70,000 tons of ballast over several miles of the "permanent way" already completed, has not rendered the slightest repair necessary, although the weather has been very unfavourable.

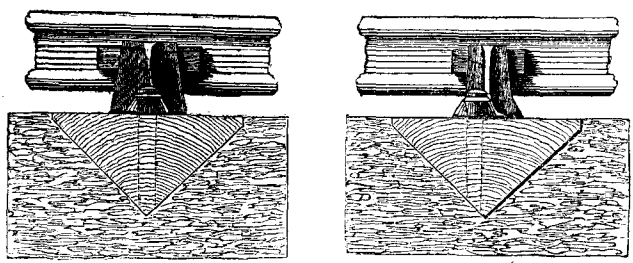
The paper is accompanied by a Drawing showing the construction of the permanent way, and it was illustrated by the exhibition of a pair of sleepers with two pieces of the rails placed in the chairs, which were fixed down with the compressed trenails, complete as on the railway; all the tools employed in laying the permanent line; and specimens of teak, oak, mahogany, hornbeam, walnut, and other timber, compressed and cut so as to show the subsequent form of the sap vessels.

Mr.C.May. In answer to questions as to the compressed fastenings, Mr. May explained that the peculiarity of the system consisted in the fibre of the timber being compressed equally from the circumference to the centre. The pieces of wood for the wedges were cut out with parallel sides and forced by hydraulic presses into tapering moulds; whilst in those moulds they were subjected to the action of heat applied through the medium of low pressure steam, and after being allowed to cool, they were forced out of the moulds, and so long as they were kept dry would retain their form; but as the operation simply contracted the dimensions of the sap vessels without crushing the fibre, the power of capillary attraction was not destroyed, and when driven into the chair and exposed to moisture they swelled so as to remain perfectly tight. There was this difference between wedges so compressed and all others; that a true wedge was formed from a piece of wood cut parallel on all sides, whilst all former modes that he was acquainted with produced, not wedges but parallel pieces.

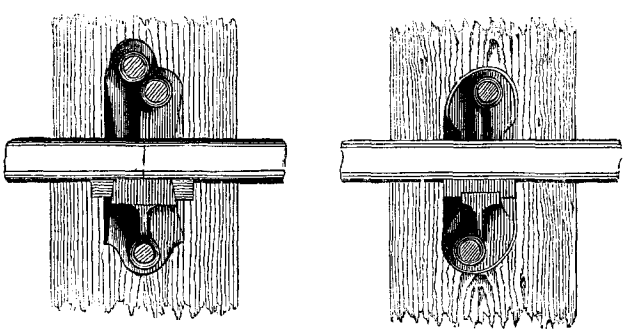
The diminution of the bulk of the trenails, by the process, is from 100 to 63, and of the wedges from 100 to 80. It is found that the wood does not swell until it is placed in a damp situation, as in the sleepers. Even the most solid woods, such as African teak, can be compressed without sustaining injury. Perfectly seasoned timber will not shrink after compression, but green wood will shrink after the process. One of the principal advantages of the compressed trenails is the firmness with which they hold into the sleeper. Around the iron spikes generally used, a sheath of rust is formed by the damp sleeper; the shaking of the carriages tends to draw them upwards, and the elasticity of the fibre around the hole in the sleeper being impaired, it is of no use to drive them down again in the same place, and the chairs eventually become loose.

The mode of casting the chairs was described to be by placing an iron plate on each side of the pattern, ramming them up in sand, and using an iron core, which being sustained in its position by a projecting tongue falling into a groove in the side plates preserves an uniform inclination of the rail in the chairs. Extraordinary precision is thus obtained, and only about 2 per cent. of waste-castings are made, although they are subjected to a rigid test, for if the bearing points allow the rail to vary $\frac{1}{16}$th of an inch from the required inclination, they are broken up. The iron cores do not unduly chill the metal, and the average strength is retained. The iron used is chiefly "Welsh Cold Blast."

JOINT CHAIR. INTERMEDIATE CHAIR.

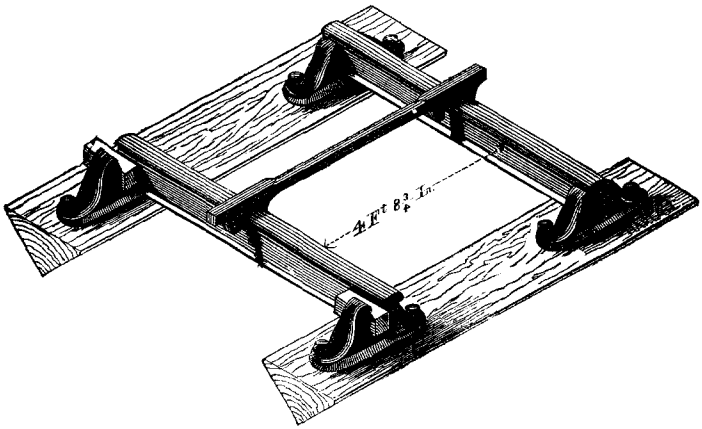


End view. End view.

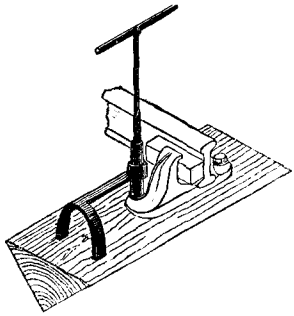


Plan. Plan.

Mr. Cubitt's object has been to lay a railway entirely upon transverse sleepers, of such a form as would expose the largest amount of bearing surface for the least portion of timber; that the bulk of the ballast should be beneath the bottom of the sleeper, where alone it is useful; to use only the best foreign timber; to have the rails rolled uniformly and sufficiently heavy; the chairs simple in form, possessing Mr. Cubitt, V. P.



Rails, Chairs, and Sleepers, with the 'cramp gauge' fixed.



Guide Tube and Auger.

great regularity, and giving the inward inclination to the rail within the chairs, instead of depending upon the rail-layer doing it in fixing them; and that the fastenings should be simple, but firm, and not liable to breakage, or to be detached by the passage of the carriages.

With these views he had directed four sleepers to be cut diagonally out of each square log of foreign timber, giving about $2\frac{1}{2}$ cubic feet to each sleeper; to place them with the right angle downwards, so that the ballast could always be consolidated by ramming, without lifting the sleeper, or digging around it, as with square, or other formed sleepers; two places are planed to receive the chairs, and one fastening hole bored in each sleeper; they are then kyanized in close tanks, completely filled with the prepared solution, under a pressure of 80 lbs. per square inch. When placed upon the ballast, the joint

chairs are first put down 15 feet apart, and the intermediate chairs loosely placed 3 feet apart; "cramp gauges," embracing the inside and outside of the rails, are then fixed between each pair of sleepers, and the wedges along one side driven up—one trenail being driven in each chair, the hole for which is previously bored in the sleeper by a gauge, to insure an equal projection on each side of the rail. A "guide tube" of an internal diameter to fit the spiral auger for boring the trenail holes, with the external lip tapered to correspond with the hole in the chair for the head of the trenail, is then used, and by its agency the holes are pierced with great accuracy, concentric with the hole in the chair, at the same time protecting the tool from being injured by the cast-iron. The intermediate chairs are then fixed in the same manner, and the operations are repeated for the opposite rails; the ballast is then consolidated by ramming. It is found that the work proceeds very rapidly; the ballast supports the sleepers throughout, and has no tendency to fall away from them; the water drains away freely, and hitherto the passage of the ballast waggons over that portion of the line which is laid (although they are without springs), has been productive of benefit rather than injury.

The inclination of the rail being given in the chair had insured such accuracy, that after one day's traffic over it, the surface of the rails is rubbed equally throughout, and not alternately on either side, as is so commonly the case.

Mr. Cubitt did not claim the invention of the angular-formed sleeper, as Mr. Reynolds had used it before for his longitudinal bearing rails, but he believed that transverse sleepers of that form had not been previously laid down; nor did he claim the compressed wedges and trenails, or the peculiar mode of casting the chairs, the merit of these was entirely due to Messrs. Ransome and May, who had entered completely into his views and wishes, and executed them with extreme intelligence.

In answer to questions from the President, Mr. May replied that it had been an object to gain in the trenails and wedges the greatest amount of strength with diminished bulk, and also to cut away as little of the sleeper as possible in boring the holes; he had, therefore, introduced this method of compressing them, with a view also, that in swelling from the damp they should fix themselves tight into the soft timber sleeper, and hold the chair fast down. Mr. May.

He hoped to extend the use of compressed trenails to ship-building, for which they were eminently adapted; if they were used, smaller holes would be bored in the timbers, and they would hold tighter

than the trenails now used, which require to have the points split and wedged up, and the heads also divided and caulked to prevent leakage through the open sap vessels of the wood.

The President. The President remarked that on the Hull and Selby Railway, the chairs were fastened to the kyanized timber sleepers by uncompressed wooden trenails.

Mr. Cubitt, V. P. Mr. Cubitt was not aware of that fact; he had always found that uncompressed wedges and trenails would not hold tight. Some of the compressed trenails had been wetted by accident, and could not be afterwards driven into the holes in the chairs; they nearly resumed their original size, and then showed the marks of the turning tool upon their surfaces. In answer to a question from Mr. Parkes as to the comparative expense of laying the line, it was rather in favour of the system he had adopted, although the prices paid for the items separately, were higher than usual, but the saving in labour, and the almost total absence of waste of materials gave the economy. He then quoted a few of the prices paid; sleepers 6*s*. 6*d*. each (ready to lay down, including kyanizing); chairs £9 per ton, free from faults in casting, the contractors for them replacing all that were broken in laying the line. Each joint chair, with three trenails and one wedge, 2*s*. 10*d*. Intermediate chairs, with two trenails and one wedge, 2*s*. 1*d*. each. The labour for laying the line was from 2*s*. to 3*s*. per yard running; the cost of fixing the sleepers, laying the rails, and ballasting complete, was from £1,500 to £2,000 per mile, including all expenses.

Mr. Macneill. Mr. Macneill fully concurred in the importance of providing for clear drainage from the sleepers; and in the advantage presented by the angular form for ramming the ballast. The transverse sleepers, with such rails as had been used on the South-Eastern Railway, were preferable to a continuous bearing, as they would prevent the gauge from widening, and preserve an uniform regularity of surface, which would tend materially to diminish the oscillating motion so common on railways, and which was so destructive to the engine and the carriages; altogether this railway appeared to be the most perfect he had hitherto seen.

He was using on the Dublin and Drogheda Railway; chairs of somewhat similar construction, with uncompressed wooden wedges and fastenings; they were very roughly cast in Scotland, with hot-blast iron, and the breakage was very great; they, however, cost less than £5 per ton. He believed that chairs such as were cast by Ransome and May, would be cheaper at £9 per ton. The uncompressed

trenails were found in many instances to become loose. In ballasting the railway, as stone was cheap, the whole surface of the line was pitched transversely with thin stones, and then a good bed of broken stone used for ballast, in the same manner as Mr. Telford had proceeded with the Holyhead Road.

Mr. William Cubitt had compressed a considerable quantity of wood wedges, by forcing them singly, by a blow of a piston, through a taper steel mould; on leaving the mould they had attained their ultimate state of compression, and they were some time before they reassumed their original bulk, but he conceived that Mr. May's plan, by which they were dried in a compressed state, enabled them to retain their form longer. He considered the systems of preparation, and of laying the road, to be the most perfect hitherto executed. Mr. Wm. Cubitt.

Some years since, Mr. Horne had made a series of experiments on the form of timber beams, which presented the greatest amount of strength with the least quantity of timber; he found that a triangular beam placed with the base upwards was one-third stronger than any other form. Mr. Horne.

Mr. Colthurst inquired whether the trenails and wedges had been found to have lost strength by compressing. He imagined that they would not bear a transverse strain so well as before compression. Mr. Colthurst.

Mr. May replied that no experiments had been tried as to the relative transverse strength of timber before and after compression. Mr. May.

Mr. S. Seaward thought it was probable the timber did suffer somewhat from compression, but that did not militate against the system, as there must necessarily be an original excess of strength in the trenails, so that no inconvenience could result from the process. Mr. Seaward.

The President observed that although uncompressed trenails do draw out of the stone blocks, they hold fast in wood sleepers. The round trenails used to fasten the chairs to the sleepers on the Hull and Selby Railway, were of a proper size to fit the hole in the chair, and at the end a square head was left, which held the chair down. The President.

Mr. Cubitt had frequently seen trenails or plugs driven into stone blocks to receive the iron spikes which fastened down the chairs; he believed they had also been used for driving through the chairs into the blocks, but he was not aware that they had been used in wood sleepers, until he employed them on the South-Eastern Railway. Mr. Cubitt.

In answer to a question from the President, Mr. Lynde explained, that upon the Hull and Selby Railway, trenails were certainly used in conjunction with wooden sleepers, a portion of them were uncompressed, but the greater part were compressed like the wedges; the latter were supplied by Mr. William Cubitt. Mr. Lynde.

Mr. William Cubitt only supplied the wedges, they were com- Mr. Wm. Cubitt.

pressed as he had previously explained; he believed that the trenails and wedges generally used upon the London and Birmingham, and other railways, were compressed by being driven through steel rings, by heavy mallets, or by a press; they were most frequently used in the stone blocks to receive the iron spikes.

March 8, 1842.

The PRESIDENT in the Chair.

"Description of the Tanks for Kyanizing the Timber for the permanent way of the Hull and Selby Railway." By John Timperley.

Kyanizing Timber.

Upon the recommendation of Messrs. Walker and Burges, the Engineers, it was determined that the sleepers of this railway should be kyanized in close vessels, using exhaustion and pressure, instead of in the open tanks usually employed. The present communication, which includes a description of the kyanizing vessels, and an account of the various circumstances connected with the operation, commences by describing the apparatus, as shown by the accompanying drawing, to consist of two tanks, a reservoir, two force pumps, and a double air pump. The tanks are cylindrical, with flat ends, and are made of wrought-iron plates, nearly half an inch in thickness; they are 70 feet in length, and 6 feet in diameter: at each extremity is a cast-iron door, flat on the outside, and concave on the inner side, provided with balance weights for raising and lowering it. Each end is strengthened by five parallel cast-iron girders, whose extremities are held by wrought-iron straps rivetted on to the circumference of the tanks. Notwithstanding the great strength of these girders, several were broken by the pressure applied during the process. The vessels are lined with felt, upon which is laid a covering of close jointed fir battens, fastened with copper rivets; this precaution is necessary to prevent the mutual deterioration which would arise from the contact of the iron and corrosive sublimate. There was originally only one brass force pump, 2 inches diameter, and 6 inches stroke; this being found insufficient, another was added of 4 inches diameter, and henceforward a pressure of 100 lbs. per square inch was easily obtained. The air pump is 10 inches diameter, and 15 inches stroke. Its construction is of the ordinary kind. The author gives in an appendix to the paper a minute description of the various parts of the apparatus, with the details of their dimensions and weight. The process is simple and rapid; the corrosive sublimate is first mixed with warm water in a trough, in the proportion of 1 lb. of the former to 2 gallons of the latter, the clear solution is then poured off into the