ing accelerations for the points G and Q respectively. In this way a second curve ACB may be drawn, and the perpendicular to b drawn from any point in it to the line ACB represents the acceleration at the given point in b in the direction normal to the axis of the latter, the scale in all cases being $-\omega^2 : 1$. Thus the acceleration of P normal to b is $AP \cdot \omega^2$, and so for other points.

The bending moment in the rod is due to the acceleration normal to the axis of the latter and hence is proportional to the distances from b to the curve ACB. Further, the bending moment is proportional to the distribution of the mass of the rod; thus it is proportional to the mass and the acceleration. In this discussion the actual bending moment is not determined, simply the *load curve.*

In Fig. 140 (a), the rod is shown along with the curve AB. Divide the rod up into a series of elementary parts, each of weight δw and of mass $\delta m = \dfrac{\delta w}{g}$, one of these masses being shown at D, at which place the acceleration is $ED \cdot \omega^2$, and hence the force acting at this point is $\delta m \cdot ED \cdot \omega^2$. In this way a *load curve* may be drawn for the rod and for the load curve thus obtained, the corresponding bending moment curve may be found by the ordinary methods of mechanics.

If the rod is of uniform diameter, then ACB is also a load curve on a scale which may readily be determined, whereas if the rod tapers uniformly from P to Q the load curve will take a form similar to that shown dotted above b. Usually the rod varies in shape and cross-section from end to end, frequently being larger in the centre than at the ends, in which case the process is rather more tedious but may be carried out to any degree of accuracy desired by the designer.

It may be mentioned that the method is essentially one for the drafting-board and the methods of the calculus are usually too cumbersome to be adopted except in the most simple shapes.

APPLICATION TO THE STEAM ENGINE

This construction and the determination of the accelerations and forces has a very useful application in the case of the reciprocating engine and this machine will now be taken up. Fig. 141 represents an engine in which O is the crank shaft, P the crank pin and Q the wrist pin, the block c representing the crosshead, piston and piston rod. Let the crank turn with angular velocity ω and have an accelera-