole. The sleeve hole wall surface **82** can have a cylindrical shape. In the assembled cutting tool **20**, the sleeve hole **80** may extend along with the tool longitudinal axis **A**.

In accordance with some embodiments of the subject matter of the present application, the outer sleeve **74** can include a forward outer sleeve component**74a** and a rearward outer sleeve component**74b**. The forward and rearward outer sleeve components **74a, 74b** can be fixedly

engaged with each other. The forward outer sleeve component **74a** is forward of the rearward outer sleeve component **74b**. It is noted that the sleeve hole **80** can be formed from a through hole in the forward outer sleeve component **74a** and a blind hole in the rearward outer sleeve component **74b** or a through hole in both the forward and rearward outer sleeve components **74a, 74b**. The forward outer sleeve component **74a** can be longer than the rearward outer sleeve component **74b**, as measured between the forward and rearward sleeve end surfaces **76a**, **76b**.

The outer sleeve **74** comprises a sleeve material. In accordance with some embodiments of the subject matter of the present application, the sleeve material can be carbide.

The tool holder **22** also includes a mass housing portion **40**. The mass housing portion **40** includes opposite forward and rearward housing end surfaces **41a, 41b** and a housing peripheral surface **39** which extends therebetween. In the assembled tool holder **22**, the housing peripheral surface **39** extends about the holder longitudinal axis **B**.

In accordance with some embodiments of the subject matter of the present application, the mass housing portion **40** can include a housing recess **84.** The housing recess **84** can include an inwardly facing recess wall surface **86**. The recess wall surface **86** can open out to the rearward housing end surface **41b**.

In accordance with some embodiments of the subject matter of the present application, the mass housing portion **40** can include a forward housing portion **40a** and a rearward housing portion **40b**. The forward housing portion **40a** can be located forward of the rearward housing portion **40b.** The forward housing portion **40a** can have a greater radial dimension than the rearward housing portion **40b**. The forward housing portion **40a** is configured to have a cutting portion **24** affixed thereat. For this purpose, in this non-limiting example shown in the drawings, the forward housing end surface **41a** is serrated for engagement with a corresponding surface of the cutting portion **26**.

In accordance with some embodiments of the subject matter of the present application, the housing peripheral surface **39** can include a forward housing peripheral surface **39a** at the forward housing portion **40a** and a rearward housing peripheral surface **39b** at the rearward housing portion **40b**. The housing peripheral surface **39** can include a housing step surface **39s** which connects the forward housing peripheral surface **39a** and the rearward housing peripheral surface **39b**. The housing step surface **39s** can face the rearward direction $\mathbf{D_R}$, preferably being oriented perpendicular to the holder longitudinal axis **B.**

Referring to Fig. 6, in accordance with some embodiments of the subject matter of the present application, the forward housing portion **40a** can include a forward housing coolant through channel **88** which can open out, at a rearward end thereof, to the housing step surface **39s**. At a forward end thereof, the forward housing coolant through channel **88** can further open out to the housing peripheral surface **39** or the forward housing peripheral surface **39a** or the intersection of both the housing peripheral surface **39** and the forward housing peripheral surface **39a** to form the coolant outlet **32**.

Referring to Fig. 7, in accordance with some embodiments of the subject matter of the present application, the rearward housing portion **40b** can include a rearward housing coolant through channel **90** which can open out to the recess wall surface **86** and the rearward housing peripheral surface **39b**.

In accordance with some embodiments of the subject matter of the present application, the rearward housing peripheral surface **39b** can include front and back rearward housing peripheral surfaces **39b-a, 39b-b** which are axially spaced apart from one another along the holder longitudinal axis **B**. The front rearward housing peripheral surface **39b-a** is closer to the forward housing portion **40a** than the back rearward housing peripheral surface **39b-b**. The front rearward housing peripheral surface **39b-a** can intersect the housing step surface **39s**. The front and back rearward housing peripheral surfaces **39b-a, 39b-b** can have a cylindrical shape. The rearward housing peripheral surface **39b** can include a middle rearward housing peripheral surface **39b-c** which extends between the front and back rearward housing peripheral surfaces **39b-a, 39b-b**. The middle rearward housing peripheral surface **39b-c** can be radially recessed with respect to the front and back rearward housing peripheral surfaces **39b-a, 39b-b**. That is to say, the middle rearward housing peripheral surface **39b-c** can form an annular recess. As such, the middle rearward housing peripheral surface **39b-c** may have a maximum radial cross-section which is smaller than the maximum radial cross-section of both the front and back rearward housing peripheral surfaces **39b-a, 39b-b**.

The mass housing portion **40** comprises a housing body material. In accordance with some embodiments of the subject matter of the present application, the sleeve material can be denser than the housing body material.

The tool holder **22** includes an elongated groove **92** formed in one of the housing peripheral surface **39** and the sleeve hole wall surface **82**. That is to say, the groove **92** is

recessed in one of the housing peripheral surface **39** and the sleeve hole wall surface **82**. In accordance with some embodiments of the subject matter of the present application, the groove **92** can be formed in the housing peripheral surface **39**.

The groove **92** has two opposite groove ends **94a, 94b**. One of the two groove ends **94a** can be located at the back rearward housing peripheral surfaces **39b-b**. The other one of the two groove ends **94b** can be located at the intersection of the front rearward housing peripheral surface **39b-a** and the housing step surface **39s**. The groove **92** extends along a groove axis **G**. In accordance with some embodiments of the subject matter of the present application, the groove **92** can extend linearly along the groove axis **G**.

Referring to Fig. 5a, in accordance with some embodiments of the subject matter of the present application, the groove **92** can include two opposite groove side surfaces **95** located on opposite sides of a half plane **HP** which contains the holder longitudinal axis **B** and the groove axis **G**, and a groove base surface **93** extending between the two opposite groove side surfaces **95**. The groove base surface **93** can extend along the groove axis **G.** The groove **92** can have a groove depth **GD** measured in a radially inward direction from a circumferential center of the groove base surface **93.** The groove depth **GD** can be between 1 mm to 2 mm. The groove **92** can have a groove width **GW** measured in a direction between the two opposite groove side surfaces **95.** The groove width **GW** can be between 3 mm to 4 mm.

The tool holder **22** includes an anti-vibration arrangement **34**. The tool anti-vibration arrangement **34** is designed to reduce or eliminate vibration of the cutting tool **20** when the cutting tool **20** performs a metal cutting operation. In accordance with some embodiments of the subject matter of the present application, the anti-vibration arrangement **34** can be disposed at a forward end of the cutting tool **20**.

The mass housing portion **40** has an interior holder cavity **36** formed therein. That is to say, the interior holder cavity **36** is enclosed within the mass housing portion **40**. The holder cavity **36** is formed, at least in part, by an inwardly facing cavity wall surface **38**. The cavity wall surface **38** delimits the holder cavity **36** from the mass housing portion **40**. The mass housing portion **40** surrounds the holder cavity **36**. The holder cavity **36** has a cavity central axis **D**. In accordance with some embodiments of the subject matter of the present application, the holder cavity **36** can be elongated along a cavity central axis **D**. The holder cavity **36** can be elongated in the same direction as the tool holder **22**. In particular, the holder cavity **36** can be

co-axial with the tool holder **22**. The cavity wall surface **38** can include two opposite cavity wall end surfaces **42** and a cavity wall peripheral surface **44** that extends therebetween. The cavity wall peripheral surface **44** can extend about the cavity central axis **D**.

Referring in addition to Fig. 3, showing an axial cross-sectional view of the holder cavity **36** (taken in a plane containing the cavity central axis **D**) through the cavity wall peripheral surface **44**, the holder cavity **36** has a cavity transverse cross-section. In accordance with some embodiments of the subject matter of the present application, said cavity transverse cross-section can be uniform along the cavity central axis **D**. The cavity wall peripheral surface **44** can have a generally cylindrical shape. The cavity wall peripheral surface **44** can have a cylindrical shape in the vicinity of the two cavity wall end surface **42**. The two cavity wall end surfaces **42** can be planar and oriented transversely to the cavity central axis **D**. The two cavity wall end surfaces **42** can be oriented perpendicular to the cavity central axis **D**.

Reverting to Figs. 1 and 2, the present tool holder **22** also includes an anti-vibration arrangement **34** which includes at least one vibration absorbing mass **54**. In accordance with some embodiments of the subject matter of the present application, the vibration absorbing mass **54** can be rigid. In some embodiments, while the mass housing portion **40** is formed from a first metallic material such as steel, the vibration absorbing mass **54** may be formed from a denser second metallic material, such as tungsten.

Referring to Figs. 2-3, the vibration absorbing mass **54** has a mass central axis **E**. The vibration absorbing mass **54** includes two axially opposite mass ends **60a, 60b,** a forward mass end **60a** and a rearward mass end **60b**, the forward mass end **60a** being forward of the rearward mass end **60b**. The two axially opposite mass ends **60a, 60b** are spaced apart from one another along the mass central axis **E**. In accordance with some embodiments of the subject matter of the present application, the vibration absorbing mass **54** can include two opposite mass end surfaces **56** and a mass peripheral surface **58** that extends therebetween. The mass peripheral surface **58** can extend about the mass central axis **E**. The two mass end surfaces **56** are located at the two mass ends **60a, 60b**, respectively. The vibration absorbing mass **54** can be elongated along the mass central axis **E**. Between the mass end surfaces **56**, the vibration absorbing mass **54** can have a generally constant cross-sectional area in a plane oriented perpendicular to the mass central axis **E.**

Referring to Fig. 3, in accordance with some embodiments of the subject matter of the present application, the mass end surfaces **56** can be conically shaped, tapering inwardly in a direction away from a central portion of the vibration absorbing mass **54**. The mass peripheral surface **58** can have a cylindrical shape.

The anti-vibration arrangement **34** further includes two resilient suspension members **62**. The two suspension members **62** are elastically deformable. In accordance with some embodiments of the subject matter of the present application, the two suspension members **62** can be formed from a material different from that of the vibration absorbing mass **54**. In some embodiments, the suspension members **62** are made of rubber, having a Durometer hardness of between 60A to 95A. The two suspension members **62** can be o-rings.

The tool holder **22** is adjustable between an unassembled state and an assembled state. In the unassembled state of the tool holder **22**, the vibration absorbing mass **54** is disposed outside the interior holder cavity **36** and/or the mass housing portion **40** is not secured to the outer sleeve **74**.

In accordance with some embodiments of the subject matter of the present application, referring to Fig. 3, the tool holder **22** includes a cavity axial sealing member **67** which defines (delimits) the holder cavity **36** in the rearward direction $\mathbf{D_R}$, and which seals the holder cavity **36**. That is to say, the cavity axial sealing member **67** forms one of the cavity wall end surface **38**. While the holder cavity **36** is unsealed by the cavity axial sealing member **67** (i.e. while the tool holder **22** is in an unassembled position), the vibration absorbing mass **54** can be inserted into the holder cavity **36**.

In the assembled state of the tool holder **22**, the vibration absorbing mass **54** is disposed within the holder cavity **36**.

In the assembled position of the tool holder **22**, in accordance with some embodiments of the subject matter of the present application, the vibration absorbing mass **54** can be elongated in the same direction as the tool holder **22**. That is to say, the mass central axis **E** can be parallel to the holder longitudinal axis **B** with axes **B**, **E** establishing the longest principal dimensions of the tool holder **22** and the vibration absorbing mass **54**, respectively. In particular, the mass central axis **E** can be co-incident with the holder longitudinal axis **B** (i.e. the vibration absorbing mass **54** can be co-axial with the tool holder **22**).

In the assembled position of the tool holder **22**, the vibration absorbing mass **54** is connected to the mass housing portion **40** via the two suspension members **62**. Thus, the vibration absorbing mass **54** is elastically suspended in the holder cavity **36** by the two suspension members **62** which contact the inwardly facing cavity wall surface **38**. Each suspension member **62** can abut a respective mass end surface **56**. It is noted that no part of the mass peripheral surface **58** is in direct contact with the inwardly facing cavity wall surface **38.** In accordance with some embodiments of the subject matter of the present application, each of the two suspension members **62** can be under compressive elastic deformation by contact against the inwardly facing cavity wall surface **38** and against one of the mass end surfaces **56**.

In the assembled position of the tool holder **22**, the mass housing portion **40** is at least partially located in the sleeve hole **80**. In accordance with some embodiments of the subject matter of the present application, only the rearward housing portion **40b** can be located in the sleeve hole **80**. The sleeve peripheral surface **78** extends about the holder longitudinal axis **B**.

At least a portion of the sleeve hole wall surface **82** surrounds at least a portion of the mass housing portion **40**. More particularly, at least a portion of the sleeve hole wall surface **82** faces a portion of the housing peripheral surface **39** along a common interface. Still more particularly, at the common interface, at least a portion of the sleeve hole wall surface **82** faces the rearward housing peripheral surface **39b.**

In accordance with some embodiments of the subject matter of the present application, at the common interface the front, back and middle rearward housing peripheral surfaces **39b-a, 39b-b, 39b-c** can all abut the sleeve hole wall surface **82**. Alternatively, in accordance with some other embodiments of the subject matter of the present application, at the common interface some portions of the rearward housing peripheral surface **39b** may not abut the sleeve hole wall surface **82**. For example, the front and back rearward housing peripheral surfaces **39b-a, 39b-b** can abut the sleeve hole wall surface **82** while the middle rearward housing peripheral surface **39b-c** can be spaced apart from the sleeve hole wall surface **82** by a distance **d** (e.g. in the configuration where the middle rearward housing peripheral surface **39b-c** is recessed with respect to the front and back rearward housing peripheral surfaces **39b-a, 39b-b** – see Fig. 5). The later configuration is easier to manufacture than the former configuration. The forward sleeve end surface **76a** and the housing step surface **39s** can abut each other. In accordance with some embodiments of the subject matter of the present application preferably, a shrink-fit

engagement is used for coupling the (heated) outer sleeve **74** with the mass housing portion **40**. Moreover, the forward sleeve end surface **76a** and the housing step surface **39s** can be fixedly brazed together.

The groove **92** is located at the common interface to form a groove coolant channel **96**. The tool holder coolant channel **28** is formed partially by the groove coolant channel **96**. That is to say, the groove coolant channel **96** is part of a tool holder coolant channel **28**. The groove coolant channel **96** includes a groove coolant wall surface **97.** The groove coolant wall surface **97** extends about the groove axis **G.** The groove coolant channel **96** has a groove coolant inlet **98** and a groove coolant outlet **100**. In accordance with some embodiments of the subject matter of the present application, the groove coolant inlet **98** and/or the groove coolant outlet **100** can be internal. The groove coolant inlet **98** can be located at one of the two groove ends **94b** and the groove coolant outlet **100** can be located at the other one of the two groove ends **94a**. The groove axis **G** can be parallel to the holder longitudinal axis **B**.

In the configuration where the front, back and middle rearward housing peripheral surfaces **39b-a, 39b-b, 39b-c** all abut the sleeve hole wall surface **82**, the groove coolant wall surface **97** is formed by the groove **92** (i.e. the groove base surface **93** and the two groove side surfaces **95)** and an opposing portion of whichever one of the housing peripheral surface **39** and the sleeve hole wall surface **82** the groove **92** is not formed.

In the configuration where the middle rearward housing peripheral surface **39b-c** is spaced apart from the sleeve hole wall surface **82**, the groove coolant wall surface **97** is formed as described in the previous sentence and also by a thin annular gap **AG** formed between the spaced apart middle rearward housing peripheral surface **39b-c** and sleeve hole wall surface **82**, which merges with the groove **92** in a circumferential direction (see Fig. 5). It is noted that the volume define by the thin annular gap **AG** can be negligible. For example, the distance **d** can have a value which ensures that the flow of coolant along the groove coolant channel **96** is not detrimentally affected. For example, even though coolant may seep into the annular gap **AG**, high pressure coolant flow can still be realized. The distance **d** can be equal or less than 0.07 mm. More preferably, the distance **d** can be equal or less than 0.05 mm.

In accordance with some embodiments of the subject matter of the present application, the groove coolant channel **96** can extend to the forward housing coolant through channel **88**. Thus, it is noted that in the configuration with the groove **92** formed in the housing peripheral

surface **39**, the groove **92** extends to the forward housing coolant through channel **88**. The tool holder coolant channel **28** can be further partially formed by the forward housing coolant through channel **88**. That is to say, the forward housing coolant through channel **88** is part of the tool holder coolant channel **28.**

In accordance with some embodiments of the subject matter of the present application, the cavity axial sealing member **67** can be located in the housing recess **84**, delimiting the holder cavity **36** in the rearward direction D_R. Thus, a forward portion of the housing recess **84** forms the interior holder cavity **36**. The rearward housing coolant through channel **90** can be rearward of the cavity axial sealing member **67**. The tool holder coolant channel **28** can be further partially formed by the rearward housing coolant through channel **90**. That is to say, the rearward housing coolant through channel **90** is part of the tool holder coolant channel **28.**

In accordance with some embodiments of the subject matter of the present application, the recess wall surface **86** can open out to the rearward housing end surface **41b** to form the coolant inlet **30**. The tool holder coolant channel **28** can be further partially formed by a portion of the housing recess **84** which extend from the coolant inlet **30**. That is to say, a portion of the housing recess **84** which extend from the coolant inlet **30** is part of the tool holder coolant channel **28.**

In accordance with some embodiments of the subject matter of the present application, the coolant outlet **32** can be rotationally aligned with the cutting insert **26** about the holder longitudinal axis **B**. This allows the coolant to be directed at the cutting interface between a cutting edge and a workpiece.

The anti-vibration arrangement **34** includes an oscillating space **68** formed in the holder cavity **36**. The oscillating space **68** is located between the vibration absorbing mass **54** and the mass housing portion **40** (and more particularly between the vibration absorbing mass **54** and the inwardly facing cavity wall surface **38**). Stated differently, the mass housing portion **40** and the vibration absorbing mass **54** are spaced apart by the oscillating space **68**. In accordance with some embodiments of the subject matter of the present application, the oscillating space **68** entirely circumferentially surrounds the vibration absorbing mass **54**. That is to say, the oscillating space **68** can extend about the full (360°) angular extent of the cavity central axis **D**. The oscillating space **68** can thus be considered an annular oscillating space that surrounds an axial extent of the vibration absorbing mass **54**.

The vibration absorbing mass **54** is configured to oscillate within the oscillating space **68** upon elastic deformation of the two suspension members **62**. Stated differently, the vibration absorbing mass **54** is oscillatingly displaceable within the oscillating space **68** when the two suspension members **62** undergo elastic deformation.

When the cutting tool **20** encounters a workpiece, it is susceptible to vibration. Typically, for turning or milling cutting operations the vibrations are lateral vibrations. Typically, for drilling cutting operations, the vibrations are torsional vibrations. The vibration absorbing mass **54** oscillates at a vibration frequency. The anti-vibration arrangement is **34** designed to provide the vibration absorbing mass **54** with a vibration frequency close to, if not identical to, the natural frequency of the cutting tool **20**, thereby reducing or eliminating vibration of the cutting tool **20**.

Advantageously, the anti-vibration arrangement **34** can be tunable (so that the vibration frequency of the vibration absorbing mass **54** matches the natural frequency of the cutting tool (**20**) without the need to disassemble any separable parts. One or more mechanisms, alone or in combination, can be used to alter the vibration frequency at which the vibration absorbing mass **54** oscillates. In one non-limiting example, the at least two suspension members **62** can be pre-loaded. For example, referring to Fig. 3, the anti-vibration arrangement **34** can include a tuning member **70** that protrudes into the oscillating space **68**. The tuning member **70** can be a screw having a threaded portion **72** (see Fig. 7). The tuning member **70** can abut the cavity axial sealing member **67.** The tuning member **70** can be displaceable along the cavity central axis **D**, and thus also displaces the cavity axial sealing member **67,** thereby adjusting the elastic properties of the two suspension members **62**. In accordance with some embodiments of the subject matter of the present application, the oscillating space **68** can be empty. For example, the oscillating space **68** can be devoid of viscous fluid.

It should be noted that one feature of the present arrangement is that the tool holder coolant channel **28** is isolated from the anti-vibration arrangement **34**. In other words, the tool holder coolant channel **28** is not in fluid communication with the vibration absorbing mass **54**. By virtue of such an arrangement, any potential leakage of coolant from the tool holder coolant channel **28** is not in the vicinity of the holder cavity **36** in which the vibration absorbing mass 54 is located. Thus, leaked coolant cannot interfere with the damping effect of the anti-vibration arrangement **34**.

A further feature of the present arrangement is that it lacks a tube (as disclosed in US 7,681,869 B2) that would interfere with oscillating of the vibration absorbing mass **54.** Further moreover, the vibration absorbing mass **54** is solid in the sense that it does not have a hollow portion (e.g. for receiving a tube), which would reduce the weight of the vibration absorbing mass **54** itself.

Although the subject matter of the present application has been described to a certain degree of particularity, it should be understood that various alterations and modifications could be made without departing from the spirit or scope of the invention as hereinafter claimed.

For example, the groove coolant channel **96** can be formed from grooves formed in both the housing peripheral surface **39** and the sleeve hole wall surface **82**, respectively. and the two grooves face each other, in the assembled tool holder.

Further for example, the tool holder **22** can include more than one coolant channel **96**. Yet further for example, the anti-vibration arrangement **34** can include more than one vibration absorbing mass **54.** In this non-limiting example shown in the drawings, the anti-vibration arrangement **34** includes two vibration absorbing masses **54a, 54b** elastically connected by two central suspension members **63** (e.g. o-rings), while the aforementioned resilient suspension members **62** support end surfaces **56** belonging to two different vibration absorbing masses.

CLAIMS

What is claimed is:

1. A tool holder (22) elongated along a holder longitudinal axis (B) thereof which defines opposite forward and rearward directions (D_F, D_R), the tool holder (22) configured to have a cutting portion (24) affixed at a forward end thereof, the tool holder (22) comprising:

an outer sleeve (74) comprising:

opposite forward and rearward sleeve end surfaces (76a, 76b) and a sleeve peripheral surface (78) extending therebetween; and

a sleeve hole (80) having a sleeve hole wall surface (82) which opens out to the forward and rearward sleeve end surfaces (76a, 76b);

a mass housing portion (40) comprising:

opposite forward and rearward housing end surfaces (41a, 41b) and a housing peripheral surface (39) extending therebetween; and

an interior holder cavity (36) having an inwardly facing cavity wall surface (38); and

an anti-vibration arrangement (34) comprising:

a vibration absorbing mass (54) comprising two opposite mass end surfaces (56) and a mass peripheral surface (58) extending therebetween; and

two resilient suspension members (62), wherein:

an elongated groove (92) is formed in one of the housing peripheral surface (39) and the sleeve hole wall surface (82); and

the tool holder (22) is adjustable between an unassembled state and an assembled state, and in the assembled state:

the vibration absorbing mass (54) is disposed in the interior holder cavity (36) and is elastically suspended therein by the two suspension members (62) contacting the inwardly facing cavity wall surface (38);

the mass housing portion (40) is at least partially located in the sleeve hole (80), such that at least a portion of the sleeve hole wall surface (82) surrounds at

least a portion of the housing peripheral surface (39) about the holder longitudinal axis (B), thereby defining a common interface;

the groove (92) is located at the common interface, thereby forming a groove coolant channel (96); and

the groove coolant channel (96) is part of a tool holder coolant channel (28) having an external coolant inlet (30) and an external coolant outlet (32) in fluid communication with each other.

2. The tool holder (22), according to claim 1, wherein the groove (92) is formed in the housing peripheral surface (39).

3. The tool holder (22), according to claims 1 or 2, wherein the sleeve hole wall surface (82) opens out to the rearward sleeve end surface (76b).

4. The tool holder (22), according to any one of claims 1-3, wherein:

the groove (92) extends linearly along a groove axis (G); and

in the assembled state of the tool holder (22), the groove axis (G) is parallel to the holder longitudinal axis (B).

5. The tool holder (22), according to any one of claims 1-4, wherein:

the mass housing portion (40) comprises a forward housing portion (40a) and a rearward housing portion (40b), the forward housing portion (40a) being forward of, and having a greater radial dimension than, the rearward housing portion (40b); and

in the assembled state of the tool holder (22), only the rearward housing portion (40b) is located in the sleeve hole (80).

6. The tool holder (22), according to claim 5, wherein:

the housing peripheral surface (39) comprises:

a forward housing peripheral surface (39a) at the forward housing portion (40a);

a rearward housing peripheral surface (39b) at the rearward housing portion (40b); and

a housing step surface (39s) connecting the forward housing peripheral surface (39a) and the rearward housing peripheral surface (39b);

the forward housing portion (40a) comprises a forward housing coolant through channel (88) opening out, at a rearward end thereof, to the housing step surface (39s);

in the assembled state of the tool holder (22), the groove coolant channel (96) extends to the forward housing coolant through channel (88); and

the forward housing coolant through channel (88) is part of the tool holder coolant channel (28).

7. The tool holder (22), according to claim 6, wherein the forward housing coolant through channel (88) further opens out, at a forward end of the forward housing portion (40a), to the housing peripheral surface (39) to form the coolant outlet (32).

8. The tool holder (22), according to claims 6 or 7, wherein:

the mass housing portion (40) comprises a housing recess (84) comprising an inwardly facing recess wall surface (86) opening out to the rearward housing end surface (41b);

the tool holder (22) comprises a cavity axial sealing member (67);

in the assembled state of the tool holder (22), the cavity axial sealing member (67) is located in the housing recess (84), delimiting the holder cavity (36) in the rearward direction (D_R), so that a forward portion of the housing recess (84) forms the interior holder cavity (36);

the rearward housing portion (40b) comprises a rearward housing coolant through channel (90) opening out to the recess wall surface (86) and the rearward housing peripheral surface (39b); and

in the assembled state of the tool holder (22), the rearward housing coolant through channel (90) is rearward of the cavity axial sealing member (67), and the rearward housing coolant through channel (90) is part of the tool holder coolant channel (28).

9. The tool holder (22), according to claim 8, wherein:

the outer sleeve (74) comprises a forward outer sleeve component (74a) and a rearward outer sleeve component (74b); and

the forward and rearward outer sleeve components (74a, 74b) are fixedly engaged with each other, the forward outer sleeve component (74a) being forward of the rearward outer sleeve component (74b).

10. The tool holder (22), according to any one of claims 6-9, wherein in the assembled state of the tool holder (22), the forward sleeve end surface (76a) and the housing step surface (39s) abut each other.

11. The tool holder (22), according to any one of claims 6-10, wherein:

the rearward housing peripheral surface (39b) comprises axially spaced apart front and back rearward housing peripheral surfaces (39b-a, 39b-b) and a middle rearward housing peripheral surface (39b-c) extending therebetween, the front rearward housing peripheral surface (39b-a) being closer to the forward housing portion (40a) than the back rearward housing peripheral surface (39b-b); and

in the assembled state of the tool holder (22), at least the front and back rearward housing peripheral surfaces (39b-a, 39b-b) abut the sleeve hole wall surface (82), respectively.

12. The tool holder (22), according to claim 11, wherein:

the groove (92) is formed in the housing peripheral surface (39);

the groove (92) comprises two groove ends (94a, 94b);

the front rearward housing peripheral surface (39b-a) intersects the housing step surface (39s);

one of the two groove ends (94b) is located at the back rearward housing peripheral surfaces (39b-b); and

the other one of the two groove ends (94a) is located at the intersection of the front rearward housing peripheral surface (39b-a) and the housing step surface (39s).

13. The tool holder (22), according to claims 11 or 12, wherein:

the middle rearward housing peripheral surface (39b-c) is radially recessed with respect to the front and back rearward housing peripheral surfaces (39b-a, 39b-b); and

in the assembled state of the tool holder (22), the middle rearward housing peripheral surface (39b-c) is spaced apart from the sleeve hole wall surface (82).

14. The tool holder (22), according to any one of claims 1-13, wherein:

the mass housing portion (40) comprises a housing recess (84) comprising an inwardly facing recess wall surface (86) opening out to the rearward housing end surface (41b);

the tool holder (22) comprises a cavity axial sealing member (67); and

in the assembled state of the tool holder (22), the cavity axial sealing member (67) is located in the housing recess (84), delimiting the holder cavity (36) in the rearward direction (D_R), so that a forward portion of the housing recess (84) forms the interior holder cavity (36).

15. The tool holder (22), according to claim 14, wherein:

in the assembled state of the tool holder (22), the recess wall surface (86) opens out to the rearward housing end surface (41b) to form the coolant inlet (30); and

a portion of the housing recess (84) extending from the coolant inlet (30) is part of the tool holder coolant channel (28).

16. The tool holder (22), according to any one of claims 1-15, wherein:

the outer sleeve (74) comprises a sleeve material;

the mass housing portion (40) comprises a housing body material; and

the sleeve material is denser than the housing body material.

17. The tool holder (22), according to claim 16, wherein the sleeve material is carbide.

18. A cutting tool (20) comprising:

a tool holder (22) in accordance with any one of claims 1-17; and

a cutting portion (24) located at a forward end of the tool holder (22), the cutting portion (24) comprising at least one cutting insert (26).

19. The cutting tool (20), according to claim 18, wherein the cutting portion (24) is releasably attached to the tool holder (22).

20. The cutting tool (20), according to claims 18 or 19, wherein the coolant outlet (32) is rotationally aligned with the cutting insert (26) about the holder longitudinal axis (B).

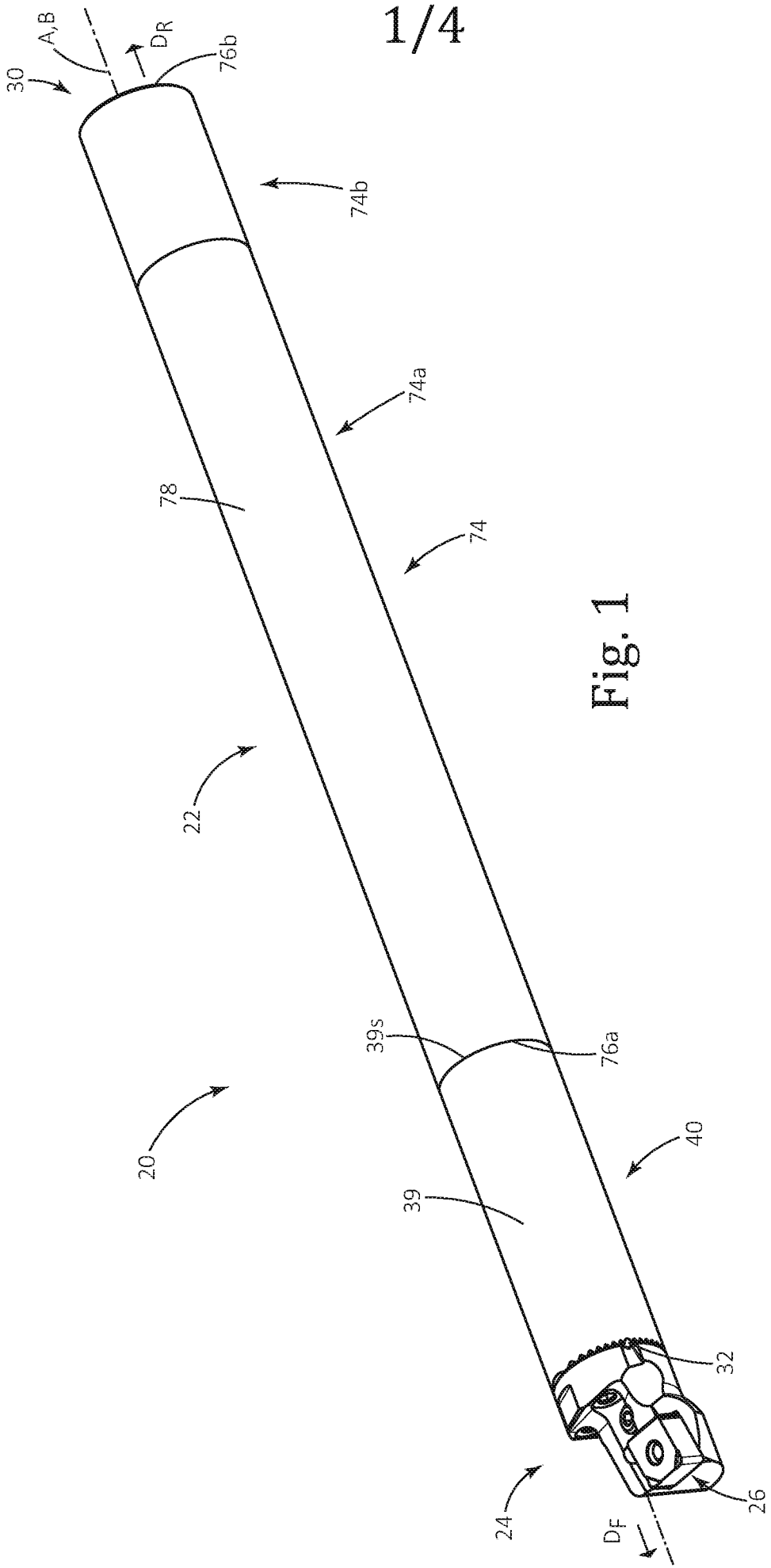


Fig. 1

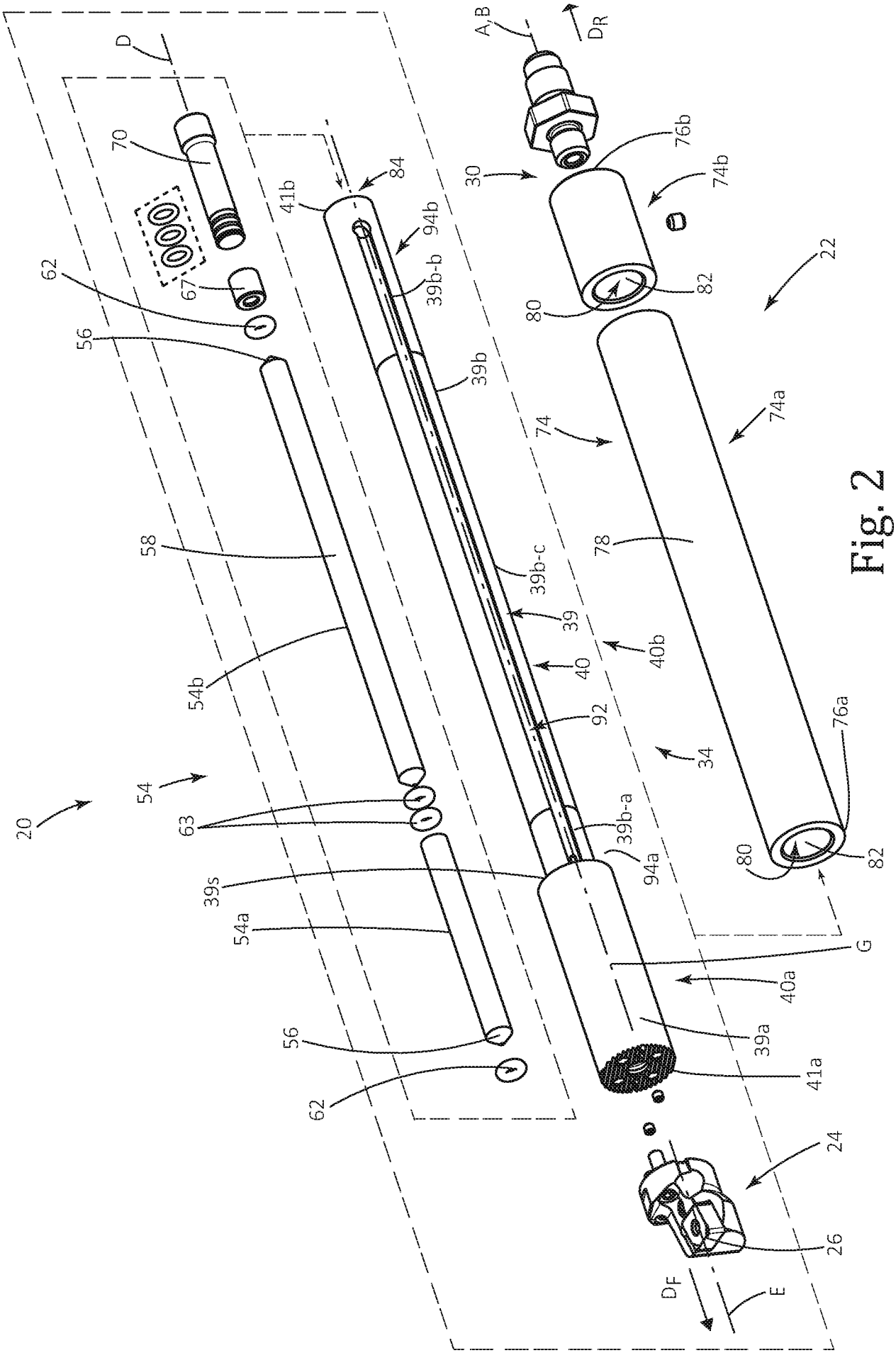

A,B
D_R
D
70
67
62
56
41b
84
94b
39b-b
39b
30
76b
74b
22
82
80
74
74a
39b-c
78
58
39
40
40b
54b
92
34
76a
54
63
20
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39s
54a
G
40a
56
39a
41a
62
24
26
D_F
E

Fig. 2

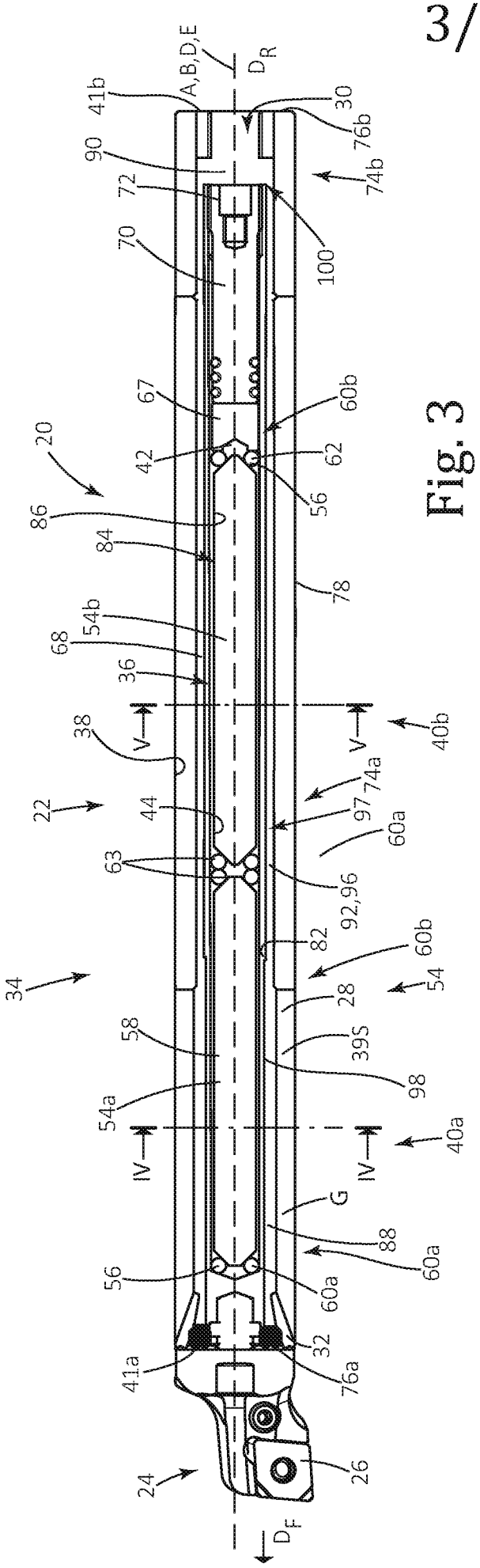


Fig. 3

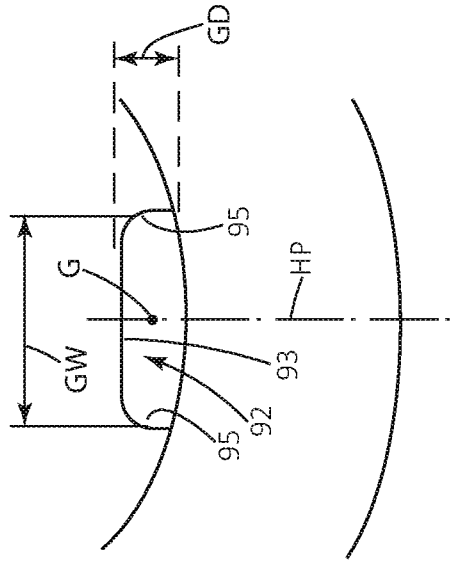


Fig. 5a

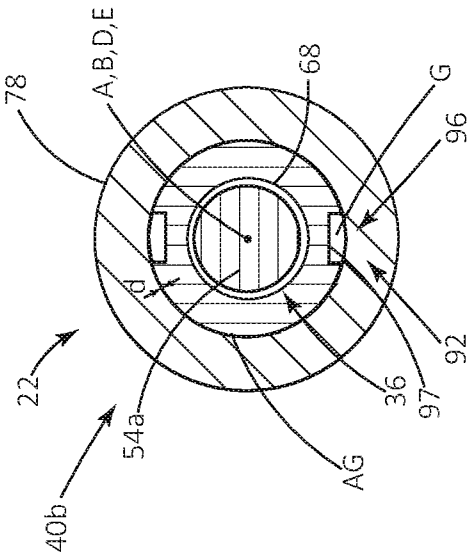


Fig. 5

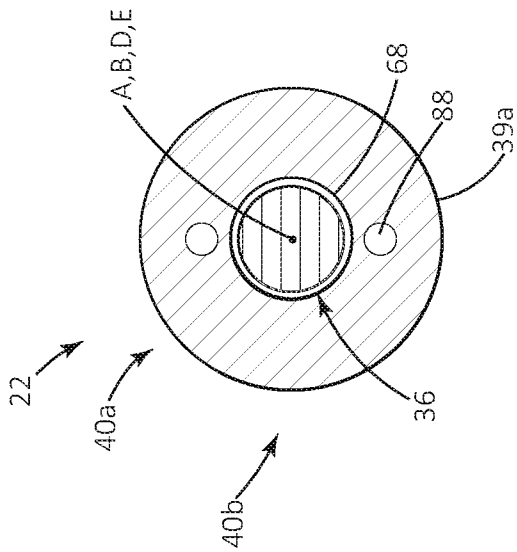


Fig. 4

Fig. 6

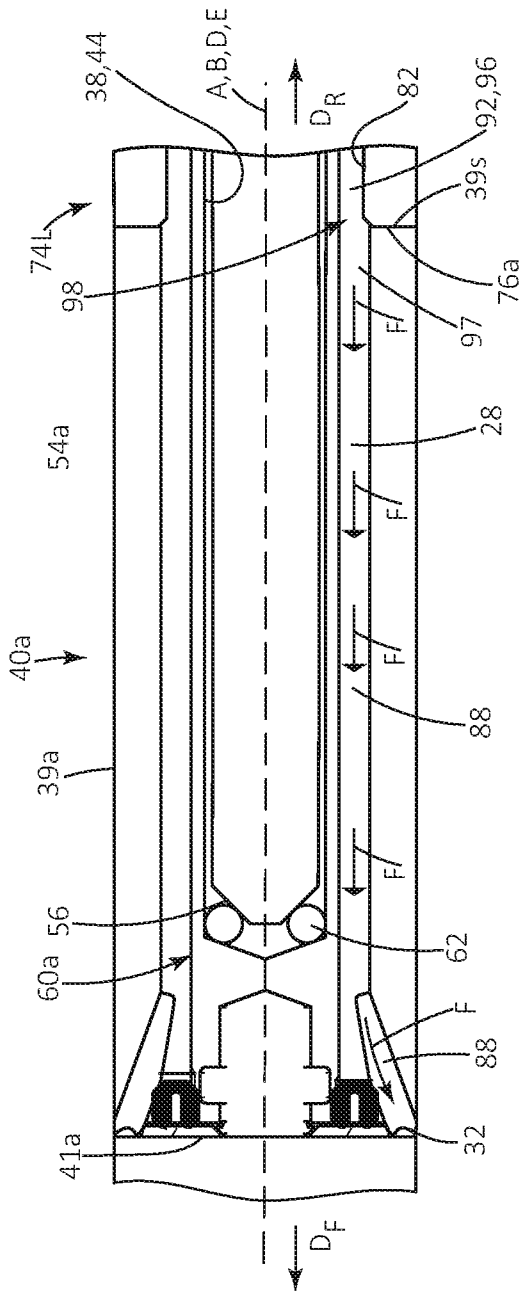
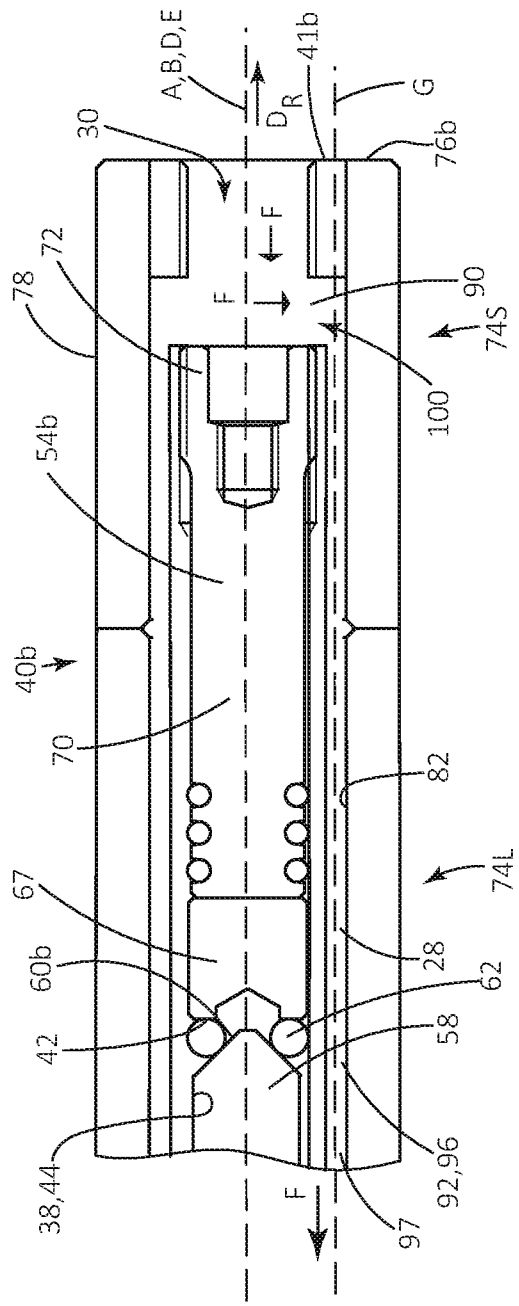

38,44
A,B,D,E
D_R
82
92,96
39s
74L
98
97
76a
F
28
54a
40a
39a
88
56
62
60a
F
88
32
41a
D_F

Fig. 7


A,B,D,E
D_R
41b
G
30
76b
F
F
78
72
90
74S
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38,44
92,96
97
F

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2022/050859

A. CLASSIFICATION OF SUBJECT MATTER
INV. B23B29/02 B23B27/00 B23B27/10 F16F7/00 B23B29/08
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)
B23B B23C F16F B23Q

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	US 2010/242696 A1 (DIGERNES ANDERS [NO] ET AL) 30 September 2010 (2010-09-30) paragraphs [0008], [0009], [0060] claims 1-3 figures 1-12	1-4, 14-20
A	US 2011/255932 A1 (COOK HAROLD D [US] ET AL) 20 October 2011 (2011-10-20) paragraph [0082] figures 1, 2, 2A, 16, 16A, 17, 17A	1-20
A	WO 2018/044216 A1 (MAQ AB [SE]) 8 March 2018 (2018-03-08) figures 1-15	1-20

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

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"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search	Date of mailing of the international search report
24 November 2022	06/12/2022

Name and mailing address of the ISA/	Authorized officer
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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2022/050859

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2016/214185 A1 (FAESSLER ROMAN [CH] ET AL) 28 July 2016 (2016-07-28) paragraphs [0068], [0088] figures 1-7	1-20
A	US 2011/318127 A1 (FREYERMUTH ALAIN [FR] ET AL) 29 December 2011 (2011-12-29) figures 1-4	1
A	US 2006/275090 A1 (ONOZUKA HIDEAKI [JP] ET AL) 7 December 2006 (2006-12-07) figure 1	1

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2022/050859

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010242696 A1	30-09-2010	CA 2654860 A1	03-01-2008
		CN 101460273 A	17-06-2009
		EP 2032293 A1	11-03-2009
		IL 196087 A	31-10-2013
		JP 5079802 B2	21-11-2012
		JP 2009542446 A	03-12-2009
		KR 20090031859 A	30-03-2009
		NO 330162 B1	28-02-2011
		RU 2008146202 A	10-08-2010
		US 2010242696 A1	30-09-2010
		WO 2008002145 A1	03-01-2008
US 2011255932 A1	20-10-2011	US 2011255932 A1	20-10-2011
		WO 2011109785 A1	09-09-2011
WO 2018044216 A1	08-03-2018	CA 3034638 A1	08-03-2018
		CN 109641279 A	16-04-2019
		EP 3507040 A1	10-07-2019
		ES 2804553 T3	08-02-2021
		JP 6799685 B2	16-12-2020
		JP 2019531202 A	31-10-2019
		KR 20190045254 A	02-05-2019
		PL 3507040 T3	16-11-2020
		US 2021291277 A1	23-09-2021
		WO 2018044216 A1	08-03-2018
US 2016214185 A1	28-07-2016	CN 105817707 A	03-08-2016
		DE 102015000797 A1	28-07-2016
		EP 3047929 A1	27-07-2016
		ES 2811770 T3	15-03-2021
		JP 6219419 B2	25-10-2017
		JP 2016132096 A	25-07-2016
		KR 20160090736 A	01-08-2016
		PL 3047929 T3	02-11-2020
		US 2016214185 A1	28-07-2016
US 2011318127 A1	29-12-2011	BR PI1102769 A2	19-02-2013
		CA 2744077 A1	28-12-2011
		CN 102294605 A	28-12-2011
		EP 2399698 A1	28-12-2011
		FR 2961728 A1	30-12-2011
		JP 2012006140 A	12-01-2012
		KR 20120001638 A	04-01-2012
		RU 2011126439 A	10-01-2013
		TW 201206594 A	16-02-2012
		US 2011318127 A1	29-12-2011
US 2006275090 A1	07-12-2006	JP 4648072 B2	09-03-2011
		JP 2006305674 A	09-11-2006
		US 2006275090 A1	07-12-2006