Dec. 11, 1962 J. P. JONES 3,068,437

MAGNETIC CORE ELEMENTS

Original Filed Nov. 3, 1955

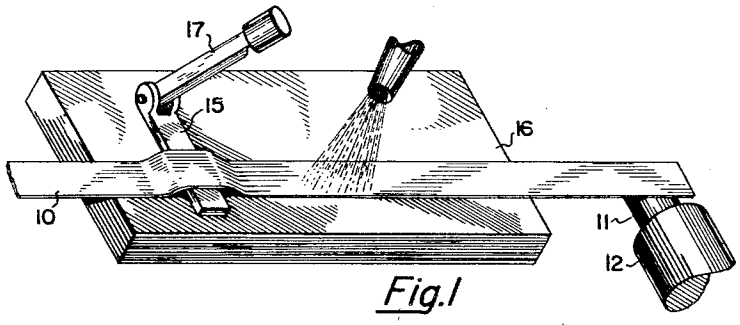


Fig.1

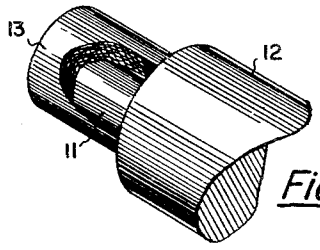


Fig.2

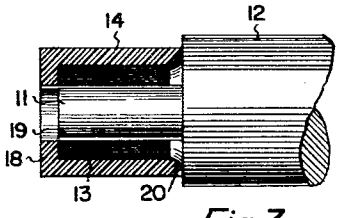


Fig.3

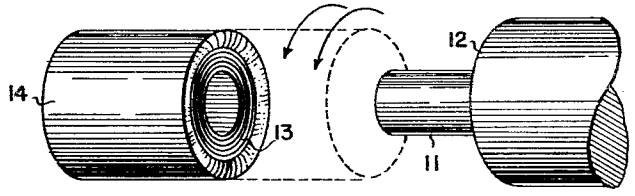


Fig.4

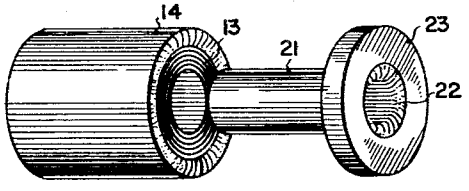


Fig.5

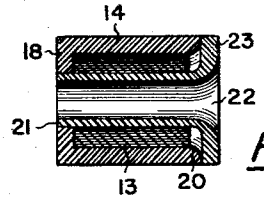


Fig.6

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MAGNETIC CORE ELEMENTS

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Original application Nov. 3, 1955, Ser. No. 544,743. Divided and this application Jan. 31, 1958, Ser. No. 712,432
2 Claims. (Cl. 336—213)

This invention relates to magnetic core elements and is a division of applicant's co-pending application entitled "Magnetic Core Elements and Methods of Forming Same," Serial Number 544,743, filed November 3, 1955.

An object of the invention is to provide a new and improved article of manufacture of the magnetic core element type.

Another object of the invention is to provide a magnetic core element which is protected from mechanical abuses.

It is still another object of the invention to provide a magnetic core element having uniform characteristics.

A further object of the invention is the provision of such a core element which is better adaptable to modern methods of manufacture.

Briefly described, a magnetic core element in accordance with the invention might comprise a sleeve of non-magnetic material, and a core formed by windings of magnetic tape laid against the inner surface of the sleeve in successive underlying laps. Preferably, however, such a core element would further include an annular flange extending inwardly on one end portion of the sleeve against which the windings are seated and a bushing of non-magnetic material having a body part adjacent to the innermost lap of the core and positioned at one end contiguous to the sleeve flange, this bushing having a peripheral flange extending outwardly and seated against the sleeve at the other end to seal the core.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing:

FIG. 1 is a perspective view showing the initial step in manufacturing a core according to the invention;

FIG. 2 is a perspective view, partly broken away, illustrating an intermediate step in forming a magnetic core in accordance with this embodiment of the invention;

FIG. 3 is an elevation view illustrating a succeeding step in this method of manufacturing the core, with the magnetic core and retaining sleeve members shown in cross section;

FIG. 4 is a perspective view illustrating schematically a succeeding step in the assembly of the element;

FIG. 5 is a similar perspective view showing a seal about to be inserted in the assembly thus produced; and

FIG. 6 is a longitudinal central sectional view of a completed core element.

Referring now to FIG. 1 of the drawing, the magnetic tape **10** is shown ready to be wound on the properly dimensioned end **11** of an applicator spindle **12** in carrying out the method of forming a magnetic core in accordance with the invention. Preferably a refractory insulating material is applied in the form of a spray or painted-on layer of a length of the unannealed thin magnetic tape **10** before the tape is wound on the spindle. This insulating material may be a liquid emulsion made by mixing oil and magnesium oxide, as disclosed and claimed in the copending application of Victor E. Damiano for Letters Patent of the United States, Serial No. 478,994, filed December 31, 1954, and assigned to the same assignee as the present invention. The insulating material may be

applied in the form of small particles or droplets, as illustrated schematically in FIG. 1.

For the tape the choice of material depends on the properties desired in the wound core. Representative of the magnetic compositions useful for various applications are iron containing some silicon and the permalloys and molybdenum-bearing permalloy. The tape has the form of a thin strip, which for applications involving high frequencies or pulse wave forms may have a thickness of the order of 0.001 inch. A tape having a thickness of about 0.0002 inch can be handled by the method of the invention. Tape widths of ⅛ to ½ inch are customary for some applications, and the diameter of the end **11** of the applicator spindle may be, for example, of the order of ⅛ inch.

The length of this thin magnetic tape **10** is wound on the spindle end **11** in successive overlying laps to a predetermined outside diameter by turning the spindle in one sense, for example clockwise as viewed in FIG. 1, to build up the wound structure. This structure is represented as **13** in the perspective view of FIG. 2, which is cut away to show the spindle end **11**. By way of example, a representative core may have from about 5 to about 15 turns or laps in the wound structure.

The spindle, carrying the tape **13**, next is placed within a refractory retaining sleeve **14**, and is shown in that position in the sectionalized view of FIG. 3. The sleeve **14** has a bore dimensioned to receive the spindle carrying the tape wound thereon, preferably with a small clearance to facilitate insertion within the sleeve without disturbing or tearing the tape. The sleeve **14** may be of ceramic material, of a non-magnetic alloy such as stainless steel, or of other material capable of withstanding annealing temperatures, and the term "refractory" is used in this specification and in the appended claims as signifying the capability of resisting and withstanding annealing temperatures, in this case without impairment of the supporting and protecting function of the sleeve.

It is desirable to measure and cut the tape **10** to the length required for the predetermined dimensions of the wound structure before the winding is done. For this purpose a guide bar **15** is provided, as seen in FIG. 1, resting on a tape-supporting measuring base **16** and adjustable along the direction of the tape travel during winding. The bar **15** is set up initially to give the required measured length and is associated with a pivoted cutting blade **17** for severing the tape **10** at the proper point. When the measured length of tape has been wound into the structure shown in FIG. 2, it has the predetermined outside diameter so as to fit closely but without damage within the sleeve **14**. A very small amount of adhesive material may be placed on the outermost end of the tape to prevent its unwinding before insertion into the sleeve **14**, but the insulating material on the tape frequently exerts sufficient cementing action for this purpose.

The sleeve **14** is shown in FIG. 3 with an annular flange **18** extending inwardly on the left end portion of the sleeve and has an opening **19** for axial alignment with the open center of the core structure. The other end of the sleeve **14** preferably is outwardly flared internally to provide an entrance guide **20**, which permits the wound tape to enter the sleeve without damage. The wound structure is inserted into the sleeve until it seats against the inner face of the flange **18**. It may be desirable to wind the tape on the spindle end **11** so that the extreme end of the spindle can pass into the opening **19** for accurate alignment.

The spindle now is withdrawn from the sleeve to leave the wound tape as a magnetic core in the sleeve. This withdrawal preferably is accomplished by giving the spindle **12** a back spin to unfurl the tape against the wall of the sleeve bore. As represented schematically in

FIG. 4, the spindle is turned in the opposite, or counterclockwise, sense from that of the winding operation to the extent required to lay the tape against the bore in successive underlying laps and release the spindle. Any cement or other temporary means for preventing unwinding of the tape prior to insertion within the sleeve should be broken loose by this reverse spinning operation. Occasionally, it will be necessary to joggle the assembly to start the unwinding, and the apparatus used may be designed to do this. The tape preferably is wound in its cold-rolled state so that its springiness gives it a natural tendency to unwind. This tendency insures that the tape unfurls itself compactly, and only a small amount of unwinding motion may be necessary to cause the tape to unfurl and release the spindle. This same tendency to unwind will be seen to anchor the tape in place firmly within the sleeve **14**.

The core then is annealed while so assembled within the sleeve, following the usual annealing techniques. Annealing is called for to develop the desired magnetic properties and also is desirable in view of the cold-working involved in forming the strip, in winding it into a core, or in both operations.

A hollow protective member advantageously may be affixed within the core and sleeve assembly to seal the open end of the sleeve **14** with its contained core structure **13**. For this purpose a bushing **21**, illustrated in FIG. 5 ready for assembly and preferably of plastic or other non-magnetic material, is provided having a bore **22** of sufficient diameter to permit the conductors of the electrical windings to be passed therethrough. It is understood that the diameter of the spindle end **11** and the bore of the sleeve **14** are dimensioned initially to that end. The bushing **21** is formed with a peripheral flange **23** extending outwardly and having a diameter such as to close the open or guide end **20** of the sleeve **14**. The bushing **21** preferably has sufficient elasticity so that it can be pushed into the core and sleeve assembly, as illustrated in cross section in FIG. 6, until the left surface of the flange **23** seats firmly against the end portion **20** of the sleeve **14** while the left end of the bushing proper is seated tightly within the flange **18** of the sleeve **14**.

Thus a sealed magnetic core element is formed as a complete article of manufacture. The core is retained within a sleeve, as distinguished from the core elements heretofore fabricated by winding magnetic tape about a ceramic sleeve. Since any tendency of the tape to unwind makes the core more compact, it is no longer necessary to affix the outer end of the wound tape to the tape lying thereunder to prevent unwinding; the use, for example, of spotwelding techniques to hold the end of the tape down during the annealing operation and thereafter, with consequent deterioration of the magnetic properties of the uppermost lap of the core, thus is avoided.

Referring to FIG. 6, it will be seen that a magnetic core element is provided which is neat, compact, and sealed so that further enclosing or encapsulating operations are unnecessary. This element comprises the sleeve **14** of non-magnetic material having the annular flange **18** extending inwardly on one end. The core **13**, formed by

windings of magnetic tape laid against the inner surface of the sleeve in successive underlying laps, is seated at one end against the sleeve flange **18**. The element also comprises the bushing **21** of non-magnetic material having its body part adjacent to the innermost lap of the core **13** and positioned at one end contiguous to the sleeve flange **18**. This bushing also has the aforementioned peripheral flange **23**, which is seated against the sleeve at the other end to seal the core.

While there has been described what at present is considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention. It is aimed, therefore, in the appended claims to cover all such changes and modifications which fall within the true spirit and scope of the invention.

I claim:

1. A magnetic core element, comprising: an outer sleeve of non-magnetic material; an annular flange extending inwardly on one end portion of said sleeve; a core formed by windings of magnetic tape disposed against the inner surface of said sleeve in successive underlying laps and seated at one end against said sleeve flange and in a manner whereby said core exerts a radially expanding force thus to hold it tightly against said sleeve; an inner sleeve of non-magnetic material extending through said core adjacent to the innermost lap with one end thereof positioned contiguous to said sleeve flange; and a peripheral flange extending outwardly from the other end of said inner sleeve and seated against the other end of said outer sleeve to seal said core.

2. A magnetic core element, comprising: a sleeve of refractory non-magnetic material capable of withstanding core-annealing temperatures and having an annular flange of said material extending inwardly on one end portion of said sleeve; a core formed by annealed windings of magnetic tape disposed against the inner surface of said sleeve in successive underlying laps and seated at one end against said sleeve flange and in a manner whereby said core exerts a radially expanding force thus to hold it tightly against said sleeve; an a bushing of non-magnetic material having a body part adjacent to the innermost lap of said core and positioned at one end contiguous to said sleeve flange, said bushing having a unitary peripheral flange extending outwardly and seated against said sleeve at the other end to seal said core.

References Cited in the file of this patent

UNITED STATES PATENTS

1,902,491	Dahl et al.	Mar. 21, 1933
2,483,815	Easton	Oct. 4, 1949
2,703,392	Rex	Mar. 1, 1955
2,833,027	Foster	May 6, 1958
2,843,822	Scott	July 15, 1958

OTHER REFERENCES

"Magnetic Cores of Thin Tape Insulated by Cataphoresis," A.I.E.E. Conference paper, December 1949.