(No Model.) 3 Sheets—Sheet 1.

H. LEMP.

ELECTRIC WELDING APPARATUS.

No. 440,641. Patented Nov. 18, 1890.

Fig. 1

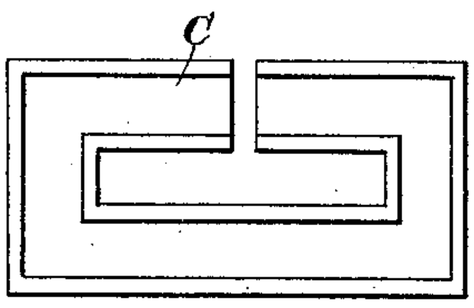


Fig. 2

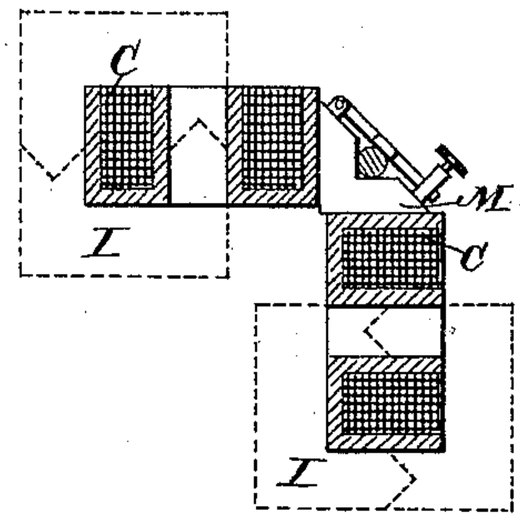


Fig. 3.

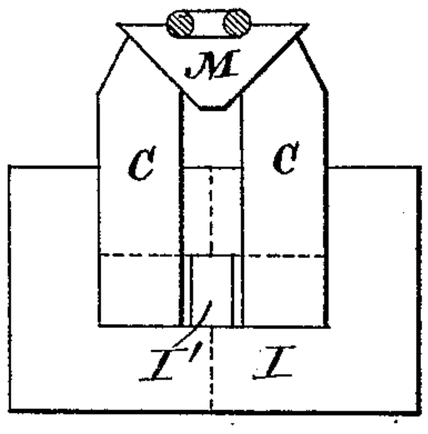


Fig. 4.

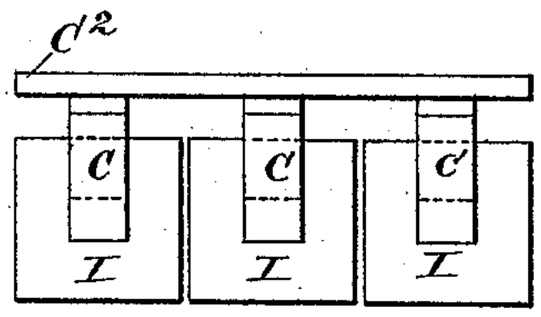
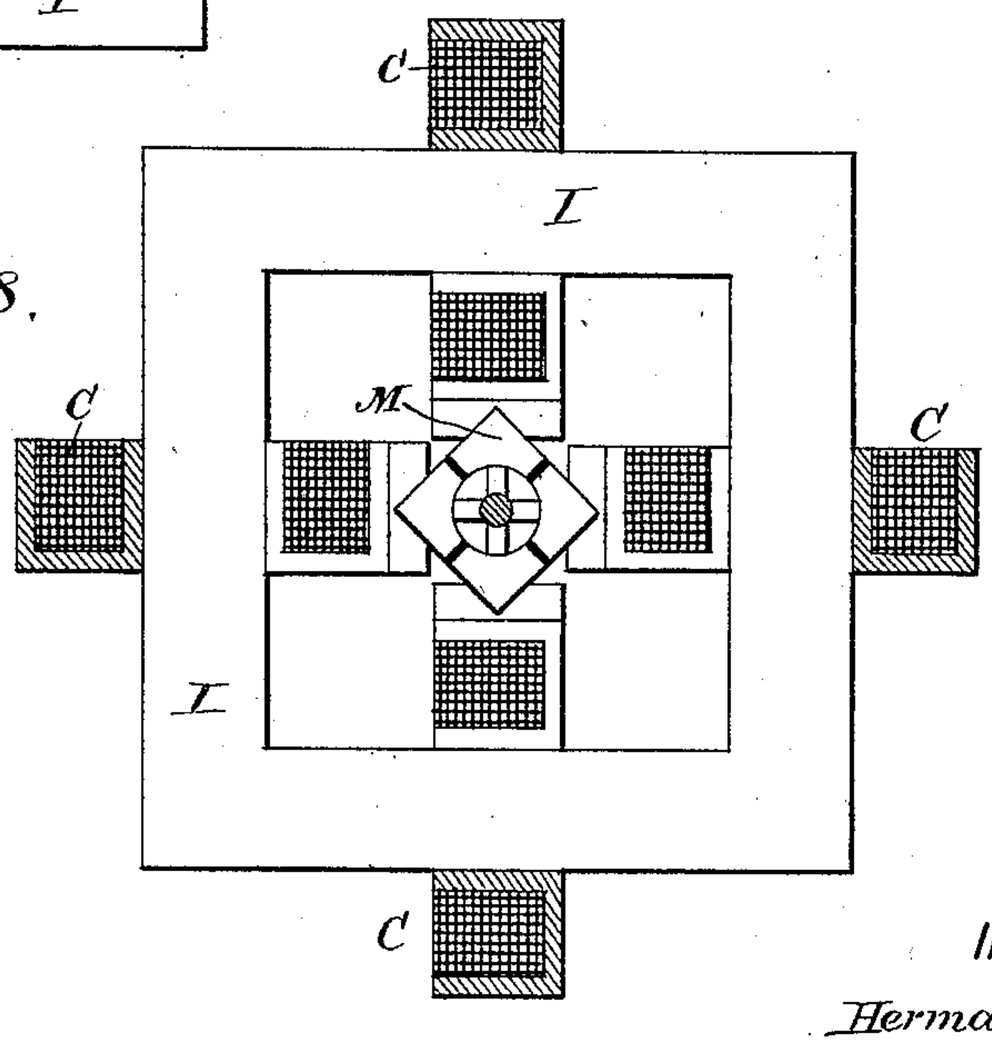


Fig. 8.



ATTEST:
J. A. Hurdle
Wm. H. Bagley

INVENTOR:
Hermann Lemp
By H. B. Townsend
Attorney

(No Model.)

3 Sheets—Sheet 2.

H. LEMP.

ELECTRIC WELDING APPARATUS.

No. 440,641. Patented Nov. 18, 1890.

Fig. 6.

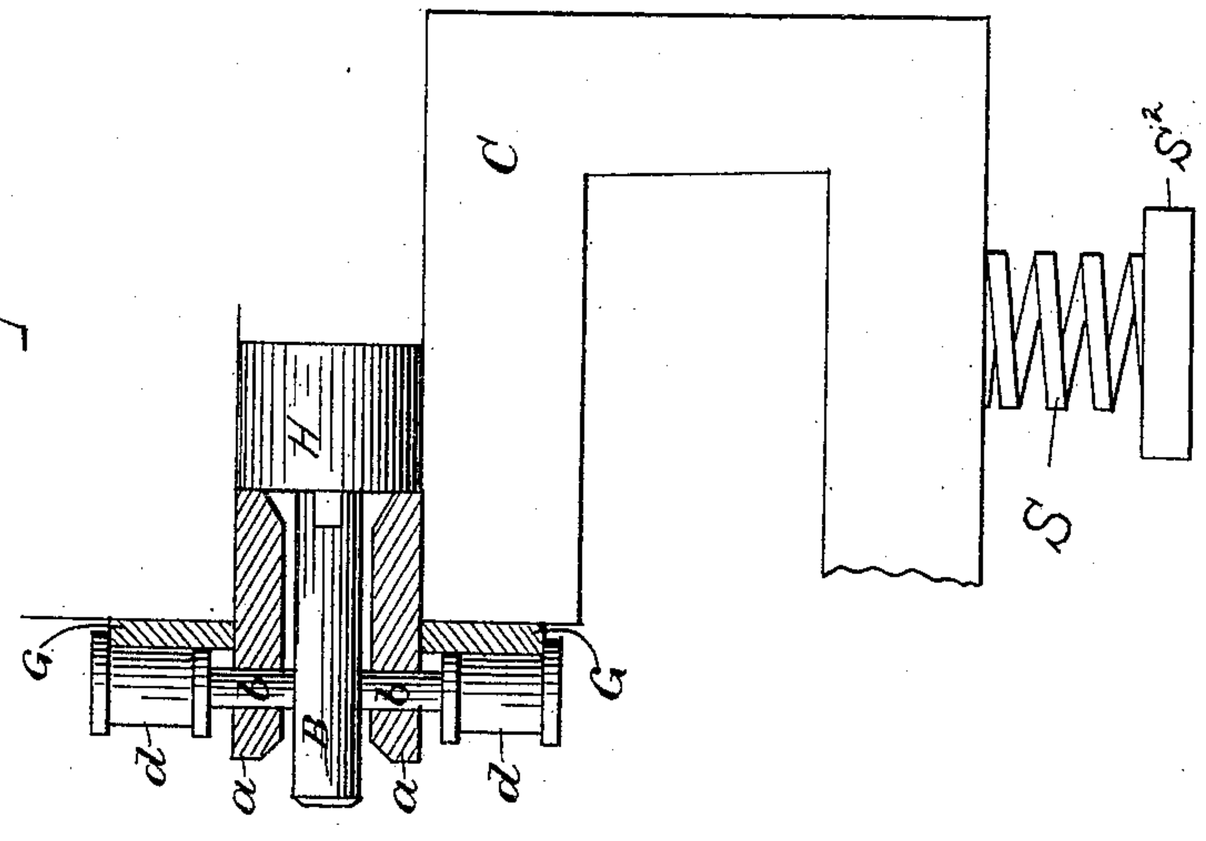
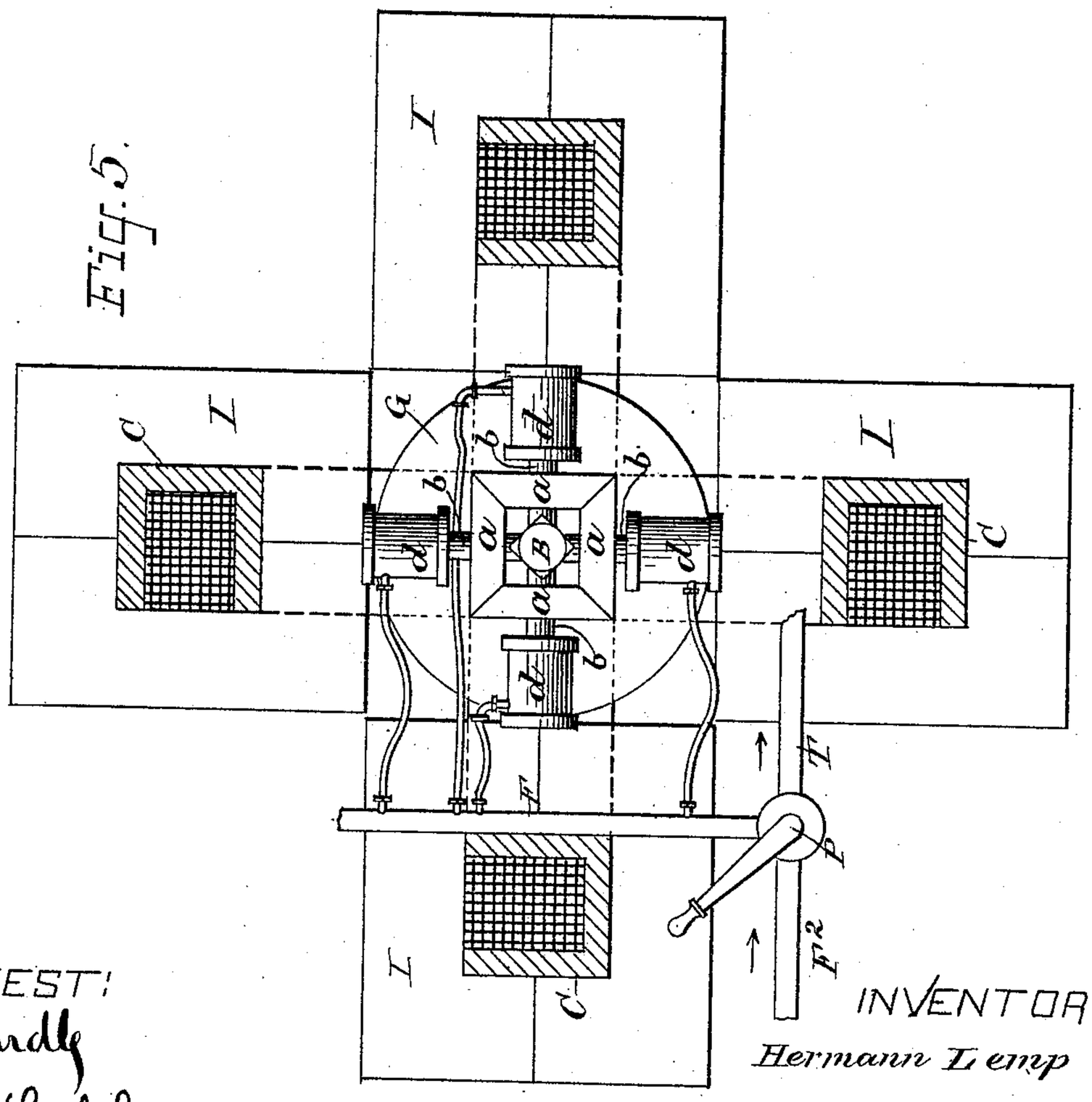


Fig. 5.



ATTEST:
J. A. Hurdle
John H. Cooper

INVENTOR:
Hermann Lemp
By H. C. Townsend
Attorney

(No Model.) 3 Sheets—Sheet 3.

H. LEMP.

ELECTRIC WELDING APPARATUS.

No. 440,641. Patented Nov. 18, 1890.

Fig. 7.

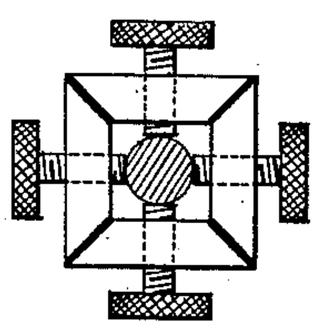
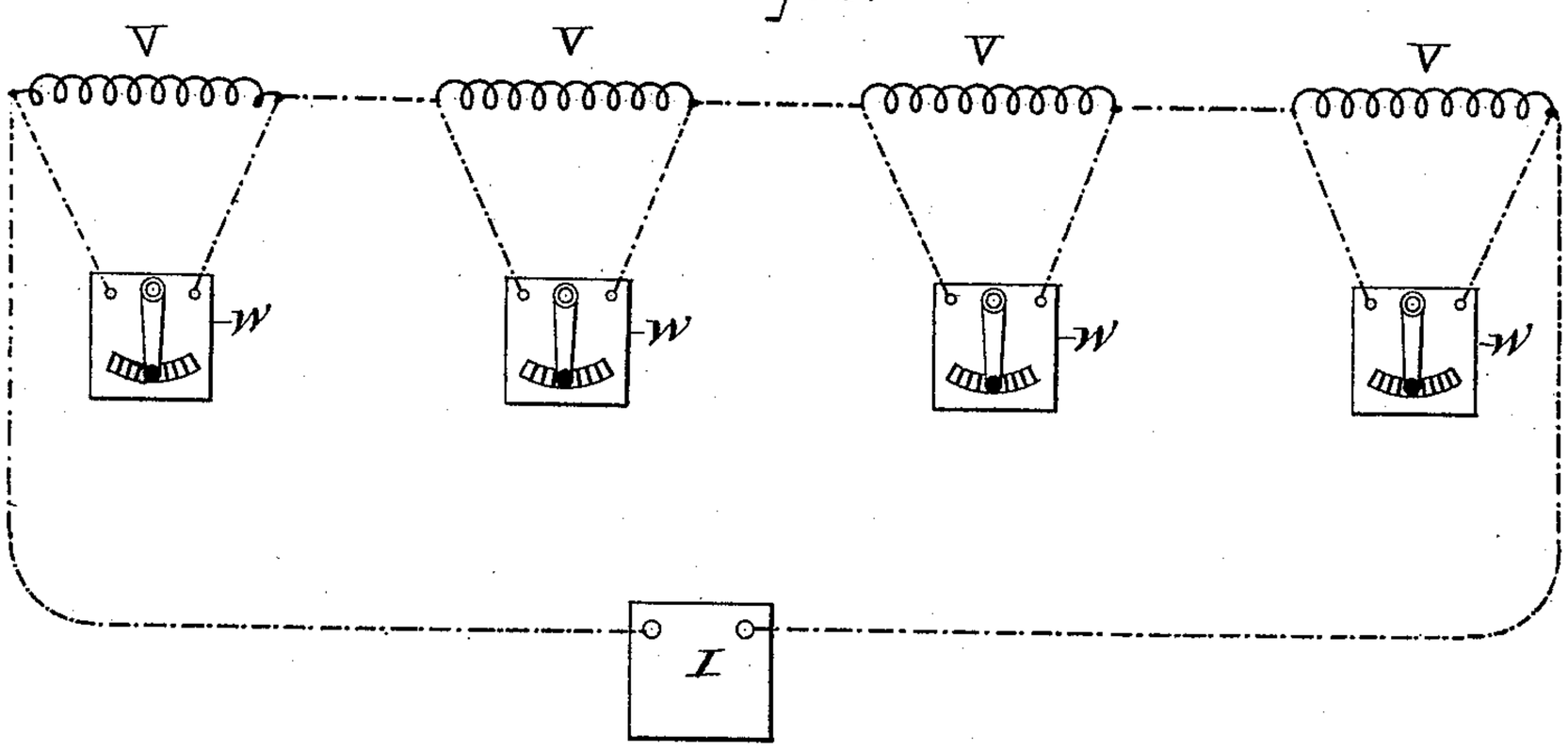


Fig. 9.



ATTEST:
J. A. Hurdle
Jr. H. Cooper

INVENTOR:
Hermann Lemp

By H. B. Townsend

Attorney

UNITED STATES PATENT OFFICE.

HERMANN LEMP, OF LYNN, MASSACHUSETTS.

ELECTRIC WELDING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 440,641, dated November 18, 1890.

Application filed June 13, 1890. Serial No. 355,320. (No model.)

To all whom it may concern:

Be it known that I, HERMANN LEMP, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Electric Welding Apparatus, of which the following is a specification.

My invention relates to the construction of electric metal-working apparatus designed for use in welding, forging, upsetting, and other operations wherein the work is heated by the passage through it of a current of large volume.

My invention is especially designed to improve the construction of that class of electric metal-working apparatus in which the current is derived from the secondary of a transformer the primary of which is of comparatively high resistance, while the secondary consists of a bar or bars of copper made in a single piece or a number of pieces fastened together and in electric connection with the clamps or holders for the work.

In metal-working operations wherein a current of large volume but of comparatively small pressure or electro-motive force is employed it is not necessary to increase the volume of current with increase in the conductivity or cross-sectional area of the metal to be heated, and in practice it has been found that the pressure or electro-motive force is in effect a practically constant factor which does not have to vary with different sizes of work. It is, in fact, desirable to have a practically uniform pressure in different sizes of apparatus because of the uniformity in construction which it permits, so far as concerns the construction of the core of the transformers. In providing for the necessary increase of volume for large work or work of low conductivity the attempt has been made prior to my invention to get the requisite quantity or volume by increasing the cross-section of the secondary bar used; but this has been found impracticable and inconvenient, owing to the large weight and size of the secondary bars which it necessitated, making the apparatus heavy and unwieldy to use and not compact. Such variation in the cross-sectional area of the secondary bar or conductor, besides introducing a variation into the size of the conductor itself, of necessity produced a variation in the length of the iron core for the apparatus, which it is obviously desirable should be of uniform length for convenience of manufacture and for other reasons.

My present invention consists, essentially, in constructing the apparatus with a plurality of transformer secondaries arranged parallel to one another and in contact with the different parts of the work-holding devices, so as to apply current to the same and to different parts of the work in multiple arc. The several secondary bars or conductors from which the apparatus is constructed may have the same or different iron cores or magnetic circuits.

My invention consists, further, in details of construction and variations in the manner of disposing the secondary bars or transformers, as will be hereinafter more fully described, and then specified in the claims.

My invention consists, also, in the combination, with a particular construction of apparatus, of means for regulating the current flowing in different parts thereof, so as to regulate the flow in different parts of the work, as hereinafter more fully described.

My invention may be carried out by the use of the construction of transformer and secondary therefor set out in my patent dated May 27, 1890, No. 428,618, or in connection with any other shape of transformer, as will be obvious to electricians; but for the sake of illustration I have herein shown the invention and described the same as embodied in an apparatus in which the several secondary bars or conductors are of the construction described in the patent aforesaid and the two holding devices are provided with V-shaped bearings.

In the accompanying drawings, Figure 1 is a side view of a transformer secondary bar of the general shape or construction described in my former patent. Fig. 2 shows in cross-section an apparatus embodying my present invention. Fig. 3 is an end elevation of a modified form of apparatus embodying the invention. Fig. 4 shows another variation. Fig. 5 is an end elevation of an apparatus wherein four transformers are employed. Fig. 6 is a side view and partial section of a portion of the apparatus shown in Fig. 5. Fig. 7 shows a modification in the clamping

devices. Fig. 8 illustrates a modification of the apparatus illustrated in Fig. 5. Fig. 9 is a diagram illustrating the way in which the current may be governed in various parts of the apparatus.

Referring to Fig. 1, C indicates the secondary bar or conductor, having a break at one side and a groove or depression in its edge adapted to receive the primary conductor, as set forth in my prior patent. At opposite sides of the break the clamps or holders for the work are arranged and mounted in any desired manner. In using a secondary bar or conductor of this general shape, to construct an apparatus in accordance with my present invention the two secondary bars, with their coils and cores, may be arranged as shown in Fig. 2, wherein I have illustrated two complete transformers—that is to say, transformers wherein the primaries and the cores therefor are separate structures. The primaries may be connected into the circuit in any desired way. The secondaries are placed at right angles with one another, so that their flat faces will form the surfaces of a V-shaped bearing, in which a V-shaped clamp-slide M may work, as described in my prior patent, No. 428,619. The current is taken up from both secondaries and delivered to the work through the slide M or other device, which serves to hold the work or to support it. The cores I may be applied in any desired way, and, as usual, are made up from laminæ of iron fastened together.

In Fig. 3 I have shown a construction wherein the two transformer secondaries C C are arranged parallel to one another at a little distance apart and have their edges beveled or inclined to form a proper V-shaped bearing for the clamp-slide M. Here the secondaries have practically the same core I. The iron bridge-piece I′ connects the opposite sides of the cores between the two secondary bars. The two primary coils are wound so as to magnetize the core equally and in the same direction, the lines of magnetic force circulating, when the work done by each is about the same, in a continuous magnetic circuit made up of the iron marked I. The bridge-piece I′ is for the purpose of taking a part of the magnetic lines of force when there is a variation produced in the flow of current in one of the primary coils, as described in another application for patent filed by me April 16, 1890, Serial No. 348,153, for the purpose of varying the current in a particular part of the work. Here the part I′ of the core only carries lines of force, which are caused to pass through the same on regulation. Practically the core is only of the size which would be necessary for a single secondary bar or conductor. It would be possible to magnetize the core by winding the primaries thereof so that all of the magnetism would normally circulate through the piece I′; but in such instance the piece I′ would need to have a magnetic conductivity twice as great as the balance of the core I, and the construction would be, so far as bulk is concerned, not materially different from two separate iron cores.

In Fig. 4 three separate transformer secondaries C C C are shown, supplying current in multiple to the same rest or plate C^2, which may carry the work or holders therefor. The transformer secondaries C here are shown as provided with separate cores I I I, though they might have a single core with intermediate bridge-pieces I′, applied after the manner indicated in Fig. 3. The construction illustrated in Figs. 3 and 4 of my present application is not specially claimed herein, as it forms the subject of claims in my application for patent filed April 16, 1890, Serial No. 348,153.

In Fig. 5 I have illustrated my invention as carried out by the employment of four separate secondary bars used in connection with a common work-holding device, which is divided into sections insulated from one another to permit the regulation of the flow of current to different parts of the work. Here I have shown four secondary bars C, each having a separate core I. The work-holding slides—four in number—indicated at *a*, are supported upon the ends of the secondary bars, as indicated in Fig. 6, and slide in contact with the flat faces thereof. The several sections *a* of the slide are insulated from one another, as indicated. Working through each is a clamp-rod *b*, carried by the piston of the cylinder *d*. The cylinders *d* are secured to a movable frame or ring G, which may be moved when the work indicated by the rod B is to be moved endwise in the welding or other operation. The clamps *b* converge upon the work, as indicated, the latter being held in any ordinary lathe-chuck H, which serves merely to center the stock, no particular care being taken to insulate such chuck or to convey current thereto. The current is conveyed to the work principally through clamp-jaws *b*. Pressure of any liquid may be conveyed to the pistons of the cylinders *d* through pipes, as shown, communicating with a common pipe F. P is a three-way cock or valve which may be turned to produce pressure in pipe F by fluid from pipe F^2, or to allow exhaust of pressure to take place through a pipe T, when the clamp-jaws are to be moved back from the work by means of springs in the cylinders *d* working against the piston.

Fig. 7 shows a similar clamping device wherein the clamp-jaws consist simply of screws working through the several slides. It is evident that two of the screws may be kept in a fixed position after once setting for any sized stock, the other two being used to allow the work to be put into place or removed. Stiff springs S between the secondaries and a frame or backing S^2 serves to press the secondaries toward the slides and preserve uniformity of contact therewith. In large work it is sometimes found that a part of the surfaces in abutment will heat more than others. To allow a regulation of the current in differ-

ent parts of the work, the supply of current from the secondaries C in an apparatus such as illustrated in Figs. 5 and 6 may be produced by providing each primary with a shunt containing a variable resistance, as indicated at W, Fig. 9. The primaries are indicated by the letter V, and are arranged in series with one another in a circuit from the source of alternating currents. Should it be found that one side of the work is heating faster than the others, the adjusting device may be used to divert the current from the primary of that secondary which is contiguous to the too-rapidly-heating portion, thus decreasing the flow of current at such part.

While I have described the secondaries as provided with separate cores in Figs. 5 and 6, they might have the same cores or magnetic circuit as indicated in Fig. 8.

I do not herein broadly claim the work-clamping devices made in parts insulated from one another, as this construction is claimed in my application for Letters Patent filed April 16, 1890, Serial No. 348,153; nor do I herein make broad claim to supplying different parts of the work from different sources of energy arranged in parallel and regulating the energy of the several sources independently of one another, as this, also, is broadly claimed in the said application.

What I claim as my invention is—

1. The combination, in an electric metal-working apparatus, of a plurality of transformer secondaries arranged parallel to one another and in contact with the work-holding devices, so as to apply current to the same in multiple arc.

2. The combination, in an electric metal-working apparatus, of two secondary bars or conductors having separate cores and arranged at angles to one another, in combination with a clamp-slide working in the angular bearing formed by the outer surfaces of the secondary bars or conductors, as and for the purpose described.

3. The combination, in an electric metal-working apparatus, of a plurality of secondary bars or conductors disposed circumferentially around the work-holding devices and in contact therewith, as and for the purpose described.

4. The combination, in an electric metal-working apparatus, of work-holding devices divided into sections insulated from one another, and secondary bars or conductors disposed symmetrically around the same at different angular positions and in contact, respectively, with the parts of said work-holding devices.

5. The combination, in an electric metal-working apparatus, of a four-part work-holding clamp, sections of which are insulated from one another, and four secondary bars or conductors disposed symmetrically around the same, as and for the purpose described.

6. The combination, with the divided work-holder, of separate transformer secondaries each having a separate core, and means for regulating the current in the primaries of the transformers, as and for the purpose described.

7. The combination, in an electric metal-working apparatus, of different secondary bars or conductors supplying different parts or portions of the work and each having a separate core, and means for varying the current in the primaries of said secondary conductors.

8. In an electric metal-working apparatus, the work-holder having two or more clamp-jaws working on converging lines and insulated from one another.

9. In an electric metal-working apparatus, a clamp slide or base divided into sections insulated from one another, and provided with separate clamp-jaws working toward a common center.

10. In an electric metal-working apparatus, the combination, with a work-holder, of a plurality of clamping-jaws, a separate pressure-cylinder for each jaw, and means for controlling the pressure in said cylinders simultaneously.

11. The combination, with a plurality of clamp-jaws *d*, working on converging lines, of a pressure-cylinder for each, a source of pressure common to said cylinders, and a valve for controlling the pressure.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 10th day of June, A. D. 1890.

HERMANN LEMP.

Witnesses:
JOHN W. GIBBONEY,
DUGALD MCKILLOP.