(No Model.) 2 Sheets—Sheet 1.

H. LEMP.

ELECTRIC METAL WORKING APPARATUS.

No. 564,331. Patented July 21, 1896.

Fig. 1.

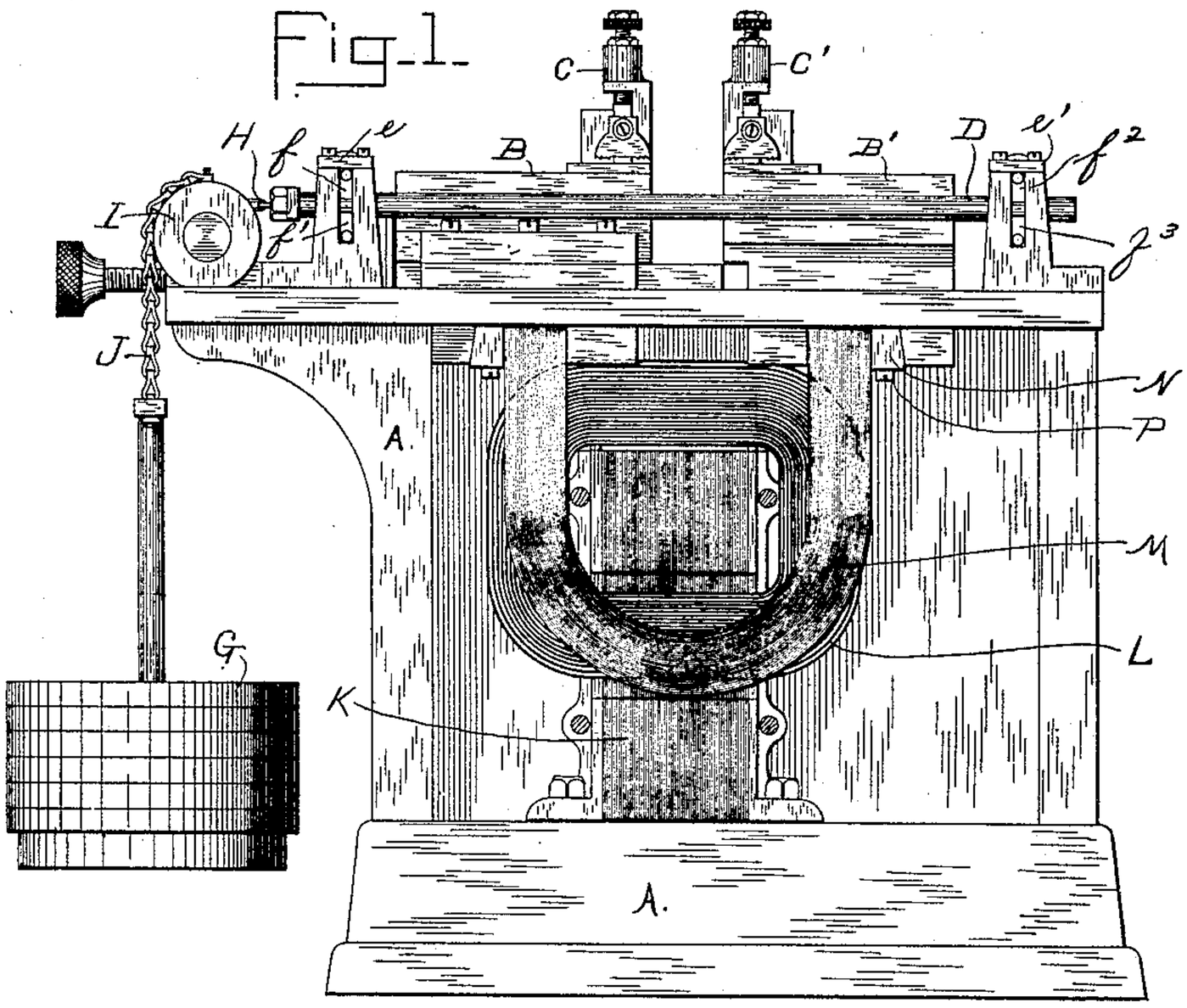
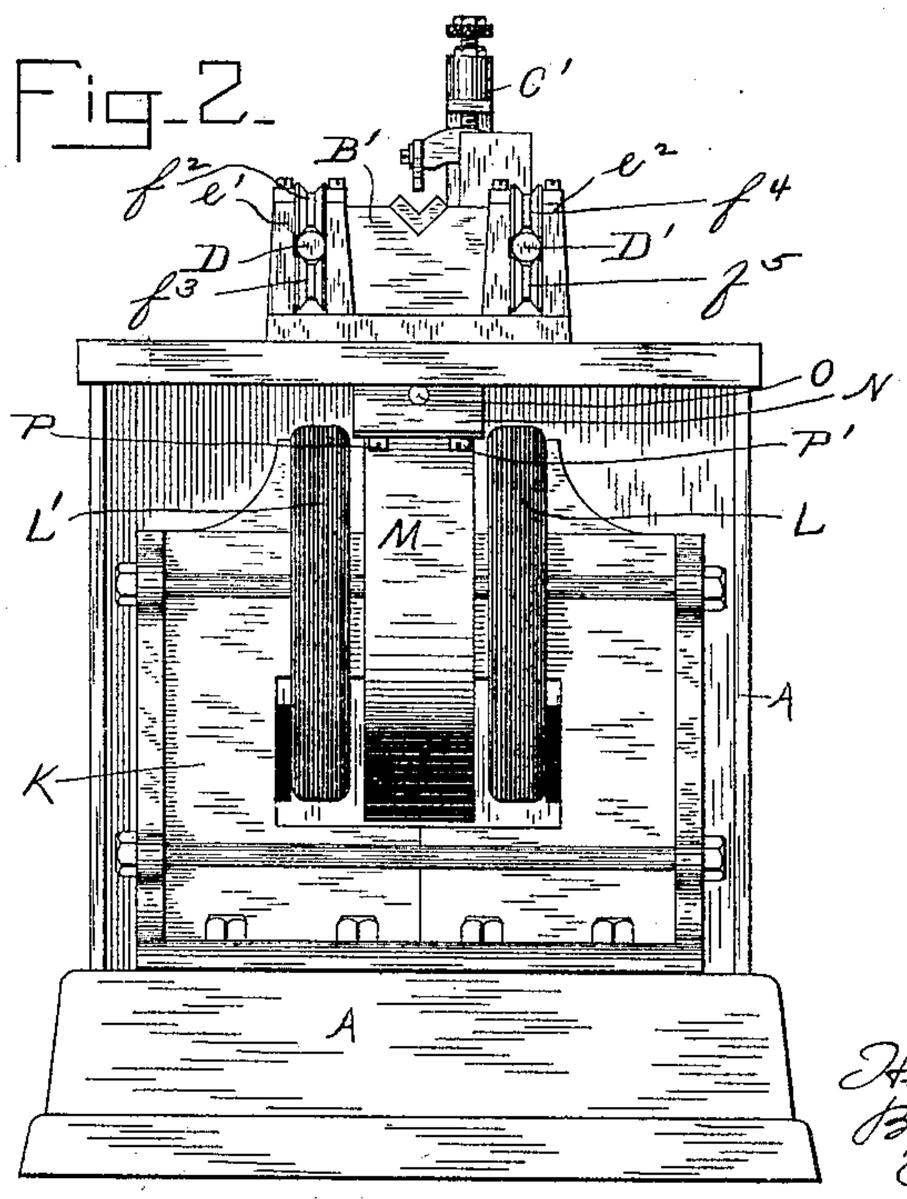


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 6.

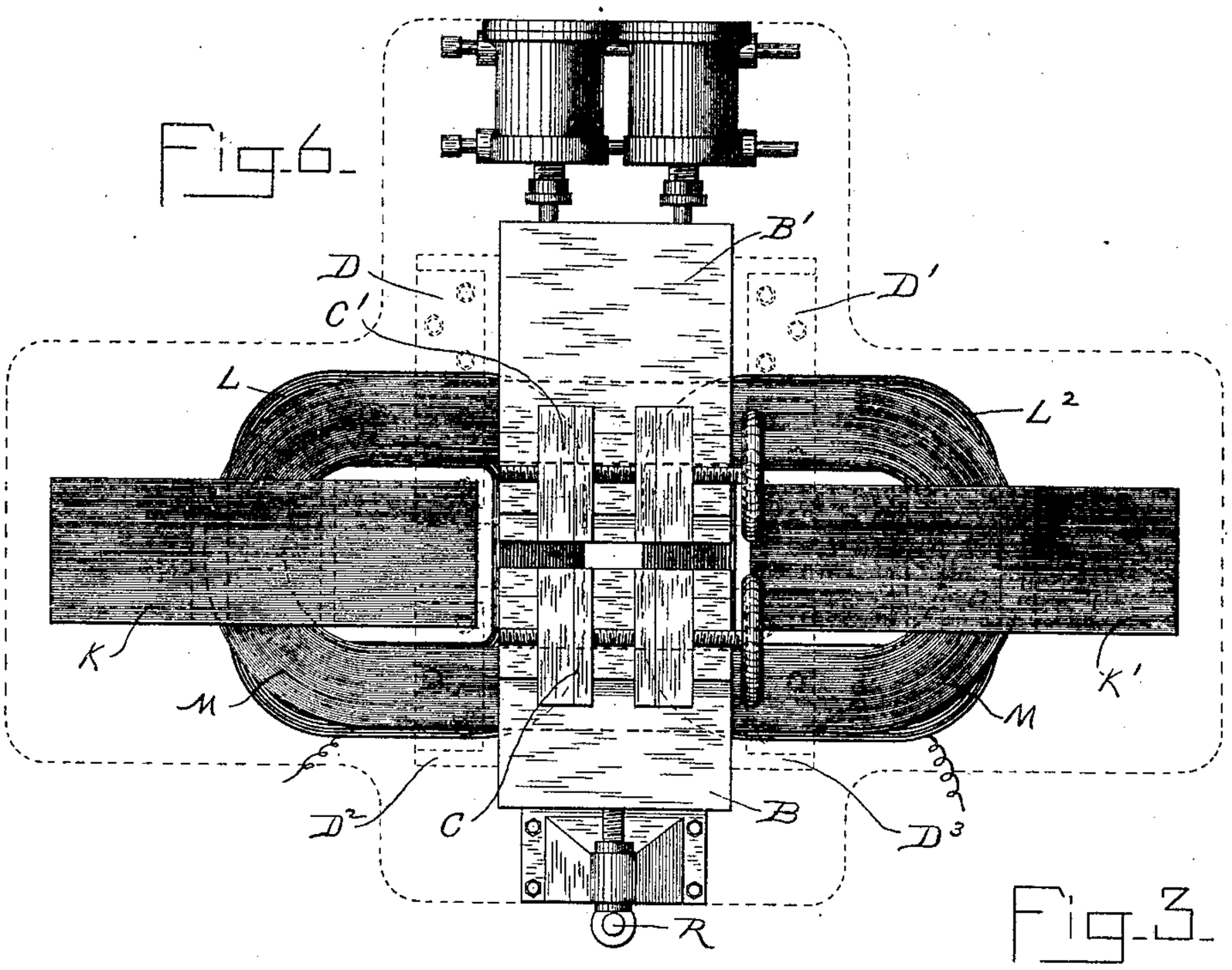


Fig. 3.

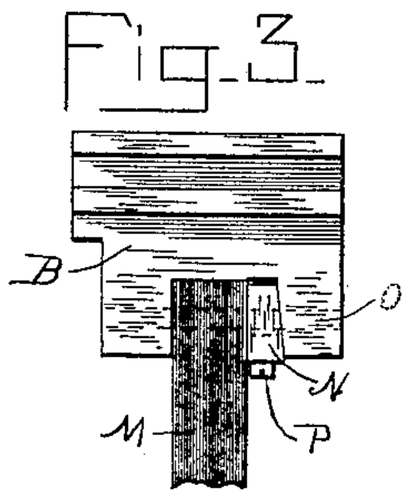


Fig. 7.

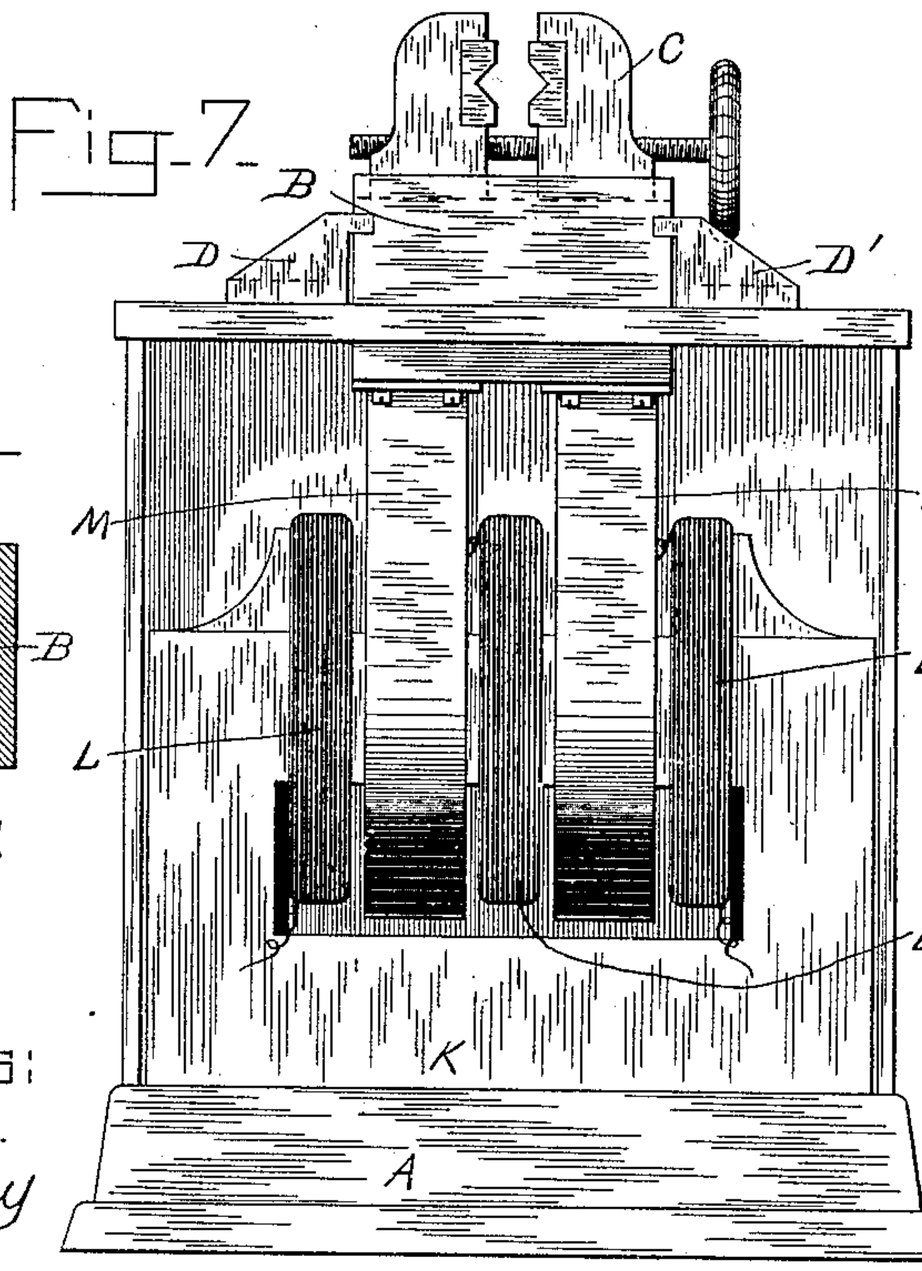


Fig. 4.

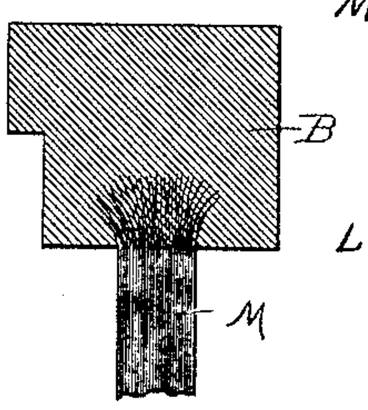
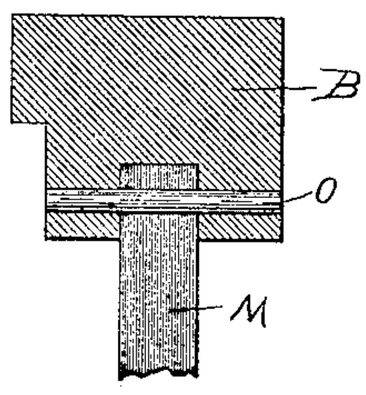


Fig. 5.



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UNITED STATES PATENT OFFICE.

HERMANN LEMP, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE THOMSON ELECTRIC WELDING COMPANY, OF MAINE.

ELECTRIC METAL-WORKING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 564,331, dated July 21, 1896.

Application filed June 15, 1891. Serial No. 396,304. (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 Metal-Working Apparatus, of which the following is a specification.

My invention relates to that class of electrical apparatus which is designed to furnish electric currents of large volume or heating effect and in which provision is made for permitting a movement of the part which is in contact with or holds the work or device to be heated, while at the same time the electrical connection to the source of heating-currents is maintained.

My invention relates more particularly to electric metal-working apparatus in which the source of the heavy heating-currents is the secondary of a transformer; and the object of the invention is primarily to avoid the losses which are due in apparatus of this character, and more especially in electric metal-working apparatus, to the resistance of the various contacts or joints through which the current passes from the secondary to the moving part of the apparatus.

In the usual types of electric metal-working devices, in which there are one or two or more sliding contacts through which a current of perhaps thousands of amperes must pass, there is a marked inefficiency arising from the C_2R losses or watts consumed in heating the joints or sliding surfaces. The only practical method heretofore employed for reducing these losses, to wit, the enlargement of the area of contact, is attained by increased cost for conducting material and labor in preparing the surfaces. Special constructions of the devices for effecting the same purpose are usually expensive, because of the complication of parts, and are not practical for rough usage.

The object of my invention is to do away with all joints or sliding contacts in electric metal-working apparatus wherein the current is supplied from the secondary of a transformer to reduce the weight of material and the cost.

To this end my invention consists, essentially, in making the whole secondary circuit continuous or without joint or break and attaching or securing the terminals or work-holding devices directly to said secondary, which latter is made movable at its polar portion or part, to which the said holder is secured.

In carrying out my invention I preferably construct the secondary as a flexible conductor made up preferably of a number of copper strips.

It is desirable to construct the secondary entirely of the copper strips or flexible pieces; but it would be within my invention to make the terminals only flexible, the work-holders being attached directly to said flexible terminals and being movable without sliding contact by reason of such flexibility. The parts of the secondary are preferably made of wrought-copper, which, being of nearly twice the conductivity, will require but half the weight necessary for the construction of secondaries from cast-copper. The cost of wrought-copper being but slightly greater than cast-copper the total cost of the secondary will be reduced nearly fifty per cent., to say nothing about the reduction in labor attendant upon the doing away with sliding contacts.

My invention consists, further, in certain details of construction and disposition of the parts, as hereinafter more particularly described, and then specified in the claims.

In the accompanying drawings, Figure 1 is a front elevation of a metal-working apparatus having a transformer constructed in accordance with my invention. Fig. 2 is an end view of the same. Figs. 3, 4, and 5 illustrate ways of attaching the terminals of the flexible secondary. Fig. 6 is a plan of a large machine embodying a modification of the invention. Fig. 7 shows a type of machine in which a number of separate secondaries are employed.

In Fig. 1 I have illustrated my invention as applied to a machine adapted for butt-welding or other operation requiring a similar movement of the work holder or holders.

A represents the frame of the machine, and B B′ the work-holding terminals, one or both of which may be made movable and which are provided with the usual jaws or clamping de-

vices C C'. These parts are practically the same as in ordinary types of electric welding-machines.

The core of the transformer which supplies the heating-currents to the terminals B B' and to the work held in them is indicated at K and is shown in Fig. 2 complete, while in Fig. 1 one-half has been removed to show the primary and secondary. One-half of the primary has also been removed in Fig. 1 in order that the secondary may be seen.

L L' are the primary coils, which are practically one coil, but are divided and disposed on opposite sides of the secondary for a reason to be hereinafter stated.

M is the secondary made of flexible strips or ribbons of conducting material, preferably copper, and to which the work holders or terminals B B' are directly fastened or secured. The secondary being flexible, it is obvious that the movement necessary for the one or both work holders or terminals will merely cause the secondary to slightly bend, and the necessity for sliding contacts, which are required with a rigid secondary, is avoided. The terminals of the secondary may be attached or fastened in any desired way. Some of the ways are indicated in Figs. 3, 4, and 5.

In Fig. 3 the work holder or terminal B is provided with a lateral groove, into which the end of the secondary is inserted and is held by a wedge or key N. The ends of the strips making up the secondary are carefully cut off, so that they will be of uniform length, and will each make contact at its end with the terminal-block B. The wedge N serves to hold the secondaries very closely together. A pin O may be applied through a hole in the end of the flexible conductor, so that when the wedge is loosened the strips will not fall apart. In preference to depending upon friction to hold the wedge in place, I employ one or more screws P P', which pass through the wedge and into the terminal, so that the wedge may be forcibly drawn up and securely held against loosening.

In Fig. 5 the ends of the strips are held in place by the pin O, which passes through the strips and the terminal or block B, and a good connection is made by soldering or brazing M and B.

The preferred method of connecting the terminal B and the strips M together is indicated in Fig. 4. This method consists in separating the ends of M slightly apart, placing them in a mold, and casting the terminal B around them.

It will be observed that in all cases the secondary is itself practically continuous or unbroken throughout its whole length, and that the work holders or terminals are always in solid electrical connection therewith during their movement, and yet that there is no sliding contact or joint in the whole circuit.

While I have described the use of thin flexible strips, and prefer to employ them as they may be made of rolled copper, I do not limit myself to strips or ribbons, but may make up the secondary from any pieces having suitable flexibility. The secondary in Fig. 1 is shown as of a U shape, but the form of the secondary in outline constitutes no part of my invention. Said secondary might, for instance, be of an endless form, like the link of a chain, as will be presently described.

In order to guide the work holder or terminal, which in the machine Fig. 1 requires to be moved, as, for instance, work-holder B', any suitable means may be employed. In the present instance I have shown for this purpose two rods D D', to which a slide B' is pinned. These rods may work in grooves in the side of B to keep D and D' in correct alinement. The rods D D' work between grooved rollers $f f' f^2 f^3 f^4 f^5$, which are mounted in suitable posts or uprights $e e' e^2$ on the frame A. These rollers prevent side movement, but allow free longitudinal movement. The pressure for welding or similar operation is obtained by the weights G, which are hung from a chain J, working on a pulley I. The chain H, attached to the rods, is fastened to the axis of the pulley I. This arrangement simply multiplies the effect of the weights.

The secondary M is placed between the two primary coils or sections of coil, as indicated in Figs. 1 and 2, for the following reasons: There is a certain repulsion between the primary and the secondary coils of a transformer, and to make practical use of this the two primaries are braced on the side away from the secondary and the latter allowed to hang freely between them. As the repelling effect will be the same from each primary, the secondary is magnetically held free from any friction with the insulation of the primary or other parts. It is also an advantage, owing to the self-induction of the secondary, to have the primary lie parallel and as close to it as possible, as shown, rather than wind it on some other part of the core.

In Fig. 6 I have shown a secondary which is of endless form and in the general shape of an oval or chain link. B B' are the work-holders, B' being the movable one operated by fluid-pressure from suitable cylinders and pistons. The work-holders are attached to the consequent poles of the secondary M. Two primary coils L L^2 are employed, and each has preferably its own iron core K K'. The connections of the coil are so made as to set up consequent poles in the secondary M, at the opposite sides thereof, where the holders or terminals B B' are attached. In this instance the upper half of each one of the two coils L L^2 is removed to allow the secondary to be seen.

C C' are the clamping devices, and D D' D^2 D^3 are suitable guides for the work-holders. These guides are shown in dotted lines. The terminal B may be made adjustable by means of a screw R. The secondary M is made of a strip or strips of sheet metal, such as copper, preferably wrought or rolled cop-

per, wound into form, as indicated. The flexibility thus secured allows sufficient movement of the work-holder B′, which, like the work-holder B, is fastened or secured directly to the secondary in any of the ways before described or in any other proper manner. As will be observed, the currents generated in the two halves of the secondary will flow in parallel from one work-holder to the other and through the work.

My invention is applicable to other forms of welding apparatus, as, for instance, to an apparatus constructed in accordance with patent of Hermann Lemp, No. 440,641. Thus, as indicated in Fig. 7, two secondaries M M might be arranged to supply the work in parallel, and the primary coil divided or made up of three coils or sections of coil L L′ L^2, one of which is placed between the two secondaries. The number of secondaries might be as many as circumstances should require.

There are other advantages attendant upon the use of secondaries constructed as hereinbefore described besides the ability to dispense with sliding contacts. Thus, for instance, with alternating currents of high frequency the current resides principally upon the surface of the conductor, the interior being of little value. When the secondary is made up in the manner described of a number of conductors, such as thin strips of metal, a much greater total surface is provided, and consequently a greater carrying capacity obtained, than when a solid bar is employed. Besides, with this construction the cooling-surface is greater and a greater current density may be employed without danger of overheating. In order to secure this effect to the greatest extent, it is desirable to lay the strips together rather loosely.

What I claim as my invention is—

1. In an apparatus for supplying heating-currents of large volume, a flexible transformer-secondary composed of pieces or strips of conducting material and having a single turn or bend, in combination with two work-holders opposed to one another and fixed rigidly and directly to each piece of the secondary for the purpose set forth.

2. In a transformer, the combination with a primary, of a secondary formed in a single turn and composed of metal strips laid in planes transverse to the direction of the turn and work-holders secured to the poles of said secondary.

3. In an electric metal-working apparatus, a transformer having a U-shaped flexible secondary constructed of thin sheets or strips of copper and laminated in planes transverse to the line of movement of the work-holders, as and for the purpose described.

4. In an electric metal-working apparatus, the combination with a flexible secondary constructed of thin sheets or strips of copper, of work-holders in direct contact with every single turn of said secondary.

5. In a transformer for electric metal-working apparatus, the combination substantially as described, with a secondary composed of sheets or strips of copper piled upon one another, of work-holders cast thereon in intimate contact with each single turn of said secondary, as and for the purpose described.

6. A transformer consisting of a secondary of endless form having consequent poles, in combination with suitable primary coils wound or connected to induce said poles, and work-holders mounted upon said secondaries at said poles.

7. In an electric metal-working apparatus, the combination with an endless flexible secondary, of work-holders attached to opposite sides thereof, and primaries for inducing currents in said secondaries.

8. In an electric metal-working apparatus, a flexible secondary of endless form having consequent poles at opposite sides thereof, work-holders mounted at such consequent polar points, and primaries suitably located to induce said poles, as and for the purpose described.

9. A transformer-secondary consisting of a mass of rolled copper strips forming a flexible support for the work-holders and movable in the magnetic field of a fixed primary.

10. The combination, substantially as described, with the two primaries or sections of primary, of the flexible secondary hanging freely between said primaries or sections of primaries, as and for the purpose described.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 12th day of June, A. D. 1891.

HERMANN LEMP.

Witnesses:

WARREN B. LEWIS,

WILLIAM L. PARKER.