boiler will immediately ruſh in, and flying all over the cylinder, will mix with the air. Much of it will be condenſed by the cold ſurface of the cylinder and piſton, and the water produced from it will trickle down the ſides, and run off by the eduction-pipe. This condensation and waste of ſteam will continue till the whole cy­linder and piſton are made as hot as boiling water. When this happens, the ſteam will begin to open the ſnifting valve *f,* and iſſue through the pipe ; ſlowly at firſt and very cloudy, being mixed with much air. The blaſt at f will grow ſtronger by degrees, and more transparent, having already carried off the greateſt part of the common air which filled the cylinder. We ſuppoſed that the water was boiling briſkly, ſo that the steam was iſſuing by the ſafety-valve which is in the top of the boiler, and through every crevice. The opening of the fteam-cock puts an end to this at once, and it has ſometimes happened that the cold cylinder abſtracts the ſteam from the boiler with ſuch aſtoniſhing rapidity, that the preſſure of the atmoſphere has burſt up the bottom of the boiler. We may here mention an ac­cident of which we were witneſſes, which alſo ſhows the immenſe rapidity of the condenſation. The boiler was in a frail ſhed at the side of the engine-houſe ; a shoot of ſnow from the top of the houſe fell down and broke through the roof of the ſhed, and was ſcattered over the head of the boiler, which was of an oblong or oval ſhape. In an inſtant the ſides of it were ſqueezed together by the preſſure of the atmoſphere.

When the manager of the engine perceives that not only the blaſt at the ſnifting valve is ſtrong and ſteady, but that the boiler is now fully ſupplied with ſteam of a proper ſtrength, appearing by the renewal of the diſcharge at the ſaſety-valve, he ſhuts the ſteamcock, and opens the injection cock S by turning its handle V. The preſſure of the column of water in the injection­pipe ZS immediately forces ſome water through the ſpout R. This coming in contact with the pure va­pour which now fills the cylinder, condenſes it, and thus makes a partial void, into which the more diſtant ſteam immediately expands, and by expanding collapſes (as has been already obſerved). What remains in the cylinder no longer balances the atmoſpherical preſſure on the ſur­face of the water in the injection-ciſtern, and therefore the water ſpouts rapidly through the hole R by the joint action of the column ZS and the unbalanced preſ­ſure of the atmoſphere ; at the ſame time the ſnifting valve *f* and the eduction-valve *h* are ſhut by the unba­lanced preſſure of the atmoſphere. The velocity of the injection water muſt therefore rapidly increaſe, and the jet will daſh (if single) againſt the bottom of the piſton, and be ſeattered through the whole capacity of the cy­linder. In a very ſhort ſpace of time, therefore, the condenſation of the ſteam becomes univerſal, and the elasticity of what remains is almoſt nothing. The whole preſſure of the atmoſphere is exerted in the upper ſurface of the piſton, while there is hardly any on its under side. Therefore, if the load on the outer end E of the working beam is inferior to this preſſure, it muſt yield to it. The piſton P muſt deſcend, and the pump piſton L muſt aſcend, bringing along with it the water of the mine, and the motion muſt continue till the great piſton reaches the bottom of the cylinder ; for it is not like the motion which would take place in a cylinder of air rarefied to the ſame degree. In this laſt case, the im­pelling foree would be continually diminiſhed, becauſe the capacity of the cylinder is diminiſhed by the deſcent of the piſton, and the air in it is continually becoming more denſe and elaſtic. The piſton would ſtop at a cer­tain height, where the elaſticity of the included air, to­gether with the load at E, would balance the atmoſpherical preſſure on the piſton. But when the contents of the cylinder are pure vapour, and the continued ſtream of injected cold water keeps down its temperature to the ſame pitch as at the beginning, the elaſticity of the remaining ſteam can never increaſe by the deſcent of the piſton, nor exceed what correſponds to this temperature. The impelling or accelerating force therefore remains the ſame, and the deſcent of the piſton will be uniform­ly accelerated, if there is not an increaſe of reſiſtance ariſing from the nature of the work performed by the other end of the beam. This circumſtance will come under conſideration afterwards, and we need not attend to it at preſent. It is enough for our preſent purpoſe to ſee, that if the cylinder has been completely purged of common air before the ſteam cock was ſhut, and if none has entered ſince, the piſton will deſcend to the very bottom of the cylinder. And this may be frequent­ly obſerved in a good ſteam-engine where every part is air-tight. It sometimes happens, by the pit-pump drawing air, or ſome part of the communication be­tween the two strains giving way, that the piſton comes down with ſuch violence as to knock out the bottom of the cylinder with the blow.

The only obſervation which remains to be made on the motion of the piſton in deſcending is, that it does not begin at the inſtant the injection is made. The piſton was kept at the top by the preponderancy of the outer end of the working beam, and it muſt remain there till the difference between the elaſticity of the ſteam below it and the preſſure of the atmoſphere exceeds this preponderancy. There muſt therefore be a ſmall ſpace of time between the beginning of the condenſation and the beginning of the motion. This is very ſmall, not exceeding the third or the fourth part of a ſecond ; but it may be very diſtinctly obſerved by an attentive ſpectator. He will ſee, that the inſtant the injection-cock is opened, the cylinder will ſenſibly riſe upwards a little by the preſſure of the air on its bottom. Its whole weight is not nearly equal to this preſſure ; and inſtead of its being neceſſary to *ſupport* it by a ſtrong floor, we muſt *keep it down* by ſtrong joiſts loaded by heavy walls. It is uſual to frame theſe joiſts into the ports which carry the axis of the working-beam, and are therefore loaded with the whole ſtrain of the ma­chine. This riſing of the cylinder ſhows the inſtantaneous commencement of the condenſation ; and it is not till *after* this has been diſtinctly obſerved that the piſton is ſeen to start, and begin to deſcend.

When the manager sees the piſton as low as he thinks proper, he ſhuts the injection-cock, and opens the ſteam-cock. The steam has been accumulating above the water in the boiler during the whole time of the piſton’s deſcent, and is now ruſhing violently through the puppet clack. The moment therefore that the ſteam-cock is opened, it ruſhes violently into the cylin­der, having an elaſticity greater than that of the air. It therefore immediately blows open the ſnifting valve, and allows (at leaſt) the water which had come in by the former injection, and what aroſe from the conden-