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three in series. The bobbin has an internal diameter of 0.115 metres and is 0.23 metres long. The primary wire is one millimetre in diameter and weighs 1.320 kilogrammes. It is wound in two layers. The secondary wire of one millimetre diameter weighs 3.400 kilogrammes. The core of soft iron wire (2 millimetres in diameter) weighs 680 grammes. The condenser is thrice the power of that usually employed with bobbins of the same size. This coil gives a brilliant spark showing the spectrum of the electrodes; and the nebulous bands due to the air are either entirely or almost invisible.

THE STRENGTH OF LARGE TIMBER.

The well-known fact that the resistance of large timbers to strains is relatively less than small pieces, has given rise to no small discussion upon the proper dimensions for test pieces. In this connection a storehouse was recently examined whose floors were constructed of 4 in. spruce plank supported by southern pine timbers 16 in. by 9½ in., 26 ft. span and 8 ft. between their centres. The floor was loaded uniformly with bales of goods weighing 125 lb. per square foot of floor. This, with the weight of the floor, made the total uniform load 141 lb. per square foot. The mean deflection of the beams was 3 in., and the modulus of elasticity corresponding to this flexure amounts to:

$$E = \frac{270\, s\, l^3\, w}{b\, h^2\, d} = \frac{270 \times 8 \times 26^3 \times 141}{9\tfrac{1}{2} \times 16^2 \times 3} = 1{,}193{,}233 \text{ lb.}$$

which is about three-quarters of that obtained in experiments upon small selected members.

THE PNEUMATIC DESPATCH IN NEW YORK.

The Western Union Telegraph Company, in New York City, are about to substitute pneumatic tubes for the distribution of city messages. Brass tubes 3 in. in diameter have been laid 4 ft. below the surface. The leather cases for messages are to be impelled by compressed air at one end and with vacuum on the other at an estimated velocity of about a mile per minute. At the terminal stations are four engines 18 in. by 36 in. cylinders with compressors or exhausters tandem with the cylinder, developing 240 horse-power each, at 18 revolutions per minute. Air is exhausted from one reservoir and compressed to 30 lb. per square inch in the other. The pumps and connections are so arranged that any of them can be used either for compression or exhaustion to either reservoir. The company have used short pneumatic tubes to some newspaper offices and to different departments for some time, but the plant now in process of construction will contain many novelties of detail in respect to facilities for sending and receiving messages from branch stations, construction of expansion joints, and convenience of operation.

MOUNTINGS FOR QUICK-FIRING GUNS.

A series of official tests have recently been made on board the gunboat Hardy in order to try the mountings that have been introduced into the Navy for the new six-pounder quick-firing shell guns, more especially to ascertain whether the construction is strong enough to stand the concussion caused by full charges of 4 lb. of powder. The weapons which had been selected for the experiments were a Nordenfelt recoil, a Hotchkiss non-recoil, and a Nordenfelt non-recoil gun. Over 200 rounds were fired from the last-named with very satisfactory results. The Hotchkiss gun was then tried, twelve rounds being fired from it. Our readers may remember that this weapon, which we illustrated and described on pages 128 and 129 of our last volume, has a padded stock with an india-rubber buffer, against which the operator rests his shoulder in taking aim. It was a moot point whether with the new mounting the rebound would be sufficient to inconvenience the operator, but the results of the experiments showed that this was not the case to any appreciable extent. After this gun had been tried the recoil Nordenfelt was mounted in its place, when twenty-four rounds were fired, giving a recoil of between 2 in. and 3 in. On the whole the results of the experiments were considered very satisfactory.

THE UNITED STATES TORPEDO SHIP "DESTROYER."

Captain John Ericsson, of New York, U.S.A., known as the inventor of the monitor class of iron-clad vessels, has been engaged for a number of years upon the design and construction of an iron-clad with submarine armament, which vessel he now offers to the United States Government for 120,000 dols. The Destroyer is intended for coast service and harbour defence, and is 130 ft. long, 11 ft. deep, and 17 ft. 4 in. wide. The vessel lies low and an intermediate arched deck, also of iron, extends from stem to stern and covers crew and machinery during action. The gun is under the inclined portion of the bow, and therefore beneath the water line. The gun measures 30 ft. in length and is 16 in. bore; and carries a projectile 25 ft. in length, weighing 1450 lb., and containing 300 lb. of gun-cotton, which is exploded by percussion. Opinions of naval officers differ widely in regard to the merits of this last work of this eminent engineer, now well over fourscore years of age, but little risk can be run by the Government in opening negotiations, as he offers every facility for examination and test. As an alternative proposition, he offers to build a steel vessel of slightly larger dimensions and guarantee the stipulated performance of both vessel and armaments, by responsible sureties, for 160,000 dols.

THE TELEGRAPH IN THE SOUDAN.

The old telegraph line to Khartoum consisted of two wires, one for express or Government messages, and the other for public correspondence. Since the rising in the Soudan this line has been dismantled, and our troops under Colonel Brackenbury recently found that the iron poles, and even the bent hooks of the insulators, had been turned into spear-heads; while great quantities of the wire had been flung into the Nile. This was appropriated by our telegraphists in running the new line. Owing to the withdrawal of our troops from their advanced position beyond Merawi, it is probable that the line will again be destroyed. While upon this subject we may mention that the new lines of the Postal Telegraph Department, erected to meet the exigencies of the sixpenny telegraph tariff, are mostly run on timber posts of Scandinavian pine. These poles are cheaper at first than iron poles, but considering that their durability can be nothing like so great as iron, that they are far less ornamental than iron poles can be made, and last, but not least, that pine poles have to be bought out of the country, whereas iron ones can be made at home, we think it is a decided pity that iron poles of a neat design were not adopted in the first instance. We shall have to come to iron poles ultimately, and may as well begin now. It is to be hoped that no further orders for wooden poles will be given, more especially if given abroad.

ABSORBING THE EXTRA CURRENT OF DYNAMOS.

In a recent Note we described the application of secondary batteries by M. d'Arsonval to the absorption of the extra current when a dynamo circuit is broken, and the prevention of injury to life by the physiological effects of that current. At a recent séance of the French Academy of Science, M. A. Daussin claimed priority for this application on the score that in 1869 (March 25th) he patented the application of these batteries to the absorption of extra sparks in the opening and closing of a relay, and the prevention of decay in the points of contact. He then observed that the suppression of the extra current was proportional to the electromotive force of polarisation of the voltameter intercalated. On this subject M. J. Raynaud suggests the use of lateral induction lightning protectors, such as are used in telegraphy to withdraw the extra spark at the moment of rupture. It would be sufficient, he points out, to connect to the poles of the dynamo machine an apparatus of this kind which would form a safety valve allowing passage to the current at the instant it became dangerous. He mentions, as apparatus to be used, the plate lightning protection with insulating layers of paper, air, &c., between, or the vacuum discharges in some cases. Such appliances were also patented in England in 1882 for the prevention of sparking with dynamos.

THE PYRO-ELECTRICITY OF THE TOPAZ.

The topaz crystal possesses a pyro-electric axis parallel to the axis of the prism, according to the observations of M. C. Friedel (see *Bulletin de la Société Mineralogique*, tome ii., page 31; 1879). Reiss and Rose have, however, announced that the axis is horizontal (not vertical), and with central poles. Recent experiments, by MM. Friedel and Curie have been undertaken to investigate the anomaly. The yellow topaz of Brazil was chiefly employed in these experiments and the electricity developed was measured by a Thomson-Mascart electrometer, the crystal being warmed by contact of a facet with a piece of heated brass. They conclude, from their experiments, that there exists in topaz crystals a direction, or vertical axis, of pyro-electricity, the intensity of electric effect developed being variable in the divers specimens of crystal examined. In some specimens the two ends of the axis are of the same sign +. These differences of intensity and sign can be explained by the existence of superposed hemitropic plates. There exists, also, in certain specimens at least, a horizontal axis of pyro-electricity. To put it distinctly in evidence it is necessary to divide, according to their planes of cleavage, crystals formed of portions optically distinct. These are regularly pyro-electric and piezo-electric. The exact position of the horizontal axis has not yet been determined.

ZINC IN DRINKING WATER.

A paper on the above subject has appeared in the *Journal of the American Chemical Society*, by Dr. F. P. Venable. It has long been known that zinc dissolves in water, and that soft water, such as rain water, dissolves it more easily than hard water. Water containing carbonic acid is specially able to dissolve it. The use of galvanised iron for pipes and tanks being so much on the increase, the subject becomes more and more important, and it is desirable to ascertain, as far as possible, to what extent solution of the zinc coating takes place, and how far water contaminated by zinc is injurious to health. The author quotes several investigators as to the latter point, the evidence being to some extent conflicting, but giving a very decided balance on the side of the view that such water is considerably injurious. Investigations made on behalf of the French Government resulted in the prohibition by the Ministry of Marine of the use of galvanised iron tanks on board men-of-war. Professor Heaton has given an analysis of a spring water, with a further analysis of the same water after it had travelled through half a mile of galvanised iron pipe. It had taken up 6.41 grains of zinc carbonate per gallon. Dr. Venable gives the results of an observation of his own, where spring water passed through 200 yards of galvanised iron pipes to a house, and took up 4.20 grains of zinc carbonate per gallon. It seems pretty clear that drinking water should not be allowed to come in contact with zinc.

EXHIBITION LITERATURE.

We think it is a matter for regret that the handbooks which formed so noticeable a feature both in the Fisheries and Health Exhibitions are not to have a counterpart in the forthcoming Inventions Exhibition. The literature of the two exhibitions that have been held constitutes a perfect source of reference for the respective subjects. This is especially the case with regard to the Fisheries literature, the volumes of which will form a standard work on a subject hitherto very scantily treated upon. The plan to be followed in the forthcoming Exhibition is to include such descriptive matter as may be considered necessary in the catalogue prefaces, of which there will be twenty-two in all. The Council have procured the services of some of the best authorities on the respective subjects. Amongst others are the names of Sir William Armstrong for Hydraulics, Sir Edward Reed for Naval Architecture, Sir Henry Nugent for Firearms and Explosives, Professor Oliver Lodge on Electricity, Mr. A. Vernon Harcourt on Gas and other Illuminants, Captain Douglas Galton on Railway Plant, Professor Unwin on Machine Tools, Professor Shaw on Elements of Machines, Mr. Snelus on Fuels and Furnaces, Mr. Bauermann on Mining and Metallurgy, Mr. Aitchison on Engineering, Construction and Architecture, and Mr. W. Anderson on Prime Movers. It will be seen that those engaged on the work are generally thoroughly capable of dealing with their respective subjects in the most efficient way, but the space that will be put at their disposal must be inadequate for the purpose of giving anything like an intelligible account of the subjects dealt with.

THE DESIGNS OF WAR VESSELS.

The speech of Lord Northbrook in the House of Lords on Friday last did not appear a very statesmanlike production, even to those who could hear it. It is evident that the heart of the First Lord is not in his work, and indeed it is hardly to be wondered at considering the legacy of incompetence and mal-administration which he has become heir to. There is one point, however, worth noticing in what the noble lord said. He attempted to snub the Committee lately presided over by Lord Ravensworth—one of the ablest and most straightforward committees that ever sat—by saying it had gone out of its way to suggest that specifications and drawings for contract-built ships for the Navy should be more complete. Whether the Committee did go out of its way or not in making this suggestion, matters little, for it appears to have had a wholesome effect. In accordance with it, Lord Northbrook went on to