June 3, 1952 I. BECKIUS ET AL 2,599,086

INDUCTION HEATING

Filed June 30, 1949

Fig.4

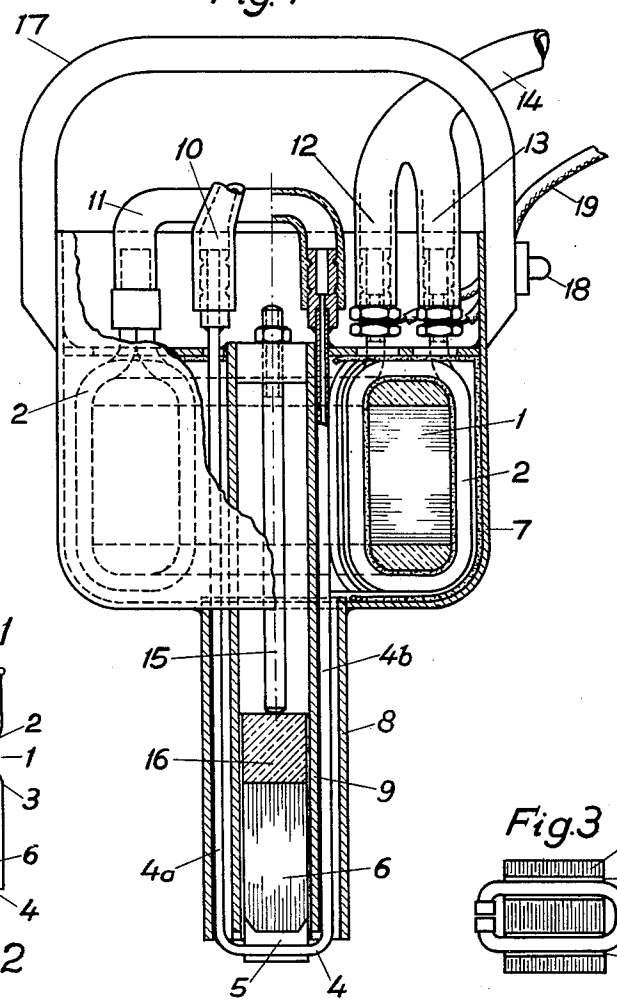


Fig.1

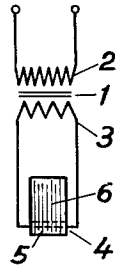


Fig.2

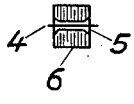


Fig.3

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Patented June 3, 1952

2,599,086

UNITED STATES PATENT OFFICE

2,599,086

INDUCTION HEATING

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Application June 30, 1949, Serial No. 102,368
In Sweden April 20, 1948

4 Claims. (Cl. 219—47)

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This invention relates to a device for local heating of objects to be subjected to soldering, hardening or similar heat treatment by means of high frequency induction currents. Since the low voltage required for the device generally cannot be produced directly in a generator in a suitable manner, a transformer is needed between the generator and the heating device.

One of the principal objects of the invention is to provide an improved heating device of this kind which allows in a simple manner concentrated heating of the work piece without leakage flux.

Another object is to construct a handy self-contained device reliable in its function and adapted to be mounted either within a supporting structure or to be used as a manually operated tool.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings and it will be understood that many changes may be made in the details of the construction and arrangement of the parts shown and described without departing from the spirit of the invention expressed in the accompanying claims. The invention, therefore, is not limited to the exact details of the construction and arrangement shown and described only by way of example.

Referring to the drawings:

Fig. 1 shows a heating device illustrating diagrammatically the connections of the heating device.

Fig. 2 shows the heating element of said device viewed from below.

Fig. 3 shows another embodiment of the heating element also viewed from below.

Fig. 4 shows by way of example partly in section a portable tool containing a heating element according to the principles of the invention.

Like parts throughout the various figures are designated by like reference numerals.

Referring to Fig. 1, the heating device comprises a transformer having a magnetic circuit 1, a primary winding 2, and a secondary winding 3. Said secondary winding has a portion 4 which constitutes the eddy current inducing heat producing element for the object to be heated, and which is embedded within a slot 5 in the end surface of a laminated iron core 6 adapted to be brought within the closest vicinity of the work piece to be heated. The slot 5 may be straight but in a preferred shape shown in Fig. 2 it has its ends widened in order to generate a flux concentration in its middle portion with the result that

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an effective spot heating of the work piece is obtained. Fig. 3 shows a modification, wherein the heating element 4 has the shape of a loop lying in two slots 5 within the end surface of the iron core 6. By this arrangement, a larger area of the work piece may be heated. Obviously, it is possible to arrange two or more heating elements in corresponding slots.

Fig. 4 shows a portable heating device, use being made of the heating element shown in Figs. 1–2. The transformer has again a magnetic circuit 1, supporting a hollow primary winding 2 which is cooled by a cooling fluid. The secondary winding 3 comprises a metal casing 7 insulatingly surrounding the primary winding 2, two tubular concentric conductors 8 and 9 fixed on the bottom and the top, respectively, of the casing 7 and protruding axially therefrom, and the heating element 4. Said heating element is U-shaped and hollow and has its upwardly extending legs 4*a* and 4*b* connected with the outer and the inner tubular conductors 8 and 9, respectively, for instance by soldering. In order to facilitate the soldering of the leg 4*a* onto the inner side of the tubular conductor 8, the tube may be cut up in axial direction so that the soldering may be made from the outside. The upper end of the leg 4*a* is connected to a tube 10 of insulating material such as rubber for supplying the cooling fluid such as water, whilst the upper end of the leg 4*b* is connected by a similar tube 11 with the hollow primary winding 2.

The fluid entering through the tube 10 flows through the conductors 4*a*, 4, 4*b*, through the communication tube 11, branches into two sections within the corresponding branches of the primary winding 2, passes these branches and leaves the winding on the primary taps of the transformer through two tubes 12 and 13 which are united to one outlet tube 14.

The iron core 6 in which the heating element 4 is embedded is arranged within the tubular conductor 9. As the iron core is subjected to wear in the long use, it may be provided with means for adjusting its position with respect to the heating element. This may be accomplished by a setting screw 15 by intermediance of an insulating piece 16. As shown in Fig. 4, the depth of the slot 5 is made greater than the height of the conductor 4, and the latter is placed in spaced relationship to the bottom of the slot.

The heating device is provided with a handle 17 fixed on the casing 7 and with a switch 18 such as a push button mounted on the handle and connected to feeders 19.

It will be understood that the device described or a plurality thereof also may be used in any desired stationary arrangement, the handle then being replaced by suitable means for attaching the device to the arrangement, such as a machine for soldering, hardening or welding.

We claim as our invention:

1. A high frequency induction heating device for locally heating a work-piece, comprising a transformer primary winding, a transformer secondary winding consisting of a ring-shaped casing enclosing the primary winding, an outer tubular conductor extending from one end of said casing and an inner tubular conductor extending from the other end of said casing, through the said casing and through the said primary winding and through the outer conductor, a magnetic core contained within and protruding beyond the free ends of said tubular conductors for direct engagement with the work-piece, a heating element connected to both said tubular conductors, at least one slot formed in the protruding end of said core and receiving a portion of said element to concentrate the heat in the work-piece, said slot being sufficiently deep to accommodate the said element with the outer surface of the element inwardly spaced from the plane of the work-piece engaging end of the core, and means for advancing the said core in the said inner conductor when the exposed end of the core is worn down, the element receiving slot in said core having sufficient depth to permit advancement of the core without moving said element.

2. A high frequency induction heating device according to claim 1, in which the slot in said core is widened at its ends to concentrate the magnetic flux within the work-piece.

3. A high frequency induction heating device according to claim 1, in which two parallel slots in close proximity to each other in the end of the core accommodate portions of said element and concentrate the magnetic flux in the work-piece.

4. A high frequency induction heating device according to claim 1, wherein the primary winding and part of the secondary winding consist of hollow conductors traversed by a cooling fluid in series.

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