25.4: Lever

> *δωςμοιπαστωκαιτανγανκινασω. (Give me a place to stand, and I shall move the Earth.)*
>
> *—Archimedes*

In this famous quote, Archimedes is referring to the lever. A lever is a rigid bar free to turn around a pivot point called the fulcrum. Levers may be divided into three classes, according to the relative position of the effort, resistance, and fulcrum (Figure 25.4.1):

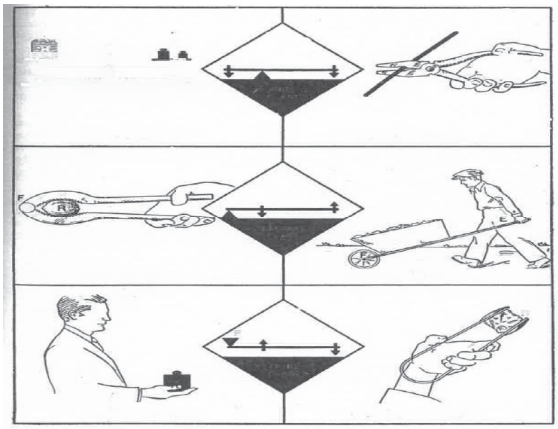

Figure 25.4.1: The three classes of levers. (Ref. [17])

- First class - the fulcrum is between the resistance and the effort.
- Second class - the resistance is between the fulcrum and the effort.
- Third class — the effort is between the fulcrum and the resistance.

The mechanical advantage of the lever may be found simply. The distance from the effort to the fulcrum is called the effort arm (r_E); the distance from the fulcrum to the resistance is called the resistance arm (r_R). Then in the absence of friction, the input work equals the output work:

$$W_i = W_o \tag{25.4.1}$$

or

$$F_E r_E = F_R r_R \tag{25.4.2}$$

Thus the mechanical advantage is then F_R/F_E, or the effort arm divided by the resistance arm:

$$M.A. = \frac{r_E}{r_R} \tag{25.4.3}$$

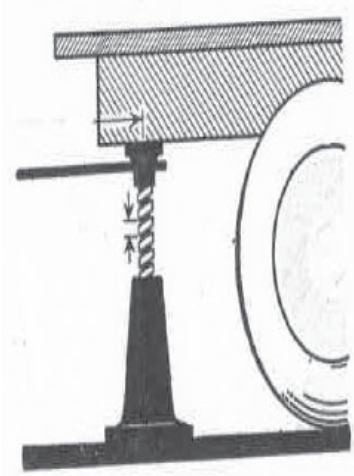

Figure 25.4.2: A jackscrew, here used to lift the back of a truck. (Ref. [17])