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INDUCTOR

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Fig. 1

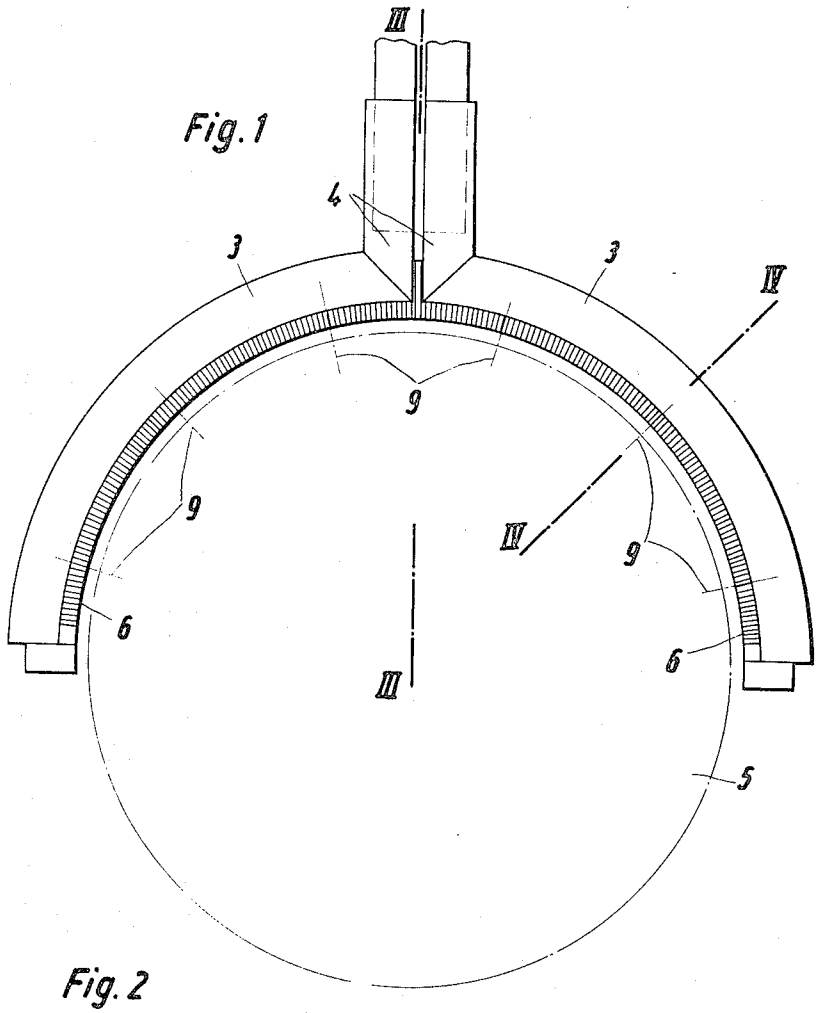
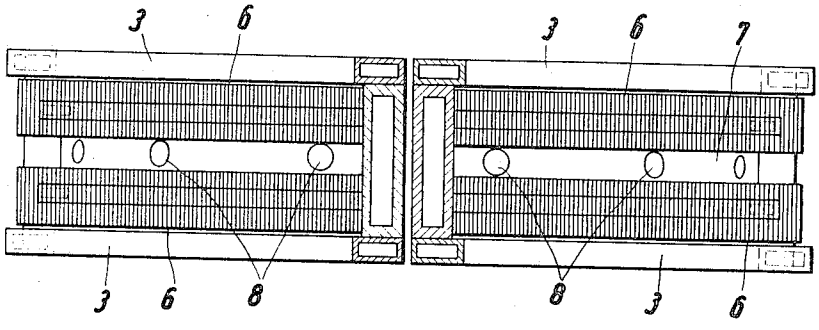


Fig. 2



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Fig. 4

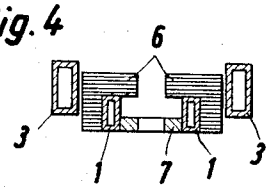


Fig. 3

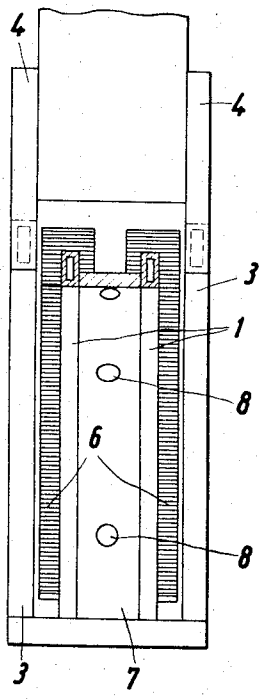


Fig. 6a

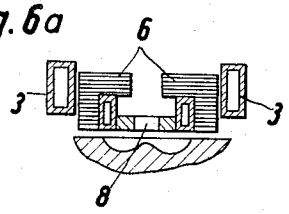


Fig. 6b



Fig. 6c

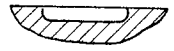
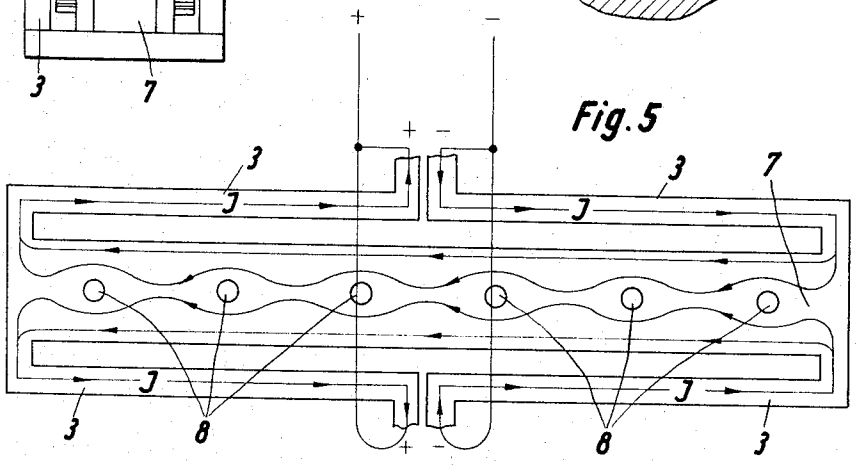


Fig. 5



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United States Patent Office

3,359,398

Patented Dec. 19, 1967

3,359,398

INDUCTOR

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Filed July 31, 1964, Ser. No. 386,707
Claims priority, application Germany, Aug. 5, 1963, D 42,179
4 Claims. (Cl. 219—10.43)

The invention relates to an inductor for the overall surface heating of workpieces. Such inductors have the form of a closed conductor loop extending over the workpiece surface. Facing that part of the workpiece which is to be heated to a given depth of penetration, for instance for the purpose of surface hardening the same, is the effective surface of the inductor or of a conductor of the inductor. The shape of these effective surfaces in conjunction with the disposition of magnetic yokes on the conductor largely determines the pattern of heat distribution, and it is a well known and conventional practice to modify and control the pattern of heat distribution by varying the shape of the effective surface and the disposition of the laminations of the yoke. In order to do this it is always necessary to dismantle the inductor and to reassemble the same, an operation which is not merely a nuisance but also expensive.

The object of the present invention is to provide means which will permit convenient adjustment and control of the pattern of heat distribution. More particularly, it is proposed that such adjustment should be possible without modification of the basic inductor construction, that is to say without the need of dismantling and reassembling the same after dimensional modification.

According to the invention the contemplated problem is solved by systematically providing the effective surface of the inductor with openings in the form of holes, slots or the like crossing the paths of the current in order to distribute the current in particular ways. At those points where say holes are located, holes being the easiest type of openings to provide, the current filaments are crowded together within the metal remaining between the edge of the conductor and the edge of the hole. In virtue of the proximity effect this modified distribution of the inductor current brings about a corresponding change in the distribution of the induced current in the workpiece. It has been found that the provision of only a few holes in the effective surface of the inductor is already sufficient to cause considerable changes in such manner that desired patterns of heat distribution can thus be achieved without the need of dismantling the inductor and modifying the same. If it is found that too many holes have been provided it is quite simple to close the unwanted holes by soldering for instance a copper plug or the like into the same. Similar possibilities naturally arise if openings in the form of slots or the like are provided.

The steps proposed by the invention can be applied to inductors of diverse kinds as their effect will then be analogous.

The invention will now be described in particular detail by reference to a preferred embodiment. The described inductor is a conductor loop for heating partial sections of cylindrical workpieces by the overall surface heating technique, said sections being afterwards hardened by quenching. When this process has been performed the machine engineer demands that a particular hardening pattern shall have been formed. This hardening pattern substantially conforms with the pattern of heat distribution which can be achieved by taking the steps proposed by the present invention. The invention will therefore be described by taking such an inductor as an example.

FIG. 1 is a view of the inductor,

FIG. 2 is a part sectional view,

FIG. 3 is a section taken on the line III—III in FIG. 1,

FIG. 4 is a section taken on the line IV—IV in FIG. 1,

FIG. 5 is a schematic representation of the current distribution.

FIGS. 6*a*, 6*b* and 6*c* exemplify the effect of the steps the invention proposes to take.

The inductor consists of two semi-circular liquid cooled hollow conductors **1** connected by feeders and returns **3** and terminals **4** to a suitable A.C. supply. The two conductors **1** which are arranged to form a closed conductor loop extending across the cylindrical surface of a workpiece **5** indicated in dot-dash lines carry laminated iron yokes **6**.

Moreover, the two conductors **1** are connected by a plate **7** which forms the effective inductor section. This plate **7** is provided with holes **8** drilled across the paths of the current. The positions of these holes are indicated in FIG. 1 by centre lines **9**. The holes **8** are located in plate **7** according to a predetermined plan in order to divert the current filaments in the manner indicated in the schematic drawing in FIG. 5. In this drawing the path of the current through the feeder return **3** through section **7** and the manner in which the filaments of current are crowded together by the presence of the holes, whereas they space themselves out equidistantly in the regions between consecutive holes, is quite clearly shown. By the choice of a suitable number of holes of appropriate diameter in relation to the width of section **7** diverse selectable patterns of heat distribution can be obtained. This will become particularly clear by studying the drawings in FIG. 6. If there is a considerable number of holes **8** the heated zone will be as indicated in drawing *a*. On the other hand, if no holes are present at all the heated zone will be as indicated by *b*. The provision of a smaller number of holes **8** than in *a* may give rise to a heated zone roughly as represented by *c*.

It is naturally quite easy to drill holes **8** into section **7** in order to achieve the desired effect. Should it then be found that too many or too large holes have been provided, then these can be closed by the insertion of say copper plugs which may be soldered into the holes, and a different arrangement of holes may be selected. This method of controlling the heating effect is particulary useful because it can be put into practice without requiring the inductor to be dismantled, freshly bent or reshaped in some other way.

The invention is not limited to the provision of circular holes. Slots or openings of some alternative kind may be provided, although round holes are naturally the easiest to provide. Moreover, the invention is not intended to be limited to a form of construction of the inductor as illustrated for instance in FIGS. 1 to 6. Other forms of inductor can be similarly treated, provided they comprise an effective section through which holes can be drilled without endangering the ducts containing the coolant.

What we claim is:

1. An inductor in the form of a closed loop for extending over a surface of a workpiece to be heated comprising:

a current conducting work section, said work section having a work surface disposed in spaced parallel relation to the surface of said workpiece, said work surface having apertures therein disposed across the path of current flowing therein for concentrating the current distribution at predetermined points to

produce a heating pattern in the workpiece, said apertures extending through said work section in a direction perpendicular to the plane of said work surface.

2. An inductor according to claim 1, comprising at least two hollow conductors adapted to be cooled by passage of liquid therethrough and having a current conducting working section between them provided in systematic disposition with holes therein across the path of the current.

3. An inductor according to claim 2, in which the said hollow conductors are provided with magnetic yokes.

4. An inductor in the form of a closed conductor loop for extending alongside and over a surface of a workpiece to be heated and comprising two hollow conductors connected by a corresponding arched bridging plate forming a current conducting working section, said plate being provided with openings across the path of the current therein for the purpose of concentrating the current distribution at predetermined points and thus to produce a heating pattern in the workpiece.

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