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ENGINES FOR SCREW STEAMERS.

There have been a great many improvements in this class of engines of late years. As screw propellers grow in popularity, more attention is given to the details of their engines until they will soon, if they do not already, rank first class as steam engines. It is very hard to overcome prejudice and popular ignorance, and we assert that the introduction of propellers has been much delayed in this country by the assumed inelegant and unmechanical appearance of their steam machinery. This is absurd. Short strokes necessitate short connections, in propellers at least, by reason of the position of the cylinders. To avoid complication they must work athwartships. If bevel gears be employed, the engines might work parallel with the keel, but this is more objectionable, for many reasons, than crowding the machinery into a small compass. Oscillating engines are employed upon our Northern lakes with very beneficial results as regards speed and economy. The custom with some engineering firms, there, is to place the cylinder as high as possible from the bedplate without injuring the stability of the hull; as a consequence, the piston rod is very long and the vibration of the cylinder reduced to a very low figure. These engines make from 75 to 80 revolutions per minute with ease, and attain to still higher velocities, for all that we know to the contrary. They are high pressure condensing engines, working steam at fifty and sixty pounds per square inch. One of these engines that we saw, not very long ago, had the air pump inside of the condenser. To get at the pump it was necessary to take up the condenser, there being no bonnet upon the top of the same, to effect an examination of the valves or renew the packing. Ericsson, in his *Monitor* batteries, has introduced a form of screw engine which appears to have some good features about it. There are two steam cylinders which are cast in one; the line of their bores is coincident, divided transversely in the center by a partition or bulkhead. That is to say, a cylinder four feet in length is divided into two cylinders nearly two feet long. From these cylinders issue trunks, in the place of piston rods, to which the pistons are keyed. At the bottom of the trunks, as usual, is jointed the rod which transmits motion from the piston to a long lever secured upon a rockshaft on the main bed-plate. This rockshaft has an additional lever to which the connecting rod is attached that drives the main shaft. Both of these cylinders work the levers and rods on one shaft. The pistons work horizontally and can be readily examined from the larboard and starboard sides of the ship. The valve gearing is very simple, nothing in fact but the ordinary eccentrics and slide valves. These engines are very plain and free from complication; there is nothing about them except what is required to impart motion or withstand strain. There are neither crossheads, side rods, or guides of any kind to the pistons, except such as are afforded by the trunks. These, we believe, are found all-sufficient. These engines afford, by properly proportioning the lengths of the arms or levers on the rock shaft, a length of crank from center to center equal to one stroke of the piston. They are compact and yet easily accessible in all their working parts. It has been urged that these engines are objectionable in one feature, that is, the springing of the levers caused by quick working. This necessitates a large clearance at one end of the cylinder, giving an unnecessary amount of steam room, and consequently incurring waste of fuel. Also that the main valves and ports are very small. It seems to us that the mechanical difficulties might be overcome by substituting heavier levers or else a different pattern of the same, whereby the trouble could be remedied, provided the evil complained of is of any magnitude. At any rate they seem capable of great simplification and are not straggled all over the ship, as is the machinery of one gunboat we know of, now building. Simplicity of design and the economical application of steam are the cardinal virtues in engines of all kinds.

THE SCIENCE OF IRON AND STEEL.

Erroneous conclusions founded upon imperfect observations frequently pass current for science. Apart from properly conducted experiments, no dependence can be placed upon mere opinions relating to questions of science. Of this we have been reminded in a striking manner by the experiments of David Kirkaldy, of Glasgow, Scotland, in testing the qualities of iron and steel in sustaining strains. He has tested several hundreds of bars, plates, bolts and angle irons, and has given to the public in a volume the results of his experiments. The subject has also been discussed upon the reading of a paper by him before the Scottish Engineers' Association. It has hitherto been assumed that the breaking strain of iron or steel indicated its quality; the results of those experiments do not confirm that assumption. A high breaking strain of steel and iron was found in qualities that were dense, fine and moderately soft, and in others that were very hard. A low breaking strain was found belonging to qualities which were hard but coarse in the texture; and in others that were very close in the texture but extremely soft. An opinion has also very generally prevailed that the breaking of shafts in steam engines and the axles of locomotives and railway cars was caused by the metal losing its fibrous character and becoming crystalline in its structure. It had been observed that broken axles and shafts of wrought iron exhibited a crystalline fracture, and we well remember how many lengthy papers were published on this subject a few years ago, all in proof of the metal changing from its fibrous to a crystalline structure by the vibrations to which it had been subjected. Mr. Kirkaldy's experiments have proved that all fibrous iron fractured suddenly invariably presents a crystalline appearance, but when fractured slowly its appearance is invariably fibrous. Take the same bar of wrought iron and snap one part suddenly and the fracture will be crystalline; then break another part of it by drawing it slowly and it will be fibrous. This puts the question of vibrations and crystallization of axles upon a new basis. Iron is less liable to snap the more it is worked and rolled. In this age of iron, when this metal is so extensively used for such a variety of purposes, such as in machinery of all kinds, ships, bridges, houses and engines on land and sea, different qualities of it are suitable for different purposes, therefore, a proper test to ascertain these separate qualities is very valuable. This has been furnished by these experiments so far as it relates to iron and steel in the moving parts of engines. This test is the breaking strain and the fractured area. For example, let us take two bars of iron, one inch square, and submit them to a severe strain until they break. If one snaps with a pressure of 45,000 pounds on the inch and at the place of fracture, the bar measures one square inch; while the other bar breaks with the same strain, but is so drawn that the fractured area measures only two-thirds of an inch square. The latter is superior to be applied for resisting strains, as it is not so liable to snap. Mr. Kirkaldy says: "The softer the iron the less liable is it to snap, and fine soft iron being more uniform in quality, it can be depended upon in practice. The load which this description of iron can suspend with safety may approach more nearly the limit of its breaking strain than can be attempted with the harder and coarser sorts." In the treatment of steel by hardening in oil and water, it is stated that when heated and plunged in water, its strength is reduced, but when cooled in oil its strength is increased. The cause of this is still inexplicable, but it is an important and valuable fact for mechanics. Iron and steel are rendered stronger by cold rolling and wire drawing. It has hitherto been supposed that this was due to the metal being condensed, but this is not the case, for the rolled iron and wire, in proportion to their thickness are not heavier than before being subjected to these operations.

In the discussion which took place on the reading of Mr. Kirkaldy's paper, W. Simons stated that the result of such experiments would tend to reform the present mode of arranging iron in building ships. Hereafter the longitudinal fiber should be placed in the direction of the most constant strain—a principle which had hitherto been ignored in marine construction. B. Conner stated that in experiments recently made at Sheffield, England, by Messrs. Naylor & Vickers, to test steel for railway axles and tyres, it was observed that the steel which could bear the least tension was superior for withstanding concussions. They have tested bars with weights falling upon them from hights varying from one to thirty-six feet, and had found that those bars which have stood the greatest tensile strain were most easily broken by concussion. Steel which stood about 35 tuns of tensile strain to the inch was the best for journals.

As it regards galvanized iron some persons have contended that the process of zinc-ing weakened the metal. Mr. Kirkaldy's experiments go to prove that galvanizing does not injure the strength of iron in large sections, and this result has also been confirmed by experiments with galvanized wire rope. Dr. Macquorn Rankin stated that ungalvanized iron was a shade stronger, but the galvanized was more extensible, and the result was that what galvanized wire rope wanted in tenacity was made up by being more extensible, and thus better able to resist a shock. Cast iron is stronger with the skin than without it, and if castings were made so perfectly as not to require turning or planing they would be much superior for most purposes. Wrought iron should always be forged as perfectly as possible, so as to avoid cutting across the fibers to make it fit. Much has yet to be learned respecting the science of iron and steel in the adaptation and application of these metals to the useful arts. The foregoing is a useful addition to the stock of general knowledge on such subjects.

GOVERNMENT PROPOSALS FOR CANNON.

Proposals have been made by Brigadier-General Ripley, Chief of Ordnance at Washington, for furnishing the Government with 13, 10 and 8-inch cannon—number not specified—also for furnishing one hundred 24-pounder flank-howitzers. They are to be fabricated of cast-iron from drawings which will be supplied by the Ordnance Department. One 10-inch trial gun is to be made of warm or cold-blast charcoal iron, to be cast hollow and cooled from the interior, and to have a tenacity of metal of not less than 30,000 pounds per square inch, to be determined by testing specimens taken from the sinking head of the gun, and from a cylinder cast from the same heat, and from metal of the same quality as that from which the gun is cast. This cylinder is to be cast on end, in dry sand molds, and is to be 72 inches high, with an elliptical base of 24 inches greater and 16 inches lesser axis. The specimens are to be cut from the gun head, and a slab 4½ inches thick from the cylinder, by planes parallel to and equi-distant from the axis of the cylinder and the lesser axis of the base. The Ordnance Department will test the specimens, furnish the ammunition, and prove the trial gun, which must be ready for trial as soon as possible, and not later than three months from the date of the contract. No contract will be given, nor will the trial gun be paid for unless it shall endure a proof of 1,000 rounds, with service charges of powder, of which 200 rounds will be with solid shot, and 800 rounds with shells.

The testing will be done free of charge to the contractor, but he is to furnish facilities for the testing. All the cannon must be made of the same quality of cast-iron as the trial gun, and each cannon is to endure the regular proof and inspection. No bids will be entertained but from founders engaged in the business. With each bid for the cannon, a penal