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Plevyak

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[54] **DOUBLE-CHAMBERED RECIPROCATABLE DOUBLE-ACTION-PISTON INTERNAL COMBUSTION ENGINE**

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[52] **U.S. Cl.** ..... **123/58 C,** 123/57 B

[51] **Int. Cl.** **F02b 75/26,** F02b 75/28

[58] **Field of Search** ..... 123/58 C, 57 B

[56] **References Cited**

UNITED STATES PATENTS

1,628,027	5/1927	Burson	123/57 A
2,532,106	11/1950	Korsgren	123/58 C
2,578,559	12/1951	Korsgren	123/58 C

FOREIGN PATENTS OR APPLICATIONS

609,650	2/1935	Germany	123/57 B

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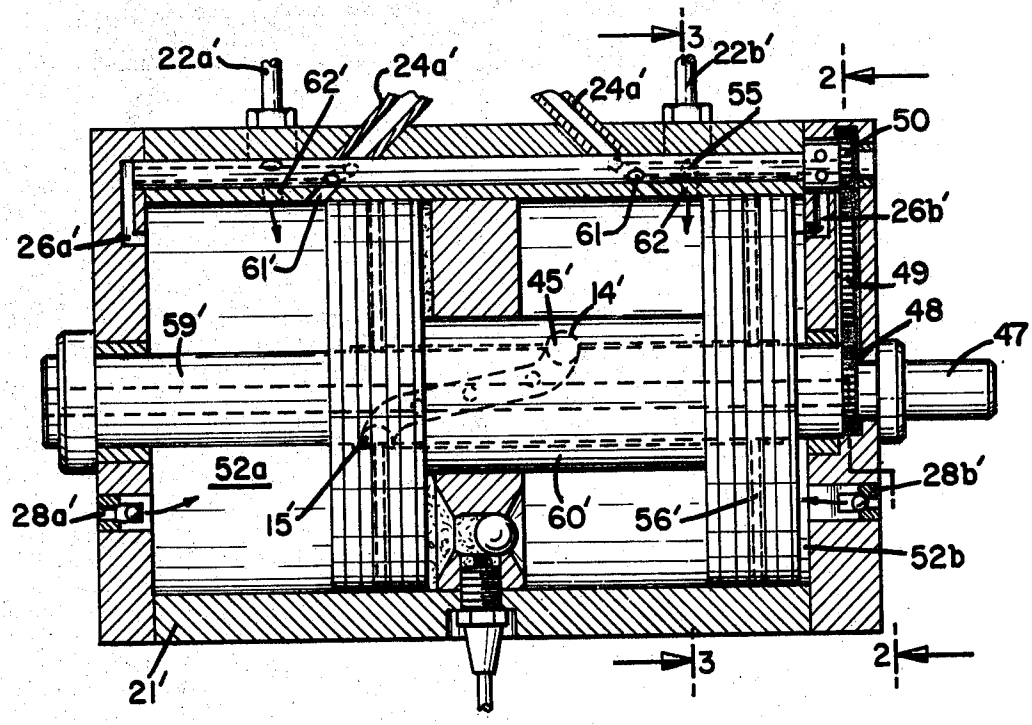
[57] **ABSTRACT**

An internal combustion engine having two piston chambers in series with interconnected pistons for synchronous reciprocating motion, the combustion-expansion cycle of one cylinder serving to return the other piston to the fuel-compression state, there being an intermediate compression and ignition chamber between the opposing piston cylinders and pistons with a valve means mounted within the piston cylinder such as a spherical ball movable between and sealable alternately of opposite-end openings of the ignition chamber opening into the opposing piston cylinders and the movement of the spherical ball valve being dependent upon return-movement of the piston bringing about compression of gases adjacent the ball thereby forcing the ball out of the vent toward the distant end of the ignition cylinder away from the approaching piston, to seal the far end of the ignition chamber, whereby as the approaching piston continues to approach and finally to become substantially flush with the piston chamber, gases within the space adjacent the approaching piston and compressed within the ignition chamber prior to ignition by a spark plug or other ignition mechanism within the ignition chamber.

11 Claims, 6 Drawing Figures



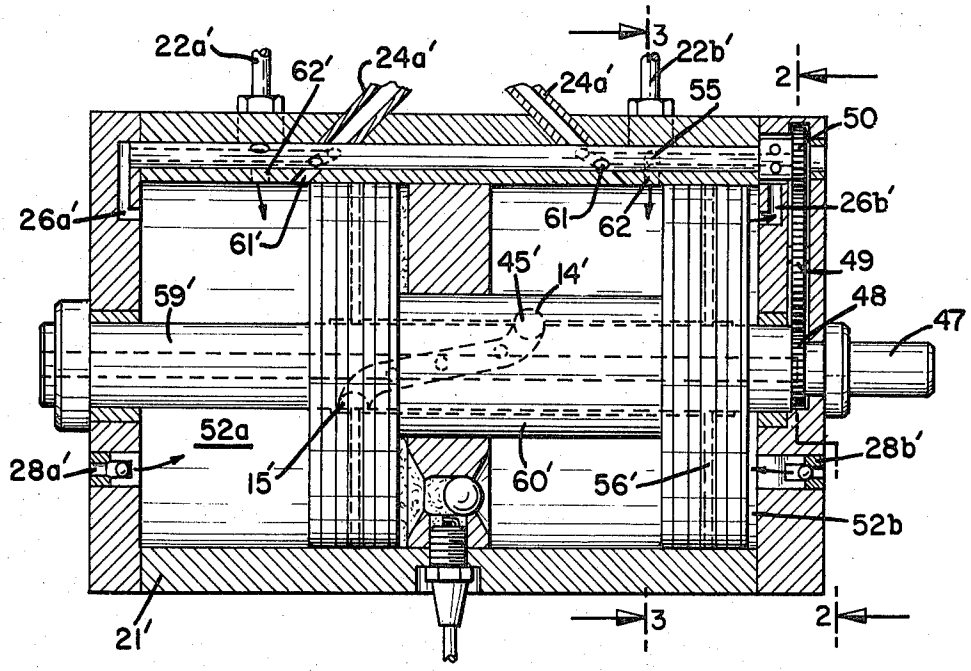


Fig. 1.

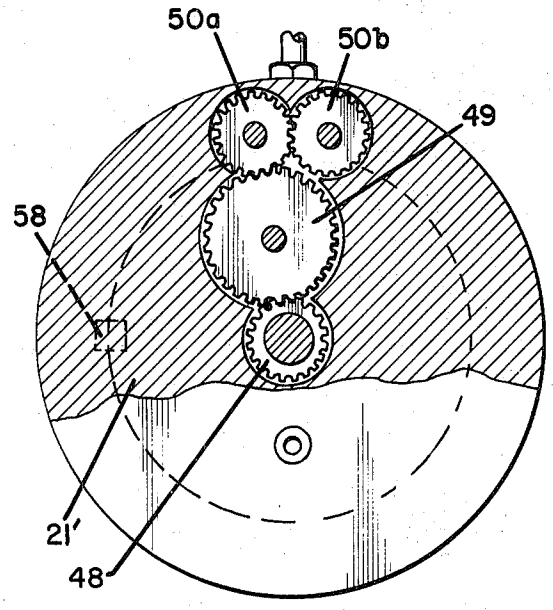


Fig. 2

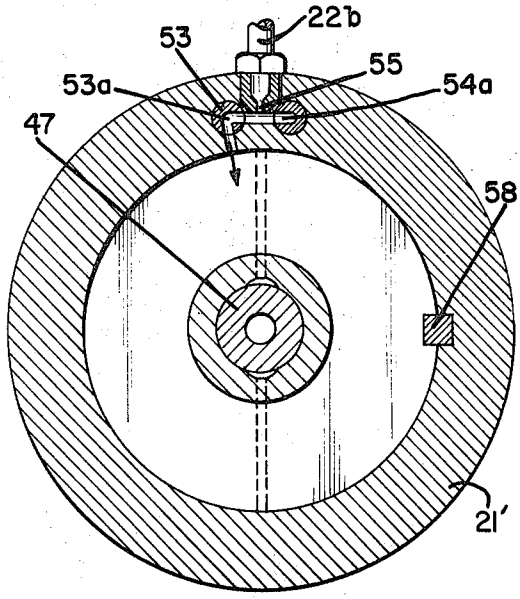


Fig. 3.

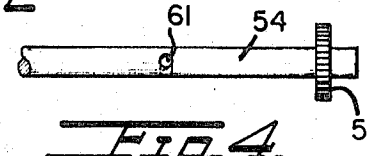


Fig. 4.

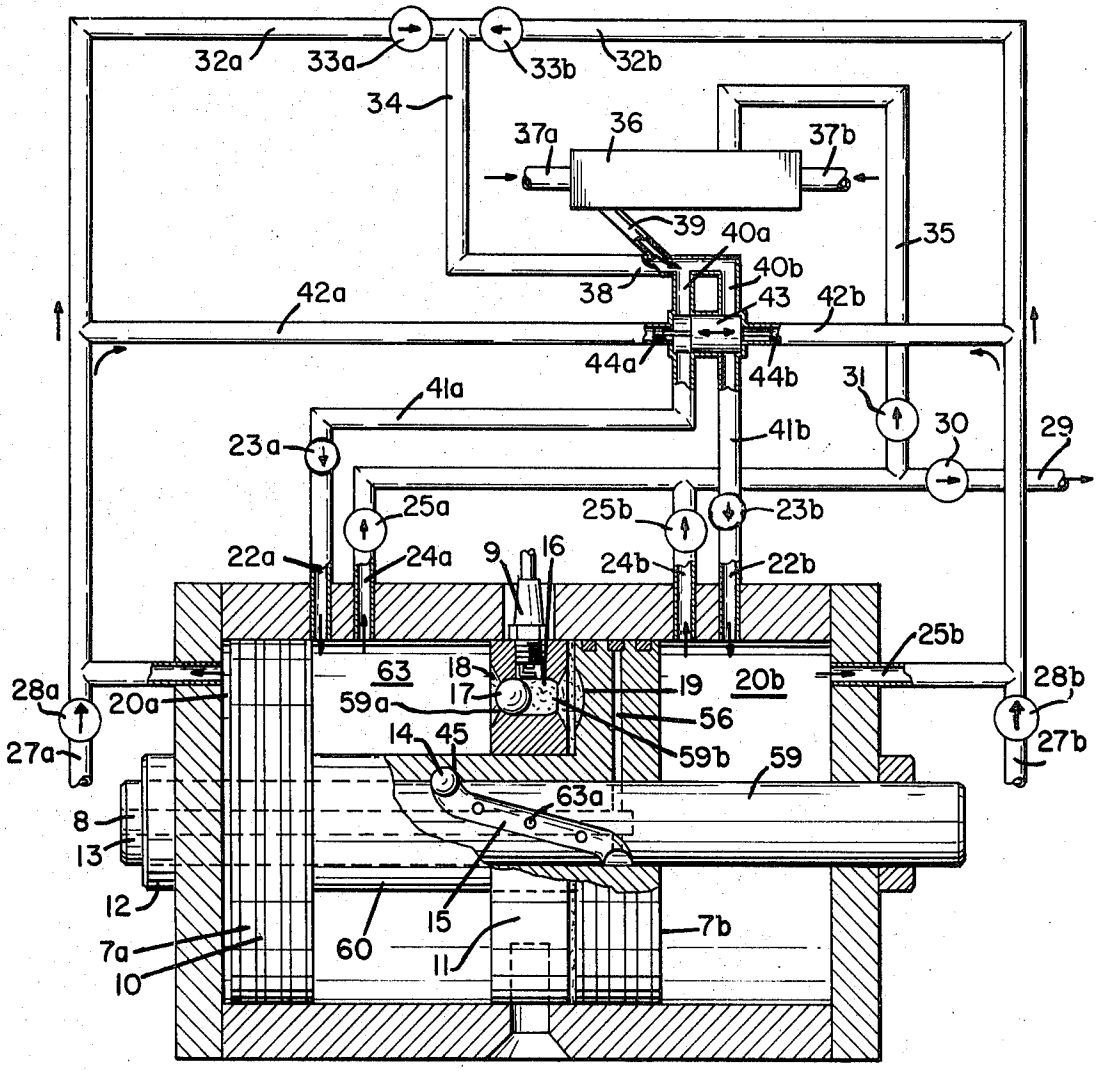

32a
33a
33b
32b
34
37a
36
37b
39
40a
35
40b
38
43
42b
42a
44a
44b
31
41a
41b
30
29
23a
25a
25b
23b
22a
24a
9
16
24b
22b
25b
28a
20a
63
18
17
19
20b
28b
59a
56
14
45
59b
59
27a
27b
63a
8
13
12
7a
10
60
15
11
7b

Fig. 5.

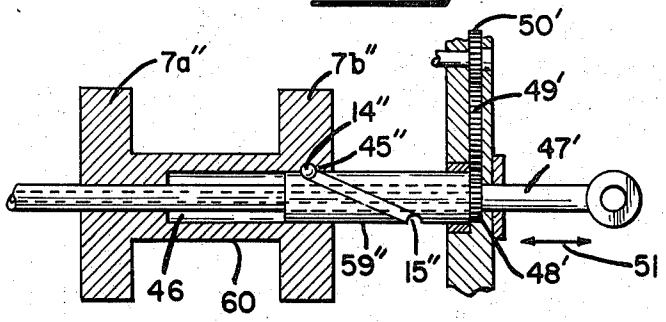

50'
7a"
7b"
49'
14"
45"
47'
46
60
59"
15"
48'
51

Fig. 6.

DOUBLE-CHAMBERED RECIPROCATABLE DOUBLE-ACTION-PISTON INTERNAL COMBUSTION ENGINE

This invention relates to an internal combustion reciprocating piston engine.

BACKGROUND OF THE INVENTION

Prior to the present invention there have existed numerous internal combustion engines for obtaining either reciprocating motion or rotary motion. In order to obtain these motions, it has generally been necessary to have a particular type structure adapted to specifically solely reciprocal motion or alternatively adapted solely to rotary motion. Moreover, in the prior internal combustion engines having pistons which move in reciprocating motion, the return motion has been conventionally by fly wheel inertia or by the driving of a crank by another of a plurality of other pistons acting in coordinated firing such as to push the crank onto another degree of revolution acting on the piston already fired, as well as each of the separate pistons requiring its own individual firing or ignition mechanism, together with valves therefor, and the like.

Also, in prior internal combustion engines, only by way of separate air compressors possibly receiving by various interconnecting levers a driving force from the drive shaft of the pistons of the internal combustion engine, have the prior engines been able to have and utilize air compressors for improving the efficiency and operation of the motor with regard to the carburetor, fuel input, and the like.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to overcome one or more of the inadequacies, shortcomings, and difficulties and problems of prior internal combustion engines, together with the obtaining of new and desirable advantages.

Another object is to obtain an internal combustion engine in which space is conserved by virtue of compactness and a new design of the present invention.

Another object is to obtain a new and more efficient internal combustion engine resulting from both the design of the combustion chambers, pistons, drive mechanisms, together with improved carburetor fuel mixing and input into the engine itself.

Other objects become apparent from the preceding and following disclosure.

One or more objects of the present invention are obtained by the invention as defined herein.

Broadly the present invention includes axially aligned with one another, two piston cylinders and pistons reciprocatably mounted in the respective piston chambers for unison reciprocation simultaneously in common directions with a common combustion chamber between and separating the opposing consecutive pistons, the combustion chamber including an ignition spark plug and a chamber valve preferably of a roll-ball valve which shifts from one outlet-inlet port adjacent one piston chamber to an opposite end of the combustion chamber to the port communicating with the opposing piston chamber. Upon the approach of one piston by virtue of the opposing piston moving away from the combustion chamber by virtue of expanding gases expanding by virtue of the heat of expansion from ignition within the combustion chamber, the approaching

movement of the one piston serves to compress newly introduced fuel vapors. Eventually as the approaching cylinder reaches the piston chamber end communicating with the combustion chamber, the compressed gases will be substantially compressed within the combustion chamber immediately prior to ignition thereof by the spark plugs. Upon ignition, the piston is thereby pushed to its far end of the piston chamber by virtue of the expanding gases of combustion and as it nears the end of its distal-end cycle, the approaching other cylinder has compressed the newly introduced fuel gases such that the ball-valve is shifted to the opposite end of the combustion chamber. During its respective cycle, each of the pistons when moving toward the combustion chamber serves to draw into the portion of the chamber from which it is moving air through a conduit having an air intake one-way valve therein and upon return movement of the piston toward the far end of the piston chamber (away from the combustion chamber) the air on the side of the piston away from the combustion chamber is compressed in this preferred embodiment and forced into a conduit through a one-way valve to and into the carburetor fuel-air mixing chamber and/or into a vacuum-creating venturi in which the vacuum portion of the venturi is connected to the carburetor outlet, and the outlet of the venturi is connected with a conduit embodying a valve for alternately feeding fuel mixture to opposing piston chambers in timed relationship, each conduit leading to the respective piston chamber including a one-way valve. Also preferably a portion of the compressed air is utilized to cause the shifting of the fuel-input valve following the carburetor and venturi such that upon compression of the air the valve by virtue of piston action is shifted to open one conduit leading to one piston chamber and to close an alternate conduit leading to the other piston chamber and vice versa. In addition to the forced-air input, there may be additional one or more intakes for air in the carburetor. Preferably the exhaust gases from the respective piston cylinders are channeled through one-way valve containing conduits preferably joined after the one-way valves into a common conduit which divides into two separate conduits thereafter, each of the separate conduits having one-way valves therein, and one of the conduits being an exhaust conduit to outside atmosphere while the other conduit feeds a portion of the exhaust gases — together with incomplete-combustion gases — into the conduit feeding the carburetor and/or into the carburetor as a means of recycling the portion of the combustion gases thereby accomplishing two purposes. First of all the recycled portion of the combustion gases at least partially re-burns incompletely burned combustion gases, and secondly the heated combustion gases fed into the carburetor serve to preheat the fuel mixture for more complete combustion of the fuel mixture upon its reaching the respective piston chambers prior to compression and combustion thereof.

It is to be understood that the reciprocating engines, fixedly attached to one another in order to achieve the simultaneous motion and in order that the forced movement of one drags along the other to achieve the compression of its particular fuel mixture, may be utilized for the production of either reciprocating shafts and/or reciprocal shafts, either of which motions may be utilized according to conventional principles as a source of locomotion or other power. Accordingly, the

physical structure associated with the slidable pistons may act on balls, or other bearing-like surfaces which in association with a grooved shaft impart rotary motion to the shaft, or alternatively the shaft itself may be fixedly attached to the piston structure and slidable reciprocatably for the power-motion to be utilized in conventional manner.

By virtue of the present invention, a power stroke is achieved with each end movement of the interconnected pistons, offering substantial increase in horse power and the absence of lost motion, and improved compression ratio, as well as other advantages discussed above. The present invention although primarily contemplated for gasoline combustion may be utilized for diesel ignition also.

In further enumeration of advantages, the present invention is such that each stroke is a power stroke, thereby eliminating power-stealing strokes and wasted stroke motion. The fact that there is no waste of strokes or motion, offers more power and higher compression ratio and smoother operation with less vibration. The fact that there is more power with less lost motion means that there is better economy. The higher compression offers better burn-out and results in the higher horse power. Also the non-moving central combustion chamber being mounted between the opposing moving pistons provides for combustion in both directions to and fro of a spool-type piston. Additionally as set forth above, the particular invention provides for air compression chambers on the outside of the spool flanges to produce compressed air for injection and emission of gases. Each single stroke of the present invention comprises economy and efficiency, consisting of fuel and air mixture, injection of fuel mixture, conversion and combustion and emission of gases. Each stroke thereby is the equivalent of about four strokes of the conventional cam shaft engine. The engine is adaptable to either air or liquid cooling. With regard to styles and arrangement, there may be singular, linear, modular, or radial arrangements, thereby offering a large range of size and horse power. Although typically a spark plug is intended for the present invention, it is also possible to utilize the principle of combustion by virtue of residual heat generated by high compression. Accordingly, as well as accomplishing prior objects and advantages recited above, a principal object is the design of an internal combustion engine that has a simple design, is inexpensive to manufacture, readily accessible for maintenance and repair, has a smaller number of parts, is small and light in weight, has better burn-out for more efficient operation and increased horse power, and runs smoothly and dependably over a long period of time.

THE FIGURES

FIG. 1 illustrates a side cross sectional view of a first embodiment of the present invention, of a reciprocatable double-chambered spool-piston internal combustion engine and valve therefor.

FIG. 2 illustrates an in-part cross sectional view as taken along lines 2—2 of FIG. 1, in particular illustrating the internal gear mechanism controlling the valves.

FIG. 3 illustrates a cross sectional view as taken along lines 3—3 of FIG. 2, further illustrating the relationship of the valve mechanism.

FIG. 4 illustrates an in-part side view of the valve mechanism and gearing of FIG. 1 and FIG. 2.

FIG. 5 illustrates a side in-part cross sectional and in-part cut-away view of a second major embodiment of the present invention including connections and conduit and valves associated with the carburetor.

FIG. 6 illustrates a cross sectional in-part view of an alternate mechanism of the embodiment of FIG. 1, the FIG. 6 embodiment serving to result in rotary motion for driving the gears while concurrently resulting in reciprocating motion as the main driving motion emanating from the combustion engine of a design of that of FIG. 5, which is otherwise similar to that of FIG. 1 which obtains a rotary driving motion.

DETAILED DESCRIPTION OF THE INVENTION

For purposes of this detailed description, reference shall first be made to the embodiment of FIG. 5 in a broad discussion of the present invention and the principle of operation of the inventive motor. With reference to FIG. 5, there is disclosed a spool type piston 7, an oil chamber 8 having oil holes to lubricate the shaft, the track, and the piston, a spark plug 9, sealing rings 10, the non-moving central combustion element 11, the securing nut 12, the cylindrical rod 13 having surface 59 and defining the chamber 8 therein, a motion-following power-transmitting ball 14 fitting within cavity 45 of member 60 connecting opposite ends 7*a* and 7*b* all making up the spool 7. The ball 14 is ridable in a channel 15 helically winding to and fro around the surface 59 such that reciprocatable motion of the member 60 slidably around the surface 59 imparts a rotary motion to the surface 59 of the rotatable member 13. Combustion chamber 16 is shaped such that valve-ball 17 is rollable to and fro between mouth 59*a* and 59*b* of the chamber 16, the mouth 59*a* and 59*b* each being of a smaller cross sectional diameter than the diameter of the ball such that compressive force behind the ball in cavity 63 (between opposing ends 7*a* and 7*b*) serves to push the ball into an opposite end of chamber 16 into the locked position blocking mouth 59*b* . Whenever ignition takes place of compressed gases within the chamber 16 as a result of a spark from spark plug 9, the expansive explosive force holds the ball 17 within its seat while forcing outwardly from the chamber 16 the most-adjacent wall 7*a* or 7*b*, causing the spool to slide in first one direction and then in an opposite direction when the ball shifts to the opposite end of the chamber as a result of compression being brought about by the approaching wall 7*a*, as it moves towards the ball 17 and as the compression within the combustion chamber and the expanding space between the wall 7*b* being moved away therefrom continues to diminish. The space 18 located adjacent each chamber and the space 19 located in the face of each of member 7*a* and 7*b* serve to provide additional areas against which compressed and/or expanding gases may act as well as providing a minimal additional volume in which the fuel-air mixture is compressed and from which expansion takes place upon ignition. Each of the enclosed spaces 20*a* and 20*b* adjacent opposite ends of the walls 7*a* and 7*b* respectively become alternately compressed or expanded within the mounting structure 21. Air-gas mixture is flowable through inlet 22*a* and 22*b* respectively alternately, back flow in these alternate fuel mixture inlets is prevented by one way valves 23*a* and 23*b*. The selection as to which of inlets 22*a* and 22*b* shall at any particular time be receivable of fuel mixture from the carburetor 36 is dependent upon reciprocatable valve

43 with its pistons 44*a* and 44*b* acted upon by compressed air flowing from chambers 20*a* and 20*b* respectively as dependent upon compression of spaces 20*a* and 20*b* forcing air outwardly through outlets 26*a* and 26*b*. It is during the expansion stage of the spaces 20*a* and 20*b* respectively that air intake is brought about through air intake conduits 27*a* and 27*b* through one way valves 28*a* and 28*b*. Compressive pressure of the compressed air causes the responsive pistons 44*a* and 44*b* to reciprocate the valve 43. However, the compressed air finds its outlet by travelling from the outlet 26*a* and 26*b* respectively through one way valves 33*a* and 33*b* respectively of conduits 32*a* and 32*b* which unite to form conduit 34 which serves to admix additional air with the fuel emanating from the carburetor outlet conduit 39, the conduit 34 being positioned relative to the conduit 39 such that a venturi 38 results from the rapidly moving gas through the conduit 34, causing a vacuum action on the conduit 39 to thereby withdraw fuel mixture through the conduit 39 from the carburetor 36. An additional air inlet 37*b* provides a predetermined amount of air to be premixed with the fuel admitted through carburetor fuel intake conduit 37*a*. Additionally, there is preferably a residual-combustion feed conduit 35 which receives exhaust gases from each respectively of exhaust gas outlets 24*a* and 24*b* through one way valves 25*a* and 25*b*. Valve 31 and valve 30 are set relative to each other such that a predetermined amount of total exhaust fumes is siphoned off through conduit 35 by virtue of exhaust pressures while the remainder of the exhaust fumes are vented through exhaust outlet 29. The siphoned-off exhaust fumes of conduit 35 are recycled through the carburetor 36 in which incompletely burned fumes are admixed with air entering through conduit 37*b* and with fuel entering through conduit 37*a*, the fuel mixture exiting through the fuel mixture carburetor outlet 39. Oil provided through conduit 8 makes its way through apertures 63*a* and through oiling channel 56, for example. The ring surfaces 10 are shown in cross section as bodies 57.

The embodiment illustrated in each of FIGS. 1, 2, 3, and 4 is an alternative to that of FIG. 5, the embodiments of FIGS. 1 through 3 and location and operation of valves as similarly numbered In particular, the revolvable shaft 47 is revolved as a result of the ball 45' riding in the indentation 14' of the spool wall 60' within the space 15' of the member 59'. The toothed annular member 48 mounted on the shaft 47 imparts rotary motion to the toothed wheel 49 which imparts rotary motion to the toothed wheel 50a which in turn imparts rotary motion to the toothed wheel 50b. The toothed wheel 50a imparts rotary motion to the shaft 54 while the toothed wheel 50*b* imparts rotary motion to the shaft 53. Shaft 53 includes an aligned passage 53a alignable at a particular point of revolution of the toothed wheel 50*a*, and similarly the member 54 is alignable of a passage 54*a* when toothed wheel 50b is appropriately located at a predetermined position in point of rotation. Accordingly the shaft 53 and conduit 53*a* serves as a valve and similarly the shaft 54 and the conduit 54*a* serves as another valve. The valve 53 and 53*a* control the air inlet 22*b* through the chamber inlet 62 while the valve 54 and 54a controls the outlet of exhaust fumes through chamber outlet 61 through conduit 24*b*. There is a similar arrangement of valves on the far end of the shaft controlling the opening and closing of air inlet and exhaust outlets for the inlet 62' and exhaust outlet 61'. The one way valve 26*a*', 26*b*', 28*a*', and 28*b*' are simple ball-check valves.

FIG. 4 illustrates an in-part view of the valve containing shaft 54 and toothed wheel 50*b*. The embodiment of FIG. 6 differs principally only in the fact that the rotary motion is utilized solely for the perpetuation of a rotary drive of the toothed wheel 48' and the wheels in series therewith, such as 49', 50' and the like. Also, the shaft 47' is not a rotary shaft but is a reciprocating shaft by virtue of shaft 47' being fixedly attached to the spool wall 60'' and the spool wall 7a'' whereby the reciprocation of the wall 7a'' and 7b'' concurrently causes the shaft 47' to slidably reciprocate within the hollow cylindrical member 59'', and the space 46 to be slidably receivable of the surface 59 as the body 60'' reciprocates to and fro along the surface 59''.

It should be understood that the various embodiments of the present invention illustrated herein are not intended to be all inclusive but are merely selective embodiments typically representing the present invention for the better understanding thereof. Accordingly, it is within the scope of the present invention to make such modifications, alterations, substitution of equivalents, and the like as would be apparent to a person skilled in this particular field.

I claim:

1. An internal combustion engine device comprising in combination: a structure defining two consecutive piston cells in series with one another separated by a common ignition chamber having opposite outlets into each of the opposing piston chambers; a valve means for closing one of said outlets while opening the other and for closing the other of said outlets while opening said one outlet alternatively; an ignition means mounted within said ignition chamber; a first piston mounted in one of the two piston chambers and a second piston mounted in the second of said piston chambers; their being a through aperture between a first of said piston chambers and the second of said piston chambers through the separating ignition means; interconnecting rigid structure connecting the first and second pistons together for common synchronized reciprocating motion; and each chamber having a fuel inlet and an exhaust outlet.

2. A device of claim 1, in which said valve comprises a spherical ball-valve seatable alternately in each of said ignition chamber outlets, said ignition chamber being structured such that said ball-valve is movable from one of the outlets to the other outlet of the ignition chamber and from the other outlet to the one outlet responsive to pressure of compressed gases upon movement of a piston toward said ball-valve.

3. A device of claim 2, in which said ignition means includes a spark plug arranged to be ignitible of compressed fuel mixture within said ignition chamber.

4. A device of claim 3, including a drive shaft means for transmitting motion of said pistons when reciprocating to a motion-utilization means.

5. A device of claim 4, including a motion-conversion means for converting reciprocal motion of said pistons to rotary motion of said drive shaft.

6. A device of claim 5, in which each of said piston chambers includes additionally a compressed gas outlet in addition to said exhaust fas outlet.

7. A device of claim 6, including conduits interconnecting said compressed gas outlet with an air-fuel car-

buretor, together with valve means for permitting intake of air and for directing compressed air to the carburetor, and for permitting the escape of excessive pressure from the closed conduit system, and for directing a predetermined amount of compressed air to a venturi system facilitatable of movement of gases through the carburetor, and for recycling a predetermined precentage of exhaust gases through said carburetor in admixture with compressed gases being passed through the carburetor.

8. A device of claim **7**, including a flip valve means alternately feeding fuel mixture from the carburetor to the first and then the second of the two piston chambers.

9. A device of claim **8**, in which movement of said pistons toward said ignition chamber is compressible of fuel-mixture gases within the respective piston chamber, is by virtue of the compressed gases causative of the ball-valve to move away from the approaching piston and to seal the outlet of the ignition chamber away from the approaching piston, and is compressible of the fuel-mixture within said ignition chamber between the approaching piston and the ball-valve.

10. A device of claim **4**, in which said drive shaft is attached fixedly to said first and second pistons and is slidably axially movable in reciprocating motion by reciprocating movement of the pistons.

11. A device of claim **5**, including toothed circular gears and rotary valve means for timed feeding of fuel to said combustion chamber for exhausting residual combustion gases from the combustion chamber, said circular gears being operatively mounted for imparting rotary motion of said shaft to said rotary valve means.

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