(No Model.) 2 Sheets—Sheet 1.

H. LEMP.

TRANSFORMER FOR HEAVY CURRENTS.

No. 428,618. Patented May 27, 1890.

Fig. 1.

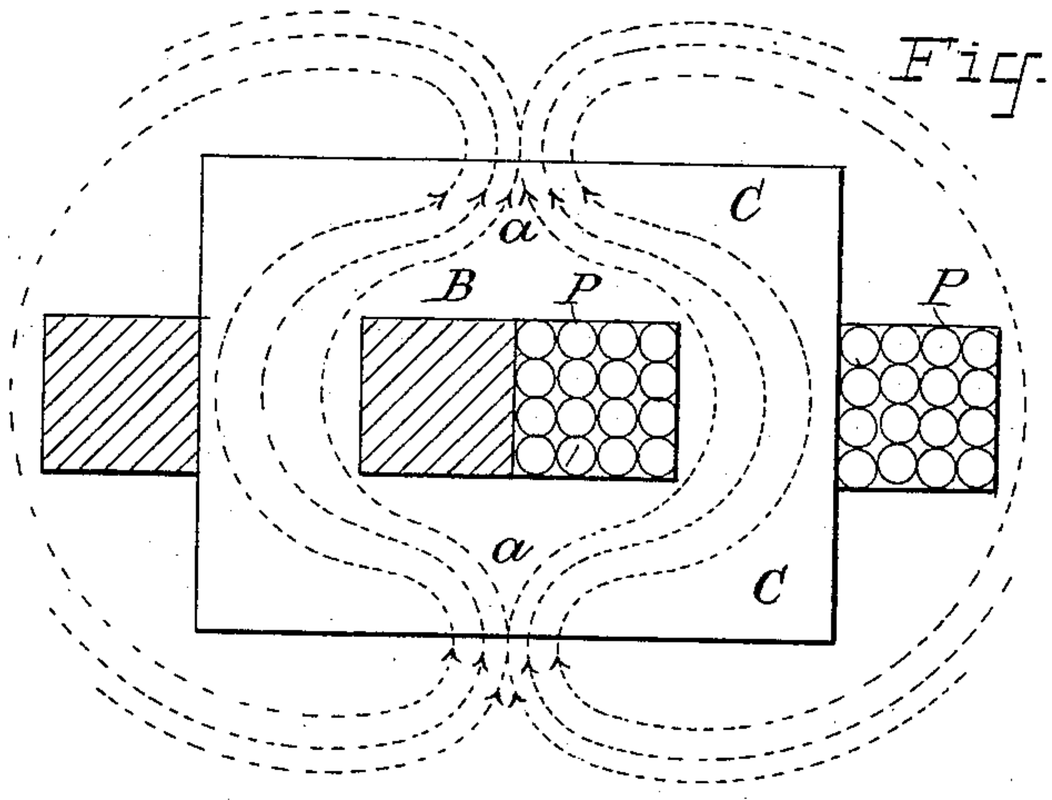
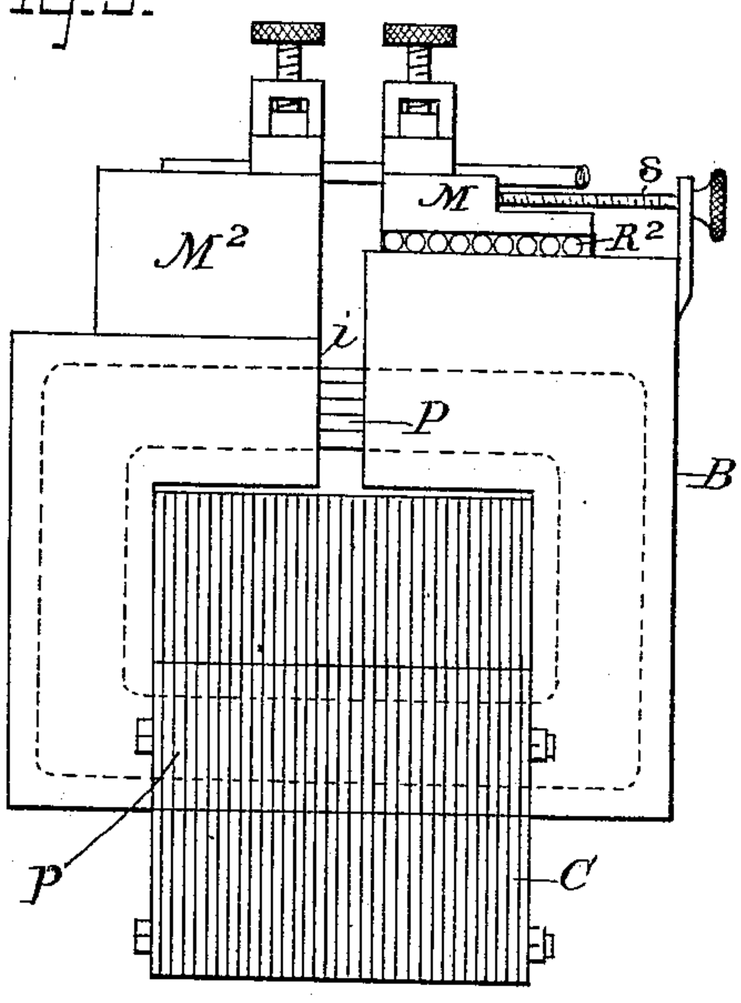
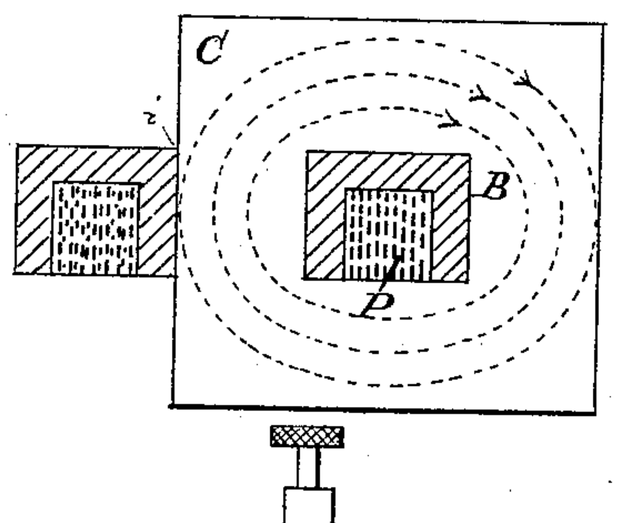


Fig. 2.

Fig. 3.





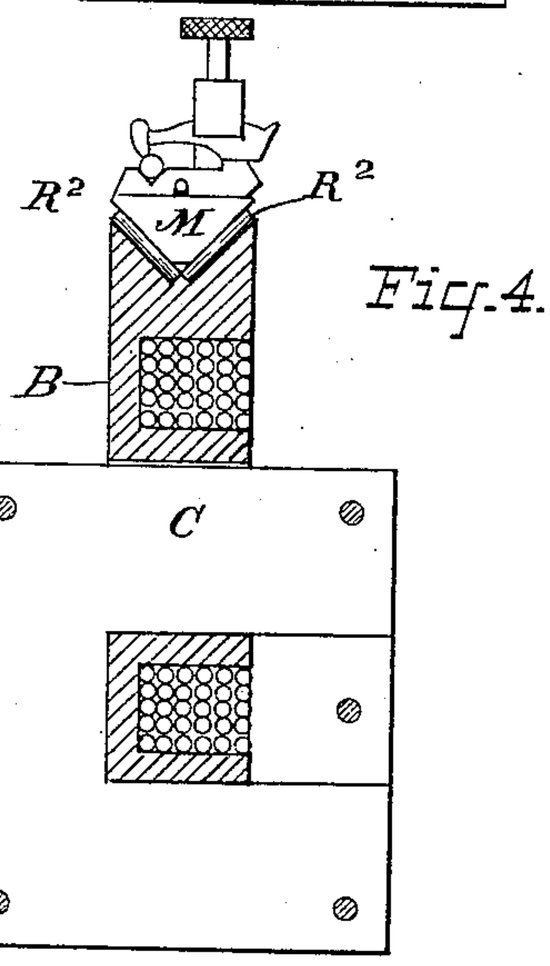


Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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TRANSFORMER FOR HEAVY CURRENTS.

No. 428,618. Patented May 27, 1890.

Fig. 5.

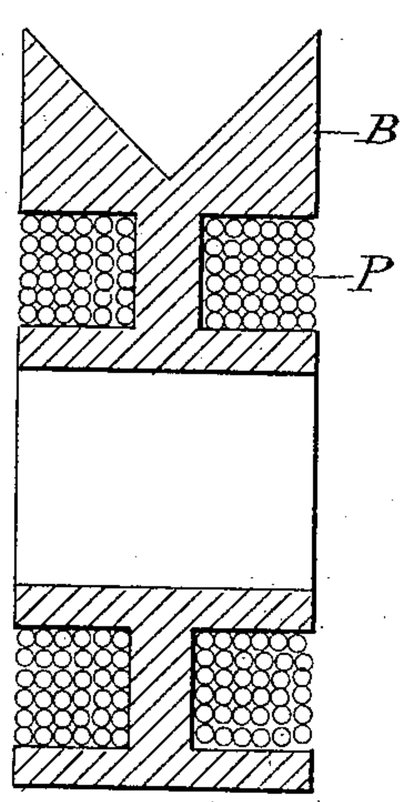


Fig. 6.

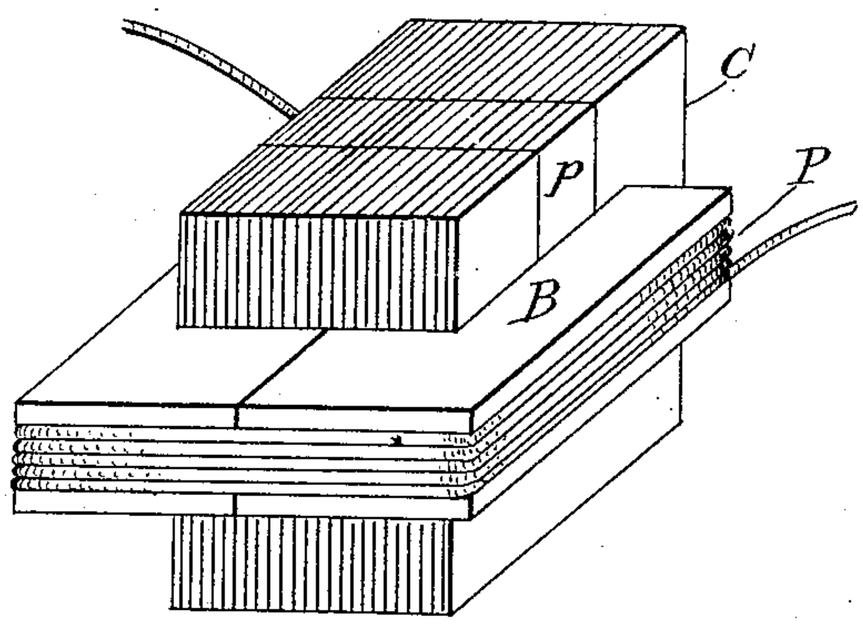


Fig. 7.

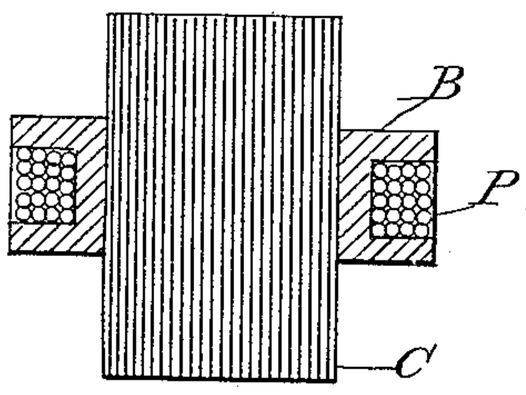


Fig. 8.

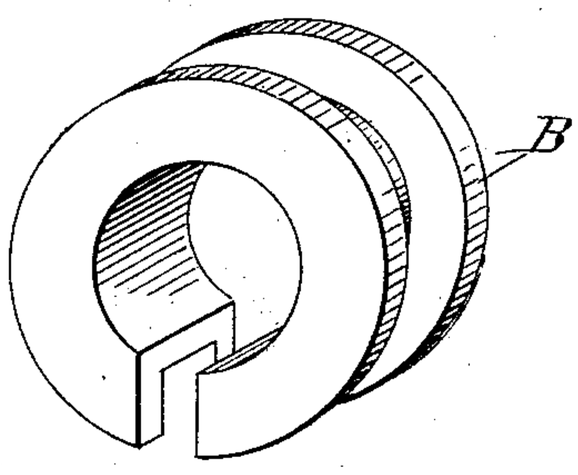
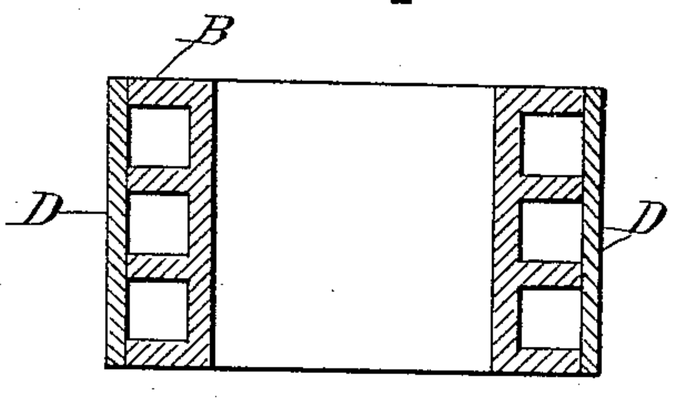


Fig. 9.



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UNITED STATES PATENT OFFICE.

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

TRANSFORMER FOR HEAVY CURRENTS.

SPECIFICATION forming part of Letters Patent No. 428,618, dated May 27, 1890.

Application filed December 26, 1889. Serial No. 335,061. (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 Improved Transformers for Heavy Currents, of which the following is a specification.

My invention relates to the construction of transformers or induction-coils built with special reference to the development of currents of great volume but low electro-motive force in the secondary.

In transformers for electric welding or metal-working operations it is customary to make the secondary as a single turn, and it is especially important in transformers employed in this art that the structure shall have as few joints as possible and shall possess strength and rigidity.

The object of my invention is to obtain a large output for a given weight of copper, to avoid as far as possible the difficulties arising in large transformers from the self-induction of the current in the secondary, and to facilitate and cheapen the construction. It is a well-known fact that the greatest output from a transformer is obtained if the secondary wires are interlaced with or intimately related to the same, so that the lines of force generated by the primary shall cut the secondary to as great an extent as possible. It is also well known that when the alternating currents in the secondary are of great volume, and such secondary is a solid copper conductor, the carrying capacity of the conductor does not increase in proportion to the section on account of the increase of self-induction. The lamination or splitting of the conductor into small conductors does not fully remedy the difficulty. The conductor should be spread out so as to occupy a large cross-section of space for a given cross-section of copper, or the primary should be intimately interlaced with the secondary. This construction, which entails the use of a large number of strands for the heavy secondary current, involves considerable difficulty in practical construction.

My invention consists, essentially, in making the secondary as a solid mass of copper having a groove or depression in its side or in its edge, in which the primary coil lies. The secondary bar or conductor may be formed by casting, forging, or other desired metal-working operation, and may take the form of a ring, cylinder, square, or other figure, which is interrupted at one side by an insulating-space, and in cross-section presents a groove or depression at its side or edge, in which the primary wires lie. The groove or depression may be formed on the edge or outer circumference of the mass of copper, or may be on the side or other face or faces of the same. By making the secondary from a solid conductor or parts of a conductor the work of constructing the transformer is greatly facilitated.

In the accompanying drawings, Figure 1 is a cross-section through a typical construction of converter heretofore employed. Fig. 2 is a cross-section through a primary and secondary constructed and related in accordance with my invention. Fig. 3 is a side elevation of a transformer having a secondary and primary constructed and related according to my invention. Fig. 4 is a vertical cross-section through the same. Fig. 5 is a cross-section through a modified form of secondary bar. Fig. 6 is a perspective view of a modification wherein the groove to receive the primary is formed on the outer periphery of the secondary. Fig. 7 is a cross-section of the form shown in Fig. 6. Figs. 8 and 9 illustrate other modifications in the form of the secondary bar.

In the plan heretofore employed and illustrated in Fig. 1 the secondary B is a heavy copper bar placed close to a part of the primary P. The primary and secondary surround, respectively, the two legs of a magnetic circuit or core of iron C. In this form there is an opportunity for the formation of consequent poles at *a a* by the joint action of the secondary and the primary—that is to say, lines of force, instead of circulating throughout the core, try to crowd out together at the points *a*, thus increasing the reaction of the primary without doing any useful work. If the secondary is, however, made as a copper bar having a groove, in which the primary lies, as illustrated in Fig. 2, thus bringing the two into a more intimate relation, the formation of consequent poles is not possible, and the lines of force will expand from the pri-

mary through the secondary into the iron core.

In the form of secondary shown in Fig. 2 the solid bar of copper, made as a bobbin, is rectangular in circumferential outline or form, but is split or interrupted at the point *i*, to prevent the currents developed in it by the alternating currents in the primary P from flowing in short circuit. The heavy current developed in the bar is taken off for utilization at points at opposite sides of the cut or interruption *i*. When used for welding or similar operations wherein the electricity is employed as the heating agent for the work, the secondary bar may have at opposite sides of the cut *i* guides or supports, on which the clamps or other parts of the welding apparatus rest directly and are guided.

M M² indicate the two clamp bodies or rests, in which the work to be welded is clamped and supported. The block or body M² may rest upon and be fastened to the secondary. The clamp body or slide M is preferably made movable toward the other by means of a screw S or other suitable mechanism, and is guided in a V-shaped groove formed in the secondary bar, as shown better in Fig. 4. The slide or block M fits in the groove, thus forming a V-shaped bearing, which prevents sticking when the parts become heated by the electric current passing through them, and also preserves a good electrical connection. It is preferable, however, to interpose conducting-rollers R² between the slide and its support. These rollers are made of copper or other good conductor.

The V-shaped guide or bearing and the rolls interposed as described are not claimed herein, as they form the subject of an allowed application for patent filed by me August 8, 1889, Serial No. 320,182.

The slide M may be held down to its seat by gravity or by other suitable device. The clamp-slide M bears suitable clamping devices, as indicated, for holding the work in a recess or groove in the slide.

The core of the secondary consists of iron, preferably composed of a bundle of sheet-iron plates, which may be applied as shown.

To facilitate the application of the core it is preferably made in two parts, one consisting of U-shaped plates, as shown, and the other of a plug *p*, which may be forced between the legs of the U to complete the magnetic circuit after the U-shaped pieces have been slipped over the secondary bar with its primary winding in place.

When the groove is formed in the side of the secondary, as shown, the primary may be wound on a suitable mold or form and then slipped into place in the groove. The secondary bar or conductor might have grooves or depressions formed on both of its faces, as shown in Fig. 5, each groove being adapted to receive a part of the primary coil or conductor.

As shown in Fig. 6, the groove or depression might be formed on the outer edge or periphery of the secondary bar. This form is not so desirable, however, since the primary cannot be wound on a bobbin and slipped into place. It will also be seen that the application of the conducting slides or rests for the work cannot be so readily applied.

It is obvious that the secondary bar might be formed, as indicated in Fig. 8, in the general shape of a round bobbin or cylinder having a groove on its outer circumference.

Instead of a single groove, as shown in Fig. 8, a number of grooves might be formed, as shown in Fig. 9, the bobbin being, however, of a solid mass or masses of copper and the primary being placed in the grooves of the bobbin. A ring or cylinder of copper D might be slipped over the primary, as indicated, thus enveloping the primary in the copper of the secondary.

What I claim as my invention is—

1. A secondary conductor consisting of a copper bar conformed to the primary circumferentially, and having one or more grooves or depressions in its face to receive such primary.

2. In a transformer, a secondary consisting of a bar of copper cast in one piece with a groove or depression adapted to receive the primary conductor.

3. In a transformer, a secondary formed of a solid bar or mass of copper, having an opening through it adapted to receive the core or magnetic mass of the transformer and provided with a groove or depression for the primary conductor.

4. In a transformer, the combination, with a primary conductor, of a secondary conductor formed as a solid bar or mass of copper having an opening through it, and provided on one or both of its faces with a groove or depression adapted to receive the primary wire or conductor.

5. In a transformer, a secondary consisting of a bar of copper cast in one piece with a groove or depression adapted to receive the primary conductor cut in two, and provided at either side of the cut with suitable clamps to transmit the current to translating devices.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 16th day of December, A. D. 1889.

HERMANN LEMP.

Witnesses:
JOHN W. GIBBONEY,
DUGALD MCKILLOP.