A CHAPTER ON BOILERS.

From the time of James Watt, until quite recently, boilers have been looked upon as mere appendages to steam engines, necessary, indeed, but more as receptacles for storing up steam than as requiring any ingenuity in their design or mechanical knowledge in their construction ; and so long as the pressure was from that of the atmosphere up to 15 pounds great strength was not required, valves even being placed on the boilers to prevent collapse when the pressure fell below that of the atmosphere. When the use of steam had become an acknowledged success and promised to extend with great rapidity into all branches of industry, and in all parts of the world, the engine being composed of moving parts, attracted the notice of engineers toward itself, to complete exclusion of the boiler ; and it has up to the present time absorbed more than its fair share of attention.

The first steam boiler—made probably by the well-known Captain Savery—was of the "billycock" shape. This was a weak form, but sufficient for the required purpose. It was used by Watt at the commencement of his experiments, but after a time he gave preference to the "wagon" shaped boiler, which may yet be seen in some out of-the-way parts of the country. These he strengthened by stays ; but the form was essentially weak, and, in comparison with modern boilers, caused extravagance in fuel. The advantages of working steam at high pressure, and expansively, could not long remain hidden, and boilers were soon required which would withstand pressure up to 40 pounds to 50 pounds to the square inch ; even then the engine was looked upon as the motor, and the boiler as a steam reservoir made sufficiently strong, it not being generally considered that the latter had any effect upon economical steam generation. But of late years the conviction has gradually forced itself upon the minds of leading engineers, more particularly in this country, that there are boilers and boilers, that is boilers which scarcely deserve the name, and boilers which claim to rank as specimens of engineering, being made on scientific principles and calculated—

1. To be throughly safe in their working.
2. Economical in fuel.
3. Durable, requiring few repairs.

When the demand arose for stronger boilers, the first improvement was the externally-fired egg-ended boiler, which is a longitudinal cylinder, with rounded ends, containing no internal flue ; but the greatest step, both in durability and economy, was the introduction of the Cornish boiler by the celebrated Engineer, Trevithick, the novelties and advantages of which consisted—

a. In the internal flue, whereby the heat is utilized to a far greater extent than was before possible.

b. The flat ends, which were stayed by the tube.

c. And the removal of the hottest part of the fire from underneath the boiler, where the sediment naturally collects, and which is consequently a dangerous part to have near a hot fire.

The boiler was still further improved by the late Mr. Fairbain in his well-known Lancashire boiler, by adopting two flue-tubes in the place of the one heretofore used. This gave greater evaporative power to the boiler by increasing the grate area. The other improvements consisted in the consumption of smoke through the gases meeting at the termination of the flues ; in the greater space underneath between the tubes, giving room for thoroughly clensing the boiler ; and the economy for fuel.

But although these inventions were great strides toward the utmost economy in fuel, still it was found that the boiler was by no means perfect, being weak in the flue for high pressures, and allowing a great amount of heat to pass away.

To remedy the first defect Mr. Fairbain proposed rings of T iron to be placed round the furnaces at proper distances, as the flue is strong in inverse proportion to its length, and these rings have the effect of dividing the boiler into so many sections ; thus, if two rings are introduced, the boiler is three times as strong as before, and so on. These rings have, however, been ascertained as liable to crack, even although attached with the greatest care, on account of two thicknesses of metal coming in contact with the fire, and not giving room for the necessary expansion and contraction which are requisite in all boilers.

Flanged seams and ridge-hoops are now universally adopted in first-class establishments, which answer admirably, although care must be exercised in their manufacture. To remedy the second defect tubes were early introduced, mostly parallel ; but of late years the cone tubes made by Messrs. Galloway and others have been well received, as it is evident they receive the best heat from the fire, and, if placed by competent men, do not check the draught. Other means have been tried with the same view, such as placing pockets in the flues, but none receive such flavor as the tubes. The desire to introduce as many of these tubes as possible, without crowding them so as to check the draught, or make the boiler difficult to clean, probably led to the idea of joining the two furnaces behind the fires into one flue, and placing the tubes vertically in this flue. This plan has been tried with several minor differences in form, but the well known "Galloway" boiler, which, we believe, has been recently improved, may be taken as the type. There are boilers also made with two furnaces, then a short combination chamber behind, after which a row of loco tubes about four feet long is placed, through which the flame passes. These boilers give a great amount of steam in a small compass, and require but little setting ; still the loco tubes are apt to spring and leak, and should be avoided whenever possible.

Yet another modification of the same plan is working in the north, and, we believe satisfactory. It consists of a combustion chamber as above, with some of the cone tubes and some of the loco tubes, but all vertical, the heat passing between the tubes. It is quite evident, however, that muddy or limy water would have a great effect upon the loco tubes, which are only three to four inches diameter, and frequent cleaning and examination are required.

We have gone this much into particulars of the Lancashire boiler and its offshoots, feeling convinced that it is the best boiler that can be put down, considering all conditions ; although a complicated boiler, such as those with loco tubes, gives steam economically and plentifully, still where space can be obtained these advantages are completely nullified by the difficulties of cleaning, the inconvenience of leaking, and the frequent repairs, entailing stoppage of work.

Of late years the desire of the principal boiler-makers has been, not so much to introduce new descriptions of boilers, or to design improvements upon the old forms, so as to secure accuracy and solidity of workmanship, which will defy for a long period the continual strain unavoidable while the boiler is working. With this object machinery is made use of whenever possible, as, if properly attended to, errors and imperfections are almost impossible, strength of work is secured, and, as a consequence, great durability. Riveting is done by machinery wherever practicable, for a planed section of the riveted joint shows that machine work closes up the holes perfectly by the pressure used, while hand-work frequently leaves small spaces, the blows from the hand-hammer being insufficient to press the rivet so as to completely fill the hole. Manufacturers in purchasing boilers should take note of this, and should also see that the pressure is not a blow, but a steady push, as the former may burst the plate, or cause the rivet-head to be so insecure as to come off with the slightest disturbance. Few first-class boiler-makers now chalk the plates with a narrow-edged tool ; they plant the edges of the plates to a slight bevel, and close them up with a broad tool. This insures the edge of the plate being perfectly straight ; the rivet-holes are consequently equi-distant from the edge, any imperfections existing there are detected, and a neat appearance is obtained. This neat appearance some persons consider unnecessary ; but workmen who have a neat and well-made article will, as a natural consequence, take more pride in preserving it intact and in better order. The flues, which were formerly riveted up, are now universally welded, which, when done well, is a great improvement ; it insures the perfect circular form of the tube, and when the plates are flanged (which should be also done by machinery), no rivets can exist in the furnaces, consequently the joints remain tight. Those who have inspected riveted flues of boilers will testify that, with a very slight tap with a hammer, rivet-heads will drop off, showing that the least increase of pressure would cause a dangerous explosion.

The engineer of the Boiler Insurance and Steam Power Company (limited), Manchester, has recently made extensive experiments, which are about being published, the result of which shows that in the longitudinal seams of boiler-shells the double riveting should be so arranged that the rivet in each row comes opposite the rivet in the other end, not opposite the space between the rivets, as was formerly considered strongest. When these experiments are published we shall doubtless be able to see the reasons for changing the system, and the extra amount of strength which is gained thereby. Steel boilers have frequently been made, but such difficulty was experienced in getting plates of an uniform quality that it fell into disrepute. No fears need now be entertained on this head, as the recent great improvements in steel manufacture enable makers to roll plates of any required length, tenacity and ductility ; they can