

**(12) STANDARD PATENT**  
**(19) AUSTRALIAN PATENT OFFICE**

(11) Application No. **AU 2013386218 B2**

(54) Title  
**Gasket, engine and automobile**

(51) International Patent Classification(s)  
**F16B 43/00** (2006.01)                      **F16H 57/04** (2006.01)  
**F16H 48/00** (2012.01)

(21) Application No: **2013386218**                      (22) Date of Filing: **2013.12.06**

(87) WIPO No: **WO14/166272**

(30) Priority Data

(31) Number	(32) Date	(33) Country
<b>201310117059.4</b>	<b>2013.04.07</b>	<b>CN</b>
<b>201310117018.5</b>	<b>2013.04.07</b>	<b>CN</b>
<b>201310117139.X</b>	<b>2013.04.07</b>	<b>CN</b>
<b>201310117029.3</b>	<b>2013.04.07</b>	<b>CN</b>
<b>201310117041.4</b>	<b>2013.04.07</b>	<b>CN</b>

(43) Publication Date: **2014.10.16**

(44) Accepted Journal Date: **2016.06.02**

(71) Applicant(s)  
**Anhui Jianghuai Automobile Co., Ltd**

(72) Inventor(s)  
**Hu, Zhisheng;Jin, Suhua;Zheng, Jiulin;Lan, Jian;Ma, Yong;Qian, Duode;Meng, Xiangshan;Hu, Biqian**

(74) Agent / Attorney  
**Shelston IP Pty Ltd., Level 21, 60 Margaret Street, Sydney, NSW, 2000**

(56) Related Art  
**CN 201368184 Y**  
**CN 201531585 U**  
**US 2004/0057813 A1**

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织  
国际局

(43) 国际公布日  
2014年10月16日 (16.10.2014)



(10) 国际公布号  
WO 2014/166272 A1

- (51) 国际专利分类号:  
F16B 43/00 (2006.01) F16H 48/00 (2012.01)  
F16H 57/04 (2010.01)
- (21) 国际申请号: PCT/CN2013/088741
- (22) 国际申请日: 2013年12月6日 (06.12.2013)
- (25) 申请语言: 中文
- (26) 公布语言: 中文
- (30) 优先权:  
201310117029.3 2013年4月7日 (07.04.2013) CN  
201310117139.X 2013年4月7日 (07.04.2013) CN  
201310117059.4 2013年4月7日 (07.04.2013) CN  
201310117041.4 2013年4月7日 (07.04.2013) CN  
201310117018.5 2013年4月7日 (07.04.2013) CN
- (71) 申请人: 安徽江淮汽车股份有限公司 (ANHUI JI-  
ANGHUAI AUTOMOBILE CO., LTD) [CN/CN]; 中国  
安徽省合肥市东流路 176 号, Anhui 230022 (CN)。
- (72) 发明人: 胡志胜 (HU, Zhisheng); 中国安徽省合肥市  
东流路 176 号, Anhui 230022 (CN)。 靳素华 (JIN,

Suhua); 中国安徽省合肥市东流路 176 号, Anhui 230022 (CN)。 郑久林 (ZHENG, Jiulin); 中国安徽省合肥市东流路 176 号, Anhui 230022 (CN)。 兰剑 (LAN, Jian); 中国安徽省合肥市东流路 176 号, Anhui 230022 (CN)。 马勇 (MA, Yong); 中国安徽省合肥市东流路 176 号, Anhui 230022 (CN)。 钱多德 (QIAN, Duode); 中国安徽省合肥市东流路 176 号, Anhui 230022 (CN)。 孟祥山 (MENG, Xiangshan); 中国安徽省合肥市东流路 176 号, Anhui 230022 (CN)。 胡必谦 (HU, Biqian); 中国安徽省合肥市东流路 176 号, Anhui 230022 (CN)。

- (74) 代理人: 北京维澳专利代理有限公司 (PACIFIC  
CHINA INTELLECTUAL PROPERTY CO., LTD.);  
中国北京市朝阳区建国门外大街 22 号赛特大厦 17  
层 1701, Beijing 100004 (CN)。
- (81) 指定国 (除另有指明, 要求每一种可提供的国家保  
护): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG,  
BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR,  
CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB,  
GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS,  
JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT,

[见续页]

(54) Title: GASKET, ENGINE AND AUTOMOBILE

(54) 发明名称: 一种垫片、发动机和汽车

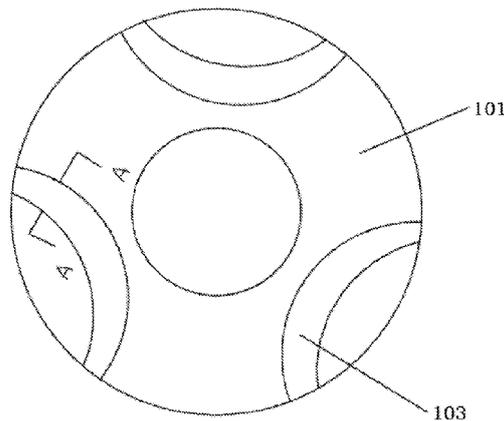


图 2 / Fig. 2

(57) Abstract: Disclosed is a gasket (105, 2100, 3100, 4100), wherein the gasket (105, 2100, 3100, 4100) is a circular ring-shaped integral (101), at least one face of which is a plane provided with an oil groove (104, 2130, 3130, 4130), and a centre line of the oil groove (104, 2130, 3130, 4130) is a curve (103) or a straight line (102). When the centre line of the oil groove (104) is a straight line (102), the included angle between the centre line of the oil groove (104, 2130, 3130, 4130) and a radial line from the centre of the circular ring of the gasket (105, 2100, 3100, 4100) is greater than zero. Further disclosed are an engine and an automobile employing the above-mentioned gasket (105, 2100, 3100, 4100). The gasket (105, 2100, 3100, 4100) has good lubrication and reduces the frequency of maintenance.

(57) 摘要: 一种垫片 (105, 2100, 3100, 4100), 所述垫片 (105, 2100, 3100, 4100) 是一个圆环形整体 (101), 其至少有一面为设置有油槽 (104, 2130, 3130, 4130) 的平面, 所述油槽 (104, 2130, 3130, 4130) 的中心线为曲线 (103) 或直线 (102)。当油槽 (104) 的中心线为直线 (102) 时, 所述油槽 (104, 2130, 3130, 4130) 的中心线同垫片 (105, 2100, 3100, 4100) 圆环心的径向线的夹角大于零度。一种采用上述垫片 (105, 2100, 3100, 4100) 的发动机和汽车。所述垫片 (105, 2100, 3100, 4100) 润滑性好, 降低了检修频次。



WO 2014/166272 A1



LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW。

CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG)。

(84) **指定国** (除另有指明, 要求每一种可提供的地区保护): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), 欧亚 (AM, AZ, BY, KG, KZ, RU, TJ, TM), 欧洲 (AL, AT, BE, BG,

**本国际公布:**

— 包括国际检索报告(条约第 21 条(3))。

# Gasket, Engine and Automobile

## Technical Field

5 The present application relates to the mechanical field and the automobile field, and in particular relates to a gasket, an engine using such a gasket and automobile using such a gasket.

## Background of the Invention

10 Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

15 The main function of a gear gasket is to restrict axial movement of a gear and thus to ensure a stable and reliable gear transmission. At present, a known idle gear gasket has an annular ring-shaped structure, the middle of which is a bolt mounting hole, and the thrust face has a plane structure.

20 The idle gear gasket is tightly pressed on the shaft of the idle gear by a fixing bolt. There is a certain axial gap between the idle gear and the idle gear gasket. At present, the axial gap is generally from 0.1-0.2 mm. The axial gap is to ensure a normal rotation of the idle gear. When there is an axial movement during rotation of the idle gear, the idle gear gasket is able to prevent axial movement of the idle gear, thus ensure a stable and reliably rotation of the idle gear.  
25 gear.

Friction may occur between the idled gear and idle gear gasket during the rotation of the idle gear. For preventing abrasion of the idle gear and idle gear gasket, lubricating oil is used on the faces where the idle gear and idle gear

gasket contact with each other to increase smoothness for reducing friction.

On the one hand, the faces where the idle gear gasket and the idle gear contact with each other are planes in the prior art. With such a plane structure, the lubricating oil cannot enter into the space between two faces easily, resulting in inefficient lubricating effect.

On the other hand, since the shaft is a rotating member, the gasket installed on the shaft may have friction with surrounding members which contact with the gasket and moving relatively during operation. Therefore, the gasket needs to be lubricated. Under present situation, one way is to have through holes on the gasket, the more the holes are, the larger the lubricating area and the better the lubricating effect. However, the more the holes are, the less the rigidity and intensity of the gasket, and the less the ability to bear axial force. Another manner is to have oil grooves on gasket, the oil grooves are generally arranged in radial radiation manner and have openings on inner circle or outer circle, which can ensure the intensity of the gasket and facilitate adding and supplementing of the lubricating oil. However, on the one hand, the oil grooves are spaced apart from each other at circumferential direction, the lubricating oil cannot be arranged on the frictional face ideally; and on the other hand, under the effect of frictional face of members contacting the gasket and moving relatively, the oil may be thrown out at radial direction under the centrifugal force at the same time of circumferential moving, and the oil grooves at radial direction provide passage for throwing out the oil, which causes oil losing. Those obviously reduce the lubricating effect of the oil to the gasket and shorten lifetime of the gasket. Further, for normal gaskets, lubricating oil is applied with only one layer during installation, or supplemented periodically. Continuous lubricating is not in consideration.

Normal gaskets are inexpensive members, used with large quantity and cannot be disassembled easily as they are installed at concealed and hard to access locations. Automotive mechanics or other service personnel have to supplement lubricating oil or replace gasket periodically, which requires the application of a human cost which is much higher than the cost of the gaskets themselves. As a matter of fact, the service personnel normally defer the replacement of gasket until larger problems arise with the engine, such as a breakdown caused by excessive abrasion of the gasket. Therefore, there is a need to derive a solution to maintain the duration of the effect of lubricating oil on gasket to the greatest extent so as to reduce abrasion and to prolong the operational lifetime of gaskets.

### **Summary of the Invention**

It is an object of the preferred embodiments of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

The secondary of object of the preferred embodiments of the present application is to overcome all the above defects, and to provide a gasket having a better lubricating effect, and thus improving the efficiency of the engine and reducing the cost of maintaining the engine.

According to a first aspect of the invention there is provided an integrally formed gasket that is a circular ring-shaped, the gasket having at least one planar face that is provided with an oil groove, wherein a center line of the oil groove is a curve or a straight line and, wherein, when the center line of the oil groove is a straight line, the included angle between the center line of the oil groove and a radial line from the center of the circular ring of the gasket is

greater than zero.

In an embodiment the gasket has at least two oil grooves, wherein the oil grooves are arranged evenly on the face of the gasket.

5

In an embodiment the gasket has two planar faces wherein both faces are provided with the oil grooves, and the oil grooves are arranged alternately on the two faces.

10

In an embodiment the shapes of the oil grooves on the two faces are same or different.

In an embodiment the number of the oil grooves on two faces of the gasket is same or different.

15

In an embodiment the gasket includes an outer end face, wherein the or at least one of the oil grooves is a through oil groove with two ends opened at the outer end face of the gasket.

20

In an embodiment the cross section of the oil groove is an isosceles trapezoid structure lacking an upper sub-face.

In an embodiment the included angle between two waist side extending lines of the isosceles trapezoid structure is 30 to 90 degree.

25

In an embodiment a circular arc shape guide angle is provided at a plane junction of two inclined planes of the oil groove and an idle gear gasket plane.

In an embodiment the oil groove follows a substantially plane spiral line,

the oil groove has openings at both an inner periphery and an outer periphery of the gasket, and the oil groove extends about the inner periphery at least once.

5 In an embodiment the width of the oil groove increases gradually from the opening at the inner periphery.

In an embodiment the width increases gradually and continuously.

10 In an embodiment the depth of the oil groove increases gradually from the opening at the inner periphery.

In an embodiment the depth increases gradually and continuously.

15 In an embodiment the oil groove substantially follows a plane spiral line, one end of the oil groove opening at the outer periphery or inner periphery of the gasket while the other end is closed, and the oil groove extends about the inner periphery at least once.

20 In an embodiment the width of the oil groove decreases gradually from the open end to the closed end.

In an embodiment the width decreases gradually and continuously.

25 In an embodiment the depth of the oil groove decreases gradually from the open end to the closed end.

In an embodiment the depth decreases gradually and continuously.

In an embodiment the gasket is integrally formed by stamping.

According to a second aspect of the invention there is provided an engine comprising:

a timing gear;

a timing chain;

a fuel spray nozzle;

a gasket according to the first aspect of the invention described above; and

wherein:

the timing chain drives the timing gear;

the timing gear contacts the gasket and rotates relative to the gasket;

the timing gear rotates in a reverse direction to the spiral direction of the gasket; and

the fuel spray nozzle provides oil to the chain and the gasket simultaneously.

According to a third aspect of the invention there is provided an engine comprising:

a shaft member;

a gear member;

a gasket according to the first aspect of the invention described above; and

wherein:

the shaft member has an oil duct for providing oil to the opening of the inner circle of the gasket; and

the gear member rotates in the same direction as the spiral direction of the gasket.

In an embodiment the gear member is a skew gear.

According to a fourth aspect of the invention there is provided an engine

having a spindle and which includes a gasket according to the first aspect of the invention described above used on the spindle.

5 According to a fifth aspect of the invention there is provided an automobile using a gasket according to the first aspect of the invention described above.

10 According to a sixth aspect of the invention there is provided an integrally formed gasket that is a circular ring-shaped, the gasket having at least one planar face that is provided with an oil groove, a center line of the oil groove is a curve or a straight line and, wherein, when the center line of the oil groove is a straight line, the included angle between the center line of the oil groove and a radial line from the center of the circular ring of the gasket is greater than zero, wherein the oil groove substantially follows a plane spiral line, one end of the oil groove opening at the outer periphery or inner periphery of the gasket while the other end is closed, and the oil groove extends about the inner periphery at least once.

15 According to a seventh aspect of the invention there is provided an engine having a spindle and including a gasket as herein disclosed used on the spindle.

20 According to an eighth aspect of the invention there is provided an automobile musing a gasket as herein disclosed.

25 For achieving the above objects, an embodiment of the present application provides the following technical solution: a gasket, which is an circular ring-shaped integral, at least one face of the gasket is a plane provided with an oil groove, and a center line of the oil groove is a curved or straight line; when the center line of the oil groove is a straight line, the included angle between the center line of the oil groove and a radial line from the center of the circular ring of the

gasket is greater than zero.

Preferably, the oil grooves are arranged evenly on annular ring-shaped face of the gasket.

5

Preferably, both faces of the gasket are provided with the oil grooves, and the oil grooves are arranged alternately on the two faces.

10

Preferably, both faces of the gasket are provided with oil grooves, and the shapes of the oil grooves on two faces are same or different.

Preferably, the oil groove is a through oil groove with two ends opened at outer end face of the gasket.

15

Preferably, the number of the oil grooves is at least two.

Preferably, the number of the oil grooves on two faces of the gasket is same or different.

20

Preferably, the cross section of the oil groove is an isosceles trapezoid structure lacking of upper sub-face.

Preferably, the included angle between two waist side extending lines of the isosceles trapezoid structure is 30 to 90 degree.

25

Preferably, a circular arc shape guide angle is provided at plane junction of two inclined planes of the oil groove and the idle gear gasket plane.

Preferably, a circular arc shape guide angle is provided at plane junction of

two inclined planes of the oil groove and the idle gear gasket plane.

5 Preferably, the oil groove is in shape of plane spiral line, the oil groove has openings at both inner circle and out circle of the gasket, and the oil groove surrounds the inner circle at least one circle.

Preferably, the width of the oil groove increases gradually from the opening of the inner circle.

10 Preferably, the width increases gradually and continuously.

Preferably, the depth of the oil groove increases gradually from the opening of the inner circle.

15 Preferably, the depth increases gradually and continuously.

Preferably, both faces of the gasket are provided with oil grooves having the same or opposite spiral direction.

20 Preferably, the oil groove is in shape of plane spiral line, one end of the oil groove is opened at the outer circle or inner circle of the gasket while the other end is closed, and the oil groove surrounds the inner circle at least one circle.

25 Preferably, the width of the oil groove decreases gradually from the opened end to closed end.

Preferably, the width decreases gradually and continuously.

Preferably, the depth of the oil groove decreases gradually from opened end

to the closed end.

Preferably, the depth decreases gradually and continuously.

5 Preferably, both faces of the gasket are provided with oil grooves having the same or opposite spiral direction.

Preferably, the gasket is formed integrally by stamping.

10 The second object of the present application is to provide an engine requiring less frequency of maintenance.

For achieving the above object, embodiments of the present application provide the following technical solution: an engine, which comprises a timing  
15 gear; a timing chain; a fuel spray nozzle; and the above mentioned gasket.

The timing chain drives the timing gear, the timing gear contacts the gasket and rotates relative to the gasket, the timing gear rotates in reverse direction to spiral direction of the gasket, the fuel spray nozzle provides oil to the chain  
20 and the gasket simultaneously.

An engine, which comprises a shaft member; a gear member; and the above mentioned gasket; the shaft member has an oil duct for providing oil to the opening of the inner circle of the gasket, the gear member rotates in the  
25 same as the spiral direction of the gasket.

Preferably, the gear member is a skew gear.

An engine, the above gasket is used on the spindle of the engine.

The third object of the present application is to provide an automobile that requires less frequency of maintenance and longer maintenance period.

5 For achieving the above object, embodiments of the present application provide the following technical solution:

An automobile, the above mentioned gasket is used on the automobile.

10 Using the gasket according to the embodiments of the present application, the oil grooves always have an opening having an angle with the rotating direction of the idle gear, so that oil film seal due to rotation of the idle gear cannot happen at the end face opening of the oil grooves on the gasket, and lubricating oil can enter into the face where the idle gear and the gasket contact to improve lubricating  
15 effect. If only one face of the gasket is provided with oil groove, it reduces processing procedure and lowers production costs.

Further, the gasket of embodiments of the present application uses oil groove, which ensures rigidity and intensity of the gasket. Moreover, as the oil  
20 groove is in shape of plane spiral line, after the lubricating oil enters oil groove from the opening of the inner circle, rough face of surrounding member (such as gear member), which is equivalent to impeller of water pump, “pumps” out the oil along the oil grooves for surrounding the inner circle along the spiral line at least one circle to ensure that the gasket is circumferentially lubricated at  
25 the entire face without being radial thrown out directly, thereby providing better lubricating effect and prolonging lifetime of the gasket. When both the inner and outer circles have openings, lubricating of surrounding positions can also be provided.

Further, when both the inner and outer circles have openings, the width or the depth of the oil groove increases gradually starting from the opening of the inner circle along the flowing direction of the oil, which is equivalent to that a pipe diameter formed between the oil groove and the surrounding member gets larger and larger so that the surrounding member (such as gear) is farther away from the inlet of the oil after rotating relatively to gasket under the action of members generating friction with gasket, and more farther away from the inlet of the oil, the slower the oil flows and the larger the static pressure of the oil. Similar to the principle of a volute water pump, the oil is pumped out of the oil groove smoothly and then gets into the next stage of machine oil circulating lubricating, such as enters oil pan of the engine. Further, a gradually wider width also satisfies the requirement that the farther away from the inner circle, the more lubricating oil is needed.

Further, the continuous and gradual change of the width and depth and the way of forming gasket integrally by stamping facilitate processing procedure.

Further, to have oil groove at both faces of the gasket may prevent incorrect installation when the spiral direction is the same, and may accommodate to different relative rotating directions when the spiral direction is opposite.

To process oil duct on shaft member of the engine can provide oil to the opening of the inner circle of the gasket. The rotating direction of the gear member is the same as the spiral direction of the gasket, i.e., the gear member and gasket form a volute oil pump, which achieves continuous lubricating of the gasket.

Further, when the oil groove has an opening at outer circle while another

end is closed, the oil enters oil groove from the opening of the outer circle and moves along the direction of spiral line of the oil groove under the action of gravity. The fact that the other end of the oil groove is closed avoids the oil from further flowing out, thereby prolonging staying time of the oil in the oil groove under the condition of the same amount of supplementing oil within a unit time, thus the oil can be kept in the oil groove longer and the lubricating effect can be lasted longer too, and accordingly, frequency of lubricating liquid supplementation is reduced, which lowers the costs of oil loss and maintenance. The fact that the spiral line surrounds the inner circle one circle ensures that the gasket is circumferentially lubricated at the entire face, thereby providing better lubricating effect and prolonging lifetime of the gasket. When the oil groove has an opening at the inner circle while the other end is closed, most of the centrifugal force suffered by the oil in the oil groove is offset by the opposite force provided by oil groove wall, the oil can only move along the direction of spiral line of the oil groove to arrive to the closed end under the action of member having friction with the gasket, which avoids the oil from being thrown out in the radial and speed up infiltration of the oil. The fact that the spiral line surrounds the inner circle at least one circle ensures that the gasket is circumferentially lubricated at the entire face, thereby having a better lubricating lasting effect and a longer lifetime of the gasket.

Further, the width or depth of the oil groove decreases gradually from the opening end towards the closed end, which reduces the diameter of the oil duct formed between the oil groove and the surrounding member. Since the oil enters the groove from the outer circle, after adding the lubricating oil, when the equipment is started and the surrounding member rotates in the opposite direction relative to the spiral direction, under the action of member having friction with the gasket, the farther away from the inlet of the oil, the quicker the oil flows and the lower of the static pressure of the oil, which makes the oil

infiltrate the entire face of the gasket quickly and benefit maintaining the oil.

Further, the continuous and gradual change of the width and depth and the way of forming gasket integrally by stamping facilitate processing procedure.

5

Further, to have oil groove at both faces of the gasket may prevent incorrect installation when the spiral direction is the same, and may accommodate to different relative rotating directions when the spiral direction is opposite.

10

Installing the gasket according to embodiments of the present application can lower generation of noise and reduce frequency of maintenance.

15

The gasket of embodiments of the present application is in form of oil groove to ensure the rigidity and intensity of the gasket.

20

Further, the width or depth of the oil groove decrease gradually along the flowing direction of oil, after adding the lubricating oil, the equipment is started and the shaft rotates, under the action of member having friction with the gasket, the farther away from the inlet of the oil, the quicker the oil flows and the lower of the static pressure of the oil, which makes the oil infiltrate the entire face of the gasket quickly without flowing out from the closed end.

25

Further, the continuous and gradual change of the width and depth and the way of forming gasket integrally by stamping facilitate processing procedure.

Further, to have oil groove at both faces of the gasket may prevent incorrect installation when the spiral direction is the same, and may accommodate to different relative rotating directions when the spiral direction

is opposite.

Installing the gasket according to embodiments of the present application in engine or spindle position of an automobile can lower generation of noise and reduce frequency of maintenance.

Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise”, “comprising”, and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to”.

### **Brief Description of the Figures**

The following provides further detailed explanation about embodiments of the present application, wherein:

Fig. 1 is a structural schematic diagram of the gasket with an oil groove face according to the first embodiment of the present application;

Fig. 2 is a structural schematic diagram of the gasket with an oil groove face according to the second embodiment of the present application;

Fig. 3 is the cross section schematic diagram of the oil groove of the gasket of the first and second embodiments of the present application;

Fig. 4 is the use schematic diagram of the gasket of the first and second embodiments of the present application;

Fig. 5 is the section view of the driving mechanism of the fuel pump of the

engine according to the third embodiment of the present application;

Fig. 6 is the R direction view of the gasket of the third embodiment in Fig 5;

Fig. 7 is the section view along the B-B line in Fig 6;

Fig. 8 is the front view of the gasket according to the fourth embodiment of the present application;

Fig. 9 is the section view along the C-C line in Fig. 8;

Fig. 10 is the operating principle diagram of the engine which uses the gasket of the fourth embodiment of the present application;

Fig. 11 is the front view of the gasket according to the fifth embodiment of the present application; and

Fig. 12 is the operating principle diagram of the engine which uses the gasket of the fifth embodiment of the present application.

### **Detailed Description of the Embodiment**

The following provides detailed description of embodiments of the present application. Illustrations of the embodiments are provided in the drawings, wherein the same or similar reference numbers represent the same or similar elements or those having the same or similar functions. The following embodiments described through referring to drawings are exemplary and aim at explaining the present application rather than restricting the present

application.

5 In the description of the present application, it needs to understand that directions and position relations indicated by terms “center”, “length”, “width”, “thickness”, “upper”, “down”, “front”, “back”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inner”, “outer”, “clockwise”, “anticlockwise”, and so on, are based on directions and position relations shown in the drawings, and are only for facilitating describing embodiments of the present application and simplifying the description, rather than indicating or implying that the  
10 denoted apparatus or elements should have specific direction and be structured and operated at specific directions. Therefore, they are not explained as limitation to the present application.

15 In addition, terms “the first” and “the second” are only for description rather than indicating or implying a relative importance or impliedly indicating numbers of the designated technical feature. In the description of the present application, the term “a plurality of” means two or more than two, unless otherwise defined clearly.

20 In the embodiments of the present application, unless otherwise defined and regulated clearly, terms “installation”, “connection”, “coupling”, “fixing” and so on should be understood in a broad sense. For example, it can be fixed connection and can also be detachable connection, or integral connection; it can be mechanical connection and can also be electrical connection; it can be direct  
25 connection and can also be indirect connection through intermediate medium, and it can be connection of inner sides of two elements. Those skilled in the art can understand the specific meaning of the above terms in examples of the present application according to specific situations.

### Example 1

As shown in Fig. 2, Fig. 3 and Fig. 4, the gasket is tightly pressed on an idle gear shaft 107 by the fixing bolt. It is designed a certain axial gap between the idle gear 106 and the gasket 105 for ensuring normal rotation of the idle gear 106. The gasket 105 is an annular ring-shaped integral 101 with an outer diameter of 38.5mm, inner diameter of 12mm, and thickness of 2.5mm. The specification of the idle gear gasket can be changed according to requirements without affecting technical solutions of the embodiments of the present application. The face opposite to the idle gear is a plane, and the face contacting the idle gear is a plane having oil groove 104 provided thereon. The center line of oil groove 104 is a curve line 103. In this embodiment, the selected material of the gasket is prior art and types of the material does not exert impact to the technical solution in the embodiments of the present application. The center line of the oil groove can be any type of curve lines, curving oil groove structure benefits storage of the lubricating oil. There are at least two oil grooves, preferably three or four, and those three or four oil grooves are arranged on gasket plane evenly. When the oil groove is curved, the lubricating oil in the oil groove undergoes resistance from the oil groove that has non-linear relation with the radial direction of the idle gear at the time of undergone a centrifugal force. At this time, the resistance and centrifugal force form a joint force, a direction thereof has an included angle with the radial direction of the idle gear. Thus, the lubricating oil is prevented from being thrown out to affect lubricating effect. Preferably both faces of the gasket are provided with oil grooves. The oil groove in the gasket's face that is opposite to the idle gear has a shape the same as or different from the shape of the oil groove in the face that contacts the idle gear. The expression "same" here refers to that the oil grooves in two faces of the gasket have the identical shape; and the expression "different" here refers to that if the shape of the oil groove in

one face of the two faces of the gasket is curved, the shape of the oil groove in the other face may be a straight-line shape. It is obvious that the oil grooves in two faces of the gasket can have other shapes that are different from each other.

5 The oil grooves are arranged in annular face of the gasket evenly, and the oil grooves in the face of the gasket that is opposite to the idle gear are arranged alternatively with respect to the oil grooves in the face that contacts the idle gear. Preferably, each oil groove is a through oil groove with both ends opened on the outer end face of the gasket. The cross section of the oil groove  
10 has an isosceles trapezoid structure lacking of upper surface, an included angle formed between two waist side extending lines of the isosceles trapezoid structure is from of 30 to 90 degree, preferably, 30 to 60 degree, and there is a circular arc guide angle in the plane junction of two inclined planes of the oil groove and the idle gear gasket. The guide angle is provided to reduce friction between idle  
15 gear and gasket and reduce striking off of lubricating oil in the contacting face.

## Example 2

As shown in Fig. 1, Fig. 3 and Fig. 4, the gasket is tightly pressed on an  
20 idle gear shaft 107 by the fixing bolt. It is designed a certain axial gap between the idle gear 106 and the gasket 105 for ensuring normal rotation of the idle gear 106. The gasket 105 is an annular ring-shaped integral 101, a face thereof opposite to the idle gear is a plane and the face contacting the idle gear is a plane having oil groove 104 provided thereon. In the present embodiment, the  
25 selected material of the gasket is prior art and types of the material does not exert impact to the technical solution in the embodiments of the present application. The center line of oil groove 104 is a straight line 102. The included angle between the center line of the oil groove and the radial line of the annular core of the gasket is greater than zero but not equal to zero. There

are at least two oil grooves, preferably three or four, and those three or four oil grooves are arranged on gasket plane evenly. The oil grooves are arranged evenly on the annular face of the gasket, and the oil grooves in the face of the gasket that is opposite to the idle gear are arranged alternatively with respect to the oil grooves in the face that contacts the idle gear. Preferably, each oil groove is a through oil groove with both ends opened on the outer end face of the gasket. The cross section of the oil groove has an isosceles trapezoid structure lacking of upper surface, an included angle formed between two waist side extending lines of the isosceles trapezoid structure is from of 30 to 90 degree, preferably, 30 to 60 degree, and there is a circular arc guide angle in the plane junction of two inclined planes of the oil groove and the idle gear gasket. The guide angle is provided to reduce friction between idle gear and gasket and reduce striking off of lubricating oil in the contacting face.

### Example 3

Fig. 5 shows a fuel pump driving mechanism in the timing gear train of an engine by illustration. The mechanism adopts gasket 2100. Of cause those skilled in the art should understand that the gasket 2100 can also be used in other timing gear trains such as driving mechanism of engine, or in position having shaft member and gear member in engine or other positions in automobile. The gear 2500 receives driving force from crankshaft, to drive axle 2200 to rotate in axle hole of flange 2400 which is fixedly mounted on cylinder block 2300. The gasket 2100 is sleeved on shaft 2200, and locates between the gear 2500 and flange 2400. An oil duct 2410 is provided on the flange 2400 to supply oil to annular oil groove 2210 on shaft 2200, the annular oil groove 2210 acts as an oil duct providing oil to gasket 2100.

Referring to Fig. 6, the gasket 2100 has an annular shape with an inner

circle 2110 and an outer circle 2120. The inner circle 2110 is for sleeving the gasket 2100 on the shaft. An oil groove 2130 having spiral line is provided on a face where the gasket 2100 and gear 2500 contact with each other and generate friction. The first end 2131 of the oil groove 2130 is opened at the inner circle 2110, and the second end 2132 is opened at the outer circle 2120. The oil groove 2130 passes through or arrives line B-B where one diameter of the gasket 2100 is at least two times from the first end 2131 to the second end 2132, i.e., the oil groove 2130 surrounds the inner circle 2110 at least one circle.

To assume that the gear 2500 rotates clockwise at the time, such a direction is the same as the spiral direction of the oil groove 2130 from the first end 2131 to the second end 2132. At this time, the oil in oil groove 2130 tends to have circular motion along with the surrounding member due to the friction of the surrounding member, the absorption and the viscous force of oil itself. Therefore, there generate actions of centrifugal force and tangential force on the oil. Since oil groove 2130 is in plane spiral line shape, at any point on the wall of oil groove 2130, the centrifugal force is substantially offset by the counterforce provided by the wall at the point and can only move along the tangential direction, i.e., the direction pointed out by the dotted line arrow in Fig. 6. In this direction, the width  $W$  of oil groove 2130 increases gradually, the fitting faces of oil groove 2130 and gear 2500 together form a water chamber structure similar to volute water pump, and the rough face of gear 2500 acts similar to impeller to “pump” out the oil smoothly so that the gasket 2100 gets into machine oil circulating lubricating system and is lubricated continuously. When gear 2500 is an idle gear and uses roller bearing, it is not convenient to lubricate roller of gear, but the oil pumped out from gasket 2100 just can provide continuous lubricating to the roller, and then enters the oil pan to take part in the following circulating lubricating, which is advantageous. The gradual increase of width of oil groove 2130 includes multistep increase and

continuous increase. The gasket 2100 can be shaped by stamping, milling, etc. It is advantageous to form gasket integrally by stamping and with gradually increased width from the view of processing efficiency.

5 Fig. 7 shows the change of the depth of oil groove 2130 in the flowing direction of the oil. The depth H1 is the largest at the second end 2132 of the opening, and the depth H3 is the smallest at the first end 2131 of the opening, the depth H2 between the first end 2131 and the second end 2132 is between H1 and H3, and the change of the depth is similar to the change of the width, that is, changed gradually, and includes multistep and continuous gradual  
10 change, preferably continuous and gradual change. The changes of depth and of width have the same beneficial effect. No repetition is given.

#### Example 4

15 Referring to Fig. 8, gasket 3100 has an annular ring shape with an inner circle 3110 and an outer circle 3120. The surrounding member contacting closely with gasket 3100 and rotating relatively with respect to the gasket 3100 may generate friction with face of gasket 3100. An oil groove 3130 in shape of  
20 spiral line is provided on the face of gasket 3100 that contacts with surrounding member and generates friction therebetween. The first end 3131 of oil groove 3130 is closed, the second end 3132 has an opening at outer circle 3120. The oil groove 3130 passes through or arrives line C-C (the line C-C is also the dividing line of Fig. 9) where one diameter of the gasket 3100 is at least two  
25 times from the first end 3131 to the second end 3132, i.e., the oil groove 3130 surrounds the inner circle 3110 at least one circle. The fact that oil groove 3130 surrounds inner circle 3110 at least one circle ensures that the face of gasket 3110 is lubricated in the entire circumferential range. To assume that surrounding member generating friction with gasket rotates clockwise, the

machine oil is added from outside of outer circle 3120, when the equipment is started at the initial stage, the surrounding member rotates with a speed faster and faster, the oil in oil groove 3130 tends to have circular motion along with the surrounding member due to the friction of the surrounding member, the absorption and the viscous force of oil itself. Therefore, there generate actions of centrifugal force and tangential force on the oil from the center of the inner circle 3110 towards outside in the direction of the diameter of circle. Since oil groove 3130 is in plane spiral line shape, at any point on the wall of oil groove 3130, most of the centrifugal force is offset by the counterforce provided by the wall at the point and can only move along the tangential direction, i.e., the direction pointed out by the dotted line arrow in Fig. 9. The direction is from the second end 3132 towards the first end 3131. In this direction, the width  $W$  of oil groove 3130 decreases gradually, after adding the lubricating oil, the equipment is started and the shaft rotates, under the action of member having friction with the gasket, the farther away from the inlet of the oil, the quicker the oil flows and the lower of the static pressure of the oil, which makes the oil infiltrate the entire face of the gasket quickly and facilitates maintaining the oil on the gasket. According to the above description, it is known that the working principle of oil groove 3130 of gasket 3100 which is designed to have the shape of plane spiral line is just opposite to that of a volute water pump. The working principle of the volute water pump is to make water flow out of the water pump smoothly and have a lager static pressure, while the working principle of oil groove 3130 in shape of plane spiral line is to make the oil move forward smoothly along the oil duct 3130 for infiltration and have the static pressure reduced gradually, and the surrounding member of gasket 3100 can be considered as impeller of water pump. The gradual decrease of width of oil groove 3130 includes multistep decrease and continuous decrease. The gasket 3100 can be shaped by stamping, milling, etc. It is advantageous to form gasket integrally by stamping and with gradually decreased width from the view of

processing efficiency. Since the first end 3131 of gasket 3100 is closed, after arriving at the first end 3131, the oil cannot move forward further to flow out of oil groove 3130, which has benefit when adding oil from outside.

Fig. 9 shows the change of the depth of oil groove 3130 in the flowing direction of the oil. The depth H1 is the largest at the second end 3132 of the opening, and the depth H3 is the smallest at the first end 3131 of the opening, the depth H2 between the first end 3131 and the second end 3132 is between H1 and H3, and the change of the depth is similar to the change of the width, that is, changed gradually, and includes multistep and continuous gradual change, preferably continuous and gradual decrease. The changes of depth and of width have the same beneficial effect. No repetition is given.

Fig. 10 shows an engine employing gasket 3100 with timing gear system as an example. The gear 3500 is a timing gear, such as fuel pump gear, water pump gear, generator gear, and so on, in timing gear system. The gear 3500 receives driving force from crankshaft through timing chain (not shown) to drive shaft 3200 to rotate in axle hole of flange 3400. The flange 3400 is fixedly mounted on cylinder block 3300. The gasket 3100 is sleeved on shaft 3200, and locates between the gear 3500 and flange 3400. The timing gear 3500 rotates clockwise from the view of R direction, and therefore, timing gear 3500 is a member generating friction to gasket 3100, and the rotation direction of the timing gear is opposite to the spiral direction from the first end 3131 to the second end 3132 of the oil groove 3130. A fuel spray nozzle (not shown) is generally used to provide machine oil to timing chain for lubricating when using timing chain. Since the opening of the gasket 3100 is located at outer circle 3120, the machine oil from the fuel spray nozzle flows into oil groove 3130 from the second end 3132 of the opening under the action of gravity, or by flowing in lubricating oil duct.

It is conceivable to those skilled in the art that the gasket 3100 according to this embodiment of the present application can also be used in other position in the engine, or other position such as wheel shaft, or other mechanical field. In case that both faces of gasket 3100 are provided with oil grooves 3130, the gasket 3100 can be prevented from being mounted reversely if the spiral directions of the oil grooves in two faces are the same (for example, all are in left-wound spiral or right-wound spiral); and the gasket 3100 will have better universality, if the spiral directions of the oil grooves in two faces are opposite, by selecting the fitting friction face of gasket 3100 to the surrounding member according to the relative rotating direction of the surrounding member (for example, clockwise or anticlockwise). Therefore, it is advantageous to have oil grooves on both faces of gasket.

#### Example 5

Referring to Fig. 11, the gasket 4100 has an annular ring shape with an inner circle 4110 and an outer circle 4120. The surrounding member clinging to gasket 4100 generates relative movement due to rotating with respect to the gasket 4100, and therefore may generate friction with face of gasket 4100. There is an oil groove 4130 in shape of spiral line on the face where the gasket 4100 contacts the surrounding member and friction occurs. The first end 4131 of oil groove 4130 has an opening at inner circle 4110, while the second end 4132 is closed near outer circle 4120. The oil groove 4130 surrounds inner circle 4110 at least one circle. The function of the opening of oil groove 4130 is to supplement lubricating oil to gasket 4100. The fact that the oil groove 4130 surrounds inner circle 4110 at least one circle ensures that the face of gasket 4110 is lubricated in the entire circumferential range. To assume that surrounding member generating friction with gasket 4100 rotates anticlockwise, and oil enters from the first end 4131, the oil in oil groove 4130 tends to have

circular motion along with the surrounding member due to the friction of the surrounding member, the absorption and the viscous force of oil itself. Therefore, there generate actions of centrifugal force and tangential force on the oil. Since oil groove 4130 is in plane spiral line shape, at any point on the wall of oil groove 4130, the centrifugal force is substantially offset by the counterforce provided by the wall at the point and the oil can only move along the tangential direction, i.e., the direction pointed by the dotted line arrow in Fig. 11, the direction extends from the first end 4131 to the second end 4132. Preferably, the width of oil groove 4130 decrease gradually on above direction, after adding the lubricating oil, under the action of member having friction with the gasket, the equipment is started and the shaft rotates, the farther away from the inlet of the oil, the quicker the oil flows and the lower of the static pressure of the oil. According to the above description, it is known that the working principle of oil groove 4130 of gasket 4100 which is designed to have the shape of plane spiral line is just opposite to that of a volute water pump. The working principle of the volute water pump is to make water flow out of the water pump smoothly and have a lager static pressure, while the working principle of oil groove 4130 in shape of plane spiral line is to make the oil move forward smoothly along the oil duct 4130 for infiltration and have the static pressure reduced gradually, and the surrounding member of gasket 4100 can be considered as impeller of water pump. Therefore, to speed up the flow of oil on the flow direction speeds up the filtration speed. The gradual decrease of width of oil groove 4130 includes multistep decrease and continuous decrease. The gasket 4100 can be shaped by stamping, milling, etc. It is advantageous to form gasket integrally by stamping and with gradually decreased width from the view of processing efficiency. Also, those skilled in the art can anticipate that the depth of oil groove 4130 can be decreased gradually on the direction from the first end 4131 to the second end 4132. The gradual decrease includes multistep and continuous change, preferably continuous and gradual decrease.

The changes of depth and of width have the same beneficial effect. No repetition is given.

Fig. 12 shows an engine adopting gasket 4100 with timing gear system as an example. The gear 4500 is a driving gear in timing gear system, which receives driving force from crankshaft to drive shaft 4200 to rotate in axle hole of flange 4400. The flange 4200 is fixedly mounted on cylinder block 4300. The gasket 4100 is sleeved on shaft 4200, and locates between the driving gear 4500 and flange 4400, and provides oil to the first end 4132 from the axle hole (not shown) of shaft 4200. To assume that the driving gear 4500 rotates anticlockwise from the view of R direction, the driving gear 4500 is a member generating friction to gasket 4100. The friction face of driving gear 4500 and oil groove 4130 form a structure similar to that of a volute water pump. However, the working principle of such a structure is opposite to that of the volute water pump, since the changes of width and depth of oil groove 4130 are just opposite to those of a water chamber of the volute water pump. The gasket 4100 has a longer use life by comparison with shapes of other oil groove of gasket used in the prior art.

It is conceivable to those skilled in the art that gasket 4100 according to this embodiment of the present application can also be used in other position in the engine, or other position such as in wheel shaft, or in other mechanical field. Also, any combination of the changes of the width and depth and spiral direction such as left-wound spiral and right-wound spiral of the oil groove can be used according to the spiral direction of the surrounding member of gasket 4100. In case that both faces of gasket 4100 are provided with oil groove 4130, the gasket 4100 can be prevented from being mounted reversely if the spiral directions of the oil grooves in both faces are the same (for example, all are in left spiral or right spiral); and the gasket 4100 will have better universality, if

5 the spiral directions of the oil grooves in both faces are opposite, by selecting the fitting friction face of gasket 4100 to the surrounding member according to the relative rotating direction of the surrounding member (for example, clockwise or anticlockwise). Therefore, it is advantageous to have oil grooves on both faces of gasket.

10 It is easy to those skilled in the field to anticipate that all the gaskets in examples 1 to 5 of the present application can be used in engine or automobile, or other mechanical field.

15 The above describes some demonstrative embodiments of the present application only by way of explanation. There is no doubt that those skilled in the art can modify the described embodiments in different ways under the guidance of the spirit and scope of the present application. Therefore, the above drawings and description are demonstrative in essential and should not be understood as limit of the protection scope of the present application.

## Claims

1. An integrally formed gasket that is a circular ring-shaped, the gasket having at least one planar face that is provided with an oil groove, a center line of the oil groove is a curve or a straight line and, wherein, when the center line of the oil groove is a straight line, the included angle between the center line of the oil groove and a radial line from the center of the circular ring of the gasket is greater than zero, wherein the oil groove substantially follows a plane spiral line, one end of the oil groove opening at the outer periphery or inner periphery of the gasket while the other end is closed, and the oil groove extends about the inner periphery at least once.

2. The gasket according to claim 1 having at least two oil grooves, wherein the oil grooves are arranged evenly on the face of the gasket.

3. The gasket according to claim 1 or claim 2 having two planar faces wherein both faces are provided with the oil grooves, and the oil grooves are arranged alternately on the two faces.

4. The gasket according to claim 3 wherein the shapes of the oil grooves on the two faces are same or different.

5. The gasket according to claim 3 or 4 wherein the number of the oil grooves on two faces of the gasket is same or different.

6. The gasket according to any one of claims 1 to 4 wherein the cross section of the oil groove is an isosceles trapezoid structure lacking an upper sub-face.

7. The gasket according to claim 6 wherein the included angle between two

waist side extending lines of the isosceles trapezoid structure is 30 to 90 degree.

5 8. The gasket according to claim 6 wherein a circular arc shape guide angle is provided at a plane junction of two inclined planes of the oil groove and an idle gear gasket plane.

10 9. The gasket according to any one of the preceding claims wherein the width of the oil groove decreases gradually from the open end to the closed end.

10. The gasket according to claim 9 wherein the width decreases gradually and continuously.

15 11. The gasket according to any one of claims 1 to 8 wherein the depth of the oil groove decreases gradually from the open end to the closed end.

12. The gasket according to claim 11 wherein the depth decreases gradually and continuously.

20 13. The gasket according to claim 1 wherein the gasket is integrally formed by stamping.

25 14. An engine having a spindle and including a gasket according to any one of claims 1 to 13 used on the spindle.

15. An automobile using a gasket according to any one of claims 1 to 13.

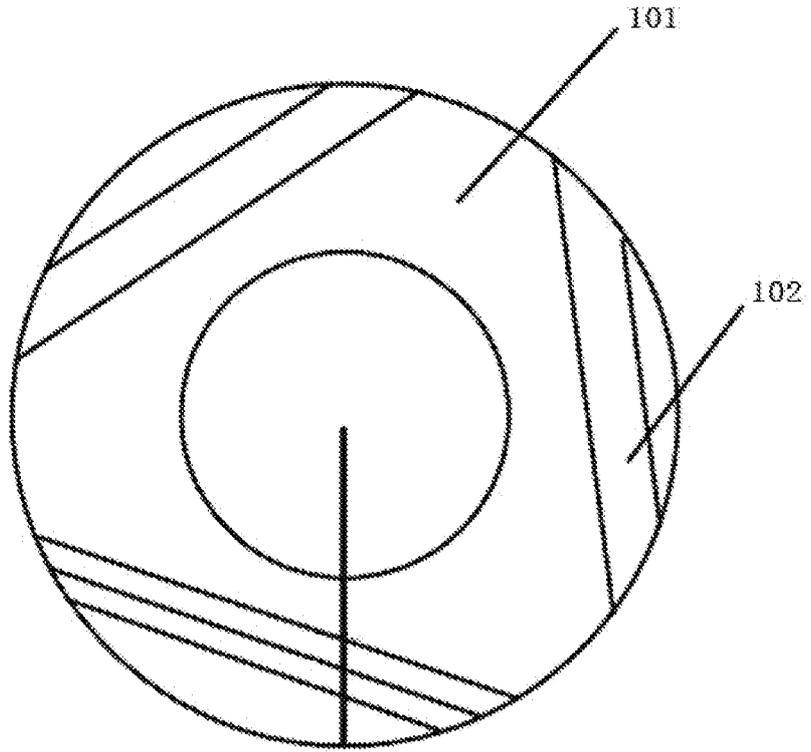


Fig. 1

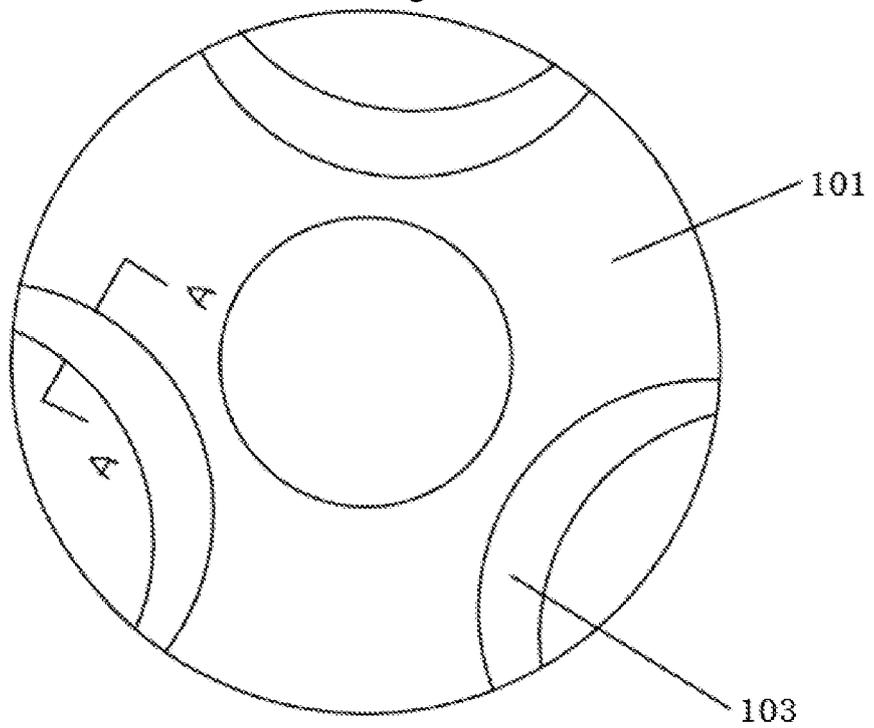


Fig. 2

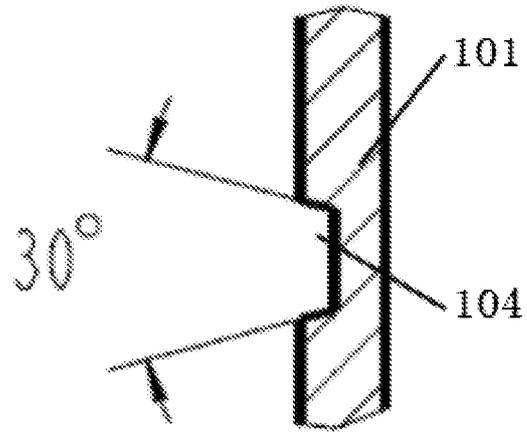


Fig. 3

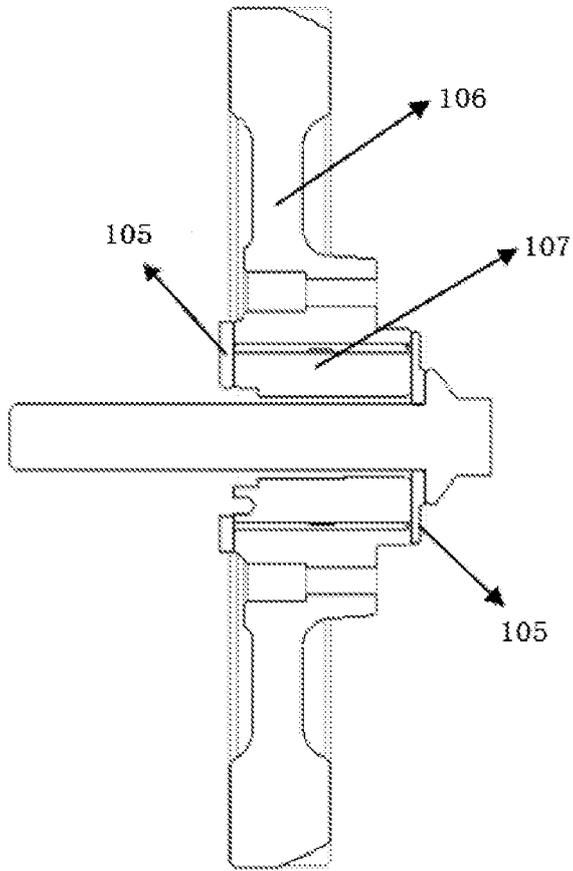


Fig. 4

5

10

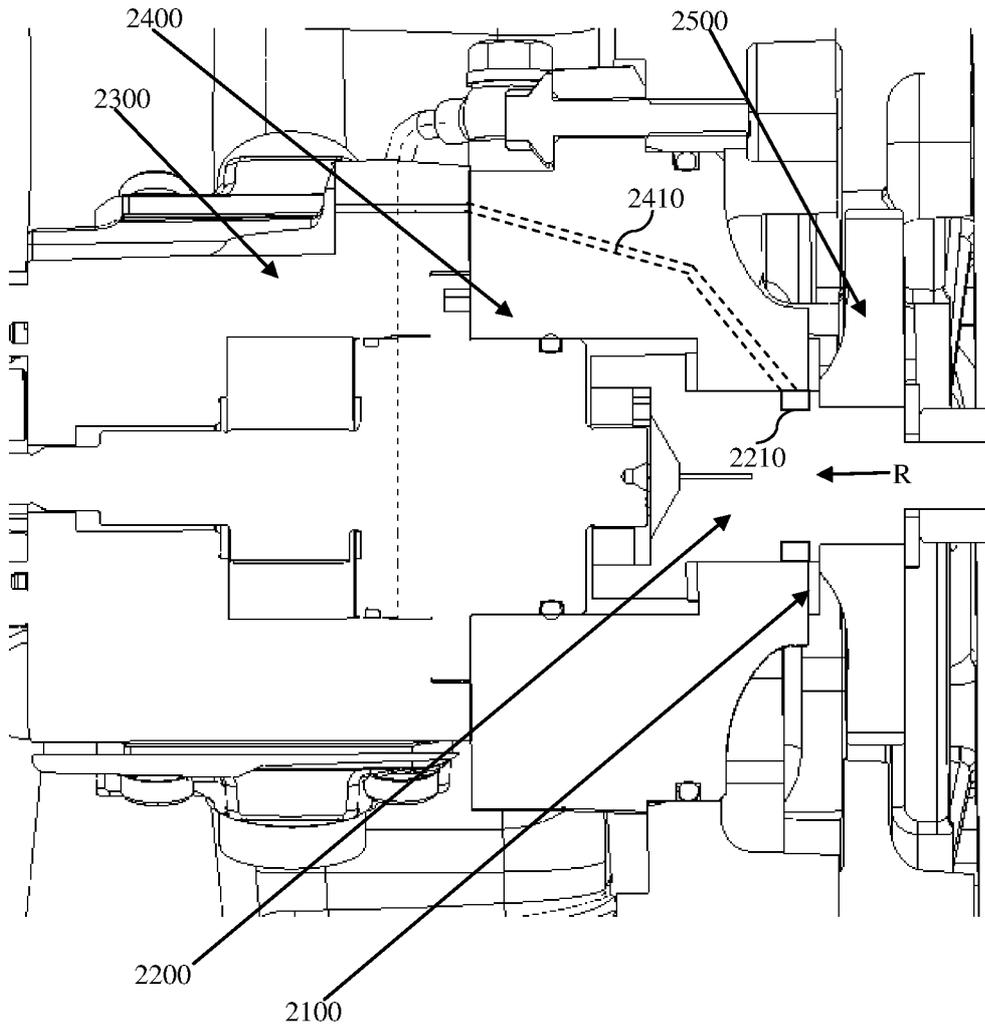


Fig. 5

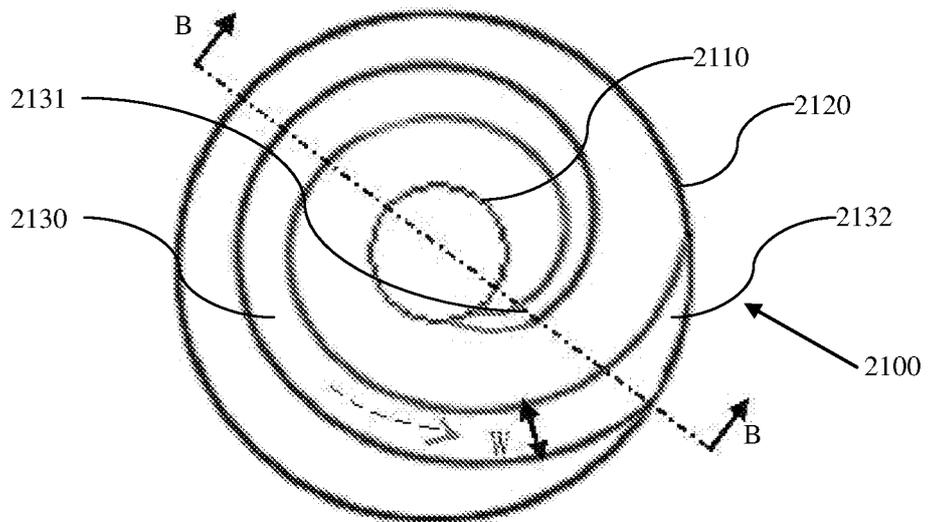


Fig. 6

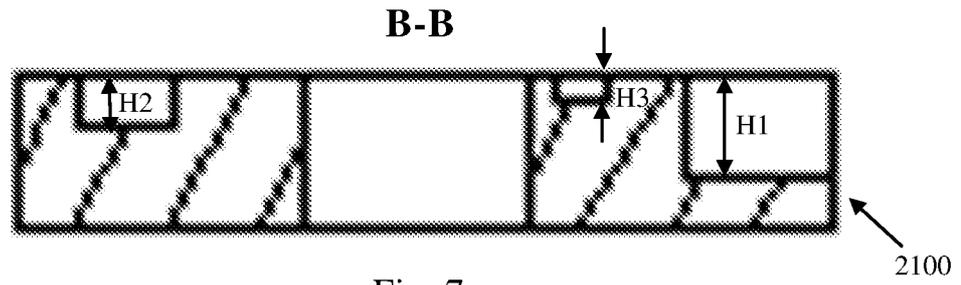


Fig. 7

5

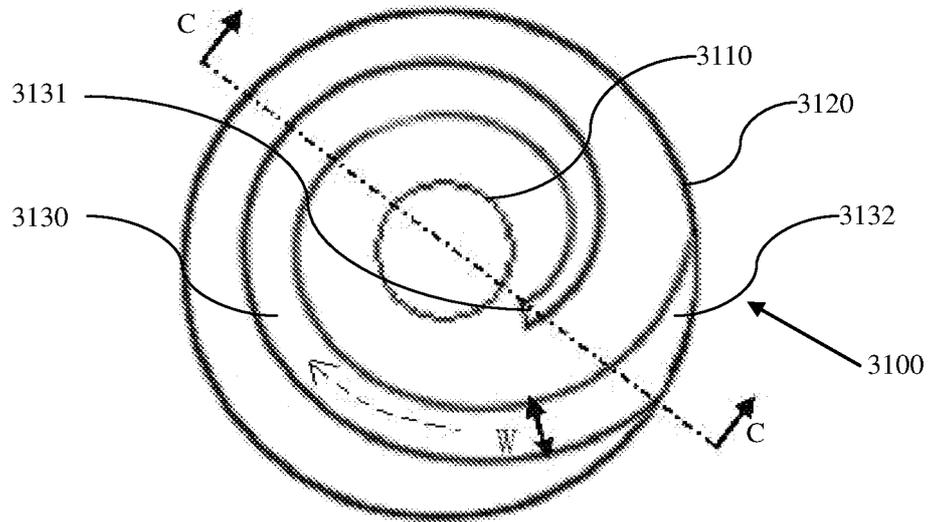


Fig. 8

10

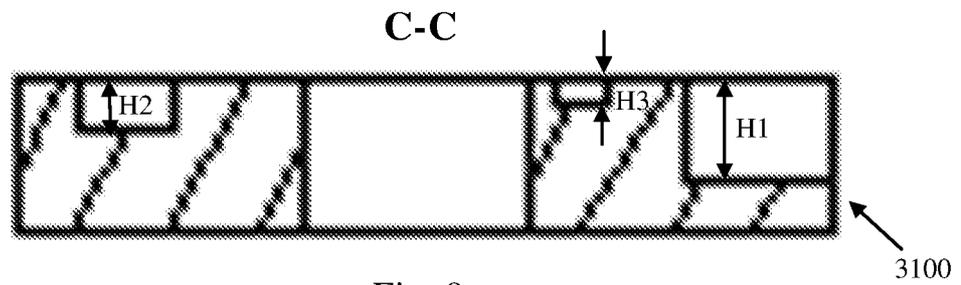


Fig. 9

15

5

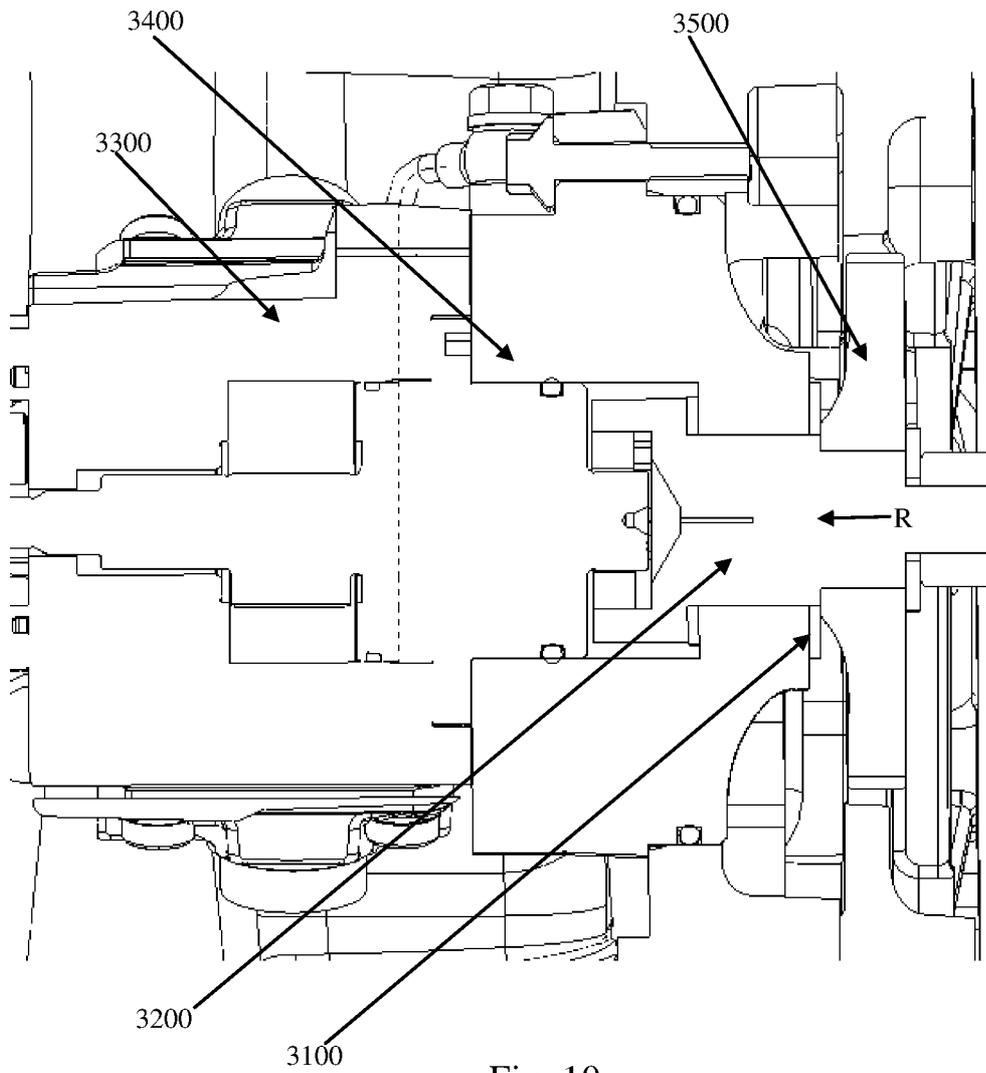


Fig. 10

10

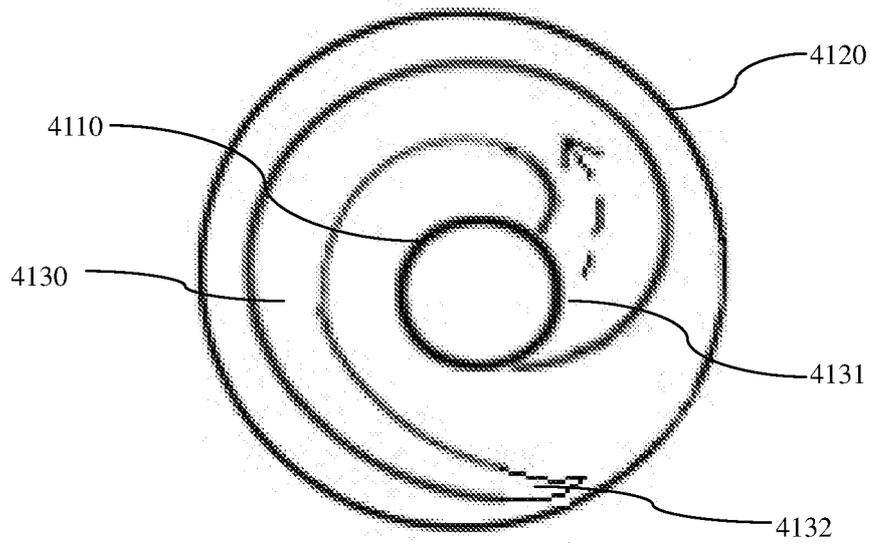


Fig. 11

5

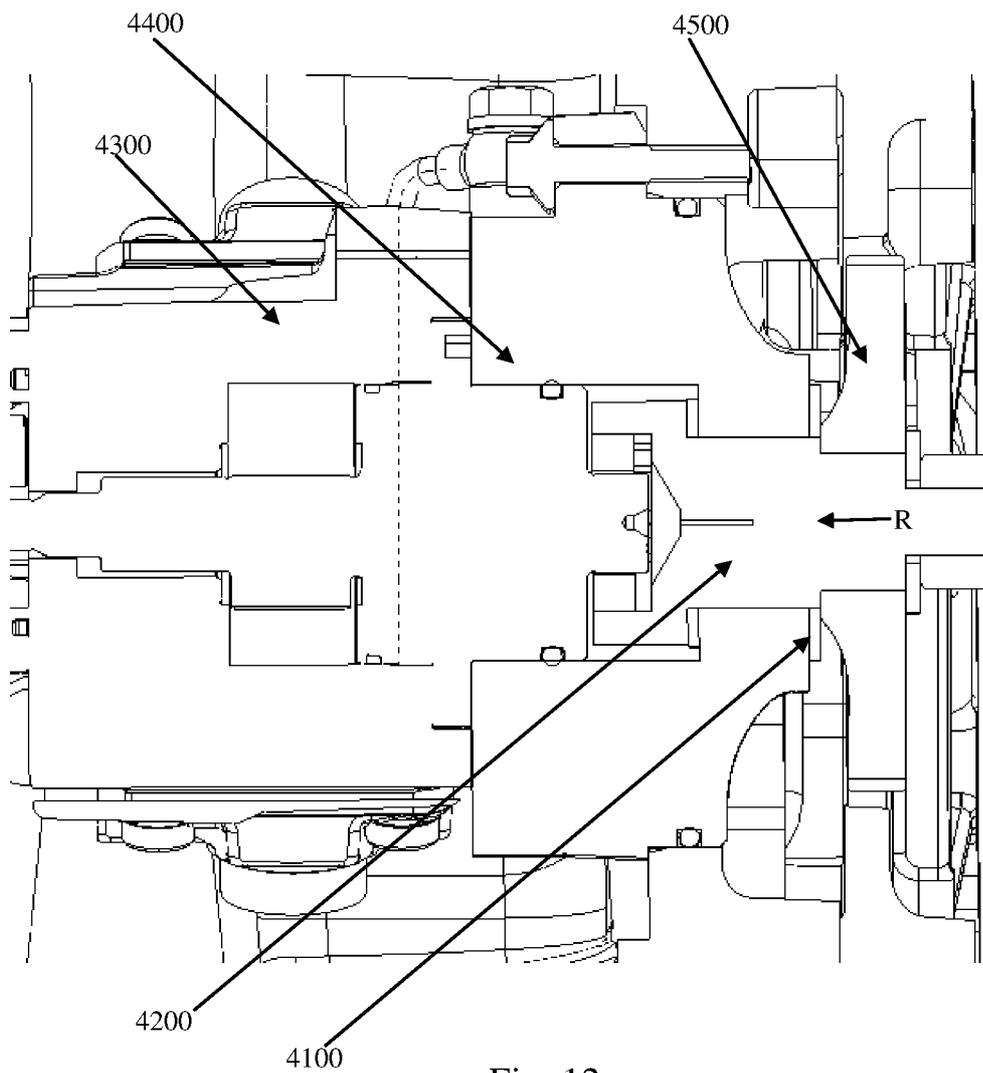


Fig. 12