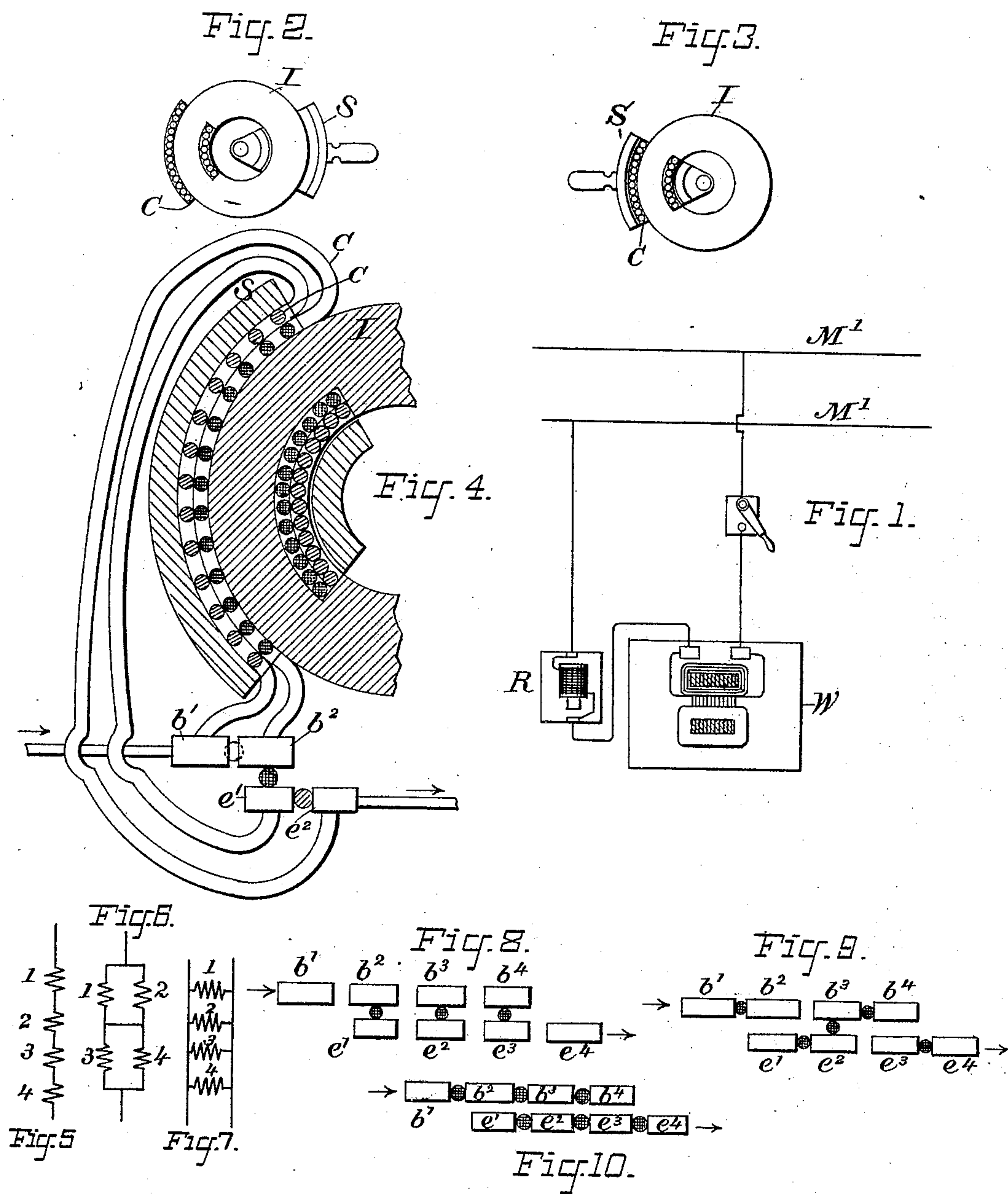


(No Model.)

H. LEMP.  
REACTIVE COIL.

No. 519,335.

Patented May 8, 1894.



ATTEST:  
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# UNITED STATES PATENT OFFICE.

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ELECTRIC WELDING COMPANY, OF MAINE.

## REACTIVE COIL.

SPECIFICATION forming part of Letters Patent No. 519,335, dated May 8, 1894.

Application filed November 21, 1889. Serial No. 329,928. (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 a certain new and useful Reactive Coil, of which the following is a specification.

My invention relates to reactive or regulating coils employed on alternating current electric circuits for governing or regulating the flow of an alternating current.

My invention is especially useful in combination with apparatus used in electric welding or other electric metal working operations where a transformer is employed and the primary of the transformer is connected with an alternating current source of approximately constant potential. In this organization some regulating device is required in series with the primary circuit of the transformer to vary the current in the heavy bar of copper forming the secondary and supplying the current of large volume to the work.

The object of my invention is to increase the range of regulation of reactive coils having the ordinary means of adjustment for adjusting their reactive effect without increasing the size of the reactive apparatus. With ordinary forms of reactive coils as for instance that shown in the patent of Elihu Thomson, No. 397,616 the range of regulation required in any organization, as in electric welding, might be increased by selecting a coil of larger size and great weight.

By my invention I aim to attain the same result without increasing the size of the coil to which end I propose to employ a reactive coil having ordinary means for adjusting its reactive effect without changing its winding and to operate the same in combination with means for changing the winding thereon as to its conductivity and reaction, the total amount of copper in the winding of the coil at any time being preferably maintained.

My invention is especially applicable to the type of reactive or regulating device forming the subject of a patent to Elihu Thomson, No. 397,616.

In the accompanying drawings:—Figure 1,

is a diagram of a welding apparatus showing the application of a reactive coil in the manner before mentioned. Figs. 2 and 3, illustrate a type of reactive device such as is described in the Thomson patent, in different positions of adjustment. Fig. 4, is a section through a reactive coil constructed in accordance with my invention. Figs. 5, 6 and 7, illustrate the various ways in which a reactive coil of four sections may be connected up in accordance with my invention, and Figs. 8, 9 and 10, illustrate corresponding arrangements of the switching devices when such switching device consists of plates provided with the ordinary connecting plugs.

Referring first to Fig. 1,  $M'$ ,  $M'$ , indicate alternating current mains of constant potential, and  $W$ , a transformer of any suitable type having its primary in the circuit between the mains.

$R$ , is typical of any reactive coil in the circuit of the primary. The type shown consists simply of coils placed in such circuit and having a movable core for the purpose of changing the self-induction.

In Fig. 2, a reactive coil such as patented to Elihu Thomson (No. 397,616), is shown in its position of maximum reaction, while Fig. 3, shows the same in its position of minimum reaction. In these figures  $C$ , is a coil which may be included in the alternating current circuit, and  $S$ , is a closed circuit band or conductor adjustable in its inductive relation to  $C$ , and movable on a core  $I$ . As described in the patent, one or both of the coils  $S$ ,  $C$ , may be included in the alternating current circuit, but it is preferable to include one of them only, as  $C$ , in such circuit and to use the other,  $S$ , as a circuit or conductor closed on itself.

In Fig. 4, one of the ways of carrying out my invention is illustrated. Here the conductor  $C$ , is shown divided into two sections preferably of the same number of turns and one superposed on the other. One section is shown black in cross section and the other white. The terminals of these sections are respectively connected to metallic bars, contacts or other corresponding parts of electric



switch apparatus by which the two coils may be coupled either in multiple or in series. Any switch of either the rotary or plug type may be employed for effecting the changes in connection and may be located in any convenient position. The type of switch illustrated is a plug switch and the two terminals of one coil or section are connected respectively to the blocks  $b'$ ,  $e'$ , of such switch, while the two terminals of the other are connected to the blocks or contacts  $b^2$ ,  $e^2$ . The terminals of the circuit in which the sections are to be included are joined to the blocks  $b'$ ,  $e^2$ , respectively.

The manner of using such an apparatus is well understood in the art. By placing a plug as shown in black between  $e'$  and  $b^2$ , the two sections are in series; by placing plugs as shown in white in the connections between  $b'$  and  $b^2$ , and between  $e'$  and  $e^2$ , the two coils will be connected in multiple in the circuit.

The reactive coil of the type described always works to the best advantage if the conductors C, S, are of approximately the same cross section. By coupling one of such conductors in different manner, as described, always utilizing however all of it, the greatest output of reactive coil can be obtained and an increase in the range of adjustment secured.

It has heretofore been proposed to vary the action of reactive coils by simply increasing or decreasing the number of turns of the coil without increasing or decreasing the conductivity so that only part of the windings could be utilized at one time. Besides in ordinary cases the change in the number of turns has been the only means at hand for regulating the effect of the coil, but in my invention, in addition to the adjustment heretofore obtained, by varying the connections from series to multiple series and to multiple, as may evidently be done, maintaining, however, the same amount of copper in the windings, a further range of adjustment may be secured—while, with the form of apparatus shown, the same smooth or gradual change of effect secured by the device of the patent, is maintained.

It is obvious that my invention is capable of extension by increasing the number of coils or sections and of switch plates. Thus if four coils be used they may be connected in the various ways shown in Figs. 5, 6 and 7, maintaining, however, the same amount of copper or conductor in the coil. In this instance the several terminals of the section will be brought to pairs of switch contacts or plates  $b'$ ,  $e'$ ,  $b^2$ ,  $e^2$ ,  $b^3$ ,  $e^3$  and  $b^4$ ,  $e^4$ , and by inserting plugs in the various ways shown in Figs. 8, 9 and 10, connections corresponding to those indicated in Figs. 5, 6 and 7, can obviously be secured.

It is obvious that my invention is likewise of utility when a device such as that covered by the patent before referred to is employed

as a motive device since by the invention the range or variation in the amount of motive influence or torque may be increased.

In applying my invention to an arrangement such as Fig. 1, its utility becomes obvious where it is desired to do the work of welding on conductors varying greatly in size. The ordinary range of regulation as obtained with a reactive coil may be sufficient for ordinary sizes of work but when it is desired to weld very small conductors on a large coil then it becomes necessary to provide an increase in the range of reactive effect which may be accomplished in my invention by changing the connections of the sectional coil from multiple to series or in such way as to increase the conducting length of the coil in a series connection from one terminal to the other of the apparatus over that which exists when all the sections are in multiple.

What I claim as my invention is—

1. The combination in a single circuit, of a reactive or motive coil for alternating electric circuits, provided with means for changing its reactive effect without changing its winding or the continuity of its core, a sectional conductor, a switch apparatus, and connections from such sections whereby the connections of the terminals may be interchanged for the purpose of changing the said sections from multiple to series or series multiple.

2. In an alternating current regulating or motive device consisting of two electric conductors movable in inductive relation to one another on a magnetic core, an electric switch apparatus having connections from its several plates or portions to the terminals of sections of one of such conductors whereby the conductivity and reaction of such sections may be changed without varying the amount of conductor producing or subject to inductive effects from the other.

3. In an alternating current regulating or motive device, the combination with a sectional conductor and a conductor or band on locally closed circuit, and adjustable in inductive relation to the first, of switch contacts, and connections to the terminals of the said sectional conductor for changing said sections from series to series-multiple or to multiple and vice versa.

4. The combination with a sectional coil placed in an alternating current circuit and surrounding an iron core, of a second closed band or coil whose inductive relation to the first is variable or adjustable, and switch contacts and connections to the terminals respectively of the said sectional coil for permitting the said sections to be changed from a series to multiple connection and vice versa, as and for the purpose described.

5. In an alternating current regulating or motive device, the combination of two conductors or coils adjustable in inductive relation to one another on an iron core, one of



said coils being divided into sections and provided with connections to a suitable switch whereby its conductivity and reaction may be changed without varying the total number of windings in action, as and for the purpose described.

Signed at Lynn, in the county of Essex and

State of Massachusetts, this 7th day of November, A. D. 1889.

HERMANN LEMP.

Witnesses:

J. WESLEY GIBBONEY,  
DUGALD MCKILLOP.