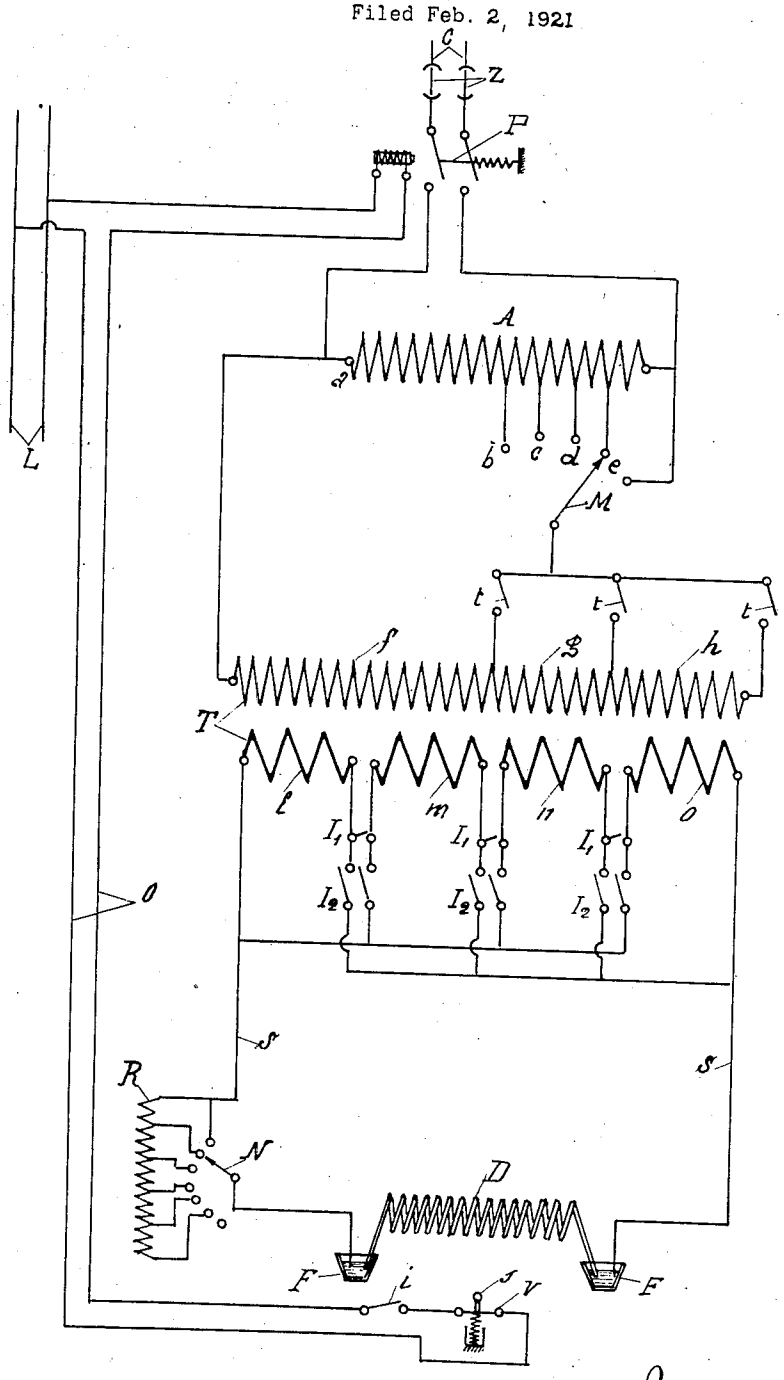
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ELECTRIC TEMPERING

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ELECTRIC TEMPERING.

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To all whom it may concern:

Be it known that I, ETTORE RAMONDO, a subject of the King of Italy, and resident of Turin, in the Kingdom of Italy, have invented certain new and useful Improvements in Electric Tempering; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings and to letters or figures of reference marked thereon, which form a part of this specification.

This invention has for its object a process for treating under the heat produced by an electric current the laminated or drawn steel used for manufacturing springs and effecting the hardening and tempering operation.

The system for transforming the electric energy into heat based on Joule's principle is already known. This invention is based on the same principle but, while in the usual transformation of electric into thermic energy the resistance of the apparatus effecting such transformation is calculated in accordance with the electromotive force of the available current, in this system the electromotive force of the current varies in agreement with the ohmic resistance opposed by the material to be treated and to its heat efficiency in respect of the temperature at which the treatment has to be effected.

My process consists substantially in the use of a current transforming apparatus from a high to a low tension, an arrangement for obtaining the various voltages required in the secondary circuit, and an apparatus for inserting the steel to be treated into the secondary circuit. This invention is substantially characterized by means for regulating the current in accordance with the diagram obtained through the electromotive force and its strength and the treatment to which the steel will be submitted.

Numerous experiments have demonstrated that steels having been submitted to the same thermoelectric treatment do not show identical characteristics; these latter vary according to the duration of the operation; this occuring also in the ordinary thermic treatment. Therefore it is absolutely necessary both from an economical and technical point of view, to vary the current characteristics in accordance with the requirements of each case.

If the steel has a very high specific electric resistance this may produce a considerable fall of potential between the ordinary current conductors and the piece to be treated. However, owing to the size of said piece, its ohmic resistance may be practically and in most cases is much lower than the ohmic resistance of the entire electric circuit in which the piece is inserted. Assuming that a steel bar measuring 1 m. length and having a section of 200 sq. mm. is heated, its resistance will be 0.0005 ohms, while all the circuit, in an ordinary plant, has a resistance of about 0.0045 ohms, namely 9 times higher. It is therefore necessary that the current strength be kept within certain limits, in this case and for the different treatments from 6 to 10 amperes for each sq. mm. of section, according to the section of the piece to be treated, so that the insertion of the piece produces the desired Joule's phenomenon.

The above said steel bar had a section of about 200 sq. mm. but a bar having a section of 50 sq. mm. may have the same ohmic resistance as the former one, as in the case of a spring formed of wire of a section of 50 sq. mm. and 25 cm. length. It is evident that if the same amount of electricity that was available for the bar having a section of 200 sq. mm. is caused to flow through the spring, this latter will not only be heated but will melt producing a short circuit. It would appear that by inserting a subsidiary resistance into the circuit and suitably varying its value in relation with the piece resistance, it would be possible to reduce the current strength according to the different pieces to be treated. Said rheostat would have to be very large and therefore not at all convenient and its office would be to absorb the surplus electricity. It is evident that in this case the cost of the process is not in proportion with the weight of the piece to be treated, but is constant for each piece, whatever be its size, be it for instance a bar 1 m. long and having a section of 200 sq. mm. or a round bar having a length of 0.25 m. and a section of 50 sq. mm., and this of course does not make the process an economical one.

By the process forming the object of this invention, the losses in the different opera-

tions are reduced to those due to the apparatus efficiency and the current consumption is proportional to the requirements of each particular case, so that the highest efficiency is obtained and the process may be used for manufacturing purposes.

This result has been obtained by means of a transforming apparatus transforming the primary current having a very low voltage and giving all the required voltages; for instance from volt to volt, from half volt to half volt, from 1 to 50 volts as it has been proved sufficient in the practice or from 0.5 to 100 volts as it might be necessary for experimental purposes.

Said transforming apparatus is constituted by a unit consisting of an auto-transformer and a series of identical transforming elements, the primary circuit of which is in series with the auto-transformer, while each element of its secondary circuit leads to terminals, by means of which and a special commutator it is possible to mount the elements in series in parallel or in multiple series.

The auto-transformer and the primary windings of the under-transformation elements are mounted in series on the main conductor of the supply line in such a manner as to allow of a certain number of element pairs to be cut out of the circuit in order to increase the number of combinations. The secondary winding of each element leads to two terminals, that, leaving each element individualized, allow of disposing by means of knife switches and according to requirements, all the elements in parallel, in series or in multiple series.

Assuming to dispose of a current of 2000 volts and an auto-transformer capable of ten boosting voltages to 2200, 2400, 2600 . . . up to 4000 volts, and each element giving a current transformed from 2000 volts to 5 volts, it is evident that for each voltage of the auto-transformer an element may have 10 different voltages of 5.5; 6; 6.5 . . . up to 10.

By inserting 16 element pairs, it is possible to obtain all the desired voltages by suitably disposing said elements in such a manner as to obtain from 5 to 10 volts with a variation from half volt to half volt; of 10 to 20 with a variation from volt to volt; of 20 to 40 with a variation from 2 to 2 volts etc. By eliminating one or more element pairs, it is moreover possible to obtain intermediate voltages so as to realize a great number of combinations satisfying not only all the work requirements, but also the eventual experiment requirements, as it is necessary in this kind of work.

In the annexed drawing is shown, by way of example, a diagrammatic form for the use of this process for the manufacture of helical springs. Evidently the same process may also be advantageously used for the manufacture of semi-elliptical and elliptical springs.

To the main primary conductors C is connected an auto-transformer A, the secondary circuit of which is branched from one of the terminals of the winding a and one of the intermediate points b, c, d, e by means of an interrupter or ordinary switch M or the like. In the secondary circuit of the auto-transformer A is mounted the transformer T, the primary of which is divided into portions f, g, h, which, by means of suitable interrupters t may be partially cut out of the circuit. The secondary of the transformer T is also divided into portions l, m, n, o, each of which is formed by a winding, the ends of which terminate in interrupters I_1 and I_2, which allow respectively of mounting all the elements in series or in parallel or, by their combined action, some element groups in series, according to requirements.

In the circuit S of the secondary of the transformer T is suitably inserted the starting rheostat R by means of an interrupter N and the piece D to be treated; this latter is preferably connected with the terminals F, allowing of the free expansion of said piece.

In the main primary circuit C is finally inserted an automatic minimum cut out P the electromagnet of which is operated from any suitable current source, for instance, as shown in the drawing, from the lighting main L to which its winding is coupled in parallel by means of conductors O. In said conductors are inserted: an interrupter i and a press switch v situated near the piece D to be treated so as to be within reach of the operator charged with the heating of the springs.

During the working, the interrupters i and v and therefore the automatic interrupter P are closed. When the operator, at the end of the operation, must break (for changing the piece) the current, he presses down the button j of the switch v, when the current being cut out from the electromagnet of the minimum interrupter P, this latter opens cutting out the current flowing to the auto-transformer A. By freeing the button j the main circuit of the auto-transformer A is again shut either automatically or not and the arrangement will again be in condition for operation.

When the work is finished, the current flowing to the main circuit is finally cut out by opening the interrupter i and the dividing knives Z.

In this arrangement either by operating the interrupter M of the auto-transformer, or by mounting in series or in parallel or in multiple series all or some of the elements of the secondary of the transformer T by means of the interrupters I_1 and I_2, it is

possible to control the strength of the current to be fed to the steel piece under treatment in order to obtain the desired result.

Claims:

1. In the art of tempering, transforming alternating current, re-transforming the transformed current and simultaneously proportioning the re-transformed current to give an amperage suited to different lengths, cross-sections and weights of the work through which the re-transformed current passes.

2. In the art of tempering, transforming by step up auto-transformation alternating current, re-transforming the transformed current downward and simultaneously proportioning such retransformed current to give an amperage suited to the requirements of different lengths, weights and cross-section of the work through which such re-transformed current passes.

3. In the art of tempering, transforming alternating current, re-transforming the transformed current and simultaneously proportioning the voltage of the re-transformed current to give an amperage suited to the requirements of the work through which the retransformed current passes, and separately controlling the voltage of the current passing through the work.

4. In the art of tempering, transforming by step up auto-transformation alterating current, re-transforming the transformed current downward and simultaneously proportioning the voltage of such retransformed current to give an amperage suited to the requirements of different lengths, weights and cross-sections of the work through which such retransformed current passes, and separately controlling the voltage of the current passing through the work.

5. In electric tempering apparatus, an auto-transformer, means to take therefrom current of different values, a second transformer having a primary winding supplied with such current and a plurality of electrically interconnectible secondary windings and means to supply current from said secondary windings.

6. In electric tempering apparatus a step-up auto transformer means to take therefrom currents of different values, a second step-down transformer supplied with such currents and comprising a primary winding and a plurality of secondary windings, means to variously connect said secondary windings to proportion the current to the work and a rheostat in circuit with said second transformer and the work.

7. In electric tempering apparatus a step-up auto transformer, means to take therefrom currents of different values, a second step-down transformer supplied with such currents and comprising a primary winding and a plurality of secondary windings, means to variously connect said secondary windings to proportion the current to the work and a rheostat in circuit with said second transformer and the work, and means at the work to disconnect the auto transformer from the line.

In testimony that I claim the foregoing as my invention, I have signed my name.

ETTORE RAMONDO.