(No Model.) 2 Sheets—Sheet 1.

G. D. BURTON.

METHOD OF ELECTRICAL METAL WORKING.

No. 475,182. Patented May 17, 1892.

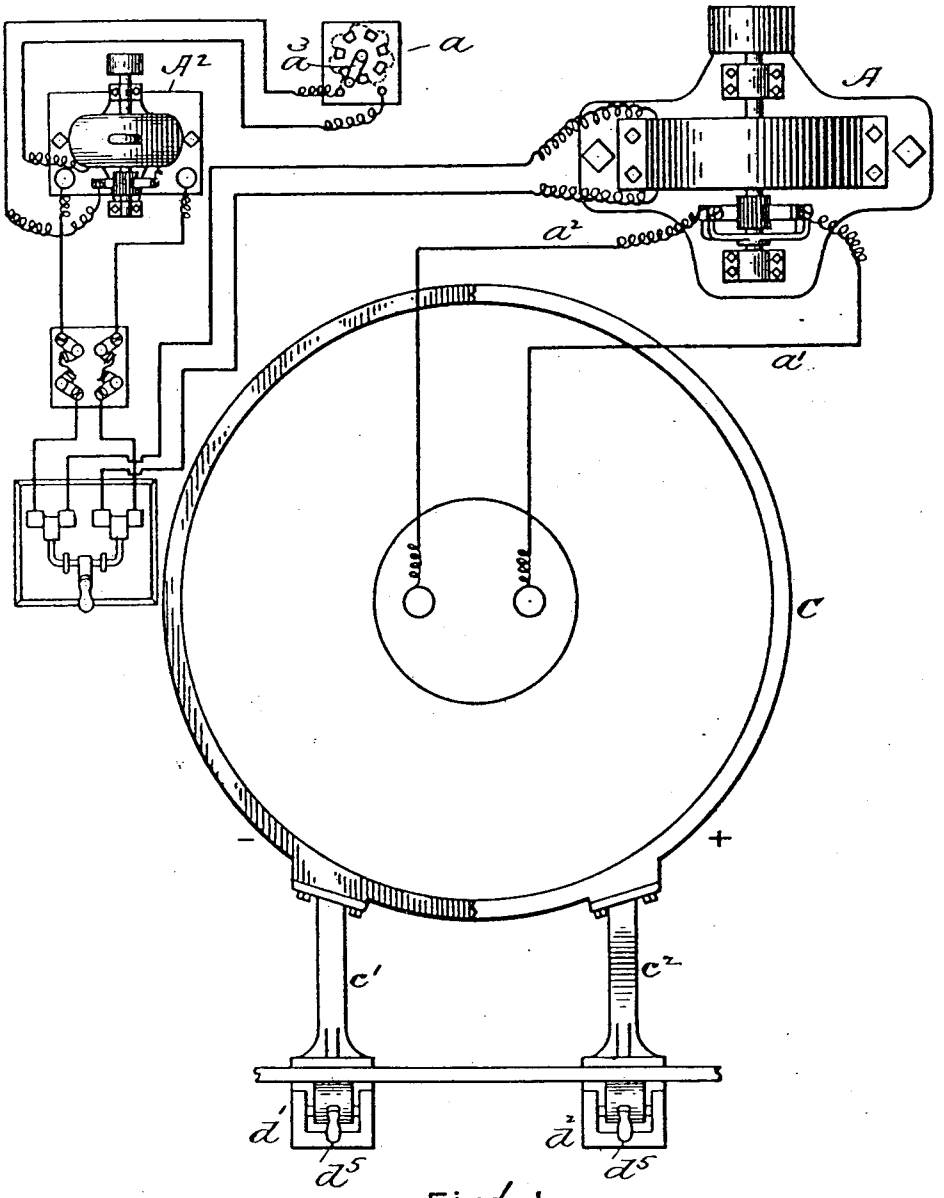

Fig. 1.

WITNESSES

C. A. Weed

H. B. James

INVENTOR:

Geo. D. Burton,

By F. C. Somes,

Attorney.

(No Model.) 2 Sheets—Sheet 2.

G. D. BURTON.

METHOD OF ELECTRICAL METAL WORKING.

No. 475,182. Patented May 17, 1892.

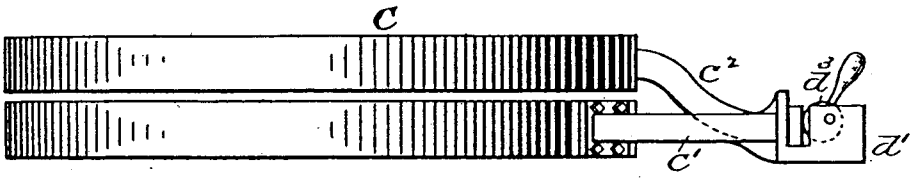

Fig. 2.

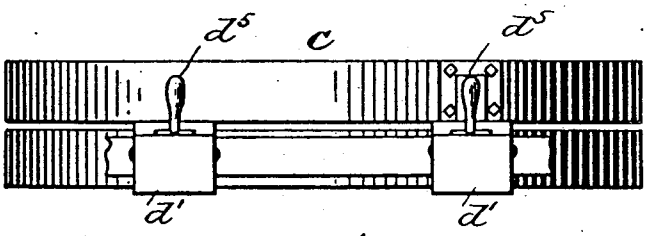

Fig. 3.

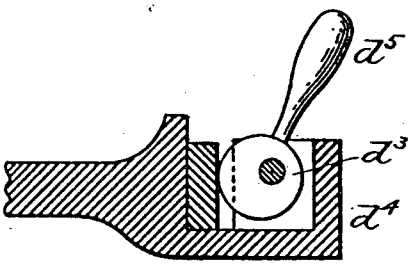

Fig. 4

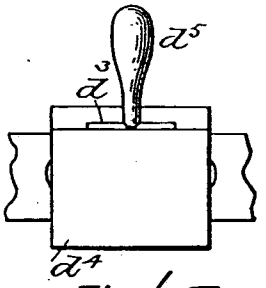

Fig. 6.

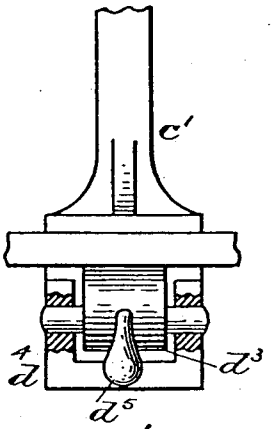

Fig. 5.

WITNESSES
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UNITED STATES PATENT OFFICE.

GEORGE D. BURTON, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE ELECTRICAL FORGING COMPANY, OF MAINE.

METHOD OF ELECTRICAL METAL-WORKING.

SPECIFICATION forming part of Letters Patent No. 475,182, dated May 17, 1892.

Application filed June 29, 1891. Serial No. 397,829. (No model.)

To all whom it may concern:

Be it known that I, GEORGE D. BURTON, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Methods of Making Steel and Iron Tools, of which the following is a specification.

My invention relates to methods of making tools or parts thereof of steel and iron; and it consists in certain new and useful steps and processes relating thereto, substantially as hereinafter described and claimed.

The drawings show certain mechanisms by which my invention is carried into effect, as follows:

Figure 1 is a top plan view of an electric-current converter and a side elevation of the dynamo for heating the steel or iron. Fig. 2 is a side elevation of the converter. Fig. 3 is a front elevation of the same. Figs. 4, 5, and 6 are enlarged detail views of one of the clamps, which secure the iron or steel in electric circuit while being heated, detached from its supporting-arm.

It has long been well known that in the process of drawing or rolling steel and iron out into bars and sheets their immediate surface was condensed and rendered very homogeneous and capable of receiving a high polish and retaining it against rust and wear. In the case of cutting-blades formed out of such rolled or drawn steel it has also been found that when the extreme cutting-edge was formed of the lamination of condensed metal lying on the immediate surface it possessed a superior smoothness and keenness. The process of forging such rolled or drawn metal bars into tools and utensils of various kinds has always heretofore removed this lamination of condensed metal, due to the rolling or drawing process, from its surface, first and chiefly in the form of scale burned off by the fire, and, secondly, by its being crushed or forced into the mass of metal underlying it on account of the forging heat being applied to the exterior of the sheet or bar and rendering that the softest. The hammering and pressing of the metal in dies therefore crushed and moved the more plastic molecules of metal on the surface away from their contiguity and arrangement with relation to each other which they assumed in the drawing process and broke these up. My invention has for its object to avoid these disadvantages and impart to irregular-shaped forged tools and utensils or parts thereof the original condensed lamination of metal which formed the surface of the rolled or drawn sheet from which they were forged. I accomplish this by heating the internal part of the bar or sheet to a much higher degree of heat than its outer surface and to such a degree of heat that the forging may be accomplished by merely bending around the exterior lamination of the metal to conform to the irregular-shaped exterior of the part of the finished tool or instrument which it becomes a portion of. This is accomplished by keeping the exterior cool enough with relation to the more plastic interior of the metal to enable it to hold its original condensed laminated character, while the tool or instrument is being shaped to the desired form under the die or hammer, and is also accomplished by the heating being performed without the application of any combustible or heating agent to the exterior of the bar or sheet being forged. Unless these two conditions are observed the invention cannot be successfully practised. To carry out these purposes I heat the bar or sheet of metal to be forged by an electric current in the open air or in some surrounding medium, which will keep its exterior surface much cooler than its internal substance, and I am careful not to raise the heat so high as to destroy the character of this surface, which was given to it in rolling or drawing the bar. I have discovered that it is possible to do this while also raising the heat of the internal substance of the bar to a degree which allows it to be forged, and, further, that the less heat of the laminated surface enables it to retain its character during the forging process and to conform to the exterior shape of the irregular tool or implement or part thereof forged, it

not being burned off in the forge by the combustion applied to it, and the electrical-heating process being so speedy that it has not time to oxidize away while being brought to the required heat.

The electric-heating current must be of sufficient volume and voltage and be applied for a sufficient time to heat the interior of the bar to a plastic forging temperature substantially even throughout the part to be forged. After the exterior surface reaches the temperature of oxidation the current must be withdrawn within a short period of time before the oxidation substantially breaks or destroys the skin of the metal. This period varies with different kinds of metal. For iron it should not generally exceed three minutes, and the current should preferably be lessened or withdrawn within one minute. For brass the period of heating after oxidation begins may be somewhat longer.

I will now describe one form of the apparatus, which may be employed to carry out my invention, although other forms may be used.

A is a dynamo of any approved construction, connected by the wires a' a^2 to the primary coil of the condenser C.

A^2 is a small dynamo properly connected up to the coils of the dynamo A as an exciter to energize the current of the latter. A rheostat or electric regulator a is introduced into the circuit of the exciter, having the swinging arm a^3, by which the strength of the exciter-current may be regulated. The secondary coil of the condenser terminates in the conductor-arms c' c^2 of great area in cross-section to accommodate the heavy current of low electro-motive force, which is delivered through them. The condenser is of any construction suitable to transform the high-tension-alternating current of the dynamo into the heavy current of its secondary coil.

On the ends of the arms c' c^2 are attached two metal clamps d' d^2. These are formed, respectively, by the cam-roller d^3, which is mounted on and pivots in the casing d^4, in such a position with relation to the end of the arm c' (or c^2) that by revolving it when any object is placed between them it will squeeze that object forcibly against the arm. The arm and roller at this point are preferably made of or faced with copper. The roller is also provided with a handle d^5, by which to revolve it.

The clamps d' and d^2 are made with area enough to their faces, which grasp the bar to be heated, to prevent undue heating of the latter where they take hold of its surface. This is very important, for if the area or conductivity of these clamps be too small the bar will be heated the highest on the surface where they grasp it.

The bar to be heated is placed in the clamps d' d^2, and they are closed down upon it and the current turned on. The size of this bar is such (say one inch wide and one-fourth inch thick) with relation to the conductivity of the secondary coil and the arms c' c^2 that it presents a comparativly high resistance to the current passing through it, and thus becomes rapidly heated to a forging heat in its internal substance. The external surface of the bar being exposed to the air remains at a much lower temperature and preserves its essential homogeneous character. While the bar is in this condition I remove it from the clamps d' d^2 and subject it to the forging process in a die so constructed as not to break the external shell by repeated blows, but merely to compress or bend it into the exterior form of the article or part thereof being forged. I may do this by a die in a press or by one mounted in a drop-hammer heavy enough to compress the article into the desired shape under its blows. The movements of the excess of metal being forged will be found to be chiefly at the more plastic center of the heated bar or strip and only a bending movement on its surface, because the hotter and more plastic metal at the center yields more easily. In this way tools—such as table-knives, chisels, augers, &c.—may be forged up either on the blade part or the handle part or on both blade and handle parts, so as to have upon them the smoothness and polish and homogeneous surface that was originally formed upon the surface of the bars or sheets of metal from which they were forged. I am thus enabled to impart a superior finish to the surfaces of such tools and render them capable of resisting rust and wear in a superior degree, and where the extreme cutting-edge can be formed of this surface part of the metal, as in the case of chisels, it has a superior smoothness and keenness. The handles of such forged tools can also be finished by polishing or nickel plating with a trifling expense compared with the present methods.

In heating the metal by the electric current, as described, it should be remembered that as the exterior of the bar or sheet is kept cooler than the internal parts the color of the heated surface will indicate a much lower temperature when the metal is ready to forge than with the methods of forging now employed; but while this color cannot be readily described in words it will be easily understood by the expert forge-operator by a little practice.

What I claim as new and of my invention is—

The method of making a metal forging, which consists in subjecting a rolled or drawn bar or sheet to be forged to the action of an electric heating current until its interior is raised to a plastic forging heat and maintaining the temperature of its exterior so far below that of the interior as to preserve its form and homogeneous character, said heat-

ing operation being performed within a period which will avoid the destruction of the external skin of the metal by oxidation, and then forging or shaping the bar or sheet into the desired irregular shape or article by bending or shaping the external skin of the bar over the internal plastic metal to form the surface of the finished article or forged part thereof without breaking or destroying said skin, substantially as set forth.

GEO. D. BURTON.

Witnesses:
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CHAS. J. TOLAND.