4. To these circumstances we may add, that it is to the possession of these properties that we may attribute the fact, that reciprocating engines are constructed of enormous weight in their moving parts, and of ponderous dimensions, without being thereby sensibly deteriorated in working. The crank acquires a slow motion at the commencement of the stroke, and an accelerated motion is thereby acquired in a manner equally gradual by all parts of the machine; and in like manner, at the termination of the stroke, it brings them to rest again in a gradation so gentle and uniformly retarded, as again to receive from them much of the impetus which it had formerly com­municated. The impetus, therefore, given to the re­ciprocating parts is only *lent,* not *lost.*

We have thus endeavoured to expose the nature of the fallacy under which they labour who imagine that the present steam-engine, as derived from Watt, is a machine which destroys or absorbs a large portion of the power it is designed to transmit, and who look to the rotatory engine as a means of increasing the amount of the power given out in useful effect. That the rotatory engines which appear day after day are not new, we show from the fact, that the five great classes which comprehend them all have already been invented and re invented by upwards of a hundred individuals. That their inventions have been unsuccessful, is manifest from the nonexistence of their machines in the daily use of ordi nary manufactures. That the failures of these contri vances did not arise from defects accidental to the peculiar arrangements and contrivances of the engine, is rendered probable by the great variety of forms in which they have been reinvented, tried, and abandoned. That they have not failed from deficiencies in the workman ship and practical details, is rendered still more probable by the circumstance of finding among the names of inventors those of the most eminent practical engineers. We have next shown, that in theory, the crank of the steam-engine in common use cannot, as has been sup posed, be attended with a loss of power, as such loss would oppose the established doctrine of virtual veloci­ties. It is also shown, from very simple and elementary considerations, that what appears to be lost in force is resumed in velocity; that in proportion as the mean force on the piston is greater than the mean force on the crank, in that proportion is the space described by the latter greater than the space described by the former; that the dynamical effect produced in a given time, is exactly in the proportion of the steam expended in that given time. And thus have we arrived at the conclusion, that the common reciprocating crank steam-engine has not the faults attributed to it in theory, and which the rotatory engines have been designed to remedy. We have next taken the practical view of the subject. In simplicity of parts, the rotatory engine has no advantage over the reciprocating piston ; in difficulty of construction, the rotatory piston far exceeds the reciprocating engine : it is more expensive at the outset—it has more friction—it is more bulky and less compact—it is inferior in precision and uniformity of action to the crank engine—and there is a radical fault inherent in the very nature of rotatory mechanism, from which it follows that the rotatory engine can never be rendered either an economical or a durable machine. We have further shown, that even if the rotatory engine could be made economical and durable, its very nature renders it un suited to the great purposes of steam navigation and inland locomotion ; objects to which it has been considered peculiarly applicable. We deemed it an appropriate and instructive conclusion to our enquiry, to examine into

the action of the crank, for the purpose of discovering what those remarkable qualities are which have given to the crank of the common steam-engine its unrivalled superiority as an element for the production of circular motion, and a degree of perfection unattainable by any other mechanism. We have seen that well constructed crank steam-engines are daily performing duty which is within ten per cent of the theoretical maximum of possible **effect—**of absolute perfection; that this practical perfection arises from the simplicity of the crank, from its wonderful adaptation to the nature and laws of tarn­ter, and of circular motion in connexion with rectilineal motion—from its reduction of errors either in construction, adjustment, or management, so as to work well without the absolute necessity of greater intelligence, expertness, and precision than belong to ordinary work men—and from the compensating nature of the arrangement of its structure, by which it is accommodated in a remarkable degree to the necessary imperfections of all human mechanism.

ON steam-engine BOILERS.

The construction of a boiler must appear so simple an arrangement of materials, as to require very little inge unity or contrivance; a large enough boiler placed upon a large enough tire being sufficient to generate any requisite supply of steam. Simple, however, as such an arrangement may seem, the best construction of boiler is a subject upon which very widely different and even opposite opinions are entertained by men of the greatest science and experience. There is perhaps no branch of practical art in which so much remains to be determined and improved, and scarcely any which science has done so little to advance. To follow servilely what has, in a given instance, been “ found to answer,” is the rule of the most sagacious mechanics, and the doctrine of the wisest authors. Those who have attempted to in vent have commonly erred ; those who have generalized have invariably been rash and unsuccessful, and their erroneous theories have led astray their followers, when they happen to have any.

The art of constructing steam-boilers is, we have said, in its infancy ; but it is likely, we think, to make rapid progress. The construction of the boiler of the locomotive-engine, which every day performs what at a former period we should have termed impossibilities, exhibited a strikingly anomalous phenomenon, by which the attention of all men who thought upon such subjects was suddenly arrested : this little barrel of water generates as much steam in an hour, as would formerly have been raised from a boiler and fire occupying a considerable house. The frequent explosion of boilers, both here and in America, has also directed attention to the efficient construction of boilers. The patient experimental enquiry that has since been set on foot, must lay open the whole of the important parts of the question so tho roughly, and bring out the facts with such clearness and precision, as to lead, by safe and rapid induction, to the general principles by which we may be able to predict the result of every supposed case, and deduce safe rules for the guidance of practical men in all circumstances. The investigation of the whole subject of steam-boilers, recently undertaken in America by the Franklin Insti tute, has already done much to settle many pointe of dispute. The publication of the reports of the American and English Governments on the explosions of steam-boilers, has elicited many valuable contributions