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ELECTRIC WELDING.

The invention of a new art and its reduction to a practical, commercial basis is an event of some importance in the world's history. It necessarily has more or less influence on a large circle of other arts and industries. The discovery of electrical induction, and the invention based on this discovery, by means of which mechanical energy is converted into electrical energy, has made electric illumination and a host of other commercial electrical applications possible. Among these applications, one of the most recent and interesting is that of the electrical welding of metals, invented by Professor Elihu Thomson, of Lynn, Mass.

The art of welding iron and steel by means of the heat of an ordinary fire is many centuries old, and it is perhaps one of those simple operations which would hardly be considered a subject for improvement; but the invention of Professor Thomson not only facilitates the welding of iron, steel, and such metals as have heretofore been welded by the old time methods, but permits of the welding of cast iron, copper, brass, German silver, zinc, aluminum, and other metals which have generally been considered poor subjects for the welding process. Besides these, this new process has been successfully applied to the welding of unlike metals; iron and German silver, iron and brass, being examples.

The electrical welding process is not particularly adapted to job work, but in the regular manufactures, such as the making of chains, wood and iron working tools, the welding of carriage axles, the joining and repairing of shafting, the joining of wires in electric factories, the union of long pipes for coils for special purposes, the making or repairing endless bands, such as band saws, wheel tires, barrel and tank hoops, it finds its legitimate application. It also finds an extensive application in shops, for lengthening screw taps, drills, reamers, augers, in mending chisels and punches, length-

(*Continued on page* 345.)

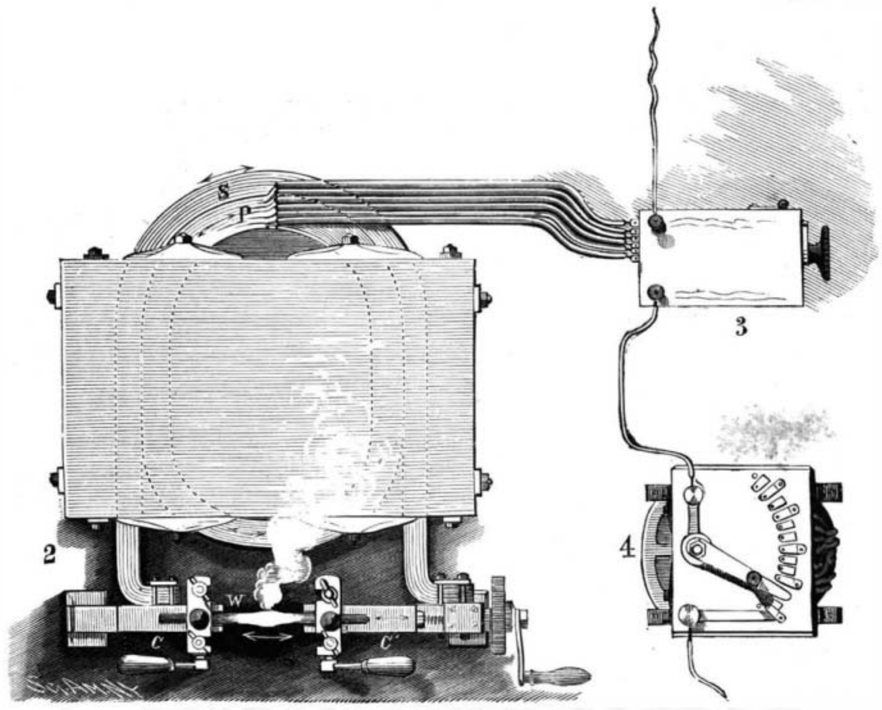


Fig. 2.—PLAN VIEW OF THE TRANSFORMER AND WELDING CLAMPS.

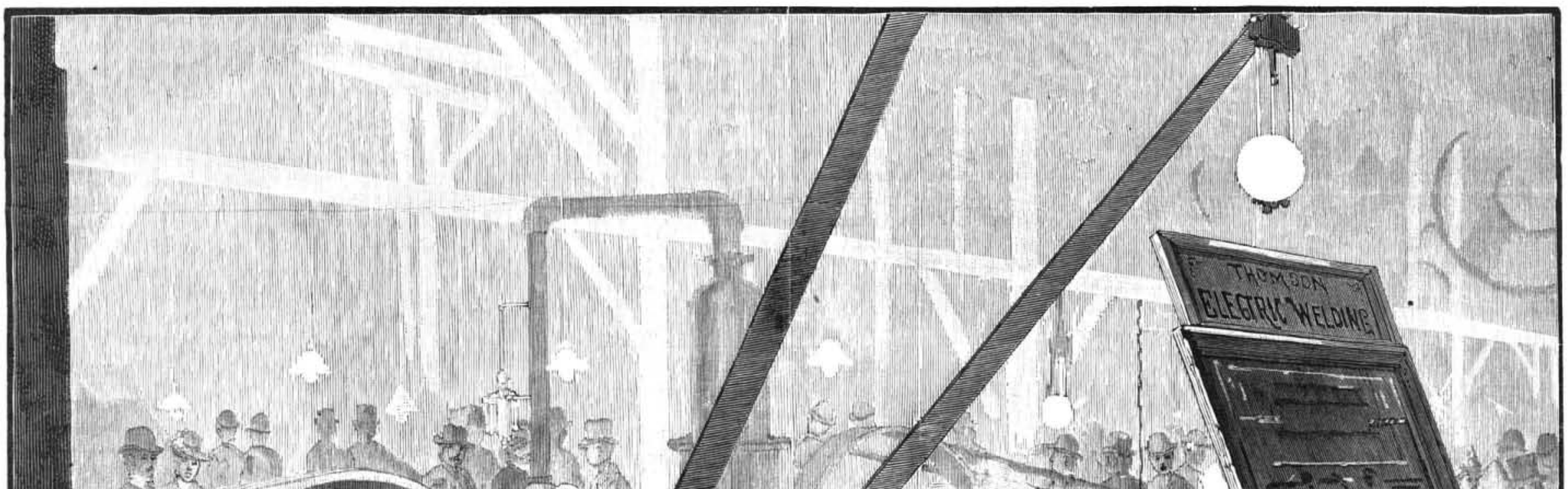


Fig. 1.—ELECTRIC WELDING AT THE AMERICAN INSTITUTE FAIR, NEW YORK.—PROFESSOR ELIHU THOMSON'S PROCESS.

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 $\frac{1}{8}$, $\frac{1}{4}$, 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 $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 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.

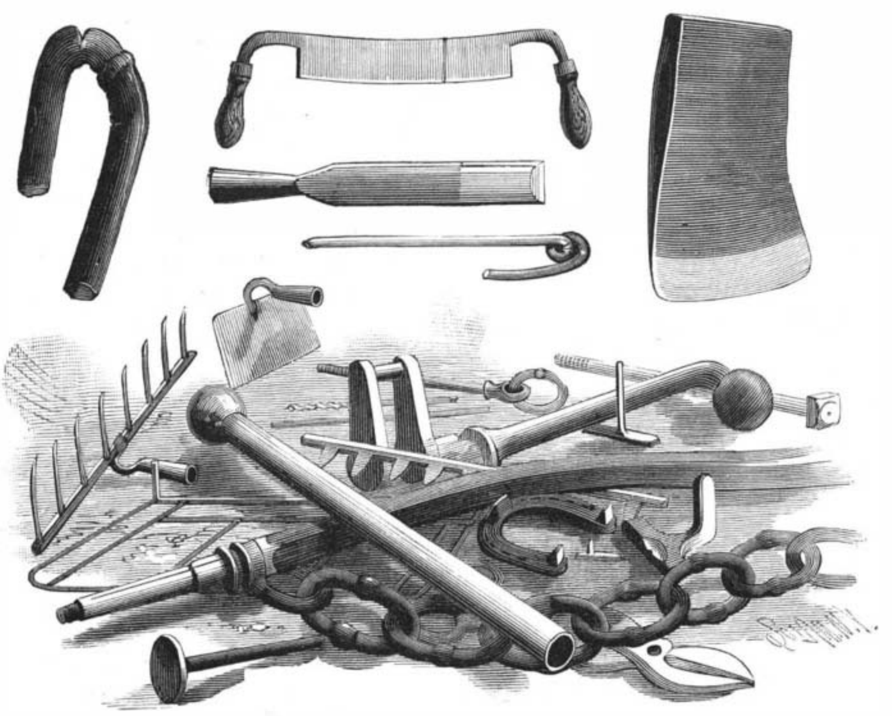


Fig. 3.—EXAMPLES OF ELECTRIC WELDING.

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.

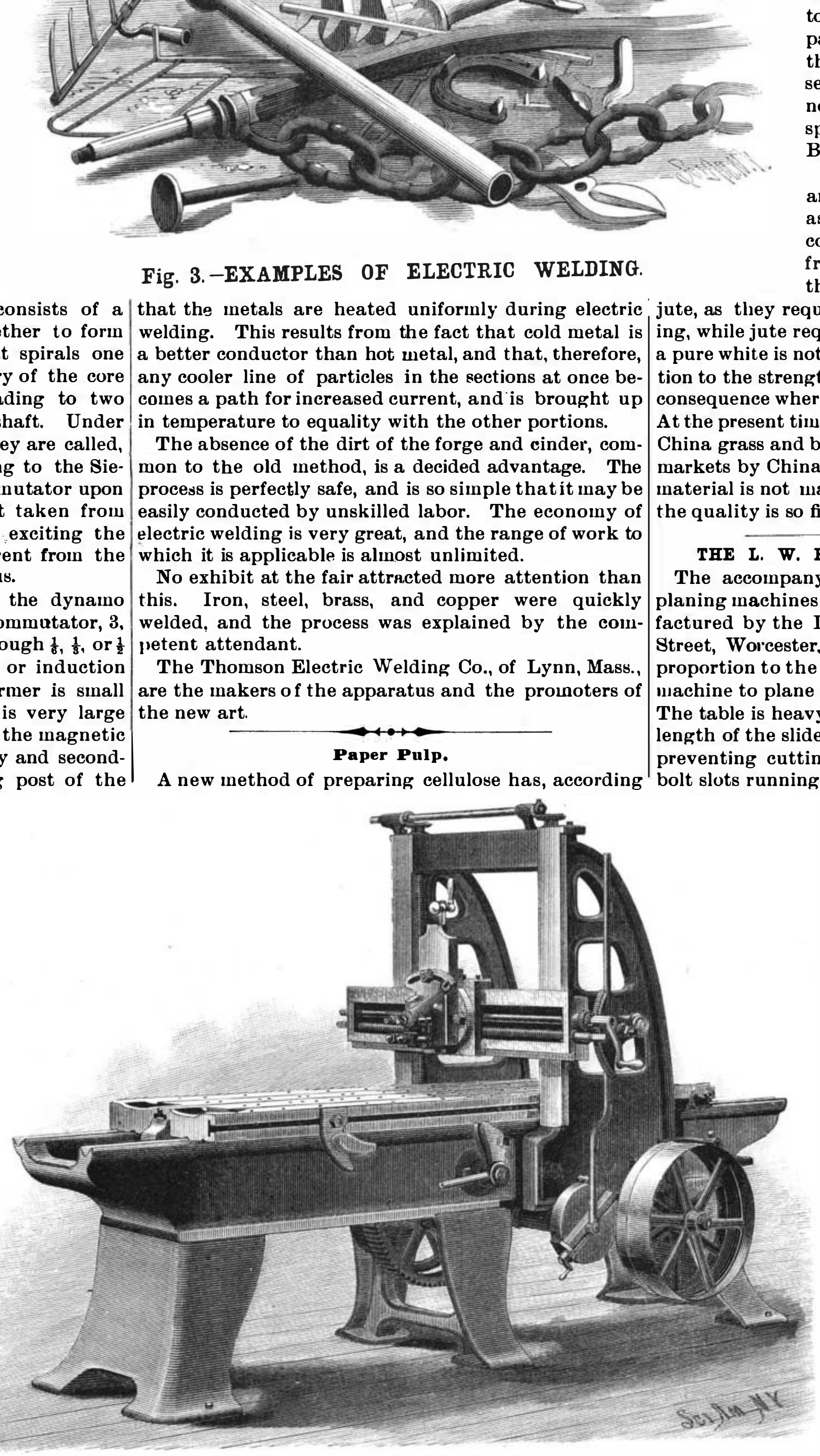
Fiber-Producing Plants in Burmah.

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.



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.

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 air-tight. 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.