ELECTRIC WELDING.

(*Continued from first page.*)

ening screws, bolts, bars, or shortening them by cutting out sections, and for renewing the cutting edges of lathe tools. The number of applications of electric welding to work of this kind seems to be almost endless. Electric welding is adapted to much of the work of the jeweler. A large proportion of the gold work now soldered may be welded. In the manufacture of gold rings it will be particularly advantageous, as it renders the ring of uniform fineness throughout.

For welding electrically, a current of great volume or quantity and very low electromotive force is required. It may be furnished directly by a dynamo of peculiar construction, or the current from an alternating machine of high electromotive force may be used by employing a transformer capable of delivering a current of low electromotive force and great volume. Practically, the current used in welding has an electromotive force of from 1 to 2 volts, while its volume may range from 1,000 to many thousand amperes, depending on the nature and size of the bodies to be welded.

In the exhibit at the fair, the primary current is furnished by a Thomson-Houston self-exciting alternating current dynamo. This current, circulating in the primary wire of an induction coil of peculiar construction, generates in the secondary conductor of the coil a current suitable for welding purposes. The dynamo used in the present instance consists of series of field magnets arranged in a circle and connected so as to present opposite poles in alternation. The armature consists of a series of thin iron disks fastened together to form a cylindrical core, and a number of flat spirals one wire in depth, mounted on the periphery of the core and connected with two terminals leading to two collector cylinders on the armature shaft. Under the flat spirals, or "pancake coils" as they are called, are placed a few coils arranged according to the Siemens system, and connected with a commutator upon the end of the hollow shaft. The current taken from this commutator is employed solely for exciting the field magnet, while the alternating current from the collectors is used in the welding apparatus.

Referring to Fig. 2, the current from the dynamo is conducted to one binding post of the commutator, 3, which is arranged to send the current through $\frac{1}{6}$, $\frac{1}{3}$, or $\frac{1}{2}$ of the primary wire, P, of a transformer or induction coil. The primary wire of the transformer is small and long. The secondary conductor, S, is very large and short, and the body of iron forming the magnetic field is placed in proximity to the primary and secondary conductors. The remaining binding post of the commutator, 3, extends to one terminal of an isolated primary coil, 4, the remaining terminal being connected with the dynamo. The coil, 4, is provided with a switch by which any number or all of its convolutions may be cut out or placed in circuit at pleasure.

The rods to be welded are placed in the clamps, C C', the fixed clamp, C, being connected with one terminal of the secondary conductor, S, the movable camp, C', being connected electrically with the remaining terminal of the secondary conductor. The movable clamp, C', is arranged to be moved forward toward the fixed clamp, C, by means of a screw. The rods are filed and rendered slightly convex at the abutting ends, and the rod carried by the movable clamp is brought into forcible contact with the rod supported by the fixed clamp, when an appropriate flux is applied. The current is then switched on to the primary in such a manner as to cause it to traverse $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{2}$, or the whole of the wire, according to the requirements of the work in hand; or the two halves of the primary may be arranged in parallel circuit. The contact surfaces of the rods to be welded at once begin to heat, and the movable clamp, C', may be advanced as fast as the softening of the abutting ends of the metal will permit.

For the nicer adjustment of the current, more or less of the coil, 4, is introduced into the circuit by means of the switch, and the inverse electromotive force generated in this coil serves to oppose the action of the current in the primary coil, P, more or less.

When the weld, W, is complete, the primary circuit is interrupted and the work is removed from the clamps. The time required for producing a perfect weld is but a few seconds on ordinary work. The work may be hammered while the welding progresses, and it may be even removed from the clamps and hammered, replaced, and reheated, if necessary, the heated portion of the metal increasing the electrical resistance so as to confine the further heating to the same part of the metal.

One of the important features of this invention is that the metals are heated uniformly during electric welding. This results from the fact that cold metal is a better conductor than hot metal, and that, therefore, any cooler line of particles in the sections at once becomes a path for increased current, and is brought up in temperature to equality with the other portions.

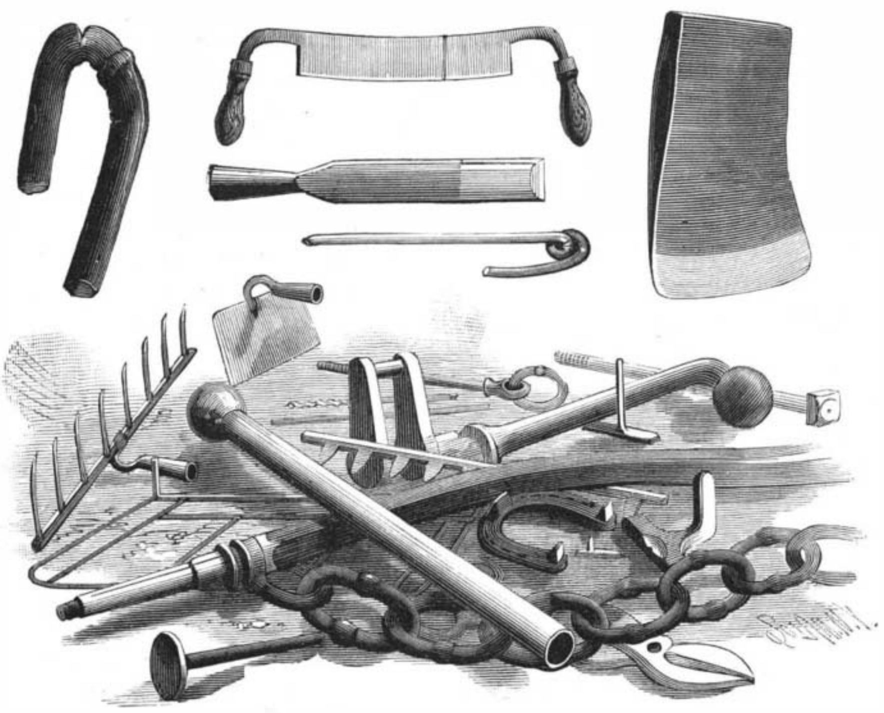


Fig. 3.—EXAMPLES OF ELECTRIC WELDING.

The absence of the dirt of the forge and cinder, common to the old method, is a decided advantage. The process is perfectly safe, and is so simple that it may be easily conducted by unskilled labor. The economy of electric welding is very great, and the range of work to which it is applicable is almost unlimited.

No exhibit at the fair attracted more attention than this. Iron, steel, brass, and copper were quickly welded, and the process was explained by the competent attendant.

The Thomson Electric Welding Co., of Lynn, Mass., are the makers of the apparatus and the promoters of the new art.

Paper Pulp.

A new method of preparing cellulose has, according to a German paper, been recently patented by a Mr. Kellner, of Podgera, Austria. The inventor produces the pulp by decomposing electrically a solution of certain chlorides, such as common salts; and allowing the chlorine gas thus obtained to act in straw, wood, or other material of similar constitution. The direction of the current is frequently changed, so that the vegetable fibers are subjected to the action of alkaline hydrates, as well as that of the chlorine. It is stated that the process has been in operation some time, and that from 170 pounds to 180 pounds of fiber are produced at each filling.

Fiber-Producing Plants in Burmah.

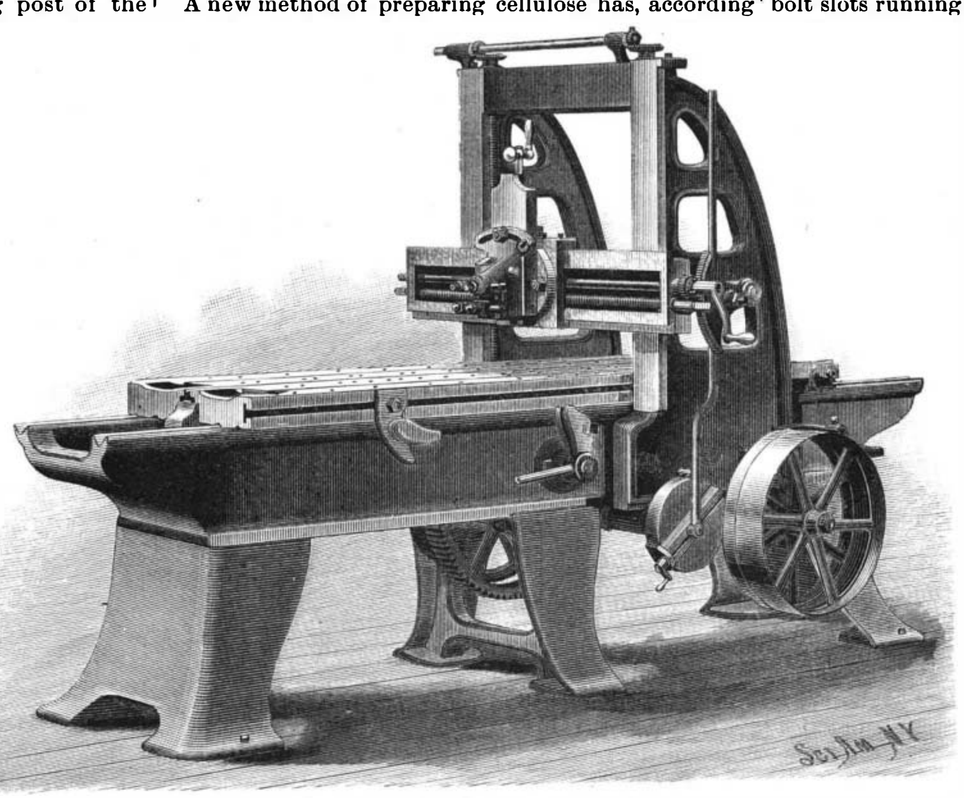
Attention is drawn by *Indian Engineering* to the fact that Burmah abounds in fiber-producing plants, of which the bamboo is the principal. If the bamboo were dried and exported, it would, on arrival at its destination, be found to be too hard for manufacture into paper, and additional expense would be incurred by having to boil it at high pressure for that purpose. The course recommended is to pick only the tender stems of the bamboo, to boil them in caustic alkali, and then to wash, tease, and dry them before packing into bales for export.

The most favorable sites for erecting such factories would be the banks of the Irrawaddy and Salween, as both localities are in easy communication with the interior, as well as the principal seaports. Besides preparing paper stock, the fiber of the plants can also be prepared for spinning purposes. The mode of treatment is very similar to that followed in the preparation of paper stock, care only being taken in the selection of bamboos, those possessing the least knots or largest internodes being best suitable; and such species are common and abundant in Burmah.

The fibers of bamboo, China grass, and pineapple can be similarly treated as jute, and spun so fine that an expert could barely distinguish the product from real silk. It is also stated that these fibers possess an advantage over jute, as they require very little chlorine when bleaching, while jute requires a large quantity, and even then a pure white is not obtainable without serious deterioration to the strength of the fiber, which is the inevitable consequence where a large quantity of chlorine is used. At the present time large quantities of cloth woven from China grass and bamboo are brought into the Rangoon markets by Chinamen from Bhamo, and although the material is not manufactured with modern looms, still the quality is so fine as to resemble tussore silk.

THE L. W. POND IRON PLANING MACHINE.

The accompanying cut represents one of the iron planing machines for heavy work designed and manufactured by the L. W. Pond Machine Co., 140 Union Street, Worcester, Mass. The bed is made very long in proportion to the length of the table, and enables the machine to plane from four to sixteen feet in length. The table is heavy, and an oil channel is cut the entire length of the slide, keeping it perfectly lubricated and preventing cutting on heavy work. There are three bolt slots running the entire length of the table. The posts or uprights are very heavy, with large breadth of base, and are firmly bolted to the bed. The driving shaft is made of steel. The cross bar is strong and heavy, and is adapted to be quickly adjusted by the raise and fall screws. The feed is transmitted to the cross, down, and angle screws through the driving shaft, by a recently patented device, and runs perfectly free and loose after having done its work at the end of the stroke. The reversing motion is also of an improved patented form, and can be easily adjusted to give either belt more or less lead, and it is entirely under the control of the operator at any part of the stroke.



IRON PLANING MACHINE.

The *American Stationer* tells its readers how they can write upon egg shells and leave the impression of engraving. The editor says all that is required is to write upon the egg shell with wax or varnish, or even tallow, and then immerse it in some weak acid, such as dilute hydrochloric acid or vinegar. The acid eats into or dissolves the lime of the egg shell, and thus the writing is left in relief. This may be successfully performed on the first experiment, although a few precautions will be found necessary. As the eggs used are usually blown, in order that they may be preserved, the holes should be plugged with wax and made airtight. As they will be found very light, some method should be devised for holding them under the surface. Two or three minutes will suffice to give the writing the proper relief, but the result will be more satisfactory if the acid is weaker and the time taken longer.

A Crooked Stick Straightened.

I had an ugly, unruly boy in my room, and he gave me more trouble than all the rest of the class. All through the different grades of the large grammar school he had been a terror to his teachers, and he was hurried on to the next teacher with surprising alacrity and precision. He never lacked promotion. When I inherited him I felt as if Nemesis had overtaken me, and just how to control him and secure any kind of work from him was a problem I long wrestled with. For several weeks he was the terror of the room, and my reputation for good order and dignity was, I felt, fast disappearing. The boy would not obey unless he felt like it, and punishments had no effect on him. He was there, he knew he was there; he had a reputation to sustain; he had earned it by several years' close application to wrong doing, and he meant to maintain it at all hazards.

It is unnecessary to narrate his pranks. Every teacher has had such boys, and will readily recognize this one. Every plan I evolved for the regeneration of the boy proved abortive. He wouldn't reform. Finally, by accident, I stumbled on the cure. I am not ashamed to say that it was an accidental plan, for it was one of those unexpected things that philosophers tell us are bound to come to pass.

I discovered that he was interested in his drawing, or rather was interested in sketching odd bits of scenery, or objects in the room, not even omitting his respected teacher, who was a typical schoolmarm and wore glasses. I resolved to make the most of this one talent—if talent it was—and so one day, when I was in my best and sweetest mood, I asked the terror if he would not draw a plan for some shelves I wanted put up in my closet. He assented, and the sketch was neatly and accurately made. There was a new look in his eyes and a new expression on his face when he gave me the paper on which his drawings were made.

Then I advanced slowly and cautiously. I needed some maps made, following a new invention of mine in cartography, and again I employed the terror, and again the result was encouraging. The maps were models of neatness and precision. I judiciously praised him, and exhibited the maps to the class and called for copies. None ever equaled his, and his joy was complete.

We were studying the continent of Asia, and the terror never had his geography lesson learned; but when I suggested that if he were to keep up his reputation in drawing he must draw the details of the country he was sketching, geography became a new study to him, and he easily made excellent progress in this branch. To do this he had to forego some of his "fooling business," and it was given up simply because he had something more to his liking to do.

In fine, and to the point, the terror came out of his chrysalis state a new creature. His old ways were left, and he readily adopted the better method of doing and living. From a slouching, unkempt, uncouth, shambling, horrid boy, he emerged into being a respectable, neat, tidy, order-loving, painstaking, and industrious young man. I had found that there was something he could do, and something he liked to do, and that was all there was to it. By doing something worth the doing he had no time or liking for doing what was not worth the doing, and mischief became no longer the object of his existence.—*Winthrop, Amer. Teacher.*

Wave Power Motor.

The *San Francisco Call* gives a graphic account of a new wave power motor just finished and proved a success. The construction of this machine or apparatus, which was begun in July, 1886, was at the time considered a half-brained scheme, but the projectors stuck to their plan, and seem now to be in the fair way to success. Great difficulty was experienced at first in getting the materials to withstand the force of rocks thrown against them by the waves, and the pipes which conduct the water up the bluff were broken and carried away no less than fourteen times. When the schooner Parallel went ashore and her cargo of dynamite exploded, the motor was completely wrecked. A mass of rock weighing six hundred tons was thrown from the cliff and fell across the chasm over which the motor was suspended, blocking it up to such an extent that nearly three months were consumed in blasting out the debris. Soon afterward another mass of stone weighing one hundred and fifty tons fell and had to be removed. The motor, which was designed and built by E. T. Steen, is a very simple contrivance, and still is capable of exerting great power.

Across a chasm in the rocks just north of Parallel Point, a bridge of heavy timbers was built. Suspended from this is a huge fan or paddle of oak timbers with the spreading portion downward. This is fastened to the bridge by immense hinges, which allow it, when in operation, to swing back and forward a distance of six feet as the waves strike it. The handle or upper portion of the fan is connected with a solid plunger pump 12 inches in diameter and having a stroke of 9 to 12 feet. This pump, in turn, is connected with a suction pipe running out into deep water. The fan is so rigged that it can be drawn up out of reach of the waves when not in use. When a wave comes in, the fan is thrown forward and forces the air out of the pump barrel in which the plunger works. On the wave receding, the fan is carried seaward and the plunger drawn out, causing a vacuum, and causes a quick rush of water into the suction pipe. The force with which the water is drawn up is sufficient to raise it to an elevation of 350 feet above the sea level.

Should this motor prove as successful as the projectors seem confident it will, several others will be built in the same neighborhood, and an immense reservoir built on the hill to contain the water.

This one motor with its 12 inch plunger is capable of raising 12,000 feet of water 350 feet high in every twenty-four hours. The uses to which the water will be put are various. A 36 inch pipe will be conducted to the city, and water will be supplied to all branches of industry where machinery is used. Bathing houses will also be supplied with salt water, and sewers flushed where it is necessary.

The first work performed will be begun in about ten days, and an 8 inch pipe is now being laid for the purpose.

The last mentioned pipe is for Adolph Sutro, and is to be utilized in sluicing away a large amount of drifting sand from the heights just back of the aquarium. This work is rendered necessary to prevent the sand from washing back on the beach and retarding the work there.

The immense fan of the motor generates a large amount of energy which is not used in working the pump, and, when everything is in shape, electric dynamos will be erected to utilize the energy for heating purposes and the like.

Tempering Springs.

A correspondent of the *English Mechanic* presents the following with respect to spring tempering:

There is, perhaps, no kind of tempering that requires so much care in manipulation as getting a good spring temper. It is necessary that the spring be carefully forged; not overheated, and not hammered too cold. The one is as detrimental as the other. To insure a spring that will not warp in tempering, it is requisite also that both sides of the forging be equally wrought upon with the hammer. If not, by the compression of the metal on one side more than another, it will be sure to warp and twist.

We will suppose that the article has been carefully forged, finished up, and is ready for tempering. Clean out the forge, and make a brisk fire with good clean charcoal; or if bituminous coal must be used, see that it is well burned to a coke, in order to free it from the sulphur it contains, as sulphur will destroy the "life" of the metal. Then carefully insert the steel in the fire, and slowly heat it evenly throughout its entire length. Give it time to heat through its thickness, and when the color shows a light red, plunge it evenly into lukewarm water, or water from which the cold chill has been taken off, so as not to chill the surface of the metal too quick before the inside can also harden, and let it lie in the water until it is of the same temperature as the water. A much better substitute for water is a good quality of animal oil—whale oil or lard oil is best. As a substitute, we have used lard, by melting it before we inserted the heated steel in it. The advantage of using oil is that it does not chill the steel as suddenly as water, and there is less liability to crack it.

Remove the hardened spring from the water after it is sufficiently cooled, and prepare to temper it. To do this make a brisk fire with plenty of live coals, and then smear the hardened spring with tallow and hold it over the coals, but do not urge the draught of the fire with the bellows while so doing. Let the fire heat the steel very gradually and evenly. If the spring is long, move slowly over the fire, so as to receive the heat equally. In a few moments the tallow will melt, then take fire and blaze for some time. While the blaze continues, incline the spring, or carefully elevate either end, so that the blaze will freely circulate from end to end, and completely envelop it. The blaze will soon die out; then smear it again with tallow, and blaze it off as before. If the spring is to be subjected to a great strain, it will be required to perform much labor—it may be lightly blazed off a third time; and if it is to be exposed to the vicissitudes of heat and cold, it must be left to cool off itself upon the corner of the forge, and not cooled by putting it in water or throwing it on the ground. Spiral springs of steel wire are tempered by heating them in a close vessel with animal charcoal or with bone dust packed around them, similar to the process of case-hardening, and when thoroughly heated cool them in a bath of oil, and proceed to temper them by putting a handful of them in a sheet iron pan, with tallow or oil, and agitate them over a brisk fire. The tallow will soon blaze, and the agitation will cause them to heat very evenly. The steel springs for fire arms are tempered in this manner, and may be said to be literally "fried in oil." If a long, slender spring is needed that requires a low temper, it can be made by simply beating the soft forging on a smooth anvil with a smooth-faced hammer. By this means the metal will be sufficiently compressed to form a very good spring without further tempering.

Use a light hammer in the process and "many blows," and a spring will be made that will last for a long time where it has to bear no great portion of labor in its action. In setting up old carriage springs where they are inclined to settle, first take the bed leaf and bring it into shape; then heat about 2 ft. in the center, plump to a cherry red; then cool it off in cold water as quick as possible. This will give the steel such a degree of hardness as to be liable to break if let fall on the floor. To draw the temper, hold it over the blaze, carrying back and forward through the fire until it becomes so hot that it will sparkle when the hammer handle is drawn across the edge; then cool off, or not, just as you please. Another mode is to harden the steel, as before stated, and draw the temper with oil or tallow. Tallow is the best. Say, take a candle, carry the spring as before through the fire, and occasionally draw the tallow the length hardened until the tallow will burn off in a blaze, then cool. Every leaf is served alike.

The Proposed Nicaragua Canal.

A corps of engineers for the survey and axial location of the Nicaragua Canal has been organized; with Mr. A. G. Menocal, Civil Engineer, U. S. N., as chief, and Mr. R. A. Peary, Civil Engineer, U. S. N, as assistant chief. The engineers are to be divided into ten parties, of which one will be the staff, having general supervision of the whole work; one will have charge of the hydrographic work, including the plans for the permanent improvement of the harbors at Greytown and Brito; six will be employed upon the topographical survey and location of the route; and two will thoroughly investigate the geological features of the country traversed by the canal, by a series of borings in all the localities where cuts are proposed.

It is expected by the promoters of the enterprise that this survey will be completed by the first of next April, when the proposed final location of the canal and revised estimates of the cost of construction are to be submitted for the inspection and approval of a board composed of the most distinguished engineers of the world, including disinterested representatives of England, France, Germany, and the United States. After the route and plans for the construction of the canal have received the approval of this board of eminent engineers, the axial location will be finally determined and the work of construction will be commenced. This plan looks a little like that of the Interoceanic Canal Congress with which M. De Lesseps commenced his work at Panama, and we suppose the inauguration of canal building is contingent upon the subscriptions to come in for the prosecution of the enterprise. Would it not be better for the Nicaragua Canal people to buy up the partially made Panama Canal works, and finish that enterprise? It looks as if it would have to be put on sale before long, although M. De Lesseps has lately issued a bulletin saying the canal would be finished in 1890, and no more money is required for its completion. The cash they have on hand, so he gives us to understand, is sufficient.

Some of the members of the canal association think that the construction will be begun before next July, but they all express the conviction that the commencement of the work upon a scale large enough to insure its completion within six years will not be delayed beyond the 1st of November, 18‑8.

The Tunnel between France and England.

At a recent meeting of the geological section of the British Association, a report was read on the present condition of the experimental heading for the channel tunnel between Dover and Calais, a distance of twenty-one miles, the completion of the work having been forbidden by the English government. A hole has already been bored seven feet in diameter, one mile and a quarter in length, nearly the whole of which is actually beneath the sea bottom. Most of the work was done five years ago, and as it has gone through a chalky formation needing no lining, it has remained perfectly dry and the substance at the surface of the boring has become harder by exposure to the air. On the French side, where only small progress has been made, as well as upon the English side, no serious obstacle has been found. The report says: "After taking all these facts into consideration, it was clear that the original estimate of £1,527,000 for the English half of the tunnel was amply confirmed by the experience obtained." That would give £3,054,000, say $15,000,000, as the entire cost of the tunnel. The authors of the report go on to consider and demolish the bugbear of foreign invasion of England, which has been the reason assigned for opposition in that country to the building of the tunnel, as follows: "Water, at the rate of 100,000 cubic feet per minute, could be admitted to the tunnel through the shaft and its connecting gallery, and five or six minutes would be sufficient to render it impassable for traffic of any kind."