kept of a low temperature, it will abſtract and condenſe the vapour from the warmer parts, till the whole acquires the elaſticity correſponding to the coldeſt part. By the ſame means much of the waſte is prevented, be­cauſe the cylinder is never cooled much below the boil­ing temperature. Many engines have been erected by Mr Watt in this form, and their performance gave uni­universal ſatisfaction.

We have contented ourſelves with giving a very slight deſcription without a figure oſ this improved en­gine, becauſe we imagine it to be of very eaſy comprehenſion, and becauſe it is only a preparation ſor ſtill greater improvements, which, when underſtood, will at the ſame time leave no part of this more simple form unexplained.

During the progreſs of theſe improvements Mr Watt made many experiments on the quantity and denſity of the ſteam of boiling water. Theſe fully convinced him, that although he had greatly diminiſhed the waſte of ſteam, a great deal yet remained, and that the ſteam expended during the riſe of the piſton was at leaſt three times more than what would fill the cylinder. The cauſe of this was very apparent. In the ſubſequent deſcent of the piſton, covered with water much below the boiling temperature, the whole cylinder was neceſſarily cooled and expoſed to the air. Mr Watt’s fertile genius immediately ſuggeſted to him the expedient of employing the elaſticity of the ſteam from the boiler to impel the piſton down the cylinder, in place of the preſſure of the atmoſphere ; and thus he restored the engine to its first principles, making it an engine *really moved by steam.* As this is a new epoch in its hiſtory, we ſhall be more particular in the deſcription ; at the ſame time ſtill reſtricting ourſelves to the eſſential circumſtances, and avoiding every peculiarity which is to be found in the prodigious varieties which Mr Watt has introduced into the machines which he has erected, every individual of which has been adapted to local circumſtances, or diverſified by the progreſs of Mr Watt’s improvements.

Let A (fig. 9.) repreſent the boiler. This has re­ceived great improvements from his complete acquain­tance with the procedure of nature in the production of ſteam. In ſome of his engines the fuel has been placed in the midſt of the water, ſurrounded by an iron or copper veſſel, while the exterior boiler was made of wood, which tranſmits, and therefore waſtes the heat very slowly. In others, the flame not only plays round the whole outside, as in common boilers, but alſo runs along ſeveral flues which ate conducted through the midſt of the water. By ſuch contrivances the fire is applied to the water in a moſt extenſive ſurface, and for a long time, ſo as to impart to it the greateſt part of its heat. So ſkilfully was it applied in the Albion Mills, that although it was perhaps the largeſt engine in the kingdom, its unconſumed ſmoke was inferior to that of a very ſmall brew-houſe. In this second engine of Mr Watt, the top of the cylinder is ſhut up by a ſtrong metal plate *g h,* in the middle of which is a collar or box of leathers *k* l, formed in the uſual manner of a jack­head pump, through which the piſton rod P D, nicely turned and poliſhed, can move up and down, without allowing any air to paſs by its sides. From the dome of the boiler proceeds a large pipe B C I O Q, which, after reaching the cylinder with its horizontal part BC, deſcends parallel to its side, ſending off two branches, *viz.* I M to the top of the cylinder, and O N to its bottom. At I is a puppet valve opening from be­low upwards. At L, immediately below this branch, there is a ſimilar valve, alſo opening from below upwards. The pipe deſcends to Q, near the bottom of a large ciſtern *c de f,* filled with cold water conſtantly renew­ed. The pipe is then continued horizontally along the bottom of this ciſtern (but not in contact), and ter­minates at R in a large pump S T. The piſton S has clack valves opening upwards, and its rod S *s,* paſſing through a collar of leathers at T, is ſuſpended by a chain to a ſmall arch head on the outer arm of the beam. There is a valve R in the bottom of this pump, as uſual, which opens when preſſed in the direction Q\_R, and ſhuts againſt a contrary preſſure. This pump delivers its contents into another pump X Y, by means of the ſmall pipe *t* X, which proceeds from its top. This second pump has a valve at X, and a clack in its piſ­ton Z as uſual, and the piſton rod Z z is ſuſpended from another arch head on the outer arm of the beam. The two valves I and L are opened and ſhut by means of ſpanners and handles, which are put in motion by a plug frame, in the ſame manner as in Newcomen’s engine.

Laſtly, there may be obſerved a crooked pipe a *b o,*which enters the upright pipe laterally a little above Q. This has a ſmall jet hole at o ; and the other end *a,* which is conſiderably under the ſurface of the water of the condenſing ciſtern, is covered with a puppet valve *v,* whoſe long ſtalk *v u* riſes above the water, and may be railed or lowered by hand or by the plug beam. The valves R and X and the clacks in the pillons S and Z are opened or ſhut by the preſſures to which they are immediately expoſed.

This figure is not an exact copy of any of Mr Watt’s engines, but has its parts ſo diſpoſed that all may come diſtinctly into view, and exactly perform their various functions. It is drawn in its quieſcent poſition, the outer end of the beam preponderating by the counter weight, and the piſton P at the top of the cylinder, and the piſtons S and Z in their lowest ſituations.

In this ſituation let us ſuppoſe that a vacuum is (by any means) produced in all the ſpace below the piſton, the valve I being ſhut. It is evident that the valve R will alſo be ſhut, as alſo the valve *v.* Now let the valve I be opened. The ſteam from the boiler, as elaſtic as common air, will ruſh into the ſpace above the piſton, and will exert on it a preſſure as great as that of the atmoſphere. It will therefore preſs it down, raiſe the outer end of the beam, and cauſe it to perform the ſame work as an ordinary engine.

When the piſton P has reached the bottom of the cylinder, the plug frame ſhuts the valve I, and opens L. By ſo doing the communication is open between the top and bottom of the cylinder, and nothing hin­ders the ſteam which is above the piſton from going along the paſſage M L O N. The piſton is now equally af­fected on both sides by the ſteam, even though a part of it is continually condenſed by the cylinder, and in the pipe I O Q. Nothing therefore hinders the piston from being dragged up by the counter weight, which acts with its whole force, undiminiſhed by any remain­ing unbalanced elaſticity of ſteam. Here therefore this form of the engine has an advantage (and by no means