The magnitude, direction and sense of W are known; the magnitude and direction of T are unknown, while the magnitude of P is also unknown.

Produce the lines of direction of P and W until they intersect at D.

The resultant of W and P must act through D; therefore the balancing force or T must act through D; but, it also acts through the point A; therefore AD is the direction of T.

Join BC. Then triangle ABC is isosceles; and therefore, triangle BDC is isosceles; hence DA bisects triangle BDC and the angle BDA = angle CDA.

Consider the resolved parts of P, W and T in the direction at right angles to AD. The resolved part of T in this direction is nothing; therefore the resolved parts of W and P must be equal; and as the angles BDA and CDA are equal, the force P must be equal to W.

Thus when a line passes over a pulley, the tension of the portion to the right of the sheave must be equal to that on the left.

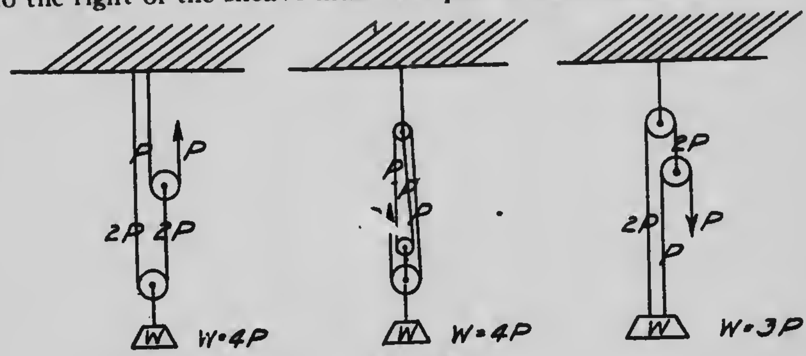

Fig. 98

It is apparent that the mechanical efficiency in the above cases, Fig. 98, are 4, 4 and 3.

In the Weston differential pulley the double block at the top has the small and large sheaves cast as one and the chain passing over both cannot slip.

Consider first the single pulley at the bottom $W=2Q$.

Let r_1 be the radius of the large sheave of the upper pulley and r_2 the radius of the smaller.

Take moments about the centre of the pulley

$$\Sigma M=0$$

$$-Qr_1+0+Qr_2+P\cdot r_1=0$$

$$\therefore \quad Pr_1=Q(r_1-r_2)$$

$$P=\frac{W}{2}\,\frac{(r_1-r_2)}{r_1}$$