May 6, 1969 J. P. SWEENEY 3,443,254

TAPE MOUNTED MAGNETIC CORE ASSEMBLY

Original Filed Nov. 13, 1961 Sheet 1 of 2

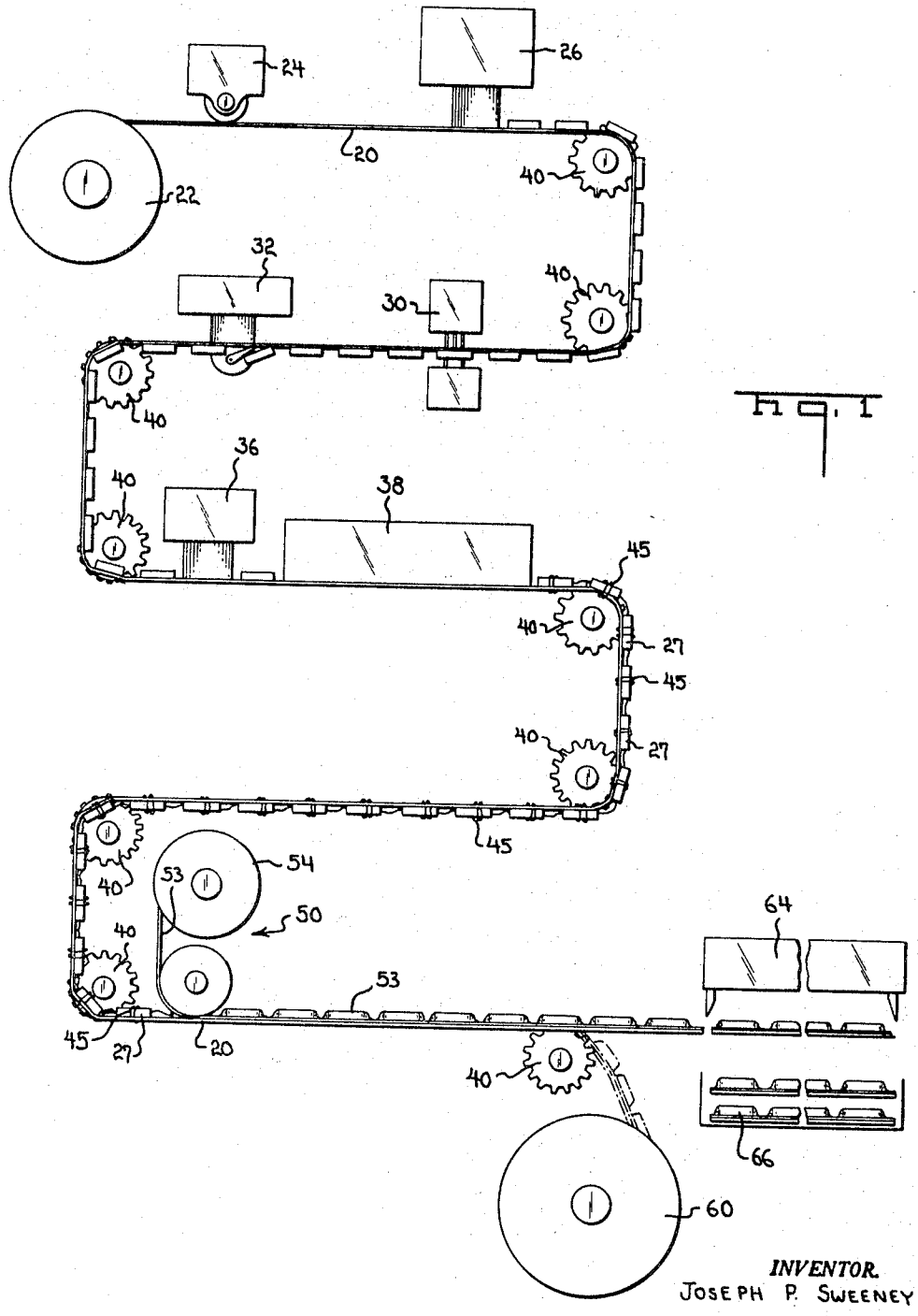


Fig. 1

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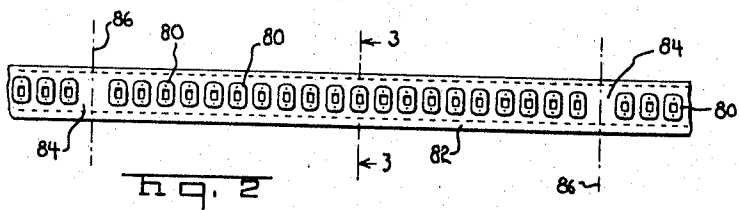


Fig. 2

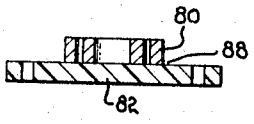


Fig. 3

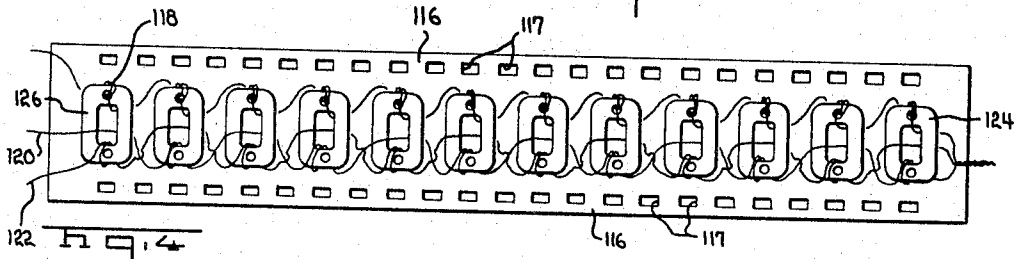


Fig. 4

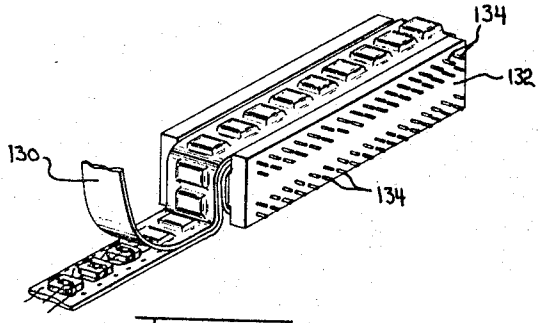


Fig. 5

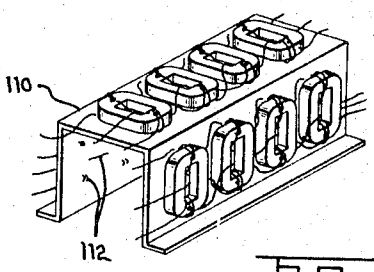


Fig. 6

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3,443,254

TAPE MOUNTED MAGNETIC CORE ASSEMBLY

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Original application Nov. 13, 1961, Ser. No. 151,797, now Patent No. 3,204,329, dated Sept. 7, 1965. Divided and this application Nov. 10, 1964, Ser. No. 417,260
Int. Cl. H01f 3/00; B23p 17/00; B65d 81/32
U.S. Cl. 335—297 2 Claims

ABSTRACT OF THE DISCLOSURE

A magnetic core assembly is disclosed featuring a thin flexible tape of insulating non-magnetizable material which is readily pierced as by a needle. Cores are stuck to the tape with a functional circuit formed by winding turns coupled to the cores by threading the wire forming the windings through the cores and the tape with a needle. An additional protective tape may then be added to the wired tape core assembly.

This invention relates to magnetic core assembly means and is a division of U.S. Patent No. 3,204,329, filed Nov. 13, 1961, and entitled, Method of Manufacturing Magnetic Core Assemblies.

A primary object of this invention is to provide a magnetic core assembly resulting in an economy of production of magnetic core devices.

Another object of invention is to provide a magnetic core package having characteristics which accommodate a continuous assembly procedure including core testing and wiring.

A further object of this invention is to provide a universal core assembly capable of use in a broad range of bit lengths and package configurations.

A still further object of invention is to provide a core assembly wherein the cores and core conductors are so arranged that various design applications may be accommodated without additional engineering of core and winding placement or proximity.

Another object of invention is to provide a magnetic core assembly adaptable to long bit lengths in a single unbroken array of cores and windings.

Still another object of invention is to provide a core assembly wherein the ratio of active components to packaging components is minimized.

An additional object of invention is to provide a core and winding assembly resistant to shock and vibration without the use of potting material.

The general trend toward miniaturization of electronic assemblies relative to equipment weight, space and power requirements has resulted in production and reliability problems which substantially offest the advantages gained through the use of solid state devices in general and magnetic core devices in particular. Moreover, the various efforts to counter the complexities of sub-miniaturized manufacture have developed packaging techniques which do not lend themselves to economic production and which produce units inherently limited as to the different space and configuration requirement of the equipment served by such devices. The present invention contemplates a magnetic core mounting member having characteristics which eliminate, to a large extent, the production problems of prior art devices and which provide an end product of broad utility.

The basic problem underlying both production and product in magnetic core devices is that large numbers of relatively small components must be combined in a manner whereby component operation will not be hampered by field interaction between cores and windings. While

much work has been done with magnetic cores, the engineering of winding impedance and core and winding proximity is, as yet, empirical and slight variations frequently effect substantial and unpredictable changes in operation. The present invention features a core and winding arrangement wherein a variety of equipment space and configuration specifications may be accommodated without substantially changing core spacing and winding length.

The magnetic core assemblies of the prior art comprising rigid panel or frame members carrying a given number of cores are representative of a design compromise between the factors of production economy, including access to cores for wiring and the factors of end product utility including unit size, weight, shape and function capability. The significant result of this compromise is that prior art devices do not satisfy either of these requirements. As an example, the use of rigid construction for core mounting members requires that the separate core units be individually handled and that means be provided to move such units between the various stages of production. As a further example, the use of rigid core mounting member requires that ideally all cores be individually pre-tested prior to the initial assembly step. The present invention employs a flexible tape-like component mounting members which may be continuously moved through all stages of magnetic core device production including core testing. The core mounting member of the invention thus serves the dual function of moving the cores through the complete manufacturing cycle, and as a core mounting means for the finished product.

The use of core mounting members of fixed dimensions, as in all known prior art devices, has the result that when employed with equipment of limited capability, a portion of the unit is unused or wasted and when employed with equipment of extensive capability, numerous units must be mechanically and electrically connected together. The present invention features a core-tape assembly which may be cut to the exact length needed by equipment served.

An additional advantage of assembly of the present invention over known devices is that the ratio of active components such as, cores and conductors to inactive components such as supporting members and potting material is minimized from the standpoint of dimension, weight and cost. One embodiment of the present invention utilizes a tape sandwich construction which eliminates the use of potting material without increasing the possibility of core and winding mis-alignment to vibration and shock.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIGURE 1 is a schematic flow diagram of the method of the invention showing the various necessary and possible steps of a production cycle.

FIGURE 2 is a plan view of one embodiment of the magnetic core assembly of the invention prior to wiring.

FIGURE 3 is an enlarged section of the assembly of FIGURE 2 taken along lines 3—3.

FIGURE 4 is a plan view of the core-tape assembly partially wired in a manner to perform a shift register function.

FIGURES 5 and 6 show two exemplary embodiments of the assembly of the invention as employed in core packages.

As heretofore mentioned, the present invention includes a magnetic core assembly means and method of assembly. The following description will treat the method of assembly initially and the assembly and its various embodiment thereafter.

Referring particularly to FIGURE 1, a plurality of successive assembly steps are shown beginning with the tape supply and ending with either assembly storage or assembly cutting and storage. As will be apparent from the following description, certain of the steps shown may be omitted or may be performed in a non-continuous manner with interim storage of the core-tape member between stages. The element **20** represents the tape member of the invention and comprises a thin flexible material having insulating and non-magnetizable qualities. Additionally, the tape member should be readily piercable without splitting or fracturing. Paper, "Mylar" (polyethylene terephthalate resin), acetate, and glass or fiber tapes are typical materials having the foregoing characteristics.

The method of the invention contemplates a continuous supply of tape provided by means such as a reel or spool **22** motivated or drawn through the various method steps by means such as sprockets **40** driven at a constant speed by any suitable means. Immediately following tape supply **22** is adhesive supply **24** which may be by roller, brush or spray depending upon the adhesive employed. As an example, if contact cement is employed, the unit **24** may comprise a roller extending the full width of the tape member so as to apply a thin coating thereon. Alternatively, if epoxy cement is used, a narrow pressure fed brush may be employed as element **24** to apply a strip or beading of adhesive along the tape member centerline. The amount of adhesive employed should be only enough to assure that the cores will remain aligned on the tape until after the core wiring step, since the core wiring being inserted through the tape will serve to hold the cores in position thereafter.

Following the application of adhesive, the tape member **20** is moved past core supply **26** and cores are deposited on the tape member and secured thereto by the adhesive coating.

As shown in FIGURE 4, the tape member **116** may include sprocket slots **117** by which the tape may be driven or propelled through the various production steps. The slots **117** additionally serve to index the tape for proper core placement. The approximate minimum spacing between cores should be 15 mils edge to edge. For example, when employing General Ceramics No. F1243–5209, cores 196 mils wide and of a configuration as shown in FIGURE 4, the center to center spacing would be at least 211 mils. When using standard 80 mil outside diameter toroidal cores, this distance would be at least 95 mils. The proper initial placement of the cores on the tape member will facilitate the further steps of production and will assure proper core and winding proximity in the end product.

The core test step follows core mounting and includes a procedure wherein the cores are tested by measuring the core switching threshold. This is accomplished by applying a magnetomotive force to the core by means of an input conductor or conductor inserted through the major aperture thereof carrying a current sufficient to first set the core; thereafter reversing the current to reset the core while measuring the voltage induced in an output conductor threading the same aperture. The currents employed should be of a quality and quantity to accomplish set and reset in a standard acceptable core with an induced voltage in the output conductor between maximum

and minimum limits. As an example, when using multi-aperture cores similar to those shown in FIGURE 4, known as General Ceramics Cores F1243–5209, the applied set pulses should be of a trapezoidal shape of an approximately 0.3 micro-second rise and fall time, 3 micro-second duration and approximately 270 milliampere amplitude. This input current pulse should produce, on the output conductor, a voltage not more than 25 microvolts. This should be followed by a similar set pulse of approximately 330 milliamperes amplitude with an output voltage of not less than 25 millivolts. Any number of voltage responsive circuits may be employed to present a visual or audible signal indicating the presence of a defective core. One simplified circuit for accomplishing this could include two switch inserted triode driven relays set to operate respectively, responsive to core output voltage above or below the standard voltage.

With the core-tape assembly of the invention, the core test may be performed by needle members connected to the input and output conductors heretofore mentioned and arranged to penetrate or pierce the tape through the major aperture of the core and cooperate with return circuit contacts for the conductors disposed on the underside of the tape member.

The numeral **32** represents core removal following any test indicating the presence of a defective core. It is contemplated that defective cores may be removed by blade or knife means arranged to slide between the core member and the tape. After removal of defective cores a second core supply **36** is provided to replace the removed cores with pre-tested cores. The number of cores removed and replaced represents a small percentage of the total number of cores used. In view of this, the adhesive material should have a setting time at least greater than the time required for the foregoing assembly steps.

After the step of core-resupply, the core-tape assembly may then be wired, as indicated schematically at **38**, by needle means inserted through the core apertures and through the tape member with the various windings being applied in a desired pattern.

Referring now to the step indicated by numeral **50**, an auxiliary tape member **53**, supplied from a reel **54**, may be applied over the tape **20**, cores **27** and wiring **45**. Tape member **53** is generally similar in construction to tape member **20**, but of a lighter weight and thickness. The tape member **53** should be firmly pressed against the core-tape assembly so as to prevent core and winding movement. In addition to insulating the cores and windings, the tape member **53** thus serves the function heretofore accomplished by the application of potting material.

As shown in FIGURE 1, the final step of the method of the invention consists of assembly storage as by reel member **60**. Alternatively, and in large production runs, the core-tape assembly may be cut as indicated at **64** to predetermined bit lengths and stored in flat sections **66**, as shown.

As heretofore indicated, it is contemplated that the foregoing steps may be performed sequentially and continuously. It will be apparent that as a matter of convenience, individual combinations of steps could be performed with intermediate storage therebetween. Such intermediate storage would follow the step of core supply or any succeeding step thereafter.

The method of the invention may be performed by hand or by machine or alternatively, by various combinations of automatically or manually operated devices. The provision of the tape slots provides a means of control assuring accurate core spacing and thereby accurate positioning for the additional production steps.

In either event, the steps above described provide a unique method wherein magnetic core devices of various sizes and shapes may be economically and rapidly assembled without individual handling of cores.

Turning now to the assembly of the invention, FIG-

URE 2 represents a segment of the core-tape as it would appear after the step of core supply **26**. It will be noted that in this embodiment a row of twenty multi-aperture cores **80**, separated by a space **84**, is positioned on one surface of the tape member **82**. The core arrangement in this embodiment is for a ten bit shift register and the spaces **84** provide a sufficient length of wiring (not shown) at each end of the core array to permit termination of the register conductors. For final use, the tape member **82** (after wiring) could be cut at lines **86** and the core-tape assembly therebetween would form a ten bit shift register package suitable for a variety of further packaging arrangements.

FIGURE 3 is included to show the disposition of components with core member **80** bedded in adhesive **88** on tape member **82**. As a matter of comparison, the ten-bit register of FIGURE 2 occupies as little as one fiftieth the volume of prior known devices of the same capability. The tape member **82**, as shown in FIGURE 3, comprises in one embodiment "Mylar" tape, 4 mils thick and 200 mils wide, as compared with a known prior art construction of epoxy glass sheet 63 mils thick and 900 mils wide.

Referring to FIGURE 4, there is shown a partially wired core-tape assembly, manufactured in accordance with the method of the invention. Referring to U.S. Patent No. 2,995,731 "Wiring Arrangements for Shift Register Employing Magnetic Cores," it will be noted that the multi-aperture cores may be connected by continuous advance and prime windings. This technique is particularly useful when employed with the present invention since the advance and prime windings may be continuously threaded along the tape length in the manner indicated. The tape member **116** may comprise any of the tape constructions heretofore described. The conductor **118**, which represents the drive common and negative prime winding, is threaded through the tape **116** and the receiving minor apertures of the cores. Conductors **120** and **122** are similarly threaded through tape **116** and the cores and represent respectively ADVANCE E to O and O to E in the manner explained in Patent No. 2,995,731. With the addition of input and output windings to the receiving aperture and transmitting aperture of the core **126** and **124** and coupling or transfer windings between cores as described in Patent No. 2,995,731, the core-tape assembly becomes a six (6) bit shift register, considerably smaller and lighter than prior art devices of the same bit capability.

It is to be understood that in instances wherein large production runs of standardized core assembly lengths are made, the tape may be pre-punched to provide holes matching the major and minor aperture configurations of the particular cores employed. Additionally, this practice may be desirable in situations wherein the number of minor aperture turns makes it difficult to thread through the tape. It will be apparent that other wiring arrangements can be utilized with the core-tape assembly for different magnetic circuit functions.

FIGURES 5 and 6 show various applications of the present invention to different core arrangements. In FIGURE 5 a wired core-tape assembly having the auxiliary tape member **130**, as heretofore described, is wound on a rectangular support **132** in overlapping fashion. A unit of this type may be readily accommodated for serial to serial, serial to parallel, parallel to serial or parallel to parallel operation by individual core connections connected as each layer of core-tape is wrapped on the support **132**.

The individual connection may be made directly to terminals **134** from each core-tape layer. The entire assembly may, if desired, be potted or alternatively wrapped with a single insulating tape cover.

FIGURE 6 shows a further embodiment of the invention wherein the tape member **110** is comprised of glass cloth. In this construction, the cloth tape, following mounting, testing and wiring, is treated with a thin coating of epoxy or phenolic resin and placed on a mold of desired shape. After the resin has set, the assembly may then be removed and utilized without additional support. As will be apparent, the setting of the resin will additionally prevent core and conductor movement due to the threading of the core conductor **112** through the cloth material.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

I claim:

1. A magnetic core assembly comprising in combination, a thin flexible tape member of a material which may be easily pierced and which has insulating non-magnetizable properties, an adhesive coating on one surface of said tape member, a plurality of magnetic cores having at least one aperture therein secured to said tape member by said adhesive in a spaced pattern, a plurality of conductors each threading at least certain of said cores through an aperture therein and threading said tape member to form circuit windings linking said cores to provide circuit functions.

2. A magnetic core assembly including in combination a flat flexible tape member having insulating and non-magnetizable properties and of a thickness accommodating penetration by needle means without tape fracture, said tape member carrying on one surface thereof a thin coating of adhesive material and a spaced array of magnetic ferrite core members fixedly disposed along the length of said tape by said adhesive material, a plurality of conductor windings linking said cores and intersecting said tape to form functional circuits, a second tape member similar in construction to said first tape member and secured thereto over said cores and conductors to prevent core and conductor displacement.

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U.S. Cl. X.R.

29—155.56; 206—47