April 18, 1933. W. J. FERRY 1,904,680

RADIAL CAM TYPE INTERNAL COMBUSTION ENGINE

Filed April 18, 1930 3 Sheets-Sheet 1

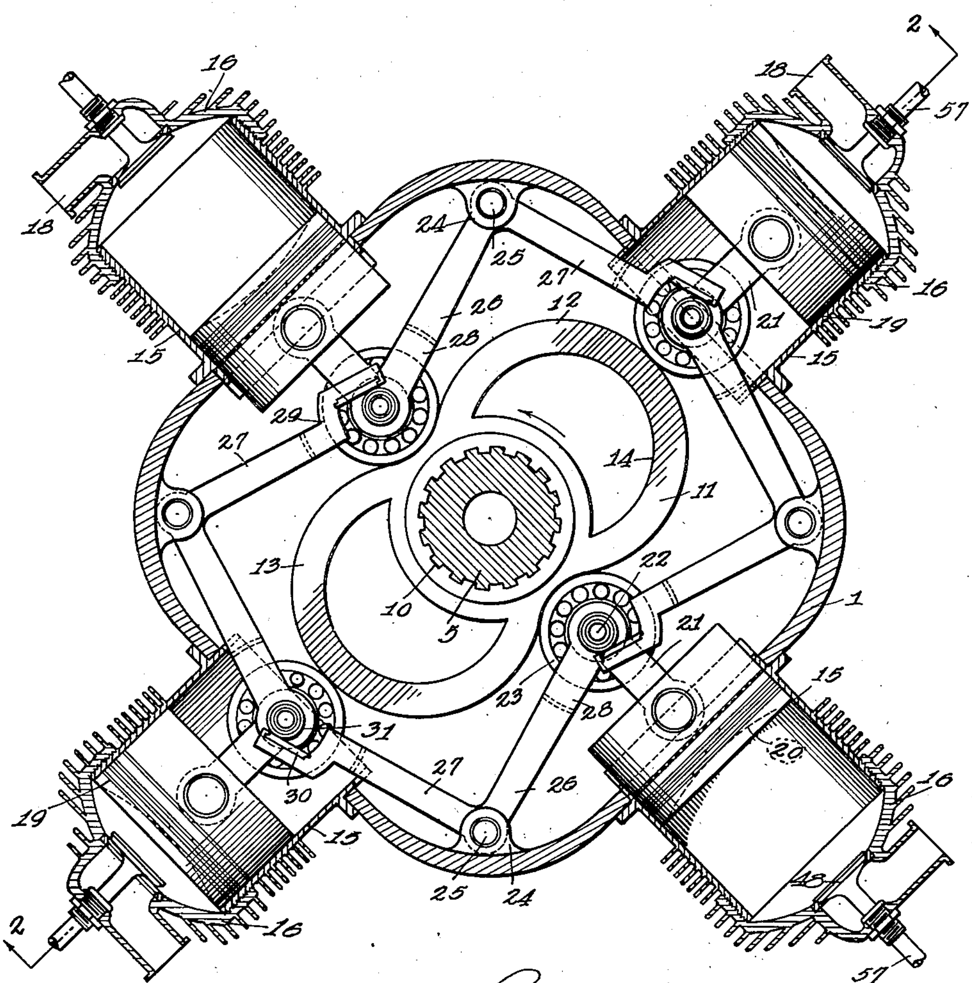

Fig. 1.

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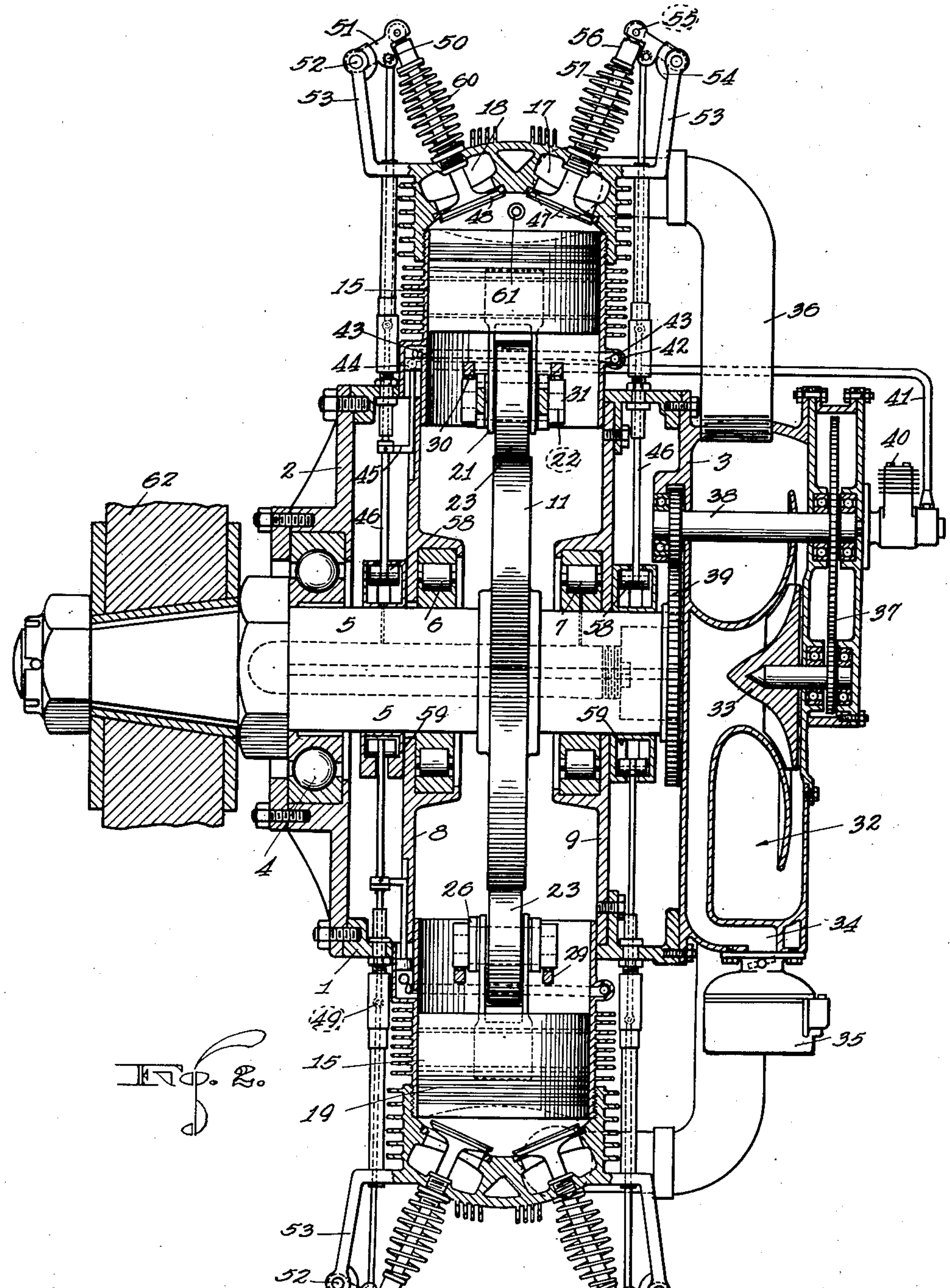

Fig. 2.

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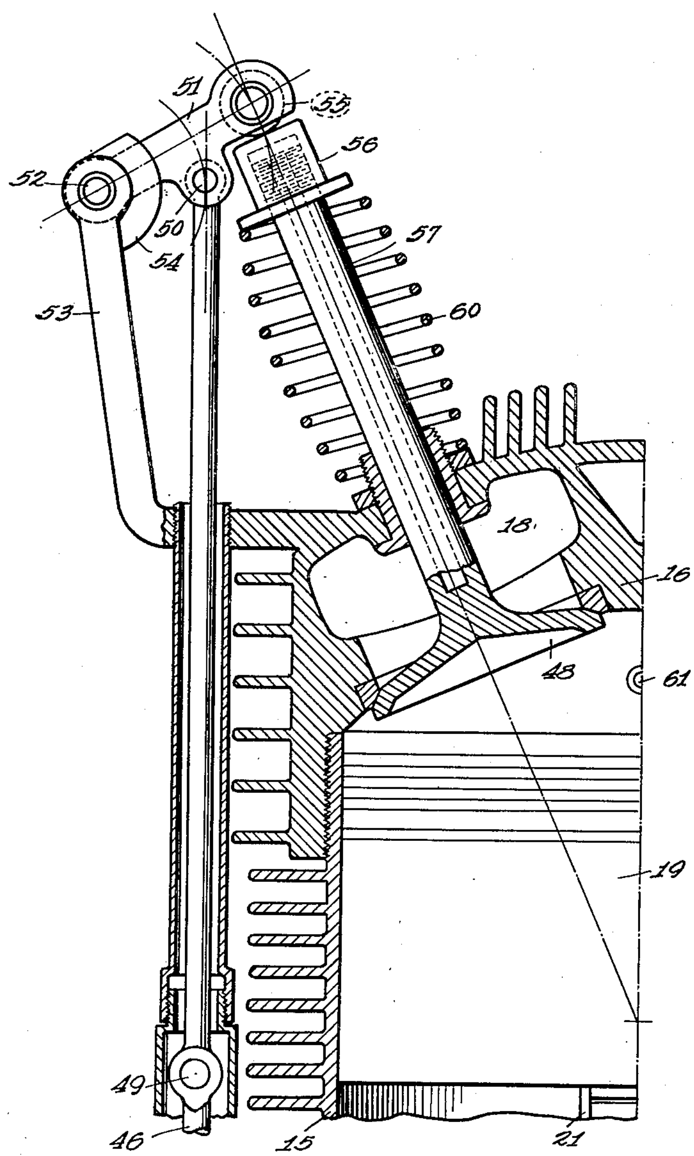

Fig. 3.

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UNITED STATES PATENT OFFICE

WILLIAM JEWELL FERRY, OF OAKLAND, CALIFORNIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO FERRY'S INCORPORATED, OF OAKLAND, CALIFORNIA, A CORPORATION OF NEVADA

RADIAL CAM TYPE INTERNAL COMBUSTION ENGINE

Application filed April 18, 1930. Serial No. 445,440.

My invention relates to improvements in radial cam type internal combustion engines, and it consists in the combinations, constructions and arrangements hereinafter described and claimed.

An object of my invention is to provide a radial cam type internal combustion engine that operates on the four stroke per cycle principle and uses the standard fuel mixtures. The cylinders and pistons are arranged in groups of four, and the adjacent pistons in each group are operatively connected together by power and intake lever arms, the power arms being provided with forked ends for receiving wrist pins that in turn are carried by the connecting rods, while the intake lever arms are provided with forked ends that ride upon bearings for keeping the large roller bearings in constant contact with the periphery of the double lobed cam.

Novel means is also provided for scavenging each cylinder with air, this air mixing with the incoming gases for providing a perfect mixture. A super-charger is employed for forcing intake gases into the cylinders at the proper time.

I also contemplate the use of a new type of valve-actuating mechanism in which the customary push rod for the valve is changed to a pull rod. This permits a lighter structure to be used in the pull rod, which in turn reduces the weight of the engine and makes it more ideal for use in airplanes.

Other objects and advantages will appear as the specification proceeds, and the novel features of the device will be particularly pointed out in the claims hereto annexed.

My invention is illustrated in the accompanying drawings, in which:

Figure 1 is a transverse section through the device, portions being shown in elevation,

Figure 2 is a section along the line 2—2 of Figure 1, portions being shown in elevation, and

Figure 3 shows an enlarged view of one of the valve actuating mechanisms.

In the drawings I have only shown one group of four cylinders, but the engine is so designed that practically any number of groups of cylinders may be arranged along the main drive shaft, and in this way the power delivered to the shaft can be determined by the number of cylinder groups used. Referring to Figures 1 and 2, it will be noted that I provide a casing 1 that in cross section resembles a square having rounded corners. The ends of the casing are closed by end plates 2 and 3 of the shape shown in Figure 2. The end plate 2 or ball bearing mounting ring carries a ball thrust bearing indicated generally at 4, and this bearing rotatably carries a main drive shaft 5. The drive shaft 5 is also supported by roller bearings 6 and 7, and these bearings in turn are supported by roller bearing mounting rings 8 and 9 respectively. If a number of groups of cylinders are arranged along the shaft 5, it is preferable to dispose one of the mounting rings between each group of cylinders, although this is not essential.

Figure 1 shows the shaft 5 as being provided with a number of splines 10. I have found that sixteen splines are needed in order that the different groups of cams may be arranged on the shaft 5 in the proper position. A double lobed cam 11 is carried by the shaft 5 and is secured in place by the splines 10. The cam has a power lobe 12 and an exhaust lobe 13. Crescent-shaped slots 14 are cut in the cam in order to lighten it.

Figure 1 also shows the casing 1 as carrying four cylinders 15, these cylinders preferably being made of steel. Duralumin dome-shaped cylinder heads 16 are secured to the cylinders 15, and these heads have intake ports 17 and exhaust ports 18 therein (see Figure 2). Pistons 19 are slidably mounted in the cylinders and have concave heads 20.

Each piston has a connecting rod 21, and each rod carries at its inner end a wrist pin 22, the pin in turn rotatably carrying an inner roller bearing 23. The rod 21 is forked for receiving the roller bearing 23, and the bearing in turn contacts with the periphery of the cam 11.

The casing 1 supports journal boxes and hangers 24 and these carry pins 25 that rotatably support power lever arms 26 and intake lever arms 27. The arms are movably mounted on the pins 25 and are connected together so as to operate in much the same manner as a bell crank lever. The arms 26 are forked and straddle the inner bearing 23. The forked ends 28 of the arms 26 receive the wrist pins 22.

The other arms 27 have forked ends 29, and these have races 30 that contact with outer roller bearings 31 (see Figure 2). During the intake strokes of the pistons, the arms 27 hold their respective roller bearings 23 in contact with the edge of the cam 11.

Referring to Figure 2, it will be noted that I provide a super-charger indicated generally at 32. This super-charger has an impeller 33 that is designed to suck a combustible mixture through an intake passageway 34 from a carburetor 35 and to force this mixture into intake pipes 36, these pipes leading to the intake ports 17. The impeller 33 is operatively connected to the main shaft 5 by gearing 37, a driven shaft 38, and gearing 39.

Means is also provided for scavenging the cylinders of exhaust gases, and this means comprises an air compressor 40 (see Figure 2) that is operatively connected to the shaft 38. This compressor forces air through pipes 41 that lead to annular passageways 42 that are disposed at the bottoms of the cylinders 15 where they will be uncovered when the pistons are in their lowermost positions. The passageways 42 communicate with the cylinder through two intake ports 43. More may be provided if desired. A special valve 44 controls the flow of compressed air into the annular passageways 42.

I have shown the special valve 44 as being connected to an arm 45, and this arm in turn is connected to a valve pull rod 46 so as to be actuated by the rod.

It is now best to set forth the particular construction of the intake and exhaust valves 47 and 48. Figure 3 shows an enlarged detail view of one of the valves. It will be noted that the pull rod 46 is provided with a pivot 49, and that the upper end of the jointed pull rod 46 is pivotally connected at 50 to an arm 51. The arm 51 is rockably mounted at 52 on a support 53, and is guided in its movement by a guide member 54.

The free end of the arm 51 carries a roller 55 that contacts with an adjustable cap 56, the cap being mounted upon the upper end of the valve stem 57.

Referring to Figure 2, it will be noted that the pull rod 46 carries rollers 58, and these are mounted in a cam 59 that is rotated by the shaft 5. The rotation of the cam 59 reciprocates the rod 46, and on the inward movement of the rod toward the shaft 5 the arm 51 will be rocked for opening the valve 48 (see Figure 3) against the compression of a valve spring 60. The return movement of the pull rod 46 allows the spring 60 to close the valve 48. I have shown the exhaust valve in Figure 3. The same construction is used in the intake valve 47, and like reference numerals will therefore be applied to both sets of valves.

From the foregoing description of the various parts of the device, the operation thereof may be readily understood.

The cam 11 will rotate counter-clockwise when looking at Figure 1, and it will be actuated by the pistons 19 on their respective power strokes. It will be noted that two oppositely-disposed pistons are moving inwardly while two oppositely-disposed pistons are moving outwardly. This results in a more even balancing of the engine during operation.

The super-charger forces a combustible mixture to all of the intake ports 17, and this mixture enters the cylinders 15 when the intake valves 47 are opened. As already stated, the pistons 19 are moved on their intake strokes by the forked ends 29 riding upon the outer ball bearing races 31.

At the completion of the intake stroke, the compression stroke starts. The valve 44 (see Figure 2) prevents air from entering the cylinder when the ports 43 are uncovered by the piston between the intake and the compression strokes. After the mixture has been compressed, the spark plug 61 will ignite the mixture and will cause the piston to move inwardly on its power stroke. This will cause the roller bearing 23 associated with the piston to impart a counter-clockwise rotative movement to the cam 11. The cam in turn will rotate the shaft 5, and the shaft will rotate a propeller 62 (see Figure 2) or it can do other work.

At the completion of the firing stroke, the ports 43 are uncovered and the valve 44 permits compressed air to enter the cylinder and to partially fill it, thus driving out the exhaust gases through the opened exhaust valve 48. The exhaust valve 48 remains open during the exhaust stroke and then closes. A small quantity of clean air will be trapped in the dome-shaped head and the concave top of the piston. During the intake stroke the intake valve 47 opens and the intake gas is mixed with the fresh air in the cylinder to form a combustible mixture. The cycle is repeated.

It should be noted that the outer races on the intake roller bearings 31 (see Figure 2) revolves in a clockwise direction during the time the large roller bearing 23 moves from top dead center to the middle of the stroke. Then the bearings reverse their movement and rotate in a counter-clockwise direction until they again reach bottom dead center. The intake valve 47 closes thirty degrees after bottom dead center and compression begins. This permits the outer race of the intake roller bearings 31 to continue to rotate in a clockwise direction during compression, power, and exhaust strokes or until they are again engaged by the intake lever race 30. These races engage the rollers 31 for one hundred and twenty degrees, i. e. from top dead center to thirty degrees past bottom dead center.

The momentum of the two outwardly moving pistons is counterbalanced by the inward movement of the other two pistons, because all of the pistons are connected together in the manner described. In this way perfect running balance is obtained, because the cam type radial engine is the only one in which there is a perfect static balance of all moving parts. I therefore claim that since the pistons move in pairs in opposite directions to that of the other pairs, and since they are connected in the manner shown, there will be no heavy shocks due to inertia or momentum of the moving parts at the end of each piston stroke. The cam roller bearings 23 will be held down on the cam lobes during the intake stroke of the pistons, and the power lever arms 26 will hold the roller bearings 23 in contact with the cam lobes during the remaining strokes. This entire combination is novel for converting a reciprocating motion into a rotary motion using a four-cycle radial cam type internal combustion engine.

It is claimed that the auxiliary admittance valve 44 is a new feature and principle used in connection with four-cycle engines. These valves admit pure clean warm air underneath the exhaust gases, and they thereby assist in driving all of the dead exhaust gases out of the cylinder on the exhaust stroke, leaving pure clean dry hot air in the combustion chamber at the start of the intake stroke. This gives efficient ignition and a quick flame propagation. The volumetric efficiency of the engine is also increased. The air cools the exhaust valves and prevents carbon deposits on the valves and spark plugs. The principle of so locating the lever arms 26 and 27 that only a small out-of-line movement or throw of the crank pin 21 is the result, gives the engine an added advantage over other types.

The particular type of valve operating mechanism is also novel. The jointed rod 46 pulls the valve 48 into open position instead of pushing it. The pull rod 46 is attached to the pull rod pin 50 at a point on a line which is at right angles to the pull rod center line at the mid stroke of the pull rod pin. The center line of the pull rod pin 50 passes over the center line of the pull rod 46 at two points for each up and down movement. This gives the least out-of-line movement to the pull rod and tends to lessen wear due to thrust on the moving elements of the valve.

In like manner the roller 55 has its axis coinciding with the axis of the valve 48, and the movement of the roller is substantially along the axis of the valve. This cuts down the wear on the moving parts. All of the parts in the mechanism are in tension when opening the valve, and the simple lever 51 takes the place of the rocker arm and its complicated parts now used in the standard engine. The parts are so designed as to dampen out the effect of any vibratory motions such as invisible valve bounce or vibrations and other molecular effects upon the valves and valve stems which give rise to inharmonic vibratory calculations of oscillating motions of fast moving parts.

Although I have shown and described one embodiment of my invention, it is to be understood that the same is susceptible of various changes, and I reserve the right to employ such changes as may come within the scope of the claims hereto annexed.

I claim:

1. An engine comprising a shaft, a cam mounted thereon, a plurality of cylinders, a piston mounted in each, a connecting rod for each piston, a connecting rod pin for each rod, a roller mounted on each pin and contacting with the cam, rigid arms pivotally mounted, each arm having one end connected to a connecting rod pin so as to be moved during both reciprocative movements of the piston, and having its other end bearing against one side of the adjacent pin for holding its associate roller in contact with said cam whereby there will be a continuous linkage of arms entirely surrounding the cam.

2. An engine comprising a casing, a shaft, a cam mounted on said shaft, cylinders disposed around said shaft, a piston mounted in each cylinder, a connecting rod for each piston, a connecting rod pin, a roller mounted on each pin and contacting with said cam, a bell crank lever pivotally mounted between adjacent cylinders, each lever having one end connected to its associate pin, and its other end bearing against one side of an adjacent pin for holding the roller carried by the pin in contact with the cam whereby each roller is held in contact with the cam by two levers.

3. An engine comprising a casing, a shaft, a cam carried thereby, radially-extending cylinders carried by said casing, pistons mounted in said cylinders, connecting rods for the pistons, a roller carrying pin secured to each rod, a cam-contacting roller carried by each rod, bell crank levers pivoted to the casing and having one end connected to the pins and their other end bifurcated and bearing against an adjacent pin and straddling the roller, the levers forming a complete chain around the cam.

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