INTERNAL COMBUSTION ENGINE V BLOCK CAM TRANSMISSION

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3 Claims

ABSTRACT OF THE DISCLOSURE

An internal combustion engine of V-type having a lobed cam disc on the power take-off shaft, a reciprocating piston in each cylinder of the engine and a piston rod firmly secured to said piston and at its free end having a rotatable roller cooperating with the cams of said cam disc, a pivotable yoke connecting the two piston rods of each pair of cylinders, each piston rod being provided with a cross-head running in grooves in guide means in the casing of the engine for taking up laterally directed forces on the piston rod, the ends of the yoke being bifurcated with the surfaces facing each other constituting rolling surfaces for cylindrical surfaces of said cross-head for avoiding wear of the co-operating surfaces.

The invention relates to an arrangement in internal combustion engines and particularly to big ship diesel engines, in which the cranks on the crank shaft are substituted by a lobed cam disc cooperating with a roller on the end of the piston rods in order to transfer the power developed in the cylinder of the engine to a power take-off shaft.

In order to achieve the high output today demanded of big ship engines it has been necessary to increase the dimensions which has the consequence that the engine-room will demand a considerable space both in the longitudinal direction as well as in the vertical direction and besides disadvantages are caused by the heavy weight and the large volume of the units of the engine. One of the reasons thereto is the low number of revolution demanded for a propeller to be coupled directly to the output shaft of the engine as devices for reducing the number of revolution of the engine such as a cog-wheel gearing or a hydraulically coupled preferably are avoided as they are expensive and also will diminish the efficiency of the plant.

In internal combustion engines having a cam disc substituting the cranks a reduced number of revolution of the output shaft is achieved without any gear, the reduction ratio being equal to the number of cams of the cam disc. For instance if the cam disc has three cams the piston in the cylinder will move three times up and down during each revolution of the output shaft whereby the capacity of the engine can be substantially reduced compared with a conventional internal combustion engine or the output of an engine having the same capacity will be substantially increased.

However there are also problems in engines of this kind. As the roller is not compulsory guided by the cams one cylinder in a multi-cylindrical engine cannot be put out of operation without taking steps for reciprocating the piston rod and the piston synchronously with the number of revolutions of the engine. Therefore it has been proposed to arrange the cylinders pair by pair in V-form and to connect the piston rods in each pair by means of a yoke pivotably mounted on a shaft. Thereby the movement of the roller will be compulsory guided partly by the piston rod and partly by the swinging movements of the yoke. Therefore one cam-curve is required for each roller of each pair as the reciprocating movements of the two rollers are phase displaced relatively to each other and both rollers should be in contact with the cam-curve.

In internal combustion engines having a piston rod only moving up and down without any swinging movement means have to be provided for taking up the thrust directed laterally.

The present invention is an improvement of means previously known in internal combustion engines of V-type of the above kind, and is characterized in that each piston rod is provided with laterally directed means, for instance a cross-head, running in guide-path in the casing of the engine, in order to take up laterally directed forces on the piston rod and that the ends of the yoke are formed as a fork with the surfaces turned towards each other constitute rolling surfaces for cylindrical surfaces provided on each cross-head in order to avoid wear of said surfaces.

The invention will be described with reference to the accompanying drawings, in which FIG. 1 is a cross-section through an internal combustion engine having a cam disc, FIG. 2 is a view seen in the direction of the arrows I—II of FIG. 1, FIG. 3 is a schematic view in the direction of the arrows III—IV of FIG. 2 showing a swingable yoke connecting the piston rods of two engine cylinders in V-form and FIG. 4 is a view corresponding to FIG. 3 with the yoke in another position.

The internal combustion engine is of V-type having a number of cylinders arranged pair by pair the angle between the rows of cylinders being dependent on the number of cams on the drive shaft. In the two-stroke engine shown a power take-off shaft 2 is rotatably mounted in a bearing frame 1 and provided with a cam disc 3 having three equally spaced cam units 6 and 7 mounted on a casing 5, the cylinders being arranged at an angle of 60°. Each cylinder 6 and 7 has a reciprocating piston 8 and is provided with common accessories such as an injection device for fuel, valves, exhaust ports, a cam shaft, a valve mechanism and a starting device. A piston rod 9 is firmly fastened to the piston 8 which piston rod at its free end is bifurcated and provided with a roller 10 rotatable on a shaft 11 extending through the shanks of the fork. In order to effectively avoid combustion products to enter the casing 5 the piston rod 9 is tightened with packings 12 in a known manner. The pistons 8 and the piston rods 9 with the rollers 10 reciprocate in the cylinders 6 and 7, the movement upwards in the cylinder being performed by the rotation of the cam disc 3 whereas the downwards directed movement is performed by the combustion thrust in the cylinder. In order to avoid shocks at the dead centres the roller 10 has to accurately follow the cam curve 4 and therefore sudden changes of said cam curve must be avoided. Thus the cam curve preferably is so formed that the radius of curvature at the top of the cam is about 50% greater than the radius of the roller 10 and that the acceleration curve for the centre of the rollers is continuous between the dead centres.

The power developed in the cylinders 6 and 7 is transferred by the piston 8 and the piston rod 9 to the roller 10 and is divided into one component in the direction of the axis of the cylinder and one component directed at right angles to said axis. According to the invention said last-named component is taken up by slides 13 on the inner wall of the casing 5 in which slides a cross-head 14 on the shaft 11 of the roller 10 is guided.

In the direction of the power take-off shaft 2 a pin 15 is inserted in the casing 5 on which pin a yoke 16 connecting the two piston rods 9 is pivotally mounted. The object of the yoke 16 is to synchronize the movements of the two piston rods 9 and also to transfer the movement.
from one piston rod to the other. As the pivot centre of the yoke 16 is stationary and the movement of the piston rods 9 is rectilinear the connection between the yoke 16 and the piston rods 9 must be loose and for that reason the ends of the yoke 16 are formed as a fork 17 having guide surfaces 18 turned towards each other which surfaces co-operate with cylindrical surfaces 19 on the crosshead 14. The crosshead 14 has plane side surfaces 20 running in a groove in the slide 13. As much as possible a sliding action between the surface 19 and the guide surface 18 of the fork 17 should be avoided when the contact point is loaded. Therefore the radius of the surface 19 is determined in such a manner that during the power stroke of the piston 8 the surface 19 at first will roll on the lower guide surface 18 of the fork and during the latter part of said stroke the rolling contact is effected on the upper guide surface 18 of the fork so that no sliding contact will occur during the whole of this stroke. Simultaneously the other piston 8 is performing its compression stroke and is therefore compulsory guided by said first-named piston 8 via the yoke 16 and then the crosshead 14 of said other piston 8 during the first half of the stroke will slide on the lower guide surface 18 of the fork whereas during the second half of the stroke the crosshead 14 will roll on the upper guide surface 18 of the fork. The contact between the crosshead 14 and the yoke 16 therefore substantially takes place under rolling action so that the lubrication problem will be simplified and a high pressure on the surfaces may be permitted.

The engine as shown is also intended for reversed rotation and therefore the expansion curves and compression curves of the cams are symmetrical but in engines intended for rotation in one and the same direction said cam curve may be unsymmetrically formed in order to produce the working conditions wanted. The cylinders and the driving means for the regulating mechanisms are, broadly speaking, constructed in the same manner as in a conventional internal combustion engine. Thus, for instance the transmissions for the cam shafts, the valves and the injection devices can be driven from the power take-off shaft 2 by means of a chain or a cog-wheel gearing having the gear ratio adjusted to the number of cams on the cam disc 3. The number of pairs of cylinders may be arbitrarily chosen up to about 15 and the power take-off shaft 2 of course must be dimensioned considering the output of the engine.

The internal combustion engine according to the invention will work with substantially less vibrations than a conventional engine and also with less pulsation of the moment in the output shaft at the same number of cylinders.

What I claim is:
1. In an internal combustion engine of V-type, comprising a bearing frame and a power take-off shaft rotatably mounted in said frame, a casing on said frame and pairs of cylinder units mounted on said casing, one cam disc for each pair of cylinder units being provided on said shaft, each cam disc having a number of equally spaced cams, a reciprocable piston in each cylinder unit, a piston rod firmly secured to said piston and at its free end having a rotatable roller co-operating with the cams of said cam disc, a pivotable yoke connecting the two piston rods of each pair of cylinder units and adapted for synchronizing the movements of the piston rods, a cross-head on each piston rod and guide means on the inner wall of said casing, said cross-head running in grooves in said guide means for taking up laterally directed forces on said piston rod, the ends of the yoke being bifurcated with the surfaces facing each other constituting rolling surfaces for cylindrical surfaces on said cross-head for avoiding wear of said co-operating surfaces.
2. An internal combustion engine as claimed in claim 1, in which the cross-head is provided on the shaft of the roller.
3. An internal combustion engine as claimed in claim 1, in which the radius of curvature of the top part of the cams is about 50% greater than the radius of the roller.

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