THE ELECTRIC DIADEMS OF THE NEW BALLET "LA FARANDOLE."

The light is produced by an incandescent electric light of very small dimensions and of feeble resistance. The lamp is supplied by two chloride of silver piles which each coryphee carries with her in a scent box attached to her belt.

Fig. 1 shows the apparatus in very much reduced size. When the danseuses are dressed, they come, forty-eight at a time, into a large hall, in which extend long tables upon which lie the various apparatus inclosed in boxes, each bearing the name of a danseuse. Each of the latter then fastens around her waist the belt of silvered metal, containing the two piles inclosed in perfume boxes (Fig. 1), and places her diadem upon her head, while an assistant attaches to the middle of her tresses the conducting wires that connect the piles mounted in tension with the incandescent lamp.

This done, the coryphees are assisted by a maid in adjusting around their waists a muslin scarf that nearly hides the apparatus. The incandescent lamp in the diadem is mounted in front of a metal star covered with green stones that imitate emeralds and form a reflector. To the belt there is fixed, at the side of the piles, a small commutator that permits the coryphee to close or open the circuit in order to light or extinguish her lamp at will. This commutator is very simple, and consists of a small cylinder of the size of a lead pencil, that is pushed into or drawn from a sheath in which it slides with slight friction.

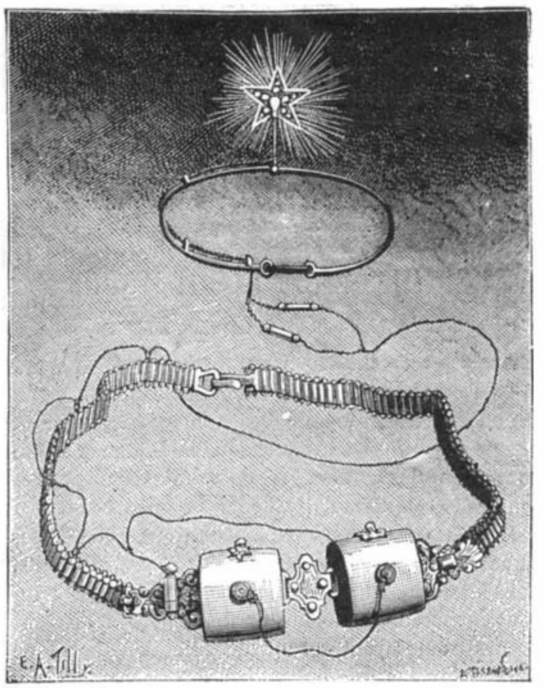


Fig. 1.—ELECTRIC DIADEM AND BELT USED IN THE BALLET OF THE FARANDOLE IN PARIS.

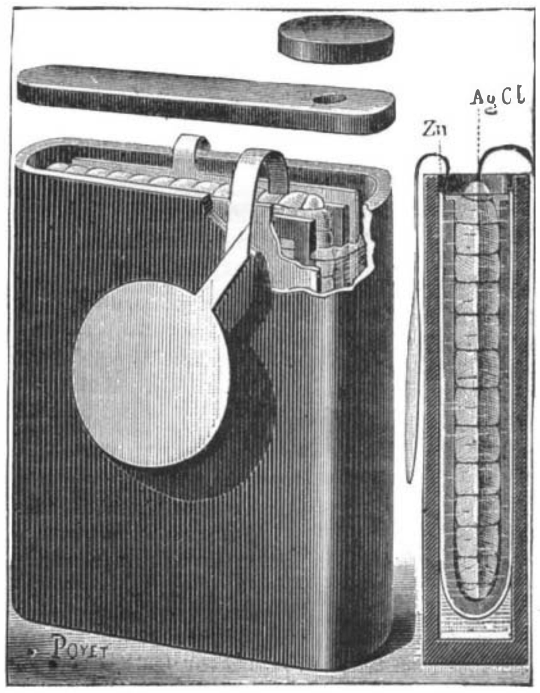


Fig. 2.—BATTERY USED WITH THE ELECTRIC DIADEM.

The pile, which is the invention or Mr. Scrivanow, is shown in Fig. 2. It is held in a gutta-percha trough. The two electrodes consist of a strip of silver covered with chloride of the same metal and inclosed in a bag made of parchment paper. The bag is surrounded by a strip of zinc bent double, and from which it is insulated by a piece of perforated gutta-percha. The section of the pile represented to the right of the figure shows its arrangement. The zinc is figured at Zn, and the bag of chloride of silver at AgCl. The exciting liquid is an alkaline solution formed of very dilute potassa. The gutta-percha trough, with the electrodes passing out to the right and left, is hermetically closed by a plate of gutta-percha in which there is an aperture for the introduction and renewal of the liquid. This aperture is closed by a cork. In the engraving these pieces are shown separate in order to make the details and arrangement better understood.

Such is the ingenious system of electric lighting adopted by the management of the opera. The only objection that we can make to it is that it is wanting in luminous intensity; but, as each pile weighs but ninety grammes, it would be possible to use three instead of two, and thus obtain a much more remarkable effect. However this may be, there is reason for congratulating the organizers or the care that they have taken in this happy application. No so important experiment as this has hitherto been made upon a French stage in lighting a ballet electrically. The apparatus is light and portable, and may find an application in this winter's cotillons.—*La Nature.*

DUJOUR AND BIANCHI'S SINGLE AXLE WINDLASS.

Upon comparing our present mechanisms for hoisting with those that were formerly used, we find that the improvements that have been introduced into these apparatus are not numerous, despite the powerful devices that are brought into play in our time for the construction of mechanical pieces. For example, the windlasses in block and pulley 10 ton cranes have at least four axles and a dozen gearings (some of them 1·2 m. in diameter), while in the most remote times there was a differential wheel and axle that permitted of quite large loads being raised. It is true that we now have two speeds for the hoisting of loads, but this advantage is obtained at the expense of simplicity and convenience without avoiding the dangers that are run by the men who operate the apparatus.

The conditions that should be satisfied in the mechanism of a windlass may be formulated thus: (1) There should be as few mechanical parts as possible, and few points of contact with the frame; and (2) the arrangement should be such that stresses exceeding the maximum charge shall be avoided, and that the men who operate the apparatus be protected from accident.

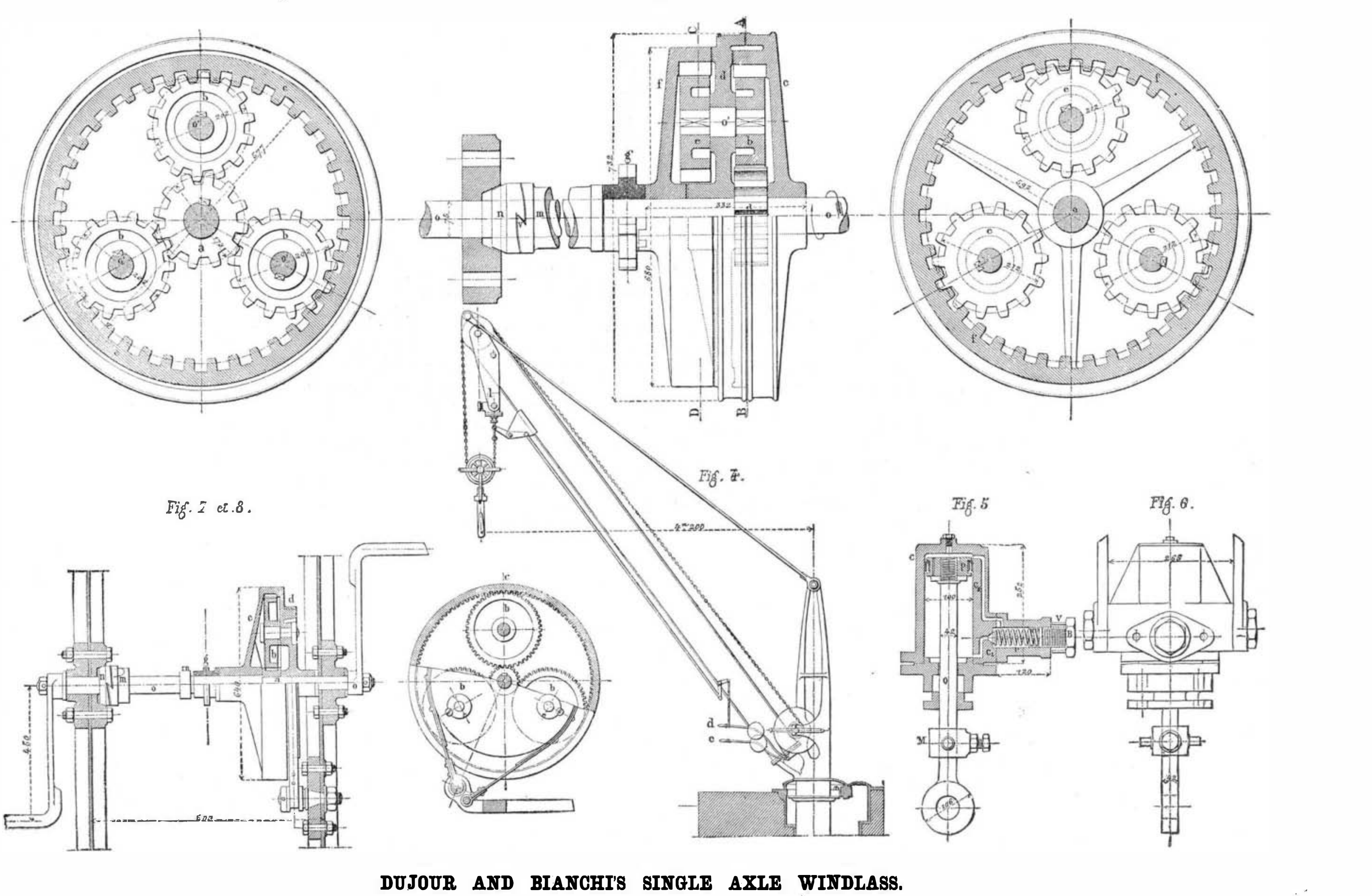
After an attentive study of this question, Messrs. Dujour and Bianchi have found a very ingenious solution of it by the invention of a single axle mechanism with automatic brake, with an automatic limiter of the load, and in which there is no reversal of the winch.

Figs. 1, 2, and 3 of the annexed engraving show the arrangement for a 10 ton crane.

The new mechanism consists essentially of an axle, O, upon which are keyed a pinion, *a*, and two winches at an angle of 180°. Then of three drums, *c*, *d*, *f*, and a ratchet, *g*, which revolve by slight friction around this same axis, and, finally, of a sleeve, *m*, that is capable of moving a friction disk, *n*, longitudinally along a hollow cone in one of the supports of the shaft.

When the rotation of O is positive, that is to say, when its effect is to lift the load when the winches are turned in the direction shown by the arrow, the tooth, *m* (which is beveled), carries along the sleeve, *n*, to the right and keeps it away from the support of the axle. On the contrary, when the axle revolves in the opposite direction the helicoïdal surface, *v*, thrusts the disk, *n*, toward the left and puts it in contact with the grooving in the frame. The friction of the cones then acts in such a way as to stop the revolution of the axle. This arrangement may, moreover, be replaced by plane or penetrating surfaces, and even by a ratchet held by means of a click, in the running of the winches in a wrong direction.

Upon examining the engravings it will be seen that the drum, *d*, carries three axles, *o'*, upon each of which are keyed two wheels, *e* and *b*, one of which gears with the wheel, *f*, fixed to the ratchet, *g*, and the other with the pinion, *a*, and the wheel, *e*. The object of these three identical systems is to distribute the pressure over three gearings



DUJOUR AND BIANCHI'S SINGLE AXLE WINDLASS.

whose dimensions are small, and upon three points of the circumference of the drums, c, d, and f, in such a way as to diminish the friction upon the axle, O. This apparatus is also provided with three friction bands that are actuated alternately by a single weight, or by two distinct ones, and capable of successively rendering immovable one or the other of the drums, c and d, during the raising of a load.

Herein consists the essential feature of this mechanism. In fact, if the drum, c, is rendered immovable, the annexed diagram shows that, upon revolving the pinion, A, a distance, x, the wheel, B, will make an entire revolution around the center, b, and this will carry along in its motion the gearing, E, whose point, e, will move in a direction contrary to x by a distance equal to

$$\frac{e\,b}{b\,a} \times x = \frac{d_2 - d_1}{2d_1} \times x.$$

Since the wheel, F, gears with the pinion, E, it will revolve this same distance around the axle, O, and carry along the ratchet, g, with which it is connected by a toothed gearing.

It suffices, then, to reduce at will the difference between the diameters of the two wheels, B and E, in order to increase the ratio of the pinion, A, to the ratchet, g. Upon making E=B, the wheel, A, would not revolve, that is to say, the ratio would be infinite. Finally, with E < B it would revolve in the same direction as the axle, O.

In designating the diameter of the circle traversed by the winches by D, and that of the ratchet, g by δ, the ratio of the chain's velocities to the winches is given by the following expression, when the drum, c, is immovable and d is free:

$$\frac{d}{D} \times \frac{d_2 - d_1}{2d_1} \times \frac{\delta}{d + d_1 + d_2}.$$

On another hand, on making the drum, d, immovable, it will be at once seen that the motion, x, of the pinion, a, will be transmitted to the wheel, f, whose revolution corresponds to

$$\frac{d_2}{d_1} \times x.$$

In this case the ratio of the chain's velocities is only

$$\frac{d}{D} \times \frac{d_2}{d_1} \times \frac{\delta}{d + d_1 + d_2}.$$

On comparing the two above expressions, we obtain the following ratio:

$$\frac{d_2 - d_1}{2d_2} = 0{\cdot}50\left(1 - \frac{d_1}{d_2}\right).$$

Now, for a 10 ton crane (5 tons upon the chain) this ratio is:

$$0{\cdot}50\left(1 - \tfrac{19}{22}\right) = 0{\cdot}0684.$$

Thus, in rendering the drum, d, immovable we give each chain a velocity of 1: 0·0684 = 14·6 times greater than on locking the brake of the gearing, c.

Moreover, in case of $e < b$, instead of $e > b$, the wheel, f, will revolve in the opposite direction, as we have seen above. Consequently, a mechanism arranged in this way would possess at the same time two velocities having alternating motions, and might be applied to planing machines as well as to parallel lathes.

In order to obtain great velocity and an opposite direction of rotation, we should act upon the disk, d, while small velocity and a direct motion would be obtained in keying the drum, c.

Figs. 5 and 6 of the accompanying engraving represent the apparatus devised by Messrs. Dujour and Bianchi for automatically limiting the maximum load to be suspended from the crane. It consists of a cylinder, C, bolted to the crane post, and provided with a piston, P, whose rod, O, is fixed to the extremity of the chain. This cylinder is filled with a liquid that is not much affected by changes of temperature (water mixed with alcohol or glycerine). When the piston moves upward the liquid in the upper part passes out through the apertures, t, by raising the rubber linings, p; but, in the down stroke, the water can return to the top of the piston only by following the channels, c_1 and c_2, and by moving the valve, v, which is held upon its seat by a spring, r.

The piston, P, then, does not descend as long as the rod, O, is supporting a pressure less than that of the regulating spring. The tension of the latter is varied, as need be, by means of a screw, B, whose entrance is limited by a ferrule, V. These parts may also be covered by a safety nut.

Upon examining Fig. 4, it will be seen that the down stroke of the piston and the mechanism of transmission (consisting of a sleeve, m, and a rod and two angle bars) act upon one of the two brake levers, corresponding to the drums, c and d, in order to render the windlass immovable. This arrangement is preferable to a throwing out of gear, since the danger of a fall of the load due to too sudden a stoppage of its descent may thus be avoided.

The "limiter" also satisfies one condition essential to security by automatically rendering the windlass immovable when the breakage of any part occurs.

After being pushed down by a load greater than that of the regulation, the piston, P, is put back in place by raising the lever of the brake with which its rod is connected. The effect of this maneuver is to disengage the windlass. It is evident that the rod of this piston must be put in communication with the brake of the drum, d, whose revolution corresponds to the greatest power of the crane.

In sum, this windlass possesses but one axle, and is of modest dimensions for all powers. It is provided with an automatic gearing which prevents the winches from turning back during the descent of the load; with a brake that is continuously actuated by a weight, and that stops the load automatically, either on lifting, when the winches are left free, or on lowering, if the lever of the brake happens to be freed; and, lastly, with an apparatus for throwing the axle of the winches into gear when the weight to be lifted is too great for the crane.

We must also add to the interesting peculiarities of this mechanism the two ratios of the winches' velocity, and their change, which latter is effected without stopping the motion of the windlass. In cranes of small power this double velocity may be dispensed with without inconvenience, and the mechanism simplified, while its advantages are at the same time preserved. For example, the ratchet, g, being directly in gear with the drum, d, we may suppress the gearings, e and f, and preserve only one brake for rendering the drum, c, immovable.

In this case the ratio of the speeds is given by the following expression:

$$\frac{d}{D} \times \tfrac{1}{2} \times \frac{\delta}{d + d_1}.$$

Figs. 7 and 8 represent a windlass in which the drum, d, is rendered immovable, while the ratchet, g, is fixed to the wheel, c. The ratio of the velocities we write thus:

$$\frac{d}{D} \times \frac{\delta}{2d_1 + d}.$$

The gearings employed in both systems present no danger for the men who operate them, since they are entirely inclosed in a drum belonging to the very parts of the windlass.

Moreover, their arrangement is applicable to all hoisting apparatus, and, in general, to the mechanism of lathes and machine tools in which are utilized one or several trains of gearings either for increasing the force and diminishing the velocity, or for having an alternating motion with change of running.—*Revue Industrielle.*

Beer Soured by Thunder.

It has long been a matter of common observation that beer, milk, and other substances liable to decomposition, undergo rapid and adverse fermentative changes during thundery weather, and "turned sour by thunder" is the generally accepted explanation of much beer going to the bad. It has been somewhat difficult to reconcile the modern theory of fermentation by germs with the well-recognized phenomena attending thunder storms, and the changes which then take place are more consistent with Liebig's cataclytic theory, who attributed fermentation to molecular instability—"the ferment propagating to surrounding molecular groups the overthrow of its own tottering combinations." According to a paper "On the Effect of Heat on the Atmospheric Dust," recently read by Mr. Aitken before the Royal Society of Edinburgh, the author showed that a disturbed electrical condition of the atmosphere greatly favored the deposition of dust; and he suggested that this might be the explanation of the common belief that beer and milk readily turn sour in thundery weather, the electrical conditions leading to the deposition of a greater number of bacteria in a given time. This explanation would apply to beer exposed to the air in open vessels, but scarcely to beer in casks, which is practically protected from the atmosphere; and we know that the beer in casks often turns sour within a few hours of a thunder-storm. It is possible that the peculiar electrical conditions of the atmosphere preceding and accompanying a thunder-storm may galvanize into full vitality the myriads of disease ferments which must, under the most favorable circumstances, be present in every cask of beer brewed under our existing system, or that the vibrations caused by the peals of thunder may move a number of these minute organisms, which until then were lying dormant and inactive. —*Brewers' Guardian.*

Tempered Cast Steel.

We translate from the *Deutsche Industrie Zeitung* the following in regard to the manufacture and properties of tempered steel, a new industry that has spread into Westphalia and the Rhine provinces from Belgium. This metal is able to compete with malleable cast iron on the one hand and with cast steel on the other, while for many purposes it is superior to either. It is made from old steel and scrap steel, which is cut in small pieces and smelted with coke in the cupola furnace, and, like ordinary cast iron, run into slightly dried sand moulds. The liquid metal is intermediate in temperature between cast iron and cast steel, and throws off many sparks. The castings are tempered by packing them in powdered red hematite ore in boxes made of refractory stone and heated in tempering furnaces. The last operation imparts to it an extraordinary degree of strength and tenacity that renders it superior to ordinary cast steel.

Its superiority to malleable cast iron is due to the nature of the material; although both are decarbureted by tempering to a certain depth, yet it will take place more rapidly and be more perfect in cast steel than in cast iron. The articles made from the former are much stronger than those from the latter, because the unaltered core in the one case is of steel and in the other of cast iron.

The greatest advantage possessed by tempered cast steel over both malleable cast iron and cast steel is its cheapness. The price of old steel and of scrap is comparatively low, and the consumption of coke for melting it in a cupola furnace is not much higher than for smelting cast iron, while the crude materials employed for steel castings as well as for malleable cast iron are much more expensive and the consumption of fuel is much higher, independently of the cost of crucibles and of cast iron tempering boxes. Tempered cast steel today costs about one-half as much as malleable cast iron.

It must, however, be admitted that this tempered steel is frequently not as free from pores as malleable cast iron, and this might be expected. Recently considerable progress has been made in overcoming this difficulty, and in most cases a few individual pores do not damage the castings.

The tempered cast steel finds extended use for the manufacture of wheels of mine cars in Westphalia and Belgium coal mines; also for ore, coke, and slag wagons.

Tempered steel also can be employed with advantage for all articles that can be cast more cheaply than wrought, and require great strength and the power of resisting jar and concussion as well as sudden changes of temperature. The pipes through which melted slag from blast furnaces flows, if made of tempered steel, can be thrown into cold water without injury.

The manufacture of tempered steel offers no special difficulty, and any foundry can make it with a small outlay for cupola and tempering furnaces.

Manufacture of Cannon.

The Secretary of State has received from Consul Potter, at Crefeld, Germany, a report on Krupp's steel ordnance works at Essen, from which the following extracts are taken:

The forging process requires vast arrangements on account of the immense weight of the pieces which are to be handled, one of which sometimes weighs more than 60 tons. The steam hammer now in use for this purpose weighs 50 tons and has a stroke of 10 feet. Another hammer is now being constructed of much greater efficiency, weighing about 150 tons, which will cost over 10,000,000 marks ($2,500,000).

Mountain guns are finished in two months after work on them is begun, while two years are required to manufacture a 16 inch gun of 35 calibers length. This apparently long time is made necessary by reason of the large surfaces that have to be worked over on a steel cannon of this description 55 feet long and weighing 121 tons. Mr. Krupp's is the largest gun foundry in the world, being much more extensive and complete than the Government establishment of England at Woolwich. It is able to complete each year from 3.000 to 4,000 field and mountain guns, 500 siege, fortress, naval, and coast guns, of light caliber, and 100 heavy naval and coast guns.

Mr. Krupp is now engaged in constructing, upon the same principle as the gun above mentioned, 40 centimeter (16 inch) guns, of 35 calibers length, weighing 121 tons, for the Italian Government. Ten guns of this latter description have been ordered, it is said, at a cost of 894,000 f. each, for the purpose of coast defense. Particulars regarding weight and measure of these guns are not yet made public, but it is ascertained that they will send a projectile weighing considerably more than a ton through any armor which a ship can carry and float in an ordinary sea. There are some interesting particulars regarding the power of these guns which I am not yet permitted to make public. It is also stated that the Chinese Government has ordered guns for coast defense and naval purposes of similar dimensions and power, which are in process of construction at this time by Mr. Krupp, who has already furnished that Government with 425 cannon of less weight, and since June last has been engaged on a contract for 450 more of his powerful steel guns.

We would add to this that after seven years of idleness the larger furnace of the South Boston Iron Works was lighted up on March 1, for the casting of a 12 inch rifle mortar for the United States Ordnance Department. This is to be the first of a lot of five heavy experimental guns authorized by the last Congress. The second will be a 10 inch breech loading rifle. The body is to be of cast iron, re-enforced by a wrapping of steel wire. The third is to be a 12 inch breech loading rifle, entirely of cast iron, and is to weigh 57 tons. The fourth is to be like the third, with the exception that it is to be lined from the breech with a short steel tube, to reach a little beyond the trunnions. The fifth is to be a 12 inch breech loading rifle. The body, of cast iron, is to be re-enforced by steel rings around the breech and to be lined the full length with a steel tube. It is expected that these heavy rifles will endure charges of 200 to 300 pounds of powder, with projectiles weighing 700 pounds, giving a velocity sufficient to penetrate 24 inches of iron. The works also have contracts with the United States Navy Department for 6 and 8 inch steel breech loading rifles for the new steel cruisers, and for the conversion of 10 inch smooth bore "Rodman" guns into 8 inch muzzle loading rifles, for the War Department.

Color Blindness.

The Pennsylvania Railroad Company still continues the examination of its employes for color blindness and other defects. This has been continued for a number of years, the men being examined in batches. The general manager of the company states that these examinations have resulted thus far in ascertaining that about four per cent of those examined have proved defective either in hearing, vision, or ability to distinguish colors. Nearly 500 men have been so unfortunate as not to pass the examination, and were suspended.