July 8, 1941. L. P. ANTHONY 2,248,323

INTERNAL COMBUSTION ENGINE

Filed April 27, 1940 2 Sheets-Sheet 1

Fig. 1

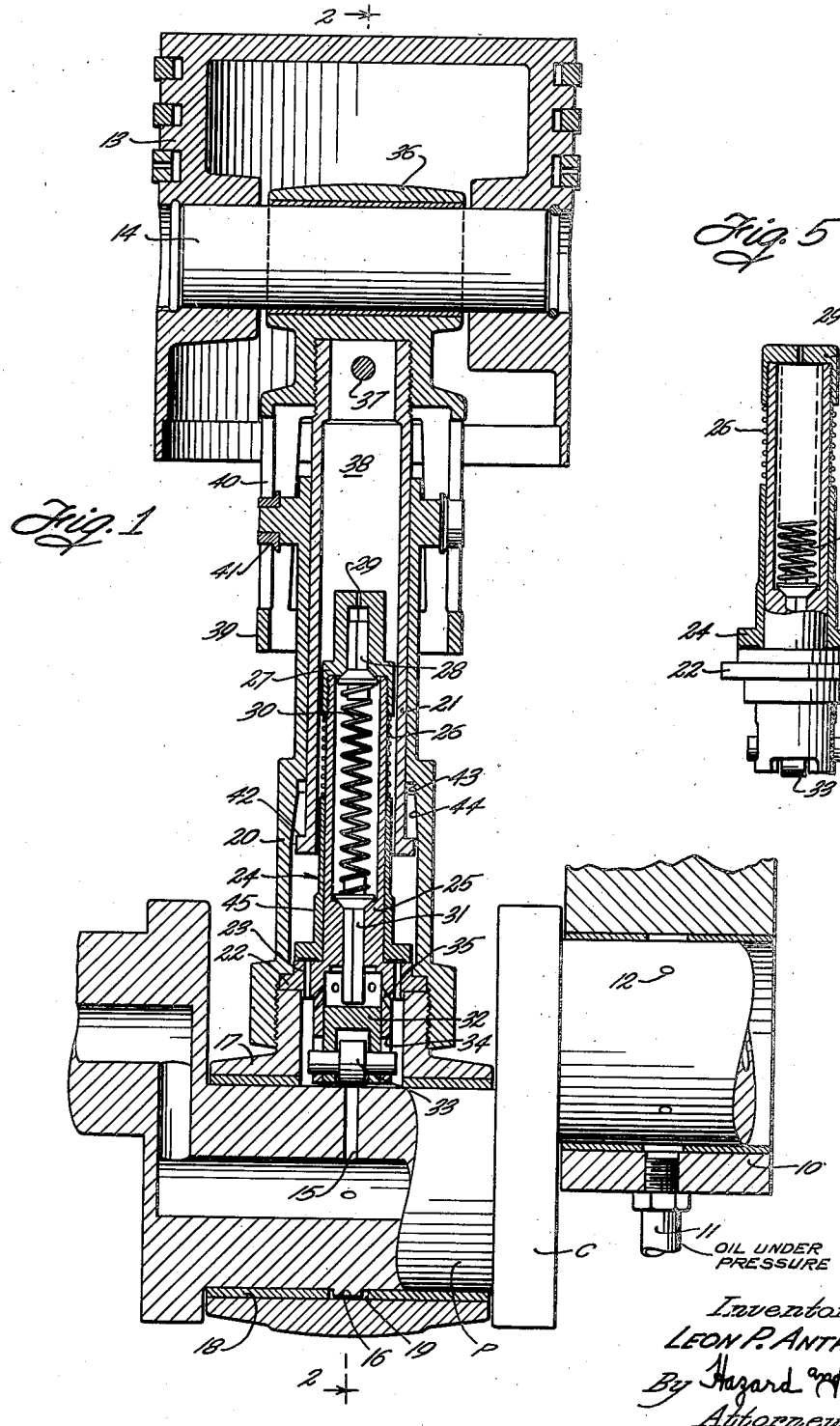


Fig. 5

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Fig. 2

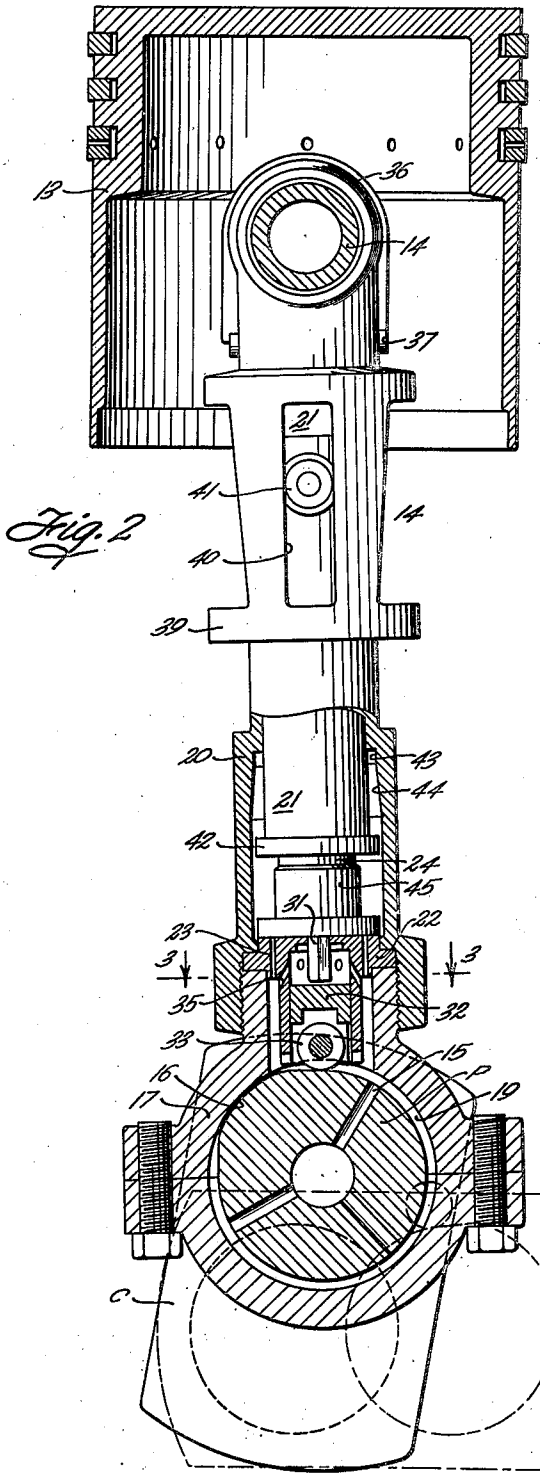


Fig. 3

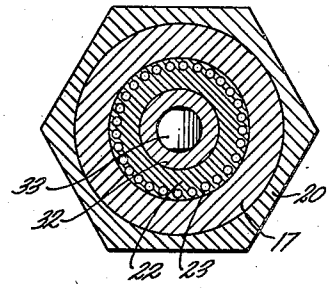
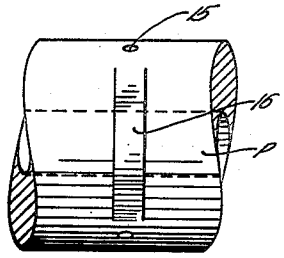


Fig. 4



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UNITED STATES PATENT OFFICE

2,248,323

INTERNAL COMBUSTION ENGINE

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Application April 27, 1940, Serial No. 331,987

10 Claims. (Cl. 123—78)

This invention relates to improvements in internal combustion engines and may be considered as an improvement or further development over the construction disclosed in my copending application Serial No. 229,868, filed September 14, 1938.

In my copending application there is disclosed a form of internal combustion engine wherein the piston of the engine is connected to the crankshaft by means of an extensible telescopic connection which is supplied with fluid such as oil under a substantially constant pressure through the crankshaft with means for entrapping the oil in the telescopic connection so as to lock the connection against collapse during working or power strokes and opening the connection to the source of fluid pressure in the crankshaft during compression and exhaust strokes whereby a substantially constant compression can be secured in the engine at any given speed regardless of whether the throttle is fully opened or fully closed or in any intermediate position. By thus securing substantially constant compression at any given speed regardless of the degree of throttle opening relatively cheap fuels may be employed which would otherwise be in danger of pre-igniting if the engine were rotating at a relatively low speed and the throttle fully opened.

It is an object of the present invention to provide an improved form of connecting rod or telescopic connection between the piston and the crankshaft which is so designed that the compression in the cylinder of the engine will not vary with the throttle opening at any given speed but will increase and decrease with the increase and decrease of the speed of the engine. In this way if the engine is operating at any given speed a change of the throttle opening produces substantially no marked effect on the compression but as the speed of the engine increases, the compression in the cylinder likewise increases with the result that at high speeds there is a noticeable increase in power due to the increase in compression. With the improved arrangement the engine may utilize relatively cheap fuels without danger of bringing about pre-ignition difficulties. Thus, if the engine is turning at a relatively low speed and the compression is such that at a nearly closed throttle there is no pre-ignition, opening of the throttle at this low speed does not bring about pre-ignition because of the fact that the compression in the engine remains substantially the same. On the other hand, if the engine is operating at a relatively high speed, the compression within the cylinder at the end of the compression stroke is considerably higher than the compression existing at low speeds. However, as the explosion or burning of the fuel in the cylinder so quickly follows the maximum compression due to the speed of the engine any tendency of pre-ignition to occur is to this extent balanced by the speed of the engine itself. By means of the improved construction I gain the advantage of being able to operate the engine at low speed with wide open throttle without danger of pre-ignition. While at high speeds where pre-ignition presents no serious problem I gain the advantage of increased compression and increased power.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a vertical section through a piston and through a portion of a crankshaft of an internal combustion engine illustrating the improved connection between the piston and crankshaft in vertical section;

Fig. 2 is a vertical section taken substantially upon the line 2—2 upon Fig. 1 in the direction indicated;

Fig. 3 is a horizontal section taken substantially upon the line 3—3 upon Fig. 2;

Fig. 4 is a partial view in elevation illustrating a portion of the crankshaft and particularly of the crank throw or crank pin; and

Fig. 5 is a sectional view illustrating a modified form of valve construction that may be employed in the connecting rod or connection between the piston and the crankshaft.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, it will be understood that the present invention may be incorporated in any preferred form of internal combustion engine having either a single cylinder or a plurality of cylinders. As the invention primarily concerns the connection between the piston and the crankshaft a single connection embodying the invention has been illustrated, it being understood that in plural cylinder engines the connection would be duplicated in connecting each piston to the crankshaft. In the conventional type of automobile engine now in general use the crankshaft C having the crank pin or throw P is supported upon main bearings 10 the main bearings being supplied with oil forced thereto through tubes 11 from the oil pump of the engine. The crankshaft is hollow as illustrated and has ports 12 which convey the lubricant supplied to the main bearings to the interior of the crankshaft. If the engine on which it is desired to incorporate the present invention is not equipped with main bearings that supply lubricant from the oil pump to the interior of the crankshaft, the crankshaft may have its interior supplied with oil delivered thereto in some other manner. The oil that is supplied to the interior of the crankshaft is maintained therein under pressure

which is preferably substantially constant. Constant pressure normally is kept by interposing a relief valve between the oil pump and the main bearings. The piston of the engine which is indicated at 13 and which has a wrist pin 14 may be of any preferred or conventional design or construction.

The details of the improved connection between the piston and the crankshaft are as follows. Adjacent the center of the crank pin or crank throw P radial ports 15 are drilled therein and as shown on Fig. 2 between these ports the crank pin P is equipped or formed with a cam 16. Surrounding the crank pin P there is a connecting rod bearing 17 the bearing metal of which is indicated at 18 which fits snugly around the pin P on opposite sides of the cam 16 and the ports 15. Adjacent the center of the bearing, however, there is an annular chamber or groove 19 which may be constantly supplied with oil under pressure from the interior of the crankshaft C, the same being supplied through the ports 15. On the top of the bearing there is threadedly or otherwise connected an outer tubular member 20 which forms one of two telescopic members, the other of which is indicated at 21 that serve to connect the wrist pin 14 of piston 13 with the crankshaft. The outer telescopic member 20 serves also as a bonnet to firmly fasten or hold a valve seat 22 against the top of the bearing. In this valve seat a plurality of apertures 23 are formed which serve to convey oil from chamber 19 to the interior of the outer telescopic member 20 when the tubular valve 24 is open. The tubular valve 24 is in the form of a sleeve slidable upon the tubular extension 25 on the valve seat 22. It is urged into normally closed position by means of a coil spring 26 compressed between the top of the valve and a cap 27 which also serves as a valve seat for a valve 28. The valve 28 as shown in the drawings is of the poppet type having a squared or non-circular stem. In the cap 27 there is formed a relatively narrow or small aperture 29 which provides the entrance to valve 28. This aperture will vary in size with different engines but under all conditions it is quite small as compared with the size of valves 28 and 31. The valve 28 is urged into closed position by means of a spring 30 and this spring also serves to urge a valve 31 having a squared or non-circular stem in closed position in the tubular extension 25 of the valve seat 22. The bottom of the valve seat 22 provides a housing for a valve actuator or valve opener 32 which in turn carries a roller 33 that serves as a follower for cam 16. The roller 33 has trunnions which extend through valve actuator 32 and into slots 34 formed in the side of the tubular lower portion of the valve seat 22. Ports 35 lead through this tubular lower portion.

The inner telescopic member 21 is threadedly or otherwise connected to the knuckle 36 surrounding the wrist pin and may be pinned in place as by pin 37. This telescopic member snugly fits within the upper portion of the outer telescopic member 20 and two telescopic members cooperate to form an internal chamber 38. If desired, rings similar to piston rings, but not shown, may be mounted on the inner telescopic member 21 or an equivalent sealing means may be used to prevent leakage between the telescopic members. A skirt 39 is attached to or formed integral with the knuckle and has vertical slots 40 formed therein within which are disposed rollers 41 that are rotatably mounted on arms adjacent the top of the outer telescopic member 20. The purpose of this roller and slot connection is to prevent the knuckle 36 and piston 13 from turning relatively to bearing 17 but at the same time to permit the effective length of the connecting rod formed by the telescopic members to increase or decrease under varying conditions. Adjacent the lower end of the inner telescopic member 21 there is provided an external flange 42 and the top of the lower portion of the outer telescopic member 20 is formed as at 43 so as to snugly fit and receive this flange. Below the portion 43 the interior of the outer telescopic member 20 enlarges on a very gradual taper as indicated at 44 and below this tapered portion the interior of the telescopic member 20 clears the periphery of flange 42 with a substantial clearance. The major portion of the stem of valve 24 clears the interior of the inner telescopic member 21 with an adequate clearance but adjacent its lower portion it is thickened as indicated at 45 and this thickened portion is capable of fitting the interior of the bottom of the inner telescopic member 21 quite closely.

The cam 16 is so designed in the preferred form of construction that as the crankshaft rotates it lifts the roller 33 and the valve actuator 32 so as to start to open valve 31 when the piston is approximately halfway on its upward stroke. It permits valve 31 to close when crank pin P is about 10° in advance of its dead center position.

The operation of the above-described construction is as follows. Oil is continuously supplied by the oil pump of the engine to the interior of the crankshaft C at a substantially constant pressure. This pressure is transmitted through ports 15, through chamber 19, and through ports 23 to the underside of the valve 24. Whenever the pressure of the oil exerted on valve 24 is sufficient to overcome the action of spring 26 which is quite light and the pressure inside of the chamber 38 imposed thereon by piston 13 the valve 24 will open and permit oil to enter chamber 38. As valve 24 is in the nature of a check valve flow of oil in the reverse direction through ports 23 is prevented. Consequently, during every exhaust stroke, when there is a minimum pressure imposed on the top of the piston, oil will be forced into chamber 38 from the crankshaft lengthening the connecting rod to substantially its maximum length. It remains in this lengthened condition during the intake stroke of the piston and even during the start of the compression stroke. When the piston is about halfway up its compression stroke, cam 16 acting through the roller 33 and valve actuator 32 causes valve 31 to be temporarily opened. If the engine is operating at a relatively slow speed with the throttle largely closed only a small charge is taken into the cylinder under these conditions. When valve 31 opens under these conditions only a small amount of oil is required to be expelled or returned to the crankshaft due to the fact that only a small charge is being taken into the cylinder which causes only a very small shortening of the connecting rod. The small size of the aperture 29 forms no serious impediment to this flow of oil under these conditions in that due to the slow speed of the engine an adequate time is allowed for the oil to pass therethrough and as the amount of charge above piston 13 is relatively small the amount of oil that must pass through the aperture and be returned to the crankshaft is comparatively small.

If the engine is rotating at a relatively slow

speed but the throttle of the engine is materially open this causes a much larger charge to be taken into the cylinder, which requires a greater shortening of the connecting rod and consequently the expelling of a larger volume of oil. The capacity of the valves 28 and 31 as compared with the capacity of the small aperture 29 is such that these valves can readily transmit all the oil that is forced through aperture 29 even when these valves are only slightly open. Under these conditions when valve 31 is open during the last half of the compression stroke, a much greater volume of oil is forced out of chamber 38 and back to the crankshaft during the period that valve 31 is open. However, the slow speed of the engine affords a sufficient time for this increased quantity of oil to be forced through the small aperture 29. Consequently, under these conditions the effective length of the connecting rod is shortened so that even though the throttle is materially open and the engine is turning at slow speed, the compression within the cylinder is substantially the same as the compression existing under substantially closed throttle conditions at the same speed. Thus, for any given speed the compression within the cylinder is substantially the same regardless of whether the throttle is wide open or substantially closed.

It will, of course, be understood that as the piston approaches the end of its compression stroke, cam 16 permits valve 31 to close so that valves 31 and 24 both being closed effectively isolate chamber 38 from chamber 19 during the working stroke. The connecting rod having its chamber filled with oil which is practically incompressible, is thus capable of transmitting all forces imposed on the piston by the burning fuel to the crankshaft.

As the speed of the engine is increased the operation of the various parts is substantially the same as that above described with the following differences. During high speeds the time that valve 31 is held open by cam 16 is reduced with the increase of speed. Consequently the time available for oil to be forced through the small aperture 29 is materially cut down. Thus, with an increase of speed although the pressure in chamber 38 may be quite great there is insufficient time for oil to be forced through aperture 29. This aperture then acts as a choke and prevents the return of oil from chamber 38 to the crankshaft in the same quantity as that which could be accomplished at slow speeds, other conditions being the same. As some oil is thus retained in chamber 38 at high speeds that would otherwise be expelled therefrom at low speeds the effect is to increase the effective length of the connecting rod at the higher speeds. Consequently, it will be noted that the compression in the cylinder varies not as a function of the throttle opening as in the case of conventional engines, but that instead, it varies as a function of the speed of the engine. At any given speed the compression in the cylinder is substantially the same regardless of the throttle opening.

Although valve 31 would have a slight throttling effect or choking effect on the oil that is expelled past it this is very minor as compared with the choking effect of aperture 29 and valve 28. The valves are made quite large as compared with the size of the aperture so that when they are barely open they immediately are capable of transmitting all oil flow that passes through the aperture. It will, of course, be understood that for any given engine conditions the strength of spring 30 may have to be adjusted or varied. The force with which this spring urges valve 28 to close is the important factor in determining the compression in the cylinder at slow speeds, but it becomes less important at high speeds. At high speeds the choking effect of the small aperture 29 becomes the important factor in determining the compression in the cylinder. At slow speeds the effect of the spring on valve 28 controls the compression for the reason that the oil must force the valve open against the spring before it can be expelled from chamber 38.

The purpose of the flange 42 and the portion 43 of the outer telescopic member 20 is to provide a type of dashpot. Under extreme conditions either from speed or from closed throttle there is a tendency for the connecting rod to lengthen to its extreme length on upward strokes. Before reaching this maximum or extreme length flange 42 enters portion 43 entrapping a small quantity of oil therein which provides a liquid cushion keeping flange 42 from coming into metal to metal contact with the internal shoulder formed on the outer telescopic member 20. Thus, even under these extreme conditions the telescopic members do not come into direct abutment with each other. Conversely, under heavy load conditions that would tend to collapse or shorten the connecting rod the inner telescopic member 21 telescopes over the thickened portion 45 of the valve 24, thus forming a closed chamber within the bottom of the outer telescopic member 20 from which the oil cannot escape. This forms a fluid or liquid cushion preventing the top of the outer telescopic member from coming into direct metallic engagement with the skirt 39. Under normal conditions the strength of spring 30 is such that a pressure will be maintained in chamber 38 so as to keep the parts of the connecting rod operating or fluctuating between these two extreme conditions.

In Fig. 5 I have illustrated a slightly modified form of construction that will be used in place of that illustrated in Figs. 1 to 4. In this form of construction the various parts of the engine are the same as that previously described with the single exception that the cap 27*a* which corresponds to cap 27 has the small aperture 29*a* formed therein corresponding to aperture 29 without making any provision for a valve seat for any valve corresponding to valve 28. Spring 30*a* merely has its upper end seated against the underside of this cap.

The operation of this form of construction is substantially the same as that previously described with the exception that the effect of spring 30*a* is not utilized as a means for controlling the pressure in chamber 38 and consequently the compression within the cylinder. In this form of construction the size of the aperture 29*a* is such as to continue to act as a choke against the quick passage of oil even at slow speeds and manifestly it acts in this manner when the engine is operating at high speeds in substantially the same manner as previously described in connection with aperture 29.

From the above-described construction it will be appreciated that the improved connecting rod or connection between the piston and the crankshaft is such that compression in the cylinder is largely independent of the throttle opening but is caused to increase and decrease with increases and decreases in the engine speed. Consequently, when the engine is operating at low speed regardless of the throttle opening the com-

pression may be adjusted so as to handle fuels most efficiently without danger of pre-ignition while at high speeds the compression is increased because under these conditions danger of pre-ignition presents no serious problem and the increase in compression brings about an increase in power.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A connecting rod for internal combustion engines including a bearing for the crankshaft of the engine having a chamber therein for receiving fluid under pressure from the interior of the crankshaft, a valve seat on the bearing, a check valve adapted to seat upon the valve seat permitting egress from the chamber but preventing return flow thereto from the connecting rod, a second valve controlling the return of flow from the connecting rod to the chamber, and means for periodically opening the second valve.

2. A connecting rod for internal combustion engines including a bearing for the crankshaft of the engine having a chamber therein for receiving fluid under pressure from the interior of the crankshaft, a valve seat on the bearing, a check valve adapted to seat upon the valve seat permitting egress from the chamber but preventing return flow thereto from the connecting rod, a second valve controlling the return of flow from the connecting rod to the chamber, and means operable by the crankshaft for periodically opening the second valve during portions of the compression and exhaust strokes.

3. A connecting rod for internal combustion engines including two telescopically arranged members one of which is connected to a piston of the engine and the other of which is connected to a connecting rod bearing, the bearing being arranged to receive fluid under pressure from the crankshaft to be supplied to the telescopically arranged members, check valve means permitting fluid flow from the bearing to the interior of the telescopically arranged members but preventing flow in the opposite direction, valve means for controlling the flow from the telescopically arranged members, and means for opening the last-mentioned valve means only during upward strokes of the piston.

4. A connecting rod for internal combustion engines including two telescopically arranged members one of which is connected to a piston of the engine and the other of which is connected to a connecting rod bearing, the bearing being arranged to receive fluid under pressure from the crankshaft to be supplied to the telescopically arranged members, check valve means permitting fluid flow from the bearing to the interior of the telescopically arranged members but preventing flow in the opposite direction, valve means for controlling the flow from the telescopically arranged members, and means cammed off of the crankshaft for opening the last-mentioned valve only during upward strokes of the piston.

5. A connecting rod for internal combustion engines including two telescopically arranged members one of which is connected to a piston of the engine and the other of which is connected to a connecting rod bearing, the bearing being arranged to receive fluid under pressure from the crankshaft to be supplied to the telescopically arranged members, check valve means permitting fluid flow from the bearing to the interior of the telescopically arranged members but preventing flow in the opposite direction, valve means for controlling the flow from the telescopically arranged members, means for opening the last-mentioned valve means during upward strokes of the piston, and means for regulating the rate of flow through the last-mentioned valve means when the same is open.

6. A connecting rod for internal combustion engines including two telescopically arranged members one of which is connected to a piston of the engine and the other of which is connected to a connecting rod bearing, the bearing being arranged to receive fluid under pressure from the crankshaft to be supplied to the telescopically arranged members, valves controlling flow to and from the interior of the telescopically arranged members, and means for opening the valve controlling the flow from the members only during upward strokes of the piston.

7. In an internal combustion engine, a piston and a crankshaft to which fluid under pressure is supplied, means including two telescopically arranged members connecting the piston to the crankshaft, check valve means controlling the flow from the crankshaft to the telescopically arranged members, valve means for controlling the flow from the telescopically arranged members, means for opening the valve means only during upward strokes of the piston, and means providing a fluid cushion limiting the extreme movements of the telescopically arranged members relatively to each other.

8. In an internal combustion engine, a piston and a crankshaft to which fluid under pressure is supplied, means including two telescopically arranged members connecting the piston to the crankshaft, check valve means controlling the flow from the crankshaft to the telescopically arranged members, valve means for controlling the flow from the telescopically arranged members, means for opening the valve means only during upward strokes of the piston, and means for isolating portions of fluid within the telescopically arranged members to cause it to act as a fluid cushion limiting extreme movements of one telescopic member relatively to the other.

9. In an internal combustion engine, a piston and a crankshaft to which fluid is supplied under pressure, means including two telescopically arranged members connecting the piston to the crankshaft, valve means controlling the flow to and from the telescopically arranged members, and means for operating the valve means including a valve actuator, a roller mounted thereon, and a cam on the crankshaft engageable with the roller.

10. In an internal combustion engine, a piston, a crankshaft to which fluid is supplied under pressure, means including two telescopically arranged members connecting the piston to the crankshaft, valve means permitting flow to the telescopically arranged members from the crankshaft, valve means controlled egress from the telescopically arranged member, means for opening the valve means to enable egress from the telescopically arranged members only during upward strokes of the piston, and means for isolating fluid within the telescopically arranged members from fluid in the crankshaft during power strokes of the piston.

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