of its principles, and have more than once pointed out the real improvements, that they may be firmly fixed and always ready in the mind. By having recourſe to them, the reader may pronounce with confidence on the merits of any new conſtruction, and will not be decei­ved by the puffs of an ignorant or diſhoneſt engineer.

We muſt except from this general criticiſm a con­ſtruction by Mr Jonathan Hornblower near Briſtol, on account of its ſingularity, and the ingenuity and real ſkill which appears in ſome particulars of its conſtruc­tion. The following ſhort deſcription will ſufficiently explain its principle, and enable our readers to appre­ciate its merit.

A and B (fig. 15.) repreſent two cylinders, of which A is the largeſt. A piſton moves in each, having their rods C and D moving through collars at E and F. Theſe cylinders may be ſupplied with ſteam from the boiler by means of the ſquare pipe G, which has a flanch to connect it with the rest of the ſteam pipe. This ſquare part is repreſented as branching off to both cy­linders. *c* and *cl* are two cocks, which have handles and tumblers as uſual, worked by the plug-beam W. On the fore-ſide (that is, the side next the eye) oſ the cylinders is repreſented another communicating pipe, whoſe ſection is alſo ſquare or rectangular, having alſo two cocks *a, b.* The pipe Y, immediately under the cock *b,* eſtabliſhes a communication between the upper and lower parts of the ſmall cylinder B, by opening the cock *b.* There is a ſimilar pipe on the other side of the cylinder A, immediately under the cock *d.* When the cocks *c* and *a* are open, and the cocks *b* and *d* are ſhut, the ſteam from the boiler has free admiſſion into the upper part of the cylinder B, and the ſteam from the lower part of B has free admiſſion into the upper part of A ; but the upper part of each cylinder has no communication with its lower part.

From the bottom of the great cylinder proceeds the eduction-pipe K, having a valve at its opening into the cylinder, which bends downwards, and is connected with the conical condenſer L @@(c). The condenſer is fixed on a hollow box M, on which ſtand the pumps N and O for extracting the air and water ; which laſt runs along the trough T into a ciſtern U, from which it is raised by the pump V for recruiting the boiler, being already nearly boiling hot. Immediately under the condenſer there is a ſpigot valve at S, over which is a ſmall jet pipe, reaching to the bend of the eduction­pipe. The whole of the condenſing apparatus is con­tained in a ciſtern R of cold water. A ſmall pipe P comes from the side of the condenſer, and terminates on the bottom of the trough T, and is there covered with a valve Q, which is kept tight by the water that is al­ways running over it. Laſtly, the pump-rods X cauſe the outer end of the beam to preponderate, ſo that the quieſcent poſition of the beam is that repreſented in the figure, the piſtons being at the top of the cylinders.

Suppoſe all the cocks open, and ſteam coming in copiouſly from the boiler, and no condenſation going on in L ; the ſteam muſt drive out all the air, and at laſt follow it through the valve Now ſhut the valves *b* and *d,* and open the valve S of the condenſer. The condemation will immediately commence. There is now no preſſure on the under side of the piſton of A, and it immediately deſcends. The communication be­tween the lower part of B and the upper part of A being open, the ſteam will go from B into the ſpace left by the piſton of A. It muſt therefore expand, and its elaſticity muſt diminiſh, and will no longer ba­lance the preſſure of the ſteam above the piſton of B. This piſton therefore, if not with-held by the beam, would descend till it is in equilibrio, having ſteam of equal denſity above and below it. But it cannot de­ſcend ſo far ; for the cylinder A is wider than B, and the arm oſ the beam at which its piſton hangs is longer than the arm which supports the piſton of B: therefore when the piſton of B has deſcended as far as the beam will permit it, the ſteam between the two piſtons occu­pies a larger ſpace than it did when both piſtons were at the tops of their cylinders. Its denſity, therefore, and its elaſticity, diminiſh as its bulk increaſes. It is therefore not a balance ; for the ſteam on the upper fide of B, and the piſton B, *pulls* at the beam with all the difference of theſe preſſures. The ſlighteſt view of the ſubject muſt ſhow the reader, that as the piſtons de­ſcend, the ſteam that is between them will grow conti­nually rarer and leſs elaſtic, and that both piſtons will pull the beam downwards.

Suppoſe now that each has reached the bottom of its cylinder. Shut the cock a and the eduction cock at the bottom of A, and open the cocks *b* and *d.* The communication being now eſtabliſhed between the upper and lower part of each cylinder, nothing hinders the counter weight from raiſing the piſtons to the top. Let them arrive there. The cylinder B is at this time fill­ed with ſteam of the ordinary denſity, and the cylin­der A with an equal abſolute quantity of ſteam, but expanded into a larger ſpace.

Shut the cocks *b* and *d,* and open the cock *a,* and the eduction cock at the bottom of A ; the conden­ſation will again operate, and the piſtons deſcend. And thus the operation may be repeated as long as ſteam is ſupplied ; and one full of the cylinder B of ordinary ſteam is expended during each working ſtroke.

Let us now examine the power of this engine. It is evident, that when both piſtons are at the top of their reſpective cylinders, the active preſſure (that is, the dif­ference of the preſſure on its two ſides) on the piſton of B is nothing, while that on the piſton of A is equal to the full preſſure of the atmoſphere on its area. This, multiplied by the length of the arm by which it is ſupported, gives its mechanical energy. As the piſtons deſcend, the preſſure on the piſton of B increaſes, while that on the piſton of A diminiſhes. When both are at the bottom, the preſſure on the piſton of B is at its maximum, and that on the piſton of A at its mini­mum.

Mr Hornblower ſaw that this muſt be a beneficial employment of ſteam, and preferable to the practice of condenſing it while its full elaſticity remained ; but he has not conſidered it with the attention neceſſary for aſcertaining the advantage with preciſion,

Let *a* and *b* repreſent the areas of the piſtons of A

@@@(c) This, however, was stopped by Watt’s patent; and the condenſation muſt be performed as in Newcomen’s engine, or at leaſt in the cylinder A.