On the Construction of Packing Rings for Pistons

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ON THE CONSTRUCTION OF PACKING RINGS FOR PISTONS.

The writer of the present paper—having invented a few years ago a metallic piston, which was described at a former meeting, (see Proceedings Inst. M. E., 1854, page 70), the packing of which is forced against the working surface of the cylinder by its own elasticity, and owing to its being comparatively slender in cross section, had to be left about 10 per cent. larger in diameter than the block of the piston, in order to give the requisite pressure for preventing the passage of steam—found, that when such packing was made of a circular figure before being compressed, it was invariably worn more rapidly at the joint, and at the part opposite, as at A, B, and C, Fig. 1, Plate 40, than at the intermediate parts D and E. It is very natural that this should be the case, and it has been the practice with many engineers, when using packing rings which are pressed against the cylinder by their own elasticity alone, to make the part C, Fig. 2, opposite the joint, where there is clearly the most strain, stronger than any other, each half being tapered off to the joint; although the writer is not aware that this has been done by any positive rule.

It was taken for granted that the unequal wear above referred to was owing to the pressure against the cylinder being unequal in different parts of the ring, and as the packing rings used by the writer are made of wire or drawn rods, and consequently uniform in thickness, it was found impracticable to ensure this equable pressure by tapering the ring, as in Fig. 2; but as this uniform pressure can be obtained by making the packing ring truly *circular in figure*, but *unequal in thickness*, it occurred to the writer, inasmuch as the rings which he employs are bent and not turned, that the same end might be gained, by conversely making the ring *equal in strength* of material but *unequal in figure*, or in other words that a ring might be made of such a shape, that although uniform in cross section, it would press equally against the working surface of the cylinder all round.

It may be possible to determine geometrically the form of ring required, but the writer preferred to solve the question in a practical manner by the following method :—A ring was first bent truly circular in shape, and of a diameter exactly equal to that of the piston for which it was in-

tended, the ends just touching at the joint, but without pressure; this ring was then placed upon a circular table, Fig. 3, and a number of strings, say 24 in all, were attached at equal distances apart round the circumference, and passed over the same number of small pulleys which were fixed at equal distances round the edge of the table; to these strings were attached equal weights FF, which acting upon equal portions of the circumference of the circular ring, brought it into the shape shown in Fig. 3, GG. The writer then conceived that if a true circle were brought into this shape, when subjected to equal radial forces acting upon equal portions of its circumference, another ring bent to the figure so obtained would conversely be brought to a truly circular shape by the application of equal forces acting in the opposite direction, that is, towards the centre instead of from it; and practice has proved that such a conclusion was correct, for a ring so bent is found to wear equally throughout, and to last much longer than those originally made circular in figure.

In trying these experiments, an important fact has been incidentally discovered, namely, that the force required to keep the packing in contact with the working surface of the cylinder, even at pressures exceeding 100 lbs. per square inch, is much less than is generally supposed. It has been argued that the pressure per square inch on the rubbing surface must be at least equal to the steam pressure which has to be resisted; but so far from this being the case, experiment has led the writer to the conclusion, that as respects the pistons of locomotive engines, this need not exceed $3\frac{1}{2}$ lbs. per square inch of rubbing surface, even when the rings are new and exerting their maximum force; and as these packing rings are practically steam tight until half worn, it follows that the average pressure upon the working surface of the cylinder does not amount to 3 lbs. per square inch. This slight pressure, taken in connection with the small amount of rubbing surface, is sufficient to account for the satisfactory performance of this description of packing.

Mr. JACKSON showed the apparatus in operation for ascertaining the correct curve for the piston rings, and exhibited two sets of the rings that had been curved on the improved plan, and had worked

in two pairs of pistons for 12,694 and 10,012 miles respectively, showing a very uniform wear of the rings throughout their length.

Mr. Joy observed that he had found a long and light elasticity was the right plan for the packing of a piston; and the results of his experience confirmed the statement in the paper, as to a very light pressure of the packing rings, not exceeding 3 or 4 lbs. per square inch upon the cylinder surface, being quite sufficient to keep them steam tight if free in their action, and the consequence was a very considerable saving in the friction of the pistons over the ordinary kinds of metallic packing.

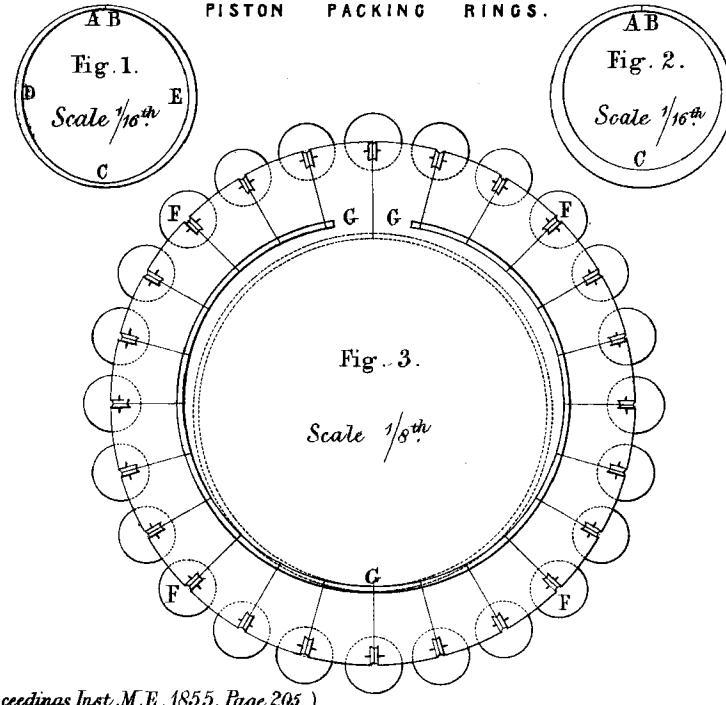
The CHAIRMAN said his object in the paper had been merely to show the practical way in which a practical difficulty had been surmounted. The result of the improved form of packing rings had been very satisfactory; and about double the mileage was now obtained from the same thickness of rings, compared to the former results, owing to their wear being nearly uniform throughout their whole length.

The CHAIRMAN then moved a special vote of thanks, which was passed, to the Council of the Royal Institution, for their kindness and courtesy in granting the use of the Lecture Theatre for the purpose of the Meeting.

A vote of thanks to the Chairman was passed, and the meeting then terminated.

After the meeting some working models were exhibited, by Mr. David Chadwick, of Manchester, of two water meters, and of a rotary steam engine, working on a similar principle, having a flexible cylinder, with transverse rollers fixed round the periphery of a wheel.

PISTON PACKING RINGS.



(Proceedings Inst. M.E. 1855. Page 205.)