STEAM BOILERS.

There are not many articles that have been produced in such a variety of forms, and been the subject of so many patents, as steam boilers, each new form professing a vast superiority over its predecessor. The waggon boiler of Watt has nearly disappeared, since, although not a wasteful one, it is quite unsuited from its form for the production of high-pressure steam. The economy attending the use of high-pressure steam employed expansively is so generally acknowledged that the high-pressure boiler has become nearly universal.

THE TREVITHICK BOILER.

This boiler, named after Richard Trevithick, the celebrated Cornish engineer, consists of an outside cylindrical case or shell, within which is a ⊃-shaped fire tube, commencing at the front and continued at the back, turning round and returning to the front, where it is connected to the chimney. The tube is tapered along its length, being largest at the furnace end gradually diminishing till it delivers into the chimney. This is a boiler which does not require setting in brickwork, will work with economy, and last a great number of years. Although nearly the first high pressure boiler made, this form is at the present time extensively patronised, thus showing the possibility of a number of alterations without improvement, as well as the sound judgment of Trevithick.

THE PLAIN CYLINDER BOILER.

This boiler is generally made with spherical or dome-shaped ends if small, sometimes it is made with dished or nearly flat ends. It is the least costly of all forms, and also the strongest; it is the most convenient form to keep clean, but should never be made more than four or at the most four and a half diameters in length, as after that limit is passed, an injurious expansion takes place. The under surface over the fire will get hot before the steam is up, and the upper part being comparatively cool, a great strain is thus brought upon the side joints. For high-pressure steam, say 60lb. or 70lb., to the inch, they ought not to go over 5ft. 6in., or at most 6ft. in diameter, and be made of half inch plate, or at the very least 7-16 in. It is a mistake to set these boilers with flues round them, they ought to be set so that the whole bottom half is exposed to the direct action of the fire, and the damper regulated to a moderate draught. Side flues are not only troublesome to clean out, but are nearly useless, for in this position the sides of the boiler become covered with a coat of carbon, through which the comparatively low temperature of the flue heat will not pass. These boilers last a long time, and are remarkably handy for chemical or steaming purposes, where close attention cannot be given to them, as they will work for three or four hours without feed, and a large slow economical fire can be put under them. Weak liquors can also be boiled down in them, so long as they are not brought to saturation, and the steam may be applied to the driving of an engine or any other purpose. In this case of course some of the liquor must be blown off at intervals, as at sea, and the boiler replenished with fresh. As there is plenty of room in these boilers they may be worked very clean by the introduction of some light shallow iron pans, made by merely turning up some light sheet iron about 3in. at the ends and sides, make them narrow enough to go through the manhole, and long enough to cover the width of fire-bars or nearly so, and put on legs to keep them 4in. from each side of the boiler to allow the circulation of the water and the passage of the steam. When the boiler is at work the dirt is held in suspension in the water, but that portion over the pans being in a comparatively quiescent state, the dirt is at liberty to sink into them, instead of as usual covering the boiler with scale where it is likely to have an injurious effect. The pans should be set in a row, and extend to a foot or two beyond the bridge of furnace, I used them and found they did me service. The only drawback to this boiler is that it takes 8 or 9 per cent. more fuel than the internal fired boiler, but as the furnace can be made large, and slow combustion practised, I believe this loss could be nearly met.

THE CORNISH BOILER.

This boiler which has been used for a great number of years in Cornwall for the pumping engines, and also at nearly all our water-works, stands A 1., and is the boiler by which others are compared. Nothing has come up to it, taking all its qualities into consideration. It is simple in form, consisting of a cylindrical shell containing a fire-tube; the casing or shell is mounted with a steam chamber. A strain on these boilers when made too long, is caused by the internal flue becoming hot, and expanding before the shell, when getting up the steam. I have the water comparatively cold at the bottom of the boiler, with the steam at full pressure. There being but a small quantity of plate between the tube and shell at the lower part of the diameter, it has not a chance to adjust itself by springing, consequently in a boiler of great length the expansion starts the work at this point. I have seen new boilers start their work in this way, and leak ever after; boilers of this description should never be more than four diameters in length, and always be made with a vertical tube or two placed behind the bridge, as this would give a general circulation of water as soon as the fire was lit: also the tubes would break up or distribute the flame and act as a heat-absorbing surface. The Cornish boiler requires care in setting; if you have only doubt about the foundation, as to its being damp, have at least 14in of concrete under it, and avoid setting on a mid-feather. I mean a line of brickwork directly under the centre of casing, to divide the flues. Let the flue turn down at the back end, and under the centre of the boiler, dividing off in front into each side flue. By setting in this way the boilers will rest upon two side walls. You cannot be too careful with the bottom of these boilers, as any leakage or dampness would find the lowest point, and there getting doses of sulphur from the coals, would act upon the iron rapidly. Should the foundation be slightly damp a mid-feather acts like a sponge holding and collecting the water.

(To be continued.)

MODERN PROCESSES OF STEEL MANUFACTURE.

The statement that a Bessemer steel rail can be produced at a cost but slightly, if at all, exceeding that of an iron rail will seem extravagant to those who have been accustomed to think of steel as the product of laborious and expensive processes, and who have not become acquainted with the great development of methods for its cheap manufacture on a large scale. But a little consideration of the subject will suffice to show that the transformation of cast iron into steel need not be more expensive than the transformation of the same material into wrought-iron. In fact the lowest grades of Bessemer steel are little more than wrought-iron melted. The texture supposed to be peculiar to wrought-iron, and known as "fibrous" or "laminated," turns out to be merely the result of the mechanical treatment involved in puddling, hammering, and rolling. In neither of which processes does the decarbonized metal undergo fusion. Hence it retains minute portions of earthy matters which are hammered or rolled out with it, imparting to it a texture which does not belong to it as iron merely. The high temperatures of the Bessemer converter and the Siemens furnace having made it possible to melt wrought-iron on a large scale, its true nature and its relationship to the steels low in carbon is better understood.

The Bessemer process is in one sense a substitute for the puddling furnace. In the latter, cast-iron is deprived of its carbon by fusion upon a hearth lined with iron-ore (oxide of iron) which yields its oxygen to the carbon of the cast-iron, forming carbonic oxide and carbonic acid, which escape as gases. The iron, deprived of its carbon, becomes infusible at the temperature of the furnace, and thickens to a pasty condition in which is it skillfully balled together by the puddler, and removed from the furnace to the "squeezers," hammer, &c. In the Bessemer process, on the other hand, the carbon is removed from the cast-iron by blowing air through a molten mass of the latter. Here it is the oxygen of the air which unites with the carbon of the pig iron. Since steel is an alloy of iron and carbon containing more carbon than wrought-iron, but less than cast-iron, it is natural to suppose that by stopping the Bessemer blast at the proper instant, the desired grade of steel might be at once obtained. This can, indeed, under certain circumstances, be accomplished, but in the vast majority of instances (and universally in English and American works — in fact, everywhere, we believe, outside of Sweden) it is found most convenient first