June 3, 1930. G. DEAN 1,761,429

CONVERSION OF RECIPROCATORY MOTION TO ROTARY MOTION OR THE CONVERSE

Filed April 5, 1926 4 Sheets-Sheet 1

Fig. 1.

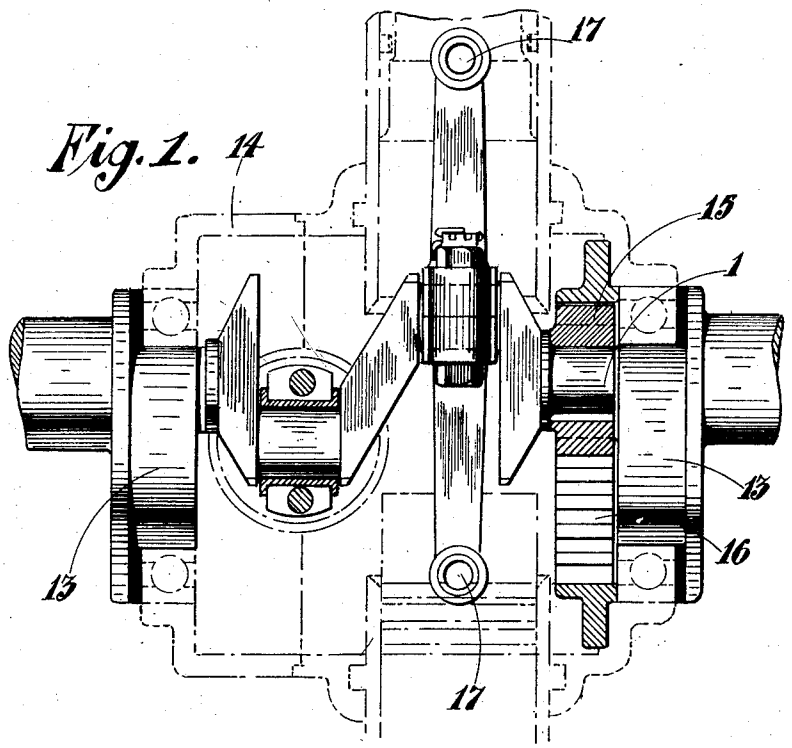
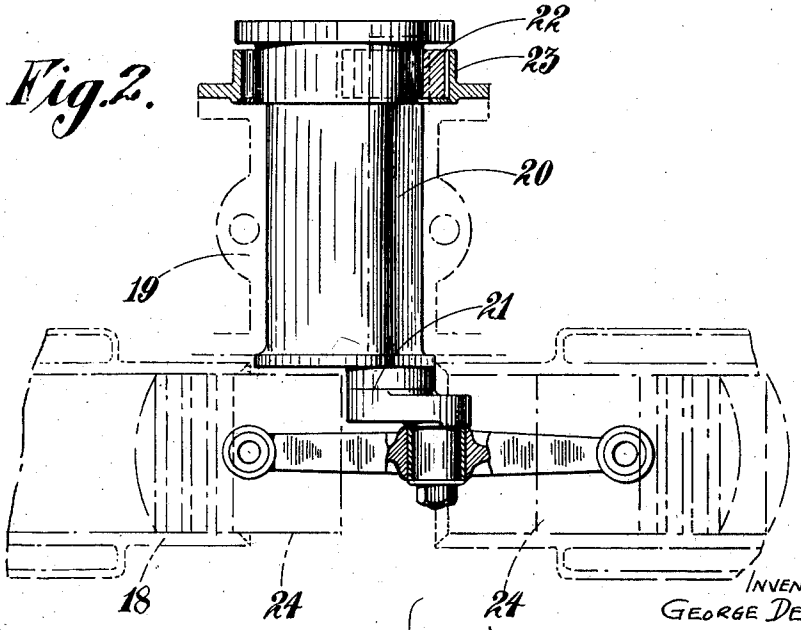


Fig. 2.



INVENTOR:
GEORGE DEAN

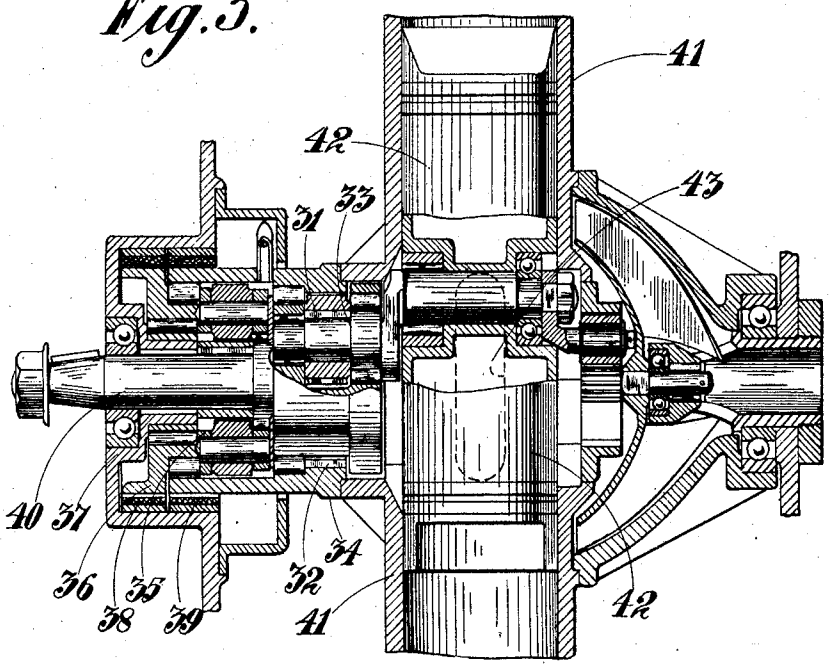
By Spear, Middleton, Donaldson & Haerr
Attys.

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Fig. 3.



INVENTOR:
GEORGE DEAN

By Spear, Middleton, Donaldson & Haeb
Attys.

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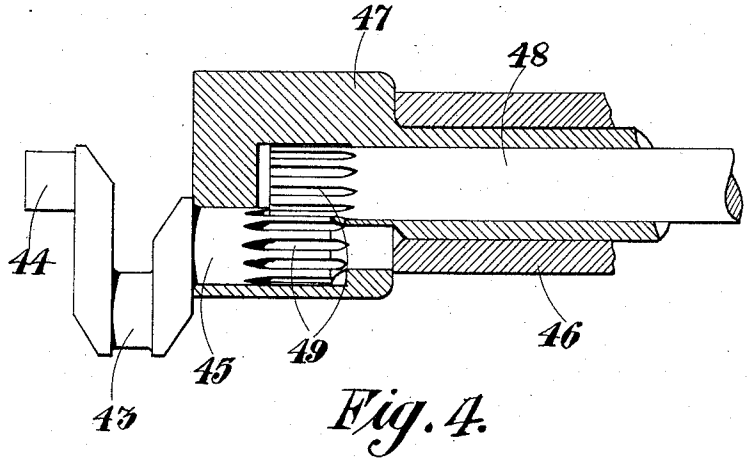


Fig. 4.

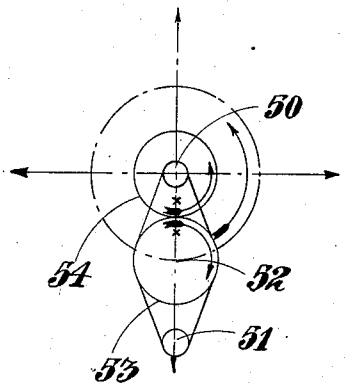


Fig. 5.

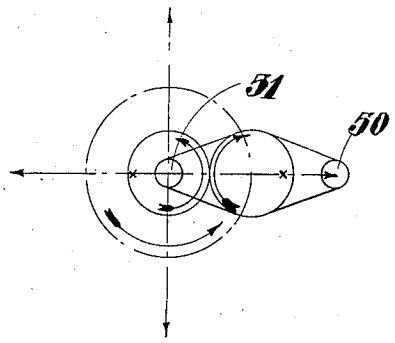


Fig. 6.

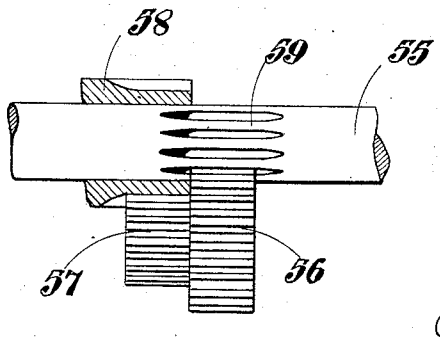


Fig. 7.

INVENTOR:
GEORGE DEAN

by Spear, Middleton Donaldson & Haes
Attys.

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CONVERSION OF RECIPROCATORY MOTION TO ROTARY MOTION OR THE CONVERSE

Filed April 5, 1926 4 Sheets-Sheet 4

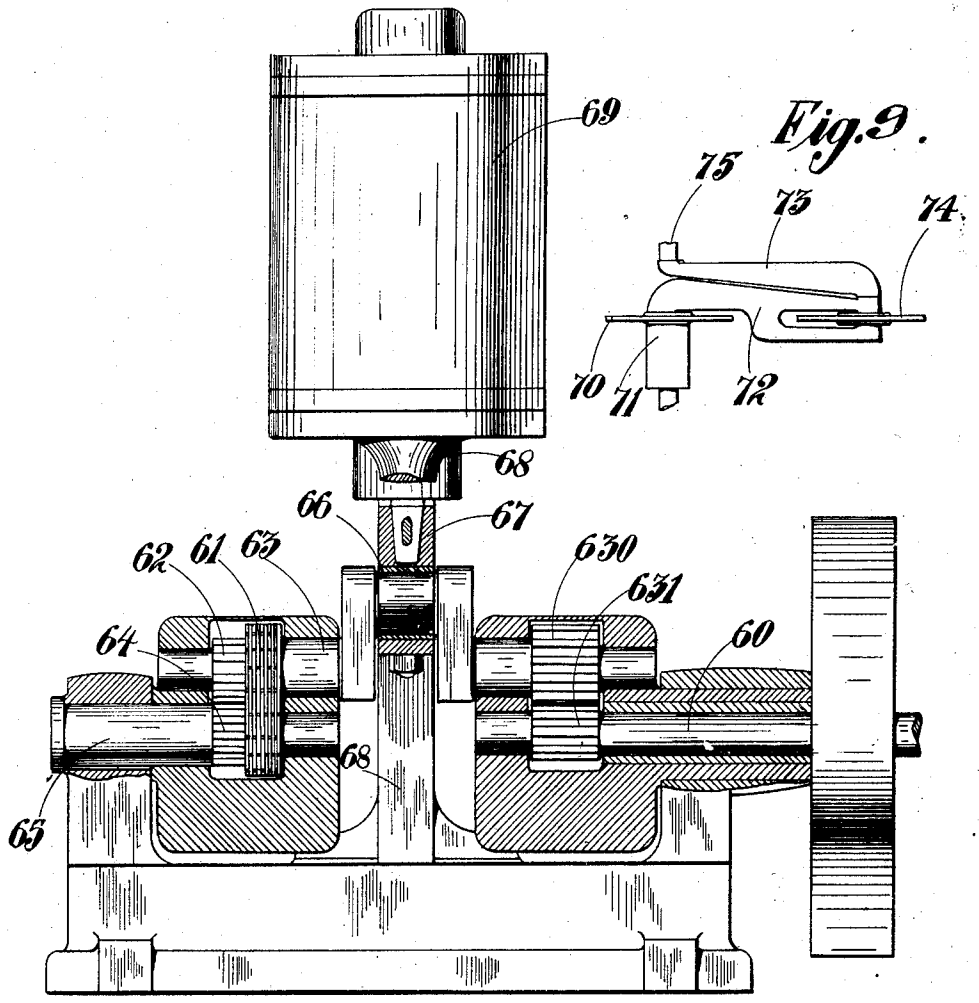


Fig. 8.

Fig. 9.

INVENTOR:
GEORGE DEAN
by Spear, Middleton, Donaldson & Haas
Attys.

Patented June 3, 1930 1,761,429

UNITED STATES PATENT OFFICE

GEORGE DEAN, OF ARMTHORPE, NEAR DONCASTER, ENGLAND

CONVERSION OF RECIPROCATORY MOTION TO ROTARY MOTION, OR THE CONVERSE

Application filed April 5, 1926, Serial No. 99,972, and in Great Britain April 16, 1925.

This invention relates to the conversion of reciprocatory motion to rotary motion, or the converse, and its principal object is to provide a simple mechanism which can be used for various purposes and is particularly applicable to internal combustion or other fluid pressure engines.

Various methods of carrying out the invention are illustrated in the accompanying drawings, in which—

Figure 1 shows an arrangement in which both ends of the crankshaft are supported and in which gearing is employed between the crankshaft and the casing surrounding the mechanism.

Figure 2 shows a construction in which only a single-throw crankshaft is employed and in which the cylinders are stationary, gearing being employed between the crankshaft and the casing,

Figure 3 shows a further construction suitable for a two-stroke engine having two cylinders, stationary or rotatory at will.

Figure 4 is a sectional fragmentary view of another arrangement of the mechanism,

Figures 5 and 6 are diagrams explanatory of the action of another modified arrangement, gearing for which is shown in Figure 7.

Figure 8 is a part-sectional elevation showing a construction of fluid pressure engine developed from the construction shown in Figure 4, and

Figure 9 is a side elevation of a crank mechanism forming a modification of that illustrated in Figure 4 and substantially the same as that shown in Figure 8.

In the construction shown in Figure 1, the crankshaft 1 at each end is rotatably mounted eccentrically in sleeves 13 having an eccentricity equal to the crank radius, with their centres in line with one another. The engine casing 14 is rotatably mounted on the peripheries of these eccentric sleeves 13, and fast upon the crankshaft is a pinion 15 engaging an internal gear 16 of double its diameter fast with the engine casing 14.

When the gearing is employed, as the movements of the crankshaft are positively controlled, the pistons no longer have to effect the rigid guiding, and, therefore they may have a floating connection with the ends of the connecting rods, that is to say, they may engage with a gudgeon pin 17 in the usual manner which allows side play and angular movement, and the axis of the gudgeon pin, as shown, is transverse to the axis of the crankshaft. Any backlash or wear of the parts is thus prevented from being transmitted to the cylinder walls, and furthermore there is no side thrust on the latter. It is apparent that the present invention being for mechanism is not limited to engines and involves the derivation of straight line motion from the rotary shaft or vice versa, and the guides which need not be limited to cylinders.

In the alternative construction for a pair of cylinders and single-throw crankshaft as illustrated by Figure 2, the cylinders 18 and the casing 19 which supports them are stationary, whilst the eccentric member 20 which carries the crankshaft 21 is adapted to revolve in the casing. Gearing comprising the pinion 22 and internal gear 23 as above described is also employed in this construction and ensures that the crankshaft and the eccentric member 20 revolve in opposite directions, thus ensuring a straight line travel of the pistons 24 in paths extending across the axial line of the eccentric.

Any number of cranks spaced around the circumference of the crank path with a corresponding number of cylinders may be used either in the last described or in the constructions herein described.

In Figure 3 is illustrated a two-cylinder two-stroke engine. As in the previously described arrangements, hypocyclic gearing 31, 32 is provided between the crankshaft 33 and the casing 34. A member 36 carrying planetary gears 35 is rotatably mounted on rollers in the fixed frame 37 and is provided with a brake band 38, so that it may be locked or may rotate freely as required. In a similar manner the casing 34 attached to the cylinders is provided with a brake band 39. By releasing both bands, a free engine position is provided for starting, and by locking the casing 34, the driving shaft 40 rotates uniformly in conformity with the piston movements.

If, however, the casing 34 is released by means of the brake 39 and the member 36 is then locked, the driving shaft by means of this planetary gearing is adapted to receive a greater number of impulses for each revolution. In this instance, also, a floating connection is provided to permit sideways movement of the crankpin in the piston. The casing carries the cylinders 41 in which are mounted pistons 42 connected to one another. This construction can obviously be modified to suit any number of cylinders.

It is of importance to notice that with any of the arrangements above described, the pistons move with true periodic (or as it is commonly termed "harmonic") motion. Thus an engine of this kind need only be balanced for the primary forces.

From the foregoing it will be seen that it is possible by this invention to provide an engine having considerably fewer parts than the usual kind, and thus frictional losses may be considerably reduced. It is to be understood, however, that although the mechanism has been described above solely in connection with fluid pressure engines, it is equally applicable to any other kind of mechanism in which reciprocatory motion is to be converted to rotary, or the converse.

In Figure 4 is shown a construction in which the crankpins 43, 44 are carried by a shaft 45 and move in straight lines at right angles to one another as in the previously described constructions. The outer bearing 46 may be fixed, whilst the shaft 45, as well as the sleeve 47 in which it is eccentrically mounted, are adapted to rotate, the shaft, as before moving in its orbital path. Any desired gear ratio may be used between the shaft 45 and the shaft 48.

In Figures 5 and 6 are diagrams showing the positions and paths of two crankpins 50 and 51 at two different positions in the cycle. These diagrams show clearly that the path of the crankpin 50 is to right and left of the drawing, whilst that of the crankpin 51 is up and down. The shaft carrying the two cranks and located at 52 moves orbitally round the crossing point of the two paths of the crankpins. In connection with this diagram it may be stated briefly that where a circle such as that indicated at 53 has oppositely arranged extensions corresponding to the crankpins 50, 51 located at a distance from its centre equal to the radius of its orbit, the rotation of the circle 53 around a circle 54, if of the same diameter, revolving at three times the orbital speed and in the opposite direction to it, will result in the extensions 50, 51 having straight line motions at right angles to one another. Gearing suitable for this purpose is shown in Figure 7 comprising a centre shaft 55 which corresponds to shaft 48 in Fig. 4, a compound wheel 56, 57 (which is mounted on the part 46, Figure 4), and a spur wheel 58 formed on the sleeve 47 gearing with the wheel 57, whilst the other wheel 56 gears with teeth 59 formed on the shaft 55. With such gearing, guiding means for the crankpins may be omitted, and the mechanism will operate correctly if only one crankpin is employed.

This arrangement may be developed for use in driving pumps, compressors, or other like machines direct from motors, or conversely when it is desired to drive high speed machinery direct from the engine.

In Figure 8 is shown a construction of engine embodying the mechanism shown in Figure 4. The shaft 60, which could be either driving or driven, rotates at four times the speed of the crankshaft 63 to which it is coupled by pinions 630, 631 and the crankshaft carries fast with it a pinion 62 connected by a chain 61 with a pinion 64 fast with the engine frame by means such as are indicated at 65.

The bearing 66 for the crankpin may have slight lateral float in a direction tangential to the orbit of the crankshaft in the cross head 67 which works between the guides 68 attached to or supporting the cylinder 69. Idlers or rollers (not shown) may be employed to take up any slack in the chain and also to permit of any necessary minute adjustment of the mechanism. These are merely jockey pulleys and one is arranged on each side of the chain so that slack can be taken up, and if both are adjusted evenly the same phase relationship is maintained. If, however, it is required to advance or retard angularly the crankshaft, this can be done by slacking one jockey and adjusting the other one. As will be apparent, the construction is exceedingly compact, and furthermore the flywheel can be kept small owing to its relatively high speed as compared with the crankshaft.

Figure 9 shows a further modification of the mechanism of the crankshaft, illustrated by Figure 4, in which is a fixed sprocket 70 fast with its stationary supporting bush 71 which latter may be secured to the engine frame and carries an arm 72 adapted to rotate about the axis of the sprocket 70 under the influence of chain gearing. At the end of this arm is a bearing for a spindle carrying another arm 73 of the same length as the arm 72. Fast with the spindle and the arm 73 is a sprocket 74 aligned with the sprocket 70 to which it is connected by a chain (not shown). Thus when the arm 72 is rotated around its support, the crankpin 75 of the second arm 73 will trace out a straight line, and to it can be attached the reciprocatory member.

By reason of the geared connection of the rotating parts, the reciprocatory masses, whether pistons or other members, have a floating engagement with their guides without any side thrust, and the mechanism as a

whole permits the guides to rotate or be stationary, with corresponding modifications in the rotational speeds of other parts of the mechanism.

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

1. In mechanism for converting reciprocatory motion to rotary motion, the combination of stationary cylinders a rotatable crankshaft having a crank pin, a reciprocatory piston, having a gudgeon pin, a connecting rod connecting the gudgeon pin with the crank pin, the axis of the gudgeon pin being at right-angles to the axis of the crank pin, said connecting rod being capable of slight movement or float between it and its guide along a line at right-angles to the crank pin axis and hypocyclic gearing between the crank and crankshaft.

2. In mechanism for converting reciprocatory motion to rotary motion, the combination of stationary cylinders a rotatable crankshaft having a crank pin, a reciprocatory piston, having a gudgeon pin, a connecting rod connecting the gudgeon pin with the crank pin, the axis of the gudgeon pin being at right-angles to the axis of the crank pin, said connecting rod being capable of slight movement or tangential float between it and its guide in the direction of the gudgeon pin axis and the crank pin axis and hypocyclic gearing between the crank and crankshaft.

3. In apparatus for the conversion of reciprocatory to rotary motion or the reverse, the combination of a rotary crankshaft having a crank pin, a reciprocatory member having a gudgeon pin, a connecting rod connecting the crank pin and gudgeon pin, the axis of the gudgeon pin being at right angles to the crank pin, means providing for side float movement of the connecting rod on the gudgeon pin, said float for clearance being in a direction tangential to the orbit of the crankshaft or to a circle concentric with said orbit, and hypocyclic gearing including a planetary gear concentrically mounted on the crankshaft and adapted to engage a main gear fixed with relation to the engine casing.

4. In apparatus for the conversion of reciprocatory to rotary motion or the reverse, the combination of a rotary crankshaft having a crank pin adapted to move in a straight line path, a reciprocatory member, a connection between the crankpin and the reciprocatory member to allow limited relative movement of the connected parts in a direction transverse to the crankpin on either side of the straight line path, thereby preventing any binding effect of the moving parts and means including gearing for guiding the crank pin in said straight line path.

In testimony whereof I have signed my name to this specification.

GEORGE DEAN.