Oct. 12, 1948. J. D. BELL 2,451,374

ENGINE DRIVE

Filed Dec. 5, 1944

Fig. 1.

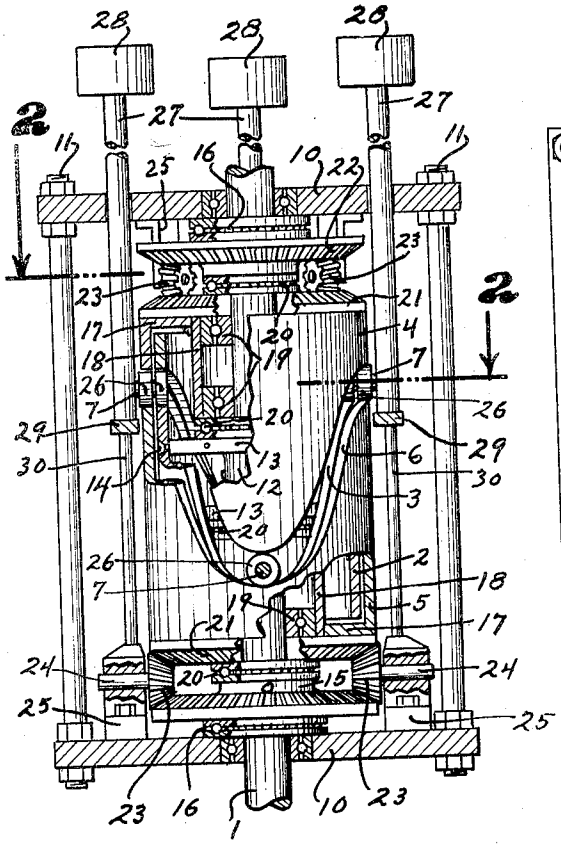


Fig. 2.

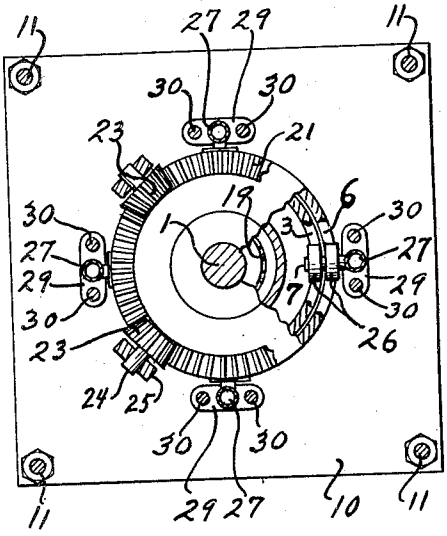
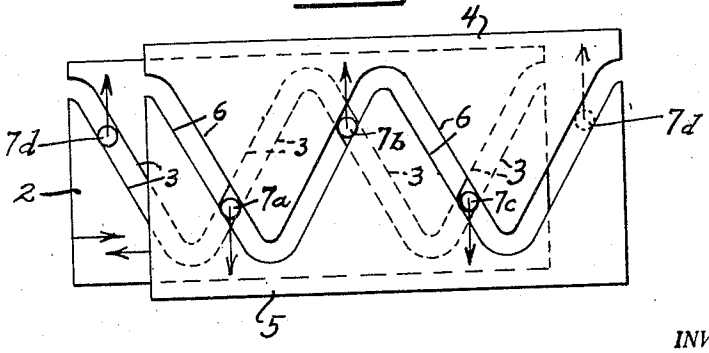


Fig. 3.



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ENGINE DRIVE

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6 Claims. (Cl. 74—57)

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The present invention relates to improvements in an Engine drive, and has particular reference to a cam drive, such as has been described in my co-pending application, Serial Number 518,466, filed January 15, 1944, now Patent 2,440,674, issued May 4, 1948.

While in the pending application, I have shown the general features of my invention, I propose, in the present application, to describe and claim more specific structure developed by me in the further pursuit of the principal idea.

In the pending application it was proposed to provide two concentric helical cam tracks interlocked for rotary movement in opposite directions, and a rectilinearly movable drive pin engaging over both cam tracks at their intersection for rotating the cam tracks on the power stroke and for being lifted by the cams on the return stroke. An additional cam track was provided to exert pull on the pin on the suction stroke of the engine.

In the present invention it is proposed to provide two cam tracks for the suction stroke as well as for the drive stroke of an engine, and this arrangement requires the solution of certain structural problems, in as much as the pin is arranged to project over the cam tracks from the outside, which makes it necessary for the outer cam at least, to extend through the entire thickness of the cylinder carrying the cam.

Thus, it becomes necessary to make the outer cam tracks in two independent pieces and to connect the same with respect to the inner cam tracks so that all the tracks move in the desired direction in exactly timed relation and without any shift in their relative positions throughout the life of the mechanism.

It is proposed in the present invention to provide a structural arrangement in which these conditions are met, and in which the two outer cam tracks, although made in separate parts, operate in unison and are made to revolve in a direction opposite to that of the inner cam tracks.

It is further proposed to provide a special arrangement whereby the two outer cam tracks are mounted with respect to the inner cam tracks so as to avoid any possibility of endwise movement of either of the outer tracks with respect to the other, without interfering with the rotary movement.

A still further object of the invention is to combine the various features into a comparatively simple structure of rugged character, arranged to allow a number of drive pins, in the case illustrated, four pins, to operate on the same

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cam tracks, whereby the four cylinders of the engine may be grouped around the axis of the tracks immediately above the cam track arrangement, so as to form a compact, powerful unit therewith.

Further objects and advantages of my invention will appear as the specification proceeds, and the novel features of my arrangement will be fully defined in the claims hereto attached.

The preferred form of my invention is illustrated in the accompanying drawings, forming part of this application, in which:

Figure 1 shows a vertical section through my engine drive;

Figure 2, a horizontal section taken along line 2—2 of Figure 1; and

Figure 3, a development of the cam tracks.

While I have shown only the preferred form of my invention, it should be understood that various changes or modification may be made within the scope of the claims hereto attached, without departing from the spirit of the invention.

Referring to the drawings in detail, my engine drive comprises in its principal features, a main shaft 1, a cylinder 2 mounted thereon concentrically and in spaced relation thereto, a pair of symmetrical helical cam tracks 3 in the cylinder, a pair of cylindrical caps 4 and 5 revolvable on the ends of the cylinder and having upper and lower cam tracks 6 symmetrical with the cam tracks of the cylinder, means for holding the caps against endwise movement, gearing interconnecting the cylinder and the caps for rotation in opposite directions, and a drive pin 7 engaging over the tracks in driving relation to paired tracks.

The shaft 1 is supported between two plates 10 which may be held in spaced relation by any suitable means, as by the bolts 11 and which should be considered, for the purpose of the present invention, as being fixed to a suitable support. The shaft is formed with a central hub 12 having two spaced discs 13 to which the cylinder 2 is secured by means of screws 14.

The shaft carries two fixed abutments 15 on opposite ends thereof, equally spaced from the hub, and suitable bearings 16 are introduced between the abutments and the plate 10, whereby the shaft 1 is firmly held against endwise motion, but is free to revolve about its own axis.

The two cylindrical caps 4 and 5 are revolvably mounted upon opposite ends of the cylinder 2 in such a manner that the cam tracks 6 of the two caps run parallel to one another and define

a slot substantially similar to that formed between the two tracks 3 of the cylinder.

Each of the two caps is formed, at its end, with a flange 17 projecting inwardly over the end of the cylinder and terminating in a tube or bushing 18 projecting inwardly toward the hub 12. The bushings are revolvable upon the main shaft through bearings 19 and are held against endwise motion between the hub 12 and the abutments 15 through interposed thrust bearings 20.

Each of the two caps 4 and 5 is geared to the cylinder 2 by means of a ring gear 21 secured upon the end of the cap, a ring gear 22 secured upon the abutment 15 and interposed beveled pinions 23 mounted on the stub shafts 24 revolvable in brackets 25 secured to one of the plates 10.

Each drive pin 7 carries two rollers 26 for engagement over the outer and inner tracks, respectively. It is carried by the piston rod 27, which may be in the form of a hollow tube, and which is connected to a piston 28 at its upper end.

The piston rod is guided for straight vertical movement by means of a plate 29 fixed to the rod and slidable on two spaced vertical posts 30. The piston may form part of a conventional internal combusion engine, not shown in the drawings.

For the purposes of the present illustration, I have shown the cam tracks as consisting of two complete waves, with four drive pins and four pistons, so that the four engine cylinders may be grouped above the upper plate 10 to form a compact unit with the drive herein described. It is obvious that the cam tracks may be readily modified to comprise one, three or more complete waves, with a corresponding or suitable change in the number of pistons employed. Thus, three-wave twin cams might be operated by three pistons, which would provide more room for the engine cylinders.

The method of assembling the structure is very simple:

After the hub has been secured to the shaft 1, and the cylinder 2 to the hub, the inner bearings 20 may be applied, and the caps with their bushings 18 and bearings 19 telescoped into place.

Next, the outer bearings 20 are applied and the abutments 15 positioned. Thereupon the outermost bearings 16 are pushed on, and the whole assembly is completed by securing the plates 10 upon the outermost bearings. The pinion 23 may be readily installed at any opportune time.

The operation of the unit is as follows:

Beginning with the position shown in Figure 1 and assuming that the inner and outer cams are rotating under the influence of momentum, and in opposite directions, sufficiently to overcome dead center. The two crests shown in the left side of the drawing will split to form a crotch and the pin 7 will drive down along a straight line to descend into the crotch and to force the cams apart for rotating the cylinder and the caps in opposite directions.

In Figure 3 this drive pin, identified by the character 7*a*, is shown on the downward path. The rotary force of the outer caps is re-transferred to the cylinder and the main shaft by the gearing 21—22—23.

In the meantime, the next drive pin 7*b*, which would be on the forward side in Figure 1, has been forced upward in the next crotch, say, on the exhaust stroke. In this case, as in the preceding one, the two lower cam tracks have done the work of rotating the cams and of lifting the pin.

The next pin 7c may be on the suction stroke and has to be forced downward by the two upper cam tracks, while the fourth pin 7*d* is on the compression stroke and has to be lifted by the lower tracks.

Thus it will be seen that for each stroke, in a four-cycle engine, there are two tracks available to cooperate with the pin in accomplishing the result. The advantage of this double-acting engagement has been more fully explained in my co-pending application.

It is obvious that opposing pistons may be added to applicant's present construction by merely continuing the lower end of the connecting rods on through the bottom frame plate and connecting pistons to it. In such a case the upper sleeve cam shown in the drawing is still more important.

I claim:

1. In an engine drive of the character described, a shaft, a cylinder mounted upon the shaft and having two axially spaced and symmetric cam tracks, two separate sleeves revolvable upon opposite ends of the cylinder in closely spaced relationship therewith and having corresponding axially spaced cam tracks registering with and of substantially the same pitch as the cam tracks of the cylinder and forming crotches with said cylinder cam tracks upon relative turning movement, and a push pin extending from the outside of the sleeves through the space between the sleeve cam tracks and into the space between the cylinder cam tracks and in driving relation with all of the cam tracks.

2. In an engine drive of the character described, a shaft, a cylinder mounted upon the shaft and having two axially spaced and symmetric cam tracks, two separate sleeves revolvable upon opposite ends of the cylinder in closely spaced relationship therewith and having corresponding axially spaced cam tracks registering with and of substantially the same pitch as the cam tracks of the cylinder and forming crotches with said cylinder cam tracks upon relative turning movement, and a push pin extending from the outside of the sleeves through the space between the sleeve cam tracks and into the space between the cylinder cam tracks and in driving relation with all of the cam tracks, and cooperable means on the sleeve and on the shaft for holding the sleeves against endwise motion and for synchronizing the rotary motion of the sleeves.

3. In an engine drive of the character described, a shaft, a cylinder mounted upon the shaft and having two axially spaced and symmetric cam tracks, two separate sleeves revolvable upon opposite ends of the cylinder in closely spaced relationship therewith, and having corresponding axially spaced cam tracks registering with the cam tracks of the cylinder and of substantially the same pitch and forming crotches therewith upon relative turning movement, a push pin extending from the outside of the sleeves through the space between the sleeve cam tracks into the space between the cylinder cam tracks and in driving relation with all of the cam tracks, and cooperable means on the sleeves and on the shaft for holding the sleeves against endwise motion and for synchronizing the rotary motion of the sleeves, said sleeves having means bearing on the shaft for steadying the sleeves.

4. In an engine drive of the character described, a shaft having a hub thereon and having two ring,

gears spaced on opposite sides of the hub, a cylinder mounted on the hub and having two axially spaced and symmetric cam tracks, two separate sleeves revolvable upon opposite ends of the cylinder in closely spaced relationship therewith and having corresponding axially spaced cam tracks registering with the cam tracks of the cylinder and of substantially the same pitch as the cylinder cam tracks and forming therewith crotches upon relative turning movement, a push pin extending from the outside of the sleeves through the space between the sleeve cam tracks into the space between the cylinder cam tracks and in driving relation with all of the cam tracks, and means on the sleeves cooperable with the ring gears for holding the sleeves against endwise motion and for synchronizing the rotary motion of the sleeves.

5. In an engine drive of the character described, a shaft having a hub thereon and having two ring gears on opposite sides of the hub spaced therefrom, a cylinder mounted on the hub and having two axially spaced and symmetric cam tracks, two separate sleeves revolvable upon opposite ends of the cylinder in closely spaced relationship therewith and having corresponding axially spaced cam tracks registering with the cam tracks of the cylinder and forming crotches therewith upon relative turning movement, a push pin extending from the outside of the sleeves through the space between the sleeve cam tracks into the space between the cylinder cam tracks and in driving relation with all of the cam tracks, and means on the sleeves cooperable with the ring gears for holding the sleeves against endwise motion and for synchronizing the rotary motion of the sleeves, said sleeves having bushings projecting into the cylinder and bearing on the shaft for steadying the sleeves.

6. In a combustion engine or the like, a frame, a shaft revolvable therein and carrying a pair of rotary members, one telescoped over the other, said members being connected for contra-rotating movement and being made with slanting tracks, a piston drive pin, the said pin being operable to rotate the members when moving in one direction and to be moved in the opposite direction by the scissor-like action of the said tracks, the pin being mounted for projection over the said tracks from one side thereof, and a second pair of similar rotary members carried by the shaft in opposing relation to the first pair and being connected for contra-rotating movement in synchronism therewith, the second pair being operable for moving the piston drive pin in the first-named direction.

JOSEPH D. BELL.

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