

pendulum piston arrangement the piston c.g. is allowed to oscillate in a circular arc or, in another embodiment, oscillates about its own c.g.

To the second category belong the rotary piston machines of which the c.g. of the power component (piston) moves at uniform or non-uniform speed in one direction along a circular or differently shaped closed path. The power component (piston) may also rotate at uniform or non-uniform velocity about its c.g.

#### **4. Types of reciprocating piston and rotary piston machines**

The working chamber volume of reciprocating machines (REM) may be varied as follows:

1 a) A piston may have straight linear motion in a stationary cylinder. Alternatively, the piston may be stationary and the cylinder may move to and fro.

A cover or cylinder head is usually firmly attached to the cylinder but may, if convenient, be replaced by a slide or rotary valve. Furthermore, a second piston may replace the cylinder head or closing valve, as in certain opposed piston machines.

1 b) Straight cylinders may be given a to and fro motion – as on some oscillating cylinder steam engines – alternatively the cylinder sleeve may reciprocate or rotate for the purpose of opening and closing of the inlet and exhaust ports – as in sleeve valve engines.

2. Pendulum-piston arrangements, although no longer produced as heat engines, are also possible; the cylinders of these units have either a round or square section bore arranged as a circular arc along which the appropriately shaped piston oscillates. Vane type manually operated pumps with these characteristics are, for example, still being made by the Allweiler Company.

3. Apart from the types indicated in 1 a and 1 b – with actual cylinders – and those indicated in 2 – with partly rotating components – it is feasible to obtain reciprocating piston movement by way of a suitable screw thread but this type of machine has apparently been ignored.

Arrangements in which the power component or working part of a chamber (piston) is connected to other moving parts, do not seem to be very numerous. In old types of reciprocating piston machines, which featured no rotating power output member, chains or connecting rods usually linked the piston to a beam. However, in reciprocating piston machines with a rotating output shaft the connecting rod is linked either directly to the crankshaft or indirectly by way of a beam, bell-crank or reversing gear. There are very few instances in which a reciprocating piston acts either directly upon suitable cams (or swashplates) or indirectly by way of interposed rollers. Finally, there are the free-piston engines in which the energy is transmitted directly by the piston to another working medium.

The familiar layout of reciprocating piston engines – in line, V, horizontally opposed,