April 6, 1937. E. A. BURNS 2,076,334

DIESEL ENGINE

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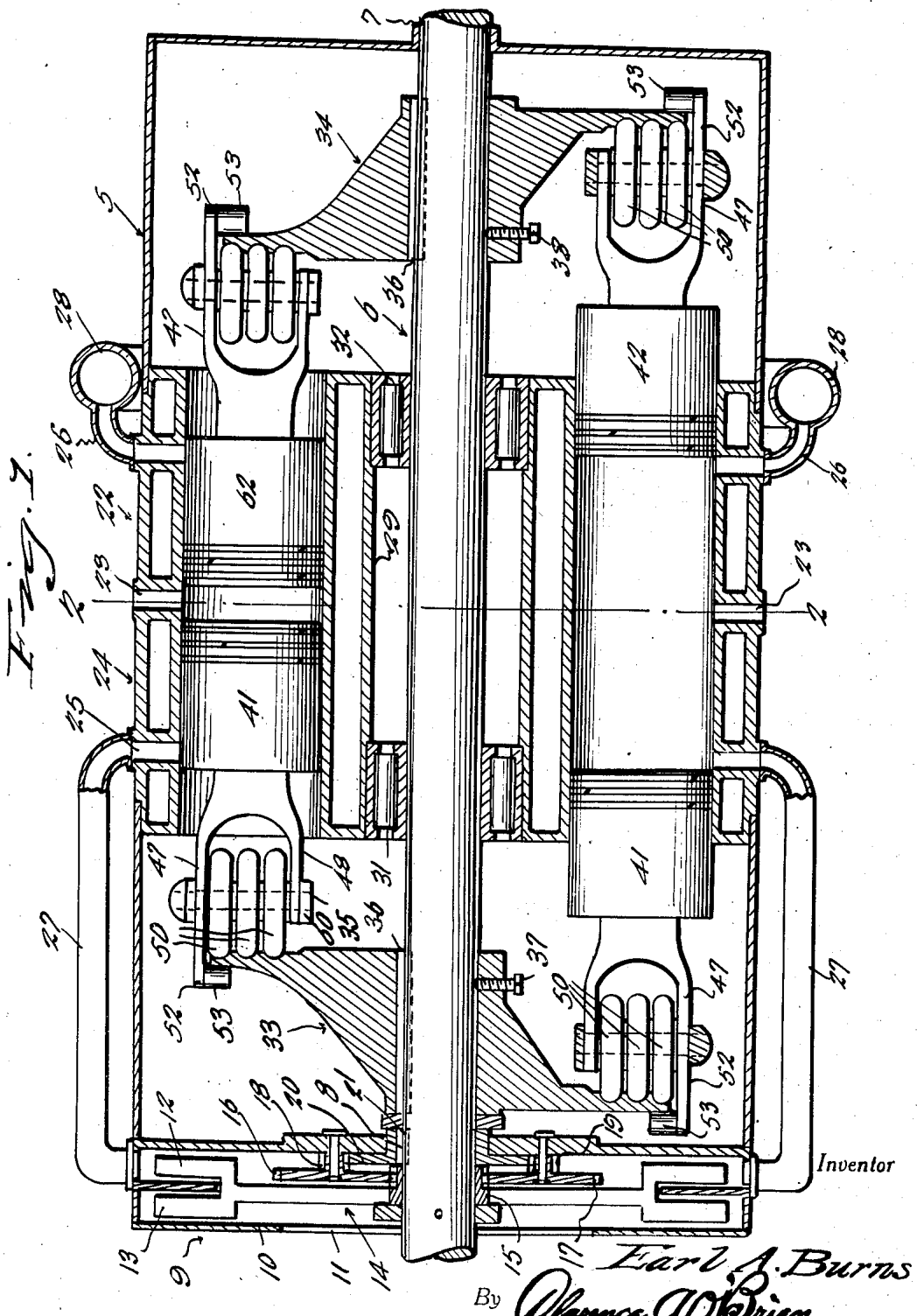

Fig. 1.

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Fig. 3.

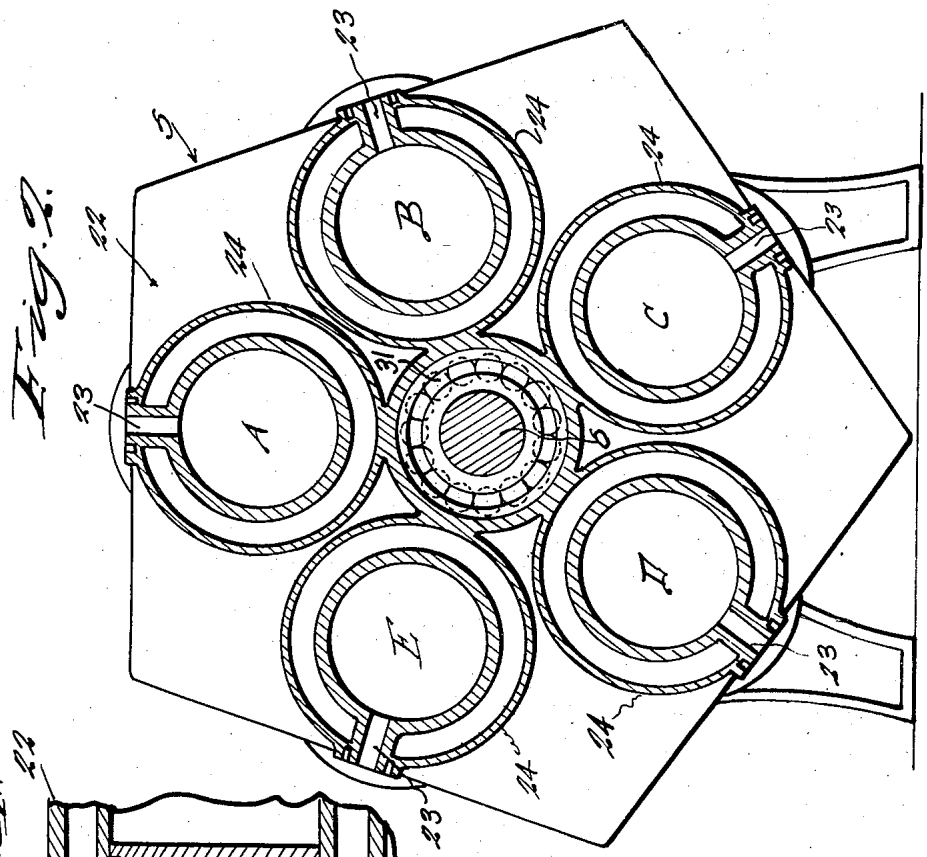
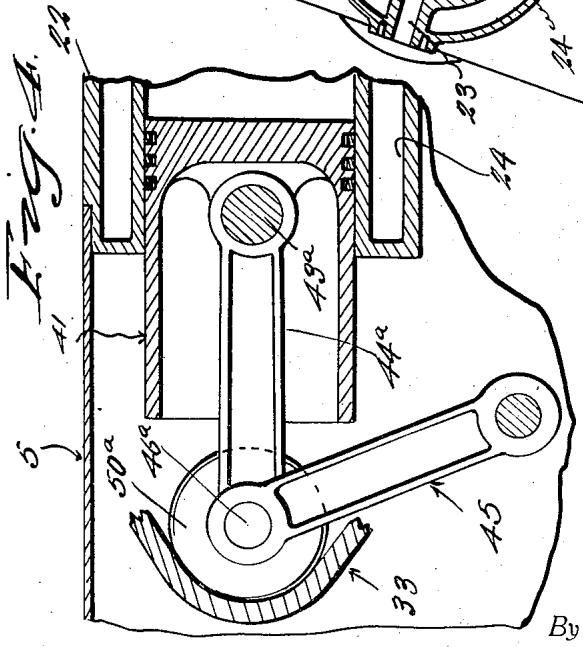


Fig. 4.



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DIESEL ENGINE

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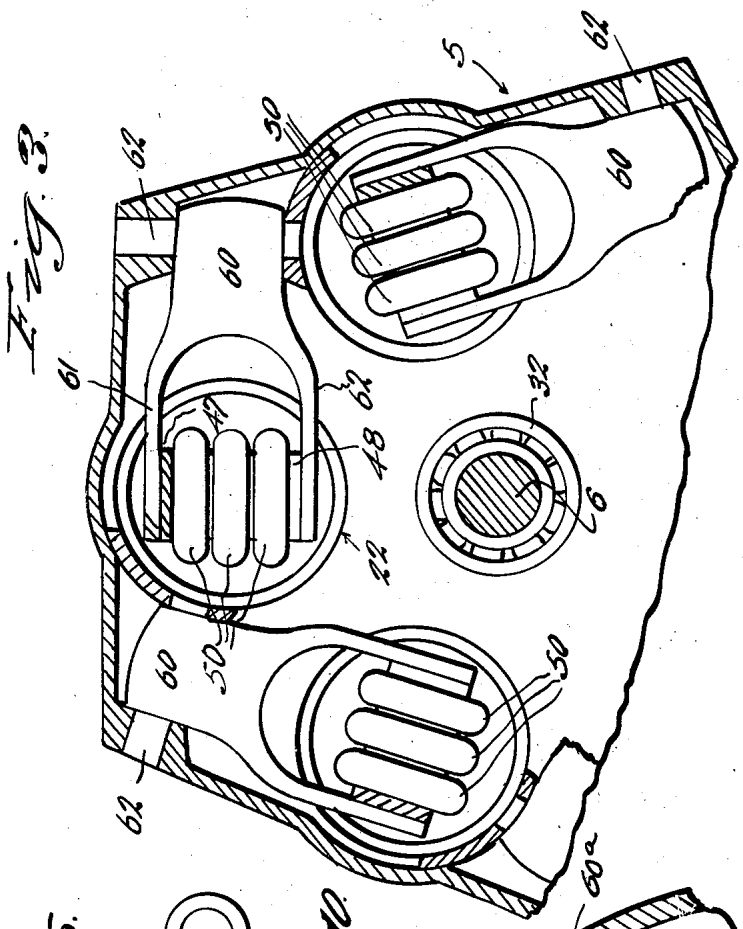

Fig. 3.

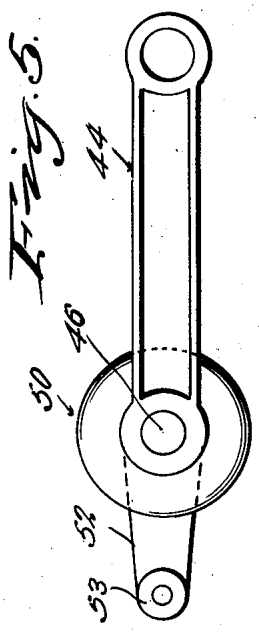

Fig. 5.

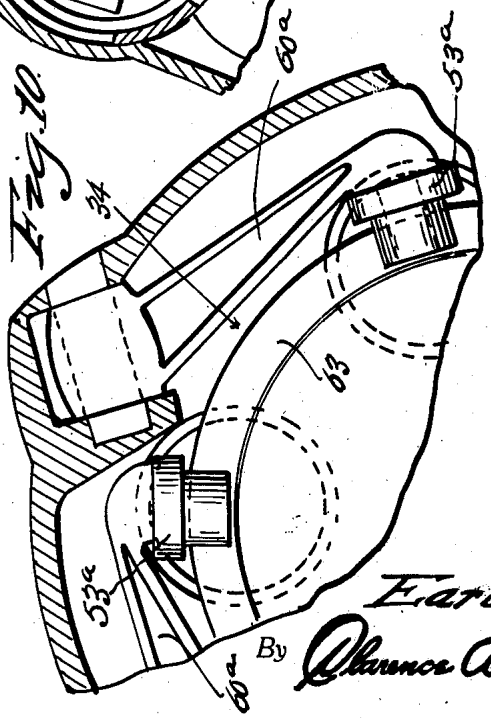

Fig. 10.

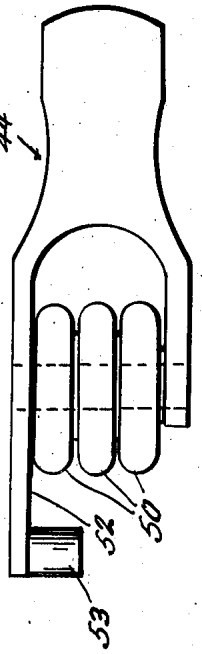

Fig. 6.

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Fig. 7.

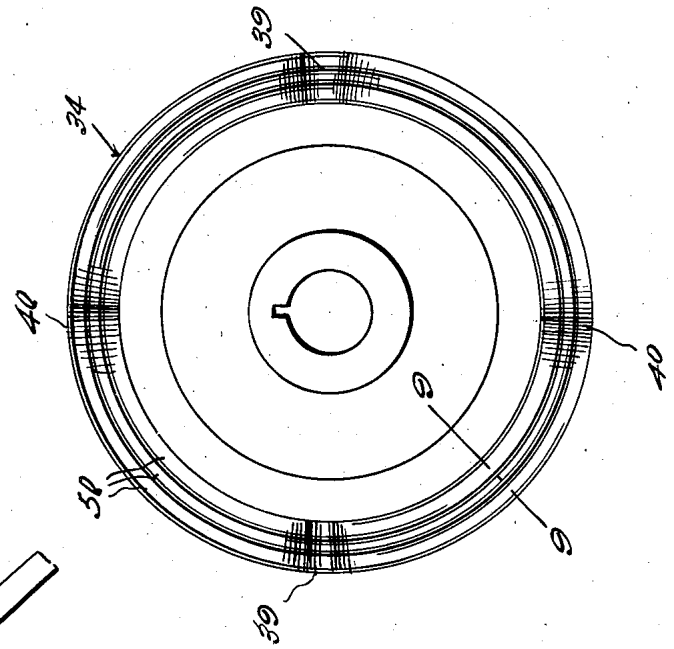


Fig. 8.

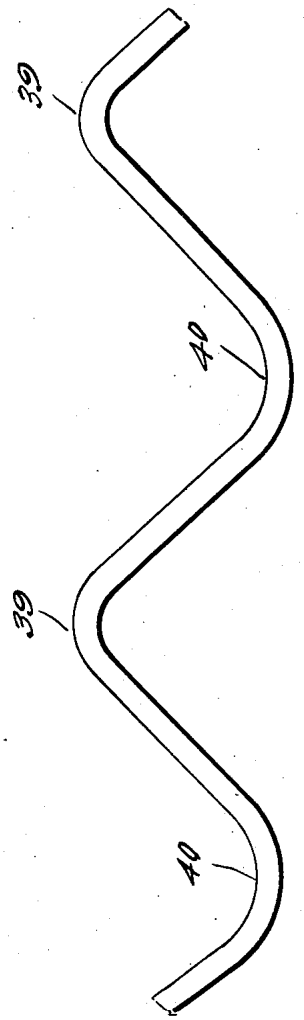
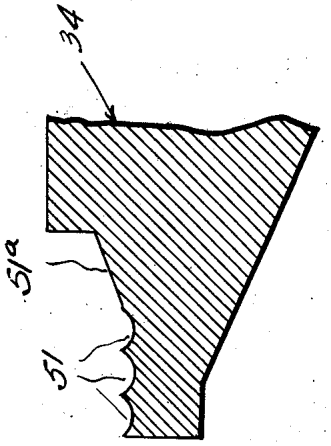


Fig. 9.



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Patented Apr. 6, 1937

2,076,334

UNITED STATES PATENT OFFICE

2,076,334

DIESEL ENGINE

Earl A. Burns, Los Angeles, Calif.

Application April 16, 1934, Serial No. 720,895

2 Claims. (Cl. 123—58)

My invention relates generally to Diesel engines, and particularly to an opposed piston type of Diesel engine in which the cylinders are arranged parallel to and circumferentially spaced around the rotary shaft, and an important object of my invention is to provide an extremely simplified engine of the type described, which has a remarkably small frontal area, the engines being readily adaptable to arrangement in tandem on a single shaft.

It is also an important object of my invention to provide an engine of the character described having a good ratio of power to weight, thereby adapting it admirably to use in aircraft.

It is also an important object of my invention to provide in an engine of the character described means for changing the reciprocating motion of the piston and connecting rods to a rotating motion of the shafts wherein binding and friction are eliminated thereby taking advantage of the greatest possible power output of a given size of cylinder and stroke.

Other objects and advantages of my invention will be apparent from a reading of the following description in connection with the drawings, wherein for purposes of illustration I have shown preferred embodiments of my invention.

In the drawings:—

Figure 1 is a longitudinal vertical sectional view through the preferred embodiment of my invention.

Figure 2 is a transverse vertical sectional view taken through Figure 1 approximately on the line 2—2.

Figure 3 is a transverse vertical sectional view taken through Figure 1 to the right of the section line 2—2 showing thrust arms and connections to housing.

Figure 4 is a longitudinal sectional view through one of the pistons and the adjacent cam.

Figure 5 is an elevational view of one of the connecting rods with its guide roller.

Figure 6 is a side elevational view of Figure 5.

Figure 7 is an elevational view of the working face of and showing the cam.

Figure 8 is a representation of the cam curvature.

Figure 9 is a transverse sectional view taken approximately on the line 9—9 of Figure 7.

Figure 10 is a view similar to Figure 3 taken through another embodiment of the invention showing an alternative manner of arranging the thrust arms.

Referring in detail to the drawings, the numeral 5 refers generally to a generally rectangular casing which has the five sided cross section indicated in Figure 2, in the longitudinal center of which is mounted the rotary shaft 6 passing through the ends of the casing as indicated at 7 and 8.

At the left hand end of the casing 5 is the scavenger blower casing 9 which may be made a part of the casing 5 and which includes the outer wall 10 with the air intake opening 11 and the interiorly spaced partition 12 on either side of which the vanes 13 of the blower rotor 14 work. The blower rotor 14 is journaled on the shaft 6 and has a pinion 15 which is driven by gears 16, 17 which are solid with small pinions 18, 19 which are driven by a gear 20 and keyed on the shaft 6 by means of the key 21, whereby the blower rotor 14 is driven at a speed relatively high with respect to the shaft 6.

At a location equally spaced from the opposite ends of the casing 5 is the cylinder assembly which is generally designated 22 which comprises five circumferentially spaced cylinders A, B, C, D, E, respectively, each of which is open at its opposite ends and has leading into the center thereof in a radial manner a fuel intake 23 with which is adapted to be connected any suitable type of fuel injector such as the "Bosch" or the "Hesselman". The cylinders, it will be noted, are designated clockwise and the shaft 6 rotates clockwise. Each of the cylinders is surrounded by a water jacket 24 and of course the fuel inlet 23 passes through the water jacket as does the scavenger air inlet 25 and the spent gas exhaust 26. It will be observed that the scavenger air inlet is connected by a pipe 27 to the peripheral portion of the blower casing. The exhaust 26 is connected to a suitable manifold 28.

The radially inward side of the cylinder assembly indicated by the numeral 29 bears on a set of longitudinally spaced roller bearings 31, 32 which are mounted on the shaft 6.

Outward of the cylinder assembly and at either end thereof and spaced therefrom is a cam wheel 33, 34, respectively, which is keyed as indicated at 35, 36, respectively, to the shaft 6 and also locked by a set screw 37, 38, respectively. The contour of the working face of the cam is indicated in Figures 7, 8 and 9. Figure 9 is a section taken on the line 9—9 of Figure 7 at a point intermediate the rise 39 and the depression or hollow 40. The cam wheel is provided with equally circumferentially spaced rises and hollows alternating, there being two rises and two hollows, thereby arranging for two power impulses transmitted to the shaft 6 for each cylinder for each

revolution of the shaft 6, the power stroke being delivered to the down slope of the rises to cause a rotation of the cam.

Each cylinder is provided with a pair of opposed pistons 41, 42 each of which has a wrist pin 43a (see Figure 4) pivotally connecting one end of the connecting rod 44a which projects outwardly from the piston and is pivotally connected at its outer end with a thrust arm 45. The pivot 46 extends between the arms 47, 48 which are formed on the outer end of the connecting rod 44 and on the pivot 46 are rotatably mounted three rotatable wheels 50 which engage the concave tracks 51 on the face of the cam. Means for maintaining the wheels 50 in engagement with the grooves 51 in the face of the cam comprises the extension 52 on the arm 47 which carries the roller 53 which engages the back of the track of the cam.

The thrust arms 45 are also forked and overlap the arms 61, 62 which are located outside of the arms 47, 48 of the connecting rod and work on the pivot 46. The opposite ends of the thrust arms 45 are pivoted on pins 62 mounted in the interior of the casing as shown in Figure 3.

A modified arrangement is shown in Figure 10 in which the thrust arms 45a are angulated in position and carry rollers 53a which engage a suitable track surface 63 on the back of the cam wheel 34.

One of the faults of all other opposed cylinder engines known to me is the fact that when their exhaust is uncovered before their scavenging port, the scavenging ports are also closed before their exhaust ports, thereby causing loss of motive power. But in my engine such a condition can be corrected simply by changing the rises in the cam wheels.

With the cylinders denominated clockwise and a clockwise rotation of the shaft 6, the firing order will be A, D, B, E, C, A, D, B, E, C, or 1, 4, 2, 5, 3, 1, 4, 2, 5, 3. This is for one revolution of the shaft and indicates how the power impulses of the engine are balanced.

It is obvious that on the compression stroke in a cylinder the pistons move toward each other and compress the air priorly introduced by the blower; and that as the compression becomes substantially at a maximum the oil is introduced and causes the motivating explosion, or combustion. The pistons then move outward away from each other and through their connecting rods and cam wheels transmit a power impulse to the cams 33, 34 causing shaft 6 to be given rotary motion. When the pistons reach the outer limits of their travel they uncover the exhaust port and scavenging air port in the cylinder walls. The blower then forces air into the cylinder displacing the burnt gases through the exhaust port and recharging the cylinder with a fresh charge of air.

Although I have shown and described herein preferred embodiments of my invention, it is to be definitely understood that I do not desire to limit the application of the invention thereto, and any change or changes may be made in material and structure and arrangement of parts within the spirit of the invention and the scope of the subjoined claims.

What is claimed is:—

1. In an internal combustion engine of the type described, a rotary shaft, a pair of axially spaced cams on said shaft, a cylinder located between said cams and having a pair of opposed pistons working therein and operatively engaging the cams, each of said cams having a pair of rises and a pair of depressions, means operatively connecting said pistons with said cams, said means including connecting rods pivoted to the pistons and to the cylinder and riding on the cams, each connecting rod having roller means operatively engaging the corresponding cam, said roller means including a plurality of rotary wheels rolling against the working face of the cam and maintained against the down slope of the cam rises during the power stroke of the pistons to rotate the cams.

2. In an internal combustion engine of the type described, a rotary shaft, a pair of axially spaced cams on said shaft, a cylinder located between said cams and having a pair of opposed pistons working therein and operatively engaging the cams, each of said cams having a pair of rises and a pair of depressions, means operatively connecting said pistons with said cams, said means including connecting rods pivoted to the pistons and to the cylinder and riding on the cams, each connecting rod having roller means operatively engaging the corresponding cam, said roller means including a plurality of rotary wheels rolling against the working face of the cam and maintained against the down slope of the cam rises during the power stroke of the pistons to rotate the cams, said working face of the cam being formed with guide-grooves in which said wheels roll.

EARL A. BURNS.