Metal propellers have the advantage of cheapness as compared with wooden propellers, but they have, on the other hand, certain drawbacks, which give rise to objection to their use. First of all they are heavy, and if they should burst under the strain of high velocity, the fragments are apt to cause damage. Then they bend easily, and on account of their great elasticity they vibrate when in use. Another drawback is the quasi impossibility of obtaining an even surface blade, and finally the difficulty of attaching the blades to the propeller arm.

If a metal propeller is to be used, perhaps aluminum is the more suitable to make the surfaces of the blades, because its lightness permits of relatively thick blades, which, increasing the moment of inertia, preserve their shape. But, all things considered, wood propellers are the best, even if they cost more.

Wood propellers are light, and this is their chief characteristic, from which many a good advantage is derived. Being light, they can be made very thick. Their thickness makes it possible to shape the blades in a way to offer the least resistance to motion, and again to cause an increase in the moment of inertia, with a consequent increase in the resistance to flexure, which permits, therefore, of a very high rate of speed with very little probability of bursting, as wood possesses greater tensile strength than the best metal, especially with the grain running in the sense of the length of the blade; but even if the propeller should burst, the fragments being light would not be so dangerous.

Wood propellers can be made in one single piece or in laminations, which are glued together with insoluble glue. One-piece propellers are cheaper, but as it is hard to find wood of straight grain without any flaws, the laminated propellers are to be preferred, because they allow the use of the best kind of wood.

A propeller is usually made with five or six laminations of mahogany, walnut or oak. The laminations, besides being

glued together, are held in place by dowels driven through them at equal distances. They are held in a press until thoroughly dry, then they are cut by machinery into propeller shape and finished by hand.

The wood used for a propeller must not be very dry, but it must contain a given amount of moisture, which must be kept constant, and to this effect the propeller is painted with a special filler and then varnished several times.

Some propellers have metallic protections at the tips and

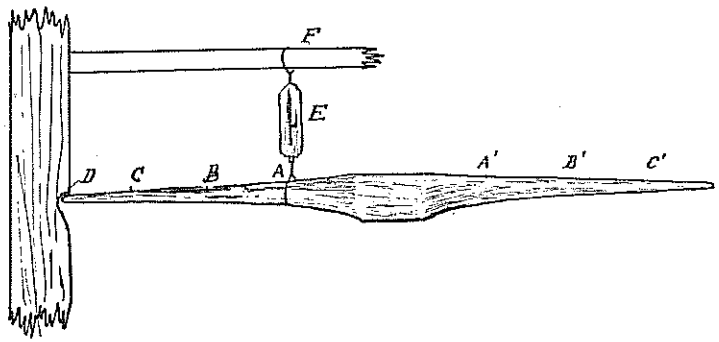

Fig. 68

as the metal can not adhere to the wood, if the machine were in flight on a rainy day, the rain would filter through and collect at the tip, causing the metal to bulge up and tear the propeller to pieces owing to the terrific centrifugal force. To avoid this, small holes are bored at the tips of the metallic protections to allow the water to run out.

Balance.—A propeller must be perfectly balanced. There are different methods to try a propeller for balance, but the best is to mark equal distances from the center to the tip on both blades and to weigh the propeller at all the marks; for an equal distance from the center, the weight on one blade must be equal to that on the other. This is accomplished by inserting one of the tips *D* (Fig. 68) in a notch cut in a wall and hooking the propeller to a spring scale *E*