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(54) CYLINDER BORE FORMED WITH OIL POCKETS

(75) Inventor: **Moon Ki Roh**, Seongnam-si (KR)

(73) Assignee: **Hyundai Motor Company**, Seoul (KR)

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(57) **ABSTRACT**

A cylinder bore for minimizing the friction loss may include a plurality of oil pockets formed on stroke sections that contact a piston on an interior circumference of the cylinder bore. The oil pockets may be formed by a laser honing method, and may have different shapes over the stroke sections or different shapes over the stroke sections according to stroke speeds. Moreover, the oil pockets may have a structure such that more oils can be supplied to an upper stroke section or to a lower stroke section than to a center stroke section of the cylinder bore. Furthermore, the oil pockets may be formed symmetrically with respect to a center stroke section of the cylinder bore.

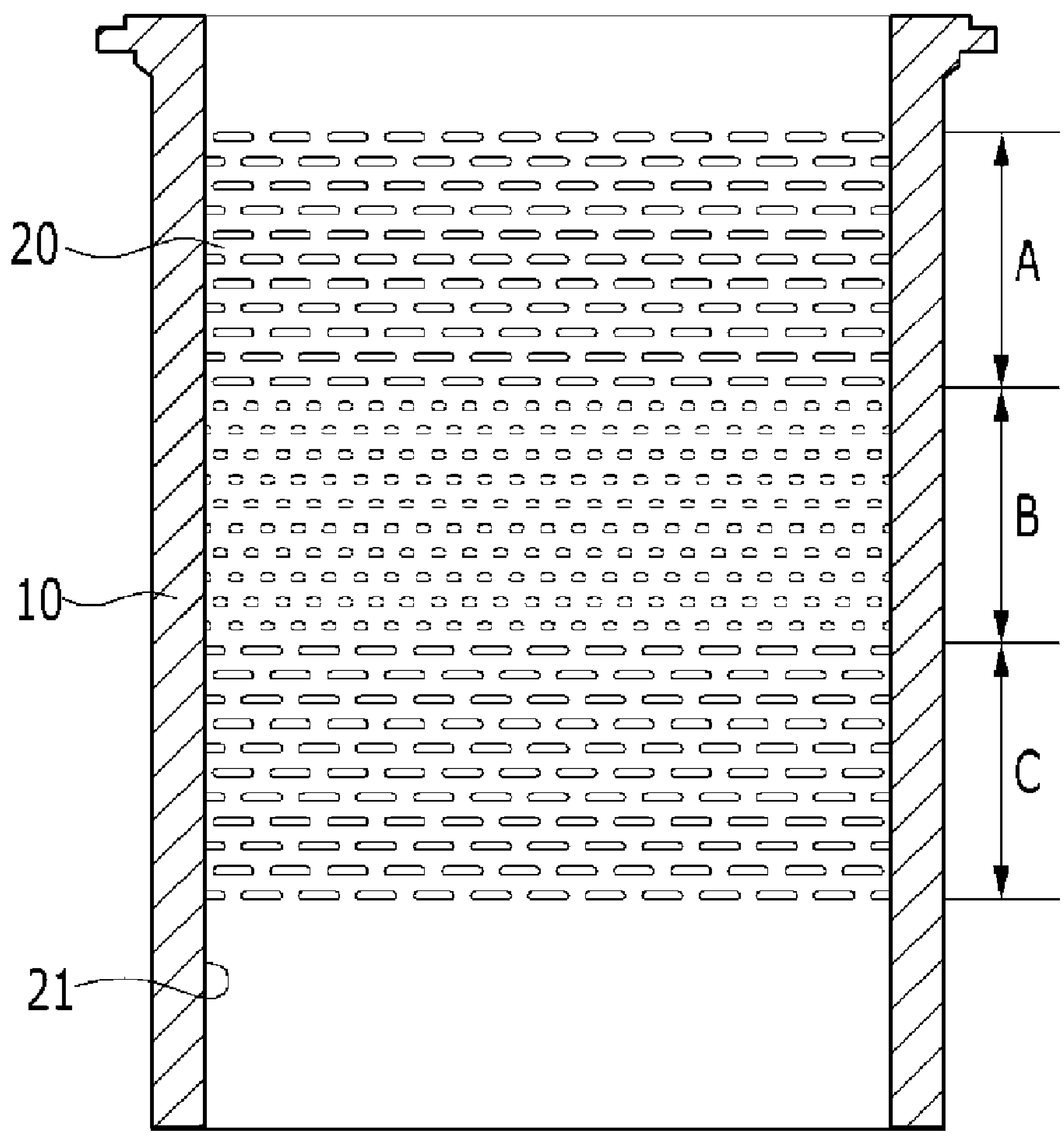


FIG.1

(Related Art)

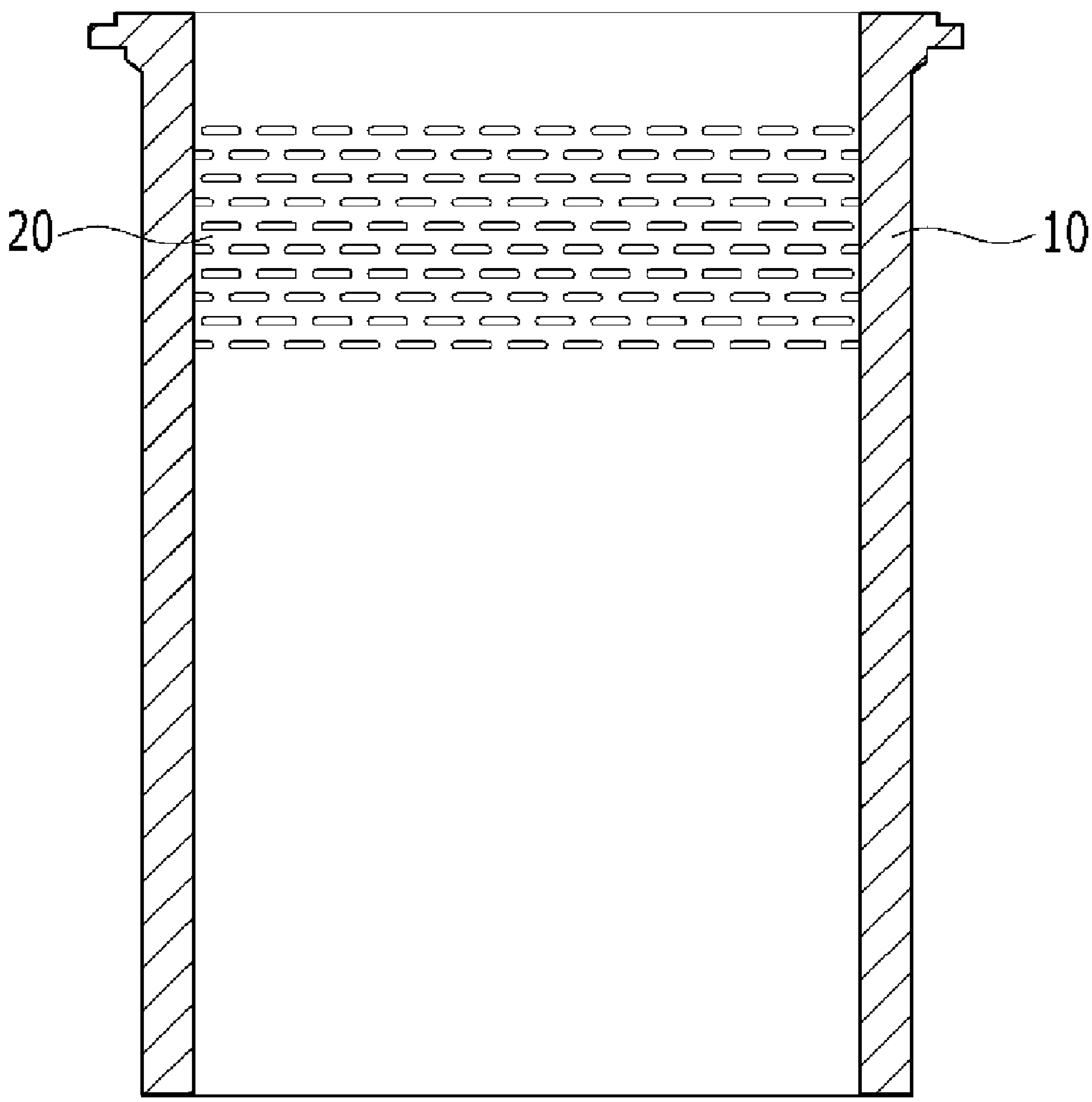


FIG.2
(Related Art)

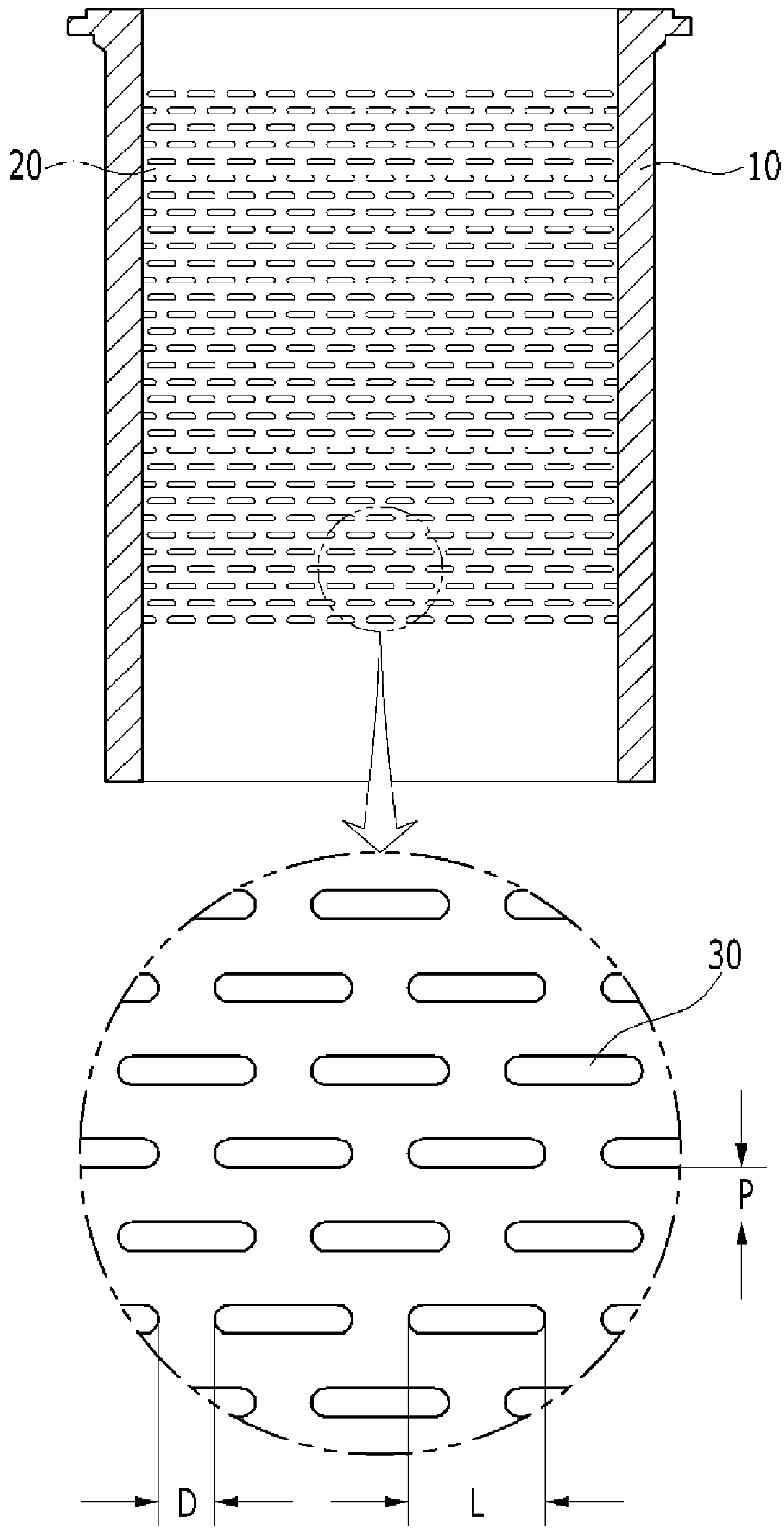


FIG.3

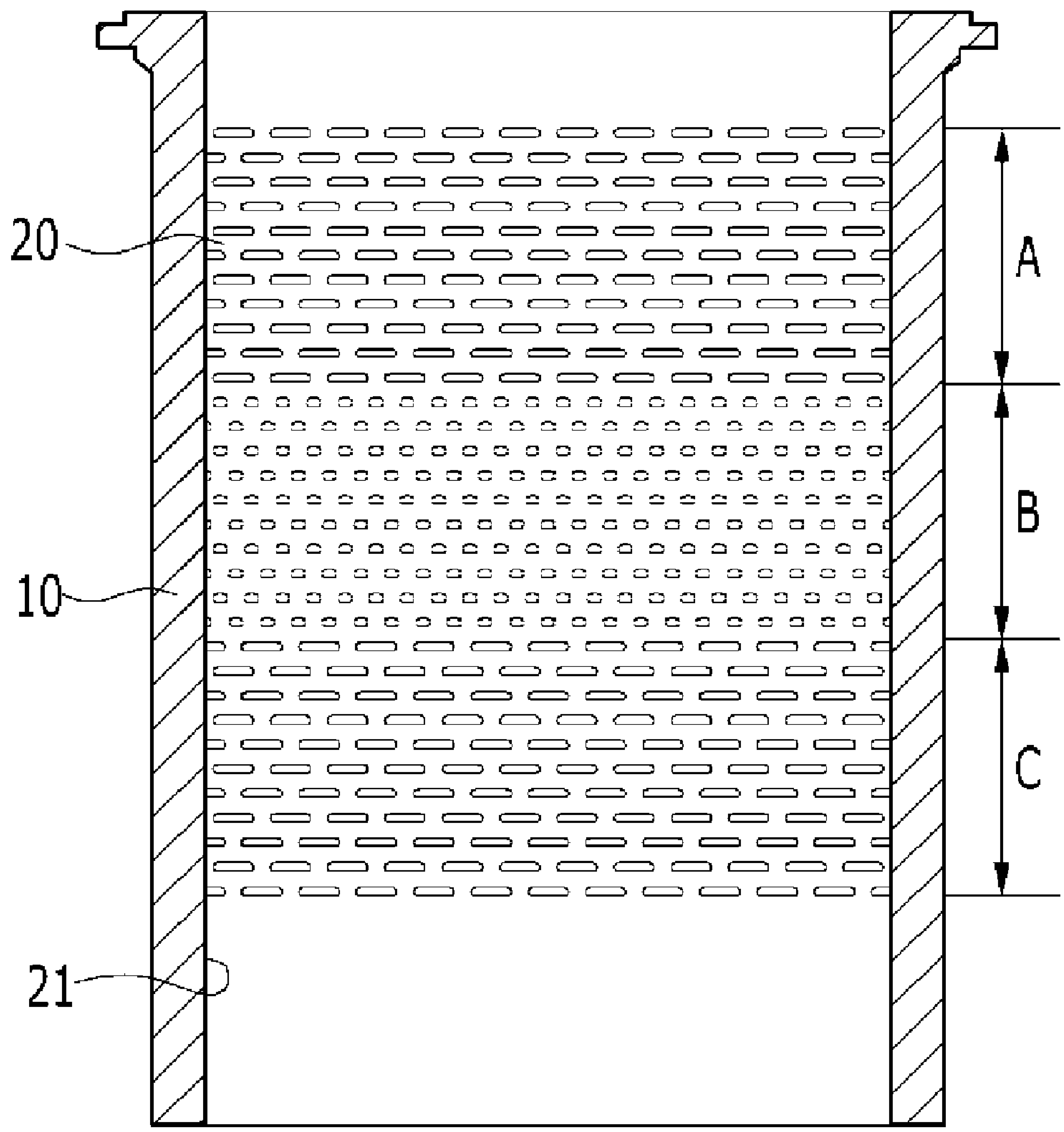


FIG.4

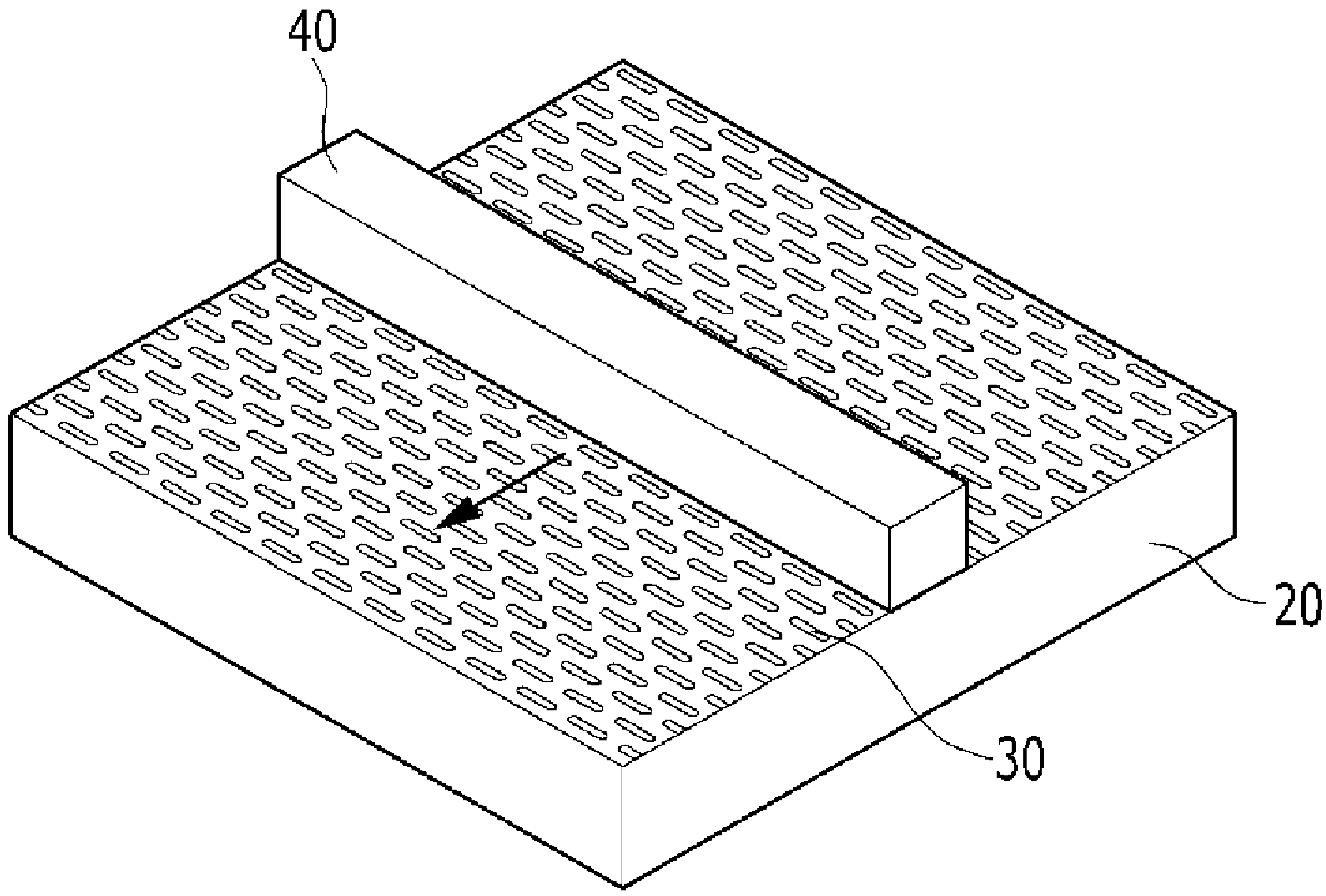
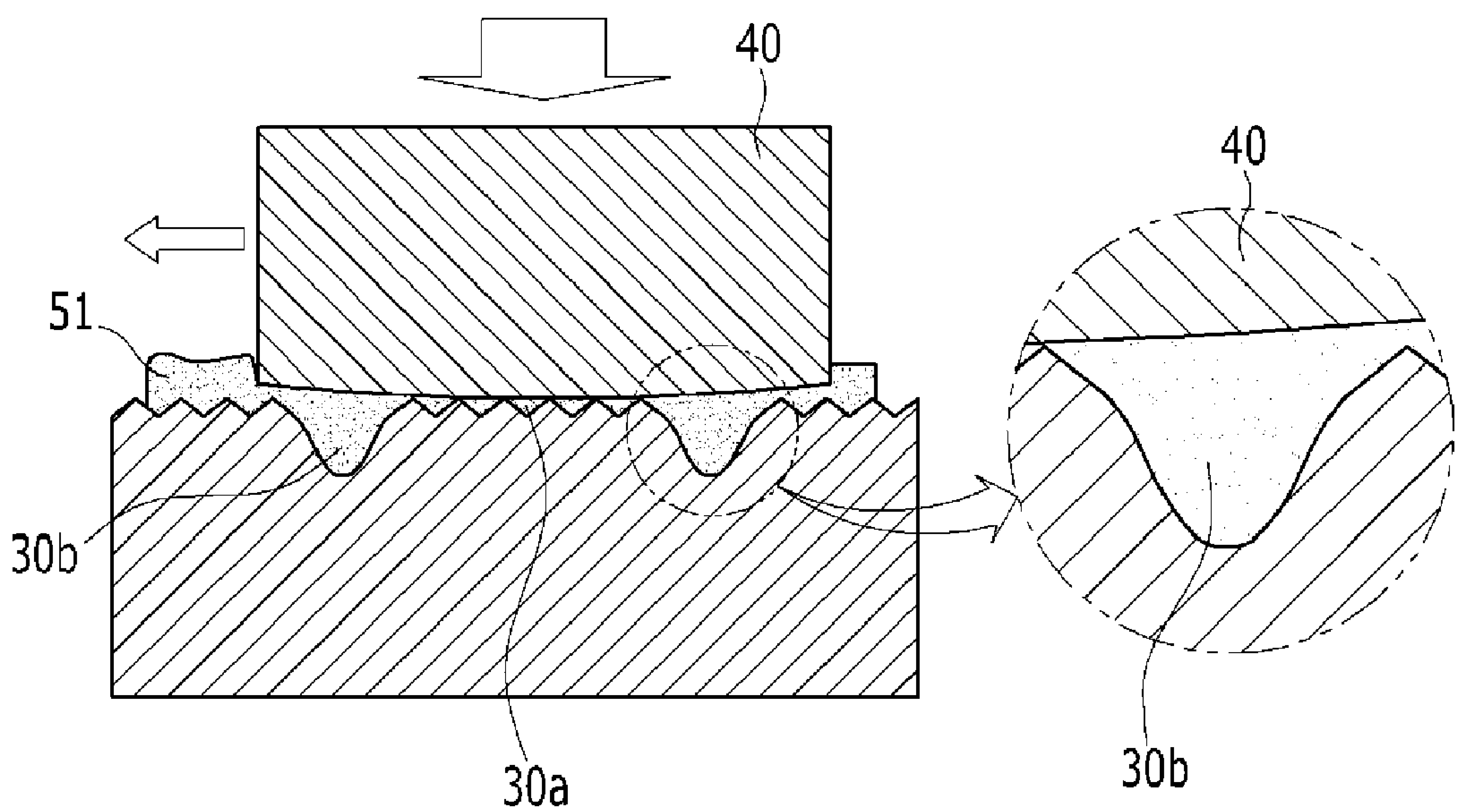


FIG.5



CYLINDER BORE FORMED WITH OIL POCKETS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority of Korean Patent Application Number 10-2010-0119808 filed in the Korean Intellectual Property Office on Nov. 29, 2010, the entire contents of which application is incorporated herein for all purposes by this reference.

BACKGROUND OF INVENTION

[0002] 1. Field of Invention

[0003] The present invention relates to a cylinder bore. More particularly, the present invention relates to a cylinder bore having oil pockets formed in different shapes by stroke sections according to stroke speed using a laser honing method.

[0004] 2. Description of Related Art

[0005] Generally, a cylinder of a vehicle is twice as long as a piston stroke, and the cylinder is an apparatus that converts thermal energy into mechanical energy by a straight reciprocal motion while maintaining oil-tightness of the piston and generates necessary power.

[0006] A cylinder block is a basic portion of an engine main body, and it has a strong influence on the lifespan of an engine main body. As shown in FIG. **1**, a cylinder block **10** has relatively low hardness so it undergoes abrasion by friction in direct contact with a piston, and a cylinder bore **20** is equipped at an inner wall of a cylinder block **10** in order to reduce this abrasion by friction which is generated by reciprocal motion of the piston.

[0007] The piston is housed in the cylinder bore **20** such that the piston can travel back and forth, but the cylinder bore **20** has a problem that abrasion by friction with cylinder bore **20** during the reciprocal motion of the piston is generated.

[0008] For his reason, a lubricant has to be supplied from the outside to the cylinder bore **20** and a friction portion of the piston.

[0009] In other words, as shown in FIG. **1**, a plurality of oil pockets are formed on an interior circumference of the cylinder bore **20**. FIG. **1** shows a cylinder bore **20** with oil pockets formed only near the top dead center section, and FIG. **2** shows a cylinder bore **20** with oil pockets formed the same shape in all sections.

[0010] In FIG. **2**, D represents the distance between oil pockets **30**, L represents the length of the oil pockets, and P is a pitch that represents the interval of lines formed with the oil pockets. As shown in FIG. **1** and FIG. **2**, if oil pockets are formed on the interior circumference of the cylinder bore **20** in the same shape over all sections without distinction of the stroke relative to the stroke speed of the piston, oil is supplied in the same amount over all the sections.

[0011] When the stroke speed of the piston is fast, a lot of oil is not necessary. This is because the piston can be moved by inertia because of a smaller friction even if a small amount of oil is supplied when the piston moves at a high speed.

[0012] Therefore, when the piston moves at a high speed, a force of kinetic friction which is smaller than the force of static friction exerted at top dead center or bottom dead center of the piston is exerted thereon.

[0013] However, the piston momentarily stops to change the direction of movement when the piston is at top dead center and bottom dead center, and when the piston begins to move again after the momentary stop, the force of static friction is exerted.

[0014] Accordingly, much more oil is necessary at the top and bottom dead centers because much larger frictional force than the force of kinetic friction in the middle of the stroke is exerted.

[0015] Thus, it is necessary for the amount of oil supply to be different in accordance with the stroke section of the piston.

[0016] The information disclosed in this Background section is only for enhancement of understanding of the general background of the invention and should not be taken as an acknowledgement or any form of suggestion that this information forms the prior art already known to a person skilled in the art.

SUMMARY OF INVENTION

[0017] Various aspects of the present invention have been made in an effort to provide a cylinder bore formed with oil pockets having advantages of minimizing friction loss of the cylinder.

[0018] Aspects of the present invention are directed to provide a cylindrical cylinder bore having a plurality of oil pockets in order for a piston ring to move smoothly during oil supply. One aspect of the exeplary cylinder bores may be characterized in that the oil pockets on the interior circumference of a cylinder bore are formed on all sections that contact a piston, and the oil pockets have different shapes by stroke sections.

[0019] Oil pockets of exemplary cylinder bores according to the present invention may have different shapes by sections according to stroke speeds. In a rapid speed section of a stroke, the length of oil pockets is shorter and the depth of oil pockets is shallower, while in a slow speed portion of a stroke, the length of oil pockets is larger and the depth of oil pockets is deeper. The shapes of the oil pockets may be symmetrical top-to-bottom from the center section.

[0020] Aspects of the oil pockets according to exemplary cylinder bores of the present invention may also be characterised in that the oil pockets have a structure in which more oil can be supplied gradually from the center section to the upper side or the lower side. Exemplary oil pockets may have the same shapes near top dead center and bottom dead center, and have different shapes from a center section.

[0021] The oil pockets of exemplary cylinder bores of the present invention are formed by a laser honing method.

[0022] As is explained above, the present invention may minimize the oil consumption, reduce the friction loss, and improve fuel efficiency by forming the oil pockets having different shapes in different stroke sections by a laser honing method.

[0023] The methods and apparatuses of the present invention have other features and advantages which will be apparent from or are set forth in more detail in the accompanying drawings, which are incorporated herein, and the following Detailed Description, which together serve to explain certain principles of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. **1** shows a traditional cylinder formed with oil pockets.

[0025] FIG. **2** shows another traditional cylinder formed with oil pockets.

[0026] FIG. **3** is a cross-sectional view of an exemplary cylinder bore according to the present invention.

[0027] FIG. **4** is a perspective view showing an exemplary cylinder bore contacting the piston ring according to the present invention.

[0028] FIG. **5** is a cross-sectional view showing an exemplary cylinder bore contacting the piston ring according to the present invention.

DETAILED DESCRIPTION

[0029] Reference will now be made in detail to various embodiments of the present invention(s), examples of which are illustrated in the accompanying drawings and described below. While the invention(s) will be described in conjunction with exemplary embodiments, it will be understood that present description is not intended to limit the invention(s) to those exemplary embodiments. On the contrary, the invention (s) is/are intended to cover not only the exemplary embodiments, but also various alternatives, modifications, equivalents and other embodiments, which may be included within the spirit and scope of the invention as defined by the appended claims.

[0030] Exemplary embodiments of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

[0031] As shown in FIG. **3**, exemplary embodiments of the present invention provide a cylinder bore **20** that has oil pockets **30** having different shapes by stroke sections according to the stroke speed of a piston, and minimize the oil loss and friction loss. To accomplish this, a piston ring **40** in exemplary embodiments of the present invention must move smoothly by forming a plurality of oil pockets **30** and supplying oil.

[0032] The piston ring **40** is located at the exterior circumference of the piston so that the piston can move slidingly while being air-tight in the cylinder. The piston ring **40** includes a compression ring that prevents the combustion gas from leaking and an oil ring that controls the amount of oil lubrication between the cylinder wall and the piston.

[0033] The oil pockets **30** are formed on all interior circumference sections contacting the piston, and the oil pockets **30** store oil and are formed to minimize the friction that is generated by movement of the piston ring **40**.

[0034] However, the friction is different by the stroke speed of the piston, and in particular the frictional force is large at top dead center or bottom dead center while the frictional force is small at the middle section of the cylinder bore **20**.

[0035] That is because the piston momentarily stops at top dead center and bottom dead center of the piston, and then the piston moves again after changing the moving direction and at this time the force of static friction is exerted. As an example, the stroke speed slows when the piston reaches top dead center and stops for a moment.

[0036] The force of kinetic friction grows larger as the moving speed grows smaller and the force of static friction is larger than the force of kinetic friction, so a large amount of frictional force is exerted from shortly before the piston reaches top dead center to the moment when the piston begins to move again after stopping. To reduce the friction force, a lot of oil has to be supplied.

[0037] This is the same at the time when the piston reaches bottom dead center. In other words, the piston slows shortly before the piston reaches bottom dead center and begins to move after stopping completely, so a large amount of frictional force is exerted between the piston ring **40** and the cylinder bore **20**. Therefore, oil has to be sufficiently supplied to the interior circumference **21** of the cylinder bore **20** corresponded to bottom dead center of the piston.

[0038] On the contrary, when the piston moves in the middle between top dead center and bottom dead center the piston moves at its highest speed, so the frictional force between the piston ring **40** and the cylinder bore **20** is smaller than that of movement near top dead center or bottom dead center. Thus, less oil may be supplied in the middle section between the top dead center and the bottom dead center.

[0039] For the same reason, as shown in FIG. **3** to FIG. **5**, the shapes of oil pockets **30** that are formed on the inner circumference **21** of the cylinder bore **20** have different shapes by sections according to the stroke speed of the piston in exemplary embodiments of the present invention.

[0040] Oil **51** is interposed between the piston ring **40** and oil pockets **30***a* and **30***b* so that the frictional force can be reduced, as shown in FIG. **5**. Particularly, in the section that needs a lot of oil supply, that is, the section where the stroke speed of the piston is low, the length of the oil pocket **30***b* is longer and the depth of the oil pocket **30***b* is deeper compared to the section that needs a little oil supply, that is, the section where the stroke speed of the piston is high, and here, the length of the oil pocket **30***a* is shorter and the depth of the oil pocket **30***a* is shallower.

[0041] For this purpose, the oil pockets **30***b* on the cylinder bore **20** corresponding to near top dead center and bottom dead center of the piston according to exemplary embodiments of the present invention are formed longer and deeper compared to the oil pockets **30***a* on the cylinder bore **20** corresponding to the middle section between top dead center and bottom dead center of the piston that are formed shorter and shallower.

[0042] The same shaped oil pockets **30** can be formed on the cylinder bore **20** corresponding to near top dead center and bottom dead center of the piston.

[0043] The oil pockets **30** can be formed by a laser honing method.

[0044] The cylinder bore **20** in exemplary embodiments of the present invention, as shown in FIG. **3**, can be divided into A, **8**, and C sections by stroke, and the oil pockets **30** in section A and section C are formed 4 mm in length, 2 mm in distance between oil pockets **30**, 2 mm in pitch, and 15 to 20 μm in depth.

[0045] On the contrary, oil pockets **30** in section B are formed 2 mm in distance between oil pockets **30** and 2 mm in pitch, which are the same as in sections A and C, but the oil pockets **30** are formed 1 mm in length and 5 to 10 μm in depth so that a little oil can be supplied.

[0046] By forming the oil pockets **30** as mentioned above, a honing shape at the sections A and C where stroke speeds are relatively low has many influences on the oil pockets **30**, while the tensile strength on the section B where the stroke speed is relatively fast has few influences. So oil consumption can be minimized and a friction loss can be simultaneously reduced by forming the honing shape differently.

[0047] Particularly, the differentiated shapes are formed by a laser honing method in the exemplary embodiments of the present invention so that the fuel efficiency can be improved.

[0048] In the above, it is mainly described that the cylinder bore is divided into three sections, and the oil pockets have the same shapes near top dead center and bottom dead center, and have different shapes from a center section. But these are just exemplary embodiments of the present invention, and the cylinder bores can be divided into multiple sections according to the stroke speeds.

[0049] That is, the shapes of the oil pockets can be symmetrical top-to-bottom from the center section in the cylinder bore. In this way, much more oil can be supplied gradually from the center section to the upper side or the lower side.

[0050] In addition, the number of stroke sections can be at least three. Further, the oil pockets can have the same shapes in the at least two sections, and the oil pockets can simultaneously have different shapes in the at least one section. That is, if the cylinder bore is divided into three sections as in the above exemplary embodiment, the shapes of the oil pockets can be the same in the sections A and B, but different in the section C.

[0051] For convenience in explanation and accurate definition in the appended claims, the terms "upper" or "lower", "shorter" or "longer", "shallower" or "deeper", and etc. are used to describe features of the exemplary embodiments with reference to the positions of such features as displayed in the figures.

[0052] The foregoing descriptions of specific exemplary embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teachings. The exemplary embodiments were chosen and described in order to explain certain principles of the invention and their practical application, to thereby enable others skilled in the art to make and utilize various exemplary embodiments of the present invention, as well as various alternatives and modifications thereof. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

What is claimed is:

1. A cylinder bore comprising:

a plurality of oil pockets formed on a plurality of stroke sections that contact a piston on an interior circumference of the cylinder bore, the oil pockets having their shapes over the respective stroke sections.

2. The cylinder bore of claim **1**, wherein the oil pockets have different shapes over the stroke sections according to stroke speeds.

3. The cylinder bore of claim **2**, wherein the oil pockets are shorter in length and shallower in depth in a high stroke speed section, whereas the oil pockets are longer in length and deeper in depth in a low stroke speed section.

4. The cylinder bore of claim **1**, wherein the number of stroke sections is at least three.

5. The cylinder bore of claim **4**, wherein the oil pockets have the same shapes in the at least two sections.

6. The cylinder bore of claim **5**, wherein the oil pockets have different shapes in the at least one section.

7. The cylinder bore of claim **1**, wherein the oil pockets are a structure such that more oils can be supplied to an upper stroke section or to a lower stroke section than to a center stroke section of the cylinder bore.

8. The cylinder bore of claim **1**, wherein the oil pockets are formed symmetrically with respect to a center stroke section of the cylinder bore.

9. The cylinder bore of claim **8**, wherein the oil pockets have same shapes at a top dead center stroke section and a bottom dead center stroke section, but different shapes in the center stroke section.

10. The cylinder bore of claim **9**, wherein the oil pockets are approximately 4 mm in length, 2 mm in distance between the oil pockets, 2 mm in pitch, and 15 to 20 μm in depth in the top dead center stroke section and the bottom dead center stroke section, whereas the oil pockets are approximately 1 mm in length, 2 mm in distance between the oil pockets, 2 mm in pitch, and 5 to 10 μm in depth in the center stroke section.

11. The cylinder bore of claim **1**, wherein the oil pockets are formed by a laser honing method.

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