OSCILLATING VANE STEAM ENGINE

ABSTRACT: An oscillating vane steam engine having a double differential control mechanism for the steam supply for operating the engine.
OSCCILLATING VANE STEAM ENGINE

BACKGROUND OF THE INVENTION

This invention pertains to oscillating vane steam engines, and is more particularly directed to improvements in the control valve mechanism for regulating the steam supply flow for the engine.

Therefore, control valve mechanisms for such engines were complex, costly to manufacture and were far too heavy for efficient use, especially in automobile applications of the engine. Further, lack of efficient design resulted in unsymmetrical loads in the engine resulting in short life for the engine under severe use.

SUMMARY OF THE INVENTION

One of the objects of this invention is to provide a steam engine configuration which is lightweight, approximately one-third the weight of prior configurations.

Another object is to construct a low cost engine in which nearly all precision parts are round and can be turned on a lathe.

Still another object is to provide engine having long life in which no side loading on pistons due to pressure of the steam.

It is also an object of this invention to provide an engine of the above type in which all steam loading is symmetrical so that no high bearing and support shaft loads occur.

Another object is to provide valves of the rotary type that are completely balanced so that friction and operating forces are at a minimum.

And a further object is to provide a valve arrangement which allow for complete control of timing and cutoff angle with simple and dependable mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end elevation of an oscillating vane steam engine incorporating the features of this invention, partly broken away to show the interior mechanism. FIG. 2 is an enlarged sectional view of the engine on the line 2-2 of FIG. 1. FIG. 3 is a sectional view on the line 3-3 of FIG. 2. FIGS. 3a through 3e are sectional views similar to FIG. 3, showing the valve mechanism in various positions. FIG. 4 is a sectional view on the line 4-4 of FIG. 2. FIGS. 4a through 4e are sectional views similar to FIG. 4, showing the valve mechanism in various positions. FIG. 5 is an enlarged fragmentary sectional view of the double differential shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As an example of one embodiment of this invention, there is shown an oscillating vane steam engine comprising an engine block 10 in which is journaled the crankshaft 11 on suitable bearings 12 and 13, the output end 14 of the crankshaft 11 being suitably connected to the apparatus to be driven, not shown. The other end of the crankshaft 11 has a crank arm 15 having a crank pin 16 at its outer end and a counterweight 17 at the opposite end.

In the illustration here, two oscillating vane units 18 and 19 are shown each connected by appropriate articulated connecting rods 20 and 21 in a well-known manner. Since each of the oscillating vane units 18 and 19 are the same, a description of the unit 19 will suffice for both. The connecting rods 20 and 21 are connected at their outer ends to the wrist pins 22 fixed in the outer end of the rock arm 23 which in turn is fixed to the rock shaft 24 journaled on appropriate bearings 24a and 24 b in the motor block 10. Fixed to the rockshaft 24 are the diametrically disposed piston vanes 25 which swing through substantially a 90° movement within the cylinder bore 26 and end surfaces 27 and 28 forming the cylinder chambers 29.
3,596,563

1 claim:

1. An oscillating vane steam engine comprising in combination:
   A. an engine block,
   B. a crankshaft having an output end,
   C. a crank pin on the crankshaft,
   D. a rock shaft,
   E. a rock arm fixed on the rock shaft,
   F. a connecting rod interconnected between the crank pin and the rock arm,
   G. a cylinder having a bore surrounding a portion of the rock shaft,
   H. piston vanes fixed on the rock shaft within the cylinder bore,
   I. segment shaped separators in the cylinder bore forming cylinder chambers with the piston vanes,
   J. a rotating valve sleeve within the rock shaft,
   K. and a power transmission connected between the engine block, the rock shaft and the rotating valve sleeve to cause the rotating valve sleeve to oscillate with the rock shaft.

2. An oscillating vane steam engine as in claim 1 wherein the power transmission includes a differential comprising a bevel gear fixed to the engine block, a bevel gear fixed to the rock shaft, and a cross pin having outer bevel pinions journaled on the outer ends of the cross pin and engaging the bevel gears.

3. An oscillating vane steam engine as in claim 1 wherein the power transmission includes a differential comprising a bevel gear rotatably adjustable and positionable on the engine block, a bevel gear fixed to the rock shaft, and a cross pin having outer bevel pinions journaled on the outer ends of the cross pin and engaging the bevel gears.

4. An oscillating vane steam engine as in claim 1 wherein there is provided a cutoff valve sleeve rotatably mounted within the rotating valve sleeve, and means on the motor block connected to the cutoff valve sleeve for rotating and positioning the cutoff valve sleeve relative to the rock shaft and rotating valve sleeve.

5. An oscillating vane steam engine as in claim 1 wherein the power transmission includes a double differential comprising an outer bevel gear fixed to the engine block, an outer bevel gear fixed to the rock shaft, a common cross pin having outer bevel pinions journaled on the outer ends of the common cross pin and engaging the bevel gears on the engine block and the rock shaft, an inner bevel gear fixed on the rotating valve sleeve, an inner bevel gear journaled on the motor block, inner bevel pinions journaled on the common cross pin engaging both of the inner bevel gears, and a second power transmission connected between the inner bevel gear journaled on the motor block and the output end of the crankshaft.

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gear 31 which oscillates bevel pinions 32 and cross pins 33. Pins 33 have mounted on them bevel pinions 45 that rotatively drive bevel gear 46. Bevel gear 46 is fixedly connected to valve sleeve 47 in which are formed cam slots 63 for receiving cam pins 62 mounted on the square socket portion 61 of shifter tube 60. The square socket portion 61 fits around the square drive shaft 57 with shaft 57 being fixedly connected to valve sleeve 53. The rotating valve sleeve 47 rotates smoothly with respect to the rock shaft 24 at one-half engine speed. With respect to the engine block 10, the rotating valve sleeve 47 moves faster or slower than the drive sprocket 39 to maintain the required constant speed with respect to the rock shaft 24. The steam is admitted under full pressure into piston chambers 29 until the cutoff valve sleeve closes the intake port 81. The steam continues to expand and apply pressure to the vanes 25, until the exhaust port 82 is opened from which the spent steam then discharges out through discharge ports 83 into bore 54, bore 64 and bore 84 to the exhaust manifold 68 and exhaust opening 69.

The exhaust port 82 remains open until the piston 25 has nearly completed the exhaust stroke. The steam pressure on the pistons 25 is transmitted through the rock shaft 24 to drive the rock arm 23, connecting rod 21 and crankshaft 11. There are two oscillating piston vane units 18 and 19 which are 90° out of phase with each other so that there is no position of the crankshaft that is on dead center so that the engine will start smoothly from any position.

It will be noted that the valve ports and valve construction is such that at all times there is balanced forces on all valves and on all shafts and bearings with the exception of the unbalanced rotary forces on the piston vanes which is required to convert the steam pressure into usable power.

FIGS. 3 and 4, and 3a to 3r, and 4a to 4e, inclusive, are a series of sectional views showing valve port positions for various piston vane positions and cutoff conditions. FIGS. 3, 3a, 3b and 3c, and 4, 4a, 4b and 4c show the conditions for a fixed cutoff of 30 percent. FIGS. 3 and 4 show a start of a counterclockwise motion with the ports formed by rotating valve sleeve 47 just opening to admit high pressure steam into the proper cylinder chambers 29 and exhaust valves 82 just opening to exhaust the other pair of cylinders.

FIGS. 3a and 4a show the vane pistons in midposition with the cutoff valve already closed and the steam expanding in the cylinder chambers 29. The exhaust ports 82 are full open and allow free exhaust of the collapsing volumes. FIGS. 3b and 4b show the end of the power stroke with steam fully expanded and all ports closed. FIGS. 3c and 4c show the start of the clockwise oscillation with steam being admitted on the opposite sides of the piston vanes and the exhaust valves opening to exhaust the expanded steam.

FIGS. 3d and 4d show the position of the piston vanes at the point of cutoff in the cycle for a 10 percent cutoff. FIGS. 3e and 4e show a similar condition for a 60 percent cutoff.