silver; and it unites metals so firmly that they may be worked in any manner whatever. As its bulk is not altered by its hardening, it fills perfectly any channels, crevices or joints into which it may be introduced.

It is prepared as follows: Perfectly pure copper is procured, either by reducing the oxyd of copper by means of hydrogen or by precipitating the metal from the sulphate of copper with zinc turnings. Either 20, 30 or 36 parts of this pure copper, according to the hardness of the alloy desired—the more the copper the harder the alloy—is moistened thoroughly in a cast iron or porcelain mortar with concentrated sulphuric acid (at 1.85 density); then to this metallic paste is added 70 parts, by weight, of mercury; the mixture being constantly stirred during the addition of the mercury. When the copper is completely amalgamated, the composition is washed with an abundance of boiling water to remove the sulphuric acid. The composition, at first soft, becomes in ten or twelve hours so hard as to take a fine polish, and to scratch gold or tin. It may at any time be made as soft as wax by heating it to about 700° Fah., or by triturating it in a mortar at a temperature of 260°. If, in this state, it is placed between metallic surfaces free from oxygen, it will unite them so firmly that they may be wrought in any way without separating.

SPIDERS.

A learned entomologist, who has made a special study of the structure and habits of spiders, states that there is not a single authentic case on record of a person being killed, or seriously injured, by the bite of a spider; all the stories about the fatal bite of the famous tarentula being simply fables. These insects are, however, exceedingly ferocious in their fights with each other; their duels invariably ending in the death of one of the combatants. In some species, the first step of the young as soon as they are hatched is to eat up their mother.

ELECTRICITY AND SOME OF ITS PRACTICAL APPLICATIONS.

ARTICLE III.

The construction of the electro-magnet, and its application to the telegraph, are fully treated in a number of works, but of late the application of electro-magnetism to the production of rotary motion —or, indeed, of any useful mechanical effect—has received but little attention, and we know of no work which treats the subject in a thorough manner.

A great number of magnetic motors have been invented, none of which have ever come into practical use in this country, although it is reported that in France a few are in use for purposes requiring certain motions.

All, or nearly all, the electro-magnetic machines constructed have made use of one or more of the following powers:—

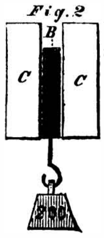
1. The attraction of a coil or helix.

2. The alternate attraction and repulsion of opposite and like poles.

3d. The attraction of an electro-magnet for soft iron.

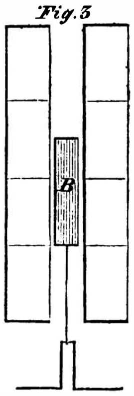
Probably the first engine operated by the attraction of a coil was that of Dr. Page. The principle of this engine is as follows: A coil of insulated wire possesses powerful magnetic properties when a current passes through it, and if a coil be made in the shape of a tube or with a hollow cone, it will communicate magnetic properties to a bar of soft iron placed within it, and if the current be sufficiently strong, the bar will be suspended without any material support. The cut represents a section of such an arrangement. C C represents the coil, and B the suspended bar. If, while the bar is in this position, the current be stopped, the bar will instantly fall out, and, when entirely without the coil, no attraction will take place; but if it be inserted part way, and the current then passed, it will be drawn wholly within. Thus, it will be seen that, by alternately breaking the current and allowing it to pass a reciprocating motion can be given to the bar, and, by means of a crank, a rotary motion may be communicated to any appropriate machinery. Such a device, however, would only exert its power through half of the stroke; but by using two coils drawing alternately in opposite directions, a constant power may be exerted throughout the stroke.

Fig. 2



The cut represents a section of an improved device invented by Dr. Page, in which a number of coils are used, piled upon each other, and so arranged that, as soon as one coil has attracted the bar to its full extent, the current shall be transferred to the one next to it; and so on for half the stroke, when the current is to be transferred to the other side of the bar, when it will be attracted in the opposite direction through the return stroke. This beautiful device has as yet failed to come into general practical use.

Fig. 3



The invention of machines which are operated by the alternate attraction and repulsion of opposite and like poles has cost an immense amount of time and money, but such machines are liable to difficulties which render them impracticable upon a large scale.

Engines which are operated by the direct attraction of an electro-magnet for iron may be divided into two classes—reciprocating and rotary. Reciprocating engines are entirely impracticable upon a large scale, for various reasons, the principal of which are:—

1. The extremely small distance through which magnetic attraction is exerted.

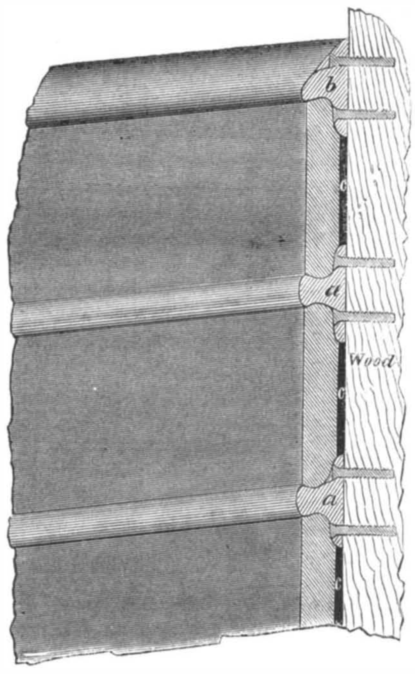
2. The waste of power by such an arrangement; and,

3. The large amount of friction to be overcome at each stroke.

These objections refer chiefly to engines in which only two magnets are used. Such machines form a part of every well-appointed philosophical apparatus.

IMPROVEMENTS IN PLATING SHIPS OF WAR WITH IRON.

As the great interest in protecting naval vessels with shot-proof plates, which now prevails in England and France, is doubtless destined to be also felt in this country, we present the accompanying illustration from the London *Mechanics' Magazine*, as an indication of the present state of the art in England.



These improvements have been invented by T. W. Plum, Esq., of Blænavon Iron Works, Monmouth, England, and of which the following is a description:

For shielding ships and batteries on land or floating with thick metal armour plates, metal ribs are used with a flange or flanges through which they are to be bolted to the ship, battery, or other structure, and a dovetailed or T.head rib for holding the plates. The flang and dovetailed ribs *a a b* may be of the forms shown in the engraving or of any similar form, so that there be a flang or flanges for bolting through, and a transverse head having more or less of dovetail shape, in order that when the plates, which are to be prepared to fit the ribs, are inserted between two of such ribs, they will be securely held in their intended position; that the plates when fixed shall cover the bolt holes, and that the joint or joints of junction between the plates and ribs shall have a tendency to tighten when struck.

In preparing the ribs, except the first, to be fixed to any structure, the bolt holes on one side of the flanges of the ribs are to be made longer, *i.e.*, oval in form in the transverse direction of the rib, so as to admit of the second and successively fixed ribs being in the first place bolted through the elongated bolt holes far enough from the rib previously fixed, to allow the plates to be inserted between them without difficulty; and the rib to be then drawn by cramps or other known means tightly to the plate; the row of bolts on the other side of the rib are then put in and made fast.

The upper and lower and vertical end ribs are made with one side only prepared to receive or hold plates, the other being rounded, moulded, or beveled off in any suitable shape, as at *b*.

The space between the back of the plates and the face of the ship or other structure shown at *c c c* may be more or less according to the dimensions determined for the ribs and plates, and may be filled with any material that may be found most suitable.

The Joint Action of Labor and Capital in Producing Wealth.

If a man is cultivating corn with a hoe, the hoe is capital. It is the saving of previous labor, and it facilitates his industrial operations, and these are the characteristics of capital. Nearly all active capital may be properly regarded as *tools* to work with. There is a regular gradation in implements from the simplest knife or ax up to the most complicated machine or the largest manufactory. There is no place in the ascending scale where a line of distinction can be drawn, and these implements are, in fact, essentially of the same character—they are all tools in the hands of industry.

There is capital, however, which cannot be regarded as of the nature of tools. Besides his hoes, plows, wagons, &c., a farmer must have food to eat and clothes to wear while raising his crops, and this food and clothing have been accumulated from previous labor, and are therefore capital; they aid the operations of labor, and are therefore active capital.

Men everywhere work with tools; consequently all wealth is the product of the joint operations of labor and capital. When Eve determined to sew some fig-leaves together, her first step was to procure a thorn or some other implement to work with, and that thorn was just as really capital as a Grover & Baker sewing machine, or the manufactory in which those machines are made. It is a curious fact that in the very first industrial operation of the human race, the first step was to procure the necessary capital.

Shoeing of Cavalry Horses.

The following circular has just been issued from the Horse Guards by the Adjutant General of the British army.

SIR:—It being very desirable that a uniform system of shoeing should be established in the cavalry, and the whole of that important subject having been recently referred to the consideration of a Board composed of officers of great experience in that branch of the service, assisted by two old and experienced professional men, the General Commanding in Chief has been pleased to direct that the following instructions, extracted from their Report, and which embody the whole of their recommendations, be circulated throughout the cavalry, accompanied by duplicates of the pattern shoes, which have been sealed and deposited at the office of Military Boards for general reference and guidance.

1. The shoe is to be beveled off, so as to leave a space and prevent pressure to the sole.

2. It is not to be grooved or fettered; but simply punched and the nails counter-sunk.

3. Calkin is to be applied to the hind shoe only, and is to be confined to the outside heel. The inside heel is to be thickened in proportion.

4. The weight of the shoes is to be from twelve to fifteen ounces, according to the size of the horse.

5. As a general principle, horses are to be shod with not less than *six* nails in the fore and *seven* in the hind shoe; nor is this shoe to be attached with not fewer than *three* nails on either side.

6. In preparing the foot for the shoe, as little as possible should be pared out, and the operation should be confined to the removal of the exfoliating parts of the sole only.

7. Both the fore and hind shoes are to be made with a single clip at the toes.