

Mr. C. MANBY, Secretary, said, that Mr. R. Roberts, who had been one of the earliest introducers of self-acting tools for metal-working, including planing, slotting, and paring machines, had forwarded some specimens of what he termed spiral planing. Within the last few years he had also made improvements in punching and riveting machines, by which, it was said, they were considerably simplified, and rendered capable of doing 50 per cent. more work, and of better quality. His 'Jacquard,' or multifarious perforating-machine, was first employed at the Conway tubular bridge, where the greater portion of the plates were 12 feet in length, 2 feet 8 inches in width, and $\frac{3}{4}$ of an inch in thickness. The holes were $1\frac{1}{16}$ of an inch in diameter, and four were punched at one time. On the average a plate could be punched, and another be placed in the machine, ready to recommence operations, in about four minutes. It was now used at the Canada Works, Birkenhead, for punching the boiler-plates to be used in the construction of the Victoria Bridge, over the River St. Lawrence, Canada. The machine punched seventy-two holes in each plate of 10 feet in length, 3 feet 6 inches in width, and $\frac{5}{16}$ ths of an inch in thickness. It could punch ninety of these plates per day of ten hours and a-half, under the management of one mechanic, three labourers to lift the plates on and off, and one boy to oil the punches. The same-sized plate, when punched by hand, would require four men marking with templates, and eight men at the machine itself—and yet it would not do anything like the same quantity of work as the Jacquard machine, especially when a large number of holes had to be made. The dies and punches in the Jacquard machine, when fairly at work, were also less costly. This machine would punch holes 1 inch in diameter, in plates 1 inch in thickness. The speed at which it worked was not affected by the number of holes across the plate, but was regulated by the number in the length. At present, when in full work, it could punch about 100 tons per week, of such plates as those to be employed for the bridge over the river St. Lawrence.

Mr. BATHO exhibited and explained two models, intended to illustrate the working of Messrs. Batho and Bauer's reciprocating drilling-machine and small planing-machine, in which the irregularity of the crank motion was prevented. The method adopted for the planing and shaping machine gave a nearly uniform motion when the tool was cutting, but it was somewhat slower at the beginning and at the end of the stroke; at the same time the speed of the return motion was nearly double its ordinary rate. The connecting-rod was attached to the nut on the screw under the table of the planing-machine (Plate 5, Fig. 14), so that an object having two, or more, surfaces, say 1 inch wide and 12 inches apart, might be planed, by simply turning the screw,

without its being necessary to traverse the whole distance between them. Instead of re-adjusting the object to be operated upon, the table on which it was clamped was moved. This machine was intended to be applied only to light objects. The reciprocating drilling-machine (Plate 5, Figs. 11 and 12) for cutting slots in connecting-rods, &c., of which samples were exhibited, had elliptical and eccentric wheels so as to insure a nearly uniform motion both ways. Elliptical wheels were not considered advisable for high speeds. This machine could be applied for drilling and boring large diameters. It was less expensive, and the working parts were more easy of access, for adjustment, oiling, &c., than that now in use. It would also cut cotter-holes, with any amount of taper, as well as parallel slots.

Mr. WHITWORTH remarked, that the arrangement described for the planing-machine enabled five of the improved machines to do the work of six ordinary ones. That saving was effected by the accelerated return motion. There was also the advantage of the regular motion forward. The subject was so interesting, that he hoped a Paper would be given on the history of the introduction of these self-acting tools, which had produced such a revolution in the manufacture of machinery.

Mr. R. STEPHENSON, M.P., said, the Paper was full of valuable details, yet it scarcely afforded any field for discussion. With reference to the key-grooving machine, he could testify to its great value, and to the precision with which the operations were performed. One of Messrs. Sharp, Stewart, and Co.'s reciprocating, drilling, or slotting-machines, for cutting key-holes and the ends of connecting-rods had been very successfully used for some time in the manufactory of Messrs. R. Stephenson and Co. As the operation of that machine had been already described, he would merely add, that originally the key-holes were cut perpendicular, and the angle had to be given to them afterwards by hand. But at his factory they had introduced an improvement, by the addition of a rocking face-plate, upon the original face-plate of the machine, by means of which the machine could cut taper key-holes, in piston and other rods, and now all the key-holes in the factory, whether large, or small, were cut to one given angle, being that which was best adapted for drawing and holding. It should be noticed, that the first introduction of self-acting tools, by which work could now be executed with a precision that hand-labour failed to accomplish, was due to Maudslay, Clement, and Bramah. Then came Fox (of Derby), Whitworth, and Roberts, and recently a great number of very ingenious inventions had been brought forward, by the numerous makers whose names were now so well known.

Mr. HUMPHRYS said, that although steam riveting-machines were very valuable, great care should be exercised in their use, as

if undue pressure were employed, the rivets were too much compressed. He had seen plates split throughout their length, along an entire row of rivet-holes, under the process of riveting; so that it might happen, that instead of making a safer boiler, in some instances the boiler might be in a condition to burst almost before it was used.

Mr. HENRY MAUDSLAY said, that Messrs. Fairbairn's riveting-machine, being driven by a strap, from a shaft making a certain number of revolutions, was obliged to be worked at a certain number of strokes per minute. It was, therefore, necessary, that the rivet should be ready on the work when the blow came, or otherwise the work was spoilt, and that part had to be cut out. It required careful adjustment of the bits which formed the rivet-head, and then it was an efficient and valuable adjunct in boiler-making. If the dies were too long, they would press the rivets into the plate too much, when there was a liability to split the plate. In all steam riveting-machinery, such as Garforth's, which worked as a simple steam-engine, having a cylinder with a piston and rod, the slide being worked by hand, the number of strokes given was in exact proportion to the work; as soon as the work was ready, the stroke was made, and but little work was spoilt. The slide-valve need not be opened until the work was prepared to receive the blow, and then one, or more blows were given on the rivet-head, according to circumstances. When the rivet-head was formed, the pressure of the steam could be maintained until the rivet was contracted by cooling. He was surprised that the Author considered Garforth's steam riveting-machine (Plate 5, Fig. 4) cumbrous and unwieldy. It had received a Jury Medal at the Great Exhibition of 1851, in consequence of its being a most efficient machine; and there were two of them in daily operation in the factory of Messrs. Maudslay, Sons, and Field, working very satisfactorily. He had not noticed in the Paper, any remarks with reference to punching and shearing plates, with mathematical accuracy. Nearly forty years ago, his grandfather had invented and worked some ingenious machinery for punching boiler-plates, for making iron water-tanks for the navy. The punching-machine consisted of an upright frame carrying two levers, so arranged that they could be thrown in, or out of gear, when the machine became self-acting. The punch was attached to these levers, and worked up and down through the plate, into a hollow die, placed in the frame. The table carrying the plate had a rack underneath, and could only move the distance required, which was equal to the distance between the punches, so that all the holes, whether made by a single punch, or by two, or three for chimneys, or coal-boxes, where the plates were thinner, came, in each case, to the required distance, and with great accuracy.

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The shearing-machine had a pair of shears fixed in the same way, in lieu of the punches; the table being the same, but without the rack. When that contract for water-tanks was undertaken, the application of mechanical appliances to such purposes was in its infancy; yet, up to the present time, that machinery was almost unrivalled, for the precision of its action, and the quantity of work it performed. By it holes could be punched with such regularity, that plates required for the repair of a boiler, or other work, in any part of the world, even though it had been made many years previously, could be prepared in England, without any risk of failure, and a perfect fit with the old work was insured. He might add that these machines had been extensively employed by the Governments of England, France, and Russia.

Mr. ALLEN RANSOME said, that in the construction of the large astronomical instruments for the Royal Observatory, the greatest accuracy was requisite, especially as regarded the axes, which were required to be not more than one thirty-thousandth part of an inch out of truth. It was not possible to obtain this amount of precision by the use of horizontal lathes; but after an approximation was obtained by these lathes, the axes were placed in a vertical position, and a succession of very light cuts was taken, by a steel tool revolving round the axes. By this means a remote approximation was all that could be obtained, and the only mode by which the accuracy required was ultimately attained, was by finishing them, by rubbing by hand, with fine emery on copper; after the manner introduced by Mr. Whitworth, for obtaining true faces on surface-plates, wherever the indications of a delicate spirit-level at the end of a lever detected the slightest inequality. Each of these axes contained about 100 superficial inches of surface.
