The dimensions of the air-pump seem to vary much, from 1/3 to 1/5 of the volume of the steam-cylinder. I do not know any disadvantage of importance in having a large air-pump; as, if properly constructed, the force which is required to work it will he nearly in the proportion of the elasticity of the gas which it has to remove from the condenser. To give the air-pump half the stroke of the cylinder and 1/3 of the area of the cylinder, or 1/3 of the stroke of the cylinder and 1/2 the area of the cylinder, are common proportions.

*The Valves and Valve Passages.—*The notion that because a horse can do most work at the rate of 21/4 miles an honr, or 220 feet a minute, therefore a steam- engine should also move at that rate, is a prescriptive error almost ridiculous ; but from which it will never­theless be difficult for ns to escape, especially as the pro­portions generally in use are derived from this absurd dogma. There is no doubt that the passages and valves should simply be as large as possible, and those valves should be used which can be most enlarged with least inconvenience. Such valves we possess in the class of equilibrium valves. These valves may have an area as large as the tenth-part of the cylinder without disad­vantage, and the velocity of the piston may thus be in­creased, and consequently the power of the engine, with great advantage, especially in steam navigation. We have the best possible means of knowing, that with pro­per valves and passages, the speed of the piston may very advantageously be increased to 250, 300, 400, and 500 feet a minute. The pistons of the swiftest vessels in the world move at that rate.

The kind of valve most commonly in use in steam- vessels is the long D-slide, as it is called ; and next to that is the short D-slide. There are scarcely any other kinds in use in Britain. A valve called the four-port slide valve has been used to a limited extent, as have also conical valves, and equilibrium valves, or double heat valves in this country, the latter very extensively’ in America. The following are diagrams of the long and short D-slides.

The four-port slide valve is a recent invention, having been the subject of a patent so lately as 1833. Since that time they have been used to a considerable extent in one part of Scotland. The same kind of valve was subsequently patented by another party in England, and these valves were put on board of some of her Majesty's frigates. The following figures represent the four-port slide valve, in two positions. A the cylinder ; *p∕>* the piston; S the steam-pipe; VVVV the slide valves. The arrows show the direction of the steam.

The equilibrium valve has already been described in the article Steam-Engine.

The size of the valves is a matter of some conse­quence. That the valves, passages, and ports by which the steam enters the cylinder should allow a free pas­sage of 1/25 of the area of the cylinder, is an old and pretty general rule. It is equally certain, however, that the eduction valves, ports, and passages by which the steam enters the condenser should be much larger. They have been made 1/12th and 1/10th of the area of the cylin­der with advantage, in the case of high velocity of the piston.

*The Eccentric*—The valves, by means of which the steam is alternately admitted to the cylinder on one side, and educted from the other side, into the condenser, are moved by the machine itself; and the very simple and beautiful automatic contrivance for that purpose is called the eccentric.

We have already described the actions of the eccen­tric in the article Steam-Engine. In the marine en­gine it is placed on the axis of the paddle wheels. In fig. 24 its usual arrangement is shown, and in the Plates many examples will be found.

As the shaft A moves round, it is plain that the pro­jection of the eccentric, first on one side of the shaft and then on the other side, will draw the eccentric rod in op­posite directions ; and the distance of the centre of the eccentric from the centre of the shaft, will be placed now on one side and now on another side of the axis. The motion thus produced is called the throw of the eccen­tric ; and half the throw is equal to the eccentricity.