

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO	
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DEP: 2020 DIRECCION DE NUEVAS CREACIONES	EVE: 1 REGISTRO/DEPOSITO/CONCESION/DEPOSITO
TRA: 3 PATENTES DE MODELO DE UTILIDAD	FOLIOS: 7
ACT: 519 PRESENTACION	

DIRECCIÓN DE NUEVAS CREACIONES

2020
Bogotá, D.C.,

Abogado(a)/Señor(a)
CARMEN AVILA CALDERON

Asunto: Radicación: 12-189443- -2
 Trámite: 3
 Evento: 1
 Actuación: 519
 Oficio: 21136
 Folios: 7

Patente de Invención				Patente de Modelo de Utilidad	X
Vía Nacional	X				
Vía PCT (Fase Nacional)		Capítulo I		Capítulo II	
No. Solicitud Internacional					
Fecha de Presentación Internacional					

Como resultado del Examen de Fondo realizado, con fundamento en el artículo 85 y en concordancia con el artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le comunica:

1. Documentos estudiados

Descripción:	Rad. N° 12-189443-00000-0000	24/Octubre/2012
Reivindicaciones:	Rad. N° 12-189443-00000-0000	24/Octubre/2012
Dibujos:	Rad. N° 12-189443-00000-0000	24/Octubre/2012

2. Objeto de la invención

En el presente documento se aplicará lo establecido en la Circular Única en su Título X, con respecto a que cuando la solicitud contenga más de diez (10) reivindicaciones y no se haya pagado la tasa complementaria, sólo se estudiarán las cubiertas por la tasa pagada al momento de realizar el examen de patentabilidad consagrado en el artículo 45 de la Decisión 486.

Título de la solicitud: “Mecanismo de funcionamiento motor tipo combustión interna sin necesidad de combustibles mediante resortes de compresión, sistema de encendido y para incrementar potencia mediante imanes accionados por electricidad y/o alambre de acero tirado con polea y/o polipasto” (modificado en el folio 145).

El problema planteado en esta solicitud, consiste en evitar el uso de combustibles fósiles en motores de combustión interna.

Para resolver este problema técnico, la solicitud en estudio propone un motor donde el movimiento de sus pistones es generado por la acción de unos electroimanes junto con un resorte de compresión.

El objeto de la presente Solicitud se relaciona con la Clasificación Internacional de Patentes (CIP): F 02 B 73/00.

3. Reivindicaciones relativas a un uso o a un segundo uso (Art 14 y 21 D 486)

Aunque la parte caracterizadora de la reivindicación 3 no contenga materia reclamable, debido a que ésta expone el funcionamiento del mecanismo conformado por la guaya (tal y como se expone en el numeral 4 de la presente comunicación) y, además, teniendo en cuenta que las únicas características técnicas de dicho mecanismo están expuestas en el preámbulo, son las características del preámbulo las que se tomaron en cuenta para realizar el examen de patentabilidad.

De acuerdo con lo anterior, un *“Mecanismo Conformado por una guaya y/o Cable de Acero unida al pistón y a la Tapa de un cilindro”* (sic), tomado como conjunto aislado, (teniendo en cuenta que la reivindicación 3 se presenta como independiente), ya había sido divulgado en el documento D3 que divulga un martillo utilizado en la perforación de suelo submarino. Cabe agregar, que el mecanismo reclamado no puede ser objeto de nueva patente, por el simple hecho de atribuírsele un uso distinto al originalmente comprendido por la patente inicial, de acuerdo con el Art 21 de la Decisión 486.

Sin embargo, es importante aclarar que esta objeción se realiza porque, de la forma como está redactado el capítulo reivindicatorio, no se logra identificar la configuración estructural de la creación reclamada en su totalidad, toda vez que cada una de sus características está expuesta en una reivindicación independiente diferente (lo anterior, será explicado en detalle en el numeral 4 de la presente comunicación). Con el fin de superar esta objeción, se sugiere al solicitante seguir las recomendaciones que se exponen en las objeciones de claridad para las reivindicaciones.

4. De la Solicitud de Patente

Titulo

El título, aunque está relacionado con el objeto de la solicitud, no expone de forma breve dicho objeto. De acuerdo con lo anterior, se sugiere al solicitante reemplazar el título por uno más conciso. Un ejemplo podría ser: “Mecanismo para el funcionamiento de motores, que comprende resorte de compresión, electroimanes y un dispositivo de poleas y guayas, instalados en cada uno de sus pistones.”

Reivindicaciones (Art 30 D 486, Art 22 PCT)

El capítulo reivindicatorio no es claro porque:

- 1- De la forma como está planteado el capítulo reivindicatorio se entiende que el solicitante quiere proteger cada componente del dispositivo reclamado separado, ya

que cada uno está definido en una reivindicación independiente diferente, de la siguiente manera:

Resorte en la reivindicación 1.

Imanes en la reivindicación 2.

Guaya, poleo o polipasto en la reivindicación 3.

Tapa de cilindros, resorte, imanes, polea o polipasto, entre otros. En la reivindicación 4,

Sin embargo, de la descripción se deduce que el objeto de la solicitud está relacionado con el mecanismo de funcionamiento para motores en su totalidad y no con cada uno de sus componentes por separado. Por lo tanto, se sugiere presentar en **una sola** reivindicación independiente, exponiendo todos los elementos estructurales (tangibles) del producto reclamado. De igual forma, es importante que en la redacción de esta reivindicación, el solicitante exponga la interacción estructural que hay entre los componentes de la invención. Un ejemplo de la nueva reivindicación podría ser: "Mecanismo para el funcionamiento de motores caracterizado por un resorte de compresión, cuyo primer extremo se ensambla en la superficie superior del pistón y su extremo restante se ensambla en la tapa del cilindro, el diámetro exterior de dicho resorte debe ser inferior en 4 mm al diámetro del pistón". También consta de electroimanes, uno de los cuales se dispone en la parte superior del pistón y el otro electroimán se dispone en la tapa del cilindro. Por otro lado, también contiene un dispositivo que comprende una guaya ensamblada en la parte superior del pistón y una polea instalada en la tapa superior del cilindro".

Se recomienda al solicitante seguir el ejemplo antes expuesto, ya que no contiene las objeciones de claridad que se exponen a continuación.

- 2- Con el fin de facilitar la identificación de las características técnicas reclamadas en los dibujos y en el resto de la solicitud, se sugiere al solicitante incluir los números de referencia de todas las características incluidas en las reivindicaciones. Se recomienda verificar que los números de referencia que se incluyan, concuerden con los presentados en la descripción y en los dibujos de la solicitud. Cabe agregar que expresiones como (Ver # 6 en Figura Representativa) no son permitidas, solo se permiten los números de referencia que acompañan a cada característica.
- 3- Los materiales, sus propiedades o sus especificaciones estándar no pueden ser objeto de protección vía modelo de utilidad. Lo anterior, debido a que en este tipo de patente solo se protegen las características constructivas del producto para el cual se solicita protección. Por ende, utilizar expresiones que hacen referencia a materiales, sus propiedades o especificaciones, como: *"el Resorte de Compresión es de Tipo Cilíndrico, Cerrado y Rectificado"* y *"y/o Cable de Acero"* no pueden ser incluidas dentro de la reivindicación independiente como una característica esencial de la invención. Cabe agregar que se pueden incluir como características particulares en reivindicaciones dependientes, pero no afectan el examen de patentabilidad. Se sugiere al solicitante mencionar dichas expresiones en reivindicaciones dependientes.
- 4- Las reivindicaciones no cumplen con lo establecido en el artículo 30 de la Decisión 486, debido a que contienen características técnicas que no están soportadas en la descripción. Dichas características son: *"Su Longitud Libre será igual al Diámetro entre el Punto Muerto Inferior del Pistón y el Borde Superior del Cilindro"* (reivindicación 1) y *"Temporizadores y/o Secuenciador"* y *"cables eléctricos"* (reivindicación 4). De acuerdo con lo anterior, se sugiere al solicitante incluir dichas características en la descripción.

Cabe agregar, que el término “*Diámetro*” no es claro, teniendo en cuenta que la distancia a la que refiere la expresión citada de la reivindicación 1 no corresponde a un círculo sino corresponde a una distancia lineal. De acuerdo con lo anterior, se sugiere al solicitante reemplazar dicho término por el término “*distancia*”.

Por su parte, las poleas, los imanes y las guayas son características que tampoco están debidamente soportadas, debido a que en los dibujos no se muestran estos elementos o no son fácilmente identificables en los mismos. Se sugiere al solicitante que muestre dichas características en los dibujos, de tal manera que reflejen la configuración estructural descrita en la descripción y en las reivindicaciones. Lo anterior, con el fin de que la modificación que se presente no amplíe la materia de la solicitud.

5- Las expresiones “*su configuración en cuanto a la Cantidad Total de Espirales, Numero (...) se Puede Adecuar a cada Uso y/o Especificación Técnica*” (reivindicación 1), “*diámetro de Acuerdo a especificaciones específicas para cada uso*” (reivindicación 3) y “*Mecanismos de Funcionamiento*” (reivindicación 4), son de carácter general y sugieren de forma imprecisa que la protección se extiende a otras posibles variaciones o modificaciones, lo que no permite comparar la creación reclamada con el estado de la técnica. Lo anterior, debido a que no mencionan los valores de las características del resorte o la guaya (número de espirales, diámetro de alambre, diámetro de cable etc.), ni tampoco es claro a qué mecanismos de funcionamiento se refiere. Debido a que el solicitante no presentó de forma clara lo anteriormente mencionado, se sugiere eliminar las expresiones citadas.

6- Las expresiones “*por ser Accionados Mediante Electricidad*”, “*El Funcionamiento de los Imanes es Secuencial y Proporcional al Funcionamiento de Los Pistones*” (reivindicación 2), “*porque es tirada por una Polea o Polipasto según la Secuencia de los Pistones y su Función es su Uso en el Encendido y Para Incrementar Potencia en el Motor*” (reivindicación 3), “*de funcionamiento secuencial para el funcionamiento de la Guaya y/o Cable de Acero*” (reivindicación 4); describen funciones, efectos, ventajas o resultados a alcanzar, de los elementos que componen la creación reclamada, los cuales no son aspectos susceptibles de patente. Como se mencionó anteriormente, el producto reclamado se debe definir técnicamente mediante sus características estructurales. Se sugiere al solicitante eliminar las expresiones citadas.

Finalmente, se sugiere al solicitante ver los Anexos 1 y 2 de la presente comunicación, los cuales muestran ejemplos guía para la presentación del capítulo reivindicatorio y el capítulo descriptivo.

Descripción (Art 28 D 486)

Al igual que para las reivindicaciones, se sugiere al solicitante incluir los números de referencia de las características incluidas en la descripción. Dichos números deben ser coherentes con los presentados en las reivindicaciones y los dibujos.

5. Determinación del Estado de la Técnica

El estado de la técnica se determinó con base en la fecha de presentación de la solicitud de patente nacional: octubre 24 de 2012, y se encontraron los siguientes documentos que anticipan el objeto de esta solicitud:

Item	Documento	Título	Fecha de Publicación
D1	US 6'552.450	'Reciprocating engine'	22/Abril/2003
D2	US 1'598.439	'Submarine hammer drill unit'	31/Agosto/1926

El documento D1 ¹ divulga un motor recíproco que comprende por lo menos un electroimán adherido a un pistón y por lo menos un electroimán adherido al cilindro (resumen).

El documento D2 ² divulga un martillo para la perforación de suelo submarino que comprende un dispositivo compuesto por una polea (d) que interactúa con la cuerda (c), para levantar el pistón (Fig. 1; Pág. 2, líneas 66 a 73).

6. Examen de Patentabilidad (Art 14 D486)

Novedad (Art 16 D486)

La reivindicación 1 consiste en un *“Mecanismo conformado por un Pistón, Resorte de Compresión Cilíndrico y Parte y/o Tapa Superior del Cilindro Caracterizado por que El Resorte de Compresión Cilíndrico se Fija al Pistón y a la Parte Superior y/o Tapa del Cilindro...”* (Ver página 13 incluida en el radicado bajo No. Rad. N° 12-189443-00000-0000).

Respecto a la reivindicación 1, cabe mencionar que aunque la configuración de motores con resortes de compresión es conocida en el estado de la técnica³, la característica novedosa radica en que el diámetro exterior del resorte *“deberá ser inferior en 4 mm al Diámetro del Pistón”*. De acuerdo con lo anterior, la reivindicación 1 es novedosa, sin embargo se recuerda al solicitante que no es clara toda vez que no permite identificar la configuración reclamada en su totalidad, por lo cual, se recomienda seguir las sugerencias expuestas en el numeral 4 de la presente comunicación.

La reivindicación 2 consiste en un *“Mecanismo Conformado por Imanes para Encendido y Para Incrementar potencia Caracterizados por ser Accionados Mediante Electricidad, los Cuales estarán Fijados al Pistón y a la Tapa del Cilindro, El Funcionamiento de los Imanes es Secuencial y Proporcional al Funcionamiento de Los Pistones”* (Ver página 13 incluida en el radicado bajo No. Rad. N° 12-189443-00000-0000).

Comparación de las características técnicas **esenciales**, con las del Estado de la Técnica:

Características esenciales	D1
Mecanismo conformado por imanes caracterizado por:	Motor caracterizado por:
Imanes fijados al pistón y a la tapa del cilindro.	Imán (3) fijado en la tapa del cilindro, Imán (4) fijado en la superficie superior del pistón (Fig. 1; Col. 2, líneas 59 a 65).

Las características **esenciales** del mecanismo de la reivindicación 1 habían sido divulgadas previamente en D1. En consecuencia, la reivindicación 2 no es nueva. Cabe agregar, que esta reivindicación fue afectable debido a que el mecanismo conformado por imanes fue reclamado de forma aislada en una reivindicación independiente. De acuerdo con lo anterior, se sugiere subsanar las objeciones de claridad expuestas en el numeral 4 de la presente comunicación.

1 <https://www.google.com/patents/US6552450?dq=6552450&hl=es&sa=X&ei=rvRmUqTYJ4PM9ATOoICQDg&ved=0CDoQ6AEwAA>

2 <https://www.google.com/patents/US1598439?dq=1598439&hl=es&sa=X&ei=iPRmUtuTE4j28wTn8oCYAQ&ved=0CEMQ6AEwAQ>

3 <https://www.google.com/patents/US4557228?pg=PA1&dq=4557228&hl=es&sa=X&ei=jfZmUqDTDIHq8gTT34GQDg&ved=0CDoQ6AEwAA>

La reivindicación 3 consiste en un *“Mecanismo Conformado por una guaya y/o Cable de Acero unida al pistón y la Tapa del Cilindro, diámetro de Acuerdo a especificaciones específicas para cada uso Caracterizadas porque es tirada por una polea o polipasto...”* (Ver página 13 incluida en el radicado bajo No. Rad. N° 12-189443-00000-0000).

Comparación de las características técnicas **esenciales**, con las del Estado de la Técnica:

Características esenciales	D2
Mecanismo caracterizado por:	Martillo caracterizado por:
Una guaya unida al pistón y la Tapa del Cilindro.	Una cuerda (c) unida a un pistón, la cual pasa por la parte superior de la estructura (H) (Fig. 1; Pág. 2, líneas 66 a 73).
Poleas o polipasto.	Polea (d) en la parte superior de la estructura H (Fig. 1; Pág. 2, líneas 66 a 73).

Como se mencionó en el numeral 3 de este documento, debido a que el mecanismo de poleas está reclamado de forma aislada, puede afectarse con un dispositivo que posea las mismas características, así se utilice en un campo técnico diferente al de la creación reclamada. Al igual que en los casos anteriores, se recuerda al solicitante que debe replantear el capítulo reivindicatorio de tal manera que pueda distinguirse la configuración estructural de la totalidad de la creación.

De acuerdo con lo expuesto, las características **esenciales** del mecanismo de la reivindicación 3 habían sido divulgadas previamente en D2.

La reivindicación 4 consiste en una Tapa de cilindros *“...Caracterizada por que en ella se Fijan los Resortes de Compresión, además se Fijan a ella los Imanes Accionados por Electricidad...”* (Ver página 13 incluida en el radicado bajo No. Rad. N° 12-189443-00000-0000).

En lo que tiene relación con la reivindicación 4, cabe mencionar que es la más cercana a describir la creación reclamada en su totalidad. Sin embargo, solo se enfoca en incluir los elementos que se fijan a la tapa, sin mencionar al pistón o especificar qué elementos también están fijados a éste. Teniendo en cuenta que dicha reivindicación es la más cercana a describir la totalidad del mecanismo, no pudo ser afectada y por lo tanto se considera novedosa. No obstante, tal y como se mencionó anteriormente, tampoco expone la configuración total del mecanismo reclamado, por lo que se reitera la sugerencia de replantear el capítulo reivindicatorio.

Conclusión

Los requisitos de Patentabilidad de la presente Solicitud están afectados así:

Ítem	Documento	Reivindicaciones afectadas	Requisito que afecta
D1	US 6'552.450	2	Novedad
D2	US 1'598.439	3	Novedad

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que debe dar respuesta dentro del término de treinta (30) días contados a partir del día siguiente de la fecha de notificación de la presente comunicación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

Se invita al solicitante se sirva indicar, si así lo considera, su renuncia al término faltante de treinta (30) días para dar respuesta a este requerimiento y presentarla por escrito.

Finalmente, se le recuerda al solicitante que si como respuesta a este requerimiento llegara a modificar el capítulo reivindicatorio y éste contenga más de diez (10) reivindicaciones, no pagará la tasa de modificación voluntaria pero sí la correspondiente al pago por reivindicación adicional.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única No. 10 de 2001.



JOSÉ LUIS SALAZAR LÓPEZ
Director de Nuevas Creaciones (c)

El anterior requerimiento fue notificado por fijación en lista, de fecha 2013-11-12

Elaboró: Monica Andrea Gutierrez Almonacid
Revisó: Rosa Patricia Tellez Chavarro



US006552450B2

(12) **United States Patent**
Harty et al.

(10) **Patent No.:** **US 6,552,450 B2**
(45) **Date of Patent:** **Apr. 22, 2003**

(54) **RECIPROCATING ENGINE**

4,507,579 A * 3/1985 Turner 310/23
5,457,349 A * 10/1995 Gifford 310/24

(76) Inventors: **William Thomas Harty**, PO Box 311,
Milk River, Alberta (CA), T0K 1M0;
John Thomas Harty, PO Box 790,
Milk River, Alberta (CA), T0K 1M0

* cited by examiner

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

Primary Examiner—Nestor Ramirez

Assistant Examiner—Iraj A Mohandesi

(74) *Attorney, Agent, or Firm*—I. Zborovsky

(21) Appl. No.: **09/878,228**

(22) Filed: **Jun. 12, 2001**

(65) **Prior Publication Data**

US 2002/0185920 A1 Dec. 12, 2002

(51) **Int. Cl.**⁷ **H02K 33/00**; H02K 7/06

(52) **U.S. Cl.** **310/16**; 310/16; 310/20;
310/12; 310/15

(58) **Field of Search** 310/16, 24, 12,
310/13

(56) **References Cited**

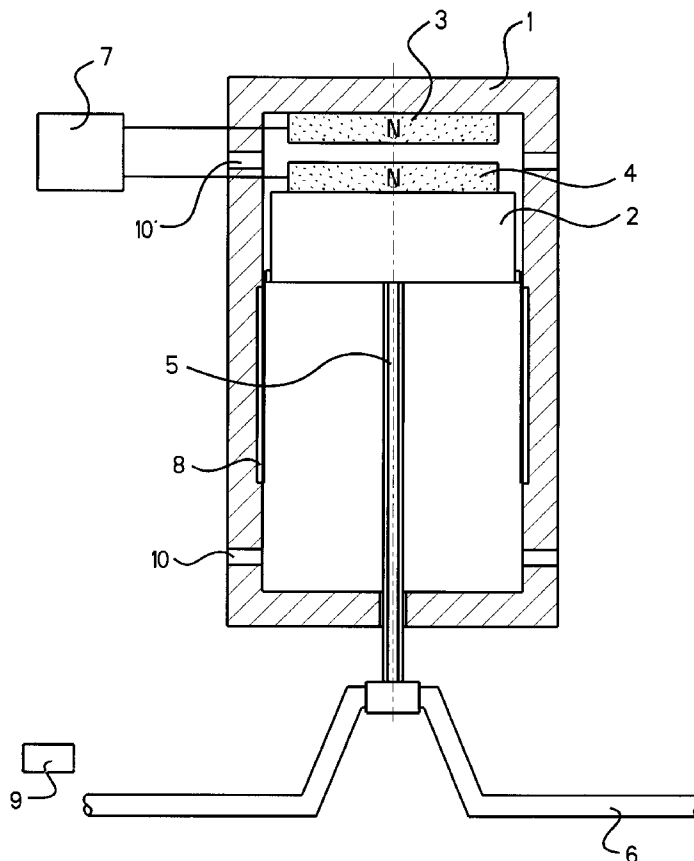
U.S. PATENT DOCUMENTS

3,967,146 A * 6/1976 Howard 310/80

(57) **ABSTRACT**

A reciprocating engine has at least one cylinder forming an inner chamber, at least one piston reciprocatingly movable in the inner chamber of the at least one cylinder, a unit for converting a reciprocating movement of the piston to move an outside object, a unit for reciprocatingly moving the at least one piston in the at least one cylinder the reciprocatingly moving unit including magnet elements with at least one electromagnet connected with the cylinder and at least another electromagnet connected with the piston, so that when a polarity of the magnet elements is changed, a magnetic interaction of the electromagnets with one another causes the reciprocating movement of the piston.

10 Claims, 3 Drawing Sheets



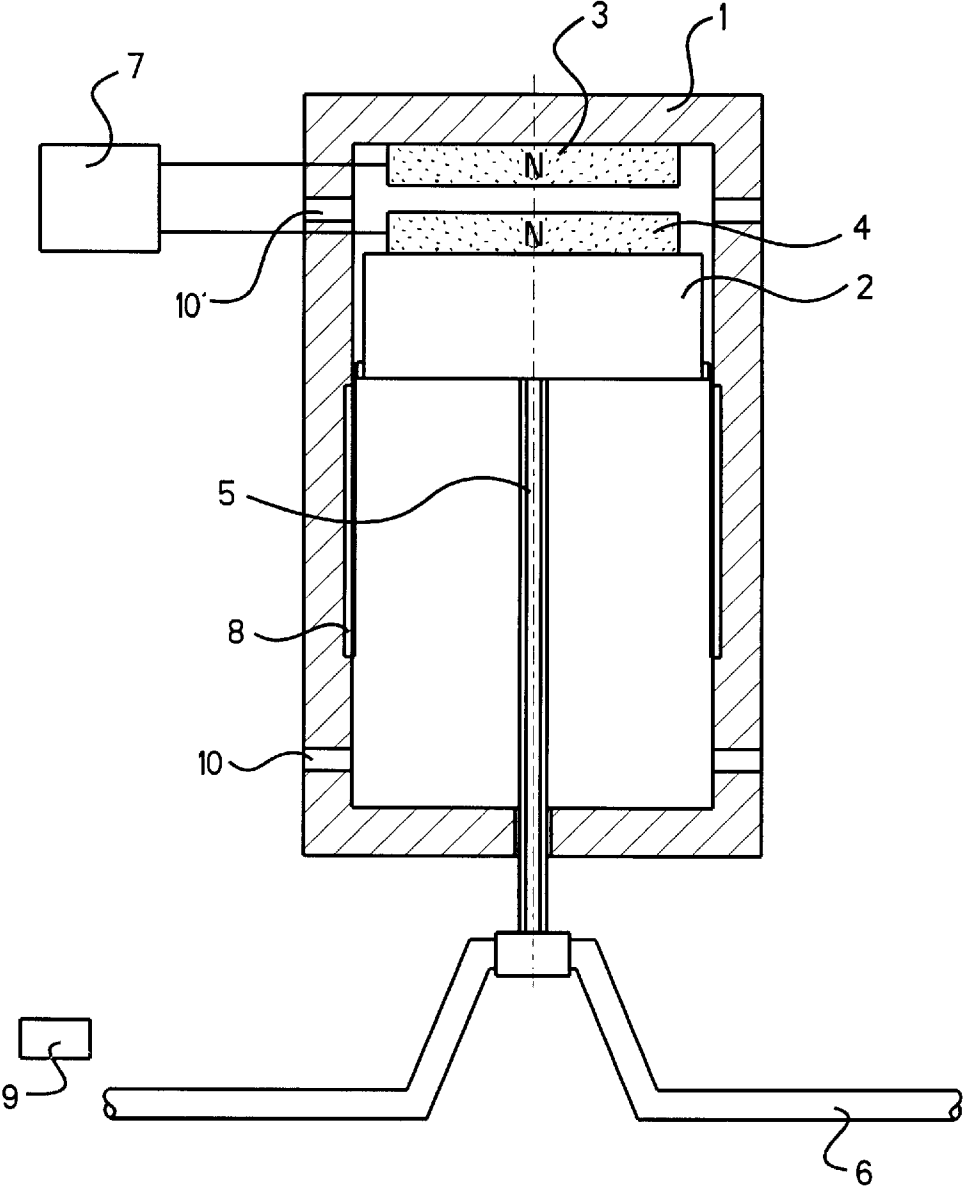


FIG. 1

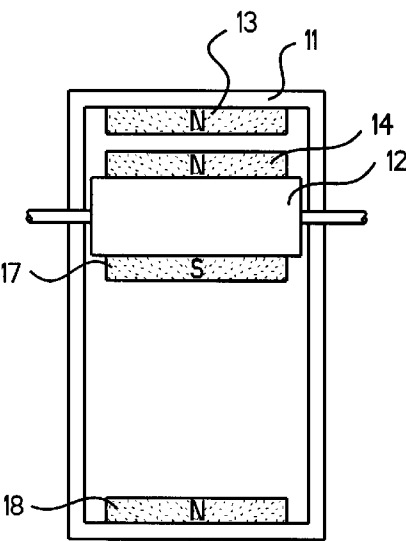


FIG. 2

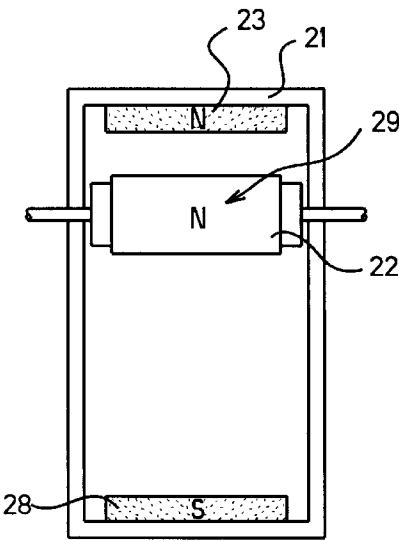


FIG. 3

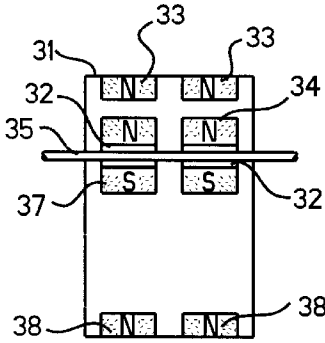


FIG. 4a

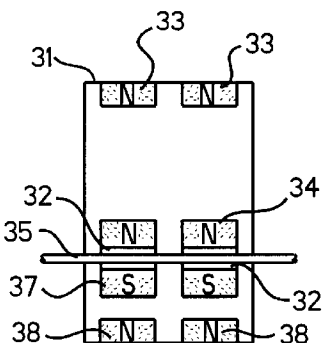


FIG. 4b

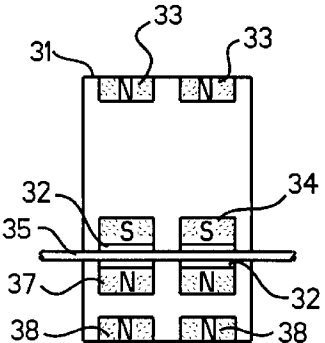


FIG. 4c

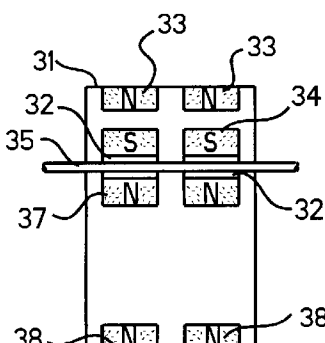


FIG. 4d

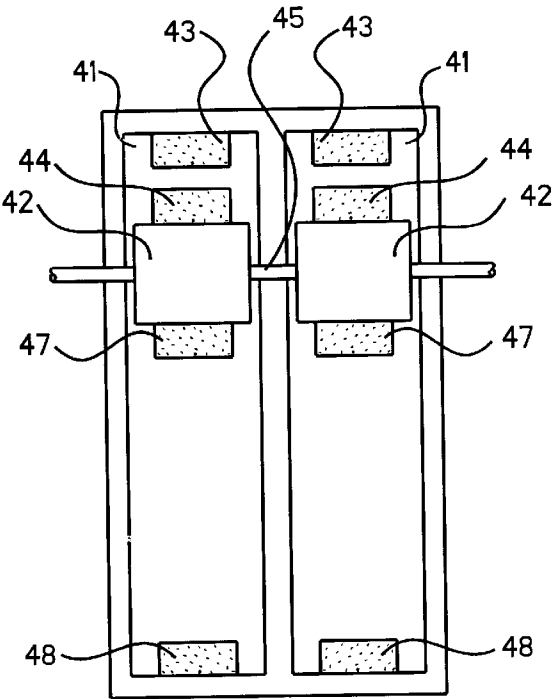


FIG. 5

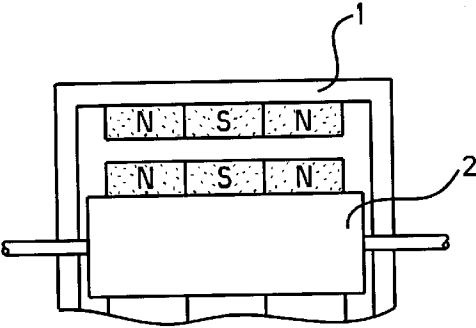


FIG. 6

RECIPROCATING ENGINE

BACKGROUND OF THE INVENTION

The present invention relates to reciprocating engines.

More particularly it relates to reciprocating engines in which a reciprocating movement of the piston is performed under the action of a magnet cooperation between magnet means of the cylinder and the piston.

Reciprocating engines of the above mentioned general type are known in the art. In the known reciprocating engines an electromagnet and a permanent magnet are utilized. By using the permanent magnet and the electromagnet, the maximum power is only achieved when they are matched in strength. When an electromagnet becomes weaker or stronger than the permanent magnet, the attraction and repulsion are not as efficient. Some of the solutions in the reciprocating engines are disclosed for example in U.S. Pat. Nos. 1,436,425; 3,105,162; 4,523,114; 5,036,930; 5,219,034; 4,317,058; 5,592,036; and the European patent document EP 0596717. It is believed that the existing reciprocating engines of this type can be further improved.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a reciprocating engine which is a further improvement of the existing engines.

In keeping with these objects and with others which will become apparent hereinafter, one feature of the present invention resides, briefly stated, in a reciprocating engine which has at least one cylinder forming an inner chamber; at least one piston reciprocatingly movable in said inner chamber of said at least one cylinder; means for converting a reciprocating movement of said piston to move an outside object; means for reciprocatingly moving said at least one piston in said at least one cylinder, said reciprocatingly moving means including electromagnet means with at least one electromagnet connected with said cylinder and at least another electromagnet connected with said piston, so that when a polarity of said magnet means is changed, a magnetic interaction of said electromagnets with one another causes said reciprocating movement of said piston.

When the reciprocating engine is designed in accordance with the present invention the electromagnets of the cylinder and the piston are evenly matched in polarity and strength to apply a reciprocating force by reversing polarities to successively attract and repel the piston in the cylinder, which piston is connected to a crankshaft to produce a rotary power.

In accordance with one embodiment of the invention, the piston and the cylinder each have one electromagnet and the polarities are switched so that the electromagnet of the cylinder repels and then attracts the electromagnet of the piston.

In accordance with another embodiment of the present invention the cylinder has two electromagnets located at opposite ends and the piston has also two electromagnets located at opposite sides, so that one electromagnet of the cylinder repels one electromagnet of the piston while the other electromagnet of the cylinder attracts the other electromagnet of the piston and vice versa.

In accordance with still a further embodiment of the present invention the cylinder can have two electromagnets which are located opposite to one another, while the piston

has only one electromagnet. The reciprocating movement of the piston is achieved by repelling the electromagnet of the piston with one electromagnet of the cylinder and attracting the electromagnet of the piston with the other electromagnet of the cylinder, and vice versa.

In accordance with still a further feature of the present invention each cylinder can have two pistons with two electromagnets, connected with one another for joint reciprocating movement.

In accordance with still a further feature of the present invention two cylinders can be provided with electromagnets, and two pistons provided with electromagnets can be connected with one another so that they jointly reciprocate in the two cylinders. Therefore if the magnetic system of one of the cylinders fails, the magnetic system of the other cylinder causes reciprocation of both pistons in both cylinders.

In accordance with still a further feature of the present invention, air which is displaced under the piston moving in a predetermined direction is relieved to flow outside and to be used for various purposes, for example for cooling of the engine.

The novel features which are considered as characteristic for the present invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view showing a reciprocating engine in accordance with one embodiment of the present invention;

FIG. 2 is a view showing the inventive reciprocating engine in accordance with another embodiment of the present invention;

FIG. 3 is a view showing the inventive reciprocating engine in accordance with still another embodiment of the present invention;

FIGS. 4a-4d are views showing the reciprocating engine in accordance with a further embodiment of the present invention in four different positions;

FIG. 5 is a view showing the inventive reciprocating engine in accordance with an additional embodiment of the present invention; and

FIG. 6 shows a further modification of the inventive reciprocating engine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A reciprocating engine in accordance with the present invention has at least one cylinder is identified as a whole with reference numeral 1 and limits an inner chamber. The reciprocating engine further has a piston which is identified with reference numeral 2 and reciprocates in the inner chamber of the cylinder 1. For this purpose electromagnet means are provided in the inventive reciprocating engine. The electromagnet means include an electromagnet 3 which is immovably connected with the cylinder, for example with an upper wall of the cylinder, and an electromagnet 4 which is immovably connected with the piston, 2 for example with the upper surface of the piston. The piston 2 is connected with means for converting its reciprocating movement into a rotary movement. Such converting means can include a

connecting rod 5 and a crankshaft 6. Means 7 are further provided for switching a polarity of the electromagnets of the inventive reciprocating engine, which can be formed as known control means.

The reciprocating engine in accordance with the present invention operates in the following manner:

In the initial position shown in FIG. 1 the piston 2 is located in its upper position which is close to the upper wall of the cylinder 1, and the electromagnet 3 and 4 have opposite polarities so that the electromagnet 4 of the piston 2 is attracted to the electromagnet 3 of the cylinder 1. Then the polarity switching means 7 change the polarity of at least one of the electromagnets, for example of the electromagnet 4 of the piston 2, so that the electromagnets 3 and 4 of the cylinder 1 and the piston 2 now have the same polarities. As a result the electromagnet 4 of the piston 2 will be repelled from the electromagnet 3 of the cylinder 1 and the piston 2 will move downwardly in FIG. 1. At the end of the stroke of the piston 2 downwardly, the polarity of the electromagnet 4 is changed again so that now the electromagnets 3 and 4 have different polarities. As a result the electromagnet 4 of the piston 2 is attracted to the electromagnet 3 of the cylinder 1 and the piston 2 is moved upwardly. This cycle repeats many times so as to provide a continuous reciprocating movement of the piston 2 in the cylinder 1, which is converted through the connecting rods 5 and the crankshaft 6 into a rotary movement.

The reciprocating engine in accordance with a second embodiment is shown in FIG. 2. The parts of this engine which are similar to the parts of the engine shown in FIG. 1 are identified with reference numerals which are increased by 10. In addition to the electromagnet 13 provided on the one end of the cylinder 11 and the electromagnet 14 provided on the one side of the piston 12, the reciprocating engine has another electromagnet 17 provided on the opposite side of the piston 12 and another electromagnet 18 provided on the opposite end of the cylinder 11. Thus, the reciprocating engine of the embodiment shown in FIG. 2 has two pairs of the electromagnets. The reciprocating engine shown in FIG. 2 operates in the following manner. The polarities of the electromagnets are controlled so that when the electromagnet 13 of the cylinder 11 attracts the electromagnet 14 of the piston 12, the electromagnet 18 at the opposite end of the cylinder 11 repels the electromagnet 17 at the opposite side of the piston 12. Thereafter the polarities are reversed. Therefore the piston 12 is subjected to the repelling-attracting forces from both sides of the piston.

Another embodiment of the reciprocating engine in accordance with the present invention is shown in FIG. 3. Here the piston 22 has only one electromagnet 29 while the cylinder 21 has two electromagnets 23 and 28 arranged at opposite ends of the cylinder. The polarities of the electromagnets are controlled so that the electromagnets 23 and 28 always have opposite polarities, and the electromagnet 29 of the piston 22 has a certain polarity. For example, the electromagnet 23 has the same polarity with the electromagnet 29 so as to repel the electromagnet 29 of the piston 22, while the electromagnet 28 has an opposite polarity so as to attract the electromagnet 29 of the piston 22 and the piston moves downwardly in FIG. 3. Then the polarities are correspondingly switched, and the electromagnet 29 of the piston 22 is repelled from the electromagnet 28 and is attracted to the electromagnet 23 of the cylinder 21 to move upwardly.

It is to be understood that switching of the polarities can be performed in different ways. In particular, it is possible to

switch the polarity of the electromagnet (electromagnets) exclusively on the cylinder, or to switch the electromagnet (electromagnets) exclusively on the piston, or both.

FIGS. 4a-4d show another modification of the inventive reciprocating engine in which two pistons 32 move in one cylinder 31 and are connected with one another by a connecting rod or pin 35. Each piston, as in the embodiment of FIG. 2 has two electromagnets 34 and 37 provided on its opposite sides, and the cylinder has electromagnets 33 and 38 provided on its opposite ends. By switching of the corresponding polarities, the electromagnets of both pistons are simultaneously repelled from the electromagnets at one end of the cylinder and are attracted by the electromagnets at the other end of the cylinder to perform a stroke in one direction, and thereafter the polarity is switched so as to perform the stroke in the opposite direction. In FIG. 4a the electromagnets 34 of the pistons 32 are close to the electromagnets 33 at the upper end of the cylinder 31 before switching a polarity, and then when the polarity is switched the pistons move downwardly. In the position shown in FIG. 4b the electromagnets 37 of the pistons 32 are attracted to the electromagnets 38 at the lower end of the cylinder. In the position shown in FIG. 4c the polarity is switched so that the electromagnets 37 of the pistons 32 are repelled from the electromagnets 38 at the lower end of the cylinder 31. In the position shown in FIG. 4d the electromagnet 34 again reach the position in which they are close to the electromagnets 33 of the upper end of the cylinder 31. In this embodiment the connecting rod or pin 35 is connected to the crankshaft.

The reciprocating engine in accordance with the embodiment shown in FIG. 5 has two cylinders which are identified with reference numerals 41 and two pistons 42 reciprocating in the corresponding cylinders 41. The pistons 42 are connected with one another by a connecting rod or pin 45. The operation of the reciprocating engine shown in FIG. 5 is substantially similar to the operation of the reciprocating piston shown in FIGS. 4a-4d. Both pistons 42 have electromagnets 44, 47 at their opposite sides, and both cylinders 41 have electromagnets 43, 48 at their opposite ends. The electromagnets at one end of the both cylinders 41 repel the electromagnets of both pistons 42, while the electromagnets at the opposite end of the cylinders 41 attract the electromagnets of the pistons 42, and thereafter the polarity is switched, to provide a continuous reciprocating movement of the pistons 42 in two cylinders. This construction has the advantage that if the electromagnet means in one cylinder failed, both pistons still will perform the reciprocating movement as long as the electromagnet means in the other cylinder operate in a normal manner.

The polarity switching means can operate in response to sensing a position of the piston, related elements for example a position of the crankshaft. For this purpose a sensor 9 can be associated with the crankshaft 6 as shown in FIG. 1. It senses a position of the crankshaft 6 and sends the signal to the polarity switching means 7, so as to switch the polarity. It is to be understood that sensing means can be associated with other movable parts of the piston-connecting rod-crankshaft assembly.

In accordance with the present invention, means 10, 10' can be provided for releasing air displaced by the piston during a corresponding stroke. This air releasing means can be formed as corresponding openings. When the piston moves in a certain direction, air in front of the piston is displaced and expelled through the respective opening. This air can be used for cooling corresponding parts of the engine.

Means can be provided for controlling the power and timing of the electromagnets, and the output power, so that

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the output power of the engine can be controlled with great precision. The timing can be controlled either mechanically or by a computerized timing device.

In the inventive reciprocating engine, a gap can be left at the end of a stroke of the piston so that no damage can occur to the electromagnets by their contact with one another. The gaps should be adjustable for the purpose of maximizing the power.

The electromagnets mounted on the pistons can be energized for example by contact strips embedded in the cylinder wall, transferring power through a brush to the electromagnets, as shown schematically in FIG. 1 and identified with reference numeral 8.

It is to be understood that electromagnets can be formed in many different ways. For example as shown in FIG. 6, each electromagnet can have several pole regions, such as N,S,N . . . etc.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in reciprocating engine, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention. Patent is set forth in the appended claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. A reciprocating engine, comprising at least one cylinder forming an inner chamber; at least one piston reciprocatingly movable in said inner chamber of said at least one cylinder; means for converting a reciprocating movement of said at least one piston to move an outside object; means for reciprocatingly moving said at least one piston in said at least one cylinder, said reciprocatingly moving means including magnet means with at least one electromagnet connected with said cylinder and at least another electromagnet connected with said piston, so that when a polarity of said magnet means is changed, a magnetic interaction of said electromagnets with one another causes said reciprocating movement of said piston; and means for allowing air to move out of said cylinder when air is displaced by said reciprocating movement of said piston in front of said piston and to move air into said at least one cylinder behind said piston.

2. A reciprocating engine as defined in claim 1; and further comprising means for changing a polarity of said magnet means so that said electromagnets initially have same polarities and therefore said electromagnet connected with said piston is repelled from said electromagnet connected with said cylinder and move said piston away from a corresponding portion of said cylinder, while when a polarity is changed said electromagnet of said cylinder

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attracts said electromagnet of said piston and therefore said piston moves toward said portion of said cylinder.

3. A reciprocating engine as defined in claim 1, wherein said magnet means include two further electromagnets with one further electromagnet connected to said cylinder and another of said further electromagnets connected to said piston, said electromagnets of said cylinder being mounted at opposite ends of said cylinder, while said electromagnets of said piston being mounted at opposite sides of said piston, said switching means being formed so that when one of said electromagnets connected with said cylinder attract one of said electromagnets connected with said piston the other of said electromagnets connected with said cylinder repel the other of said electromagnets connected with said piston.

4. A reciprocating engine as defined in claim 1, wherein said magnet means further have another electromagnet connected with said cylinder, said electromagnets connected with said cylinder being mounted at opposite ends of said cylinder, said means for switching polarity being operative so that one of said electromagnet of said cylinder repel said electromagnet of said piston, while the other electromagnet of said cylinder attracts said electromagnet of said piston, and when the polarity is switched the other electromagnet of said cylinder repels said electromagnet of said piston and the one electromagnet of said cylinder attracts said electromagnet of said piston.

5. A reciprocating engine as defined in claim 1; and further comprising another piston reciprocatingly movable in said at least one cylinder and provided with an electromagnet; and means for connecting said pistons with one another, so that said electromagnet of said cylinder simultaneously magnetically interacts with both said electromagnets of said both pistons.

6. A reciprocating engine as defined in claim 1; and further comprising another cylinder provided with another electromagnet and another piston movable in said another cylinder and provided with another electromagnet, said pistons of said cylinders being connected with one another for joint reciprocating movement, so that if said magnet means in one of said cylinders fail, said magnet means in the other of said cylinders operate and provide reciprocating movement of both said pistons in both said cylinders.

7. A reciprocating engine as defined in claim 1, wherein said allowing means is formed so as to supply the air moved out of said cylinder for cooling of the reciprocating engine.

8. A reciprocating engine as defined in claim 1, wherein said polarity switching means include sensor means sensing a position of said at least one piston, and control means operative in response to a signal produced by said sensor and changing a polarity of said magnet means.

9. A reciprocating engine as defined in claim 8; and further comprising a crankshaft connected with said at least one piston, said sensing means being formed as a sensor which senses a position of said crankshaft.

10. A reciprocating engine as defined in claim 1, wherein said switching means is formed so that during a movement of said at least one piston in one direction a gap remains between said electromagnet of said piston and said electromagnet of said cylinder preventing a direct contact of said electromagnets of said piston and said cylinder.

* * * * *

Aug. 31, 1926.

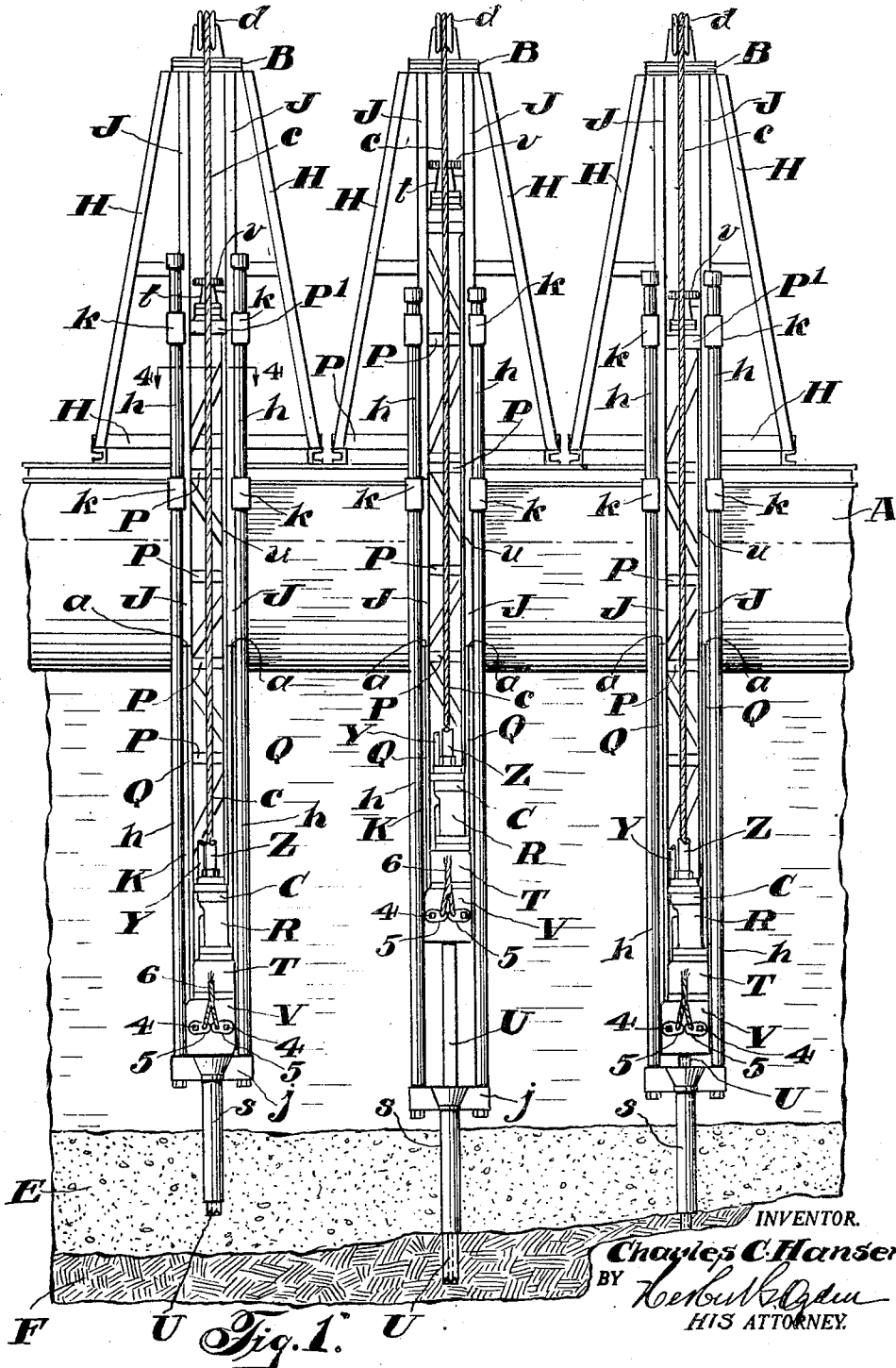
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C. G. HANSEN

SUBMARINE HAMMER DRILL UNIT

Original Filed August 24, 1925

3 Sheets-Sheet 1



Aug. 31, 1926.

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C. C. HANSEN

SUBMARINE HAMMER DRILL UNIT

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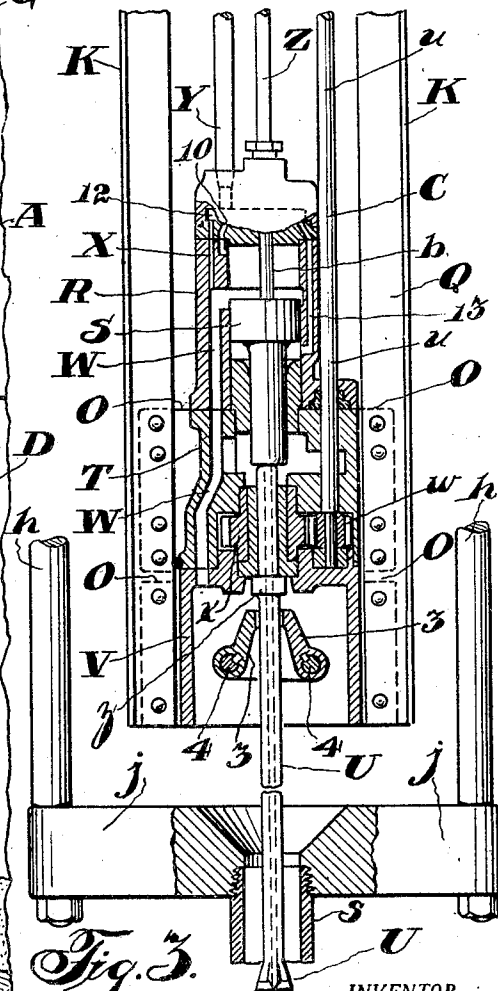
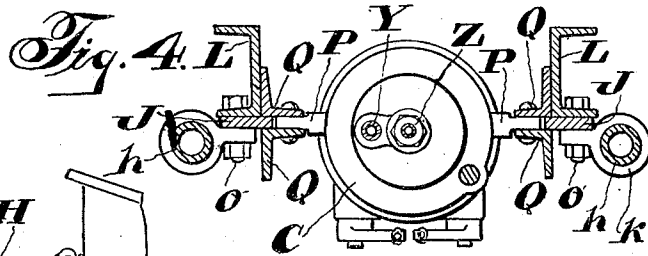
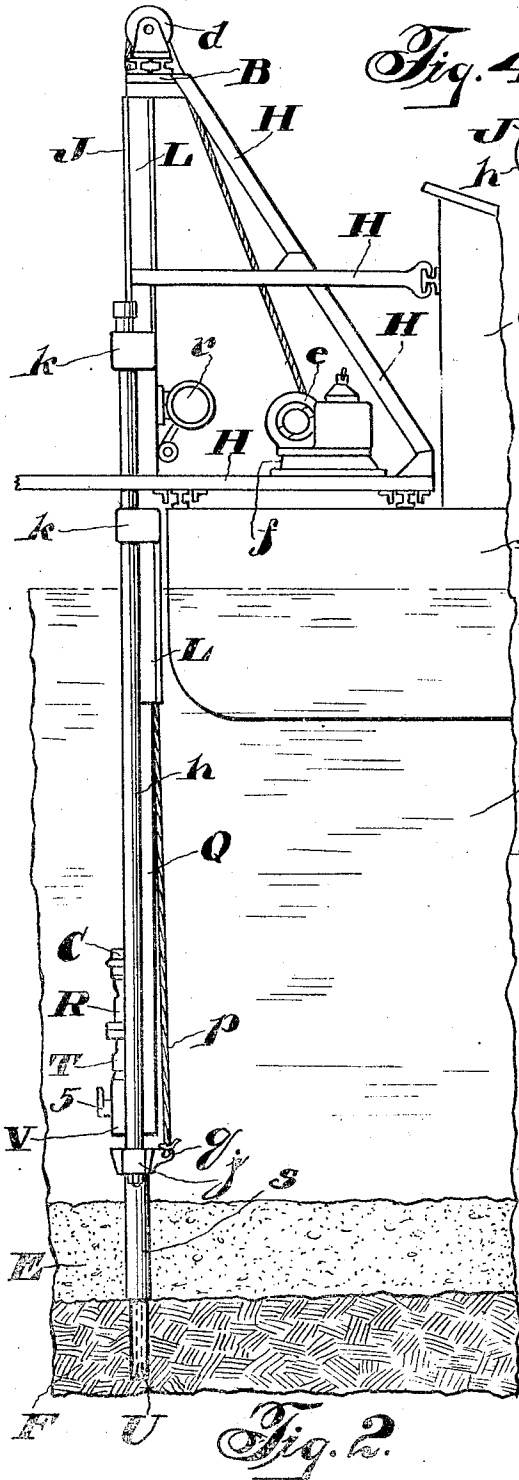


Fig. 3.

INVENTOR.
Charles C. Hansen
BY *Herbert K. Ogden*
HIS ATTORNEY.

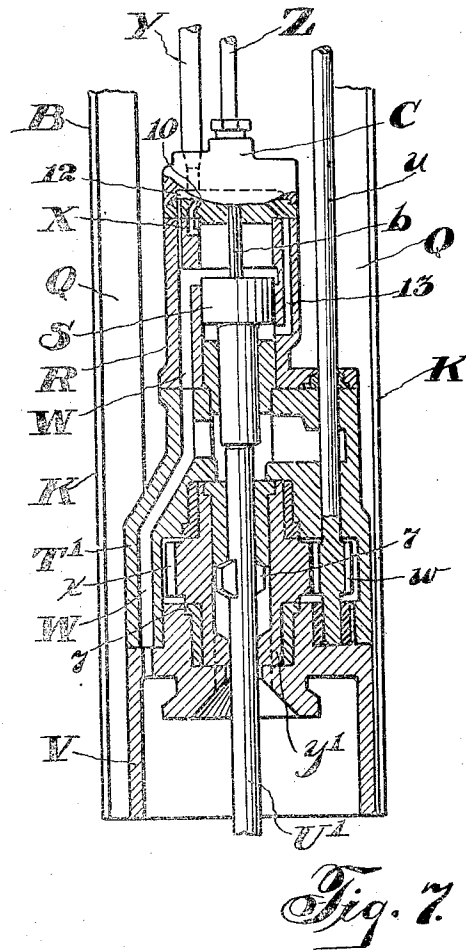
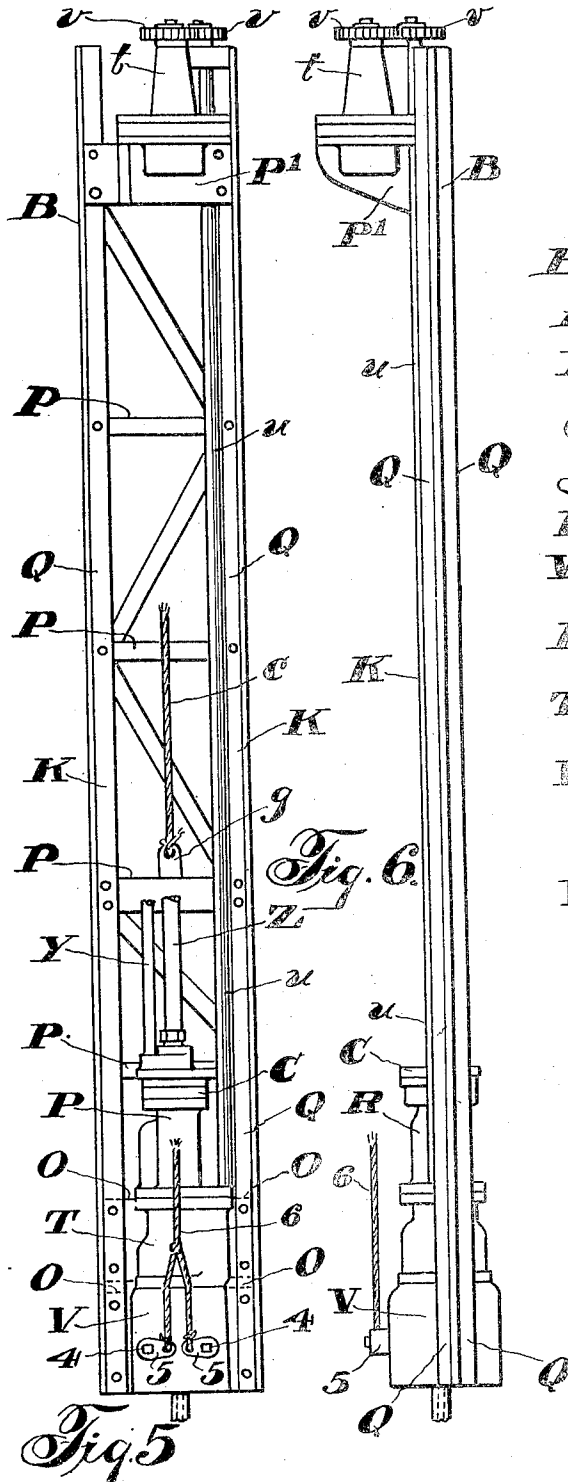
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C. C. HANSEN

SUBMARINE HAMMER DRILL UNIT

Original Filed August 24, 1925 3 Sheets-Sheet 3



INVENTOR.
Charles C. Hansen.
 BY *Herbert C. Hansen*
 HIS ATTORNEY.

UNITED STATES PATENT OFFICE.

CHARLES C. HANSEN, OF EASTON, PENNSYLVANIA, ASSIGNOR TO INGERSOLL-RAND COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

SUBMARINE HAMMER-DRILL UNIT.

Original application filed August 24, 1925, Serial No. 52,136. Divided and this application filed March 19, 1926. Serial No. 96,101.

This invention is a division of my copending application, Serial No. 52,136, filed August 24, 1925.

This invention relates to submarine drills, but more particularly to a submarine hammer drill unit, in which a fluid actuated rock drill of the hammer type is lowered into the water and effects the drilling operations while submerged. The rock drill may be raised for changing steels as the depth of the drilled hole increases, and the entire operation of submarine drilling is carried out by substantially the same mode of operation which obtains on land with drills of the hammer type.

The objects of the invention are to obviate the great length of steel required with ordinary submarine drills of the percussive or reciprocating piston type, commonly known as piston drills, as distinguished from hammer drills, avoid the necessity of high towers on the drill barge, reduce the weight of the drilling units, lighten the labor of the drill operators and simplify and cheapen the cost of the entire operation of submarine drilling.

To all these ends the invention is shown in one of its preferred forms in the accompanying drawings, in which—

Figure 1 is a side elevation partly broken away and partly in section showing a portion of a barge having submarine hammer drills mounted thereon. Three positions of the drill steel are shown;

Figure 2 is an end elevation of the barge and machines shown in Figure 1;

Figure 3 is an enlarged detail sectional elevation partly broken away showing the submarine hammer drill cylinder and including the rotation mechanism for the drill steel and the submarine front head bell. In this view the drill steel is in the act of being lowered into the mud guard or protective shield which is projected through the loose material and broken rock down to the submerged rock or hard material layer to be drilled;

Figure 4 is an enlarged detail transverse sectional view partly broken away taken on line 4—4 of Figure 1;

Figure 5 is an enlarged detail side elevation of the vertically slidable drilling element or frame carrying the hammer drill and rotation mechanism;

Figure 6 is an end view of the drilling element shown in Figure 5; and

Figure 7 is an enlarged detail sectional elevation partly broken away of a modification showing the hammer cylinder provided with a lug chuck to take lugged steel.

Referring to the drawings, the barge A, only a portion of which is shown, may be of any suitable or usual construction for submarine drilling and is adapted to have mounted thereon one or more submarine drilling units B as shown in Figure 1, in this instance three being shown, and each unit being provided with the submarine rock drill C of the hammer type adapted to be submerged in the water D during the operation of drilling. The loose material and broken rock usually lined in the bed of a river or on the bed of any body of water is represented at E and the rock or hard material to be drilled is represented at F.

The barge A may be provided with the usual shed or housing or several sheds or housings G for sheltering the usual compressors, engines, pumps, implements and tools required for submarine drilling, although, for purposes of simplicity, these particular engines and machines are not shown, it being understood that the rock drills C forming a part of this invention are preferably adapted to be operated by motive fluid, as for instance compressed air, in which case a compressor or compressors would be required.

Each submarine drilling unit of the hammer type, as shown, is provided with a main frame H of any suitable construction preferably in the form of a tower of moderate height and having guides J which may be in the form of plates extending downwardly a sufficient distance, as for instance to the points a, to form guides for the drilling element or frame K shown separately in Figures 5 and 6, which element or drilling frame is slidable vertically on the guides J, but is preferably of sufficient length so that the upper end of the drilling frame remains out of water and is never submerged during the operation of drilling.

The guides J are conveniently secured to the channels L forming a part of the main frame H and the drilling frame is formed with the side plates O and cross braces P

to which angle irons Q are secured, thus forming guide channels into which the guide plates J extend so that the drilling frame may be guided on the guides.

5 A fluid actuated rock drill of the hammer type is suitably secured to the lower end of the drilling frame or element K and preferably comprises the cylinder R containing the reciprocating hammer piston S, the separable front head T containing the chuck parts of rotation mechanism for the drill steel U which is preferably a hollow steel so that cleansing fluid may be supplied through the steel, and a bell V into which the exhaust of the rock drill passes through the exhaust passage W in any suitable manner so that water is prevented from entering the rock drill parts. The hammer piston S may be operated automatically in any suitable manner, as is customary with hammer drills, in this instance live pressure fluid being supplied to the rearward end of the cylinder R through the port 10 leading from the valve chamber 12 for driving the piston forwardly, and is supplied to the forward end of the cylinder through the passage 13 for driving the piston rearwardly, while the exhaust passes forwardly through the exhaust passage W. Any suitable valve (not shown) may be provided in the valve chamber 12, since these elements form no part of the present invention. The pressure fluid supply pipe Y is understood to be controlled by any suitable form of main valve, to turn on and off the air from the main line, and the rock drill itself would be provided with the usual throttle (not shown) for controlling the starting and stopping of the operation of the hammer piston. The efficiency of the submarine hammer piston is maintained by operating at higher air pressure from the supply than on land, due to the back pressure. It will also be observed that the chuck cavity into which the shank of the drill steel extends is subject to exhaust pressure because of the loose fit of the drill steel shank in the chuck and because of access through other front head parts which further aid in keeping water out of the rock drill. A small bleeder port X is also preferably formed in the cylinder R leading from the pressure supply pipe Y and valve chamber 12 to the exhaust passage W so that live pressure fluid is constantly supplied to the bell which aids in keeping the water out of the rock drill parts as the machine is being lowered beneath the water and before the drill starts in operation and during submergence and operation. The air through the small bleeder port X is not sufficient to start the drill alone. Cleansing water is supplied to the rock drill in the usual manner through the water supply pipe Z and water tube 3 which pipes are adapted to be carried in any suitable manner to the drill barge A

as for instance, through hose pipes and there supplied with air and water respectively under pressure. The drilling frame K is adapted to be raised and lowered by means of the rope or cable *c* passing upwardly over the sheave *d* at the top of the main frame H and connected to be operated by any suitable winding engine *e* having the frame *f*. This lifting and lowering cable *c* may be connected to one of the plates P of the drilling frame at the point *g*.

A supplemental frame formed by the rods *h* and the foot piece *j* to which the rods are suitably connected is vertically slidable in the brackets *k* carried by the main frame H and conveniently secured to the guide plates P as by means of the bolts *o* shown particularly in Figure 4. A rope or cable *p* connected to the foot piece *j* of the supplemental frame at the point *q* passes upwardly over a small winding engine *r* of any suitable type supported from the main frame H as shown in Figure 2, so that the drilling frame or element K and the supplemental frame formed by the members *h* and *j* are independently vertically movable and adjustable. The supplemental frame carries a tubular mud guard or protective shield *s* which is adapted to be forced through the loose or broken material E on top of the rock F for the purpose of protecting the drill steel and the hole to be drilled. By reason of the construction described, a convenient method of forcing or driving the mud guard *s* down into the rock is that indicated in Figure 1 in which the supplemental frame *j* is first lowered until the mud guard is within the material E and then the drilling frame K is lowered until the weight of the frame and the parts carried thereby rests upon the foot piece *j*. A short length of drill steel U preferably projects through the mud guard *s* as shown in the drill unit at the left hand side of Figure 1. The operation of the hammer drill is then started and cleansing water is at the same time forced down through the drill steel through the pipe Z. The weight of the drilling frame and its parts together with the vibration caused by the operation of the hammer and the cleansing effect of the water forced down through the drill steel will quickly drive or thrust the mud guard through the loose or broken material E until the mud guard rests upon hard surface or rock F to be drilled. The drilling frame is then raised and a longer drill steel inserted and again lowered for the operation of drilling the hole *s* indicated in the central drilling unit in Figure 1. The drilling unit at the right hand side of Figure 1 indicates the drilled hole as about completed, it being assumed that the longest length of drill steel U necessary for this purpose has been used.

In order that the rotation of the drill

steel may be at all times observed from a point above the surface of the water on the barge A, independent rotation is applied to the drill steel operated by a suitable motor t carried on the bracket P' at the upper end of the drilling frame K. This motor may be a pressure fluid motor or an electric motor or one of any other suitable type and is moved up and down together with the drilling frame. Suitable operative connections are provided between the rotation motor t and the rotation mechanism located in the front head of the rock drill and for this purpose a rod or shaft u may be conveniently provided operated by the motor gears v at the upper end and provided with a pinion w at the lower end meshing with the rotation gear x on the chuck y into which the shank of the drill steel U extends. By this means the rotating shaft or rod u and the motor are always visible from the barge A and if the drill steel sticks the operator is aware of the fact and can cease drilling until the drill steel is released. Furthermore, the operator always knows whether or not drilling is being effected.

In Figure 3 a collared drill steel is shown having the collar z and means are provided in the form of rocking clamps 3 for clamping the drill steel. These clamps are secured to the pivots 4 on the bell V and are provided with levers 5 outside the bell connected by the rope 6 which leads to a suitable point on the barge A so that the drill steel clamp may be set or released as desired by hand.

In the modification shown in Figure 7, a Leyner chuck of the rock drill is shown adapted to receive a lug steel having the lugs 7 so that the drill steel clamp is unnecessary and the drill steel is released by slightly turning the rock drill which may be effected at any suitable manner as by twisting the rotating shaft or reversing the motor t .

I claim:

1. In a submarine hammer drill unit, the combination of a main frame having guides, a vertically movable drilling element on said guides comprising a drilling frame, a fluid actuated rock drill of the hammer type secured to the lower end of said drilling frame, means for clamping the drill steel, and means for controlling said clamping means from above the surface of the water.

2. In a submarine hammer drill unit, the combination of a main frame having guides, a vertically movable drilling element on said guides comprising a drilling frame, a fluid actuated rock drill of the hammer type secured to the lower end of said drilling frame and adapted to be bodily submerged for drilling purposes, a bell at the front end of said rock drill into which the rock drill exhausts to prevent water from entering the rock drill while submerged, means within the bell for clamping the drill steel, and means for controlling said clamping means from above the surface of the water.

3. In a submarine hammer drill unit, the combination of a main frame having guides, a vertically movable drilling element on said guides comprising a drilling frame, a fluid actuated rock drill of the hammer type secured to the lower end of said drilling frame and adapted to be bodily submerged for drilling purposes, a bell at the front end of said rock drill into which the rock drill exhausts to prevent water from entering the rock drill while submerged, means within the bell for clamping the drill steel, means for controlling said clamping means from above the surface of the water, and independent means for rotating the drill steel adapted to be partially submerged at the level of the rock drill but having rotating portions visible from above the surface of the water in which the rock drill is operating, whereby the operator may constantly observe from the surface whether or not the drill steel is being rotated.

4. In a submarine hammer drill unit, the combination of a main frame having guides, a vertically movable drilling element on said guides comprising a drilling frame, a fluid actuated rock drill of the hammer type secured to the lower end of said drilling frame, said rock drill including a hammer cylinder and reciprocating fluid actuated piston, a separable front head containing rotation mechanism, a separable bell forwardly of the front head into which the rock drill exhausts to prevent water from entering the rock drill while submerged, means within the bell for clamping the drill steel, and means for controlling said clamping means from above the surface of the water.

In testimony whereof I have signed this specification.

CHARLES C. HANSEN.

[54] **PISTON AND SPRING POWERED ENGINE**

[76] **Inventor:** **Arthur J. Samodovitz**, 1 Lakeshore Dr., Apt. A-4, Farmington, Conn. 06032

[21] **Appl. No.:** **533,935**

[22] **Filed:** **Sep. 20, 1983**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 335,864, Dec. 30, 1981, abandoned.

[51] **Int. Cl.⁴** **F02B 75/00**

[52] **U.S. Cl.** **123/78 E; 60/699; 74/592**

[58] **Field of Search** **123/48 R, 48 B, 78 R, 123/78 E, 78 F, 197 A; 60/699; 185/40 R, 11; 74/581, 589, 592**

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Primary Examiner—Ira S. Lazarus

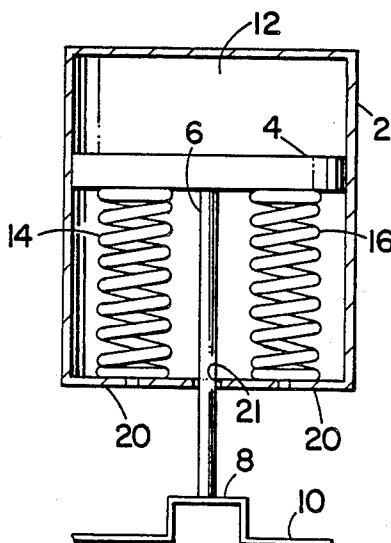
Assistant Examiner—R. S. Bailey

[57] **ABSTRACT**

The invention is an improved piston engine, either two stroke or four stroke. In one, two stroke, one cylinder embodiment, the improvement comprises two springs connecting between the piston and the base of the piston. These springs are relatively relaxed when the crank is at top dead center. Then during the power/intake stroke, some of the fuel's energy is delivered to the crankshaft and some is used to compress the springs. The stored energy in the springs is delivered to the crankshaft during the exhaust/compression stroke while the springs return to their relatively relaxed condition. As a result, energy is delivered to the crankshaft during both strokes of the cycle, and the engine runs smooth.

In one, four stroke, two cylinder embodiment, each cylinder has springs as described above, the cranks of each cylinder are aligned, and the cam sets one cylinder in the power stroke while the other is in the intake stroke. As a result, the engine runs smooth because energy is delivered to the crankshaft during all four strokes of the cycle, during two of the strokes by the burning fuel and during the other two by the release of energy in the springs. In both embodiments, a heavy crankshaft is not needed because of the more uniform power delivery.

14 Claims, 8 Drawing Figures



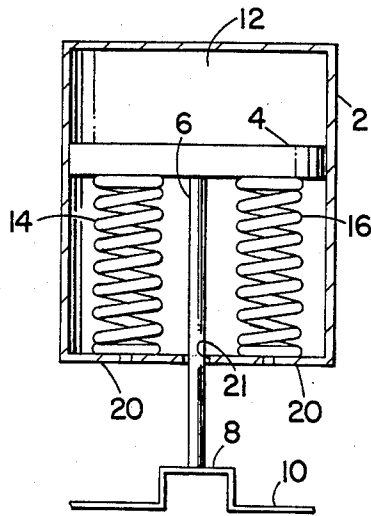


FIG. 1A

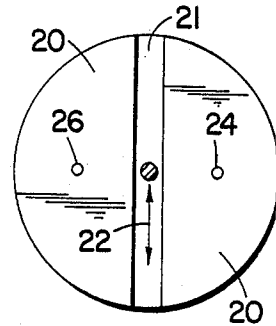


FIG. 1B

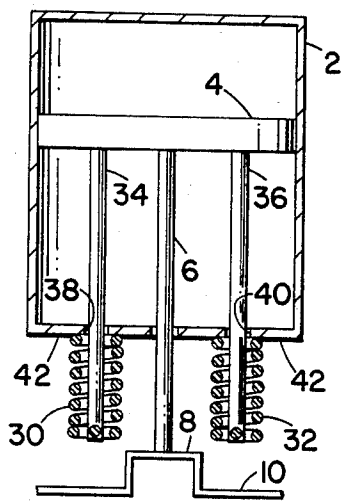


FIG. 2

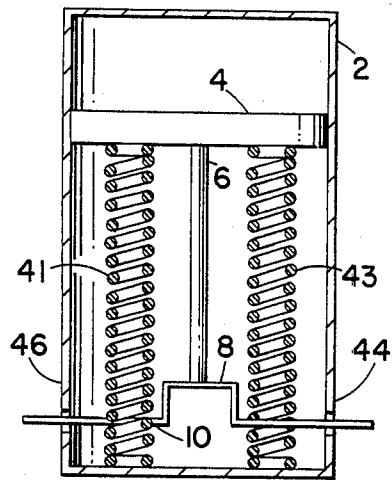


FIG. 3

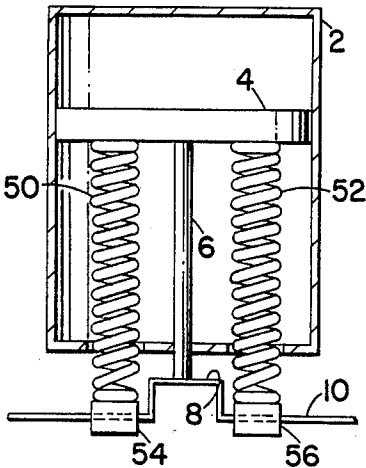


FIG. 4

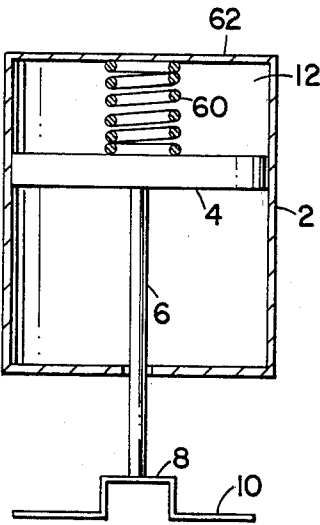


FIG. 5

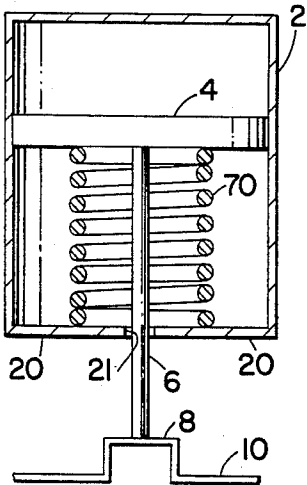


FIG. 6

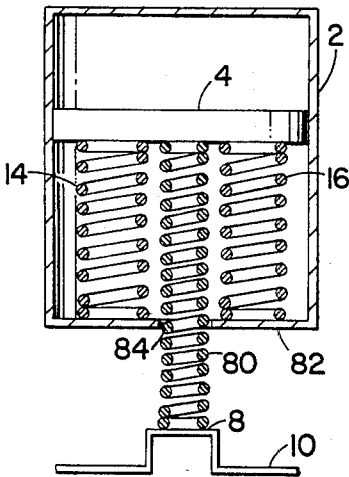


FIG. 7

PISTON AND SPRING POWERED ENGINE

This is a continuation in part of the "Piston to Spring Power Engine", Ser. No. 335,864, filed 12/30/81, now abandoned.

BACKGROUND OF THE INVENTION

1. Field

The invention relates generally to internal combustion engines, and more particularly to a piston engine which runs smooth because energy is delivered to its crankshaft and stored in springs during the power stroke, and energy is delivered to the crankshaft during the exhaust stroke by the release of the spring's energy.

2. Description of the Prior Art

A standard four stroke, piston engine utilizes intake, compression, power, and exhaust strokes, and delivers power to the crankshaft during the power stroke of each cylinder. Therefore, in a one cylinder, four stroke engine, power is delivered to the crankshaft only one fourth of the time. In most typical, two cylinder, four stroke engines, the cycles of each cylinder are phased apart so that the power strokes of each cylinder occur at different times. As a result, power is delivered to the crankshaft only half of the time. In a conventional one cylinder, two stroke engine, power is delivered to the crankshaft only half the time, during the power/intake stroke. Engine vibration results from this sporadic power delivery in the three engines described above as well as high frequency fluctuations in vehicle speed, acceleration during the power strokes, and deceleration during the other strokes due to the load friction, and other loss factors.

One conventional remedy is to use a heavy crankshaft which acts as a flywheel or a flywheel itself, which, by its inertia, tends to keep the crankshaft speed constant. However, there are at least three problems with this system. First, the weight of the crankshaft or flywheel causes excess gas consumption, and makes the vehicle less manageable if it is otherwise light weight such as a motorcycle, motorized bicycle, or lawn mower. Second, the flywheel/crankshaft is not totally effective in maintaining engine speed. Third, it does not prevent the relatively low frequency engine vibration at the frequency of the crankshaft rotation in a two cylinder, four stroke engine or in a one cylinder, two stroke engine due to the sporadic power delivery to the crankshaft.

Another remedy is to build the engine with as many cylinders as strokes, and sequence the power strokes from each cylinder to provide one power stroke during each stroke. This system provides a more uniform power delivery to the crankshaft and so, less, low frequency vibrations and fluctuations in speed, but it is costly, heavy, and gas consumptive. Note that one cylinder, two stroke engines have less of a problem than one cylinder, four stroke engines because this two stroke engine has a power stroke during half of the cycle instead of one fourth in the four stroke.

SUMMARY OF THE INVENTION

It is a first object of the invention to provide a smooth running piston engine with less, low frequency vibrations and vehicle speed fluctuations.

It is a second object of the invention to make a piston engine which runs smoothly with only a lightweight crankshaft.

It is a third object of the invention to provide a smooth running piston engine with less cylinders than its number of strokes per cycle.

To satisfy these objects and others, there are provided one, two, or more springs connected between the piston and the crankshaft side of each cylinder or between the piston and some other point. These springs are compressed or stretched as the case may be to store energy released by the burning gases during the power stroke of their respective cylinders. Some of the energy released by the burning gases also works to drive the crankshaft during the power stroke. Then, during the exhaust stroke, the springs deliver their stored energy to the crankshaft. Also, during the intake stroke, energy is stored in the springs and this energy is delivered to the crankshaft during the next compression stroke. As a result, a two cylinder, four stroke engine phased so that when one cylinder is in the power stroke, the other is in the intake stroke, can provide net energy delivered to the crankshaft during each stroke. Also, in a one cylinder, two stroke engine, net energy is delivered to the crankshaft during both strokes, the power/intake stroke and the exhaust/compression stroke. As a result, low frequency vibrations in the engine and low frequency fluctuations in speed are reduced, and the engine runs smoother.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1(a) shows a schematic diagram of major parts of a one cylinder unit of the first embodiment of the invention.

FIG. 1(b) shows a top view of the base of the cylinder of FIG. 1(a), an arrow shows the back and forth motion of the connecting rod, and circles show where the springs attach.

FIG. 2 shows a schematic diagram of major parts of a one cylinder unit of the second embodiment of the invention.

FIG. 3 shows a schematic diagram of major parts of a one cylinder unit of the third embodiment, and includes the crankcase.

FIGS. 4-7 show schematic diagrams of major parts of a one cylinder unit of each of the fourth through seventh embodiments, respectively.

DETAILED DESCRIPTION OF THE FIRST EMBODIMENT

The first embodiment is a two cylinder, four stroke piston engine, and one cylinder unit is shown in FIG. 1(a). This engine can be used in a motorcycle, lawn-mower, or any other device which uses a conventional two cylinder, four stroke piston engine.

The top and vertical sides of cylinder 2 are standard except the sides of the first embodiment may be elongated. Piston 4, connecting rod 6, crank 8, and crankshaft 10 are typical of conventional piston engines. In this cylinder of the four stroke engine, fuel enters the top chamber of cylinder 2, fuel chamber 12, although the valves are not shown. Then, the gaseous fuel is compressed in the standard way by the upward movement of crank 8, connecting rod 6, and piston 4. Then, the fuel is ignited in the usual way in the fuel chamber 12 by a spark plug, not shown. The burning fuel expands and pushes the piston downward, according to the orientation of FIG. 1, although the cylinder can be oriented in any direction and still work and connecting rod 6 also proceeds downward against crank 8. This

power stroke drives crankshaft 10, and ultimately the load.

However, unlike typical four stroke piston engines, all of the work produced when the fuel burns does not go towards driving the crank. Instead, approximately one fourth of that work at moderate loads goes toward compressing springs 14 and 16, so that approximately as much work is delivered to the crank as is stored together in springs 14 and 16 and the analogous springs in the second cylinder the energy of the four springs being delivered to the crankshaft during the subsequent exhaust/compression stroke. Springs 14 and 16 and their analogous ones in the other cylinder were relayed or only slightly compressed or stretched when crank 8 was at top dead center, TDC, the end of the compression stroke, and are significantly compressed when the crank is at bottom dead center, BDC.

The cranks of both cylinders point in the same direction meaning that when one is at TDC the other is at TDC. Also, both cranks drive the same crankshaft 10. The cam and fuel intake and exhaust means are set up such that when one cylinder is in the power stroke, the other is in the intake stroke. As a result, when each cylinder delivers energy to crankshaft 10 by its power stroke, the springs in both cylinders are compressing and storing energy. Then, during the next stroke, the exhaust stroke for one cylinder and the compression stroke for the other cylinder, both pairs of springs deliver their energy to the crankshaft. This two stroke process is repeated as the two cylinders swap roles. Note that exhaust means such as valves exhaust the burnt gases during the exhaust stroke from fuel chamber 12.

To obtain the most constant energy delivery to the crankshaft, each pair of springs after one power/intake stroke should store approximately one half the energy delivered by one piston during one power stroke to the crankshaft during average loads for the following reasons: Both pairs store energy during the same two intervals, one cylinder's power stroke and other's intake stroke and vice versa, so, as much net energy goes to the crankshaft as into both pairs of springs during these two intervals. Then, both pairs deliver their energy to the crankshaft during the same two intervals, one's exhaust stroke and the other's compression stroke and vice versa, so, the same amount of energy will be delivered to the crankshaft during these two intervals as was delivered during the prior two. Thus, the springs work together to deliver approximately the same amount of energy to the crankshaft during the exhaust/compression strokes as is delivered by the piston and hot gas to the crankshaft during each power/intake stroke. Note that the springs store the same amount of energy during the power and intake strokes regardless of the load or the amount of fuel that is burned at any time, so, their stiffness should be such as to equalize their energy storage with the energy delivered to the crankshaft by one piston at an average or usual load.

Because of the energy delivery to the crankshaft by the springs during the non-power stroke intervals, there are only short periods when no energy is being input to the crankshaft, when the crank 8 is about TDC and BDC. As a result, the "coast" durations of crankshaft 10 are much less than in a standard two cylinder, four stroke engine when the crankshaft must coast half of the time. Therefore, a much lighter crankshaft can be used than in a standard two cylinder, four stroke engine. Also, the vibrations and fluctuations in engine speed are

less and they have a higher frequency; as a result, they are less noticeable and less offensive to the operator. In fact, this two cylinder, four stroke engine with the springs should run, at certain loads, as smooth as a standard, four cylinder, four stroke engine.

FIG. 1(b) shows a top view of the base 20 of cylinder 2 with a slot 21 to accommodate connecting rod 6. A slot is needed because back and forth motion of the rod results from its revolution about the axis of crankshaft 10. Arrow 22 shows the directions of this motion. Circles 24 and 26 show the location of the connection of springs 16 and 14, respectively, to base 20. Two springs are used instead of one in order to balance the force upon the piston 4. If only one spring were used, either 14 or 16, it would put a torque on the piston since neither spring is aligned along the axis of piston 4; this one spring per cylinder system would still store and deliver energy, and so, function in the same way as the two spring per cylinder system, but it would cause more friction on the piston edges.

In a slight variation of the first embodiment, base 20 is replaced by another base comprising two rods connecting from the front to the back of the bottom of cylinder 2 (according to the orientation of FIG. 1), on either side of the slot, and beneath springs 14 and 16. This variation has the advantage of being lighter in weight since this "rod" base weighs less than base 20 with its watermelon-slice shaped parts.

In another variation, the engine has two strokes per cycle only, and has only one cylinder unit. This cylinder unit is typical of two stroke engines with a conventional piston, cam, fuel intake means, exhaust means, connecting rod, crank, and crankshaft, although all these parts are not shown, plus the novel springs such as springs 14 and 16 situated as are springs 14 and 16 between the piston and the base of the piston. Also, the height of the cylinder may be greater to allow more length to the springs, the added length makes it easier to find a spring which can store the necessary energy. In a manner analogous to that described above for the four stroke engine, power is delivered to the crankshaft 10 and stored in said springs during the power/intake stroke, and power is delivered by the springs to the crankshaft during the exhaust/compression stroke; the springs were relaxed or only slightly compressed or stretched when the crank was at TDC and the springs were most compressed when the crank was at BDC. Also, the springs have a stiffness such that at moderate loads, approximately the same amount of energy is delivered to the crankshaft during the power/intake stroke as is stored in the springs during the same stroke. Thus, during the next exhaust/compression stroke, a like amount of energy is delivered to the crankshaft. As a result, this one cylinder, two stroke engine should run about as smooth as a conventional two cylinder, two stroke engine at a certain load corresponding to where the energy into the crankshaft during the power/intake stroke equals the energy into the crankshaft from the springs during the exhaust/compression stroke.

In another variation, springs 14 and 16 connect to piston 4 and base 20 (or substitute rod base) via vertical rods, nipples, or supports attaching to either end of said springs and to the piston or base.

In another variation of the first embodiment, the structure of FIG. 1 is the lone cylinder unit of a one cylinder, four stroke engine, it operates as does the first embodiment except, during the power stroke, the springs 14 and 16 store approximately the same amount

of energy as is delivered to crankshaft 10 by the piston and burning gases under moderate load or a usual load. This variation does not provide as constant of an energy delivery to the crankshaft as does the two cylinder, four stroke engine or the one cylinder, two stroke engine because, during the intake stroke, energy is actually drawn from the crankshaft to compress the springs; during the other three strokes, energy is delivered to the crankshaft. But, this variation should lessen the low frequency vibration as compared to a standard one cylinder, four stroke engine operating at the same power output.

Some conventional fastening means secures springs 14 and 16 to piston 4 and base 20, as well as the other springs in subsequent embodiments to their points of attachment. Connecting rod 6 attaches to piston 4 by conventional pivoting means, and is rotatably mounted to crank 8.

DETAILED DESCRIPTION OF THE SECOND EMBODIMENT

One cylinder unit of the second embodiment of the invention is shown in FIG. 2, and is similar in operation and structure to the first embodiment, and has similar applications and variations except that springs 30 and 32 attach between spring rods 34 and 36 respectively and the base 42 of the piston. As a result, springs 30 and 32 are relaxed when crank 8 is at TDC, and are most stretched when crank 8 is at BDC; springs 30 and 32 deliver their stored energy to crankshaft 10 during the same strokes as did springs 14 and 16 except springs 30 and 32 deliver their stored energy by relaxing from their stretched condition instead of relaxing from their compressed condition as did springs 14 and 16. Springs 30 and 32 have the advantage of being more accessible during replacement since they are in the crankcase (not shown).

Spring rods 34 and 36 move up and down through holes 38 and 40 in base 42. Springs 30 and 32 straddle holes 38 and 40 respectively and attach by rigid means to base 42. Base 42 is similar to base 20, except base 42 has the additional holes 38 and 40; rods can also be used.

To provide more length for springs 30 and 32, spring rods 34 and 36 can be elongated and can extend below crankshaft 10 (according to the orientation of FIG. 2). If so, rods 34 and 36 and their respective springs should be situated on opposite sides of crankshaft 10, one in front and one in back (according to the orientation of FIG. 2) so as to minimize torque on piston 4. The added length of the springs makes it less likely that their compression will permanently deform them; with the increased length, it is easier to provide springs which operate in their elastic region.

In a variation to the second embodiment, the spring rods are further extended downward and pass through holes in the bottom of the crankcase; the springs attach between the ends of their respective spring rods and the bottom of the crankcase. This arrangement provides much easier access to the springs during their replacement since the springs are outside the cylinder and the crankcase.

DETAILED DESCRIPTION OF THE THIRD EMBODIMENT

One cylinder of the third embodiment is shown in FIG. 3, and is similar in structure and operation to the first embodiment and has similar variations and applications except energy storage springs 40 and 42 connect

between the piston and the bottom of the crankcase 44. Spring 40 is situated in front of crankshaft 10, and spring 42 is situated in back of crankshaft 10 (according to the orientation of FIG. 3), and both springs are in the same plane as the axis of piston 4 to minimize torque on the piston. The attachment of the bottom of springs 40 and 42 to the bottom of the crankcase allows more length to these springs so that their compression is less likely to permanently deform the springs.

Portion 46 of crankcase 44 is where the crankcase can be expanded to accommodate an adjacent cylinder unit with another crank and an extended crankshaft 10.

DETAILED DESCRIPTION OF THE FOURTH EMBODIMENT

One cylinder unit of the fourth embodiment is shown in FIG. 4, and is similar in structure and operation to the first embodiment and has similar variations and applications except the energy storage springs 50 and 52 connect between piston 4 and crankshaft 10 by means of sleeves 54 and 56. Crankshaft 10 rotates with little friction within these sleeves because of ball bearings or oil or other conventional friction minimizing means within said sleeves. As in the first and third embodiments, springs 50 and 52 are relaxed or only slightly stretched or compressed when crank 8 is at TDC, and are most compressed when crank 8 is at BDC. The advantage of the fourth embodiment over the first is that the fourth allows more length for the energy storage springs. The disadvantage is the torque put on the springs by the rotation of the crankshaft despite the friction minimizing means within the sleeves 54 and 56.

DETAILED DESCRIPTION OF THE FIFTH EMBODIMENT

One cylinder unit of the fifth embodiment is shown in FIG. 5, and is similar in structure and operation to the first embodiment and has similar variations and applications except the energy storage spring 60 connects between the top of piston 4 and the top 62 of cylinder 2. Spring 60 is located in the fuel chamber 12, it is relaxed or only slightly compressed or stretched when crank 8 is at TDC, and it stores energy by stretching; the most stretched condition exists when crank 8 is at BDC. Since spring 60 is located on the axis of piston 4, only one spring is needed.

In a variation of the fifth embodiment, a spring rod attaches to the top of piston 4 and extends upward through a hole in cylinder top 62; the lone storage spring attaches between the top of this spring rod and the top of cylinder top 62. This spring is relaxed at TDC and compressed at BDC. If the "head" (for the valves) is located on top of cylinder 2, then this rod should also pass through the head, and the energy storage spring attaches between the top of this spring rod and the top of the head.

DETAILED DESCRIPTION OF THE SIXTH EMBODIMENT

One cylinder unit of the sixth embodiment is shown in FIG. 6, and is similar in structure and operation to the first embodiment and has similar variations and applications except the storage spring 70 fits over connecting rod 6. The diameter of spring 70 must be large enough so that connecting rod 6 can move back and forth freely within slot 21. Spring 70 attaches between the bottom of piston 4 and the base 20 (or substitute base rods) of

cylinder 2. Since spring 70 is situated along the axis of piston 4, no other balancing spring is needed.

DETAILED DESCRIPTION OF THE SEVENTH EMBODIMENT

One cylinder unit of the seventh embodiment is shown in FIG. 7, and is similar in structure and operation to the first embodiment and has similar applications and variations except connecting rod 6 is replaced with connecting spring 80. Spring 80, like connecting rod 6 is rotably mounted to crank 8 by conventional means. The purpose of using the connecting spring 80 instead of the connecting rod is to allow more compression of energy storage springs 14 and 16 during heavy loads because during heavy loads much fuel burns and pushes down on piston 4 extra hard. As a result, connecting spring 80 compresses and allows piston 4 to move closer to base 20 than if connecting rod 6 were used, and energy storage springs compress more and store more energy. Then, during the exhaust stroke, more energy is delivered to crankshaft 10 by the springs, and the energy delivery during the power and exhaust strokes is better balanced (as well as the energy deliver during the other two strokes in a four stroke engine). See Wuerfel U.S. Pat. No. 4,111,164, Campbell U.S. Pat. No. 2,372,472, and the Swiss patent by Zala No. 570,548 for a discussion of the design and uses of this connecting spring.

In variations of the seventh embodiment, the Wuerfel, Campbell, and Zala connecting spring assemblies are utilized instead of spring 80 between piston 4 and crank 8. Those assemblies include an assortment of springs, sleeves with guide rods, resilient means, and dashpots to control the movement of the main spring. Spring 80 and said spring assemblies "connect" piston 4 to crank 8.

Base 82 is similar to base 20 of the first embodiment except slot 84 is wider than slot 21 to accommodate the diameter of spring 80 which is larger than the diameter of connecting rod 6.

I claim:

1. In a piston engine having a cylinder, means for introducing fuel into the cylinder, means for igniting said fuel, means for exhausting the burnt gases, a piston within the cylinder, a crank, a connecting rod pivotally connecting the piston to the crank, and a crankshaft, the improvement comprising:

resilient means for storing energy received from the piston and burning gases during the outward movement of the piston, and for delivering most of said stored energy to the crankshaft during the inward movement of the piston in a manner which drives the crankshaft in its existing direction of rotation, said resilient means comprising a spring connecting between the piston and a point stationary relative to the cylinder.

2. The piston engine of claim 1 wherein the cylinder has a base, and the spring connects between the piston and said base.

3. The piston engine of claim 2 wherein the resilient means further comprises a second spring connecting between the piston and said base, the springs connecting to said base on opposite sides of the connecting rod.

4. The piston engine of claim 2 wherein the spring surrounds the connecting rod and the diameter of the spring is large enough to allow the piston rod to oscil-

late within the spring without causing the spring to oscillate with it.

5. The piston engine of claim 1 further comprising a second rod, said second rod having one end connecting to the piston and extending outward, and wherein the cylinder has a base, and said spring connects between said base and the outer end of said second rod.

6. The piston engine of claim 5 further comprising a third rod, said third rod having one end connecting to the piston, and wherein said resilient means further comprises a second spring connecting between said base and the other end of said third rod.

7. The piston engine of claim 1 further comprising a crankcase, and wherein said resilient means comprises a spring connecting between the piston and the crankcase.

8. The piston engine of claim 7 wherein said resilient means further comprises a second spring connecting between the piston and the crankcase.

9. The piston engine of claim 1 wherein said spring means comprises a spring connecting between the piston and the crankshaft.

10. The piston engine of claim 9 wherein said spring means further comprises a second spring connecting between the piston and the crankshaft, the springs connecting to the crankshaft on opposite sides of the crank.

11. The piston engine of claim 1 wherein the cylinder has a top, and said spring means comprises a spring connecting between the piston and said top.

12. In a two cylinder, four stroke piston engine having power, exhaust, intake, and compression strokes, two cylinders, means for introducing fuel into each cylinder, means for igniting the fuel, means for exhausting the burnt gases, a piston within each cylinder, a crank for each cylinder, a connecting rod for each cylinder pivotally connecting the respective piston to the respective crank, and a common crankshaft, the improvement comprising:

resilient means for each cylinder for storing energy received from its piston and burning gases during the outward movement of said piston, and for delivery most of said stored energy to the crankshaft during the inward movement of said piston in a manner which drives the crankshaft in its existing direction of rotation, said resilient means for each cylinder comprising a spring connecting between the piston and a point stationary relative to the cylinders, and wherein

both cranks point in substantially the same direction, and

said means for introducing fuel into each cylinder, said means for igniting the fuel, and said means for exhausting the burnt gases set one cylinder in the power stroke while the other cylinder is in the intake stroke.

13. The piston engine of claim 12 wherein each cylinder has a base, and wherein said stationary point with respect to each cylinder is located on the base of each cylinder.

14. The piston engine of claim 12 further comprising a crankcase and wherein said stationary point with respect to each cylinder is located beneath each cylinder on the crankcase.

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