July 9, 1940. T. M. BERR 2,206,871

BALL CRANK MOTOR

Filed April 6, 1938 2 Sheets-Sheet 1

Fig. 1.

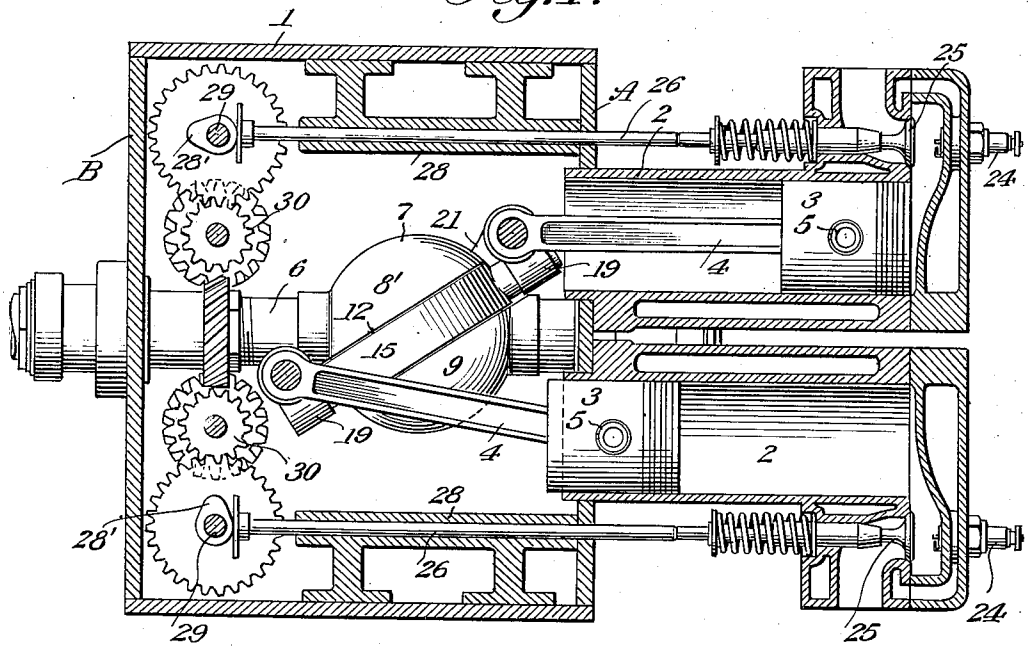
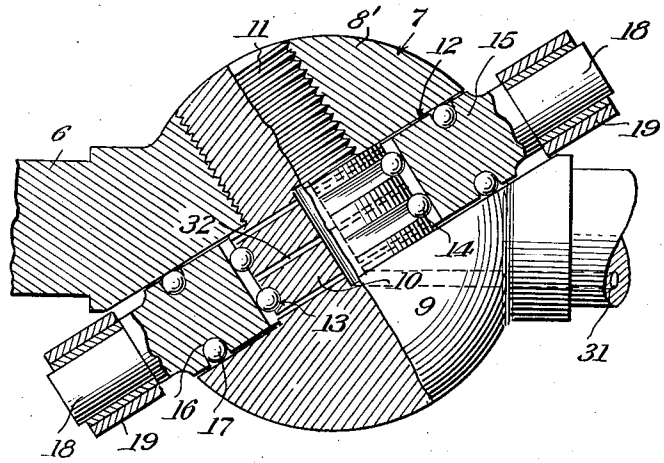


Fig. 5.



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Fig. 2.

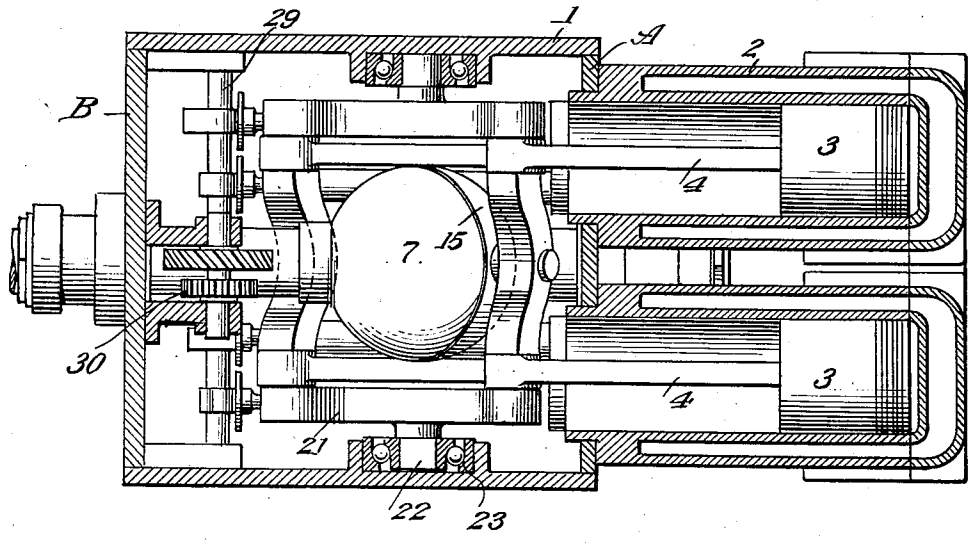


Fig. 3.

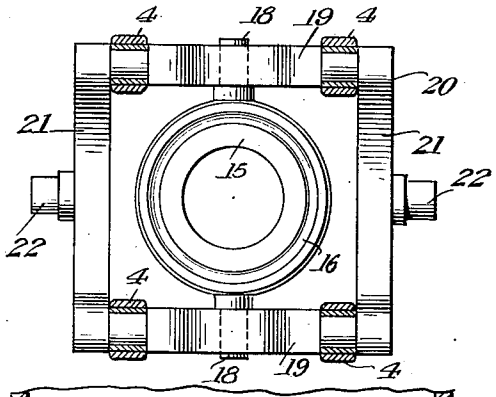
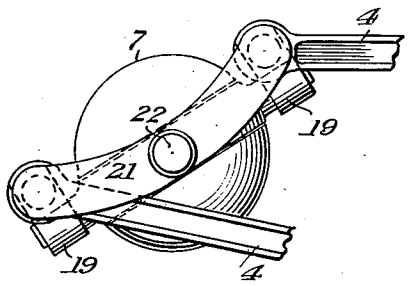


Fig. 4.



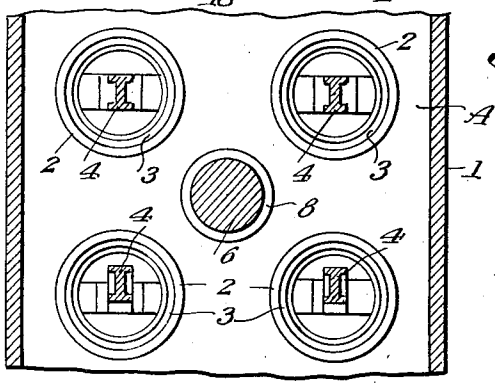


Fig. 6.

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2,206,871

BALL CRANK MOTOR

Thompson M. Berry, New Orleans, La.

Application April 6, 1938, Serial No. 200,520

4 Claims. (Cl. 74—60)

This invention relates to internal combustion engines of the character set forth in my United States Letters Patent 2,056,088, and has for the primary object the provision of an improved ball crank mechanism for converting reciprocatory motion into a rotary movement with the number of parts and friction reduced to a minimum.

Another object of this invention is the provision of a ball crank mechanism which will permit the grouping of the cylinders of the engine parallel with the engine shaft or the axis of rotation of the latter and to deliver the power from the pistons of said cylinders to said shaft at right angles to the axis of rotation of said shaft and to provide periods of substantial idleness to the pistons during the continued rotation of the engine shaft, whereby the compression strokes of the pistons will be completed prior to the ball crank mechanism reaching dead center position and the pistons remaining substantially idle until the ball crank mechanism reaches a position well past dead center when the firing of the fuel charge may take place, thereby reducing loss of compression in the cylinders to a minimum and permitting firing of the fuel charge under the highest degree of compression and taking complete advantage of the full strokes of the pistons.

With these and other objects in view, this invention consists in certain novel features of construction, combination and arrangement of parts to be hereinafter more fully described and claimed.

For a complete understanding of my invention, reference is to be had to the following description and accompanying drawings, in which

Figure 1 is a longitudinal sectional view illustrating an internal combustion engine constructed in accordance with the present invention.

Figure 2 is a longitudinal sectional view taken through the engine at right angles to the showing made in Figure 1, illustrating the ball crank mechanism connecting the connecting rods of the pistons of the cylinders to the engine shaft.

Figure 3 is a plan view, partly in section, showing the ring member and the yoke coacting therewith.

Figure 4 is a side view of the ring, ball member and yoke showing the connecting rods of the pistons journaled on said yoke.

Figure 5 is a fragmentary vertical sectional view showing the ball member and yoke ring mounted thereon.

Figure 6 is a fragmentary transverse sectional view showing the grouping of the cylinders in relation to the engine shaft.

Referring in detail to the drawings, the numeral 1 indicates a combined engine base and crank case, the wall A thereof providing a mounting for four cylinders 2 in which are reciprocally mounted pistons 3 having connecting rods 4 connected to said pistons by wrist pins 5. The connecting rods 4 extend out of the cylinders into the combined engine base and crank case 1. The wall B of the combined engine base and crank case and which is opposite to the wall A provides a journal support for an engine shaft 6 and which includes in its construction a ball member 7. One end of the engine shaft is piloted in a journal 8 provided in the wall A. The grouping of the cylinders is parallel to the plane of the engine shaft.

The ball member 7 includes companion half ball sections 8' and 9. The opposed plane surfaces of the half ball sections 8' and 9 are arranged obliquely and spaced apart parallel with each other by a reduced annular portion 10 including a screw threaded shank 11. The opposed plane surfaces of the ball sections and reduced annular portion 10 coact to provide a groove 12 in the ball member 7 and which is on approximately a thirty degree angle to the axis of rotation of the engine shaft. The section 8' of the ball member has a screw threaded opening in which is threaded the extension 11 of the reduced annular portion 10 for detachably joining the ball sections 8' and 9. The reduced annular portion 10 forms an integral part of the ball section 9 and when the extension 11 thereof is threaded fully into the opening of the section 8' the annular portion 10 abuts the section 8' so as to hold the sections 8' and 9 in proper relation to form the groove 12. The annular portion 10 has ball raceways 13 to receive antifriction balls 14 on which is mounted a ring 15. The side faces of the ring have ball raceways 16 to receive antifriction balls 17 to contact the opposed faces of the ball section 8' and 9 and cooperate with the antifriction balls 14 in mounting the ring for rotation with a minimum amount of friction on the ball member 7. Integral with the ring 15 are diametrically opposed pins 18 and journaled on said pins 18 are opposed end members 19 of a substantially rectangular shaped yoke 20. The opposed side members 21 of the yoke 20 have integral therewith trunnions or pins 22 journaled in bearings 23 carried by opposed walls of the combined engine base and crank case 1. The pins 22 are oppositely disposed and arranged at right angles to the pins 18. The members 19

and 21 of the yoke 20 are arcuately curved. The pins 22 are formed on their respective members 21 of the yoke midway between the ends of said members. The bearing openings provided in the members 19 for the pins 18 are midway between the ends of said members 19. The connecting rods 4 of the pistons of a pair of cylinders are journaled on one of the members 19 and the connecting rods of the pistons of the other pair of cylinders are journaled on the other member 19 of the yoke 20. The yoke connected to the pistons as described brings about simultaneous reciprocation of the pairs of pistons, the pairs of pistons corresponding, of course, to the pairs of cylinders. This engine operates on a four cycle principle, the ignition mediums being indicated by the character 24 and the valves by the character 25. The valve lifters for the valves 25 are indicated by the character 26 and are slidably mounted in guides 28 mounted in the combined engine base and crank case and are operated by cams 28 of cam shafts 29. The cam shafts are driven by the engine shaft 6 through timing gears 30.

The engine shaft 6 is drilled to form a lubricant passage 31 fed by lubricant in any well known manner. The lubricant passage extends into the annular portion 10 and is in communication with a plurality of lubricant passages 32 opening outwardly through the annular portion 10 for directing lubricant into the groove and onto the ring 15 and the antifriction balls.

The ball crank mechanism consisting of the engine shaft, ball member 7, groove 12, ring 15 and the yoke 20 connected to the connecting rods of the pistons convert a rectilinear motion into a rotary motion with friction reduced to a minimum and with the employment of a minimum number of parts. The use of the yoke 20 in the ball crank mechanism permits the use of straight connecting rods and eliminates guides therefor and permits the travel of said connecting rods to be substantially parallel to the line of travel of the pistons during the greater part of the stroke of each of said pistons, the connecting rods only making an appreciable angle with the line of travel of the pistons near the ends of the strokes of said pistons after substantially all of the power has been delivered. The offsetting of the members of the yoke eliminates entirely the necessity of guide bars and permits the advantage of fastening the connecting rods onto the crank provided by the yoke and the ring and ball member. The yoke being mounted in ball bearings or similar bearings fixed on opposite sides of the combined engine base and crank case obviates the use of guide bars for the movement of the connecting rods and consequently eliminates friction which would be set up by the use of said guide bars. The simplicity of assembling the yoke and ring on the ball member removes all complications so that these parts can be assembled and disassembled without errors.

A ball crank mechanism of the character described consisting of a ball element having the ring groove and ring therein arranged at approximately a thirty degree angle to the axis of rotation of the engine shaft and said ball member thereon, together with the coacting yoke swivelly connected with said ring and journaled transversely on the combined base and crank case of the engine for a rocking movement, will cause to the pistons, during their reciprocal motion, periods of substantial idleness, the periods of idleness of the pistons occurring at the ends of the strokes of said pistons and prior to the ball crank mechanism reaching dead center position and lasting throughout movement of the parts of the mechanism the same number of degrees past dead center position, so that the pistons on their compression strokes will complete said compression strokes prior to the ball crank mechanism reaching dead center position and remain idle during movement of said mechanism through a corresponding number of degrees past dead center position, permitting firing of the fuel in the cylinders when the ball crank mechanism is past dead center position, which eliminates loss of compression in the cylinders at the time of completion of the compression and until the time of igniting the fuel. Also, this arrangement gives an advantage of the full strokes of the pistons for fuel intake as well as without loss of the compression of the fuel in the cylinders. The arrangement of the yoke and the coacting ring permits the connecting rods at the ends of the strokes of the pistons to have hinging movement with the pistons remaining substantially idle.

More specifically stated, the engine shaft 6 does not pause in its rotation during the operation of the engine, but continues by momentum of the flywheel (not shown but obviously provided) even though the rocking yoke frame 20 and the respective pistons 3 do pause at the ends of their respective strokes, that is to say, as just above described, the pistons remain idle at the ends of their travels inwardly and outwardly in the cylinders 2 during the time the engine shaft 6 is continuing its rotation and carrying the ring member 15 to a distance of few degrees into and the same number of degrees past dead central position, during which movement yoke frame 20 will, of course, be accordingly oscillated about the axis of its trunnions 22, but such oscillation will cause only a slight swinging movement of the connecting rods 4 about the axis of the wrist pins 5 in the respective pistons without appreciable longitudinal movement, if any, of the pistons while at the ends of their strokes. This is not to be misunderstood by the showing of the ball crank mechanism in neutral or dead central position in Figures 1 and 2 of the drawings, as the ball crank mechanism does not pause in this position during the operation of the engine but is moved by momentum past such position, as just above described, and the ignition of the explosive charge in the cylinders occurs sequentially according to the four cycle principle of the engine and the ball crank parts being positioned off dead center at the time the ignition occurs in the respective cylinders to drive the pistons on their power strokes and just at the time the ring member 15 is at its ideal angle of leverage for translating the reciprocatory motion of the pistons into the rotary operating motion of the engine shaft.

What is claimed is:

1. In an internal combustion engine of the character described, a power shaft rotatably supported and having a spherical enlargement, said spherical enlargement being circumferentially grooved obliquely around its center at an angle of approximately thirty degrees to the axis of rotation of the shaft, a ring element fitted rotatably within the circumferential groove of said spherical enlargement of the driving shaft, a companion pair of power cylinders mounted in parallel relation to each other and in a common plane parallel to the axis of the driving shaft,

an opposed pair of like companion cylinders mounted in a common plane at the opposite side of the axis of said shaft, each of the cylinders having a reciprocatory piston therein and the respective pistons having individual connecting rods pivotally attached at one end thereto, an open yoke frame surrounding the spherical portion of the driving shaft, said yoke frame being pivotally mounted at its opposite sides to oscillate on an axis coincident with the center of said spherical enlargement, the ring element in the circumferential groove of said spherical portion of the driving shaft being pivotally attached at diametrically opposite sides to the transverse side members of the yoke frame and on an axis coincident with the center of the spherical shaft portion and the axis of the shaft, the connecting rods of the pistons in one companion pair of cylinders being pivotally attached at their ends remote from the pistons to said yoke frame on a transverse axis forwardly of the exis of the pivotal attachment of the ring element to the adjacent transverse side member of the yoke frame and the connecting rods of the pistons in the opposite companion pair of cylinders being likewise attached to the opposite transverse side member of the yoke frame.

2. In an internal combustion engine of the character described, a power shaft rotatably supported and having a spherical enlargement, said spherical enlargement being circumferentially grooved obliquely around its center at an angle of approximately thirty degrees to the axis of rotation of the shaft, a ring element fitted rotatably within the circumferential groove of said spherical enlargement of the driving shaft, a companion pair of power cylinders mounted in parallel relation to each other and in a common plane parallel to the axis of the driving shaft, an opposed pair of like companion cylinders mounted in a common plane at the opposite side of the axis of said shaft, each of the cylinders having a reciprocatory piston therein and the respective pistons having individual connecting rods pivotally attached at one end thereto, an open yoke frame surrounding the spherical portion of the driving shaft, said yoke frame having alined trunnions at its opposite sides supportingly journalled for oscillation of the yoke frame on an axis coincident with the center of said spherical enlargement, the ring element in the circumferential groove of said spherical portion of the driving shaft having diametrically opposite trunnions journalled in the transverse side members of the yoke frame transversely of the axis of oscillation of the yoke frame and on an axis coincident with the center of the spherical shaft portion and the axis of the shaft, the connecting rods of the pistons in one companion pair of cylinders being pivotally attached at their ends remote from the pistons to said yoke frame on a transverse axis forwardly of the axis of the pivotal attachment of the ring element to the adjacent transverse side member of the yoke frame and the connecting rods of the pistons in the opposite companion pair of cylinders being likewise attached to the opposite transverse side member of the yoke frame.

3. In an internal combustion engine having an engine shaft divided into separate endwise abutting sections, a ball unit including companion half ball sections respectively formed integrally on the meeting ends of the shaft sections and having oblique opposed faces spaced apart to form a circumferential groove in the ball unit disposed approximately at an angle of thirty degrees to the axis of rotation of said shaft, a central perpendicular cylindrical boss formed integrally on the oblique face of one of the half ball sections and having a screw-threaded reduced extension, the companion half ball section having a screw-threaded central opening to receive the screw-threaded extension of the first named half ball section with the adjacent oblique face portion of the second named half ball section abutting the boss portion of the base of the screw-threaded extension, cylinders supported in parallelism with the axis of rotation of the engine shaft, reciprocatory pistons in said cylinders, straight connecting rods journalled at one end in said pistons, a ring member fitted rotatably in the circumferential groove of the ball unit, antifriction means between said ring and the oblique faces of said half ball sections and between said ring and the central boss portion of the one half ball section, diametrically opposed circumferential pins on said ring member, a substantially rectangular yoke frame having the circumferential ring pins journaled centrally in the end members thereof parallel with the axis of the engine shaft and having the piston connecting rods pivotally attached thereto at opposite sides of the ring pins, and opposed pins on the side members of said yoke frame supportingly journaled transversely of the axis of the engine shaft.

4. In an internal combustion engine having a rotatably supported engine shaft having a spherical enlargement provided with a circumferential groove arranged about its center at an angle of approximately thirty degrees to the axis of the shaft, a ring member fitted rotatably in said circumferential groove of the spherical shaft portion and provided with diametrically opposed circumferential pins, cylinders supported in parallellism with the axis of said shaft and having reciprocatory pistons therein, said pistons provided with pivotally attached straight connecting rods, of a substantially rectangular yoke frame having arcuate end and side members, the end members of the frame having medial bearings paralleling the axis of the engine shaft and having the circumferential pins of said ring member journaled therein, the side members of the frame having medial pins supportingly journaled transversely of the axis of said shaft, and the frame having the respective piston connecting rods pivotally attached thereto at opposite sides of the axis of the circumferential pins of the ring member, the axes of the connecting rod attachments to the frame being forwardly of the axis of the pins on the side members of the frame.

THOMPSON M. BERRY.