Nov. 24, 1959 J. J. ANTALEK ET AL 2,914,276

VARIABLE INDUCTANCE DEVICE

Filed July 6, 1955 2 Sheets-Sheet 1

Fig. 1

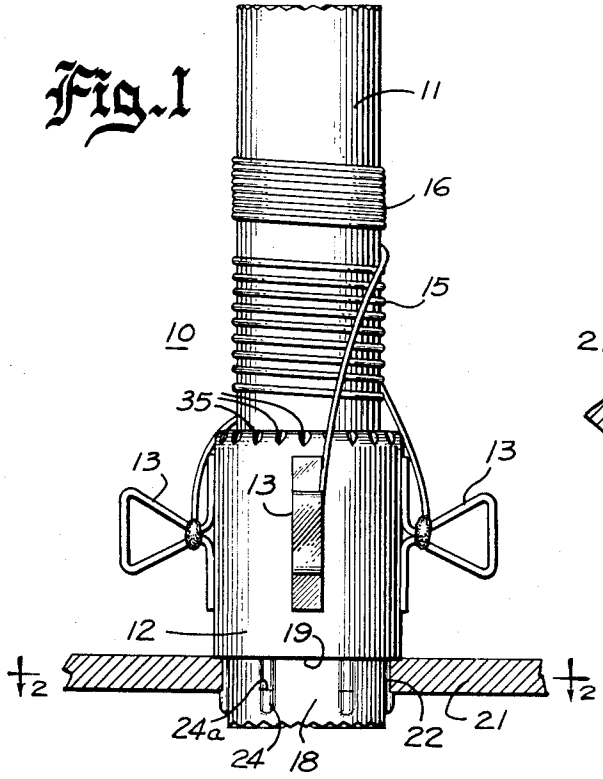


Fig. 2

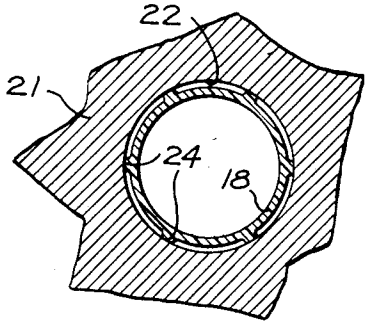
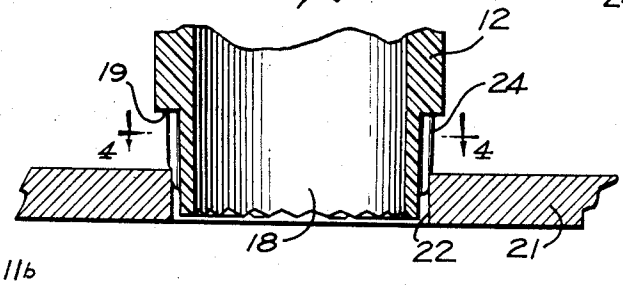


Fig. 3



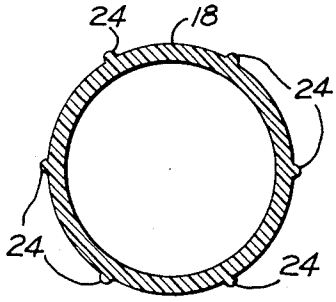


Fig. 4

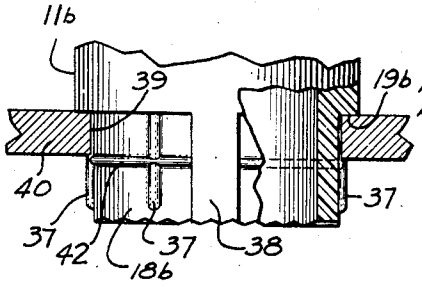


Fig. 9

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Fig. 5

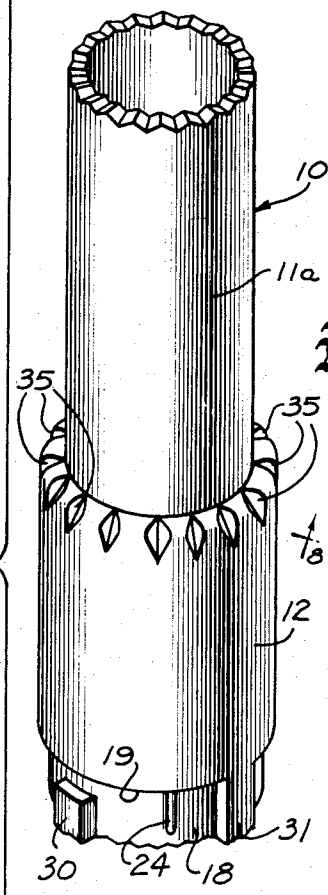


Fig. 6

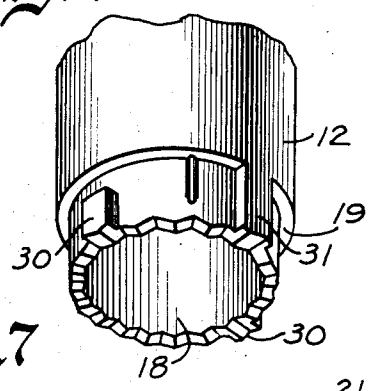
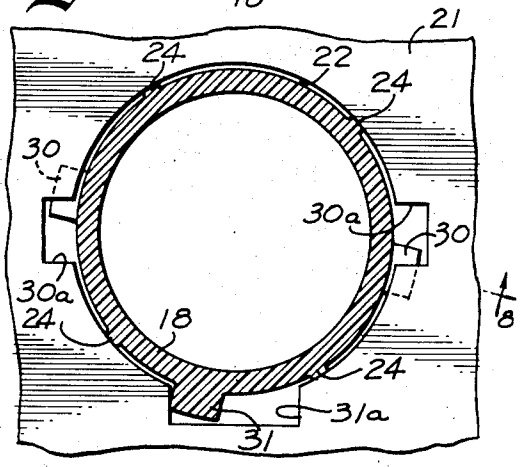
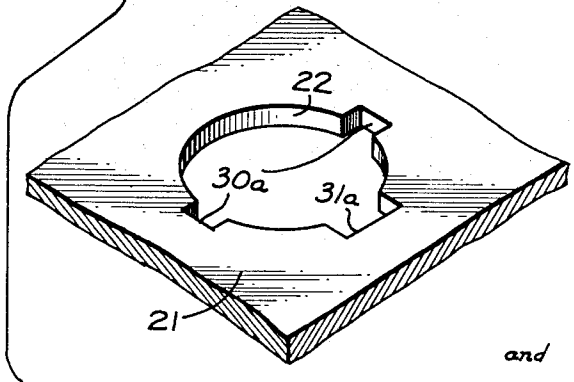


Fig. 7





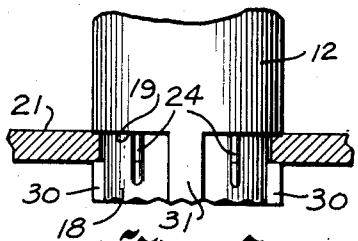


Fig. 8

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2,914,276

VARIABLE INDUCTANCE DEVICE

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Application July 6, 1955, Serial No. 520,331

5 Claims. (Cl. 248—27)

The present invention relates to variable inductance devices of the type having one or more conductive coils mounted on a tubular coil form in the bore of which a threaded core member is adjustably positioned, and more particularly to a coil form which facilitates initial fabrication of the inductance device and further facilitates attachment thereof to a support member such, for example, as a chassis.

With the advent of printed circuit techniques, complete mechanization of production lines for assembling electrical communication equipment may be economically achieved, and therefore, it becomes desirable to provide a variable inductance device which is susceptible to automatic assembly thereof on a printed circuit or conventional chassis. Also, in order to minimize the manufacturing cost of the individual variable inductance devices, the coil form therefor should be such as to be suitable for use in automatic equipment for winding the various coils thereon.

Therefore, an important object of the present invention is to provide a new and improved variable inductance device suitable for use in equipment which is assembled on mechanized production lines.

Another object of the present invention is to provide a variable inductance device having improved means for facilitating attachment thereof to a printed circuit chassis or other support member.

Still another object of the present invention is to provide a variable inductance device having an improved coil form for facilitating winding of the coil thereon by automatic machinery.

A further object of the present invention is to provide a new and improved coil form which enables greater ease in the fabrication of a variable inductance device than is possible with coil forms of the prior art type.

Briefly, the above objects are realized in accordance with the present invention by the provision of a molded unitary tubular coil form having an enlarged cylindrical portion terminating in a collar which extends outwardly from one end of the form. A plurality of deformable ribs, integral with the collar portion of the form, are disposed on the outside thereof and extend parallel with the principal axis of the form. Where desirable, a plurality of protrusions are provided near the end of the collar to aid in firmly maintaining the variable inductance device secured to a support member. So as to facilitate the winding of a conductive wire on the form by means of automatic coil winding machinery, both ends of the coil form are serrated and a plurality of notches are provided in that end of the enlarged cylindrical portion which is displaced from the collar.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof will best be understood by reference to the following detailed description taken in connection with the accompanying drawings in which:

Fig. 1 is a front elevational view of a variable inductance device embodying the present invention which is assembled to a chassis, only a fragmentary portion of which chassis is shown, and such portion being in cross-section;

Fig. 2 is a sectional view of the arrangement of Fig. 1 taken along the line 2—2 thereof;

Fig. 3 is an enlarged sectional view showing the variable inductance device of the present invention while it is being inserted into an aperture in a chassis;

Fig. 4 is a sectional view of the device of Fig. 3 taken along the line 4—4 thereof;

Fig. 5 is an exploded perspective view of an alternative embodiment of the present invention;

Fig. 6 is a fragmentary perspective view of the device shown in Fig. 5 looking at the bottom portion thereof;

Fig. 7 is a plan view partially in section of the inductance device of Fig. 5 assembled to a chassis;

Fig. 8 is a fragmentary sectional view of the assembly of Fig. 7 taken along the line 8—8 thereof assuming the entire unit to be shown therein; and

Fig. 9 is a fragmentary elevational view of an alternative embodiment of the invention showing an inductance device mounted on a chassis, a portion of the device being broken away and another portion being shown in section.

Referring now to the drawings, and more particularly to Fig. 1 thereof, there is shown a variable inductance device **10** consisting of a tubular coil form **11** having an enlarged, cylindrical lower portion **12** on which is mounted a plurality of conductive terminal members **13**. The coil form **11** is molded of an insulating material, suitably a plastic, and in the particular device shown, a pair of helical coils **15** and **16**, which may conveniently be formed of copper wire, are wound on the coil form **11** having the ends thereof conductively connected as by brazing to different pairs of the terminal members **13**. It will be understood that although the inductance device shown in Fig. 1 to illustrate the invention is a transformer utilizing a pair of coils **15** and **16**, a greater or lesser number of coils may be provided on the form **11**, if desired.

Although the manner in which the inductance of the windings **15** and **16** and the magnetic coupling therebetween does not constitute a part of the present invention and, therefore, is not shown in the drawings, it will be understood by those skilled in the art that a ferromagnetic core member conventionally shaped in the form of a cylinder is movably supported within the upper portion of the coil form **11** thereby to intercept the magnetic field produced by each of the windings **15** and **16**.

A collar member **18** extends downwardly from the enlarged portion **12** and, being of lesser diameter than the portion **12**, defines an annular shoulder **19** on the coil form **11**. A portion **21** of a printed circuit chassis or of a metal chassis, as the case may be, is provided with a circular aperture **22** having a diameter slightly exceeding that of the collar **18** but being considerably less than the diameter of the enlarged portion **12**. Therefore, as shown in Fig. 1, when the variable inductance device **10** is assembled to the chassis **21** with the collar **18** located within the aperture **22**, the shoulder **19** engages the top of the chassis **21** in an area surrounding the aperture **22** thereby to support the device **10** at the top of the chassis **21**.

In order to facilitate the attachment of the variable inductance device **10** to the chassis **21** while insuring that the device **10** is firmly attached thereto, a plurality of outwardly extending ribs **24** are provided on the collar **18**, the ribs **24** extending in a direction parallel with the principal axis of the coil form **11**. As best shown in Fig. 4, the ribs are semi-cylindrical in shape having an out-

wardly extending dimension such that the cylinder defined by the outer edges of the ribs **24** has a diameter exceeding that of the aperture **22**. The ribs **24** are formed integral with the collar **18** and the material of which they are formed is selected so that the ribs **24** are deformable. In a reduction to practice of the invention, nylon has been proven to be suitably deformable for this purpose.

In order to assemble the variable inductance device **10** to a chassis **21**, the collar **18** is inserted into the aperture **22**, and as best shown in Fig. 3, the ribs **24** are compressed as they pass into the aperture **22**. Once the device has been fully inserted into the aperture **22** so that the shoulder **19** engages the top of the chassis **21**, the lower portions of the ribs **24** which extend a considerable distance below the bottom of the chassis **21** expand outwardly because of the natural elasticity thereof so as to provide an upwardly facing shoulder **24***a* on each rib which engages the bottom of the chassis **21** in the area adjoining the aperture **22**. Removal of the device **10** is thus prevented by the shoulders **24***a* on ribs **24** and rotation thereof is also prevented by the engagement of the intermediate portions of the ribs **24** with the walls of the aperture **22**.

In the event that the variable inductance device **10** is to be used in equipment which is subjected to excessive vibration as well as severe shocks, it may be desirable to provide securing means in addition to the ribs **24** to insure that the device **10** is not jarred loose from the chassis **21**. Referring to Figs. 5 to 8, inclusive, there is shown a coil form **11***a* which is an alternative embodiment of the coil form **11**, and wherein means in the form of a plurality of protuberances **30** are provided on the collar **18** for coaction with the chassis **21** to maintain the device **10** in engagement with the chassis **21**.

In this embodiment, the collar **18** is provided with a plurality of outwardly directed protuberances **30** which are spaced from the shoulder **19** by a distance slightly exceeding the thickness of the chassis **21**, and with an additional protuberance **31** which extends from the enlarged portion **12** to the bottom of the coil form **11***a*. Adjacent the aperture **22** in the chassis **21** there is provided a plurality of slotted recesses **30***a* which are shaped and positioned so as to receive therein the protuberances **30** when the form **11***a* is placed on the chassis **21** with the collar **18** disposed in the aperture **22**. An elongated recess **31***a* is positioned in the board **21** so as to receive the protuberance **31** when the protuberances **30** are aligned with the recesses **30***a*. The width of the recess **31***a* exceeds that of the protuberance **31** to permit rotation of the form **11***a* through a limited angle after it is inserted in the aperture **22** thereby to move the protuberances **30** out of alignment with the recesses **30***a* and partially beneath the chassis **21**.

When, therefore, the coil form is placed on the chassis **21** such that the collar extends through the aperture **22** and the protuberances **30** and **31** are in alignment with their respective recesses in the baseboard **21**, the coil form **11** may be inserted until the shoulder **19** thereon engages the top of the chassis **21**. At this time the coil form **11** is rotated clockwise with respect to the support **21** as viewed from the top, so that the protuberances **30** extend beneath the support **21** out of alignment with their respective recesses **30***a* (Fig. 7).

Since, as the collar **18** is pressed into the aperture **22** the ribs **24** thereon are compressed as described above, when the device **10** is rotated with respect to the chassis **21**, the shoulder **24***a*, which appears on the ribs **24** as they mold themselves in place after having been compressed, and the intermediate portion of the ribs **24** respectively bear upwardly and outwardly against the wall of the aperture **22** in the chassis **21** thereby to prevent spurious rotation of the variable inductance device **10**.

Referring to Fig. 9, a plastic coil form **11***b* is provided with a collar **18***b* having a plurality of ribs **37** substantially identical with the ribs **24** in the device of Fig. 1 and with a protuberance **38** corresponding in every detail to the protuberance **31** in the coil form **11***a* of Fig. 5. The collar **18***b* is disposed in an opening **39** in the chassis **40**, it being understood that the opening **39** has a slot-like portion for receiving the protuberance **38**. Therefore, the protuberance **38** and the corresponding recess therefor in the chassis **40** provides indexing means to insure proper positioning and orientation of the form **11***b* on the chassis **40**.

In order to provide additional means for securing the device **11***b* to the chassis **40**, an annular semi-toroidal protrusion **42** is provided on the collar **18***b*. The annulus **42** lies in a plane parallel to that occupied by the shoulder **19***b* on the form **11***b* and is spaced from this shoulder by a distance somewhat exceeding the thickness of the chassis to be used therewith. The annulus **42** being integral with the collar **18***b* is deformable and since the outer diameter thereof exceeds that of the opening **39** in the chassis, as the collar **18***b* is inserted into the opening **39** the annulus **42** deforms as it passes through the opening **39** in the chassis **40**. When the shoulder **19***b* engages the top face of the chassis **40**, the annulus **42** is disposed below the chassis **40** out of contact therewith and thus expands and bends toward its initial state, thereby removably holding the form **11***b* on the chassis **40**.

As mentioned above, it is desirable if not altogether necessary to automatically and rapidly wind the coils **15** and **16** on the coil form during the fabrication of the variable inductance device **10**. Furthermore, it is desirable that a large number of such devices be simultaneously wound on a single winding machine. In one conventional type of apparatus for simultaneously winding the coils on a plurality of coil forms, the coil forms are placed end-to-end over a cylindrical mandrel, compressed together such, for example, as by a spring and locking arrangement, and the end one or ones of the forms are positively rotated. Wire conductors are attached as by brazing to respective ones of the terminal members **13**, and as the coil forms are rotated the coils **15** and **16**, as shown in Fig. 1, are wound thereon. It has been found that because the material of which it is desirable to make the forms **11** has a very smooth surface, during the winding operation the innermost ones of the forms **11** frequently rotate through a lesser angle than the end ones of the forms **11**, if they rotate at all. As a result, the coils which are wound on the inner ones of the coil forms do not necessarily consist of as many turns as do the coils which are wound on the end ones of the forms. Also, since this slippage between adjacent ones of the coil forms **11** is not constant, and for other reasons, it is difficult to adjust the winding apparatus to compensate for this slippage.

In accordance with another aspect of the present invention, both end surfaces of the coil from **11** are serrated at **32** (Figs. 1 through 8, inclusive) so that when a number of coil forms are contiguously arranged on a mandrel, no slippage therebetween can occur and every one of the forms rotates a fixed amount, thereby to provide coils having a fixed number of turns.

In accordance with another aspect of the invention, the upper shoulder of the enlarged cylindrical portion **12** is provided with a plurality of radial notches **35** which, during rotating of the coil forms during the coil winding operation, engage the conductors to prevent them from partially slipping around the form **11**, which slippage would result in coils having different numbers of turns even though the coil forms may be rotated a fixed amount in every case.

While there has been described what is at present considered to be the preferred embodiments of the invention, it will be understood that various modifications may be made therein which are within the true spirit and

scope of the invention as defined in the appended claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. Means for securing an electrical device to a support member through an aperture in the member, comprising a portion of said device which is adapted to loosely fit within said aperture, means on said device for engaging one side of said support member to prevent movement of said device through said aperture, and outwardly directed protrusions on said portion for engagement with the walls of said aperture and with the other side of said support member, said protrusions being formed of a material which is sufficiently resilient that as said portion is inserted into said aperture said protrusions are deformed and the portions of said protrusions which extend beyond the side of said member opposite to said means return to their original shape after insertion thereof through said aperture, thereby to prevent spurious rotation of said device on said support member.

2. The combination set forth in claim 1 wherein said means on said device for engaging one side of said support comprises a collar.

3. The combination set forth in claim 1 wherein said protrusions comprise a plurality of longitudinal ribs lying parallel to the principal axis of said aperture.

4. Means for securing an electrical device to a support member through an aperture in the member, comprising a portion of said device which is adapted to loosely fit within said aperture, shoulder means on said device for engaging one side of said support member to prevent movement of said device through said aperture, and a plurality of outwardly directed protrusions on said portion for engagement with the walls of said aperture and with the other side of said support member, said protrusions being formed of a material which is sufficiently resilient that as said portion is inserted into said aperture said protrusions are deformed and the portions of said protrusions which extend beyond the side of said member opposite to said means return to their original shape after insertion thereof through said aperture, thereby to prevent spurious rotation of said device on said support member.

5. The combination set forth in claim 4 which further comprises an annular protrusion spaced from said shoulder, said annular protrusion being formed of a material which is sufficiently resilient that as said portion is inserted into said aperture said protrusion is compressed to permit passage thereof through said aperture and to cause said annular protrusion to return to its original shape after the insertion thereof through said aperture, said annular protrusion being spaced from said shoulder by a distance equaling the thickness of said support.

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