may traverse it free

ly lengthwise. The

semicircular ends are

polished, and ren

dered truly cylindri

cal, that the pack

ing in the valve

chest may embrace

them perfectly. The

steam-pipe is repre

sented as entering

the valve-chest from

below at S, and the

eduction-pipe in the

middle as at E. In

this valve-chest are placed packing-boxes, as they are called, immediately opposite to the ports of the cylin der. They contain a quantity of soft elastic hemp, soaked in oleaginous matter, the object of which is to press against the outside of the slide-valve when in its place, and make steam-tight partitions in the valve-chest between the middle and ends of the valve, so that no communication of steam can take place between the middle and the two ends.

In the figures 78 and 79, the valve is shown *in situ.* In figure 79, the steam from S rises up along the centre of the slide, and enters the upper part A, while the steam in the under part of the cylinder has free egress through B to the eduction-pipe E. In figure 78, the steam has free access to the lower part B, while the steam already above the piston has free egress through the port A, through the eduction-pipe E. In this species of slide, there is scarcely any loss of steam in the passages, as it is cut off close to the cylinder.

Instead of the long D-slide, which is very heavy on a large scale, two short slides, similar to its two ends, and connected together by bars, have been used in the following form. Fig. 80 is a section of the slide, fig. 81, a

face view ; and fig. 82, a section of the cylinder with the valves in their place.

In this case, however, there are two eduction-pipes E E instead of one, as formerly, and the steam-pipe enters between the valves.

A cylindrical slide-valve of the following form is in

use in a considerable number of

engines, and works well in those

cases which we have had an op

portunity of examining. The

valve-chest is an upright cylin

drical pipe P Q, the inside of

which is bored truly cylindrical,

and is exactly fitted by two me

tallic cylindrical plugs, which are

ground so smooth in their places

as to be steam-tight. It will be

apparent from the figure that

these two plugs being raised

and depressed by the valve-rod

which connects them, will effect

the same purpose as the former

valve.

The conical valve is a species of valve introduced by Mr Watt, and improved by his assistant Mr Murdoch, from whom the steam-engine of Watt has received many valuable appendages, and much of its practical perfection. It has been applied in two forms. Mr Watt's own form, the earlier one, is given in the following figures. For a single engine four valves are required. One of them is represented separately in figures 84. 85, which are vertical sections through the valve, at right angles to each other. The valve is shown open in fig. 84, and shut in 85. S is

the entrance of the

steam, A the port,

V the conical valve,

and N the seat or noz

zle which it covers.

On a cursory glance,

it is evident that

when the conical cover V of the aperture N is up, as in the first diagram, the steam has free entrance ; and when it is closed, the steam will merely press the valve down into its seat, without obtaining an escape from the nozzle. The manner in which this is effected for all the passages, is shown in the following perspective diagram, fig. 86. *add* is the steam pipe from the boiler; *g g* the eduction-pipe ; *b* the upper steam-valve; *e* the lower steam valve; *h* the upper exhausting valve ; *i* the lower exhausting valve; c the upper part of the cylinder; *f* the lower part. The seats of the exhausting valves Λ and *i* are in verted, so that these valves open when drawn down wards, while the steam-valves open when drawn upwards. Each valve has a toothed rack attached to it, which is acted on by a toothed sector, fixed on an axis, whose end passes through the valve-box, and carries an arm or handle by which it is moved as follows ;—the arm or handle of the upper steam-valve is connected by the rod 10 with an arm fixed on the axis *t*, and the arm on the axis of the lower exhausting valve is also connected by the rod 11 with a similar arm fixed on the same axis *t.* The arms of the lower steam-valves and upper exhausting valves are in the same manner connected with arms on the axis *u,* by means of the rods 13, 14. These axes *t, u,* carry each a handle *t r*, *u s*; and on these the plugs or chocks 1, 2, 3, 12, of the plug-rod *l,* 12, act. When the plug rod is descending, its chock 1 comes in contact with the handle *t r* of the axis *t,* and depressing it, turns round the axis *t,* so as to shut the upper steam-valve and the lower exhausting valve ; and at the same instant its chock 3 comes in contact with the handle *us of* the Iower axis *u*, and depressing it, opens the lower steam-valve and the upper exhausting valve. In the upward motion of the plug-tree, the position of the handles arc reversed by the chocks 12, 2. The axis *t* carries a short lever 4, to the end of which there is a weight hung through the rod 4 4. When the valves connected with the axis *t* are opened, this weight keeps them open; but is prevented from open­