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CAM SHAFT DRIVES FOR THE VALVE GEAR OF MULTIBANK INTERNAL COMBUSTION ENGINES

Filed Oct. 26, 1953 2 Sheets-Sheet 1

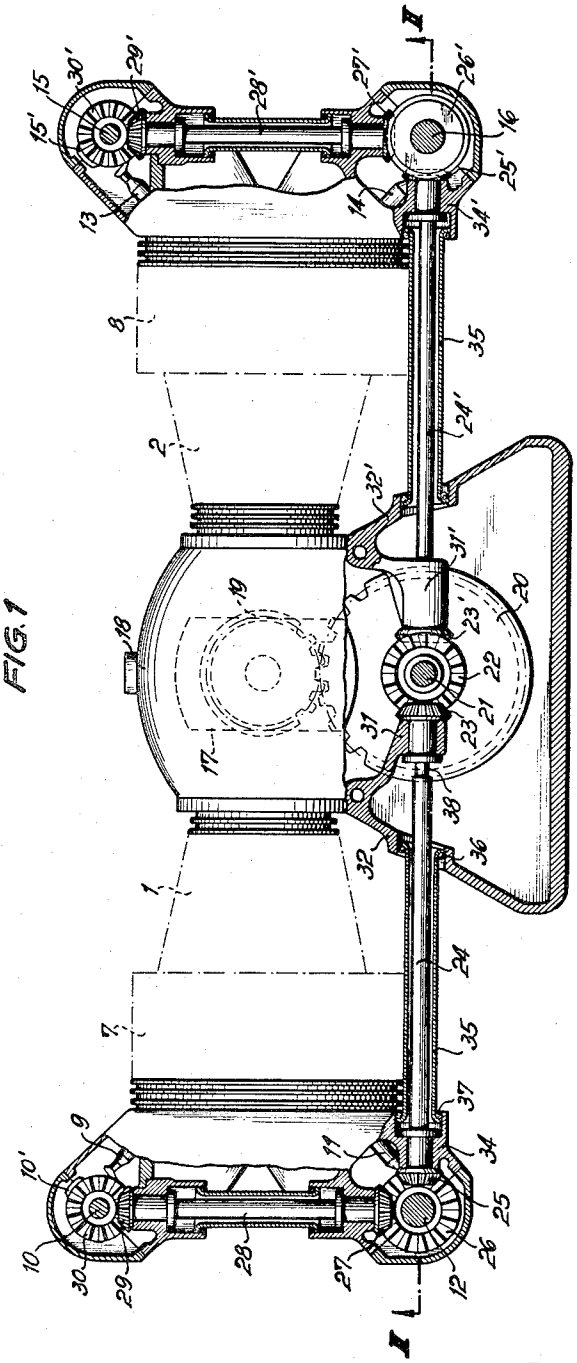

FIG. 1

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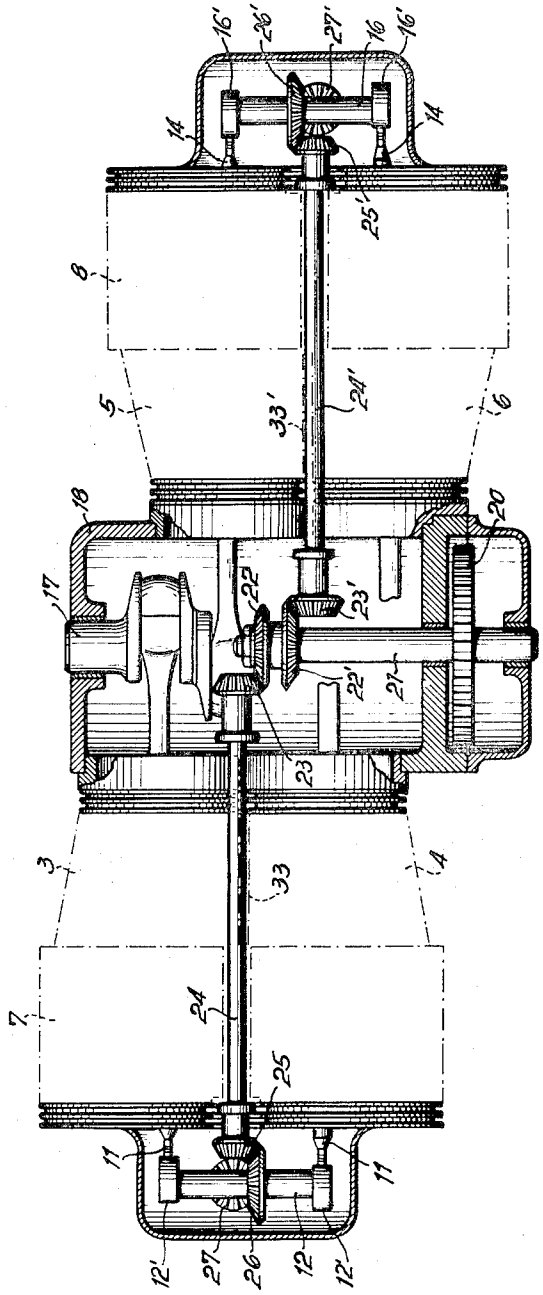
FIG. 2



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CAM SHAFT DRIVES FOR THE VALVE GEAR OF MULTIBANK INTERNAL COMBUSTION ENGINES

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5 Claims. (Cl. 123—90)

This invention relates to improvements in cam shaft drives for the intake and exhaust valves of internal combustion engines of the multi-bank type including king shafts, particularly for use in connection with Boxer engines.

Cam shaft drives of the type in which cam shafts are arranged over the cylinder heads of an internal combustion engine and driven by means of king shafts located at the front or rear of the engines, are known. Arrangements of this type require the use of special casings for accommodating the driving elements and, therefore, make the engine longer and heavier as well. Since internal combustion engines of the type under consideration are generally used in motor vehicles for sporting purposes, this additional length and greater weight has an unfavorable effect on the power to weight factor.

The primary object of the present invention is, therefore, to provide an improved cam shaft drive for engines of this type which will avoid the drawbacks and disadvantages referred to above.

A further object of the invention is to provide a cam shaft drive mechanism for the valves of multi-bank internal combustion engines, which is compact in form and which requires no special housings.

In accordance with the invention the drawbacks and disadvantages encountered in previous constructions are overcome by arranging the king shafts, which are located substantially parallel to the axes of the cylinders, between the cylinders, so that a compact structure is obtained.

In this construction direct actuation of the inlet and exhaust valves for the engine cylinders is obtained by providing a king shaft for each of the engine banks and mounting it for driving a cam shaft at right angles thereto for one set of valves, this cam shaft in turn operating a connecting drive shaft extending at right angles to the king shaft and cam shaft for driving a second cam shaft operating another set of valves for the engine bank. The king shaft and associated drive mechanisms for the different banks of the engine are made exactly alike so that they are interchangeable and the elements of one may be used in the other, thereby reducing the number of different parts to be manufactured.

In a preferred construction the king shafts are mounted underneath the engine crank shaft in the crankcasing and each is arranged between or along the joint between two adjacent cylinders, a part of each king shaft being surrounded by a protecting pipe or tubular casing secured and sealed to the engine casing and crankcasing by means of rubber rings.

The invention includes other features and advantages described more in detail hereinafter in connection with one illustrative embodiment of the invention shown in the accompanying drawings, wherein:

Fig. 1 is a simplified cross-sectional view of a Boxer engine, used for explaining the invention, Fig. 1 showing the parts of a cam shaft drive arrangement according to the invention, and

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1, with parts broken away.

The internal combustion engine shown in the drawings is provided with opposed cylinder banks 1 and 2 (Fig. 1), arranged on opposite sides of a crankcasing 18, bank 1 including cylinders 3 and 4 and bank 2 including cylinders 5 and 6 (Fig. 2), the respective banks of cylinders being joined by means of undivided or integral cylinder heads 7 and 8. Inlet valves 9 for the cylinders 3 and 4 are located in the cylinder head 7 at the top of the bank 1, as indicated in Fig. 1, these inlet valves being actuated by a cam shaft 10 provided with actuating cams 10'. Exhaust valves 11 are also located in the cylinder head 7 at the lower part of bank 1 for the cylinders 3 and 4, these valves being actuated by a cam shaft 12 carrying actuating cams 12' (Fig. 2).

The arrangement for the two banks of cylinders is the same, and inlet and exhaust valves 13, 14 located in the head 8 are provided for the cylinders 5 and 6 of the bank 2, the inlet valves being actuated by a cam shaft 15 provided with actuating cams 15', while the exhaust valves 14 are actuated by a cam shaft 16 provided with actuating cams 16'. The four cam shafts of the engine are mounted in parallel arrangement and extend lengthwise of the cylinder banks. These four shafts are driven by a crankshaft 17 mounted in the engine casing 18 between the banks of engine cylinders, the drive from the crankshaft being through a pair of gear wheels 19 and 20 to a shaft 21 (Fig. 2) mounted underneath the crankshaft and parallel thereto. The gear wheel 19 is fixed to the crankshaft 17 and meshes with the gear wheel 20 fixed to the shaft 21. A bevel gear 22 is fixed on the shaft 21 and drives the camshaft 12 for actuating the exhaust valves 11 through a bevel gear 23, meshing with the gear 22, a king shaft 24 extending from the gear 23, and a further pair of intermeshing bevel gears 25 and 26, respectively fixed to the king shaft 24 and the camshaft 12.

The king shaft 24 also drives the camshaft 10 and this is effected by means of a bevel gear 27 meshing with the bevel gear 26 and driving the camshaft 10 for the inlet valves 9 through a drive shaft 28, on which the bevel gear 27 is fixed. The drive shaft 28 is arranged at right angles to the king shaft 24 and carries at its opposite end a bevel gear 29 meshing with a bevel gear 30 fixed to the camshaft 10.

The camshafts 15 and 16 for the cylinders 5 and 6 are driven in exactly the same manner as the camshafts for the cylinders 3 and 4, the corresponding driving elements being given the same number to which a prime has been added. Briefly stated, it will be noted that a bevel gear 22' is fixed to the shaft 21 adjacent to the bevel gear 22. The bevel gear 22' meshes with the bevel gear 23' to drive king shaft 24', which in turn drives the cam shafts 15 and 16 for operating the inlet and exhaust valves 13 and 14 for the cylinders 5 and 6.

In accordance with the invention and as shown in the drawings, the king shafts 24 and 24' are arranged so that they are substantially parallel to the axes of the engine cylinders and are respectively arranged between the pairs of cylinders 3, 4 and 5, 6. The king shafts, as shown, are preferably mounted below the crankshaft 17 and their inner ends are carried in brackets 31, 31' in the crankcasing, respectively, the shafts themselves respectively extending through openings 32, 32' in the opposite crankcasing walls. Outside the crankcasing the king shafts 24, 24' extend in the joint spaces or between the joinings 33, 33' (Fig. 2) formed by adjacent cylinders 3, 4 and 5, 6, respectively, and to the housings 34, 34', respectively, in which the camshafts 12 and 16 are located.

The foregoing arrangement enables the drive to be effective in the middle of the camshafts, as shown in Fig. 2, so that they can be made relatively short, or only

of a length necessary for actuating the valves for the number of cylinders provided in the bank. The sections of the king shafts 24, 24' extending outwardly through the openings 32, 32' are each surrounded by a protecting casing or pipe 35 sealed by rubber rings 36 and 37, respectively, in the opening 32, or 32' and in the casing 34 or 34'.

The elements of the camshaft drive for one bank of cylinders are constructed so that they can be interchanged with the corresponding elements belonging to the camshaft drive for the other bank of cylinders. With this end in view, all of the elements or parts are made the same and the king shafts 24, 24' are connected to the gears 23, 23', respectively, by means of splines 38, as shown in one instance in Fig. 1, the gears 23, 23' being mounted as independent elments in the bearings of brackets 31, 31', respectively, as shown in Fig. 1, so that the king shafts may be readily withdrawn and inserted in driving connection with the gears 23, 23'.

It is to be understood that the present invention is not limited to the construction shown in the illustrative example, but that it can also be applied to engines in which the cylinders are arranged in banks in the V-manner. Furthermore, while in the illustrative example only two cylinders are shown per bank, it is to be understood that the number of cylinders per bank may be more than two.

What we claim is:

1. In a multi-bank internal combusion engine including king shafts for driving the mechanism for operating the inlet and exhaust valves of the cylinders of the engine banks, the improvement in which the king shaft for each bank of cylinders is located between adjacent cylinders of the bank and extends substantially parallel to their axes, said mechanism for operating the inlet and exhaust valves for each bank including a camshaft for the inlet valves and a cam-shaft for the exhaust valves parallel to each other, a driving shaft at right angles to and interconnecting said camshafts, and means for driving one of said camshafts from the king shaft of said bank.

2. A multi-bank internal combustion engine as claimed in claim 1, in which the camshaft driven by the king shaft is at right angles thereto.

3. In a multi-bank internal combustion engine including a crankshaft, and king shafts for driving the mechanism for operating the inlet and exhaust valves of the cylinders of the engine banks, the improvement in which the king shaft for each bank of cylinders is located between adjacent cylinders of the bank and extends substantially parallel to their axes, the king shafts being located below the crankshaft of the engine, and the king shaft for each bank extending through the crankcase of the engine and along the joint between two adjacent cylinders of the bank.

4. In a multi-bank internal combustion engine of the type in which the cylinders of one bank are arranged in opposition to the cylinders of the other bank and each bank includes a plurality of parallel cylinders, a crankcasing located between the banks of cylinders, a crankshaft in the casing, and mechanism for operating the inlet and exhaust valves of the cylinders of the engine banks, the improvement comprising a king shaft for each engine bank located below and parallel to the axes of the cylinders of the bank and extending into the crankcasing below the crankshaft therein, means in the crankcase operatively associated with the crankshaft for driving the king shafts for the banks of engine cylinders, said mechanism for operating the inlet and exhaust valves of each bank of cylinders including spaced parallel camshafts extending lengthwise of the bank of cylinders, means for directly driving one of said camshafts by the king shaft for said bank, and means for driving the other camshaft from the camshaft driven by the king shaft.

5. In a multi-bank internal combustion engine of the type in which each bank includes a plurality of parallel cylinders, a crankcasing located between the banks of cylinders, a crankshaft in the casing, and mechanism for operating the inlet and exhaust valves of the cylinders of the engine banks, the improvement comprising a king shaft for each engine bank parallel to the axes of the bank of cylinders and extending into the crankcasing below the crankshaft therein, means in the crankcase operatively associated with the crankshaft for driving the king shafts for the banks of engine cylinders, said mechanism for operating the inlet and exhaust valves of each bank of cylinders including spaced parallel camshafts extending lengthwise of the bank of cylinders at right angles to the king shaft therefor, means for directly driving one of said camshafts by the king shaft for said bank, said means for driving said one camshaft including a bevel gear fixed to the camshaft intermediate its ends, and means including a shaft provided with a gear meshing with said bevel gear for driving the other camshaft.

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