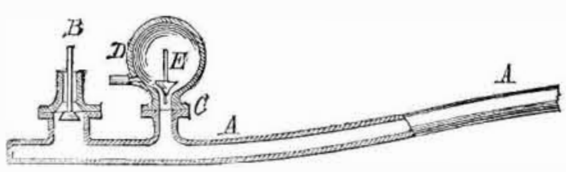
around the uptakes of the boilers has been removed a distance of twelve or fifteen inches, and cement substituted.

In relation to the superheating of steam, we have frequently shown that it was always difficult to bring up the vapor to a temperature sufficient to cause ignition, and, practically, impossible to do so in any of the boilers ordinarily used. In the case of the Alaska, if we are correctly informed, the ordinary boiler pressure is 30 pounds, and at this pressure the ordinary heat of the steam, on issuing from the superheater, as shown by the thermometer, is from 276° to 278° F. Every intelligent person knows that this heat is not sufficient to ignite combustibles such as felting or wood. On the occasion of the fire referred to, the engineer reports that the fires in the furnaces were low, indicating that the pressure and temperature of the steam were not as high as usual.

### THE HYDRAULIC RAM.

We have received a number of communications, recently, from readers who desired information relative to the construction and efficiency of the hydraulic ram, and take pleasure in giving them a brief account of it.

This ingenious piece of apparatus is generally said to have been invented by the French aeronaut, Montgolfier, and improved by his son, but the earliest recorded accounts of the apparatus indicate that it was built in a ruder form, and still earlier, by an English watchmaker, Whitehurst, of Derby, in 1772. It consists simply of a pipe, A, large enough to convey the whole required volume of water from the upper to the lower level, and fitted at its lower extremity with a check valve, B, so weighted that it will remain open until the water, rushing out around it at nearly the maximum velocity due to the hight of fall, lifts it and suddenly closes the orifice. The long column of water contained in the pipe A, is thus, while in rapid motion, refused egress at B, and its great inertia and its almost perfect inelasticity compel it to seek some other outlet; and if that were not found the heavy shock of such a mass of water, instantaneously checked, would burst a very strong pipe unless it were "cushioned" by an air chamber. In the hydraulic ram the new outlet is at C, and the water forces its way up through the air cham-




ber, D, lifting the check valve, E, without difficulty, and is finally delivered by a properly arranged pipe, leading to a reservoir which may be at a considerably higher level than the original source.

This action is one of those whose effects are estimated by reference to the principles stated in an article which we recently published on the laws of impact. Were there no friction, the energy due to the weight of water and the hight of fall would all be expended in raising a part of the water to the reservoir. One hundred gallons falling ten feet would be capable of raising ten gallons to a hight of one hundred feet, or twenty gallons fifty feet. As soon as the work done in throwing water into the reservoir has equaled the energy of the whole moving mass, the stream ceases flowing and the valve, C, closes, B opens and the stream starts again, its velocity accelerating until B is again thrown up to its seat, and the operation just described is repeated.

The friction of the pipe and the tortuous course of the water prevents the full realization of the effect as above estimated. This machine where well designed and properly made gives, on the average, about sixty per centum of the perfect result. We have, in our replies to correspondents, assumed forty per centum as the more common measure of its efficiency. It evidently is not as efficient a means of raising water as a good turbine or overshot wheel and pumps, as the latter should be capable of throwing nearly twenty per centum more water into the reservoir than the ram, with the same available quantity of water. The ram is, however valuable where the quantity of water is too small to justify the use of the wheel. The fact that small wheels are not as effective as large ones is also a fact telling strongly in favor of the ram.

### ESTIMATING POWER BY SIZE AND SPEED OF BELTS.

We have already complied with the request of some of our readers who desired us to state how the proper width of belting to transmit a given power was estimated.

We have now before us a request from others that we should give the rules adopted in determining the power actually transmitted by belts of given widths and speeds.

The rule already given was expressed by a formula which can be readily transformed into another, which shall meet the wants of the present case. It would be $HP = \frac{W\,S\,V}{7{,}000}$, that is: Multiply the width of the belt by its speed and by the length of that portion of the circumference of the smaller pulley which is in contact with the belt, and divide the product by 7,000. The result is the power which the belt is proportioned properly to drive.

Or, accepting the common millwrights' rule of 1,100 feet per minute on a belt one inch wide, for a horse power, we should state it thus: Multiply the speed of belt in feet per minute by its width in inches, and divide by 1,100. The result is, as before, the proper amount of power to be driven by the belt. The first rule is the most exact, the latter the most convenient for rough estimation. It must be remarked, however, that it by no means follows that the belt, in any particular case, transmits this estimated power. It may drive much less or, if running very tight, it can be made to carry more than the proper amount.

It is evident that, where power is rented, its amount cannot be accurately computed from the size and speed of belts. The policy of those who have power to rent to others is always to charge for the maximum capacity of the belts, and those who use the power and pay for it will use the smallest belts and drive them at the highest power possible. The only satisfactory method of settling disputes between landlord and tenant is by the application of the dynamometer, thus measuring precisely the power used. Every one dealing in power should keep a dynamometer of good construction on hand, and should use it more frequently than a good engineer uses his steam engine indicator. There are several good dynamometers in the market; and if those directly interested cannot use them, or do not find time, they can always find reliable consulting engineers to do the work for them. We know manufacturers who understand this, and who send hundreds of miles for an engineer and his apparatus, to give them trustworthy information regarding the amount of power which their machinery is using.

### ZIRCONIUM.

This metal takes its name from zircon, the mineral in which it was discovered by Klaproth in 1789. Although the metal is rarely met with and has no use in the arts, the mineral zircon is comparatively plentiful. It is found in many parts of the United States, among which the localities nearest to New York city are in Orange and Essex counties, N. Y., and at Trenton and Franklin, N. J. It is usually of a reddish brown color, and is very hard. The colorless and yellowish zircons of Ceylon have long been called *jargons* in jewelry, in allusion to the fact that, while resembling diamonds in luster, they are comparatively worthless. Zircons occur in crystaline rocks, especially in granular limestone and granite. They are infusible before the blowpipe. If pulverized and fused with soda on a platinum wire, the product when dissolved in dilute muriatic acid, gives a characteristic orange color to turmeric paper. Zircons are almost pure silicate of zirconium, containing less than 2 per cent of oxide of iron. The finer specimens of zircon have been used for ornaments, resembling, as we have said, the diamond. Zircons have also been employed, on account of their hardness, for axles and bearings.

Metallic zirconium was first prepared in the amorphous form in 1824, by Berzelius; Troost prepared crystallized zirconium in 1865. The former obtained it by heating a mixture of the double fluoride of zirconium and potassium with metallic potassium. It can also be prepared by conducting the vapor of chloride of zirconium through a red hot porcelain tube containing metallic sodium; or by heating the chloride of zirconium and sodium in a crucible with sodium or magnesium. The amorphous metal prepared in this way burns with a bright light at a temperature below redness. *Aqua regia* and the ordinary acids have but little effect on it; although it dissolves in hydrofluoric acid.

Crystallized zirconium was prepared by Troost by heating 2 parts of the double fluoride of potassium and zirconium with 3 parts aluminum to the melting point of iron in a plumbago crucible, and dissolving out the aluminum with hydrochloric acid. In this state it is easily attacked by *aqua regia*, but resists the ordinary acids. It is less fusible than silicon, and burns only at the temperature of the oxyhydrogen blow pipe.

A metal possessing such a remarkable power of resisting the action of acids and heat will one day become invaluable in the arts, if methods of preparing and working it with some degree of facility are ever discovered. Let those inventors who wish that they had been born a century or two earlier, before everything had been invented, take heart, for wide fields of usefulness as well as glory await those who possess real genius and talent. To-day metallic zirconium is of no use, and only exists as a curiosity in a few cabinets.

Oxide of zirconium, or zirconia, is more easily prepared and better known, for Tessie Du Motay and others have proposed to employ it instead of lime or magnesia for the oxyhydrogen lamp. It is prepared by Du Motay for this purpose by mixing the finely pulverized zircons with charcoal and exposing to the action of a current of dry chlorine gas, which decomposes it into the volatile chloride of silicon and the basic chloride of zirconium, which latter is sublimed, and may be dissolved in hydrochloric acid and the zirconia precipitated by ammonia. The precipitate is dried, ignited, and mixed with borax, clay, etc., and pressed into cylinders the size of a pea. When these cylinders are heated in a jet of oxygen and hydrogen gas, they become intensely luminous, giving a steady white light fourteen times brighter than street gas. The advantage which it possesses over lime and magnesia are its perfect infusibility and its non-attraction for moisture from the air; it crumbles as lime does by air slaking. The great difference in cost has, however, overbalanced the advantages on the side of zirconium, and it seems doubtful at present whether it will ever meet with extended use.

When perfectly pure oxide of zirconium is required, the above method cannot be employed; for although the chloride of silicon is much more volatile than the chloride of zirconium, it is practically very difficult to separate them completely in this way. A better method is that of Marignac. The mineral is broken in small pieces and ignited in a platinum dish with 2 or 3 parts of the acid fluoride of potassium. The mass, which consists of the double fluoride of potassium and zirconium, mixed with the double fluoride of potassium and silicon, is boiled with water containing a little hydrofluoric acid, filtered, and the residue washed with a small quantity of hot water. On cooling, the fluoride of potassium and zirconium crystallizes out. After purifying by recrystallization, the crystals are evaporated to dryness with concentrated sulphuric acid, and the sulphate dissolved in water. From this solution the hydrated oxide is precipitated by ammonia.

As to the salts of zirconium, the preparation of the chloride and fluoride has already been described. Bromide of zirconium was first prepared in 1869 by D. E. Melliss of New York, then a student of Professor Wöhler at Göttingen. The oxide of zirconium was mixed with charred sugar, and kneaded into pellets by means of starch paste and dried. These were then introduced into a tube of hard Bohemian glass. The tube was heated to redness, while a current of bromine vapor was conducted through it by means of dry carbonic acid. The bromide of zirconium is a white crystaline powder. It has a great affinity for water, with which it forms an oxybromide of zirconium, by exchanging two atoms of bromine for one of oxygen. The sulphide of zirconium is prepared by heating the metal with sulphur in a vacuum or in hydrogen gas. Zirconium forms double fluorides resembling the fluorsilicates. Its oxide also combines with bases after the manner of silica.

Zirconium, then, may be said to stand intermediate between silicon and aluminum, being willing to combine with either: with this difference, that no compound of silicon and zirconium has been prepared without oxygen, while its union with aluminum more nearly resembles an alloy. At all events, until it has been more thoroughly studied, we must class it among the metals.

### PATENT MEDICINES.

The German scientific papers are accustomed to publish the results obtained by analyzing the various quack medicines and nostrums that come under their notice, thus exposing humbugs and warning their readers against wasting money and endangering their lives by the use of such compounds. Of course our American patent medicines are often subjected to the same test. Recently the Berlin *Industrie Blätter* published the composition of Mrs. Allen's "World's Hair Restorer." In a recent number of the same journal the following is given as the composition of the stuff sold as Dr. Sage's "Catarrh Remedy":

It contains 7 grains carbolic acid, 7 grains camphor, and 2·57 drams common salt. The whole is colored with a little Prussian blue, and sold at 50 cents per bottle, which affords a nice little profit above the expense of labels, advertising, etc. The same number of this journal exposes an eye balsam sold by a widow Müller in Berlin, which is warranted to cure every form of eye disease. It consists simply of 3 grains oxide of mercury (red precipitate) and 2·5 drams strong, unsalted butter. This old and well known salve is sold in boxes holding about 3 cents worth for the modest sum of 15 cents. From this statement it will be seen that the German quacks are satisfied with smaller profits than our people; for it is not long since a Philadelphian firm had the audacity to put up less than a cent's worth of carbolic soap and sell it for 25 cents as a sure protection against small pox.

The composition of the article called Dr. Pierce's alterative extract or "Golden Medical Discovery" is given as follows: 4 drams purified honey, 15 grains extract of poisonous lettuce, 30 grains tincture of opium, 3·5 ozs. dilute spirits tasting like fusel oil and wood spirits, and about 3 5 ozs. of water. Ten cents worth of this trash sells for $1.00.

### The Cincinnati Industrial Exposition.

The fourth yearly Industrial Fair will open in Cincinnati on the 3rd of September and close on the 4th of October. We take this early opportunity of calling to it the notice of our readers generally, and of suggesting that they prepare their contributions in due season. The exhibition, we are informed will be one of the largest and most extensive yet held in the West, and will form an excellent medium for Eastern manufacturers to introduce their new products to the people of that great section of the country. Rules, premium lists, etc., may be obtained upon application.

### New British War Steamer.

An event of interest recently took place at Chatham, Eng., in the launch of the Raleigh, a ship built, not, as the majority lately constructed, to offer great resistance to shot and shell, but with a view to combine great speed with a very heavy armament. She is therefore built of iron, sheathed with wood and coppered, and lined with brown cardboard, as being less likely to splinter, and also less inflammable than timber; and her dimensions are: Length, 298 feet; breadth, 48 feet 6 inches; draft of water, forward, 20 feet: aft, 23 feet; tunnage, 3,210 tuns; armament, upper deck, two 12½ tun guns, four 64-pounder guns: main deck, fourteen 90 cwt. guns, two 64-pounder guns; horse power, 800; crew, 530; and she is estimated to cost, when entirely finished, about $1,000,000.

A SHELL which exploded recently at the shell foundery at the Royal Arsenal, Woolwich, when placed in a cupola for being melted down, is believed to have been a 600 pounder for the 11 inch gun, a conical projectile constructed on the Palliser system which had been returned from the practice ground at Shoeburyness. The roof and skylights of the adjacent buildings were damaged more or less by fragments of coke and chalk thrown up from the furnace by the force of the explosion, but the mischief done is comparatively trifling.

A GENIUS in New York has notified the Post Office department that he has applied for a patent for printing two or more advertisements on the newpostal cards. He wishes he may get the patent, but probably he won't.