

Fig. 44

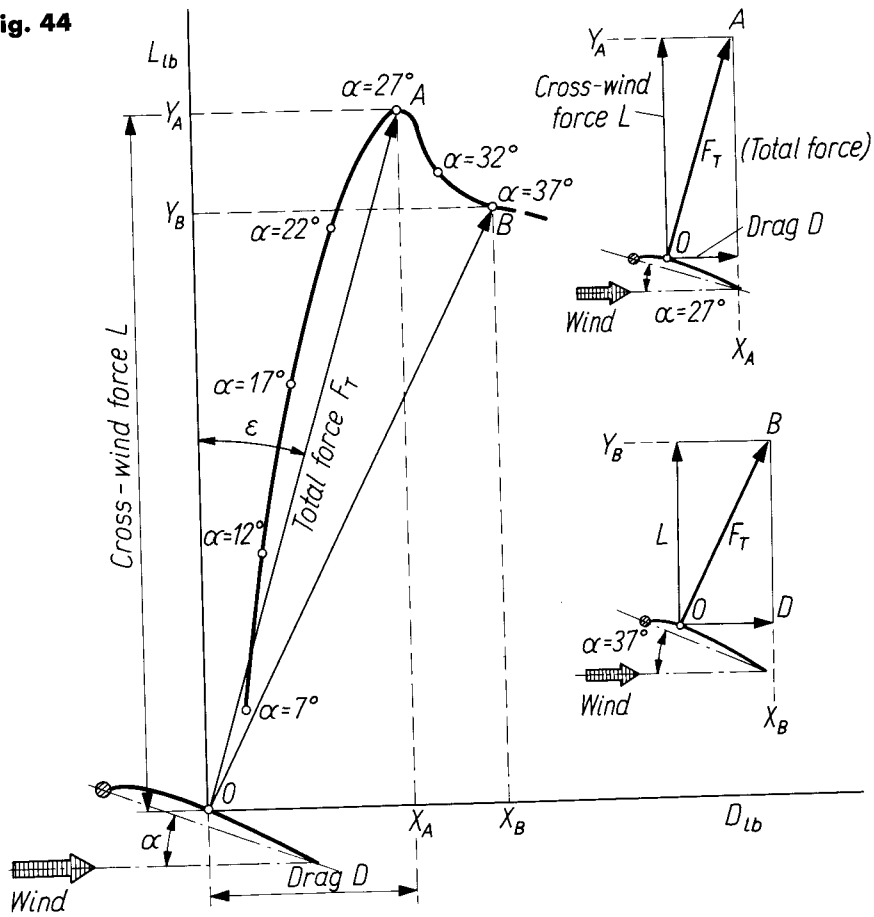


Fig. 45

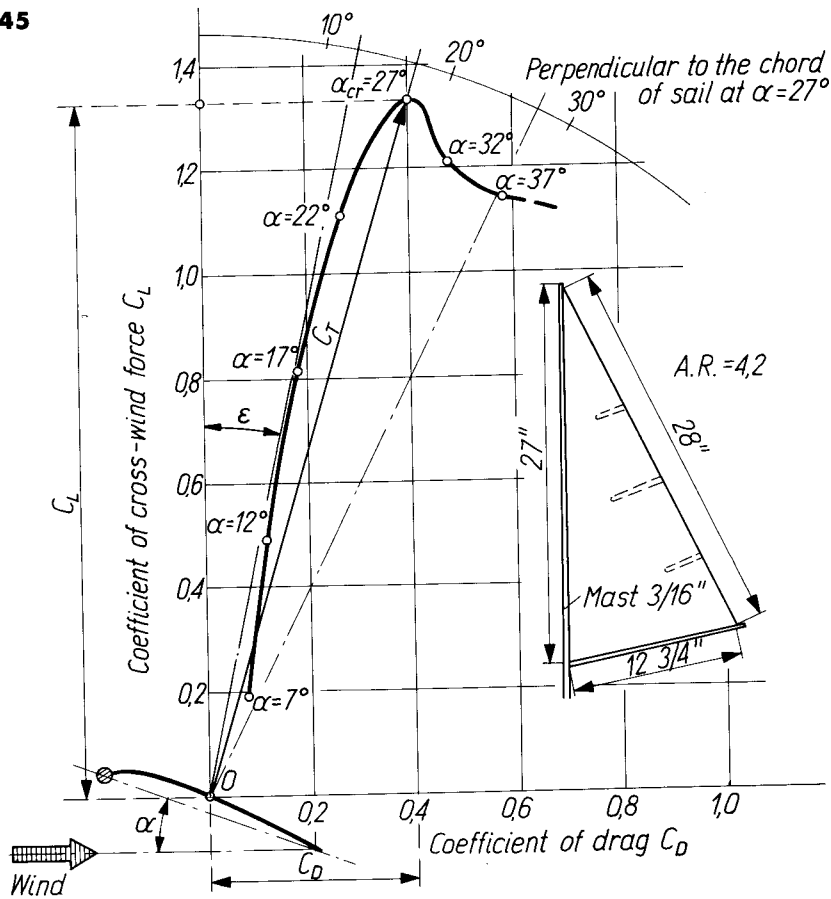
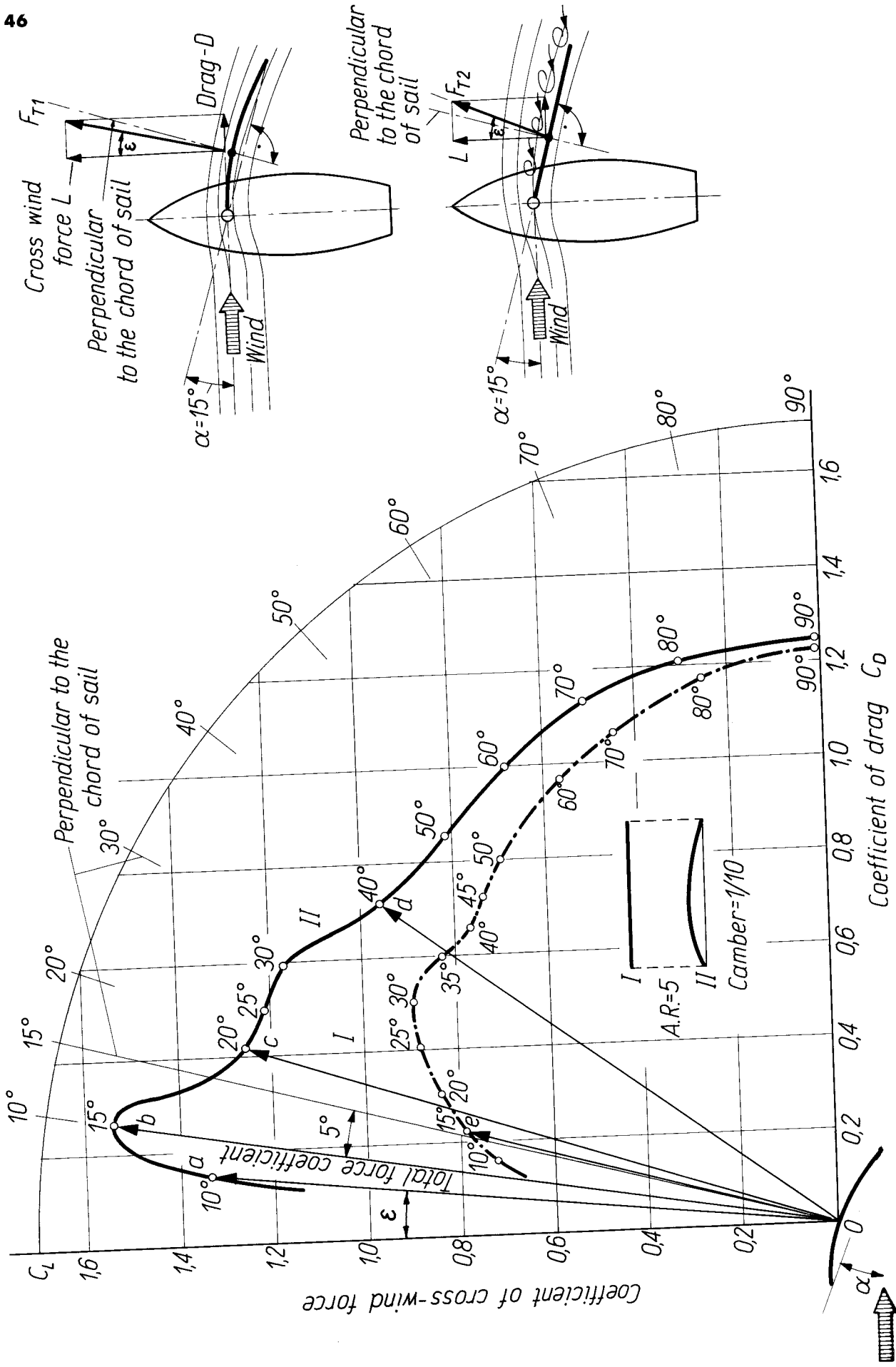


Fig. 46

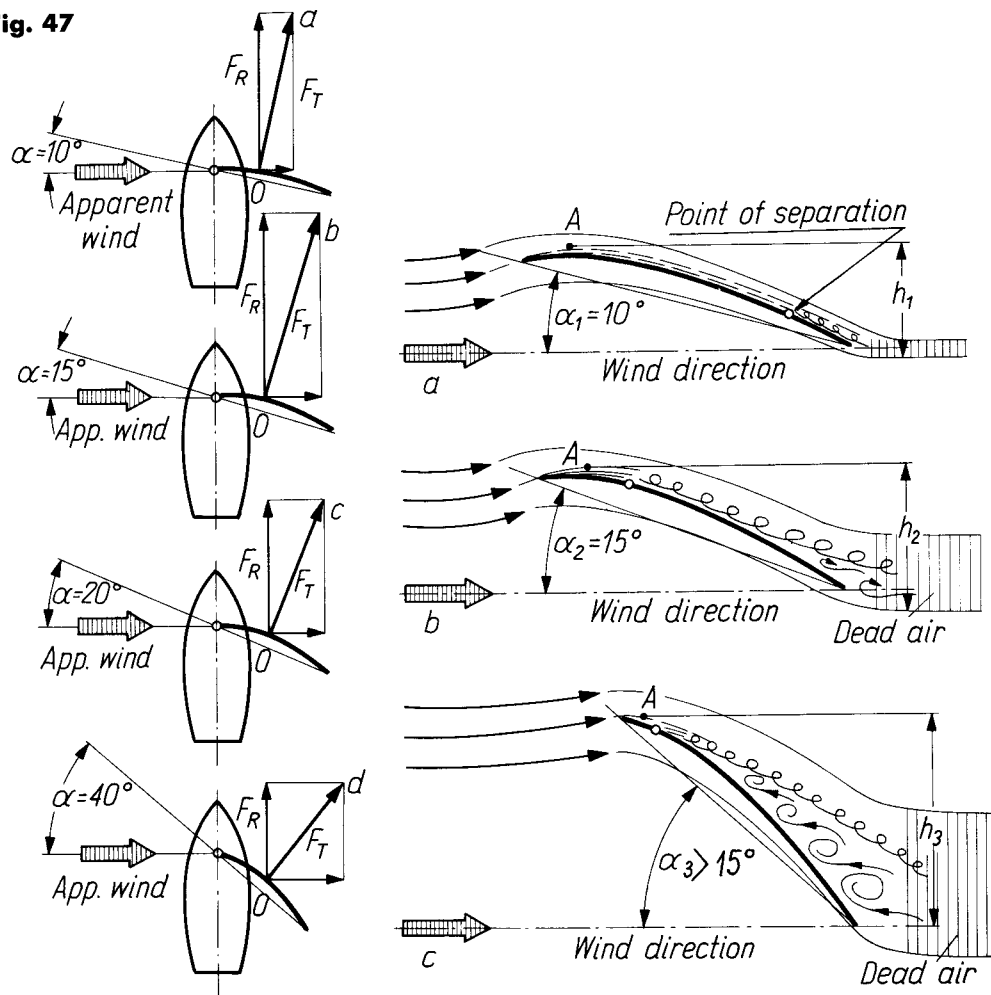


conveyed in a more concise manner in Fig. 46 by the two lines Ob and Oe. The perpendiculars to the sail chord are drawn as radii from O to the outer circular arc, bearing in mind that the wind direction lies along the horizontal C_D axis.

The great differences between Curves I and II can be largely attributed to the different flows over the leeward sides, as a result of the curvature. With the perfectly flat sail, the flow finds it impossible to travel smoothly round the leading edge of the sail, and so separates, covering the lee side of the sail with eddies. One effect of camber is to introduce the leading edge more gradually into the flow, which in consequence does not separate. Instead, it passes smoothly round the lee side, accelerating as it is constricted, giving rise to a large suction. At greater angles of incidence, when the flow separates over most of the cambered sail also, the differences between the two sails tends to disappear. At an angle of incidence $\alpha = 90^\circ$, corresponding to sailing on a run, the difference is so slight as to be negligible. At this high angle of incidence, the total sail force depends a lot less on the lee-side suction forces than on the lesser angles of incidence. The foregoing remarks explain why a perfectly flat sail is bad. Later the disadvantages of too large a camber will also be explained.

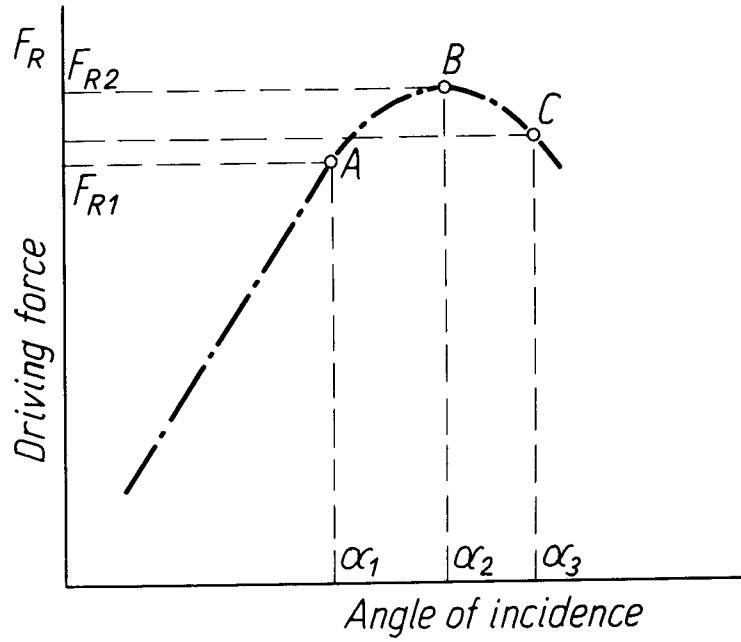
In Fig. 46 we will now consider the total force coefficients Oa, Ob, Oc, and Od at the respective angles of incidence $\alpha = 10^\circ, 15^\circ, 20^\circ,$ and 40° . If these results are translated in terms of actual sailing on a reach, as in Fig. 47, we can clearly

Fig. 47

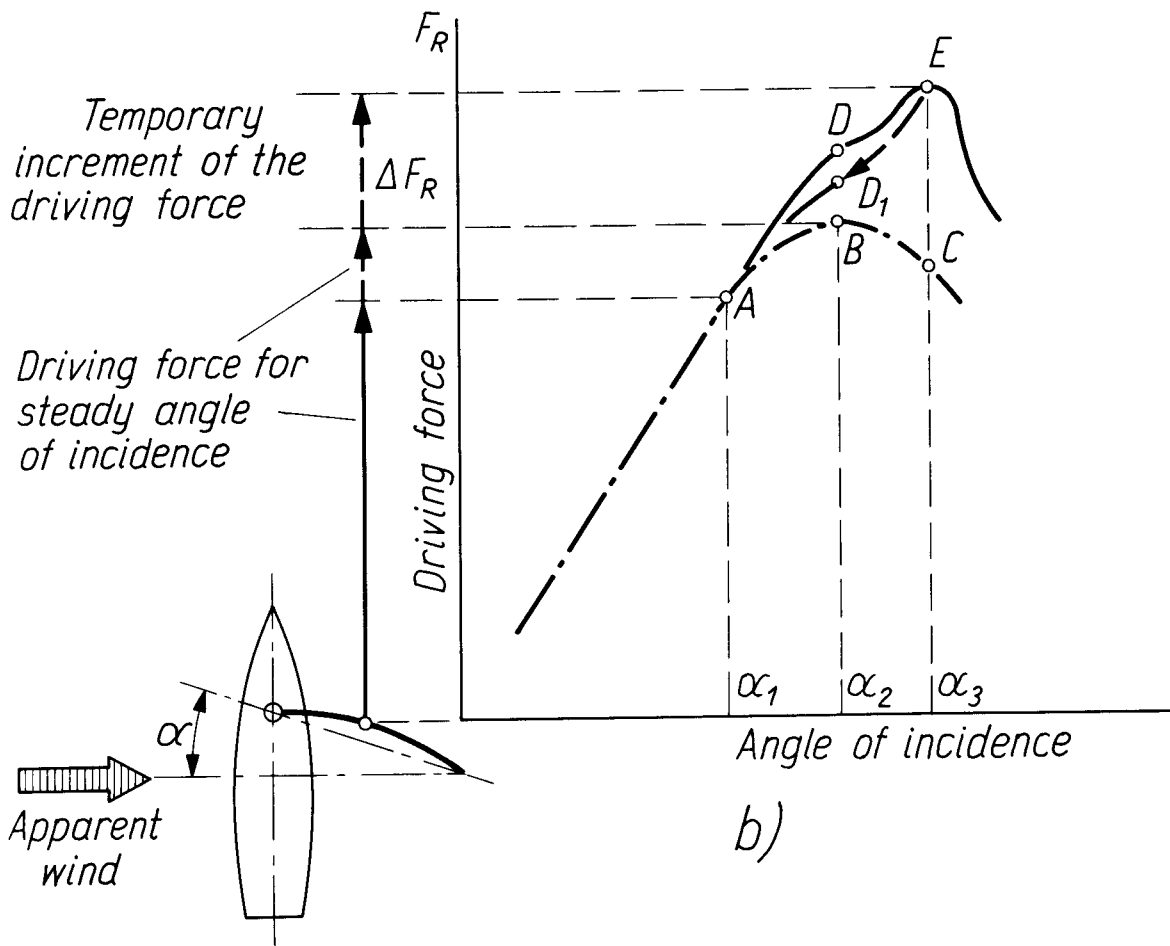


Wind direction

Fig. 48

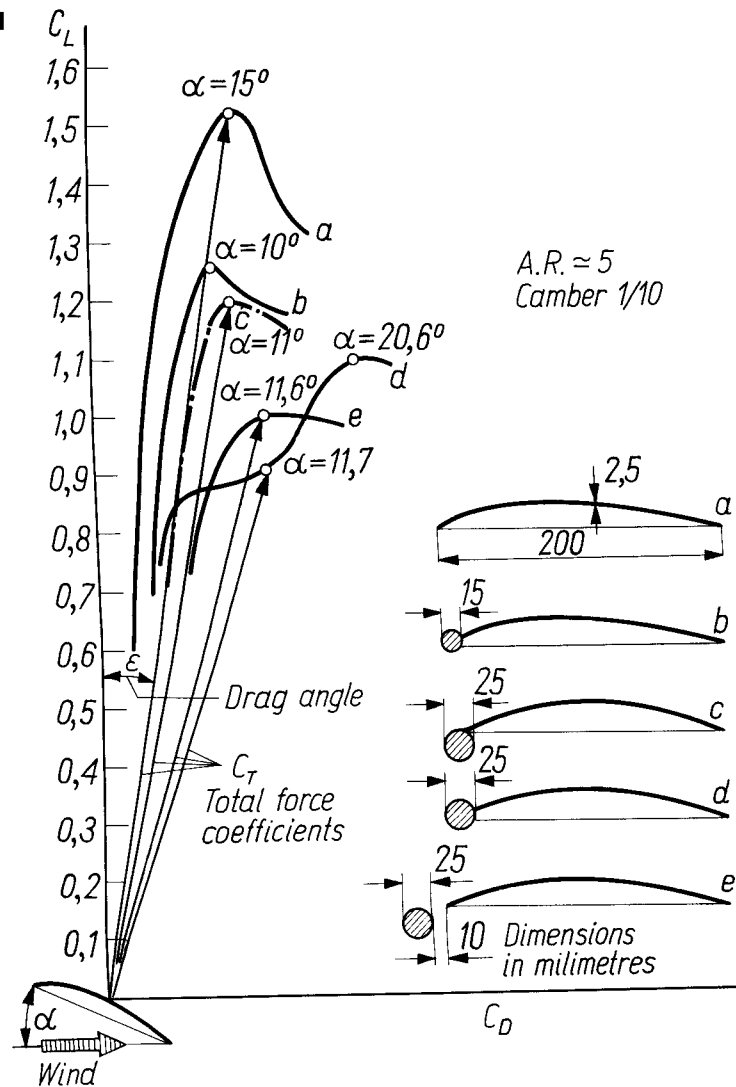


a)



b)

Fig. 61



tude and direction of the total aerodynamic force F_T which can arise under conditions from beating to reaching (Fig. 62).

The reader will be able to see clearly how, when one is close-hauled, the angle of drag (ϵ) is of great importance in determining the yacht's performance, and that as one comes off the wind, the drag angle becomes of less importance, its place being taken by the magnitude of the maximum force (F_T) or its coefficient (C_T).

Taking as a datum model a, without a mast, we can see that the addition of a circular mast of diameter 7.5 per cent of the sail chord, model b, causes a fall of 18 per cent in the value of the maximum aerodynamic force. A further increase of the mast diameter to 12.5 per cent of the sail chord, model d, produces a further reduction in the sail force. At the same angle of incidence $\alpha = 11.7^\circ$, the loss in aerodynamic force is about 30 per cent, and furthermore the direction of action of the force is altered for the worse, particularly when considering a close-hauled course.

The position of the mast in relation to the sail is also extremely important. If the mast is offset to windward, as for model c (Fig. 61), the sail performance is much

Fig. 62

