July 11, 1939. M. J. FARRELL 2,165,791

DRIVING MEANS FOR INTERNAL COMBUSTION ENGINES

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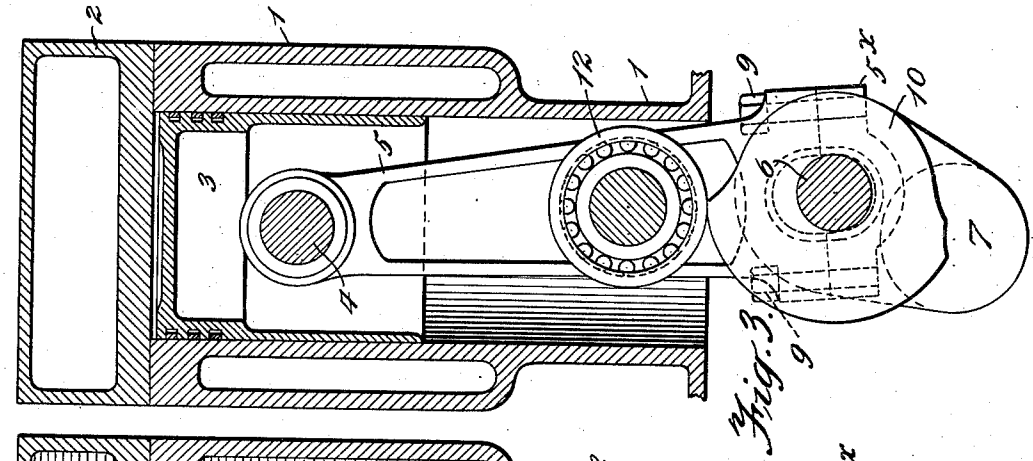


Fig. 3.

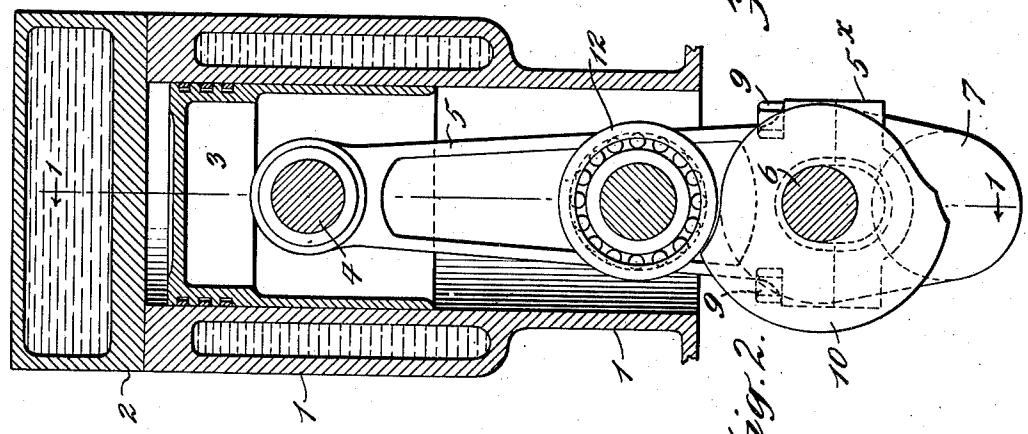


Fig. 2.

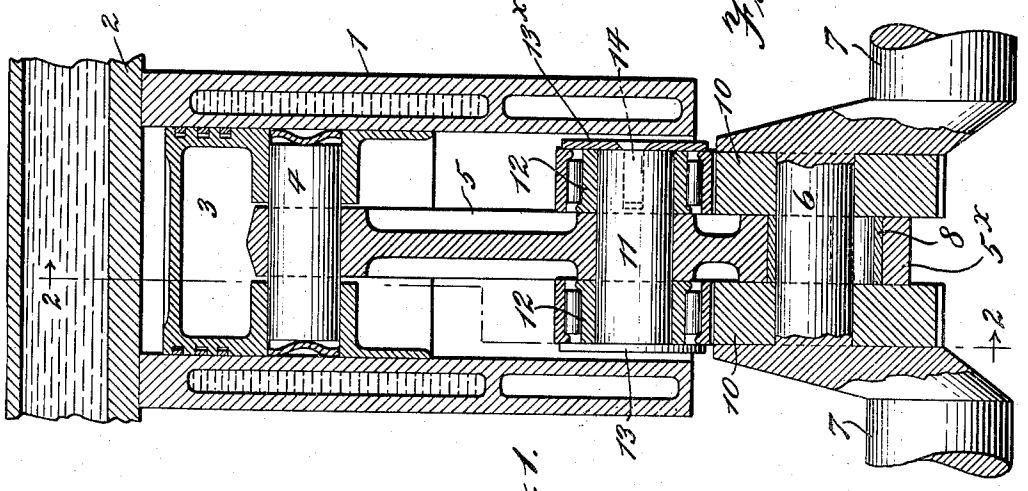


Fig. 1.

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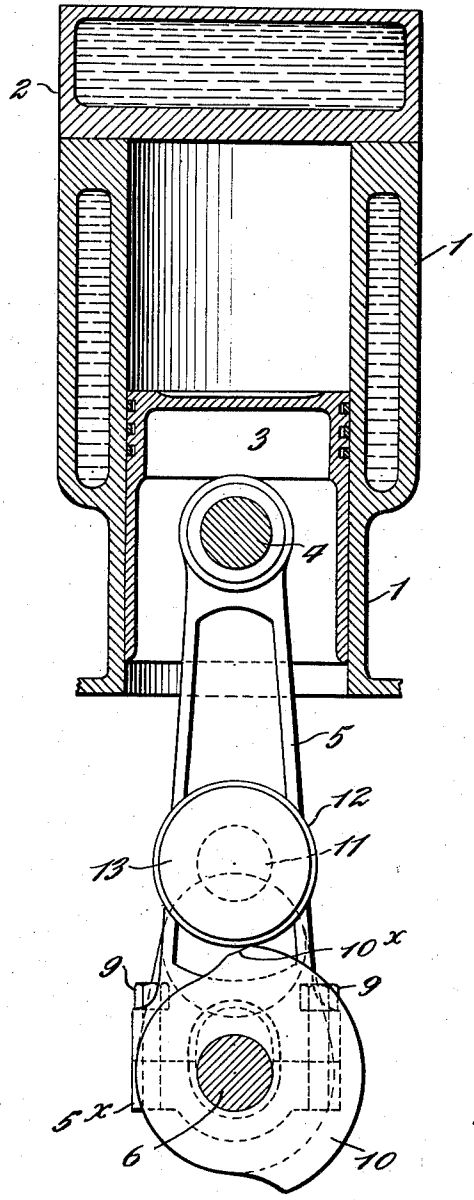


Fig. 4.

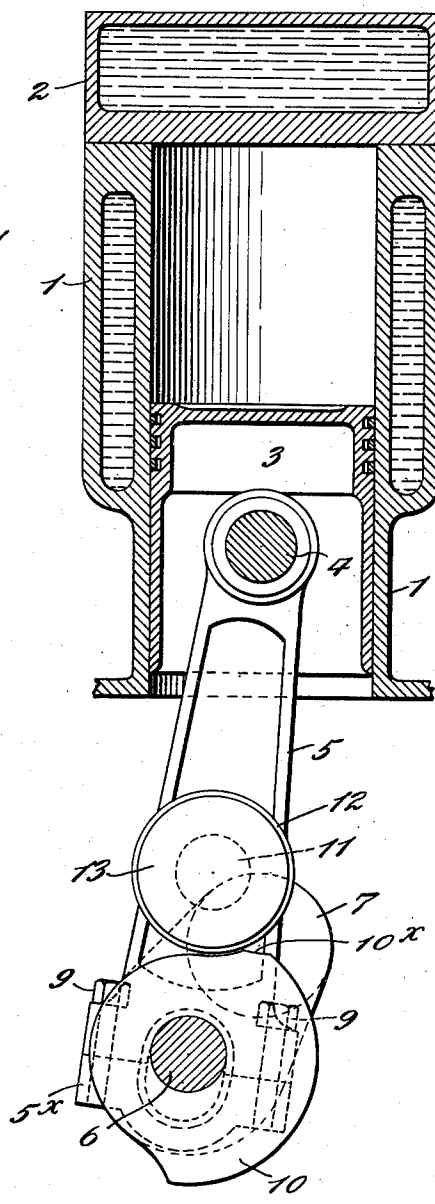


Fig. 5.

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UNITED STATES PATENT OFFICE

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DRIVING MEANS FOR INTERNAL COMBUSTION ENGINES

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Application July 16, 1937, Serial No. 153,891

1 Claim. (Cl. 74—44)

The object of the invention is to change the characteristics of a crank shaft applied piston movement to overcome certain serious limiting factors in crank shaft motor design which are detrimental to obtain efficiency, economy and maximum power.

In the embodiment of the invention, a cam or cams are placed on the crank shaft with the axis thereof in line with the longitudinal center of the crank on the shaft, the cams acting upon two contact points on the connecting rod so that in the reciprocation of the latter a single crank shaft may have the characteristics of two crank shafts performing harmoniously as one.

In the embodiment of the invention, the crank shaft, in cooperation with the connecting rods, performs as an eccentric variable crank in the downward motion and as a fixed crank on the upward motion. A crank shaft so designed may perform as an intermediate eccentric variable crank on both the upward and downward motions of the crank shaft, that is to say, it may be capable of imparting two distinct crank throws from the same crank pin in both the upward and downward motion. Thus, by means of the invention, a top dead center firing position of the piston, connecting rod and crank shaft may be eliminated as the highest point of compression is reached after the crank has passed top dead center.

Further objects of the invention will hereinafter appear.

The invention will be described with reference to the accompanying drawings, in which:

Figure 1 is a sectional elevation showing a cylinder, a piston and the improved connecting rod and crank shaft construction in position, with the elements in top dead center position, the section being taken on the line 1—1, Figure 2.

Figure 2 is a view similar to Figure 1, the section being taken however transversely of the crank shaft, the section being taken on the line 2—2, Figure 3.

Figure 3 is a view similar to Figure 2, showing the position of the parts at the highest point in compression, the crank having passed top dead center.

Figure 4 is a view similar to Figures 2 and 3, showing the bottom dead center position of the elements.

Figure 5 is a view similar to Figure 4, showing the position of the parts immediately prior to an exhaust or compression stroke.

Referring to Figures 1 and 2 of the drawings, I have shown at 1 a cylinder block and at 2 a conventional cylinder head, the parts being largely diagrammatic. Within the cylinder block 1 is a piston 3 carrying a piston pin 4 by means of which the piston is connected to the top of connecting rod 5. At its lower end connecting rod 5 is apertured to receive a crank pin 6 of crank shaft 7, a bearing sleeve 8 being interposed between the two.

To enable the fitting of the connecting rod upon crank pin 6, the lower end of the rod comprises a split section 5x connected to the upper section by means of bolts 9. At each side of the connecting rod 5 and preferably formed integrally with the crank shaft, is a cam 10, the cams being identical in form.

Above cams 10 the connecting rod is apertured to receive a shaft 11, the shaft projecting laterally of the connecting rod so that in order that at each side of the rod there may be mounted upon the shaft a heavy-duty roller bearing indicated generally at 12. One end of the shaft may be formed with a retaining disk 13 and to the opposite end may be applied a retaining disk 13x secured in position by screw 14. Each one of the roller bearings will abut one of the cams 10.

It will be seen that the rod aperture at its lower end, receiving the crank pin 6, is elongated in a direction longitudinally of the connecting rod, for a purpose now to be explained.

Connecting rod 5 receives a power impulse which is transmitted to the crank shaft through the heavy-duty roller bearings and cam 10. This will be noted by reference to Figure 3. In turn, the crank pin 6 receives a rotary motion. By such rotary motion the cams move clockwise until toward the end of the power stroke, the parts reach the position of Figure 4, at which time the forward portion of a clearance section 10x on each cam meets the lower peripheral wall of its appropriate roller bearing 12 and in continued rotation of the cams a gradual recession thereof from the roller bearings enables a combined downward and swinging movement of the connecting rod and a slight downward movement of the piston from the dead center position, until the parts reach the position shown in Figure 4 immediately preliminary to an exhaust stroke, the crank pin then bearing upon the top wall of the elongated aperture in the lower end of the connecting rod. Such transition in position of the pin relatively to the crank pin aperture in the connecting rod, is controlled by the cams throughout and there is no slap or sudden abutment.

On the exhaust stroke the crank pin bears upon top areas of the lower crank pin aperture of the connecting rod and the crank pin on the

upward motion imparts a direct throw to the connecting rod and piston until the parts reach the position of Figures 1 and 2.

The intake stroke is, of course, under the conditions above specified with regard to the power stroke, and the compression stroke is under the conditions above specified with regard to the exhaust stroke, except that there has not been described the final movement of the parts from the position of Figure 2 to Figure 3.

In the compression stroke, the upward movement of the connecting rod and piston from the position of Figure 5 to that of Figure 2, is through the direct impulse of the crank pin **6**. At this point however, the cams **10** take over the control of the connecting rod. Reference to Figure 2 will show the cam **10** there shown is in such position that in the continued clockwise movement of the crank shaft that cam, and its coacting cam, will impart an upward thrust directly upon the roller bearings **12** so that the connecting rod will move upward relatively to the crank pin until it assumes the position shown in Figure 3. Whereas, at the end of the upward thrust of the crank pin, the pin, connecting rod and piston will be in dead center position, the action of the cams will impart an upward final compression movement to the piston and, of course, the connecting rod, whilst the latter is swinging with the crank pin away from dead center, and in an ideal position to transmit the power impulse to the crank shaft. In other words, the firing will take place when the connecting rod and crank pin are off dead center.

It will be seen from the above that a slight movement of the connecting rod will effect a change from a variable throw to a fixed throw, and that the variable throw may be any multiple of the fixed throw, a slight movement of the rod alternating from one to the other. Also, as soon as the power stroke lags or is zero, a fixed throw is automatically reached without shock. This variable throw feature effectively eliminates vibration and certain conflicting forces set up in the usual type of crank shaft motor which are detrimental to obtaining full efficiency and power, and incidentally, a much cooler motor may be obtained.

A crank motion is an excellent motion to deliver power to a reciprocating member or receive power from a reciprocating member, provided the power is more or less constant as derived from a stored up supply, such as steam. However, a crank has not been the ideal medium for receiving power from a reciprocating member when the power is built up in a fraction of a second, particularly where compression conditions require that the firing of the power charge takes place when the crank is at dead center. The advantages of the variable power transmitting elements of the present invention are numerous. For example, it enables a slow speed, light, compact motor and flexibility in bore and stroke ratios. It overcomes the disadvantages of a short stroke motor in delivering relatively low power at slow speed. It overcomes the disadvantages of poor acceleration of a slow speed motor, and it enables such control of the piston stroke that the pistons do not have the tendency to "get away" from the charge.

Having described my invention, what I claim and desire to secure by Letters Patent, is as follows:

In driving means for internal combustion engines, a cylinder, a piston mounted for reciprocation in the cylinder, a crank shaft having a crank pin, a connecting rod carrying the piston through said crank pin, rollers carried at opposed faces of the piston rod and pivotally held thereon against bodily movement, cam members carried by the crank and movable therewith and in contact with said rollers, and an elongated bearing aperture formed in the base section of the piston rod and embracing the crank pin.

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