to, and it is generally equal to, the diameter of the crank pin circle. The flywheel is attached to the crank shaft. (*e*) The remaining parts consist of the valve gear and governor, and in this preliminary discussion will not be dealt with, their consideration being taken up later.

Take a second well-known machine, a lathe, which consists of the frame, the live spindle which rotates in bearings in the frame, the carriage which slides along the frame and contains a tool post having a cross motion, the change and back gears, the lead screw, belts, etc., all of which have certain definite duties to perform.

These two machines are typical of a very large number and from them we may develop the definition of the machine. Each of these machines contains *more than one part*, and if we think of any other machine we will see that it contains at least two parts, thus a crowbar is not a machine, neither is a shaft nor a pulley, if they were it would be difficult to conceive of anything which were not a machine. The so called "simple machines"—the lever, the wheel and axle, and the wedge—give confusion along this line because the complete machine is not inferred from the name; thus the bar of iron cannot be called a lever, it only serves such a purpose when along with it is a fulcrum, the wheel and axle only acts as a machine when it is mounted in a frame with proper bearings, and so with the wedge. So that we say a machine consists of a *combination of parts*.

Again these parts must offer some resistance to change of shape to be of any value in this connection. Usually the parts of a machine are *rigid*, but we very frequently find belts and ropes used, and it is well known that these are only of value when they are in tension because only when they are used in this way do they offer *resistance to change of shape*. No one ever puts a belt in a machine in a place where it is in compression. Springs are often used as in valve gears and governors, but they offer resistance wherever used. Thus the parts of a machine must be *resistant*.

Now under the preceding limitations a ship or any other *structure* could readily be included, and yet we do not call them machines, in fact, we would not call anything a machine in which the parts were incapable of motion with regard to one another. In the engine, if the frame is stationary, all the other parts are capable of moving, and when the machine is serving its true purpose they do move; in a bicycle, for example, the wheels, chain, pedals, etc., all move relatively to one another, and in all machines the parts must have