

## CHAPTER I.

### THE NATURE OF THE MACHINE

In discussing any subject it is very important to know its distinguishing characteristics and also the features which it has in common with other and in many cases more fundamental matters. In the case of the machine this is particularly necessary, for the problems connected with the mechanics of machinery do not differ in many ways from those of the mechanics of free bodies, the same laws applying to both, and yet the machine has certain laws peculiar to itself which we must examine and classify. Further, machinery is now in such common use that it is well worthy of special consideration.

In order to clear our ideas let us first of all examine some of the well-known machines and see what their properties are. Take one of the most common, the reciprocating steam engine, which is known to consist essentially of the following parts:—(a) The frame or part which is fixed to some stationary or rigid object such as a foundation, or the frame work of a ship. This part carries the crank shaft bearing, the cylinder and steam chest and the crosshead guides, and as these are frequently cast in one piece we may treat the whole as the one part called the frame. (b) The piston, piston rod and crosshead which may from the point of view of mechanics be treated as the second part, which we may briefly call the piston. This part moves relatively to the frame, all points in it having a pure motion of translation or sliding; it contains the *wrist pin* to which the third part about to be mentioned is connected.

The connecting rod or third part (c) has a somewhat peculiar motion, one end of it being bored to receive the wrist pin, and therefore having a motion of translation or a reciprocating motion, the other end being bored to fit the crank pin which rotates in a circle. Thus this rod swings about the wrist pin similarly to a pendulum but also moves in the general direction of its length at the same time. (d) The fourth part consists of the crank and crank shaft, the latter rotating in the crank shaft bearing on the frame and carrying the crank pin, the axis of which is parallel with that of the shaft, and which describes a circle about the axis of the latter. Since the connecting rod is attached to the crank pin and also to the wrist pin the *stroke* of the piston will be proportional