April 10, 1962 W. G. STRATTON ETAL 3,028,660

FERRITE CORE SPLITTING PROCESS

Filed Sept. 24, 1958

FIG. 1.

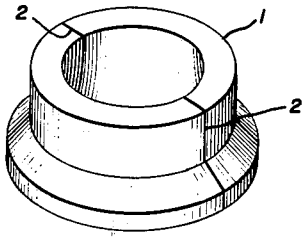


FIG. 2.

FIG. 3.

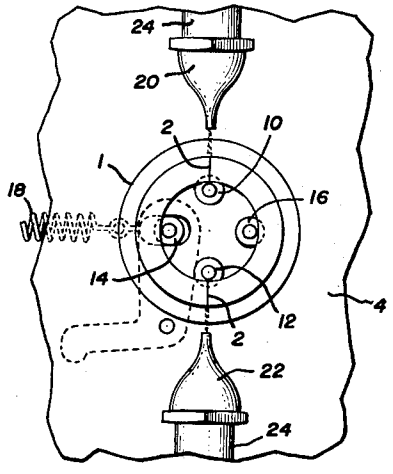
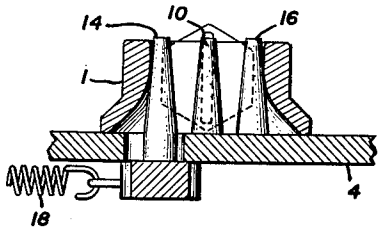


FIG. 4.



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FERRITE CORE SPLITTING PROCESS

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This invention relates to the manufacture of annular ferromagnetic ceramic members such as cylindrical ferrite inductor cores for cathode ray tube deflection systems and the like. More particularly the invention relates to improvements in a method of splitting such annular ceramic members into a plurality of segments.

In the production of deflection coil cores for use with cathode ray tubes and the like, accurate conformance of the shape and size of the deflection coil core to the exterior surface of the neck or cone-to-funnel transitional portion of the cathode ray tube envelope is essential for desired uniformity of deflection characteristics of the resulting system. When assembled on the neck of a cathode ray tube the core must provide a uniform annular flux path concentric with the tube neck for desired deflection characteristics, and accordingly any deviation of the core in size, shape or magnetic permeability from that required is highly undesirable.

To facilitate assembly of annular deflection coil cores on the necks of cathode ray tubes or the like, it has been the practice heretofore to manufacture the cores as single integral annular members, and then after all of the high temperature processing of each core is completed the integral piece is split into two or more partly annular segments. The individual segments are subsequently fitted together about the neck of the cathode ray tube, and held in place with the associated coil windings by a suitable fastener such as a band or collar. It is highly desirable that the individual segments fit together with sufficient intimacy so that no high reluctance air gap exists between the pieces and the resulting reassembled structure has substantially the same electrical and magnetic properties as the single integral member before splitting, as well as being of identical size and shape as the single integral member before splitting.

One known prior art method of accomplishing such core splitting involves scoring of the core along desired fracture lines, followed by the localized application of a high temperature heat source having a temperature in the neighborhood of 3000°–4000° C., such as an oxy-hydrogen flame, until the material cracks at or near each score line as a result of uneven local heating. This technique has certain disadvantages, however, in that the high temperature of 3000°–4000° C., produced by the oxy-hydrogen flames or equivalent heat treatment tend to cause highly undesirable spalling or chipping of the material at the vicinity of each split. Such spalling or chipping of course not only changes the size and shape of the segments separated by the split, but the absence of the chips from the reassembled segments creates appreciable air gaps causing high reluctance paths in the reassembled cores which render their electrical and magnetic properties non-uniform. Also, scoring of the cores is time consuming and expensive, and even the slight change in physical dimensions produced by scoring of a core is likely to result in an appreciable non-uniformity in its electrical and magnetic characteristics.

One object of the present invention, therefore, is to provide an improved method for dividing ceramic members, which eliminates spalling, chipping, flaking, and the like, adjacent the split, and which eliminates the necessity for preliminary scoring of the member.

Another object is to provide an improved ceramic splitting method which avoids the need for heating of the ceramic member to high temperatures such as to cause spalling.

Another object is to provide an improved method of splitting ferromagnetic ceramic annular members which enables an improved degree of control of the location of the split.

These and other objects of the present invention will be apparent from the following description taken in conjunction with the appended claims.

Briefly the present invention arises from the discovery that the foregoing objects can be readily achieved by the application to the ceramic member to be divided of relatively low temperature localized heating, i.e. to a temperature of 400°–900° C. and with a heat source of temperature less than 1000° C., accompanied, desirably, by simultaneous application of a slight tensile stress or light mechanical shock to the member at substantially right angles to the desired plane of fracture. When tensile force is applied in the case of splitting an annular ceramic member into two substantially equal segments, the tension stress should be not less than ½ p.s.i., preferably created by exerting pressure on the interior surface of the annular member at points diametrically spaced along a line generally perpendicular to the plane of the desired fracture.

In the drawing:

FIG. 1 is a ferromagnetic ceramic member divided into segments according to the present invention.

FIG. 2 is a perspective view of an exemplary core splitting apparatus constructed for operation in accordance with the present invention.

FIG. 3 is a fragmentary view of a portion of the apparatus of FIG. 2; and

FIG. 4 is a fragmentary sectional view of another portion of the apparatus of FIG. 2.

Referring to the drawing, FIG. 1 shows an annular ferromagnetic ceramic member **1** suitable, for example, for mounting on the neck of a cathode ray tube as a deflection coil core. The core shown consists of two substantially symmetrical segments which fit together along the fracture line **2**. The apparatus shown in FIG. 2 includes a base plate **3** carrying a slide **4** reciprocable in guides **6, 8**. On the slide **4** are mounted four upstanding pins **10, 12, 14, 16** around which a core to be split is adapted to be placed. Two of the pins **10, 12** are fixed to the slide along a line transverse to the direction of slide movement. The alternate two pins **14, 16** are arranged on a line perpendicular to pins **10, 12**, one pin **16** being fixed to the slide **4** and the other pin **14** being movable relative to the slide in the direction of slide movement. According to one aspect of the invention, pin **14** is radially outwardly urged, as by spring **18**, with sufficient force to create a tensile force in the core to be split of not less than ½ p.s.i. throughout the entire area of desired fracture.

Arranged opposite the pins at diametrically spaced points on a core disposed thereon are respective heat sources in the form of burners **20, 22** arranged so as to be radially inwardly directed at the core and adapted to be supplied through hoses **24** with suitable combustible gases for producing flames. The burners are each provided with a plurality of small orifices and are so shaped and positioned as to produce a thin sheet of flame directed toward diametrically spaced lines on the core opposite the fixed pins **10, 12** and extending generally parallel to the axis of the core. The sheet of flame from each burner is preferably maintained as thin as possible, being desirably for example of the order of twenty thousandths of an inch in thickness. In accordance with the invention the maximum temperature of the heat source should not exceed 1000° C., and its spacing from the core on the pins should be such as to provide an outside core surface temperature

at the points of desired fracture of about 400°–900° C. While any suitable fuel and oxidizer may be supplied to burners **20**, **22**, or another heat source may be employed to produce temperatures in the ranges above defined, in one satisfactory burner arrangement petroleum natural gas having a heat content of 1050 B.t.u. per cu. ft. was employed for the fuel, at a pressure of approximately 6 inches of water, plus sufficient oxygen to provide a clean blue flame, and with the burners spaced from the surface of approximately ¼ inch from the surface of the core to be fractured.

In lieu of application of the tensile force, or in addition thereto, the core may be subjected to light mechanical shock or vibration, as by tapping lightly, during heating.

After the desired fracture occurs, usually only a few seconds after the core is subjected to the simultaneous tensile force and localized heating, it is desirable to remove the segments promptly from the heat source. This may be done for example manually, automatically by movement of the slide responsive to release of pin **14** when the core fractures, or by any other desired means.

By the method of the present invention as above described spalling of the pieces is substantially completely eliminated with resulting uniformly high yield on a production basis, and also eliminated is any marring or adverse dimensional change of the parts due to heretofore required scoring. The surfaces exposed at the respective fracture lines are clean, exhibit a conchoidal fracture, and fit together on reassembly of the segments with a uniformly extremely intimate contact such as to leave an effectively zero air gap therebetween. So chip-free and close is the fit on reassembly, in fact, that is generally impossible to tell with the naked eye where the splits have occurred. Individual segments of the core may be subsequently fastened together as by means of any suitable collar, and the resulting structure provides an effectively continuous magnetic path of high permeability.

It will be appreciated by those skilled in the art that the invention may be carried out in various ways and may take various forms and embodiments other than those illustrative embodiments heretofore described. It is to be understood, therefore, that the scope of the invention is not limited by the details of the foregoing description, but will be defined in the following claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. The method of dividing a relatively thin member of ceramic material along a desired plane of division comprising subjecting the member to a tensile stress of not less than ½ p.s.i. in a direction substantially normal to the desired plane of division, and simultaneously locally heating the exterior surface of said member in the vicinity of said desired plane of division to a temperature of from 400° to 900° C.

2. The method of dividing an annular member of ceramic material along a desired plane of division comprising subjecting the material to a tensile stress of not less than ½ p.s.i. in a direction substantially normal to the desired plane of division, and simultaneously subjecting the exterior surface of the member to localized heating in the vicinity of the desired plane of division to a temperature of less than 900° C. with a heat source having a temperature not exceeding 1000° C.

3. The method of dividing an annular member of ferromagnetic ceramic material into a pair of semi-annular segments comprising applying radially outwardly directed pressure to the interior surface of the member at two substantially diametrically spaced points thereon in a direction generally normal to the desired surfaces of division, and simultaneously locally heating the exterior surface of the member to from 400° to 900° C. at the desired places of division.

4. The method of dividing an annular member of ferromagnetic ceramic material along a desired plane of division into a pair of semi-annular segments comprising radially outwardly directed pressure to the interior surface of the member at substantially diametrically spaced points thereon in a plane generally normal to the desired plane of division, and simultaneously directing at the exterior surface of the member along diametrically spaced lines in the desired plane of division flames having a temperature of less than 1000° C. and arranged to heat the surface of the member in the vicinity of said diametrically spaced lines to a temperature of between 400° and 900° C.

5. The method of dividing an open member of ceramic material across the opening therein at two substantially diametrically opposed places comprising simultaneously locally heating the exterior surface of said member in the vicinity of the desired places of division to a temperature of from 400° to 900° C. with a heat source having a temperature not exceeding 1000° C. and subjecting the member to light mechanical shock during said heating.

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