its ſeat and box. Suppoſe it one of the eduction valves. RH is part of the pipe which introduces the ſteam, and GG is the upper part of the pipe which communicates with the condenſer. At EE maybe obſerved a piece more faintly ſhaded than the ſurrounding parts. This is the ſeat of the valve, and is a braſs or bell-metal ring turned conical on the outſide, ſo as to fit exactly into a conical part of the pipe GG. Theſe two pieces are fitted by grinding; and the cone being of a long taper, the ring flicks firmly in it, eſpecially after having been there for ſome time and united by ruſt. The clack it­ſelf is a ſtrong braſs plate D, turned conical on the edge, ſo as to fit the conical or ſtoping inner edge of the ſeat. Theſe are very nicely ground on each other with emery. This conical joining is much more obtuſe than the outer side of the ring ; ſo that although the joint is air-tight, the two pieces do not ſtick ſtrongly together. The clack has a round tail DG, which is freely moveable up and down in the hole of a croſs piece FF, On the upper side of the valve is a ſtrong piece of metal DC firmly joined to it, one side of which is formed into a toothed rack. A is the ſection of an iron axle which turns in holes in the oppoſite sides of the valve-box, where it is nicely fitted by grinding, ſo as to be air-tight. Collets of thick leather., well ſoaked in melted tallow and roſin, are ſcrewed on the outſide of theſe holes to prevent all ingreſs of air. One end of this axis projects a good way without the box, and carries a ſpanner or handle, which is moved by the plug-frame. To this axis is fixed a ſtrong piece of metal B, the edge of which is formed into an arch of a circle having the axis A in its centre, and is cut into teeth, which work in the teeth of the rack DC. K is a cover which is fixed by ſcrews to the top of the box H J J H, and may be taken off in order to get at the valve when it needs repairs.

From this deſcription it is eaſy to see that by turn­ing the handle which is on the axis A, the ſector B muſt lift up the valve by means of its toothed rack DC, till the upper end of the rack touch the knob or but­ton K. Turning the handle in the oppoſite direction brings the valve down again to its ſeat.

This valve is extremely tight. But in order to open it for the passage of the ſteam, we muſt exert a force equal to the preſſure of the atmoſphere. This in a large engine is a very great weight. A valve of six inches diameter ſuſtains a preſſure not leſs than 400 pounds. But this force is quite momentary, and hardly impedes the motion of the engine ; for the inſtant the valve is de­tached from its ſeat, although it has not moved the tooth part of an inch, the preſſure is over. Even this little inconvenience has been removed by a delicate thought of Mr Watt. He has put the ſpanner in ſuch a poſition when it *begins* to raiſe the valve, that its me­chanical energy is almoſt infinitely great. Let Q\_R (fig. 14.) be part of the plug-frame deſcending, and P one of its pins just going to lay hold of the ſpanner N O moveable round the axis N. On the ſame axis is ano­ther arm NM connected by a joint with the leader ML, which is connected alſo by a joint with the ſpan­ner L A that is on the axis A of the ſector within the valve-box. Therefore when the pin P puſhes down the ſpanner NO, the arm N M moves ſidewiſe and pulls down the ſpanner A L by means of the connecting rod. Things are ſo dispoſed, that when the cock is ſhut, L M and MN are in one ſtraight line. The intelligent me­chanic will perceive that, in this poſition, the force of the lever O N M is inſuperable. It has this further ad­vantage, that if any thing ſhould tend to force open the valve, it would be ineffectual ; for no force exerted at A, and tranſmitted by the rod L M, can possibly puſh the joint M out of its poſition. Of ſuch importance is it to practical mechanics, that its professors ſhould be perſons of penetration as well as knowledge. Yet this circum­ſtance is unheeded by hundreds who have ſervilely copied from Mr Watt, as may be ſeen in every engine that is passed on the public as a discovery and an improvement. When theſe puppet valves have been introduced into the common engine, we have not ſeen one inſtance where this has been attended to ; certainly becauſe its utility has not been obſerved : and there is one ſituation where it is of more conſequence than in Mr Watt’s engine, viz. in the injection-cock. Here the valve is drawn back into a box, where the water is ſo awkwardly diſpoſed round it that it can hardly get out of its way, and where the preſſure even exceeds that of the atmoſphere. Indeed this par­ticular ſubſtitution of the button-valve for the cock is moſt injudicious.

We poſtponed any account of the office of the fly X X (fig. 11. ), as it is not of uſe in an engine regulated by the fly V V. The fly X X is only for regulating the reciprocating motion of the beam when the ſteam is not admitted during the whole deſcent of the piſton. This it evidently muſt render more uniform, accumula­ting a momentum equal to the whole preſſure of the full ſupply of ſteam, and then ſharing it with the beam during the rest of the deſcent of the piſton.

When a perſon properly ſkilled in mechanics and chemiſtry reviews theſe different forms of Mr Watt’s ſteam-engine, he will eaſily perceive them ſuſceptible of many intermediate forms, in which any one or more of the diſtinguiſhing improvements may be employed. The first great improvement was the condenſation in a ſeparate veſſel. This increaſed the original powers of the engine, giving to the atmoſpheric preſſure and to the counter weight their full energy ; at the ſame time the waſte of ſteam is greatly diminiſhed. The next im­provement by employing the preſſure of the ſteam instead of that of the atmoſphere, aimed only at a ſtill farther diminution of the waſte ; but was fertile in ad­vantages’, rendering the machine more manageable, and particularly enabling us at all times, and without trou­ble, to suit the power of the engine to its load of work, however variable and increaſing ; and brought into view a very intereſting propoſition in the mechanical theory of the engine, viz. that the whole performance of a, given quantity of ſteam may be augmented by admitting it into the cylinder only during a part of the piſton’s motion. Mr Watt has varied the application of this propoſition in a thouſand ways ; and there is nothings about the machine which gives more employment to the ſagacity and judgment of the engineer. The third improvement of the double impulſe may be conſidered as the finiſhing touch given to the engine, and renders it as uniform in its action as any water-wheel. In the engine in its moſt perfect form there does not ſeem to be above one-fourth of the ſteam wasted by warming the apparatus ; ſo that *it is not poſſible* to make it one-fourth part more powerful than it is at preſent. The only thing that ſeems ſuſceptible of conſiderable improvement