Nov. 22, 1932. D. O. BRANT 1,888,448

CRANK MECHANISM FOR RECIPROCATING ENGINES

Filed Sept. 29, 1930

Fig. 1.

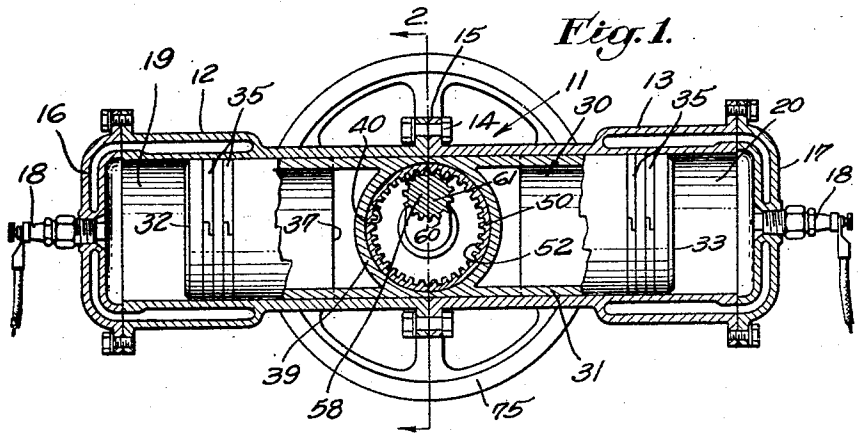


Fig. 2.

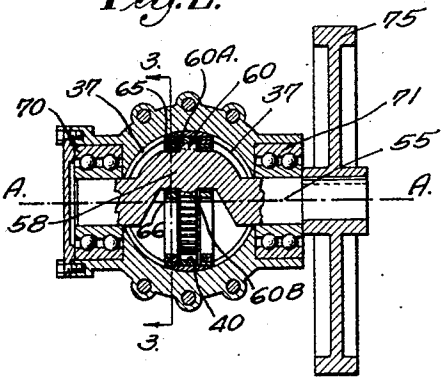


Fig. 3.

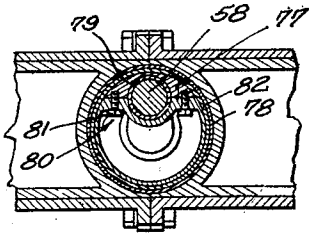
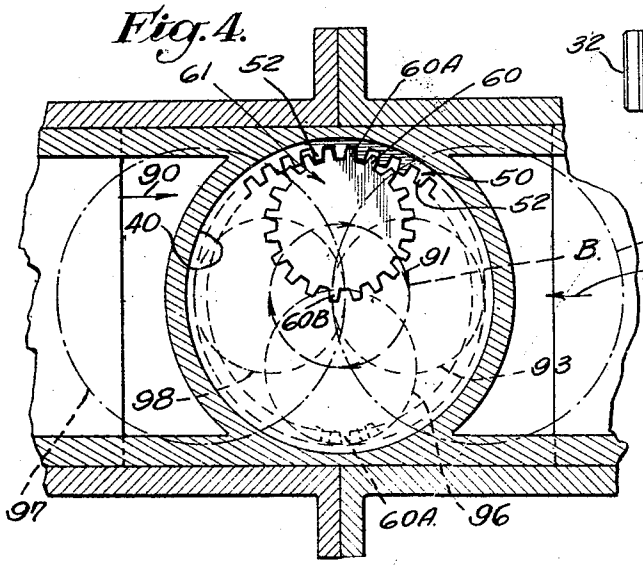


Fig. 4.



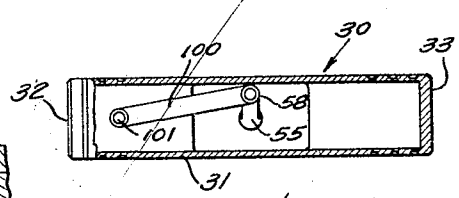


Fig. 5.

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Patented Nov. 22, 1932

1,888,448

UNITED STATES PATENT OFFICE

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CRANK MECHANISM FOR RECIPROCATING ENGINES

Application filed September 29, 1930. Serial No. 485,055.

My invention relates to motors of the general class in which power is developed by the reciprocation of piston members in cylinders, and relates in particular to a novel means for converting reciprocal motion into a constant rotary motion.

Certain principles of the invention are adapted to both internal combustion engines and to other reciprocating engines in which a power medium in the form of fluid under pressure is introduced into the cylinders in such a manner as to reciprocate the pistons, such engines being represented by the steam engine.

Transmission mechanisms, embodied in reciprocating engines for converting the reciprocating motion of a piston into the rotary motion of a drive shaft, consist usually in a connecting rod pivotally connected at its opposite ends to the piston and an eccentrically rotating crank shaft, the eccentric portion of the crank shaft rotating in an orbit around the longitudinal axis of the shaft. In this type of mechanism the diameter of the orbit in which the crank travels is necessarily equal to the throw of the piston.

It is an object of my invention to provide in a reciprocating engine, such as a gasoline motor, a novel crank mechanism in which the diameter of the orbit through which the crank member travels is equal to half the throw of the piston, thus enabling a considerable reduction in size as compared to the horse-power developed, and reducing the weight in the general construction of internal combustion types of motors.

It is another object of my invention to provide a crank mechanism of the type described comprising an eccentrically rotating crank provided with a spur gear, the axis of which is revolvable in an orbit around the axis of the crank, and an internal ring gear secured to a reciprocating piston, the ring gear engaging the spur gear in a manner to revolve it in its orbit and rotate the crank when the piston is reciprocated.

This novel crank mechanism included in the features of my invention is particularly adapted for use in connection with a double acting reciprocating internal combustion motor, and for the purpose of illustration I have shown the device embodied in a motor of this general type.

It is another object of my invention to provide in a motor of the above described type a piston structure comprising a shell forming a double ended piston adapted for reciprocation in a cylinder, and an eccentrically rotating crank shaft extending through apertures in the sides of the piston, the crank being provided with a spur gear, of the type described above, which engages an internal ring gear secured within the shell forming the piston and is actuated thereby to rotate the crank shaft when the piston is reciprocated.

It is another object of my invention to provide guide means for guiding the spur gear in its orbit of rotation relative to the ring gear, and to prevent the disengagement thereof.

It is a further object of the invention to provide a reciprocating means including a pair of eccentrically mounted members which will operate in such a manner that a long throw of a piston will be accomplished with a side thrust on the piston much less than the side thrust produced in the common type of crank mechanism employed in reciprocating engines, thereby reducing the wear on the piston and cylinder walls to a minimum.

These and other objects will be apparent from a perusal of the following specification, the accompanying drawing and the appended claims.

Referring to the drawing:

Fig. 1 is a longitudinal sectional view on a median plane through a cylinder of a motor embodying the features of my invention, without the eccentric sleeve bearing which I use to prevent disengagement of the spur and ring gears.

Fig. 2 is a vertical sectional view taken as indicated by the lines 2—2 of Fig. 1.

Fig. 3 is a fragmentary sectional view taken as indicated by the line 3—3 of Fig. 2, this view showing the eccentric sleeve bearing serving as a means for preventing the disengagement of the gears of the crank mechanism.

Fig. 4 is an enlarged diagrammatic view similar to the central portion of Fig. 1.

Fig. 5 is a longitudinal sectional view through a double ended piston showing its use in connection with an alternative form of crank mechanism.

Referring to Figs. 1 to 4, in which I illustrate a preferred form of my invention, and to Fig. 1 in particular, I show a cylinder 11 which is an embodiment of a double acting internal combustion engine of an ordinary type, this cylinder comprising mating halves 12 and 13 positioned co-axially and secured together by bolts 14 extending through flanges 15, formed for the purpose, upon the respective halves of the cylinder 11, as shown.

The outer ends of the cylinder 11 are provided with removable heads 16 and 17 secured to the cylinder 11, as shown, and each of these heads is provided with a spark plug 18 threadedly secured therein, these spark plugs projecting into the end portions 19 and 20 comprising the opposed firing chambers of the cylinder 11. The firing chambers 19 and 20 are provided with the usual intake and exhaust ports (not shown).

The foregoing description relates to an ordinary construction of gasoline motor, and it should be apparent that the scope of my invention should not be limited to use in connection with motors of this particular type, but should be construed as pertaining to a mechanical movement for use in power transmission devices in general adapted for converting reciprocating motion to rotary motion.

Coming now to a description of the unique features of my invention, I show a piston structure generally designated by the numeral 30, which comprises a cylindrical shell 31 having closed end walls 32 and 33, the shell 31 being exteriorly grooved adjacent each of these ends for the accommodation of piston rings 35, as shown. The piston shell 31 is provided with a pair of diametrically disposed longitudinally extending apertures 37 in the side walls thereof, and is also provided with an interior cylindrical wall or web 39 in which is formed an annular bore 40, the axis thereof being transverse with respect to the longitudinal axis of the piston structure 30. Nonrotatably secured centrally of the bore 40 is a ring gear 50 having a circular series of internal teeth 52.

Extending through the apertures 37 and the bore 40 is a crank shaft 55 having an eccentric portion 58 revolvable within the bore 40, this eccentric portion 58 being provided with a circular series of external teeth 60 forming a pinion 61 which is adapted for engagement with the ring gear 50. This pinion is of half the pitch diameter of the ring gear 50 and is non-rotatable on its own axis, but may merely pass through a circular orbit "B", indicated in Fig. 4, circumscribing the longitudinal axis A—A of the crank shaft 55. The pinion 61 rotates on an eccentric axis and does not revolve on its own axis.

As best shown in Fig. 2, the eccentric portion 58 with respect to its rotation around the axis A—A of the crank shaft 55, has an outer portion 65 and an inner portion 66; in other words, as the crank 58 rotates, the outer part 65 will always be on the outside with respect to the center of rotation and the inner part will always be faced inwardly toward the center of rotation. Therefore, we may designate the pinion 61 as having outer teeth 60A and inner teeth 60B.

The crank shaft 55 is journalled in the walls of the cylinder 11 by suitable bearing structures shown at 70 and 71 in Fig. 2, and upon one of the ends of the shaft 55 may be secured a suitable means for transmitting the rotational motion of the shaft, such as the flywheel indicated at 75 in Fig. 2.

Positioned in the bore 40 on each side of the ring gear 50 is a pinion guide means 77, the details of which are best shown in Figs. 2 and 3, each pinion guide means including an annular friction ring 78 pressed into the bore 40. Surrounding the eccentric portion 58 of the crank shaft 55 is a bushing 79, around which is assembled a split, eccentric bearing member 80 secured to the shaft as by screw means 81 indicated in Fig. 3. Surrounding the eccentric bearing member 80 is a bearing sleeve 82 adapted for slidable contact with the inner surface of the friction ring 78.

The operation of this form of my invention is as follows:

In Figs. 1 and 4 the crank mechanism may be considered at an intermediate position with the piston structure 30 at a central point between the two extremes of its stroke. It will be seen that the outer teeth 60A of the pinion 61 are in engagement with the teeth 52 of the ring gear 50.

Assuming at this time that the piston structure is caused to move in the direction of the arrow 90 of Fig. 4, it will be seen that the eccentric portion 58 will be moved along its circular orbit B, in the direction of the arrow 91 of Fig. 4. The teeth 60 of the pinion 61 extending leftwardly of the outer teeth 60A thereof will consecutively engage the teeth 52 of the ring gear 50, so that when this ring gear 50 has reached its extreme rightward position, shown in dotted lines 92, the spur gear will have attained the position indicated in dotted lines 93, at which time the inner teeth 60B will face leftwardly and will be in engagement with the teeth 52 of the ring gear 50. When the pinion 61 rotates rightwardly the eccentric bearing member rotates leftwardly or anticlockwise; therefore, during the continuous rotation of the crank in one direction, the eccentric bearing will continuously rotate in the opposite direction.

Subsequent movement of the piston structure will be in the direction of the arrow 95 causing the spur gear to continue its travel through its orbit B in the direction of the arrow 91, additional teeth 60 of the pinion consecutively engaging the ring gear 50 until the intermediate position 96 is reached, whereupon the outer teeth 60A will again be in engagement with the ring gear teeth 52, but at the lower portion of the ring gear 50. When the piston structure 30 reaches its extreme leftward position 97 the spur gear 61 will have reached the position indicated by the dotted lines 98 in Fig. 4, and the inner teeth 60B will face rightwardly and will have again attained a position in engagement with the ring gear 50.

It should be understood that I have described the cycle of operation of the crank mechanism in connection with but a single cylinder of a motor for the purpose of simplicity, and it is clear that any additional number of cylinders and their cooperating pistons and crank mechanisms would be operated a certain number of degrees out of phase, proportionate to the number of cylinders used.

It will be seen that by the use of a spur gear and internal gear combination of the character described, the diameter of the orbit through which the crank revolves is equal to half the throw of the piston.

It will be understood that momentum of the fly-wheel 75 will carry the crank mechanism past dead centers and that when a force is applied to the piston structure 30 in the direction of the arrow 95 while the ring gear and the spur gear are passing through their respective positions indicated at 92 and 93, the bearing structure compels the spur gear to travel in its proper orbit relative to the ring gear.

In Fig. 5 I have shown a modified form of my invention including a double ended piston structure 30 of the same general character as that shown in connection with the preferred form, this piston being adapted for reciprocation in a cylinder 11 identical with that previously described or with a pair of opposing cylinders.

In this form the eccentric portion or crank 58 of the crank shaft 55, revolvable within the shell 31, is pivotally connected to a connecting rod 100 which in turn is pivotally connected to the piston structure 30 by a wrist pin 101, the entire connecting rod and the crank being operable within the space confined by the shell 31 as shown. A feature of this double end piston is that its axis is aligned with the axis of the cylinders and therefore wear on the piston and cylinders is minimized and piston slap is kept at a minimum.

Although I have shown a complete ring gear 50 and a complete spur gear 61, the device may be operated without the use of such complete gears, for all of the teeth of the spur gear 61 may be eliminated except the teeth shown at the outer portion 60A, and the teeth 52 of the ring gear 50 may be eliminated except at the top and bottom of the member 50 in the position shown in the drawing. The eccentric bearing member, or part 80, which is rotatable upon the crank 58 serves as a link for connecting the crank 58 with the piston structure which will cause the piston structure to be moved forwardly during the rotation of the crank 58 and the eccentric member 80 in opposite directions. The engagement of a single tooth at 60A during the time that the eccentric member 80 is in a position concentric to the axis A—A will operate to move the piston member and the eccentric member 80 out of eccentric position, thus preventing a spinning or concentric rotation of the crank 58 and the eccentric member 80 on the axis A—A and causing the eccentric member 80 to operate as a link for forcing the piston structure through its path of travel. For a piston throw of four inches, a crank 58 having an eccentricity of one inch is employed. The forces are transmitted between the piston structure and the crank 58, through the operation of the eccentric member 80 and the cooperating gears, in such a manner that substantially no side thrusts are placed on the piston to cause side wall wear which rapidly destroys the ability of the piston and cylinder to maintain maximum compression, which is essential to high efficiency in the operation of reciprocating engines.

Although I have herein shown a preferred and an alternative form of my invention it should be understood that I do not wish to limit the invention to the details of construction as shown and described, for numerous embodiments of the invention might be devised without departing from the spirit and scope thereof.

I claim as my invention:

1. In a transmission mechanism of the character described, the combination of: a reciprocating member having a gear thereon; a rotatable member; and a pinion fixed on said rotatable member in a position eccentric to the axis of rotation of said member, said pinion being in toothed engagement with said gear to be revolved thereby to rotate said member.

2. In a transmission mechanism of the character described, the combination of: a reciprocating member having a gear thereon; a rotatable member; a pinion fixed on said rotatable member in a position eccentric to the axis of rotation of said member, said pinion being in toothed engagement with said gear to be revolved thereby to rotate said member; and means for holding said pinion in engagement with said gear.

3. In a transmission mechanism of the character described, the combination of: a re-

ciprocating member having an internal gear thereon; a rotatable member; a pinion fixed on said rotatable member in a position eccentric to the axis of rotation of said member, said pinion being in toothed engagement with said gear to be revolved thereby to rotate said member; and means for holding said pinion in engagement with said gear.

4. In a transmission mechanism of the character described, the combination of: a reciprocating member having an internal circular gear thereon; a rotatable member; a pinion fixed on said rotatable member in a position eccentric to the axis of rotation of said member, said pinion being in toothed engagement with said gear to be revolved thereby to rotate said member; and means for holding said pinion in engagement with said gear.

5. In a transmission mechanism of the character described, the combination of: walls forming a cylinder; a double ended piston structure adapted for reciprocation in said cylinder; a gear having internal teeth secured to said piston structure; and a rotatable member having an eccentric portion provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said rotatable member when said piston is reciprocated.

6. In a transmission mechanism of the character described, the combination of: walls forming a cylinder; a double ended piston structure adapted for reciprocation in said cylinder; a gear having a circular series of internal teeth secured to said piston structure; and a rotatable member having an eccentric portion provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said rotatable member when said piston is reciprocated.

7. In a transmission mechanism of the character described, the combination of: walls forming a cylinder; a shell forming a double ended piston having apertures in the sides thereof, said piston being adapted for reciprocation in said cylinder; a gear having a circular series of internal teeth secured within said piston; and a rotatable member extending through said apertures and having an eccentric portion revolvable within said piston, said eccentric portion being provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said member when said piston is reciprocated.

8. In a transmission mechanism of the character described, the combination of: walls forming a cylinder having a pair of diametrically disposed openings therein; a shell forming a double ended piston having apertures in the sides thereof in register with said openings, said piston being adapted for reciprocation in said cylinder; a gear having a circular series of internal teeth secured within said piston; and a rotatable member journalled in said openings and extending through said apertures and having an eccentric portion revolvable within said piston said eccentric portion being provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said member when said piston is reciprocated.

9. In a crank mechanism for reciprocating engines, the combination of: a shell forming a double ended piston having apertures in the sides thereof, said piston being adapted for reciprocation in a cylinder; a gear having a circular series of internal teeth and being non-rotatably secured to said piston with the axis thereof intersecting transversely of the longitudinal axis of said piston; and a rotatable shaft extending through said apertures and having an eccentric crank portion revolvable within said piston adjacent said ring gear, said eccentric portion being provided with a circular series of external teeth forming a spur gear, the axis of which revolves in an orbit concentric with the longitudinal axis of said shaft, said external teeth engaging said internal teeth to be actuated thereby to revolve said crank portion and rotate said shaft when said piston is reciprocated.

10. In a transmission mechanism of the character described, the combination of: walls forming a cylinder; a double ended piston structure adapted for reciprocation in said cylinder; a gear having internal teeth secured to said piston structure; a rotatable member having an eccentric portion provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said rotatable member when said piston is reciprocated; and means for preventing the disengagement of said external and said internal teeth.

11. In a transmission mechanism of the character described, the combination of: walls forming a cylinder; a double ended piston structure adapted for reciprocation in said cylinder; a gear having a circular series of internal teeth secured to said piston structure; a rotatable member having an eccentric portion provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said rotatable member when said piston is reciprocated; and means for preventing the disengagement of said external and said internal teeth.

12. In a transmission mechanism of the character described, the combination of: walls forming a cylinder; a shell forming a double ended piston having apertures in the

sides thereof, said piston being adapted for reciprocation in said cylinder; a gear having a circular series of internal teeth secured within said piston; a rotatable member extending through said apertures and having an eccentric portion revolvable within said piston, said eccentric portion being provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said member when said piston is reciprocated; and means for preventing the disengagement of said external and said internal teeth.

13. In a transmission mechanism of the character described, the combination of: walls forming a cylinder having a pair of diametrically disposed openings therein; a shell forming a double ended piston having apertures in the sides thereof in register with said openings, said piston being adapted for reciprocation in said cylinder; a gear having a circular series of internal teeth secured within said piston; a rotatable member journalled in said openings and extending through said apertures and having an eccentric portion revolvable within said piston, said eccentric portion being provided with a circular series of external teeth engaging said internal teeth to be actuated thereby to revolve said eccentric portion and rotate said member when said piston is reciprocated; and means for preventing the disengagement of said external and said internal teeth.

14. In a crank mechanism for reciprocating engines, the combination of: a shell forming a double ended piston having apertures in the sides thereof, said piston being adapted for reciprocation in a cylinder; a gear having a circular series of internal teeth and being non-rotatably secured to said piston with the axis thereof intersecting transversely of the longitudinal axis of said piston; a rotatable shaft extending through said apertures and having an eccentric crank portion revolvable within said piston adjacent said ring gear, said eccentric portion being provided with a circular series of external teeth forming a pinion, the axis of which revolves in an orbit concentric with the longitudinal axis of said shaft, said external teeth engaging said internal teeth to be actuated thereby to revolve said crank portion and rotate said shaft when said piston is reciprocated; and guide means operable to guide said crank portion in said orbit and to prevent the disengagement of said external and said internal teeth.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 24th day of September, 1930.

DAVID O. BRANT.