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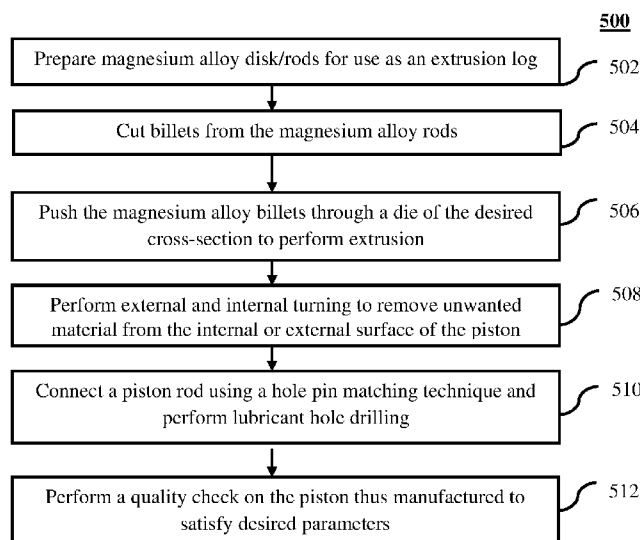


FIG. 5

(57) Abstract: The embodiments herein provide a lightweight piston device for use in an internal combustion engine. According to an embodiment herein, the piston is made from a magnesium alloy. The piston made from magnesium alloy is lighter in weight thereby reducing the inertia forces within the cylinder. By reducing the inertia forces, the efficiency of the engine increases which eventually increases the horse power. A method is provided for manufacturing piston from magnesium alloy using metal spinning or extrusion technique. Die punching is carried out on the cylinder shape of magnesium alloy in order to make a hole for piston pin. External and internal turning is performed using machining. The piston rod is then connected to matching hole pin and the lubricant hole drilling is performed.



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## **LIGHTWEIGHT PISTON**

### **CROSS-REFERENCE TO RELATED APPLICATION**

[0001] The embodiments herein claims the priority of the Indian provisional patent application 201641035882 filed on 20/10/2016 deffered the priority date by 20/11/2016 with the title, "LIGHTWEIGHT PISTON" and the entire contents of which are included as reference herein.

### **A) TECHNICAL FIELD**

[0002] The embodiments herein is generally related to automobile industry. The embodiments herein is particularly related to fluid pressure translating devices of the reciprocating type. The embodiments herein is more particularly related to a system and method for manufacturing lightweight piston for internal combustion engines with increased engine efficiency.

### **B) BACKGROUND OF THE INVENTION**

[0003] Piston is one of the main components used in internal combustion engines. The primary function of a piston is to suck the air-fuel mixture in order to compress the said mixture. The pistons are designed to tolerate a sudden rise in temperature caused by an ignition of compressed air-fuel mixture and expulsion of the exhaust gases. Thus, piston is the most active part of a combustion engine and needs to withstand heat, friction, inertia and vibrations caused by the crankshaft and rods.

[0004] The pistons are usually designed to minimize inertia in a high-speed engine and also designed to satisfy the above-mentioned attributes/qualities like heat dissipation etc. Therefore, standard pistons are made of high density, high strength, gas permeable steel or

cast iron. Because of the use of thick steel or cast iron, the pistons are substantially heavy in weight.

[0005] In order to overcome this drawback, the pistons are made of combination of steel and aluminium. The aluminium is added as a material for making piston to greatly benefit the manufacturers with weight reduction. The piston head is exposed to heavy pressure when the engine is operated under load due to the constant forces exhibited by the expanding the gases generated out of combustion of air-fuel mixture. Thus the upper portion of the piston is usually made of high density steel and the lower portion is made of aluminium alloy to withstand high temperature and pressure and to reduce an overall weight of the piston. However, the use of combination of high density steel and aluminium still poses the problem of piston being thick and heavy. Thus, typically pistons are casted completely with aluminium alloy to further reduce the piston weight. Replacing cast iron (density 7.8) with aluminum (density 2.8) saves about 8% of fuel consumption simply because of its weight reduction.

[0006] The heavy weight of piston exhibits high inertia during combustion leading to decreased engine efficiency thereby decreasing horse power, increasing fuel consumption and causing air pollution. There is a constant endeavour to reduce the piston weight without compromising other desired qualities like good wear resistance, high strength to weight ratio, good thermal conductivity, rust resistance, easy to cast, minimal vibrations and the like.

[0007] Hence there is a need for a lightweight piston device for use in an internal combustion engine. There is also a need for an improved piston which is efficient in operation, relatively inexpensive and simple to manufacture. Further, there is a need for an improved piston which increases fuel efficiency and horse power of the automobile and reduces pollution.

[0008] The above-mentioned shortcomings, disadvantages and problems are addressed herein and which will be understood by reading and studying the following specification.

### **C) OBJECT OF THE INVENTION**

[0009] The primary object of the embodiments herein is to provide a lightweight piston device for use in an internal combustion engine.

[0010] Another object of the embodiments herein is to provide an improved piston which is efficient in operation, relatively inexpensive and simple to manufacture.

[0011] Yet another object of the embodiments herein is to develop an improved piston with reduced fuel consumption of the automobile.

[0012] Yet another object of the embodiments herein is to develop a lightweight piston device using special magnesium alloy for use in an internal combustion engine.

[0013] Yet another object of the embodiments herein is to provide a system and method for manufacturing piston to achieve thinner wall cross section of the piston.

[0014] Yet another object of the embodiments herein is to manufacture a connecting rod for the piston using magnesium alloy.

[0015] Yet another object of the embodiments herein is to provide a piston with reduced inertial forces exhibited by the mass of the piston within the engine.

[0016] Yet another object of the embodiments herein is to provide an improved piston with increased fuel efficiency of the automobile.

[0017] Yet another object of the embodiments herein is to provide an improved piston with reduced pollution.

[0018] Yet another object of the embodiments herein is to reduce an overall weight of the vehicle.

[0019] These and other objects and advantages of the embodiments herein will become readily apparent from the following detailed description taken in conjunction with the accompanying drawings.

#### **D) SUMMARY OF THE EMBODIMENTS HEREIN**

[0020] The embodiments herein provide a method for manufacturing a lightweight piston from magnesium alloy. The method comprises forming a cylindrical shaped piston from magnesium alloy. The method also comprises preparing a hole in the cylindrical shaped piston for inserting a piston pin using die punching technique. The method further comprises performing external and internal turning to remove unwanted material from the internal and external surface of the cylindrical shaped piston. The method still further comprises connecting a piston rod using a hole pin matching technique and performing lubricant hole drilling and performing a quality check on the cylindrical shaped piston to satisfy a plurality of desired parameters.

[0021] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy further comprises cold welding a steel or aluminium alloy metal sheet with magnesium alloy to form a disk as an input material for making the piston. The cylindrical shaped piston is formed from the input material either by using metal spinning technique or extrusion technique.

[0022] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy using extrusion technique further comprises cutting one or more magnesium alloy rods into a plurality of billets. The plurality of billets are heated and pressed against a dummy block through a die to form the piston.

[0023] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy using metal spinning technique further comprises

rotating the magnesium alloy disk along with a mandrel and applying pressure on the disk by a tool with every passing rotation.

[0024] According to one embodiment herein, the method further comprises coating the external surface of the cylindrical shaped piston with a corrosion and heat resistant coating for protecting against corrosion and heat.

[0025] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy further comprises fabricating piston rings onto the cylindrical shaped piston body.

[0026] According to one embodiment herein, the step of preparing a hole in the cylindrical shaped piston further comprises punching the piston head on both sides using die punching for making hole to insert the piston pin. The piston pin is inserted through the hole to connect the piston with a connecting rod.

[0027] According to one embodiment herein, the method further comprises manufacturing the connecting rod using magnesium alloy.

[0028] The embodiments herein provide a lightweight piston device for use in an internal combustion engine. According to an embodiment herein, the piston is made from a magnesium alloy. The piston made from magnesium alloy is lighter in weight thereby reducing the inertial forces within the cylinder which are directly proportional to the weight of the piston. By reducing the inertial forces, the efficiency of the engine increases which eventually increases the horse power.

[0029] According to one embodiment herein, a method for manufacturing piston from magnesium alloy is provided. The method comprises, manufacturing a piston from magnesium alloy using metal spinning technique. The magnesium alloy is spun to a cylinder shape. Die punching of the cylinder shaped magnesium alloy is carried out to make a hole for

piston pin. External and internal turning is performed using machining. The piston rod is then connected matching hole pin and the lubricant hole drilling is performed.

[0030] According to one embodiment herein, a method for manufacturing piston from magnesium alloy is provided. The method comprises cutting the magnesium alloy rods into pieces as billets. These aluminium or magnesium billets are used as input pieces for extrusion. The billets are heated and then loaded into the container in the press. A dummy block is placed behind the billet. The billet is pushed out of the die with a ram. Based on the required properties, the piston is either heat treated or cold worked.

[0031] According to one embodiment herein, a method for reducing the inertial forces of the piston is provided by manufacturing the piston from magnesium alloy. The magnesium alloy piston is lighter in weight and thereby reducing the inertia forces. By reducing the inertia forces, the efficiency of the engine increases which eventually increases the horse power.

[0032] According to one embodiment herein, a method for increasing a fuel efficiency of the internal combustion engine is provided.

[0033] According to one embodiment herein, a lightweight piston composition comprises a magnesium metal alloy, and wherein the magnesium metal alloy is clad or reinforced with a steel alloy sheet or aluminium alloy sheet, and wherein the magnesium alloy is a heat resistant magnesium alloy and wherein the heat resistant magnesium alloy is a magnesium alloy clad with steel alloy sheet or aluminium alloy sheet coated with a heat resistant and corrosive resistant coating.

[0034] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following descriptions, while indicating the preferred embodiments herein and numerous specific details thereof, are

given by way of an illustration and not of a limitation. Many changes and modifications may be made within the scope of the embodiments herein without departing from the spirit thereof, and the embodiments herein include all such modifications.

#### **E) BRIEF DESCRIPTION OF THE DRAWINGS**

[0035] The other objects, features and advantages will occur to those skilled in the art from the following description of the preferred embodiments herein and the accompanying drawings in which:

[0036] FIG. 1 illustrates a side view of a magnesium alloy sheet used as base material for manufacturing the piston, according to one embodiment herein.

[0037] FIG. 2 illustrates a flowchart explaining a method of manufacturing a piston using metal spinning technique, according to one embodiment herein.

[0038] FIG. 3 illustrates a front view of a piston manufactured using metal spinning technique, according to one embodiment herein.

[0039] FIG. 4 illustrates a side view of a piston depicting a process of making a hole for inserting a piston pin, according to one embodiment herein.

[0040] FIG. 5 illustrates a flowchart explaining a method of manufacturing a piston using extrusion technique, according to one embodiment herein.

[0041] FIG. 6 illustrates a cross sectional view of the internal structure of a piston, according to one embodiment herein.

[0042] FIG. 7 illustrates a piston movement when placed inside a cylinder, according to one embodiment herein.

[0043] Although the specific features of the embodiments herein are shown in some drawings and not in others. This is done for convenience only as each feature may be combined with any or all of the other features in accordance with the embodiments herein.

**F) DETAILED DESCRIPTION OF THE INVENTION**

[0044] In the following detailed description, a reference is made to the accompanying drawings that form a part hereof, and in which the specific embodiments that may be practiced is shown by way of illustration. These embodiments are described in sufficient detail to enable those skilled in the art to practice the embodiments herein and it is to be understood that the logical, mechanical and other changes may be made without departing from the scope of the embodiments herein. The following detailed description is therefore not to be taken in a limiting sense.

[0045] The embodiments herein provide a method for manufacturing a lightweight piston from magnesium alloy. The method comprises forming a cylindrical shaped piston from magnesium alloy. The method also comprises preparing a hole in the cylindrical shaped piston for inserting a piston pin using die punching technique. The method further comprises performing external and internal turning to remove unwanted material from the internal and external surface of the cylindrical shaped piston. The method still further comprises connecting a piston rod using a hole pin matching technique and performing lubricant hole drilling and performing a quality check on the cylindrical shaped piston to satisfy a plurality of desired parameters.

[0046] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy further comprises cold welding a steel or aluminium alloy metal sheet with magnesium alloy to form a disk as an input material for making the piston. The cylindrical shaped piston is formed from the input material either by using metal spinning technique or extrusion technique.

[0047] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy using extrusion technique further comprises cutting one

or more magnesium alloy rods into a plurality of billets. The plurality of billets are heated and pressed against a dummy block through a die to form the piston.

[0048] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy using metal spinning technique further comprises rotating the magnesium alloy disk along with a mandrel and applying pressure on the disk by a tool with every passing rotation.

[0049] According to one embodiment herein, the method further comprises coating the external surface of the cylindrical shaped piston with a corrosion and heat resistant coating for protecting against corrosion and heat.

[0050] According to one embodiment herein, the step of forming the cylindrical shaped piston from magnesium alloy further comprises fabricating piston rings onto the cylindrical shaped piston body.

[0051] According to one embodiment herein, the step of preparing a hole in the cylindrical shaped piston further comprises punching the piston head on both sides using die punching for making hole to insert the piston pin. The piston pin is inserted through the hole to connect the piston with a connecting rod.

[0052] According to one embodiment herein, the method further comprises manufacturing the connecting rod using magnesium alloy.

[0053] The embodiments herein provide a lightweight piston device for use in an internal combustion engine. According to an embodiment herein, the piston is made from a magnesium alloy. The piston made from magnesium alloy is lighter in weight thereby reducing the inertial forces within the cylinder which are directly proportional to the weight of the piston. By reducing the inertial forces, the efficiency of the engine increases which eventually increases the horse power.

[0054] According to one embodiment herein, a method for manufacturing piston from magnesium alloy is provided. The method comprises, manufacturing a piston from magnesium alloy using metal spinning technique. The magnesium alloy is spun to a cylinder shape. Die punching of the cylinder shaped magnesium alloy is carried out to make a hole for piston pin. External and internal turning is performed using machining. The piston rod is then connected matching hole pin and the lubricant hole drilling is performed.

[0055] According to one embodiment herein, a method for manufacturing piston from magnesium alloy is provided. The method comprises cutting the magnesium alloy rods into pieces as billets. These magnesium billets are used as input pieces for extrusion. The billets are heated and then loaded into the container in the press. A dummy block is placed behind the billet. The billet is pushed out of the die with a ram. Based on the required properties, the piston is either heat treated or cold worked.

[0056] According to one embodiment herein, a method for reducing the inertial forces of the piston is provided by manufacturing the piston from magnesium alloy. The magnesium alloy piston is lighter in weight and thereby reducing the inertia forces. By reducing the inertia forces, the efficiency of the engine increases which eventually increases the horse power.

[0057] According to one embodiment herein, a method for increasing a fuel efficiency of the internal combustion engine is provided.

[0058] According to one embodiment herein, a lightweight piston composition comprises a magnesium metal alloy, and wherein the magnesium metal alloy is clad or reinforced with a steel alloy sheet or aluminium alloy sheet, and wherein the magnesium alloy is a heat resistant magnesium alloy and wherein the heat resistant magnesium alloy is a magnesium alloy clad with steel alloy sheet or aluminium alloy sheet coated with a heat resistant and corrosive resistant coating.

[0059] FIG.1 illustrates a side view of a magnesium alloy sheet used as a base material for manufacturing the piston, according to one embodiment herein. Steel or aluminium alloy metal sheet such as aluminium clad Alclad metal sheet (102) is obtained by cold welding aluminium alloy with magnesium alloy (104) to form a disk as an input material for making the piston either by using metal spinning technique or extrusion technique.

[0060] According to one embodiment herein, tough steel or tough aluminium alloy material is used to provide the desired capability of corrosion resistance and to meet the heat dissipation demands of the piston as magnesium is susceptible to corrosion and does not fulfil the desired heat dissipation criteria.

[0061] Other alternative technique such as coating the external piston are also applied to get the desired qualities for protecting against corrosion and heat. As the density of magnesium is very less (1.7) when compared to aluminum (2.8), comparatively lightweight pistons are manufactured with the use of magnesium alloy.

[0062] FIG. 2 illustrates a flowchart explaining a method of manufacturing a piston using metal spinning technique, according to one embodiment herein. The method comprises the steps of manufacturing a piston from magnesium alloy using metal spinning technique (202). Metal spinning technique is employed using a rotating mandrel to form a symmetric part across an axis. To provide the desired shape, a force is applied using a tool with smooth edges such as rounded end or the roller. The process is started with withholding a magnesium alloy disk along with mandrel. As the apparatus is rotated, the required pressure is applied on the disk by the tool to gradually move up the mandrel with every passing rotation. This causes the disk to slowly take over the shape as desired and final shape is dictated by the shape of the mandrel. Cold metal spinning is generally performed but in some cases the parts are subjected to warm or hot spinning.

[0063] Once the piston is manufactured using a metal spinning technique, die punching is carried out on the cylindrical shaped magnesium alloy piston for making hole to insert piston pin (204). During punching, a punch tool is pressed on the workpiece to create a hole. Usually, the punch is passed through the workpiece in a die. The die is located on the opposite side of the piston. The material is supported around the perimeter of the hole to localize the shearing forces for a cleaner edge. There is a small amount of clearance between the punch and the die to prevent the punch from sticking in the die thereby requiring lesser force to make the hole. The punch is forced through the workpiece to produce the hole that has a diameter equivalent to the punch or slightly smaller after the punch is removed.

[0064] According to one embodiment herein, turning is carried out to remove unwanted material from the internal or external surface of the piston (206). During turning, a cutting tool is moved linearly while the piston is rotated to produce tubular components and to achieve precise diameters and depths. The piston rod is then connected using a hole pin matching technique and the lubricant hole drilling is performed (208).

[0065] According to one embodiment herein, hole pin machining is performed to enable connecting piston rod to the piston. Further drilling is performed to make lubrication holes on to the piston. Further, the quality of the piston thus manufactured is checked to satisfy the desired parameters. Further, a quality check is performed on the piston thus manufactured to satisfy desired parameters (210).

[0066] Metal spinning technique enables manufacturing of thin cross section area of piston wall. All the required parameters of the piston are satisfied even with the thin cross section as magnesium sheet metal possesses higher strength as compared to aluminium sheet. Thus, piston manufactured with magnesium alloy using metal spinning technique is very lightweight due to thin cross section of piston walls and magnesium being lightweight (density 1.7).

[0067] FIG. 3 illustrates a front view of a piston manufactured using metal spinning technique, according to one embodiment herein. With respect to FIG. 3, the magnesium alloy is spun into a cylinder shape using the metal spinning technique. As illustrated, the piston rings are also fabricated onto the piston body.

[0068] FIG.4 illustrates a side view of a piston explaining a process of making a hole for inserting a piston pin, according to one embodiment herein. With respect to FIG. 4, the piston head is punched on both sides (402) using die punching for making holes to insert the piston pin. The piston pin is inserted through these holes to connect the piston with the connecting rod to provide a bearing for the connecting rod to pivot upon as the piston moves, after the punching of the hole. The connecting rod is also manufactured using magnesium alloy that in-turn further reduces the overall weight of the piston.

[0069] FIG.5 illustrates a flowchart explaining a method of manufacturing a piston using extrusion technique, according to one embodiment herein. The magnesium alloy disk/rods are used as an extrusion log (502). Firstly, the magnesium alloy rods are cut into pieces as billets (504). These aluminium or magnesium billets are used as input pieces for extrusion.

[0070] According to one embodiment herein, objects of a fixed cross-sectional profile are extruded. The magnesium alloy billets are pushed through a die of the desired cross-section (506). The billets are heated (for hot or warm extrusion). The billet is then loaded into a container in the press. A dummy block is placed behind the billet and a ram is used to press the billet to push the billet out of the die. Based on the required properties, the piston is either heat treated or cold worked. An excellent surface finish process is applied for the piston. The outcome of extrusion is very close to the desired shape of the piston. The piston is then put through turning process as explained above followed by a hole pin machining process (508). Further, lubrication holes are formed within the piston. The weight

of the piston is reduced by 40% by using extrusion method for the manufacturing of piston in comparison with existing die casting methods. Further, a quality check is performed on the piston thus manufactured to satisfy desired parameters (510).

[0071] FIG. 6 illustrates a cross sectional view of the piston formed using magnesium alloy through either the metal spinning technique or extrusion technique, according to one embodiment herein. With respect to FIG. 6, the cross section view highlights the hollow piston with thin magnesium alloy walls along with lubrication holes. The cross section view additionally highlights the piston pin placement within the piston head. In some example embodiments herein, other materials such as silicon is added to the magnesium alloy die casting to further enhance the properties of the piston.

[0072] FIG 7 illustrates a piston movement when placed inside a cylinder, according to one embodiment herein. The piston is moved front and back inside the cylinder. As the inertial forces within the cylinder are directly proportional to the weight of the piston, high inertial forces are developed during a change in the piston movement direction. Magnesium piston is lighter in weight and thus reduces the inertia forces. By reducing the inertia forces, the efficiency of the engine is increased thereby eventually increasing the horse power.

[0073] The foregoing description of the specific embodiments herein will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments herein. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred

embodiments herein, those skilled in the art will recognize that the embodiments herein can be practiced with modifications.

### **G) ADVANTAGES OF THE INVENTION**

[0074] The embodiments herein provide a lightweight piston. The piston is manufactured using magnesium alloy through metal spinning or extrusion technique. The piston made from magnesium alloy is lighter in weight since the density of magnesium (1.7) is less as compared to aluminium (2.8) and thus reduces the inertia forces within the cylinder which are directly proportional to the weight of the piston. By reducing the inertia forces, the efficiency of the engine increases which eventually increases the horse power.

[0075] The weight reduction of upto about 60% is achieved when the piston is manufactured using magnesium alloy through metal spinning technique. Further, weight reduction of upto about 40% is achieved when the piston is manufacture using magnesium through extrusion technique. In both the cases, the weight reduction is quite substantial as compared to the weight reduction of piston manufactured from aluminium alloy which is usually only about 20% to 30%.

[0076] The metal spinning technique is used for manufacturing the magnesium alloy piston. Metal spinning technique is performed to manufacture pistons with walls having thin cross section area. Due to thinner cross sectional area and due to use of low density magnesium alloy, substantially lightweight pistons are manufactured.

[0077] The extrusion technique is additionally used for manufacturing of the magnesium alloy piston. The advantages of extrusion process over other manufacturing processes is its ability to create very complex cross-sections with an excellent surface finish.

[0078] The foregoing description of the specific embodiments herein will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such as specific

embodiments herein without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments herein. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments herein, those skilled in the art will recognize that the embodiments herein can be practiced with modifications. However, all such modifications are deemed to be within the scope of the claims.

**CLAIMS**

What is claimed is:

1. A method for manufacturing a lightweight piston from magnesium alloy, the method comprising:
  - forming a cylindrical shaped piston from magnesium metal sheet, and wherein a magnesium metal sheet is reinforced with a steel alloy sheet or an aluminum alloy sheet;
  - preparing a hole in the cylindrical shaped piston for inserting a piston pin using die punching technique;
  - performing external and internal turning operations to remove unwanted material from an internal surface and an external surface of the cylindrical shaped piston;
  - connecting a piston rod using a hole pin matching technique and performing lubricant hole drilling; and
  - performing a quality check on the cylindrical shaped piston to satisfy a plurality of desired parameters.
2. The method according to claim 1, wherein the step of forming the cylindrical shaped piston from magnesium alloy further comprises cold welding a steel or aluminium alloy metal sheet with magnesium alloy to form a disk as an input material for making the piston, and wherein the cylindrical shaped piston is formed from the input material either by using a metal spinning technique or an extrusion technique.
3. The method according to claim 2, wherein the step of forming the cylindrical shaped piston from magnesium alloy using extrusion technique further comprises cutting one

or more magnesium alloy rods into a plurality of billets, and wherein the plurality of billets are heated and pressed against a dummy block through a die to form the piston.

4. The method according to claim 2, wherein the step of forming the cylindrical shaped piston from magnesium alloy using a metal spinning technique further comprises rotating the magnesium alloy disk along with a mandrel and applying pressure on the disk by a tool with every passing rotation.
5. The method according to claim 1, further comprises coating the external surface of the cylindrical shaped piston with a corrosion and heat resistant coating for protecting against corrosion and heat.
6. The method according to claim 1, wherein the step of forming the cylindrical shaped piston from magnesium alloy further comprises fabricating piston rings onto the cylindrical shaped piston body.
7. The method according to claim 1, wherein the step of preparing a hole in the cylindrical shaped piston further comprises punching the piston head on both sides using die punching for making hole to insert the piston pin, and wherein the piston pin is inserted through the hole to connect the piston with a connecting rod.
8. The method according to claim 1, further comprises manufacturing the connecting rod using magnesium alloy.
9. A lightweight piston composition comprises:

magnesium metal alloy, and wherein the magnesium metal alloy is clad or reinforced with a steel alloy sheet or aluminium alloy sheet, and wherein the magnesium alloy is a heat resistant magnesium alloy and wherein the heat resistant magnesium alloy is a magnesium alloy clad with steel alloy sheet or aluminium alloy sheet coated with a heat resistant and corrosive resistant coating.

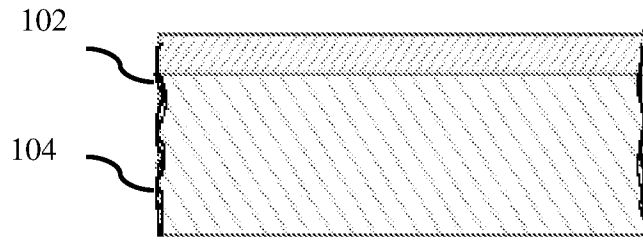
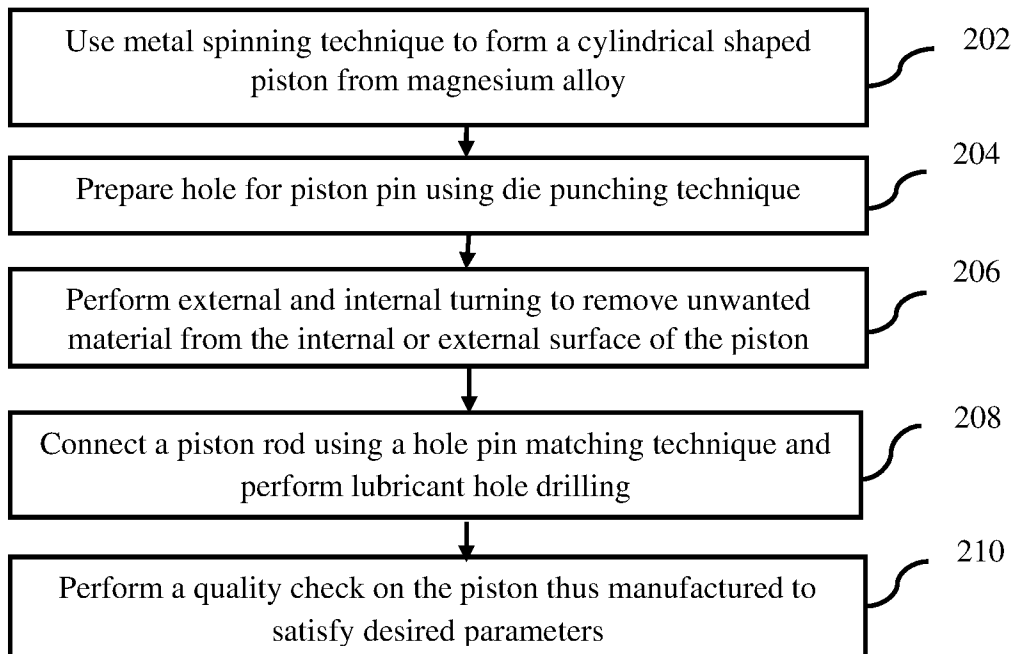
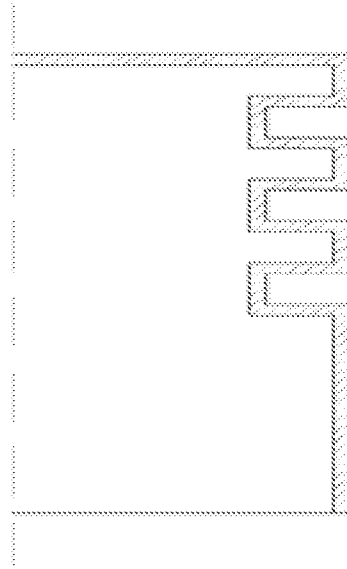
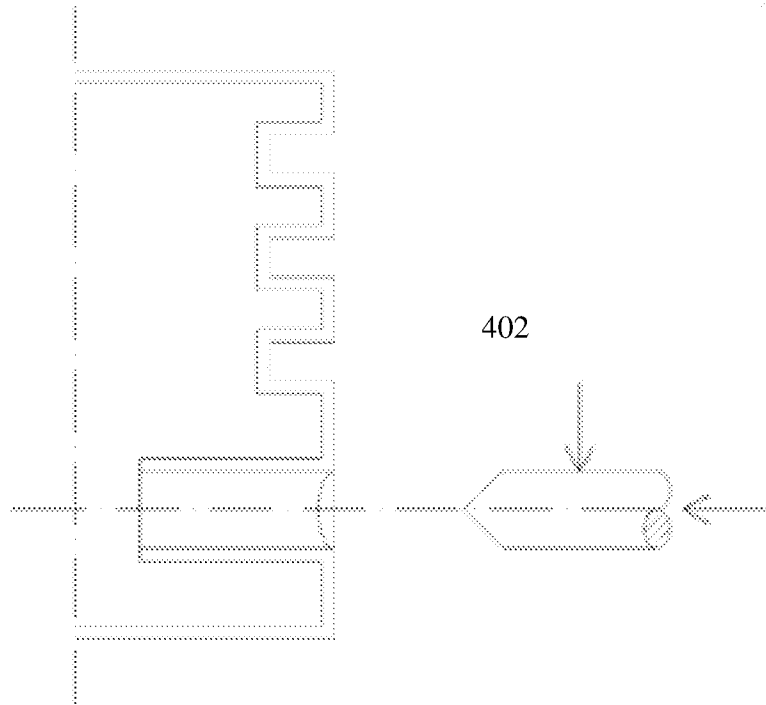


FIG. 1

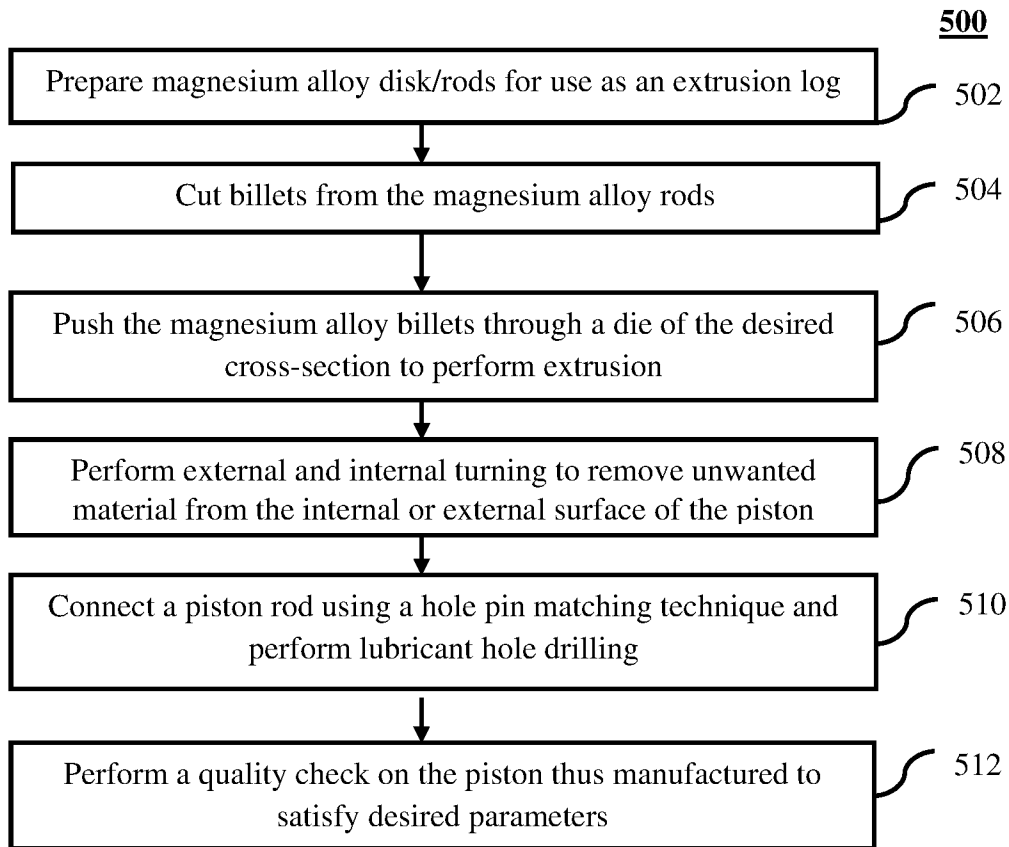
**FIG. 2**



**FIG. 3**



**FIG. 4**

**FIG. 5**

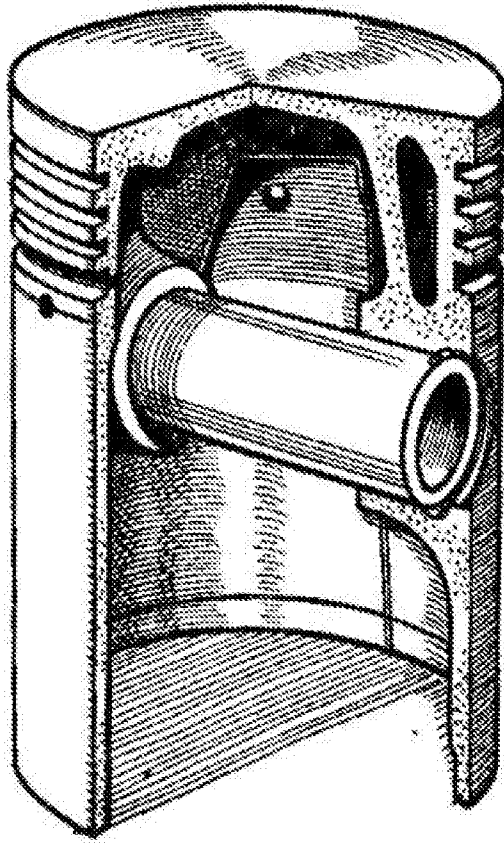


FIG. 6

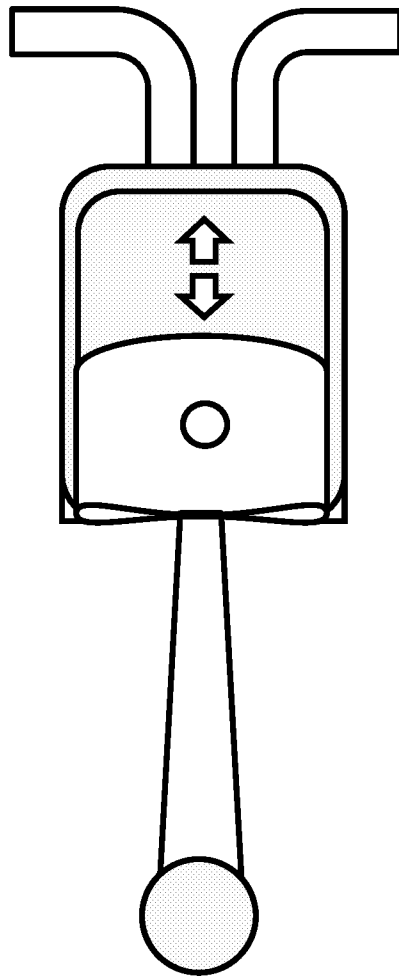


FIG. 7

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2017/057224

A. CLASSIFICATION OF SUBJECT MATTER IPC (2018.01) F02F 3/00, F16C 7/00  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) IPC (2018.01) F02F 3/00, F16C 7/00, F02F 3/10, F16C 7/02  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Databases consulted: Derwent Innovation, Orbit Search terms used: bore, recess, cavity, die, boss, engine, punch, manufacturem drill		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012160206 A1 TAKAHASHI NORIKAZU [JP]; SASAKI MASATO [JP]; SATO TAKANORI [JP]; HITACHI AUTOMOTIVE SYSTEMS LTD [JP] 28 Jun 2012 (2012/06/28) Entire Document	1-8
A	Entire Document	9
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Date of the actual completion of the international search 15 Mar 2018		Date of mailing of the international search report 15 Mar 2018
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Facsimile No. 972-2-5651616		Authorized officer CHOVER Nimrod Israel  Telephone No. 972-5651692

## INTERNATIONAL SEARCH REPORT

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