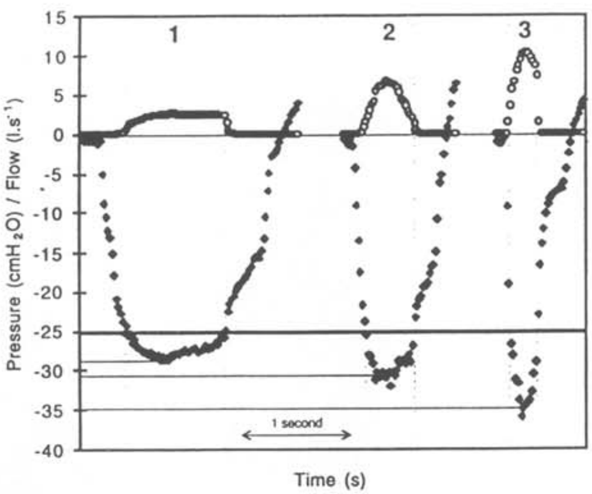

Figure 3 A series of plots illustrating the effect of flow rate upon pressure profile, using the threshold device on a −25 cm H_2O setting. ◆, pressure; ○, flow.

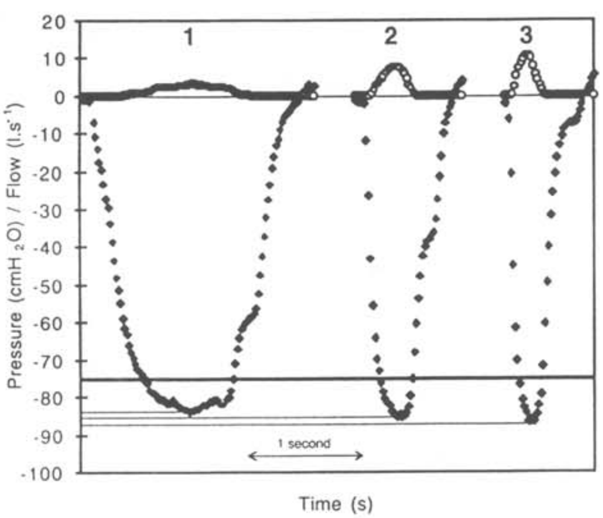

Figure 4 A series of plots illustrating the effect of flow rate upon pressure profile, using the threshold device on a −75 cm H_2O setting. ◆, pressure; ○, flow.

is observed. During human use this does not occur; rather, as soon as the user fails to maintain flow they cease to generate inspiratory pressure and start to initiate expiration.

Figure 3 was generated using a low load setting (−25 cm H_2O), a number of points emerge. Firstly, it can be seen that initiation and cessation of flow occurs very close to the threshold pressure in each instance; thus, threshold pressure is independent of flow rate. However, a second observation is that peak pressure varies from −28.5 cm H_2O to −35 cm H_2O according to flow rate. This gradated increase occurs because at low loads the extent of valve opening is flow sensitive. Furthermore, the change in spring compression as the valve opens is large relative to its initial compression.

Figure 4 was generated using a moderate load setting (−75 cm H_2O). Again, a number of points emerge. Firstly, it can be seen that initiation and cessation of flow occurs very close to the threshold pressure in each instance; threshold pressure is thus independent of flow rate. Furthermore, in this instance, the peak pressure observed under each condition was similar, ranging from −83 to −86 cm H_2O. This homogeneity can be explained by the fact that at higher loads the extent of valve opening is reduced relative to changes in flow rate. Hence, the greater the absolute force acting on the valve, the shorter the distance it travels off its seat per unit increase in flow. Therefore, both the percent increase in load (above threshold) and the disparity in peak load are relatively less at higher loads.

Ergonomic and practical considerations

The current device incorporates a respiratory mouthpiece and nose-clips, the design of which ensures both user comfort and effective sealing. The latter point is particularly important when the user is inspiring against a high load. The design also ensures separate inspiratory and expiratory flow, this is desirable because the moving parts are subjected to inspired air only. Contamination and water saturation is thus isolated to nonmoving components, in addition, dead-space is minimised. The current device uses a simple twist lock to seal the main body to the lower chamber, sterilisation requires the user to separate these two subassemblies only.

Discussion

The current device provides true threshold, near flow-independent, loading between −5 and −150 cm H_2O. Whilst flow-independent loading