boiler in spiral circuits till it reaches the outside, and thence passes to the chimney.

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In the same way it has often been provided that the furnace should be in the interior of a cylindrical boiler, by placing another cylindrical tube of large dimensions in the interior of the outer case, to serve at once as fur nace and flue. This was probably first done by Trevithic, the advocate of high-pressure engines in this country.

To the great central flue there have been sometimes added lateral flues on each side, for the return of the products of combustion, fig. 221. Thus, again, this internal flue has been made elliptical, fig. 222, a dangerous and weak form.

It is one of the faults of the boilers that have their fires in the internal tubes, that the ashpit and interior of the furnace over the fuel are so confined, as to pre vent that perfect combustion of fuel which may bo obtained by a deep ashpit, a large expanse of fire grate, and a deep and wide furnace. These evils may, in some measure, be obviated by an internal flue of large dimensions ; but this very large one is extremely dangerous, and liable to explosion. The evil has been remedied by the following species of boiler, where the fire is still surrounded by water, and gives ample room for most perfect combustion.

In this species of boiler, the tube opens out at the front,

so as to leave a semicircle or a semi-cylinder above the fire, and two vertical spaces, or “ water legs,” as they are called, which cover the fire on both sides ; thus obstructing the heat that would otherwise pass away into the brick building, and at the same time covering a large and wide space of furnace bars, a deep ashpit, and so ensuring adequate combustion. The internal surface of this boiler has been still further increased, by substituting for this single tube a number of smaller ones six inches in diameter.

After passing through all these tubes, the flame and hot gases again return along the bottom and sides on the right of the boiler, and pass back on the other side to the chimney. A form of boiler similar to this is much used in Lancashire, and is called the Butterly Boiler. It has the large internal flue, but wants the fire-legs, and in this respect is inferior to the former.

Those boilers, already described, are the practical forms in use among intelligent engineers. The varieties of boiler that have been invented, amount to some hundreds. The Patent Records of the present day teem with new and improved boilers ; and yet it is a matter of constant complaint with engineers, that no great improvement has ever been made in boilers, but that as satisfactory results have been obtained from plain, simple boilers, of the kind used half a century ago, as from the modern and most complex forms.

The conclusion to be drawn from all that has been attempted or achieved in boilers is, we believe, the following: that there exist certain limits prescribed by the constitution of fuel, the nature of metals, and the properties of water and steam, which cannot be exceeded without incurring evils that greatly overbalance the par­tial gain. The best boilers that have ever existed have been those in which a large number of principles have been applied, and so adjusted in relation to each other as to gain the maximum, not of any one property, but of all the valuable properties, each in the degree of its individual importance. The first cost of the boiler must not be rendered too great, or that will neutralize the economy of using it : the space to which it is confined may be as small as possible ; but if that be produced by intricacy of construction, the loss may surpass the advantage. Then, again, if complex and confined, it may be impossible to cleanse or to repair the boiler ; and therefore it must be remembered, that, unless easy access can be gained to every part of a boiler, and of its flues, that boiler will soon become totally useless. Then it is further demanded