(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 827 914 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
02.06.2021 Bulletin 2021/22

(21) Application number: **19842248.7**

(22) Date of filing: **23.07.2019**

(51) Int Cl.:
B22D 17/20 *(2006.01)*

(86) International application number:
PCT/JP2019/028761

(87) International publication number:
WO 2020/022304 (30.01.2020 Gazette 2020/05)

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
KH MA MD TN

(30) Priority: **26.07.2018 US 201862703564 P**

(71) Applicant: **MORESCO CORPORATION**
Kobe-shi
Hyogo 650-0047 (JP)

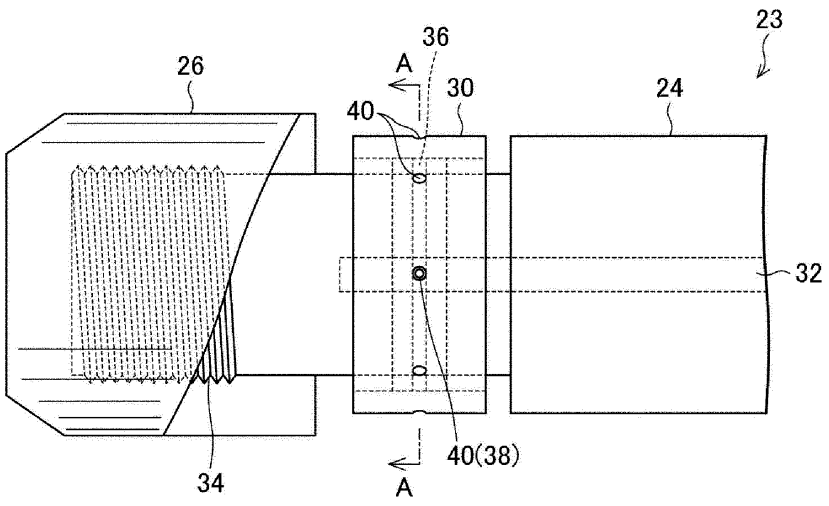
(72) Inventor: **BOGAN, Robin**
Fountain Inn ,
South Carolina 29644 (US)

(74) Representative: **Bittner, Thomas L.**
Boehmert & Boehmert
Anwaltspartnerschaft mbB
Pettenkoferstrasse 22
80336 München (DE)

(54) **BACK-SPRAY SYSTEM AND INJECTION PISTON**

(57) A back spray system comprising an injection piston having a plunger tip (26) and a shot rod (24) with a shot rod hole (32) drilled through the length of the rod connecting a lubricating supply to a collar (30) located right directly behind the plunger tip (24). The collar (30) has a predetermined number of collar holes (40) positioned circumferentially about the collar (30) sized and positioned to dispense a precise and uniform amount of lubricant to the space between the plunger tip (24) and the shot sleeve (20). Under the collar (30) is a channel with two drilled holes (38) connected to the shot rod hole (40).

FIG. 4



EP 3 827 914 A1

Description

[0001] The present invention relates to a back spray system for an injection piston used in a die casting machine. More particularly, the present invention comprises a system to sufficiently lubricate the interior of the die casting sleeve and plunger tip from the die mold to a pouring port.

Background

[0002] In die casting, molten metal, such as aluminum, is poured into a shot sleeve through a pouring port in the shot sleeve. A predetermined amount of the molten metal is transferred into a shot sleeve for insertion by an injection piston into a die cavity forming a casting, the metal is cooled and the casting removed from the die. The injection piston, consisting of a shot rod and a plunger tip, is axially moved or extended into the shot sleeve to "shoot" the molten metal into the die cavity. It is necessary to both lubricate and cool the plunger tip and the shot rod due to the high temperatures, the presence of molten metal on the plunger tip and the plunger rod, and the friction between the plunger tip and the shot sleeve.

[0003] A shot system is prone to many different problems. Excessive wear and poor lubrication frequently occur between the enlarged plunger tip and the shot sleeve, as well as dripping and wasting of lubricant used to minimize wear. Lubrication of these contiguous surfaces has heretofore suffered from inefficiency and plugging of the lubricating lines and the lubricating holes causing excessive wear and parts fatigue. The cleaning of these lubricating holes or ports has been difficult and time consuming, while excess emission lubrication and improper lubrication creates a smoke emission problem during die casting operation.

[0004] In attempting to overcome lubrication problems, various lubricating systems have been developed. However, it is difficult to cause the lubricant to spread around the peripheral surfaces from the clearance between the end face of the shot sleeve and the end face of the injection piston, causing an early abrasion or fouling of portions that are not covered by the lubricant.

Summary

Technical Problem

[0005] It is an object of an aspect of the present invention to provide, for example, a system that allows lubricant to get to a proper place in a shot sleeve.

Solution to Problem

[0006] A back spray system in accordance with an aspect of the present invention is a back spray system for lubricating a shot sleeve of a die casting machine, including: a shot sleeve; an injection piston having a plunger tip and a shot rod connected to the plunger tip; a groove surrounding the shot rod; and a collar surrounding the groove; the shot rod having a shot rod hole through the length of the shot rod; the groove having at least one groove hole connected to the shot rod hole; the collar having a predetermined number of collar holes in communication with the groove and positioned circumferentially about the collar, and lubricant, having been supplied to the shot rod hole, flowing through the at least one groove hole into the groove, and then being released from the groove through the collar holes to a space between the plunger tip and the shot sleeve.

[0007] An injection piston in accordance with an aspect of the present invention is an injection piston used in combination with a shot sleeve, including: a plunger tip; a shot rod connected to the plunger tip; a groove surrounding the shot rod; and a collar surrounding the groove; the shot rod having a shot rod hole through the length of the shot rod; the groove having at least one groove hole connected to the shot rod hole; the collar having a predetermined number of collar holes in communication with the groove and positioned circumferentially about the collar, and lubricant, having been supplied to the shot rod hole, flowing through the at least one groove hole into the groove, and then being released from the groove through the collar holes to a space between the plunger tip and the shot sleeve.

Advantageous Effects of Invention

[0008] An aspect of the present invention allows lubricant to get to a proper place in a shot sleeve.

Description of Embodiments

[0009]

FIG. 1 is a diagram illustrating a general description of a die casting machine;
FIG. 2 is a side view of a conventional shot sleeve showing the injection plunger at a with-drawn position;
FIG. 3 is a side view of an injection piston of one embodiment of the present invention showing the plunger tip and the shot rod;
FIG. 4 is a side view of the injection piston showing the collar disposed over the groove; and
FIG. 5 is a cross section view of the injection piston taken along line A-A of FIG. 4.

[0010] Having described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale.

[0011] The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be con-

strued as limited to the embodiments set forth herein; rather these embodiments are provided so that this disclosure will be through and complete and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to the elements throughout.

[Summary]

[0012] It is therefore the general object of one or more embodiments of the present invention to provide a lubricating system to apply lubricant as far forward in the shot sleeve as possible. Another object is to sufficiently atomize lubricant to cover all the interior of the shot sleeve from die mold to pouring port.

[0013] There is provided back spray system comprising an injection piston having a plunger tip and a shot rod with a gun drilled hole through the length of the rod connecting a lubricant supply to a collar located behind the plunger tip.

[0014] The collar has a predetermined number of holes or ports positioned circumferentially about the collar sized and positioned to dispense a precise and uniform amount of lubricant and air to the space between the plunger tip and the shot sleeve. The number of holes depends on the circumference of the shot rod. Under the collar is a channel with two drilled holes connected to the shot rod hole that extends the length of the shot rod.

[0015] When the injection piston is in use a lubricant and air mixture travels through the shot rod holes to the collar where the mixture is released or sprayed out to thoroughly cover the shot sleeve and plunger tip and apply lubricant to the far forward portion of the shot sleeve.

[0016] Other objects features and advantages of the invention will be apparent to those skilled in the art from the following detailed description taken in conjunction with the drawings.

[Configuration of die casting machine]

[0017] Turning now to FIG. 1 there is shown a simplified diagram of a die casting machine 10. The die casting machine 10 comprises a frame 12 which includes a fixed die 14 mounted to the frame 12 and a movable die 16 acting as a second die which is driven by reciprocating motion (not shown) toward and away from the fixed die 14 and when the movable die 16 is brought into abutment against the fixed die 14 a cavity 18 is formed there between. A shot sleeve 20 passed through the fixed die 12 and communicates with the cavity 18. In shot sleeve 20 there is an injection piston 23, comprised of a plunger tip 26 and a shot rod 24. The shot rod 24 is slideably disposed within shot sleeve 20 and is driven back and forth through the shot sleeve 20. The shot sleeve 20 is a symmetrical round metal sleeve through which the shot rod 24 slides. The shot rod 24 pushes the molten metal into the cavity 18 of the die after the molten metal is poured into the pour hole - opening 22. The pour hole 22 is located at the end position of the shot sleeve 20 away from the dies. The pour hole 22 is located at an upper portion of the shot sleeve 20, so as to allow molten metal to be poured into the shot sleeve 20. The molten metal is poured into the shot sleeve 20 when the injection piston 23 assumes its retrenched position.

[0018] In FIG. 2 there is shown a conventional shot sleeve 20 showing the injection piston 23 having a plunger tip 26 and a shot rod 24 at a withdrawn position. In FIG. 2 the injection piston 23 is awaiting input of a molten metal, such as aluminum, to be placed into the shot sleeve 20 through pour hole 22. As the injection piston 23 is pushed toward the die there is a tight space 25 between the periphery of the plunger tip 26 and the inside of the shot sleeve 20. This space 25 varies depending upon the inside diameter of the shot sleeve 20 and the outside diameter of the plunger tip 26 but is generally on the order of 0.03 to 0.06 mm. This tight clearance causes excessive wear due to poor lubrication.

[Description of back spray system]

[0019] The lubrication problem has been overcome by the back spray system of the present invention one embodiment of which is shown in FIGs. 3 and 4 and comprises an injection piston 23. The injection piston 23 of the back spray system comprises a shot rod 24 having a collar 30 at the forward end. Note that the back spray system is similar in configuration to such conventional die casting machines 10 as illustrated in FIGs. 1 and 2, except for the configuration of the injection piston 23.

[0020] Inside shot sleeve 20 the back spray system will apply lubricant to the inner periphery of the shot sleeve 20 so that as the plunger tip 26 is pushed into and out of the shot sleeve 20 the lubricant coats the entire area. Any of the conventional lubricating oils may be used as the lubricant. To get the lubricant to the proper place a shot rod hole 32 is drilled the length of the shot rod 24 to right behind the forward end of the shot rod 24. The size of the shot rod hole 32 will vary depending upon the size of the shot sleeve 20 and injection piston 23 and to an extent the lubricant used. Typically the shot rod hole 32 is from approximately 6.5 mm to about 19.05 mm (about 1/4 to 3/4 inch) in diameter. The lubricant is supplied under pressure to the rear end of the shot rod 24 through equipment known to those skilled in the art.

[0021] The plunger tip 26 is connected, such as a screw connection, by threads 34 to the end of shot rod 24. Behind the plunger tip 26 is a recessed groove 36. In the examples of FIGs. 3 and 4, the shot rod 24 has a tip having a reduced diameter, and such a reduced diameter part is provided with a groove 36. Note, however, that the shot rod 24 does not necessarily need to have the reduced diameter part and the groove 36 also does not necessarily need to be provided in the reduced diameter part. The collar 30 covers the groove 36, as shown in FIGs. 3 and 4. Then, the groove 36 and an inner wall surface of the collar 30 constitute a channel. As shown in the embodiment of FIG. 5, which is a cross-sectional

view taken along line A-A of FIG. 4, in the groove 36 there are two groove holes 38 spaced 180° apart that connect to the shot rod hole 32. The groove holes 38 are through holes connecting the surface of the shot rod 24 and the shot rod hole 32. These groove holes 38 pass lubricant from the shot rod hole 32 to collar holes 40. It should be understood that the number of groove holes 38 may vary but typically these groove holes 38 can be from approximately 6.5 mm to about 19.05 mm (1/4 to 3/4 inch) in diameter but do not have to be the same size as the shot rod hole 32 and typically each is smaller in diameter so that the amount of lubricant/air mixture in the shot rod hole 32 is equal to the amount of lubricant/air mixture in groove holes 38.

[0022] In the embodiment shown in FIG. 4, the collar 30 is seated over recessed groove 36. The collar 30 has a tubular structure and has an outside diameter that is smaller than a diameter of the plunger tip 26 and larger than a diameter of the shot rod 24 around the groove 36. In order to allow lubricant to get to an inner deep part of the shot sleeve 20, the collar 30 is preferably provided as close as possible to the plunger tip 26 (for example, at a location behind the plunger tip 26 and as close as possible to the plunger tip 26). The collar 30 may be fixed in place, such as by inserting the collar 30 over the portions forming recessed groove 36 to form a tight fit. The collar 30 may be removable from the groove 36. The collar 30 that has been removed from the groove 36 as shown in FIG. 3 facilitates cleaning of the inside of the groove 36 and the groove holes 38. The groove 36 may be formed in a variety of ways. For example, it may be formed by providing two ring-shaped members on the surface of the shot rod 24 or it may be formed as part of the shot rod 24 (for example, formed by shaving the surface of the shot rod 24). Collar 30 has a plurality of holes (collar holes) 40 drilled symmetrically around the collar 30. The collar holes 40 are through holes connecting the outer periphery and the inner periphery of the collar 30. The number of collar holes 40 depends on the circumference of the shot rod 24. These holes are preferably from about 1.81 mm to about 6.5 mm (1/14 inch to 1/4 inch) in diameter. The collar holes 40 are typically smaller than the groove holes 38 so that the amount of lubricant/air mixture in the groove holes 38 is equal to the amount of lubricant to air in collar holes 40. The collar holes 40 are preferably countersunk to help the radial effect of the lubricant when being supplied to the shot sleeve 20.

[0023] As is clear from FIGs. 4 and 5, lubricant supplied from an end (an end to which no plunger tip 26 is connected) of the shot rod hole 32 is passed through shot rod hole 32 into groove holes 38 under the collar 30, then the lubricant (which is mixed with air) travels into groove 36, finally coming out of the collar holes 40. This design allows maximum coverage with minimum volume of the lubricant. The back spray system also allows the lubricant to get to the furthest point in shot sleeve 20 and have the lubricant be right behind the plunger tip 26. When the plunger tip 26 is pulled backward in the shot sleeve 20 for the length of the shot sleeve 20 uniform lubricant coverage is provided from the dies to the shot pour location with the ability to add extra lubricant at any location as needed. While the shot rod 24 retracts the lubricant/air mixture will be pushed down from the shot rod hole 32 in the shot rod 24 to the groove holes 38 in the channel behind the collar 30, then the lubricant/air mixture is pushed out the collar holes 40 in an atomized fashion to make a radial spray to cover the shot sleeve 20 with the lubricant as the shot rod 24 fully retracts.

[Examples]

[0024] In an example of practicing this invention, a shot rod 24 was drilled with one 7.94 mm (5/16 inch) diameter shot rod hole 32 the length of the shot rod 24 to push a lubricant/air mixture to a channel with two 7.94 mm (5/16 inch) gun drilled groove holes 38 in a channel covered by the collar 30 that has eight (8) collar holes 40 drilled to disperse the lubricant/air mixture. The lubricant/air mixture was pressurized in the shot rod 24 inside the shot rod hole 32 then pushed into the groove 36 behind the collar 30, then pushed out of the eight collar holes 40 under pressure as the shot rod 24 retracts the length of the shot sleeve 20. The lubricant/air mixture was pressurized through the shot rod hole 32 to efficiently atomize lubricant, while the shot rod 24 was pulled back, the atomized spray delivered the lubricant the length of the shot sleeve 20 and draw.

[0025] In a conventional example the amount of lubricant/air mixture spraying down the porthole was 2 to 2.5 ml per shot. After the back spray system of this invention was installed the usage dropped to 0.75 -1.0 ml per shot. During a two month time period there were 11 plunger tip 26 changes with the conventional method of spraying down the porthole and 4 plunger tip 26 changes with the back spray system. Shot sleeve 20 life was also improved. Decreased consumption of lubricant was obtained as well as extended plunger tip 26 and shot sleeve 20 life. Decreased porosity of die cast parts was also observed.

[0026] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

[Cross reference to related application]

[0027] The contents of Provisional Application U.S. Serial No. 62/703,564 filed July 26, 2018, on which the

present application is based and benefit claimed under 35 U.S.C. §119(e), in incorporated by reference.

Reference Signs

[0028]

20	Shot sleeve
23	Injection piston
24	Shot rod
26	Plunger tip
30	Collar
32	Shot rod hole
36	Groove
38	Groove hole
40	Collar hole

Claims

1. A back spray system for lubricating a shot sleeve of a die casting machine, comprising:

- a shot sleeve;
- an injection piston having a plunger tip and a shot rod connected to said plunger tip;
- a groove surrounding said shot rod; and
- a collar surrounding said groove;
- said shot rod having a shot rod hole through the length of said shot rod;
- said groove having at least one groove hole connected to said shot rod hole;
- said collar having a predetermined number of collar holes in communication with said groove and positioned circumferentially about said collar, and
- lubricant, having been supplied to said shot rod hole, flowing through said at least one groove hole into said groove, and then being released from said groove through said collar holes to a space between said plunger tip and said shot sleeve.

2. The back spray system according to Claim 1 wherein said collar has eight collar holes.

3. The back spray system according to Claim 1 wherein said at least one groove hole comprises at least two groove holes.

4. The back spray system according to Claim 1 wherein said collar is located behind said plunger tip.

5. The back spray system according to Claim 1 wherein said lubricant is lubricating oil and is atomized with air.

6. An injection piston used in combination with a shot sleeve, comprising:

- a plunger tip;
- a shot rod connected to said plunger tip;
- a groove surrounding said shot rod; and
- a collar surrounding said groove;
- said shot rod having a shot rod hole through the length of said shot rod;
- said groove having at least one groove hole connected to said shot rod hole;
- said collar having a predetermined number of collar holes in communication with said groove and positioned circumferentially about said collar, and
- lubricant, having been supplied to said shot rod hole, flowing through said at least one groove hole into said groove, and then being released from said groove through said collar holes to a space between said plunger tip and said shot sleeve.

7. The injection piston according to Claim 6 wherein said collar has eight collar holes.

8. The injection piston according to Claim 6 wherein under said collar is a channel with at least two holes connected to said shot rod hole.

FIG. 1

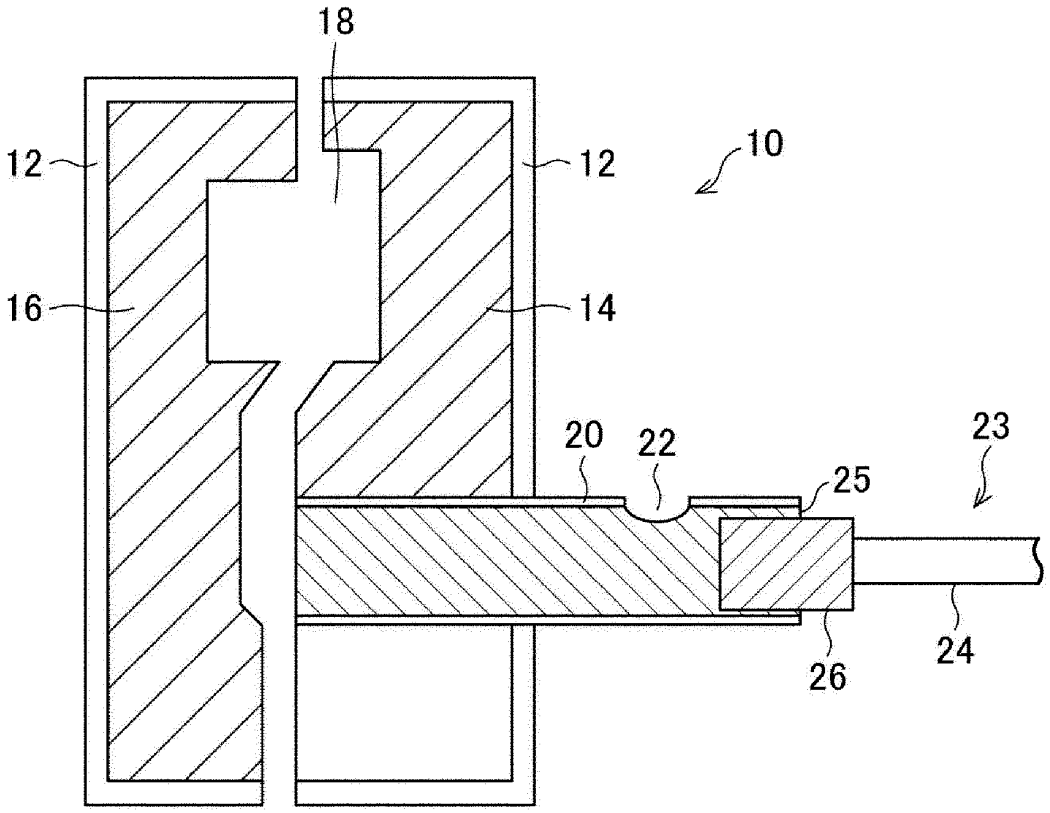


FIG. 2

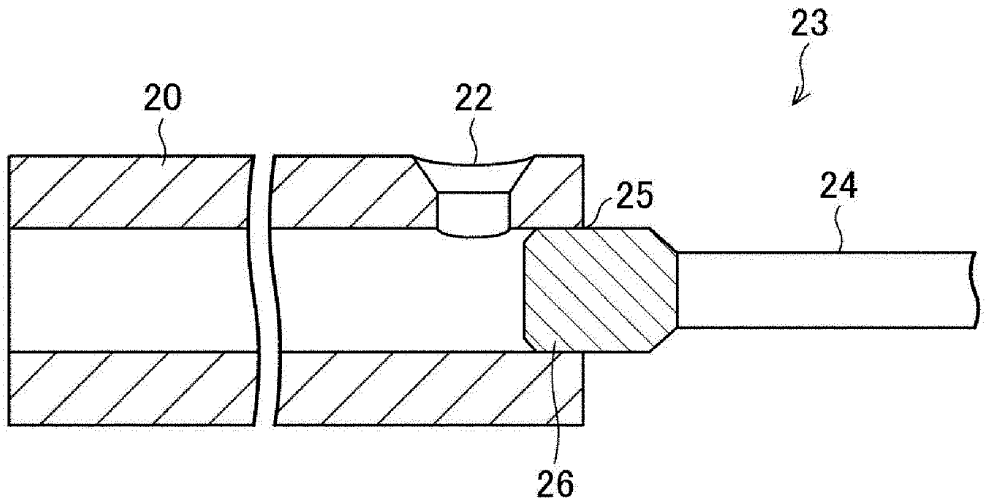


FIG. 3

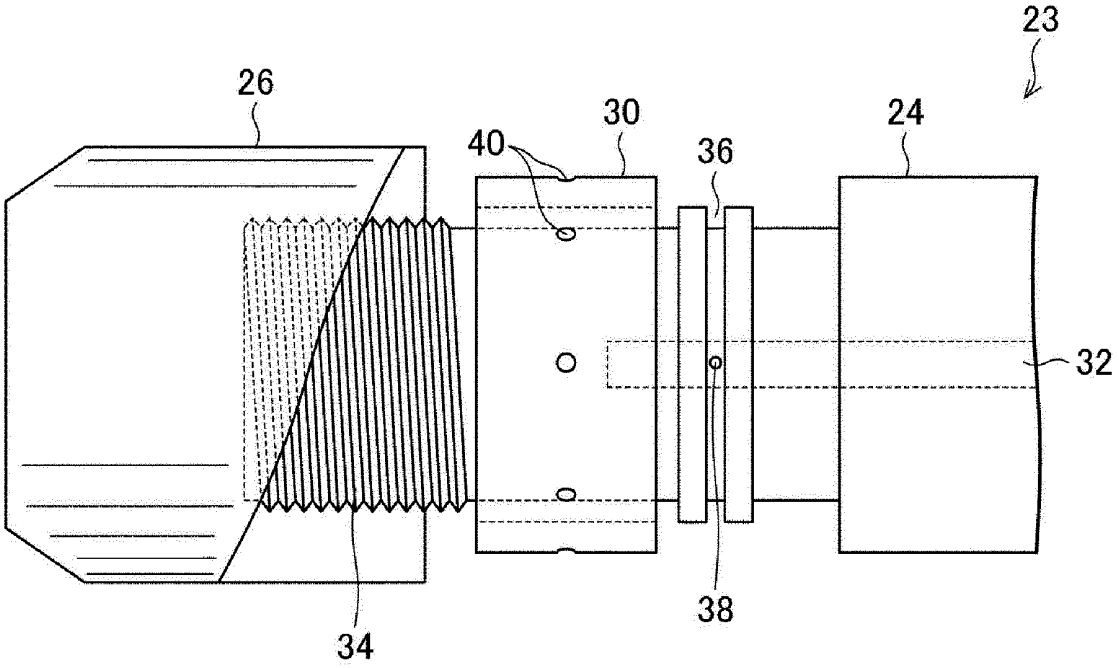


FIG. 4

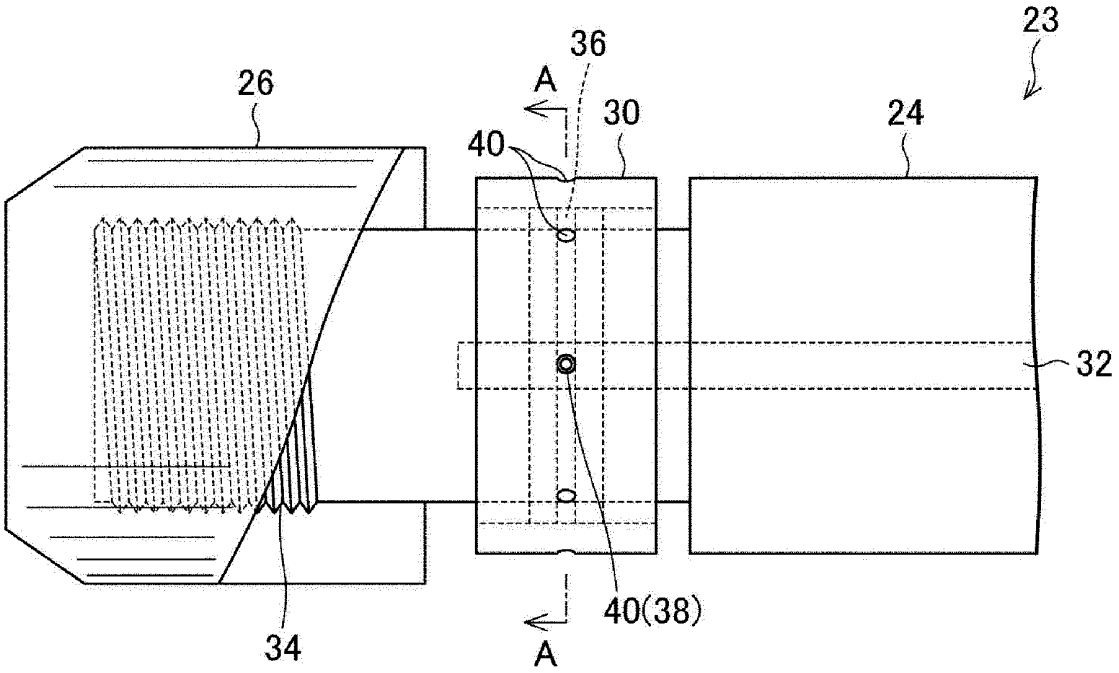
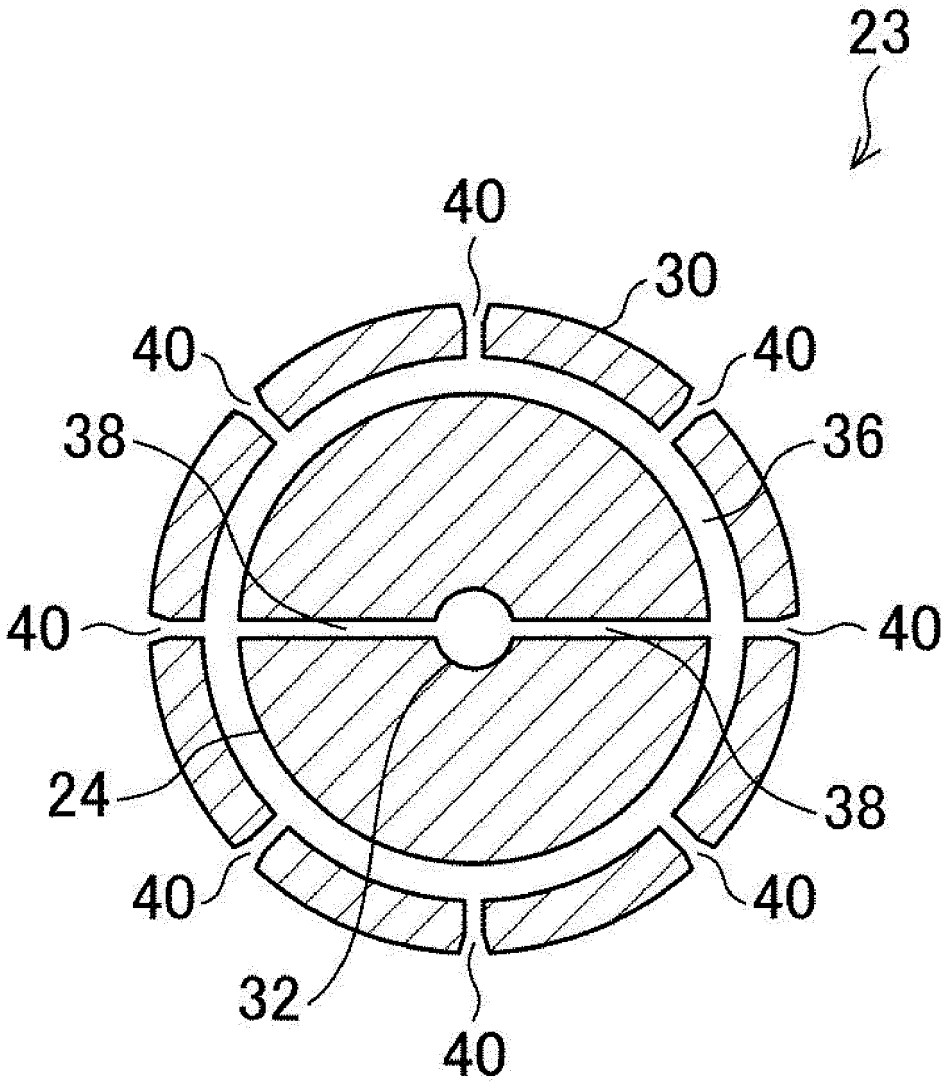


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/028761

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. B22D17/20(2006.01)i

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)
Int.Cl. B22D17/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2005-349452 A (AISIN SEIKI CO., LTD.) 22 December 2005, paragraphs [0020]-[0034], fig. 1-3 (Family: none)	1-8
A	JP 6-87060 A (KOBE STEEL, LTD.) 29 March 1994, paragraphs [0017]-[0024], fig. 1 (Family: none)	1-8
A	JP 2010-269319 A (KATSUMI, Masashi) 02 December 2010, paragraphs [0024]-[0034], fig. 1-3 (Family: none)	1-8

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 04 October 2019 (04.10.2019)	Date of mailing of the international search report 15 October 2019 (15.10.2019)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/028761

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2017-226004 A (DAIHATSU MOTOR CO., LTD.) 28 December 2017, paragraphs [0012]-[0028], fig. 1-3 (Family: none)	1-8

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

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 62703564 **[0027]**