expensive. Wilde's machine, driven by a fifteen horse power —the armature making from 1500 to 2000 revolutions a minute, a rapidity that gives rise to several inconveniences— achieved a great feat when it fused a platinum bar 2 ft. long and 25 in. in diameter. We have seen the Gramme machine which we have been describing, driven by a three-horse power, the coils rotating at the rate of 350 revolutions per minute, fuse almost instantaneously an 18 gauge platinum wire 8 ft. long A copper wire, 22 ft. long and of 96 per cent. conductivity, being stretched between the terminals was fused in less than two seconds. A piece of a round file ½ in. in diameter and 4 in. long was burnt away in five minutes, and a piece of diamond was volatilised in less than as many seconds. These facts speak more eloquently than all the words we could string together in elucidation of the vast heating energy of this machine.

But however valuable the apparatus may be by its illuminating power, it is still more so in its applications to electro-chemistry. In this branch, it will no doubt be productive of very great results The high cost of other like machines precludes the possibility of using them with advantage. There is here an extensive and commercially important department, and we are glad to say that it is in the hands of so able a chemist as Mr. Werdermann. We are informed that Mr. Werdermann is devoting much attention to this subject, and he is already cheered in his researches by satisfactory results and equally encouraging anticipations. He expects to produce chemically pure copper at the price of the ordinary commercial; aluminium for about half, potassium and sodium for less than half their current prices; and other metals, such as calcium and magnesium at rates which may bring them into the chemistry of commerce. He expects to purify 2 tons of pig iron in 20 minutes at a saving of two-thirds the fuel. We shall not even be surprised to see Mr. Werdermann unlocking further secrets of nature, and adding a few more names to our list of metals.

We have already stated that Mr. Werdermann has introduced this invention into England. Though the patent was taken out some three years ago, it was only last November that this gentlemen found in Messrs. Whieldon and Cooke a firm able and willing to make the machine We can scarcely blame people for being slow to believe startling novelties, as we are all more or less conservative, and often yield only to ocular conviction. Mr. Conrad W. Cooke, who unites the qualities of electrician to those of mechanical engineer, is well fitted for the undertaking. He has now in course of construction two of these machines of very large dimensions. In them several valuable improvements are introduced.

The simplicity of the principle embodied in this magneto-electric machine, as well as the marvellous effects obtained from it, lead us to think that it is destined to play an important part in the development of the various branches of electro-chemistry and metallurgy generally. On the other hand, it is a striking example of the transformation of mechanical into electrical energy. In the steam engine that drives the coils, we see heat developed into a gigantic motive power, whilst in the machine itself we see this motion instantly converted into a continuous stream of electricity. We are gradually finding our way to a comprehensive and complete dynamic theory, and it is pleasing to notice that the great tendency of modern science is to establish the general correlation and unity of physical forces.

THE "LEVEY ENGINE."

(See page 68.)

This invention was noticed in our list of Patents in the first number of this work, but the advantages of the improvements patented are of such importance to all who use steam power that we think it worthy of a much wider and fuller publicity.

A glance at the two girders, or bed plates, shown above will convey an idea of one very great advantage the "Levey Engine" possesses over those of ordinary construction. The lines *a, a, a, a*, may be considered to represent the centre lines of the two piston rods, and consequently the lines of strain, in two Engines, and the lines *b, b, b, b*, to represent the lines of resistance in the same engines. Girder A represents an engine of the ordinary construction, and girder B a "Levey Engine." In A it will be observed that the strain is acting between two levers, the length of which is determinable by the distance from the top of engine bed to the centre of the cylinder at one end, and from the top of the bed to the centre of the shaft at the other. While in B the line of strain is in the same place as the top of the bed which is also the centre line of the Engine.

The frame of the engine is enlarged at C to facilitate the removal of the cylinder cover or the packing of the gland. The cylinder is made in sections divided in the direction of its length or entire, and fitted with slide or rocking valves at the option of the purchaser.

In either case the face of the bed is the centre line and the parts are so arranged that it is impossible to put the engine out of line.

There are some other very important improvements in the engine which we have not space to notice.

Chas. Levey & Co., of Toronto, are the Patentees and manufacturers.

HUNTER'S COMBINATION RAIL.

(See page 68.)

Our last issue contained a notice of the above recent invention. We are able, however, in the present issue to describe it more thoroughly with the aid of the accompanying illustration. The rail is a combination of iron or steel, and wood As shewn in the illustration, the steel and iron portion is held throughout on wood, and kept in position by means of bolts passing through the web, the wooden rail and the chairs, which secure the latter to the ties; the web fitting the groove of the wooden portion, and the jaws rolled on the head of the iron rail securing its lateral position perfectly. The chairs or fastenings may be spiked or bolted to the ties as desirable.

The rail is rolled in the shape of an old-fashioned (or English) letter T with the "foot" taken off. The *web* is calculated to give the rail the proper vertical rigidity, it being almost impossible to curve or bend it upwards, upon the same principle that it is exceedingly difficult to bend even a very light board edgewise,—i. e. in a direction parallel to its plane. The bolt-holes through the web are slotted so as to allow for contraction and expansion. The face of the rail from its peculiar form (as shown by the cut), for the same reasons which enable it to resist a vertical strain, preserves adequate strength against any lateral strains to which it may be subjected.

The economy resulting from the use of this rail is believed to be demonstrable. The saving in metal where a 56-lb rail is ordinarily used, is fully four-sevenths. At the same time the metal being supported entirely throughout on an elastic rail or cushion of wood, resting on wooden ties, a road perfectly easy and free from jar and vibration is obtained, the bearing capacity of which is fully equal to that of the heavier iron rail. Another advantage gained in the combined form of this rail is its perfect continuity; the iron and wood breaking joints alternately, and consequently another important feature is its perfect immunity from fracture by frost, which is now the cause of so many frightful disasters; for even if the rail should break (which seems hardly probable), there would be strength enough in the stringer to maintain a passing train of cars in place. And again, the combined rail being bolted through and through the chairs, prevents their sliding or "creeping" down grade, and thus throwing the road out of line and gauge.

In the number of ties to be employed at least 25 per cent. is saved, computing in the same ratio the expense of the stringers to be used. The cutting of the slot in these is a quick and cheap process, and may be effected either at the mills where they are manufactured, or in the woods, or even by very simple machinery carried along the grade as they are laid. It is apparent at a glance that all the material being so light it is far easier to handle than the old patterns, and hence that this kind of track may be laid more rapidly, especially when it is remembered that no such nice adjustment of chairs or fish-plates, with a multiplication of nuts, washers, "stops," etc., is required as in the old system.

One admirable feature of the invention is the ease with which a rail may be reversed after the "flange side" has be-