with the friction of both, does not exceed the whole preſſure exerted by the ſteam-engine during its work­ing ſtroke; and provided that the momentum of the fly, ariſing from its great weight and velocity, be very great, ſo that the reſiſtance of the work during one return­ing ſtroke of the ſteam engine do not make any very ſensible diminution of the velocity of the fly. This is evi­dently poſſible and eaſy. The fly may be made of any magnitude ; and being exactly balanced round its axis, it will ſoon acquire any velocity conſiſtent with the mo­tion of the ſteam-engine. During the working ſtroke of the engine it is uniformly accelerated, and by its ac­quired momentum it produces in the beam the movement of the returning ſtroke; but in doing this, its momen­tum is ſhared with the inert matter of the ſteam-engine, and conſequently its velocity diminiſhed, but not entire­ly taken away. The next working ſtroke therefore, by preſſing on it afreſh, increaſes its remaining velo­city by a quantity nearly equal to the whole that it acquired during the firſt ſtroke. We say *nearly,* but not quite equal, becauſe the time of the second working ſtroke muſt be ſhorter than that of the firſt, on account of the velocity already in the machine. In this manner the fly will be more and more accelerated every ſucceeding ſtroke, becauſe the preſſure of the engine during the working ſtroke does more than reſtore to the fly the momentum which it loſt in producing the returning movement of the ſteam-engine. Now suppoſe the working part of the machine to be added. The acce­leration of the fly during each working ſtroke of the ſteam-engine will be leſs than it was before, becauſe the impelling preſſure is now partly employed in driving the working machine, and becauſe the fly will lose more of its momentum during the returning ſtroke of the ſteam- engine, part of it being expended in driving the work­ing machine. It is evident, therefore, that a time will come when the ſucceſſive augmentation of the fly’s velo­city will ceaſe ; for, on the one hand, the continual acce­leration diminiſhes the time of the next working ſtroke, and therefore the time of action of the accelerating power. The acceleration muſt diminiſh in the ſame proportion ; and on the other hand, the reſiſtance of the working machine generally, though not always, increaſes with its velocity. The acceleration ceaſes whenever the addi­tion made to the momentum of the fly during a work­ing ſtroke of the ſteam-engine is juſt equal to what it loſes by driving the machine, and by producing the re­turning movement of the ſteam-engine.

This muſt be acknowledged to be a very important addition to the engine, and though ſufficiently obvious, it is ingenious, and requires conſiderable ſkill and addreſs to make it effective @@( b).

The movement oſ the working machine, or mill of whatever kind, muſt be in ſome degree hobbling or unequal. But this may be made quite inſenſible, by ma­king the fly exceedingly large, and dispoſing the greatest part of its weight in the rim. By theſe means its mo­mentum may be made ſo great, that the whole force required for driving the mill and producing the return­ing movement of the engine may bear a very ſmall pro­portion to it. The diminution of its velocity will then be very trifling.

No counter weight is neceſſary here, becauſe the re­turning movement is produced by the inertia of the fly. A counter weight may, however, be employed, and ſhould be employed, viz. as much as will produce the returning movement of the ſteam-engine. It will do this better than the ſame force accumulated in the fly ; for this force muſt be accumulated in the fly by the intervention of rubbing parts, by which ſome of it is loſt ; and it muſt be afterwards returned to the en­gine with a ſimilar loss. But, for the ſame reaſon, it would be improper to make the counter weight alſo able to drive the mill during the returning ſtroke.

By this contrivance Mr Fitzgerald hoped to render the ſteam-engine of moſt extenſive uſe; and he, or others aſſociated with him, obtained a patent excluding all others from employing the ſteam-engine for turning a crank. They alſo publiſhed propoſals for erecting mills of all kinds driven by ſteam-engines, and ſtated very fairly their powers and their advantages. But their propoſals do not ſeem to have acquired the confidence of the public ; for we do not know of any mill ever having been erected under this patent.

The great obſtacle to this extenſive uſe of the ſteam- engine is the prodigious expenſe of fuel. An engine having a cylinder of four feet diameter, working night and day, conſumes about 3400 chaldron (London) of good coals in a year.

This circumſtance limits the uſe of ſteam-engines ex­ceedingly. To draw water from coal-pits, where they can be flocked with unſaleable ſmall coal, they are of univerſal employment : alſo for valuable mines, for ſupplying a great and wealthy city with water, and a few other purpoſes where a great expence can be borne, they are very proper engines ; but in a thouſand caſes where their unlimited powers might be vaſtly ſerviceable, the enormous expenſes of fuel completely excludes them. We cannot doubt but that the attention of en­gineers was much directed to every thing that could promiſe a diminution of this expenſe. Every one had his particular noſtrum for the conſtruction of his furnace, and ſome were undoubtedly more ſucceſsful than others. But ſcience was not yet ſufficiently advanced : It was not till Dr Black had made his beautiful diſcovery of latent heat, that we could know the intimate relation between the heat expended in boiling off a quantity of water and the quantity of ſteam that is produced.

@@@(b) We do not recollect at preſent the date of this propoſal of Mr Fitzgerald ; but in 1781 the Abbé Arnal, canon of Alais in Languedoc, entertained a thought of the ſame kind, and propoſed it for working lighters in the inland navigations ; a ſcheme which has been ſucceſsfully practiſed (we are told) in America. His bro­ther, a major of engineers in the Auſtrian ſervice, has carried the thing much farther, and applied *it* to manu­factures ; and the Aulic Chamber of Mines at Vienna has patronized the project : (See *Journal Encyclopedique,* 1781). But theſe ſchemes are long poſterior to Mr Fitzgerald’s patent, and are even later than the erection of ſeveral machines driven by steam engines which have been erected by Meſſrs Watt and Boulton. We think it our duty to ſtate theſe particulars, becauſe it is very uſual for our neighbours on the continent to allume the credit of British inventions.