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O. D. MUNN, S. H. WALES, A. E. BEACH.

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(Illustrations are indicated by an asterisk.

POWER REQUIRED TO DRIVE MACHINERY.

"How many pounds of steam does it take to turn your engine over without the machinery at work?" said one engineer to another recently.

"Well I don't know," he replied; "about ten, I suppose."

"I will wager," said the other, "you cannot pass the center with less than thirty."

He looked incredulous.

"To-morrow morning I will try it," and he did so.

He opened the throttle when the gage showed fifteen pounds and the crank was on the dead half center, but the wheels never stirred. He waited a little until the cylinder got hot; he blew the condensed water out and tried it again at twenty, but the crank never moved. At twenty-five pounds it made half a stroke but stopped on the center, and at thirty it barely turned over.

"I wouldn't have believed it," he said to himself.

This was a high pressure engine, 11 1-2-inch cylinder and 32 inch stroke, working at a boiler pressure of fifty-five and sixty pounds to the square inch. Nearly two-thirds of the pressure was absorbed in the friction of the belts, shafting, and machinery. This is not an isolated case. It is quite common, and few engineers are aware of the great loss daily incurred by simple neglect.

It is not difficult to account for it when we reflect that in many shops it is accounted of no importance if shafting is out of line, or belts laced up so tight that bearings heat; that it is of no moment whether the separate machines are in good order or not, and that one kind of oil is thought as good as another. To us it seems strange that men should be willing to pay tithes to carelessness—to waste means on nothing when money is so hard to get. It is certainly a small thing to line up shafting and to look after the other details. In the matter of oil, it is a well settled fact that the purest is the best, and that the use of cheap lubricants (so called) is a mistake. Shafting that is in line will work without any binders on the bearings, for the belts serve the same purpose, and no cap is needed except a slight cover to keep dust out.

By actual test with a dynamometer Bourne gives the following work done by an engine of 23 1-2 horse-power: Two pair of stones, 4 feet 8 inches diameter, grinding wheat; two of the same size grinding oatmeal; one dressing machine; one fanner; one dust screen, and one sifter. One set runs 85 revolutions per minute, the other 90. The oatmeal stones run 120 and 140 revolutions per minute.

He also instances a cotton mill of 2,562 spindles, each making 2,200 revolutions per minute. The bobbins were $1\frac{7}{8}$ long, the thread portion being $2\frac{3}{16}$ long; there were also five turning lathes, three polishing lathes, two bobbin machines, two saws, one 22 inch, the other 14, and 24 bobbin heads. When all the machines were off except the spindles, the actual power required was that of 21 horses, so that each horse-power drives nearly 123 spindles. A small engine of 10-inch bore and 4-feet stroke, making 35 revolutions, with steam at 90 pounds, drove two muley saws of 34-inch stroke, cutting 30 feet of yellow pine per minute, 18 inches thick.

The friction of a steam engine in good order is variously estimated at from five to eight pounds to the square inch. Of course the proper way to find out the actual figures is to take a diagram with the engine and shafting in motion, and another with the engine alone—the difference of the two showing the effective pressure. Very few persons are willing to take the trouble to do this, but go on grumbling at the high price of coal and of the waste of fuel, when they alone are to blame.

If we are to have any radical change in the waste of power in manufacture, we must begin at the details. We have spoken of this so much that we fear our readers are almost as tired of it as we are, but when we reflect upon the immense losses through simple and sheer neglect, we cannot keep silent.

PETROLEUM AS FUEL FOR STEAM ENGINES TO BE TESTED.

Among the amendments to the Naval Appropriation bill which have been agreed to by both Houses of Congress, is one appropriating $5,000 to test the value of petroleum as a fuel under marine boilers. It is to be hoped that this slice of the people's money will be entrusted to the hands of men who will expend it for the people's benefit—who will conduct their experiments in a fair and open manner, allowing all their steps to be made public as the experiments proceed.

There has been very general complaint among the engineers of the country, and manufacturers who are using steam power, that the costly experiments which are being made at the Novelty Iron Works, to test the economy of expansion, are withheld from the public. It is hinted that the conductors of these experiments, in forbidding the press access to the trial, intend to keep the public, who pay the expense of these costly private exhibitions, in blissful ignorance of the result until they can come out with a ponderous gilt-edged volume of reports, at another heavy expense, for their own glorification.

ZINC PLATES FOR PRESERVING BOILERS FROM CORROSION.

The statement seems incredible, that for forty-two years science has been in possession of cheap and simple means for completely protecting steam boilers from rust, and yet these means have never been made use of in the arts. The great Collins steamer *Baltic* is now lying in the East river, and on the wharf by her side is an enormous pile of iron rust, that formerly made up the tubes and tube sheets of her boilers. These boilers cost many thousands of dollars, and their condition is similar to that of hundreds of other boilers in this and other countries. Can it be that a few plates of zinc soldered to these boilers would have preserved them entirely from this decay? There is every reason, short of extensive practical trial, to suppose that they would.

In the year 1824, Sir Humphrey Davy announced his discovery that if a metal which is corroded in salt water is placed in contact with a second metal that is more easily corroded, the action is confined to the second metal, and the first is perfectly preserved. This principle is not limited to the action of salt water, but holds in regard to all corrosive fluids; the most easily corroded metal is called the positive, and the protected one the negative.

Sir Humphrey Davy proposed to protect the copper sheathing of ships from corrosion by attaching to it pieces of zinc, but the plan did not prove a practical success. It has been generally understood that the cause of the failure was the perfection with which the copper was preserved—it was said that the copper was kept so bright that barnacles adhered to it, a slight coating of the poisonous oxide of copper being supposed necessary to drive these shell fish away. M. Becquerel says that this impression of Davy's was erroneous, that neither barnacles nor seaweed adhere to bright copper, but that the real cause of the failure of Davy's process was the erroneous theory adopted by its author. Davy supposed that the mere contact of the two metals was sufficient, while the fact is, the protection is due to the chemical action going on between the more easily corroded metal and the liquid. A coating of oxide or other salt soon forms on the surface of this metal, and stops the action, when the protection ceases. To continue the protection, therefore, it is necessary that this coating should be constantly, or frequently, removed.

There is a limit to the area of iron surface which a piece of zinc will protect, though it is very large. A few small pieces of zinc would probably protect the largest boiler; they should be soldered to the iron, and should be so situated that their surfaces could be frequently scoured or scraped.

A BRILLIANT SERIES OF EXPERIMENTS.

Arrangements have been made for a course of three lectures at the Academy of Music, in Brooklyn, by R. Ogden Doremus, M. D., Professor of Chemistry and Toxicology in the Bellevue Hospital Medical College, and Professor of Chemistry and Physics in the Free Academy, on "Views of Life through the Medium of Natural Science." It is stated that "efforts will be made to demonstrate the recent discoveries in science, especially in the departments of heat, light, electricity, magnetism, eleotro-magnetism, thermo-electricity, etc., on a scale commensurate with the size of the edifice in which they will be exhibited."

As Professor Doremus is distinguished for the magnificent scale on which he conducts his experiments, and as these are to surpass all his former efforts, the opportunity to witness them must be a rare treat. Among them will be exhibited the cascade of light, of which we spoke in a recent issue.

THE ENGLISH IRON CLADS.

One of the latest English iron-clads, the *Bellerophon*, is only half clad. That is, for a portion of 160 feet on each side, she is entirely without protection. The central armor is only 100 feet in length, but an iron-plated bulk head $5\frac{1}{2}$ inches thick incloses and protects the battery. All the forward part of the ship is vulnerable to shells, and may therefore be blown to splinters. Possibly the battery and the iron bulk head $5\frac{1}{2}$ inches thick, the engines and boiler possess sufficient buoyancy to keep the frigate afloat after one-half of her has been destroyed. It is said that broadside vessels cannot be completely protected and retain their speed; in other words, that fine models cannot carry the weight of armor necessary to render them invulnerable, but one of our ship builders has shown in the *Re D, Italia*, that a vessel of 285 feet in length, and 50 feet beam, $4\frac{3}{4}$ inches of armor all round, can cross the Atlantic fully equipped at the average speed of 11 knots, without in the least straining herself or even opening the seams in her armor.

NEW PUBLICATIONS.

AMERICAN JOURNAL OF MINING.—This is a neat well-printed journal, lately started, and devoted, as its title indicates to mining and kindred matters. It is illustrated and contains full reports of the condition and prospects of the mines in Colorado, California, and other territories. It is published by Western & Co., 37 Park Row, at $4 a year.

THE MOTHER'S ASSISTANT AND THE HOME MONTHLY—These are two different publications issued from the same house, and are calculated to elevate the taste and morals of families. Select tales of an unexceptional character, together with music of a devotional nature, are given in each number. Besides there are poetry and pictures, so that all tastes are likely to be suited. C. H. Pearson & Co., Boston Mass., and American News Co., New York.

STEEL MARKING STAMPS.—Our readers frequently inquire for the above tools, especially patentees who wish to stamp the date of patent upon their inventions, upon brass or iron. Makers of dies would do well to keep a short standing advertisement in the SCIENTIFIC AMERICAN.

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