ELECTRICAL HEATING CARTRIDGE

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Filed: Sept. 17, 1974

Appl. No.: 506,888

Foreign Application Priority Data
Sept. 19, 1973 Germany.................. 2347090

U.S. Cl............ 219/523; 174/52 R; 219/526; 219/536; 338/218

Int. Cl2.......................... H05B 3/06

Field of Search .......... 219/201, 205, 335, 523, 219/526, 530, 536, 544, 552, 553; 338/218; 29/451; 165/185; 174/52 R, 65 R, 86

References Cited
UNITED STATES PATENTS
1,416,897 5/1922 Simon.......................... 219/523
2,371,696 3/1945 Levitt.............................. 338/218 X
2,499,961 3/1950 Lennox.......................... 338/218 X
2,623,978 12/1952 Cantrell...................... 219/526 X

2,913,987 11/1959 Clymer......................... 174/86 X
3,096,426 7/1963 Axelson.......................... 219/538 X
3,213,263 10/1965 Steenbergen.................. 219/205
3,335,459 8/1967 Tyrner.......................... 219/523 X
3,461,275 8/1969 Poole............................ 219/553

ABSTRACT

A heating cartridge insertable into a bore of a body to be heated comprises a slightly tapering metallic shell whose larger end is cylindrical and carries a thread coupling sleeve freely rotatable thereon. A coil of resistance wire within the shell has turns more widely spaced at the center than at its ends to provide a more uniform heating effect.

4 Claims, 4 Drawing Figures
ELECTRICAL HEATING CARTRIDGE

FIELD OF THE INVENTION

Our present invention relates to a resistive heating element insertable into a thermally conductive body of a machine tool or other equipment to be held at a desired temperature.

BACKGROUND OF THE INVENTION

Heating elements of the type described are commercially obtainable in various versions. They are used in particular where a controlled and localized heating effect is desired, e.g. in the processing of synthetic resins by injection, compression or extrusion.

Conventional heating cartridges generally comprise a cylindrical shell, usually of a high-grade alloy steel, enclosing a helical resistance wire serving to convert electrical energy into heat. A threaded coupling at the supply end of the shell enables the heating cartridge to be screwed into a corresponding threaded bore of the body to be heated.

Important criteria to be considered in such a heater are its service life and the efficiency of energy conversion. To optimize these criteria, the manufacturing processes, the choice of materials and the techniques of assembly of such units have been progressively refined. Thus, excessive play between the outer shell surface of the cartridge and the bore receiving same is detrimental to its service life and efficiency. This means that the assembly tolerances are to be kept as small as possible, which requires very careful machining of both the shell and the corresponding bore.

OBJECTS OF THE INVENTION

The general object of our invention, therefore, is to provide an improved heating cartridge in which the aforementioned requirements of close fit and good heat transfer are largely satisfied.

A more particular object is to provide means in such a cartridge for enabling it to be conveniently secured to any body which is to be heated thereby.

It is also an object of our invention to provide a heater construction substantially equalizing the heating effect over the entire cartridge surface.

SUMMARY OF THE INVENTION

In accordance with an important feature of our invention, the cartridge has a thermally conductive shell whose outer surface deviates from the conventional cylindrical configuration by tapering slightly from a first or bottom end to a second or top end, thereby insuring a secure seating of the shell in a bore of complementary frustoconical shape despite unavoidable manufacturing tolerances. A conicity on the order of 50:1 has been found highly satisfactory.

Since the shell may have to be inserted to a greater or lesser extent into the bore, depending upon the aforementioned tolerances, another feature of our invention resides in the provision of a coupling affording the desired flexibility without subjecting the cartridge body to any objectionable stress. Such a coupling comprises an externally threaded cylindrical sleeve fitted onto a cylindrical extremity of the shell at its bottom end, the sleeve being freely rotatable on that extremity and being held in position by axial abutments such as a pair of split rings or one split ring and a fixed collar or flange on the shell. Advantageously, an annular clearance is left between the inner sleeve surface and the cylindrical surface of the shell extremity to compensate for possible axial disalignments between the coupling sleeve (or its seat in the bore) and the shell (or bore) axis. The free-wheeling of the sleeve on the shell prevents any rotary entrainment of the latter during mounting or extraction of the cartridge and thus avoids frictional damage.

We have found that the usual heating coil, with constant axial spacing of its helical wire turns, does not afford uniform heat distribution since the heating effect is more concentrated at the longitudinal center of the cartridge than at its ends. Therefore, pursuant to another important feature of this invention, we prefer to make the density of the helicoidal wire turns relatively low at mid-length and relatively high at the ends, for the purpose of substantially equalizing their heating effect. This feature is particularly advantageous in conjunction with the close-fitting frustoconical shell described above since in that case the heat on the outer shell surface passes directly into the surrounding body, with no intervening air cushion providing a certain leveling effect.

BRIEF DESCRIPTION OF THE DRAWING

The above and other features of our invention will now be described in detail with reference to the accompanying drawing in which:

FIG. 1 is a somewhat schematic elevational view of our improved heating cartridge inserted into the body of a workpiece;

FIG. 2 is a similar view of such a cartridge, shown partly in longitudinal section;

FIG. 3 is a longitudinal sectional view of the lower extremity of the heating cartridge, drawn to a larger scale and illustrating the mounting of a coupling sleeve; and

FIG. 4 is a view similar to FIG. 3, showing a modified sleeve mounting.

SPECIFIC DESCRIPTION

A heating element or cartridge 10, shown in FIGS. 1 and 2, has a slightly frustoconical metallic shell 11 tapering from its bottom end to its top. The shell 11 fits closely within a similarly tapering bore 13 of a workpiece body 29 to which the cartridge 10 is attached within bore 13 by means of an externally threaded coupling sleeve 14 as illustrated in FIG. 1. Sleeve 14 is freely rotatable on shell 10 as more fully described below with reference to FIGS. 3 and 4.

FIG. 2 shown a pair of leads 15 supplying current to a coil 16 of resistance wire imbedded in an insulating mass 30 within shell 11. The thickness of this shell decreases progressively from its bottom to its top, its inner peripheral wall being of substantially cylindrical shape. Shell 11 could also be of uniform thickness, in which case the space accommodating the coil 16 would be frustoconical.

The density of the helicoidal turns of coil 16 varies over its length and is lowest at its longitudinal center, increasing progressively toward both ends. This arrangement is designed to provide more uniform heat distribution along the surface of cartridge 10.

Sleeve 14 terminates in a hexagonal head 17, engageable by a wrench, and carries male threads 18 mating with corresponding female threads in the bore 13 of workpiece or support 29. The smooth inner sleeve
surface 19 has a slightly larger diameter than the confronting outer surface 20 of the cylindrical lower extremity 21 of shell 11, thus defining therewith a narrow annular clearance to facilitate correction of any disalignment between the axes of the frustocone and the threads in either the cartridge 10 or the bore 13.

FIG. 3 shows the mounting of sleeve 14 on the lower, heavier end of shell 11 by means of two split rings 22, 25 seated in a pair of axially spaced annular grooves 23 of the shell and in internal annular recesses 24 and 27 of the sleeve. This mode of mounting enables the replacement of the sleeve on the cartridge, e.g. for insertion of the latter into a different workpiece, or use of the same sleeve to retain a replacement cartridge in the body 29.

FIG. 4 shows a modified sleeve mounting with replacement of the lower split ring 25 by a peripheral flange 28 at the bottom end of shell extremity 21. With this structurally simpler arrangement the sleeve 14 can be mounted or detached only by way of the upper end of the shell 11.

The conicity of the mating surfaces of shell 11 and bore 13, i.e. the cotangent of half the vertex angle of the frustocone, is advantageous about 50:1; such tapers can be easily machined with commonly available tools.

We claim:
1. A heating cartridge comprising:
a thermally conductive shell having a frustoconical outer surface tapering from a larger end to a smaller end thereof with a conicity on the order of 50:1, said shell being closed at said smaller end and being provided at said larger end with a cylindrically tubular extremity;
a pair of axially spaced-apart, substantially nondeformable annular abutments on the outer surface of said extremity;
an externally threaded rigid sleeve freely rotatable on said extremity between said abutments in an axially fixed relative position, said sleeve having an inner diameter slightly exceeding the outer diameter of said extremity whereby an annular clearance is formed between said extremity and said sleeve;
a heating coil insulatedly received in said shell and provided with a supply lead passing through said shell and provided with a supply lead passing through said extremity; and
a thermally conductive dielectric mass in the interior of said shell, said heating coil consisting of resistance wire imbedded in said mass.
2. A heating cartridge as defined in claim 1 wherein said coil has helicoidal turns more closely spaced at the ends of said coil than at mid-length thereof.
3. A heating cartridge as defined in claim 1 wherein at least one of said abutments is a split ring received in a peripheral groove of said extremity.
4. A heating cartridge as defined in claim 3 wherein the other of said abutments is a peripheral flange integral with said extremity.

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