

July 16, 1946.

J. H. FLEDEL-BECK

2,403,969

SPLIT INDUCTION COIL FURNACE

Filed March 10, 1943.

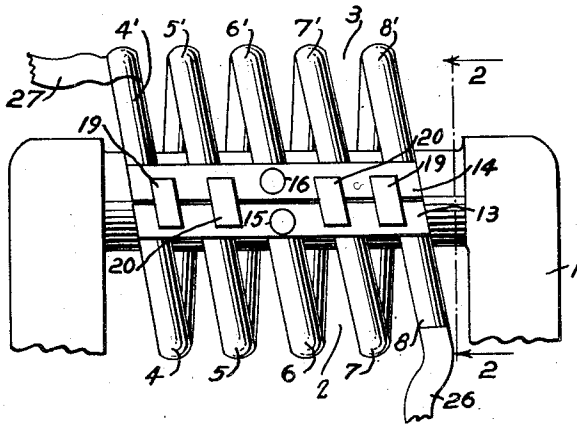


Fig. 1.

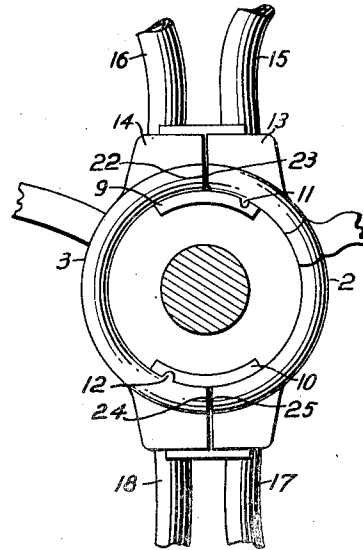


Fig. 2.

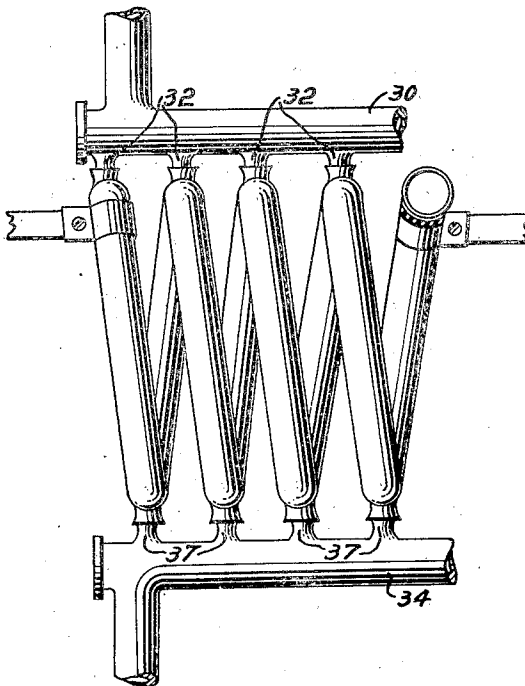


Fig. 3.

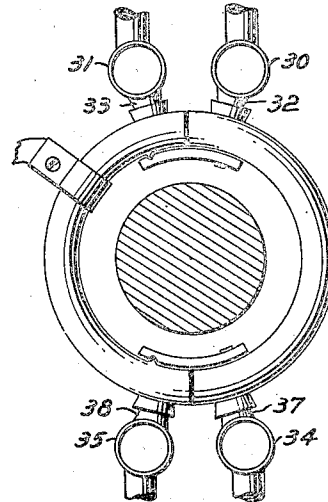


Fig. 4.

INVENTOR
JACOB H. FLEDEL-BECK.

BY.

Ezekiel Wolf
his ATTORNEY

UNITED STATES PATENT OFFICE

2,403,969

SPLIT INDUCTION COIL FURNACE

Jacob H. Fledel-Beck, Dorchester, Mass.

Application March 10, 1943, Serial No. 478,634

3 Claims. (Cl. 219-13)

1

The present invention relates to induction furnaces and in particular to their use in the treatment of metals already shaped and formed.

The present invention more particularly concerns the adaptation of induction furnaces for the purpose of heat treating such articles in which the ordinary induction furnace could not be used.

The present invention is particularly useful in the heat treatment of crank shafts for airplanes and Diesel engines and also for automobiles, trucks and tanks and is capable of speeding up the output of mechanical parts for such equipment as is now used in the war effort.

Sometimes it is desired to treat only a part of an article, as for instance a bearing on a shaft or a crank shaft or a cutting end of a tool, and this is impossible because of geometrical shape of the article. This is particularly true in the case of crank shafts for internal combustion engines where the crank arms extend in all radial directions and are at different places along the shaft. The only way to treat such a shaft in a furnace is to stick the whole shaft in the furnace in which case the whole shaft becomes treated, which is undesirable since while the bearing surfaces of the shaft should be hard, the rest of the shaft should be tough and resilient. To avoid this, flame hardening has been used which is undesirable because it causes distortions and sometimes cracking of the crank shaft.

In the present invention this is avoided by the construction of a split coil furnace which may be placed only around the parts of the article which it is desired to treat in the same way. In the case of crank shafts these split coil furnaces may be placed around the shaft bearings leaving the rest of the shaft untreated. In other types of articles the split coil may be yoked around the parts of the article it is desired to harden or heat treat, leaving the rest of the article free from heating in any way.

In the present invention the induction coil is cooled by cooling water or other fluid, the shell or pipes enclosing the water or fluid carrying the high frequency current which is induced into the metallic article being treated.

The present invention will be more fully described in connection with embodiments of the invention illustrated by the drawing annexed in which:

Figure 1 shows the invention in one form as applied to crank shaft.

2

Figure 2 shows a section on the line 2-2 of Figure 1.

Figure 3 shows in elevation another form of the invention similar to that shown in Figure 1, and

Figure 4 shows an end view of the modification shown in Figure 3.

In Figure 1, 1 shows a shaft whose bearing it is desired to treat, for hardening purposes. The induction coil is composed of two arcuate sections 2 and 3 each having helical semi-circular turns of tubing, 4 and 4', 5 and 5', 6 and 6', 7 and 7' and 8 and 8'. The ends of the same numbered pairs abut against each other and may make contact by abutting surface ends which may be made of silver or other suitable metals. In addition to this, on the inside of each turn there may be provided spring straps of beryllium copper or other resilient conductive material 9 and 10, which may hook into catches or latches 11 or 12 on one section, for instance, and be riveted to the other section; or if desired, the resilient spring strips may be attached alternately in successive turns first to one section and then to the other section.

Each section may be cooled by providing a manifold or chamber 13 and 14 for the sections 2 and 3 respectively to which cooling water is conducted by pipes 15 and 16 respectively and drawn off in the outlet pipes 17 and 18 respectively. Spring straps 19 and 20 may extend across over the top surface of the manifold, one pair fastened to the top of one manifold and the other fastened to the top of the other manifold. These together with the springs inside the coils hold the two half-sections together. The manifolds are made of some non-conductive material such as molded "steatite" or other insulating material while the inside springs make good contact across the individual coil elements or turns from one side to the other so that the current flows in a completed coil around the piece to be treated. In this the spring latches are such that the electrode ends of the coil turns 22 and 23, and 24 and 25, bear with pressure against each other. This is accomplished by making the electrode ends or faces yielding so that as the two halves of the coil are brought together, the contacts will be pressed against one another reacting against the spring latches and strap springs. Current is conducted to the coil through the terminal conductors 26 and 27.

In the arrangement shown in Figures 3 and 4, the same general construction is shown as in Figures 1 and 2 except that two individual pipes

3

30 and 31 serve in place of the manifolds in Figures 1 and 2. These pipes 30 and 31 have individual non-conductive conduits 32, 32, 32, 32 and 33, 33, 33, 33 to each half-turn of the coil. The outlets are built up in the same manner by means of the pipes 34 and 35 and the outlets non-conductive conduits 37, 37, 37, 37 and 38, 38, 38, 38.

The sections are put together in the same manner as in Figures 1 and 2 and may thereby be clamped around a shaft on which a formed coil could not otherwise be put.

The induction furnace of the present invention is intended to be used for high frequency induction work where frequencies of the order of 100 k. c. to greater are used. In this use the element to be treated must be capable of conducting current. An increased effect is obtained where the current conducting properties are high. In the treatment of shafts, both solid and hollow, the high frequency current is confined around the surfaces so that the greatest heating effect is in those places. This is highly desirable since for the most parts it is desired only to harden the surface of the shaft and leave the inside tough and ductile. Therefore after heating the shafts to the right temperature as exhibited by their outside temperature and color, they are rapidly cooled, thus hardening the surface but keeping the inside of the shaft tough and ductile.

Having now described my invention, I claim:

1. An induction furnace comprising a helical cylindrical coil split along the axis of the coil forming two parts, the parts being formed as segments of hollow conductive turns sealed off along

4

the split portions, inlet and outlet means adjacent the split ends for supplying cooling fluid to circulate through the hollow conductive members, and means mechanically and electrically joining the two parts at their split ends for permitting current to circulate through the helical turns of the coil.

2. An induction furnace comprising a helical cylindrical coil split along the axis of the coil forming two parts, the parts being formed as segments of hollow conductive turns sealed off along the split portions, inlet and outlet means of insulating material connected to the segments of the turns adjacent the sealed off ends of the segments for supplying cooling fluid to circulate through the hollow conductive members and means mechanically and electrically joining the ends of the segments forming continuous turns for permitting current to circulate through the helical turns of the coil.

3. An induction furnace comprising a helical cylindrical coil split along the axis of the coil forming two parts, the parts being formed as segments of hollow conductive turns sealed off along the split portions, an insulated manifold chamber having fluid connections to the segments of the turns adjacent the sealed off ends of the segments for supplying cooling fluid to circulate through the hollow conductive member and means mechanically and electrically joining the ends of the segments forming continuous turns for permitting current to circulate through the helical turns of the coil.

JACOB H. FLEDEL-BECK.