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TWO-CYCLE INTERNAL-COMBUSTION ENGINE

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The principal objects of the invention are, to effect the rapid opening and closing of the intake and exhaust ports in a two cycle engine maintaining the maximum period of wide open port and enabling the opening of the exhaust port in advance of the opening of the intake port to effect the rapid reduction of cylinder pressure prior to the opening of the intake.

A further object is to enable the use of larger port openings than are possible in the ordinary two cycle engine.

The principal feature of the invention consists in the arrangement of a pair of valving elements supported by the piston and operated through the swinging movement of the crank or connecting rod to effect the opening and closing of the ports in the cylinder.

In the drawings, Figure 1 is a vertical mid-sectional elevational view of an engine cylinder and piston connection illustrating the application of this invention.

Figure 2 is a vertical sectional and elevational view illustrating a modified form of the invention.

Figure 3 is a cross section through the line 3—3 of Figure 1.

In the accompanying drawings the engine cylinder 1 is provided with intake and exhaust ports 2 and 3 respectively which are substantially in alignment.

The piston 4 which is connected by the connecting rod 5 to the crank is of smaller diameter than the interior of the cylinder and arranged between the outer surface of the piston and the cylinder wall are a pair of semi-circular valve members 7 and 8, each of the longitudinal meeting edges 9 of which are butted in a close fitting joint.

Each of the valves are formed with inwardly extending bosses or lug projections 10 which extend through the slots 11 in the side wall of the piston.

The connecting rod 5 in the form shown in Figure 1 is provided with a pair of rigid right

angularly extending arms 12 and 13, the outer ends of which are preferably provided with the spherical surfaced portions 14 which extend into the cylindrical orifices in each of the bosses 10.

It will be readily seen that the tilting of the connecting rod on the piston pin 16 will swing the arm 12 downwardly and the arm 13 upwardly and vice versa, reciprocating the valves 7 and 8 in opposite directions.

In the operation of the device, as the piston moves downwardly the connecting rod 5 moves downwardly at an angle to the axis and as the crank approaches the lower part of its movement it swings laterally carrying the connecting rod across the axis of the cylinder, thereby tilting the arms 12 and 13 to operate the valves 7 and 8.

As the piston 4 approaches the downward limit of its stroke the port 17 in the upper end thereof and the port 18 in the valve 7 which are then in register, are opened to the exhaust port 3.

The valve 8 on the opposite side of the piston during this period closes communication between the cylinder and the inlet port, but as the crank swings across the axial centre, the arm 12 of the connecting rod swings downwardly with a rapid movement drawing the valve across the port 18 in the piston closing the exhaust. Simultaneously with the movement of the valve 7 the arm 13 on the connecting rod swings upwardly bringing the port 19 in the valve 8 into register with the port 20 in the piston and with the inlet port 2. The inlet port is then closed by the upward movement of the piston and at the upper end of the stroke of the piston the position of the valves 7 and 8 is reversed, without of course having any effect other than to place them in proper arrangement to carry out the function required of them at the lower end of the stroke.

In the form of the invention illustrated in Figure 2 the valves 7' and 8' are operated

by means of connecting rods 12' and 13' which are pivotally secured at one end to the lugs 10' and at the other end are pivotally connected to a pivot pin 21 secured in the connecting rod 5 adjacent to its point of connection with the crank 6 or these connecting rods may be mounted directly upon the crank pin.

It will be seen that as the main crank of the engine swings across the axial centre there will be a downward pull exerted on the connecting rod 12' and an upward thrust upon the rod 13' which is the equivalent movement to the tilting action of the arms 12 and 13 and effects the operation of the valves 7' and 8' in a manner corresponding with the operation of the valves 7 and 8.

The mechanical structure of the mechanism is extremely simple and adds very little to the cost of the construction of the engine, whereas such construction will add very materially to the efficiency of operation.

The opening of the exhaust port is delayed until the piston is well below the upper edge of the port and the action of opening the port by the operation of the valve 7 is very rapid. This allows the maximum length of travel of the piston under its power impulse and accomplishes a very rapid release of the exhaust with a corresponding valve action retaining the intake valve closed until after the exhaust port has been opened and the pressure in the cylinder materially reduced.

What we claim as our invention is:—

1. In a two-cycle combustion engine, the combination with a cylinder having inlet and exhaust ports, a crank shaft, a piston operating in the cylinder, and a connecting rod operatively connecting said crank shaft and piston, of a pair of valves moving with said piston, and means flexibly and operatively connecting said valves with said connecting rod beyond its longitudinal mid-point whereby a differential longitudinal reciprocation is imparted to said valves to control the inlet and exhaust ports.

2. In a two-cycle combustion engine, the combination with a cylinder having inlet and exhaust ports, a crank shaft, a piston operating in the cylinder and a connecting rod operatively connecting said crank shaft and piston, of a pair of valves moving with said piston, and link members flexibly connected at one end to said valves and at their other end to said connecting rod beyond the longitudinal mid-point of the latter whereby a differential longitudinal reciprocation is imparted to said valves to control the inlet and exhaust ports.

3. In a two-cycle combustion engine, the combination with a cylinder having inlet and exhaust ports, a crank shaft, a piston operating in the cylinder and a connecting rod oper-

atively connecting said crank shaft and piston, of a pair of valves moving with said piston, and link members flexibly connected at one end to said valves and at their other end to said connecting rod at a common point in the length thereof whereby a differential longitudinal reciprocation is imparted to said valves to control the inlet and exhaust ports.

4. In a two cycle combustion engine, the combination with a cylinder having inlet and exhaust ports, a crank shaft, a piston operating in the cylinder and a connecting rod operatively connecting said crank shaft and piston, of a pair of valves moving with said piston, and link members flexibly connected at one end to said valves, said link members being pivotally connected at their other ends to said connecting rod, at a common point in the length thereof, the axis of said pivotal connection of the link members with said connecting rod intersecting the longitudinal centre line of said connecting rod whereby a differential longitudinal reciprocation is imparted to said valves to control the inlet and exhaust ports.

5. In a two-cycle combustion engine, the combination with a cylinder having inlet and exhaust ports, a crank shaft, a piston operating in the cylinder and a connecting rod operatively connecting said crank shaft and piston, of a pair of valves moving with said piston, link members flexibly connected at one end to said valves, and a cross pin carried by said connecting rod extending transversely of the plane of reciprocation of the latter and pivotally connecting the free ends of said link members to the connecting rod whereby a differential longitudinal reciprocation is imparted to said valves to control the inlet and exhaust ports.

6. In a two-cycle combustion engine, the combination with a cylinder having inlet and exhaust ports, a crank shaft, a piston operating in the cylinder and a connecting rod operatively connecting said crank shaft and piston, of a pair of valves moving with said piston, link members flexibly connected at one end to said valves, and a pivot pin secured in said connecting rod adjacent the big end thereof and extending at right angles to the plane of reciprocation of the connecting rod and beyond the latter, the free ends of said link members being pivotally mounted on the extending ends of said pivot pin whereby a differential longitudinal reciprocation is imparted to said valves to control the inlet and exhaust ports.

7. In a two-cycle combustion engine, the combination with a cylinder having inlet and exhaust ports, a crank shaft, a piston operating in the cylinder and a connecting rod operatively connecting said crank shaft and piston, of a pair of valves moving with said piston, and link members disposed one at each side of said connecting rod out of alignment

with its central plane of reciprocation, said link members being operatively connected at one end to said valves and at the other end to said connecting rod beyond the longitudinal mid-point of the latter and forming operative connections between the respective valves and the connecting rod whereby a differential longitudinal reciprocation is imparted to said valves to control the inlet and exhaust ports.

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