ON AN IMPROVED LOCOMOTIVE BOILER.

The locomotive boiler, from the very high pressure at which steam is now used, has demanded much attention, in order to obtain a form of great strength and safety. The parallel boiler has of late years been adopted, as giving greater strength in its form and greater durability than the raised firebox form, which latter, although made sufficient by stays, is exposed to constantly varying expansions and strains, leading to leakage at the angles. The parallel form however has the objection, more particularly in large engines where much heating surface is necessary, that the steam space is contracted or limited, besides being much occupied by stays as well as by the steam pipe and regulator. The water level is necessarily high in the boiler, leaving only a small segment of the circular area for the regulation of the proper water line; so that the engine driver has very little variation to work upon between too much water and too little, the former causing the engine to prime, and the latter involving danger of burning the firebox or bursting the boiler.

The boiler described in the present paper, and shown in Figs. 1, 2 and 3, Plate 86, is designed by the writer to obviate this defect; and for this purpose there is added on the top of the boiler a steam chamber A, consisting of a portion of a cylinder of smaller diameter than the barrel of the boiler B, the two cylinders being connected at their junction by a strong diaphragm plate C, forming as it were a common chord to the two circles given by the section of the cylinders, as seen in Fig. 2. By this construction a correct form is obtained, the strength of which is equal to the full resistance of the plates to the internal pressure of steam. It will be observed that no angle iron is used in this construction of boiler, and that the strain is entirely in the direction of the plates.

In order farther to provide against the danger of explosion from overheating the roof of the firebox, in consequence of the water getting too low, which the writer believes is the cause of most explosions, the firebox roof D is depressed in a circular shape, Fig. 1, whereby a more correct form of roof girder or crown stay is obtained, and one which is really the strongest that can be got to support the weight or pressure upon the roof. The ordinary parallel girder is not correct in form, the greatest strain for rupture being across the centre of the firebox roof, where the parallel girder has the least power of resistance. In the new plan of firebox, the circular shape of the roof also gives the plates greater power of resistance, independently of the roof girders. As an additional precaution, the top row of tubes is somewhat raised at the smokebox end. The result of this arrangement is that a considerably greater range of water level is obtained with perfect safety; for in case the water line gets as low as the top of the firebox, the crown will be perfectly safe, and the top row of tubes, at the smokebox end, will first give way; and should the water get lower, the part of the crown first exposed to be heated is the strongest portion, and will stand safely till the tubes burn and give warning of the danger. It may be objected to the depressed firebox crown that it will be more apt to collect deposit than the flat crown; but the writer does not think there need be much apprehension on this point, as there is a free and level communication across the top of the firebox from side to side. It should be remarked however that the locomotive engine is never worked to economy with bad water; and money expended in obtaining proper water is more than compensated for in the saving on the engines and in the safety of the boilers.

Another improvement in the boiler now described consists in an arrangement for using coal instead of coke. In the ordinary firebox the production of gaseous matters from the coal is too rapid to obtain a proper combustion; and even if oxygen is supplied by the admission of air into the firebox, the very great variation of temperature in the furnace, caused by every fresh supply of fuel, renders the complete combustion of the gaseous products very difficult. To get over this difficulty, the back part of the firebox under the door is lined with large fire brick blocks E, having tubular openings through them forming a communication between the interior and exterior of the firebox; in the same manner a bridge F is formed in front of the fire with a similar series of tubular openings through it. The fire brick blocks will become highly heated by the action of the fire, and consequently the air drawn through them will also be highly heated, ready for effecting the combustion of the gases, the moment the air enters the furnace in the form of jets. They also maintain a more equal degree of heat in the furnace at each new supply of fuel, which is of great importance. It is not thought that any difficulty need be anticipated in the fixing and maintaining of the fire brick blocks.

The above construction of boiler is expected to afford a more steady supply of steam, and also to give the engine driver better opportunity of working the fire with economy of fuel.

Professor RANKINE said in the unavoidable absence of Mr. Neilson he had been requested to give any requisite explanations respecting the paper. He observed that the principal object had been to prevent the failure of the roof of the firebox, as the result of such an accident was very serious and generally fatal, whilst the failure of the other portion of the boiler, the tubes, seldom caused more than delay. He had been struck with the importance of the subject by seeing recently the result of the failure of a firebox with a level top, where all the roof girders broke across the top, two only of the girders having been notched at that part. An exactly similar firebox was tested with water pressure, and it was found that 470 lbs. pressure per square inch was required to make the roof give way in a similar manner, being nearly five times the working pressure; that pressure however must have been attained in the case of the accident referred to. The object of the plan now proposed was both to strengthen the roof by giving it a curved form and increasing the depth of the girders, and to protect it by preventing it from being laid bare of water in the centre, leaving the tubes to be first exposed when the water got low. He now suggested the slightly curving the roof in a convex form transversely, to give the deposit a tendency to clear itself at the sides.

Mr. FENTON observed that it was very unusual for a failure of the roof girders to occur; when the roof of a firebox had given way, it had generally come down in one piece, with the roof girders entire. The case that had been referred to was the only instance he believed on record of a roof failing across, and in that case there were also no stays from the roof up to the outer shell. A supplementary steam chamber as proposed in the paper might perhaps have some advantage, and he remembered several being so constructed under his superintendence for the Hanoverian Railway.

Mr. TOSH had found great difficulty in preventing an injurious accumulation of sediment on flat roofed fireboxes, even with 1½ inch water spaces between the copper roof and the roof bars; any hollow form of roof must increase the evil, and he thought that such a roof would be found very troublesome in practice.

A vote of thanks was proposed and passed to Mr. Neilson for his paper.

The following Paper, by Mr. James Wallace, Jun., of Glasgow, was then read :—

LOCOMOTIVE BOILER

Plate 86.

Fig. 1. *Longitudinal Section.*

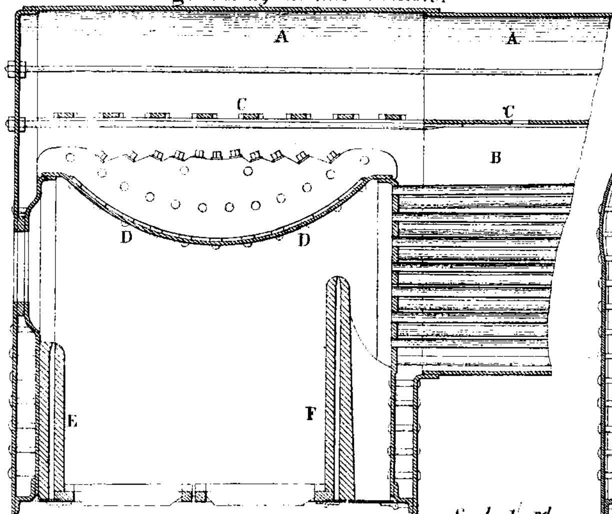


Fig. 2. *Transverse Section.*

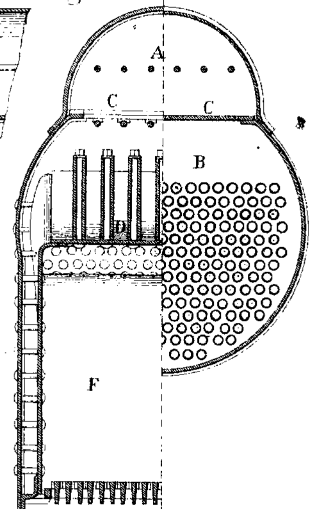
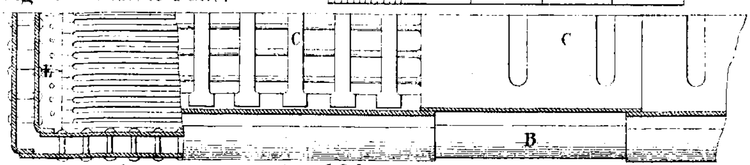


Fig. 3. *Sectional Plan.*

Scale 1/32nd

Ins. 12 6 0 1 2 3 4 Feet.



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