Nov. 28, 1944. G. N. REILAND 2,363,804

TWO DIRECTIONAL COMBUSTION ENGINE

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Fig. 1.

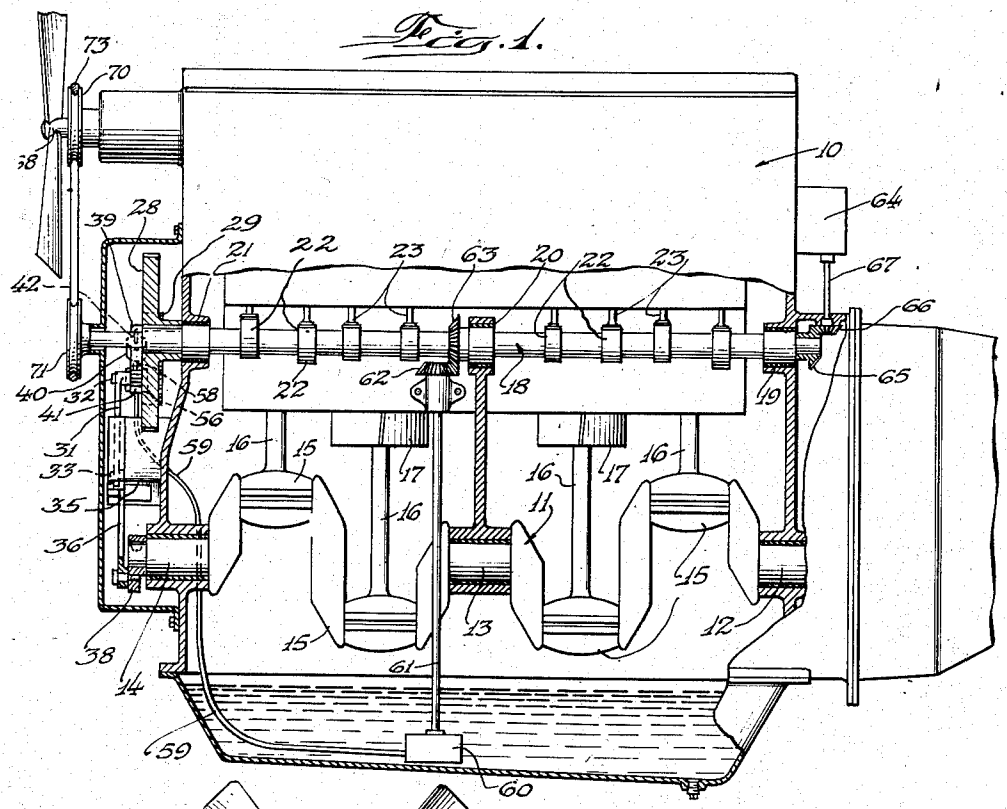
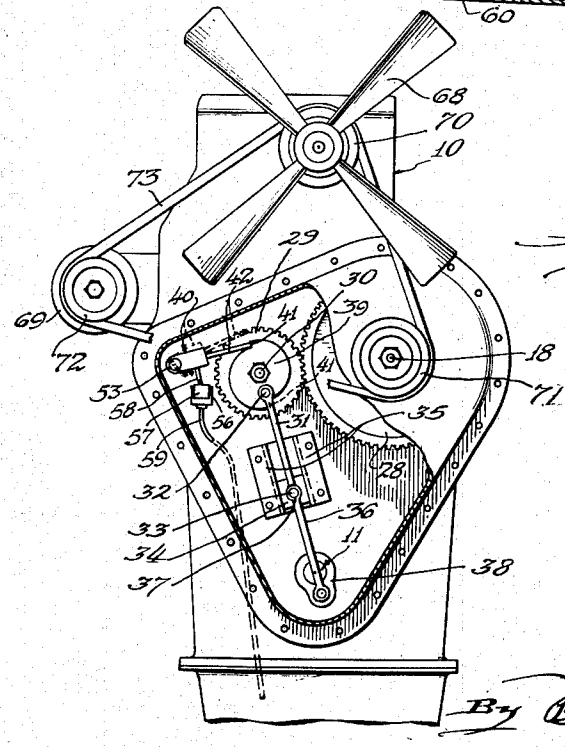


Fig. 2.



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Fig. 3.

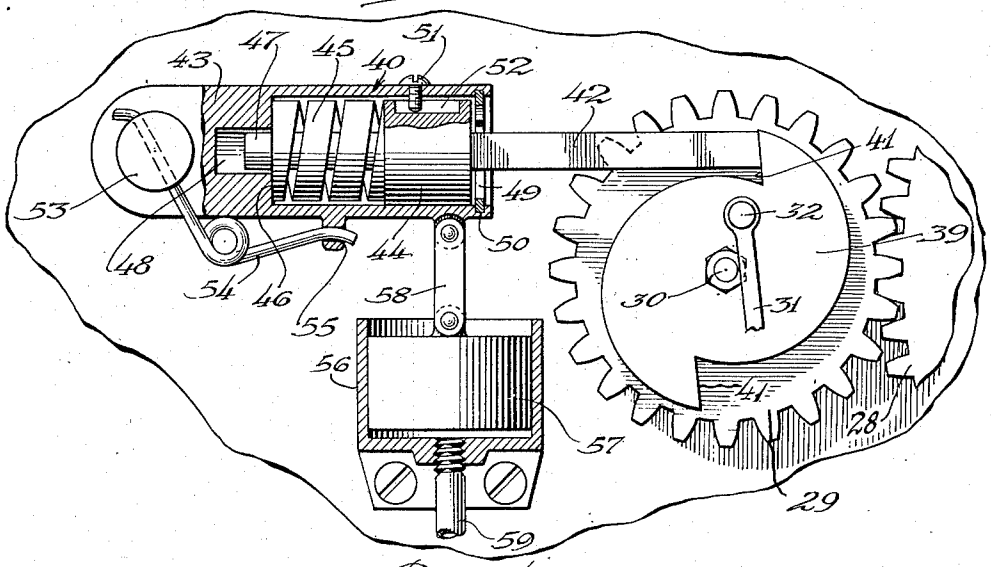
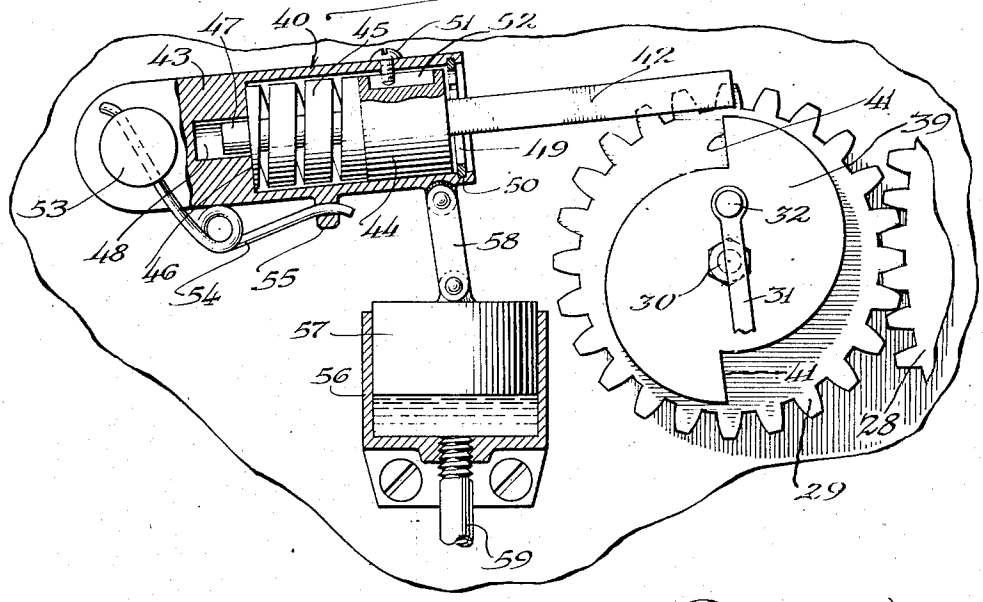


Fig. 4.



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Fig. 8.

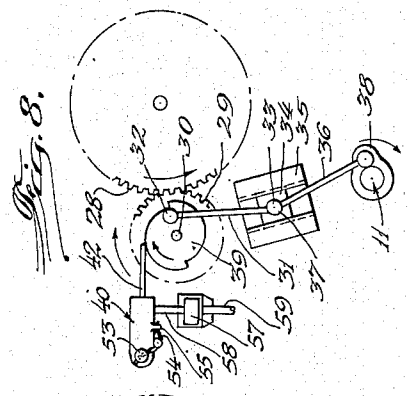


Fig. 12.

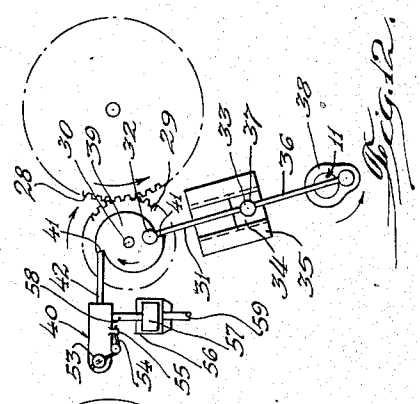


Fig. 7.

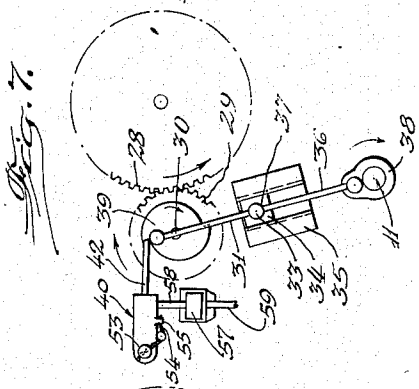


Fig. 11.

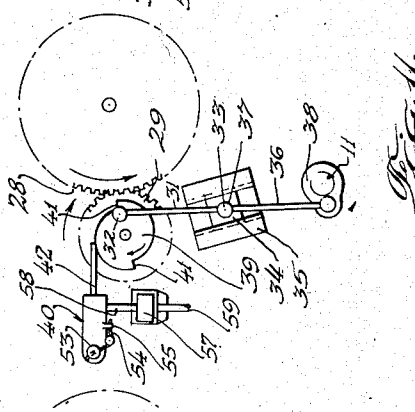


Fig. 6.

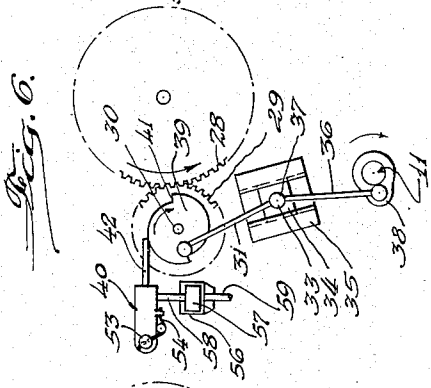


Fig. 10.

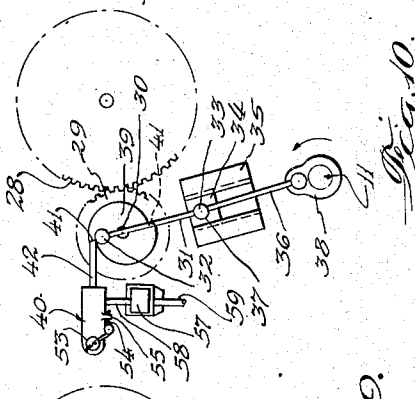


Fig. 5.

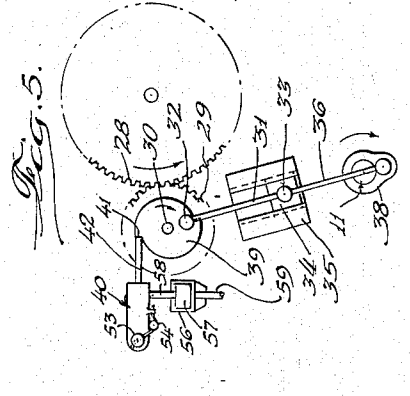
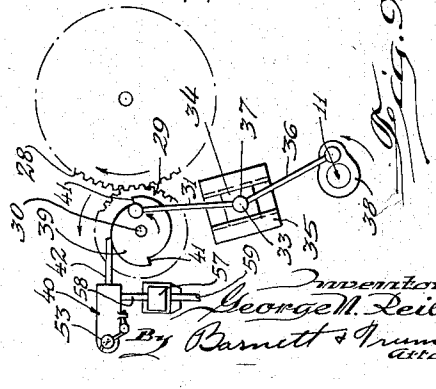


Fig. 9.



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Patented Nov. 28, 1944 2,363,804

UNITED STATES PATENT OFFICE

2,363,804

TWO DIRECTIONAL COMBUSTION ENGINE

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Application March 20, 1943, Serial No. 479,832

15 Claims. (Cl. 123—41)

This invention relates to new and useful improvements in combustion engines, and particularly to engines of the general class in which the power shaft may be operated in clockwise and also in counter-clockwise direction as may be desired.

With the exception of a few internal combustion marine engines which include complicated and expensive mechanism for reversing their direction of operation, most combustion engines operating on the spark ignition or Diesel principle have no provision for reversing the operating direction of their power shafts. Any reversal of power is effected by reverse gears adapted to be clutched to the power shafts. This condition has prevailed in spite of the fact that combustion engines having the capacity for reversing the operating direction of their power shafts present distinct advantages, in many situations, over the conventional structures in which the power shafts rotate in only one direction. There is also a distinct advantage in operating any type of internal combustion engine in opposite directions, in that the wear on the bearings and various movable parts of the engine will be more equally distributed, whereas in the one directional engine the wear, to a large extent, is localized, because of the thrusts and pressures exerted on the parts, for example on the bearings, shafts, pistons and cylinder walls, because of the continuous operation of the engine in one direction.

The present invention appertains particularly to the provision of improvements in two directional engines, and has as one of its principal objects the provision, in an engine of the above general class, improved constructions and arrangements of cooperating parts whereby the power shaft of the engine may be rotated in either clockwise or counter-clockwise directions, as may be desired, without changing the normal operating direction of the valve operating and ignition mechanisms or other operating parts of the engine.

Another and more specific object of the invention is to provide, in a combustion engine having a crank shaft operable in either forward or reverse directions, a simplified driving connection between the engine power shaft and the valve operating the ignition means, whereby these mechanisms, as well as the other operating devices adapted or required to be operated in timed relation to the movement of the engine pistons, may be driven in predetermined directions regardless of the direction of movement of said power shaft. In this connection, the invention contemplates the provision of a reciprocating connection between the engine power shaft and a revoluble element for imparting continuous movement in the desired directions, to the said valve operating and ignition mechanisms.

Another object is to provide in a mechanism of the above character, a buffer device which will be effective to limit reverse movement of the said valve operating and ignition mechanisms and which, in the event of such limited reverse movement, will be effective to start the said mechanisms moving in the desired directions.

A further object is to provide, in combination with a buffer device adapted to function as above mentioned, means automatically effective to move the buffer device out of its operating position when the engine attains a predetermined speed and which will permit the said buffer to assume its operating position when the engine operation is slower than said predetermined speed.

Other objects and advantages of the invention will be apparent from the detailed description of one preferred embodiment shown in the accompanying drawings.

In the drawings

Fig. 1 is a side view, partly in section, of an internal combustion engine constructed and adapted to operate in accordance with the principles of this invention.

Fig. 2 is a front view, with parts broken away, to illustrate a suitable means for operatively connecting the power shaft of the engine with a revoluble member for imparting one directional movements to the valve operating and ignition mechanisms of the engine.

Fig. 3 is a vertical section through a detent mechanism made in accordance with this invention and cooperating with the said revoluble member to insure one directional movement of the valve operating and ignition mechanisms without regard to the direction of movement of the power shaft.

Fig. 4 is a view similar to Fig. 3 but showing the detent moved out of the path of movement of said revoluble member.

Figs. 5, 6, 7 and 8 are diagrammatic views illustrating the full cycle of the engine's operation in one direction; and

Figs. 9, 10, 11 and 12 are diagrammatic views illustrating the manner in which the detent mechanism functions to insure movement of the valve and ignition mechanism in the proper direction when the power shaft is operated in the reverse direction.

The improvements of the present invention are

shown in Figs. 1 and 2 embodied in an internal combustion engine which, for the most part, is of conventional construction. It is a four cylinder spark ignition engine constructed to operate on the four-cycle principle. This particular type of engine, however, is shown merely as a convenient structure for illustrating the principles of the present invention and is not intended as a limitation.

The engine herein shown includes a cylinder block 10, a power shaft 11, journaled in suitable bearings 12, 13 and 14 and provided with the usual crank portions 15. The piston connecting rods 16 are connected to the crank portions of the power shaft and to suitable pistons 17 which operate in the usual and well known manner to compress the fuel and transmit the force of the combustion thereof to the power shaft.

The cam shaft for opening the inlet and exhaust valves associated with the several cylinders of the engine is indicated at 18. It is journaled in bearings 19, 20 and 21, and is formed with eight cams designated collectively by the numeral 22, for actuating the valve tappets 23. The cam shaft and ignition mechanisms in most engine structures now made for general use are normally operated in a predetermined direction, the cam shaft being operated by gear or belt connections with the power shaft. With such constructions, reverse movement of the crank shaft also reverses the operation of the valves and the ignition mechanisms. Consequently, such engines will not operate in a reverse direction.

In the present invention, the cam shaft 18, the ignition distributor 64, the oil pump 60, the fan 66 and the generator 69 are all operated in a continuous direction, and at the same time permit the power shaft of the engine to operate in forward or reverse direction, as may be desired.

The above results are accomplished by means of the following connections: The cam shaft 18 is provided with a timing gear 28 which meshes with a smaller gear 29. The smaller gear is mounted on a suitable stub shaft 30, extending outwardly from the cylinder block 10. In engines of the four cycle type, as herein illustrated, the gears 28 and 29 have a two to one ratio so that the smaller gear will make two full revolutions for each revolution of the larger gear. The small gear 29 is operatively connected to the power shaft of the engine so as to make one complete revolution for each revolution of the power shaft. This connection includes a connecting rod 31, pivotally suspended from a crank pin 32 which has a fixed relation to the gear 29. The other end of the rod 31 is pivotally connected at 33 to a reciprocating slide member 34. The said slide member is supported in suitable guideways 35—35, so as to avoid any lateral movement and is provided with a connecting rod 36 or other suitable means for engaging a portion of the crank shaft adapted to impart reciprocating movement to the slide member.

In the present embodiment, the connecting rod 36 is pivotally connected at one end to the slide at 37 and its other end is connected to a short crank portion 38, formed at the forward end of the power shaft 18. The length of the crank portion 38 of the power shaft corresponds to the distance from the center of the crank pin 32 to the longitudinal axis of the stub shaft 30. It will be apparent, therefore, that when the engine crank shaft is in a dead center position relative to the piston rods 16, the connecting rods 31 and 36 will be aligned with each other and in similar dead center position. However, the relative positions of the cranks 11 and 38 may be shifted, if desired.

When the engine crank shaft is in dead center position, the shaft may be rotated in either clockwise or counterclockwise directions without affecting the normal movement of the engine piston.

When the engine crank shaft is in dead center position relative to the connecting rods 31, 36 and the small gear 29, the crank shaft may be rotated from such position in either forward or reverse directions. However, in order to insure continued one directional movement of the gears 28 and 29, a locking cam 39 is carried by the gear 29 and adapted to cooperate with a detent 40 so as to prevent reverse movement of the gears 28 and 29 beyond the point corresponding to the dead center position of the crank shaft 18.

The cam is formed with a suitable number of abutment shoulders 41 adapted, during a reverse movement of the crank shaft to a dead center position, to engage the outer end of a buffer member 42 of the said detent. Preferably, the abutment shoulders 41 and the end of the buffer member 42 are inclined from the vertical plane, as indicated best in Figs. 3 and 4, so that the said abutment shoulders 41 will bear flat against the inclined end surface of the buffer member 42 before the cam is moved to a position corresponding to the dead center of the crank shaft. The buffer member 42 of the detent is supported in the housing 43 with capacity for lengthwise movement. An enlargement 44 substantially fits a cylindrical recess in the housing 43 and serves as an abutment for one end of coil spring 45 interposed between the said enlargement 44 and the bottom face 46 of the cylindrical recess. The buffer member 42 is also provided with a reduced portion 47 which enters a center bore 48 in the housing 43 and serves as a stop to limit the inward movement of the buffer member. The length of the buffer member is such that the portion 47 will engage the bottom surface of the bore 48 so as to stop the lengthwise movement of the buffer when, during a reverse movement of the cam 39, either shoulder 41 is brought to a position corresponding to the dead center position of the crank 38 relative to the connecting rod 36. The force exerted by the compressed spring 45, therefore, tends to move the cam 39 in a clockwise direction as soon as the crank 39 moves beyond its said dead center position. The buffer member is retained within the housing by means of a split resilient ring 49 which fits in a groove 50 formed on the inner surface of the cylindrical recess near the outer end of the housing. The buffer member may be held against rotation within the housing by any suitable means; for example, a screw 51 may extend through the housing 43 into a slot 52 formed in the enlargement 44. The detent 40 is pivoted on a stud 53 which extends outwardly from the engine block and is biased toward its cam engaging position by means of a spring 54 extending through an opening in the stud 53 and having its other end extending through an opening in the lug 55 formed on the detent casing. In order to avoid the tapping sound which may result from the buffer member 42 dropping off the outer end of the shoulder 41 of the cam as the cam is rotated in a clockwise direction, provision is made to move the detent out of the path of travel of the shoulder 41 after the engine has attained a predetermined speed. Various devices may be used for accomplishing this result. However, in the present embodiment a simplified

means is shown for accomplishing the above purpose which consists of a cylinder **56** adapted to be fixed to the engine block. A piston **57** is fitted within the cylinder and is connected by means of a connecting link **58** with the housing **43** of the detent **40**. A conduit **59** leads from the lower portion of the cylinder **56** to an oil pressure pump **60**, positioned at any suitable location within the crank casing of the engine. The oil pump is preferably driven by means of a shaft **61** provided at its upper end with a gear **62** which meshes with a gear **63** on the cam shaft. It will be obvious, however, that the pump **60** can be driven from any other suitable operating member of the engine so as to force the oil from the crank case into the cylinder **56** beneath the piston **57** so as to move the detent mechanism **40** from the position shown in Fig. 3 to the position shown in Fig. 4 of the drawings. The oil pressure is used for this purpose in the present embodiment so that the detent **40** will remain in the position indicated in Fig. 3 until the engine has attained a sufficient speed to build up an oil pressure in the said cylinder **56**. As soon as the speed of the engine falls below that required to provide the necessary oil pressure, the detent will move to its normal position as indicated in Fig. 3.

The operation of the improved mechanism of this invention will be readily apparent from inspection of the diagrams shown in Figs. 5 to 12, inclusive. The diagrams shown in Figs. 5 to 8, inclusive indicate respective positions of the parts when the engine crank shaft is rotated in a clockwise direction, for example when the engine is starting and before it has acquired sufficient speed to elevate the detent **40**. Fig. 5 shows a dead center position of the crank shaft with the buffer rod **42** in engagement with the shoulder **41** of the cam member **39**. The rotation of the engine crank shaft **11** in the clockwise direction will necessarily move the cam **39** in the direction indicated by the arrow in Fig. 6 since it can not rotate in any other direction because of its engagement with said buffer rod **42**. At the end of one-half revolution of the crank shaft the pivoted rods **31**, **36** are again in a dead center position, but the fixed rotation of the cam **39** will continue in a clockwise direction for the same reason as previously mentioned in connection with Fig. 5. Assuming that the engine has come to rest in the position indicated in Fig. 9, and the crank shaft is rotated in a reverse direction so as to start the counter-clockwise operation of the engine, the cam member **39** is rotated in a reverse direction from the position shown in Fig. 9 to the position shown in Fig. 10 so as to bring one of its shoulders **41** against the buffer **42**. From this position the crank shaft **11** and the connecting rod **36** will continue in a counter-clockwise direction, but the cam **39** will thereafter move in a clockwise direction as shown in Figs. 11 and 12.

The ignition distributor **64** is driven by means of a direct connection with the cam shaft **18**. This connection comprises preferably a beveled gear **65** on the cam shaft which meshes with the beveled gear **66** on the distributor shaft **67**. All other operating parts, including the fan **68** and the generator **69** which are normally driven in one direction, are preferably driven by connections with the cam shaft, such, for example as pulleys **70**, **71** and **72** and belt **73**.

By reason of the reciprocating connection between the power shaft of the engine and the one directional revoluble members, such as the valve operating means and the ignition means, it will be readily understood from the previous description of the diagrams in Figs. 5 to 12, inclusive, that the combustion in the engine cylinder may take place at either side of the dead center position of the crank shaft and have the same relationship with the down-stroke of the pistons regardless of whether the crank shaft is rotated in a clockwise or in a counter-clockwise direction. With the timing device connection to operate from the cam shaft, as previously described, the operation is set for what may be considered perfect operation in one direction of the engine. This condition will prevail in exactly the same manner for operation of the engine in the reverse direction.

While one preferred embodiment of the invention is illustrated in the accompanying drawings, it will be understood that various modifications in structure, including different arrangements and the use of equivalent devices for accomplishing the same result as herein described, may be made without departure from the principles of this invention. It will be understood, therefore, that this invention contemplates all such modifications and equivalents which come within the scope of the appended claims.

I claim:

1. In combination with the power shaft of an internal combustion engine and a revoluble member for imparting movements to other parts of the engine in timed relation to the movement of the power shaft; means for operatively connecting the power shaft with the revoluble member and buffer means positioned in the path of movement of said revoluble member for preventing movement thereof beyond a predetermined position in one direction regardless of the direction of the movement of the power shaft.

2. In combination with the power shaft of an internal combustion engine and a revoluble member for imparting movements to other parts of the engine in timed relation with the movement of the power shaft; reciprocating means for operatively connecting the power shaft with the first revoluble member, and buffer means positioned in the path of movement of said revoluble member for preventing movement thereof beyond a predetermined position in one direction regardless of the direction of movement of the power shaft.

3. In combination with the power shaft of an internal combustion engine and a revoluble member for imparting movements to other parts of the engine in timed relation with the movement of the power shaft; means for operatively connecting the power shaft with the revoluble member, a buffer means positioned in the path of movement of said revoluble member and effective during the initial movement of the power shaft of the engine to limit reverse movement of said revoluble member to a predetermined position.

4. In combination with the power shaft of an internal combustion engine and a revoluble member for imparting movements to other parts of the engine in timed relation with the movement of the power shaft; reciprocating means for operatively connecting the power shaft with the movabel member, buffer means positioned in the path of said revoluble member for limiting reverse movement thereof during the initial operation of the engine, and means automatically effective, when the engine attains a predetermined speed, to move said buffer out of the path of movement of said revoluble member.

5. In combination with the power shaft of an internal combustion engine and a revoluble member for imparting movements to other parts of the engine in timed relation with the movement of the power shaft; reciprocating means for operatively connecting the power shaft with the movable member, a resilient buffer positioned in the path of movement of said revoluble member for preventing movement thereof beyond a predetermined position in one direction regardless of the direction of movement of the power shaft, and means automatically effective, when the engine attains a predetermined speed to move said buffer out of the path of movement of said revoluble member.

6. In combination with the power shaft of an internal combustion engine and a revoluble member for imparting movements to other parts of the engine in timed relation with the movement of the power shaft; reciprocating means for operatively connecting the power shaft with the movable member, a pivoted buffer positioned in the path of movement of said revoluble member for preventing movement thereof beyond a predetermined position in one direction during the initial operation of the engine, a fluid pressure means for moving the said buffer out of the path of movement of said revoluble member, when the engine attains a predetermined speed.

7. In combination with the power shaft of an internal combustion engine, which shaft is revoluble in opposite directions, and the valve operating and ignition mechanisms; means for operatively connecting the power shaft with said mechanisms comprising a reciprocating means operatively engaging the power shaft and said valve operating mechanism, means including a revoluble member associated with the valve operating mechanism, and a pivoted detent cooperating with said revoluble member for preventing movement of said valve operating means beyond a predetermined position in one direction.

8. In combination with the power shaft of an internal combustion engine, which shaft is revoluble in opposite directions, and the valve operating and ignition mechanisms; means for operatively connecting the power shaft with said mechanisms comprising a reciprocating means operatively engaging the power shaft and said valve operating mechanism, means including a revoluble member associated with the valve operating mechanism and a pivoted detent cooperating therewith for preventing movement of said valve operating mechanism beyond a predetermined position in one direction, and means driven by the said valve operating mechanism and adapted, when the engine attains a predetermined speed, to move said detent out of its engagement with said revoluble member.

9. In combination with the power shaft of an internal combustion engine, which shaft is revoluble in opposite directions, and the valve operating and ignition mechanisms; means for operatively connecting the power shaft with said mechanisms comprising a reciprocating means operatively engaging the power shaft and said valve operating mechanism, means including a revoluble member associated with said valve operating mechanism and a pivoted detent cooperating therewith for preventing movement of said valve operating means beyond a predetermined position in one direction regardless of the direction of movement of said power shaft, and means driven by said valve operating mechanism and adapted, when the engine attains a predetermined speed, to move said detent out of its engagement with said revoluble member.

10. In combination with the crank shaft of an internal combustion engine, which shaft is revoluble in opposite directions, a cam shaft for actuating the inlet and exhaust valves of the engine and having operative connection with a revoluble member, whereby the cam shaft makes one half rotation for each rotation of said revoluble member; means for operating said cam shaft in timed relation to the crank shaft comprising a reciprocating slide, a connecting rod pivotally attached at one end to said revoluble member at a location spaced from its axis of rotation and having its other end pivotally attached to said slide, a second connecting rod pivotally attached to said slide member and having a crank attachment to said crank shaft, and means for insuring movement of the said cam shaft in a predetermined direction regardless of the operating direction of the crank shaft.

11. In combination with the crank shaft of an internal combustion engine, which shaft is revoluble in opposite directions, a cam shaft for actuating the inlet and exhaust valves of the engine and having operative connection with a revoluble member, whereby the cam shaft makes one-half rotation for each rotation of said revoluble member; means for operating said cam shaft in timed relation to the crank shaft comprising a reciprocating slide, a connecting rod pivotally attached at one end to said revoluble member at a location spaced from its axis of rotation and having its other end pivotally attached to said slide, a second connecting rod pivotally attached to said slide member and having a crank attachment to said crank shaft, and means for insuring movement of the said cam shaft in a predetermined direction regardless of the operating direction of the crank shaft, comprising a detent for limiting reverse movement of said cam shaft.

12. In combination with the crank shaft of an internal combustion engine, which shaft is revoluble in opposite directions, a cam shaft for actuating the inlet and exhaust valves of the engine and having operative connection with a revoluble member, whereby the cam shaft makes one-half rotation for each rotation of said revoluble member; means for operating said cam shaft in timed relation to the crank shaft comprising a reciprocating slide, a connecting rod pivotally attached at one end to said revoluble member at a location spaced from its axis of rotation and having its other end pivotally attached to said slide, a second connecting rod pivotally attached to said slide member and having a crank attachment to said crank shaft, and means for insuring movement of the cam shaft in a predetermined direction regardless of the operating direction of the crank shaft comprising a detent having a resilient buffer cooperating with said revoluble member to limit reverse movement of said cam shaft.

13. In combination with the crank shaft of an internal combustion engine, which shaft is revoluble in opposite directions, a cam shaft for actuating the inlet and exhaust valves of the engine and having operative connection with a revoluble member, whereby the cam shaft makes one-half rotation for each rotation of said revoluble member; means for operating said cam shaft in timed relation to the crank shaft comprising a reciprocating slide, a connecting rod pivotally attached at one end to said revoluble member at a loca-

tion spaced from its axis of rotation and having its other end pivotally attached to said slide, a second connecting rod pivotally attached to said slide member and having a crank attachment to said crank shaft, and means for insuring movement of the said cam shaft in a predetermined direction regardless of the operating direction of the crank shaft comprising a pivoted detent having a movable buffer rod cooperating with said revoluble member to limit reverse movement of said cam shaft, and a coil spring on the buffer rod adapted, in the event of reverse movement of said revoluble member to exert pressure against said member to force it in the desired direction.

14. In combination with the crank shaft of an internal combustion engine, which shaft is revoluble in opposite directions, a cam shaft for actuating the inlet and exhaust valves of the engine and having operative connection with a revoluble member, whereby the cam shaft makes one-half rotation for each rotation of said revoluble member; means for operating said cam shaft in timed relation to the crank shaft comprising a reciprocating slide, a connecting rod pivotally attached at one end to said revoluble member at a location spaced from its axis of rotation and having its other end pivotally attached to said slide, a second connecting rod pivotally attached to said slide member and having a crank attachment to said crank shaft, means for insuring movement of the said cam shaft in a predetermined direction regardless of the operating direction of the crank shaft comprising a cam carried by said revoluble member, a pivoted detent having a movable buffer rod for cooperating with said cam to limit reverse movement of the said cam shaft, a coil spring on the buffer rod adapted, in the event of reverse movement of said cam, to exert pressure against the cam to force it in the desired direction, and means effective when the engine attains a predetermined speed to move the detent free of said cam.

15. In combination with the crank shaft of an internal combustion engine, which shaft is revoluble in opposite directions, a cam shaft for actuating the inlet and exhaust valves of the engine and having operative connection with a revoluble member, whereby the cam shaft makes one-half rotation for each rotation of said revoluble member; means for operating said cam shaft in timed relation to the crank shaft comprising a reciprocating slide, a connecting rod pivotally attached at one end to said revoluble member at a location spaced from its axis of rotation and having its other end pivotally attached to said slide, a second connecting rod pivotally attached to said slide member and having a crank attachment to said crank shaft, means for insuring movement of the said cam shaft in a predetermined direction regardless of the operating direction of the crank shaft comprising a cam carried by said revoluble member, a pivoted detent having a movable buffer rod for cooperating with said cam to limit reverse movement of the said cam shaft, a coil spring on the buffer rod adapted, in the event of reverse movement of said cam, to exert pressure against the cam to force it in the desired direction, and means effective when the engine attains a predetermined speed to move the detent free of said cam comprising an oil pressure pump, a pressure actuated device connected to the detent, and a conduit connecting the pressure actuated device with the oil pump.

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