Nov. 8, 1966 F. STELZER 3,283,752

FREE PISTON MACHINE

Filed May 5, 1964 2 Sheets-Sheet 1

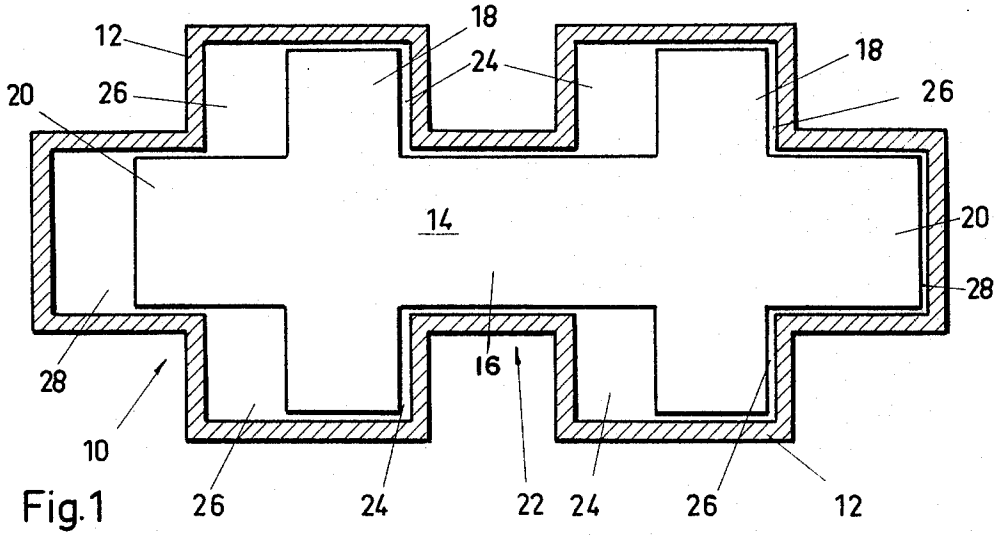
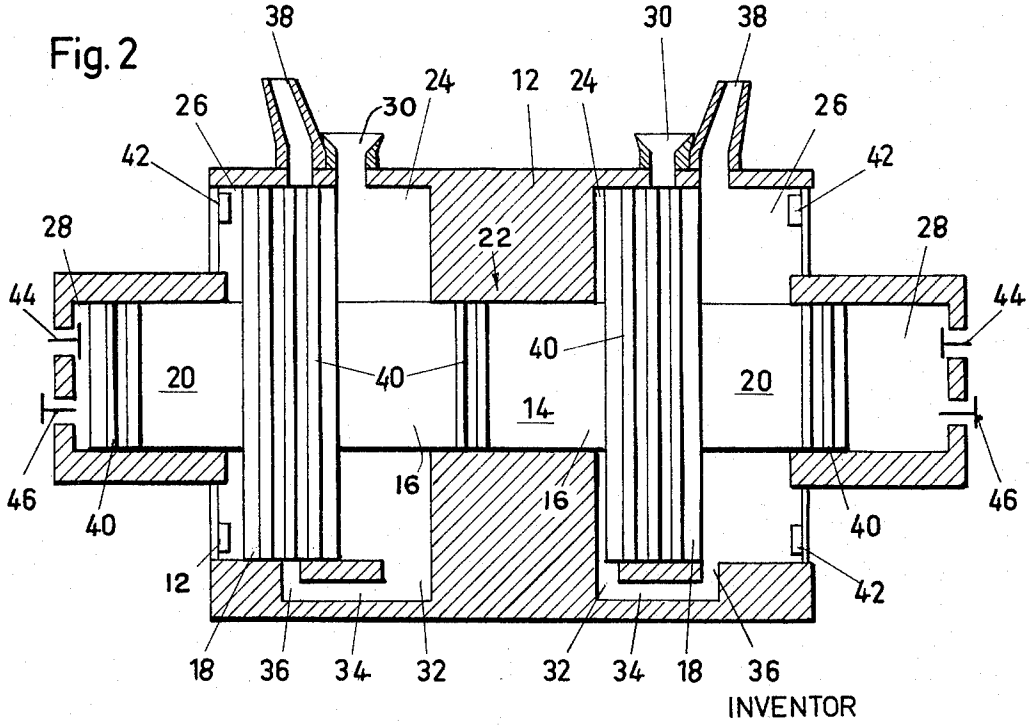


Fig.1

Fig. 2



INVENTOR

Frank Stelzer

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FREE PISTON MACHINE

Filed May 5, 1964 2 Sheets-Sheet 2

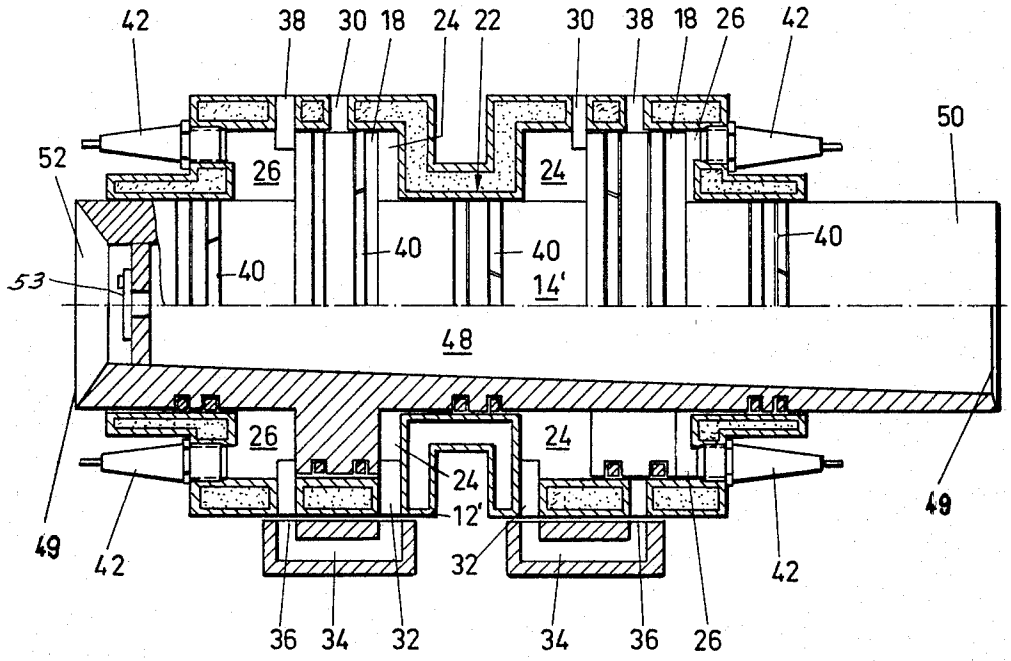

Fig.3

INVENTOR

Frank Stelzer

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FREE PISTON MACHINE

Frank Stelzer, Elbestrasse 59,
Raunheim, near Frankfurt, Germany

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2 Claims. (Cl. 123—46)

The present invention relates to a free piston machine, and more particularly to a free piston machine operating according to the two cycle principle and being a combined prime mover and engine.

It is one object of the present invention to provide a combustion engine which is particularly suited for propelling vehicles or for driving other machines.

Another object of the invention is to provide a free piston of simple and economical construction which reliably operates.

Another object of the invention is to provide a free piston machine in which moving mechanical parts, such as cranks, connecting rods and crank shafts are omitted.

Another object of the invention is to provide a machine with a movable element which is driven to produce power which is partly used for doing work.

With these objects in view, the present invention relates to a free piston machine which operates on the two cycle principle, and compresses a gaseous fuel before the same is ignited.

One embodiment of the invention comprises cylinder means having two cylinder spaces separated by a transverse wall; a piston means including two pistons located in the cylinder spaces and a connecting portion of smaller diameter passing through an opening in the transverse wall.

Each piston forms in the correlated cylinder space a compression chamber and a combustion chamber contracting and expanding during reciprocation of the piston means.

Means for supplying fuel into the compression chambers, means for exhausting burned gases from the combustion chambers, and passage means for connecting each compression chamber with a combustion chamber are provided.

In the preferred embodiment of the invention, the two pistons have the same diameter, and the connecting portion between the pistons, as well as two end portions of the pistons have a smaller, and preferably equal diameter. The end portions of the piston are advantageously guided in cylinder portions at the ends of the cylinder means, and may be used as pump or compressor pistons.

In another embodiment of the invention, the entire piston means has an inner axially extending cavity narrower at one end than at the other end, and preferably provided with a check valve, so that a fluid supplied to the wider end of the cavity will be compressed or accelerated at the narrower end of the cavity when the piston means is reciprocated.

The novel features which are considered as characteristic for the 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, in which:

FIG. 1 is a diagrammatic cross-sectional view illustrating the shape of a cylinder means and piston means in accordance with the principle of the present invention;

FIG. 2 is an axial sectional view of one embodiment of the invention, conventional elements being schematically illustrated for the sake of simplicity; and

FIG. 3 is an axial sectional view illustrating another embodiment of the invention.

Referring now to the drawings, and more particularly to FIGS. 1 and 2, a cylinder means **12** has walls which define an inner cavity **10** in which a piston means **14** is disposed for axial reciprocating movement. Piston means **14** has two pistons **18**, a connecting portion **16** of smaller diameter than pistons **18**, and two cylindrical end portions **20** located in cylinder portions which define cylinder chambers **28**. The two cylinder spaces of larger diameter formed by the cylinder means **12** are respectively divided by the pistons **18** into axially outward located combustion chambers **26**, and axially inward located compression chambers **24**. The connecting portion **16** of piston means **14** is slidably guided in an opening **22** and, as shown in FIG. 2, piston rings **40** on connecting portion **16** prevent communication between compression chambers **24**. Piston rings **40** are also provided on pistons **18** so that each compression chamber is separated from the correlated combustion chamber located in the same cylinder space.

The cylinder spaces **28** are closed by transverse end walls in which inlet valve means **44** and outlet valve means **46** are located.

In each combustion chamber **26**, igniting means **42**, such as a sparkplug, or a member permanently heated by the heat of the combustion, are provided.

An outlet **38** for discharging combustion gases is provided in each combustion chamber spaced from the igniting means **42** in axial direction so that the respective outlet **38** is closed when piston **18** is in the position shown for the left piston in FIG. 2.

An inlet means **30** for fuel, or fuel-air mixture, or other suitable fluid, is provided in each compression chamber **24** adjacent the respective outlet means **38**.

A passage **34** connects each compression chamber **24** with the correlated combustion chamber **26**, and has a slot-shaped port **32** in the respective compression chamber adjacent the central wall, and a slot-shaped port **36** which opens into the respective combustion chamber.

The inlet means **30** are connected with a conventional fuel carburetor or fuel injection device, not illustrated.

The machine operates in the following manner:

The combustion chamber **26** on the left of FIG. 2 is contracted to the minimum volume since the piston means is in its left dead center position, or shortly before the same. When the igniting means **42** have ignited the compressed fuel in combustion chamber **26**, or if the compressed fuel was ignited without igniting means due to its great volatility, for example, gasoline, piston means **14** is driven to the right as viewed in FIG. 2.

The left piston **18** first closes the inlet **30**, then compresses the gaseous fuel in compression chamber **24**, and finally presses the fuel through passage **34** when piston **18** has travelled far enough to uncover port **36** of passage **34**. The fuel flows in compressed condition into combustion chamber **26**.

During the same stroke the piston means **14** moves the right piston **18** to the right to first close the outlet **38** and port **36**, and to then compress the already pre-compressed fuel in the right combustion chamber **26** until arriving in the right dead center position where the compressed fuel in the right combustion chamber **26** is ignited.

At the same same, the right piston **18** uncovers the inlet **30** so that a fresh fuel mixture can enter the right compression chamber **24**. At the same time, the left piston **18** has arrived in its right dead center position closing port **32**. In this manner, the piston means **14** is reciprocated in two cycles.

The end portions **20** of the piston means reciprocate at the same time in the correlated cylinder chambers **28**, and it will be understood that a fluid entering through

inlet valves **44** during movement of the piston means in one direction will be discharged through outlet valves **46** during a reciprocating stroke of the piston means in the opposite direction. Since the discharge from the two pump chambers **28** takes place alternately, a fairly constant flow is assured.

FIG. 3 illustrates a modified embodiment of the invention, and corresponding parts are indicated by like reference numerals. The pump chambers **28** are omitted, and opeen cylinder portions **49** provided at the ends of cylinder means **12'**. The piston means **14'** is provided with longer end portions **50** which project out of the cylinder portions **49**. The piston means **14'** has an inner frusto-conical cavity **48** wider at the right end and narrower at the left end of piston means **14'**, a short wider portion **52** being provided at the narrow end of cavity **48**.

When the piston is reciprocated due to the combustion of gases in the combustion chambers **26**, a fluid medium surrounding the right end of piston means **14'** will be compressed or accelerated in cavity **48** while piston means **14'** moves to the right. A check valve **53** arranged in cavity **48** prevents the return of fluid during the stroke in the opposite direction so that the fluid is pumped from the wider open end **50** to the narrower end **52** of the cavity.

As compared with conventional two cycle motors with slot-shaped ports and transverse flow of the air, the machine of the invention has great advantages inasmuch as no connecting rods and crankshafts are required, and a single piston means operates in two combustion chambers to be driven during opposite strokes. The moving mass is small, and consequently a higher degree of compression, and a more exact timing can be achieved than with conventional two cycle motors, particularly since the pre-compression takes place only in the compression chambers **24**, whereas in known constructions, the pre-compression is effected also within a crankshaft case. The compression chambers **24**, in which the fuel is pre-compressed, have an exactly determined volume.

The power given to the piston means by the combustion of the fuel is transformed into work by the piston end portions **20** or by the direct action of the piston means, as explained with reference to FIG. 3. A single piston means is driven, and also operates to pump a liquid, or to compress a gas. Of course, the power of the reciprocating piston means may be used in any other suitable manner. In the embodiment of FIGS. 2 and 3 where a fluid is pumped, the fluid may be supplied to turbines, for example, to turbines located in the wheels of a vehicle so that all wheels are driven from the two cycle combustion engine of the invention.

In order to start the machines according to the invention, the operation is reversed, and a compressed fluid, for example, compressed air is supplied in intermittent and alternating thrusts into the chambers **28** of the machine so that the piston means is reciprocated and compresses the fuel mixture to start the regular operation.

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 free piston machines differing from the types described above.

While the invention has been illustrated and described as embodied in a two cycle free piston double-acting combustion 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 and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A two cycle free piston machine comprising, in combination, a cylinder means having wall means forming two cylinder spaces having the same diameter, said wall means including a transverse wall separating said two cylinder spaces and having an opening connecting said cylinder spaces, said cylinder means including two cylinder portions at the ends thereof coaxial with said cylinder spaces; a piston means including two pistons having the same diameter and being respectively located in said cylinder spaces, two cylindrical end portions slidable in said cylinder portions of said cylinder means, and a connecting portion having a smaller diameter than said pistons and passing through said opening in said transverse wall, each piston forming in the correlated cylinder space a compression chamber and a combustion chamber, said chambers contracting and expanding during reciprocation of said piston means; inner conical cavity means extending from one of said cylindrical end portions to the other of said cylindrical end portions and being wider at one end than at the other end thereof whereby during reciprocation of said piston means a fluid can be compressed in or pumped through said cavity means; means for supplying fuel into said compression chambers; means for exhausting gases from said combustion chambers; and passage means for connecting each compression chamber with the correlated combustion chamber.

2. A free piston machine as set forth in claim **1** including a check valve in said cavity means.

References Cited by the Examiner

UNITED STATES PATENTS

735,863	8/1903	Duryea et al.	123—46
1,405,551	2/1922	Nichols	123—46
1,741,731	12/1929	Nordensson	230—56
2,067,358	1/1937	Thornton	230—35
2,178,310	10/1939	Pescara	230—56
3,170,406	2/1965	Robertson	103—54

FOREIGN PATENTS

827,407 2/1960 Great Britain.

MARK NEWMAN, *Primary Examiner.*

WENDELL E. BURNS, *Examiner.*