United States Patent [19]

Renskers et al.

[11] **3,743,990**

[45] **July 3, 1973**

[54] **AN INDUCTOR WITH MOUNTING MEANS**

[75] Inventors: **John O. Renskers,** Crystal Lake; **Charles S. Liebman,** McHenry; **Robert J. Salzman,** Woodstock; **Charles E. Schroeder,** Mundelein, all of Ill.

[73] Assignee: **Coilcraft, Inc.,** Cary, Ill.

[22] Filed: **Oct. 5, 1970**

[21] Appl. No.: **77,875**

Related U.S. Application Data

[62] Division of Ser. No. 634,789, March 6, 1967, Pat. No. 3,534,309, which is a division of Ser. No. 387,139, Aug. 3, 1964, Pat. No. 3,368,276.

[52] **U.S. Cl.** **336/192,** 336/65, 336/208

[51] **Int. Cl.** **H01f 15/10**

[58] **Field of Search** ..... 336/65, 198, 208, 336/209, 192; 174/117 F, 117 FF, 117 A

[56] **References Cited**

UNITED STATES PATENTS

2,355,477	8/1944	Stahl	336/198 X
2,486,751	11/1949	McMichael	336/192 X
2,511,174	6/1950	Osborne	336/198
2,749,525	6/1956	Henderson	336/209
2,858,514	10/1958	Henderson	336/209
2,864,064	12/1958	Heaton	336/65
2,902,661	9/1959	Henderson	336/209
3,131,371	4/1964	Brekke	336/198 X

FOREIGN PATENTS OR APPLICATIONS

198,739	6/1923	Great Britain	174/117 A
997,508	7/1965	Great Britain	174/117 A
1,319,821	4/1962	France	174/117 A

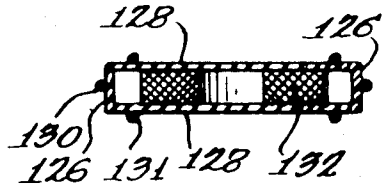
Primary Examiner—E. A. Goldberg

Attorney—Howard H. Rogers, Jr.

[57] **ABSTRACT**

A mounted multi-lead circuit element having a plurality of leads for separate external connection comprising segments of a strip of relatively stiff insulating material having stiff parallel terminal wires secured thereacross and extending beyond said strip at both ends secured directly or indirectly to the circuit element or wrapped thereabout in supporting relation to provide at least as many of said wires as there are of said leads, the leads being secured to one end of the terminal wires and the other ends of the terminal wires being available for connection into a circuit.

3 Claims, 30 Drawing Figures



PATENTED JUL 3 1973

3,743,990

SHEET 1 OF 2

Fig. 1.

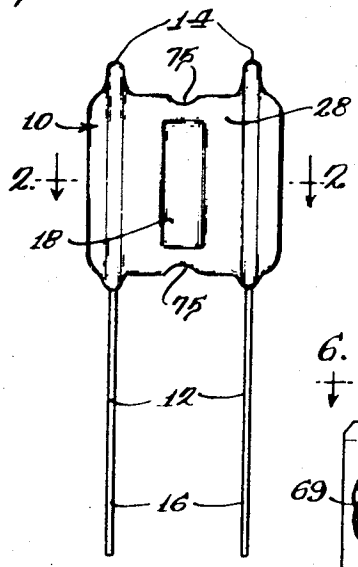


Fig. 2.

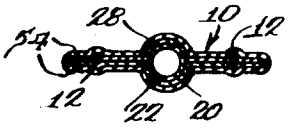


Fig. 3.

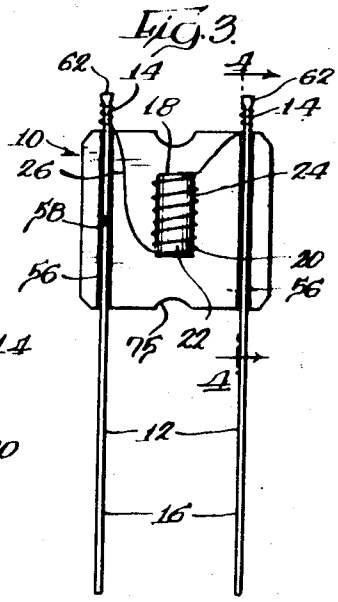


Fig. 4

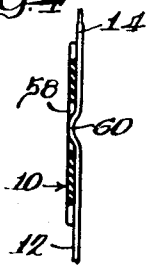


Fig. 5.

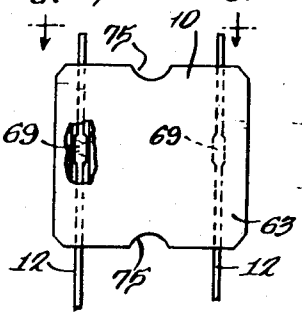


Fig. 6.

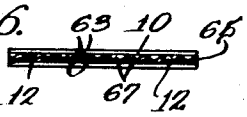


Fig. 7.

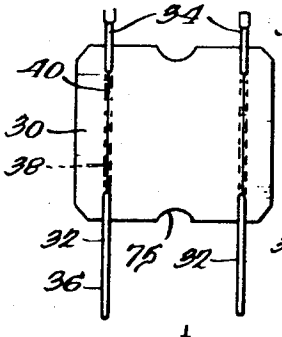


Fig. 8.

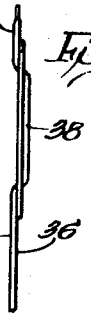


Fig. 9.

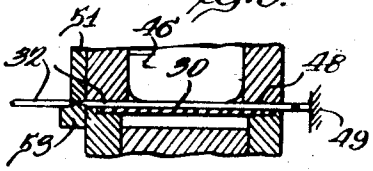


Fig. 10.

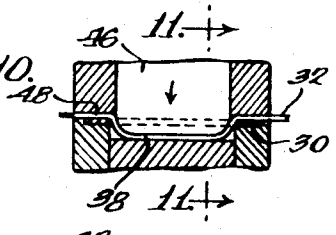


Fig. 11.

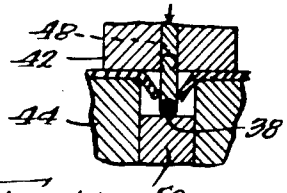


Fig. 12.

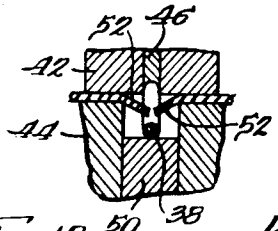
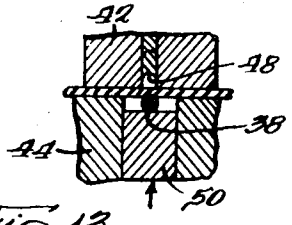


Fig. 13.



Inventors:
John O. Renskers
Charles A. Liebman
Robert J. Salzman
Charles E. Schroeder

Attys

Fig. 14.

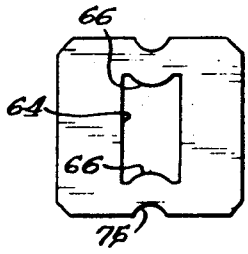


Fig. 16.

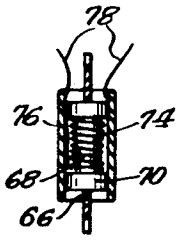


Fig. 15.

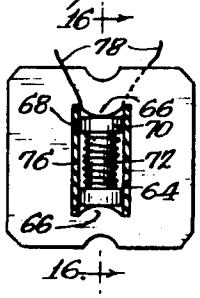


Fig. 17.

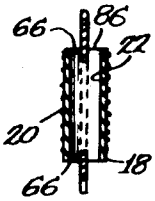


Fig. 18.

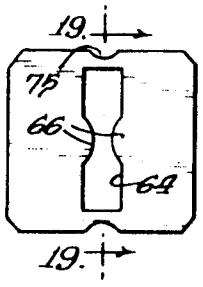


Fig. 19.

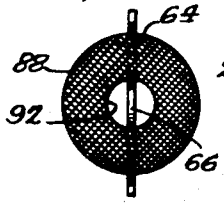


Fig. 20.

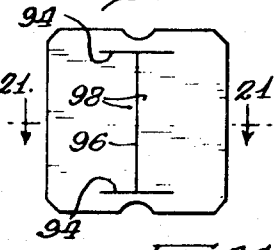


Fig. 21.

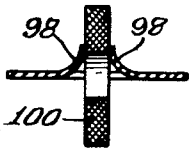


Fig. 22.

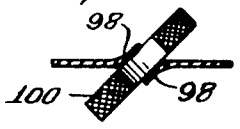


Fig. 23.

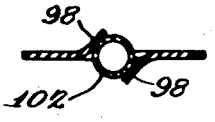


Fig. 24.

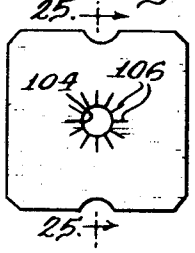


Fig. 25.

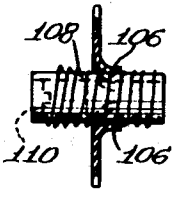


Fig. 26.

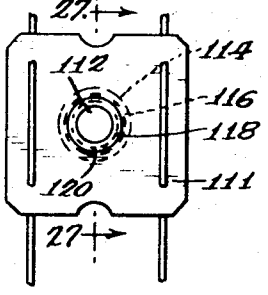


Fig. 27.

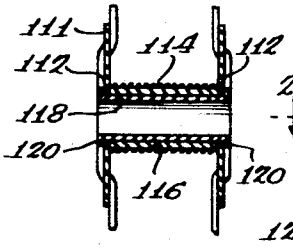


Fig. 28.

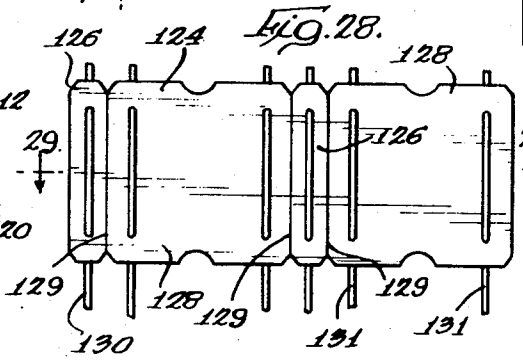


Fig. 29.

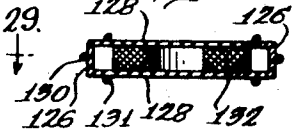
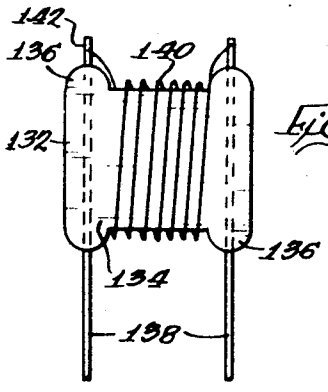


Fig. 30.



Inventors:
John O. Renskers
Charles S. Liebman
Robert J. Salzman
Charles E. Schroeder

Attys

AN INDUCTOR WITH MOUNTING MEANS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a division of Ser. No. 634,789 filed Mar. 6, 1967, now U.S. Pat. No. 3,534,309 dated Oct. 13, 1970, which in turn is a division of Ser. No. 387,139, filed Aug. 3, 1964, now U. S. Pat. No. 3,368,276 and issued Feb. 13, 1968, both applications being filed under the title of "MOUNT FOR CIRCUIT ELEMENTS" by John O. Renskers et al., the earlier patent issuing as "A Method for Mounting a Circuit Element" in the name of John O. Renskers sole.

BACKGROUND OF THE INVENTION

The present invention relates to a mount for electric and electronic circuit elements or, more narrowly, for coils and transformers and to coils, etc. so mounted for insertion into electronic and electric circuitry.

A mounted coil somewhat similar to the invention hass been devised wherein staples are driven into the edge of a rectangular stiff paper board and the staple ends then splayed out to extend beyond the edges of the paper. A coil is glued to the face of the paper between the staples and the coil leads are wrapped around the staple ends projecting beyond one edge of the paper.

There are several difficulties with this construction. Since the attaching wires are inserted in a true stapling fashion, i.e., the wires are bent into a U-shape and the ends of the wires driven through the paper material, the wire ends must be equal and somewhat limited in length. That is, the legs of a paper staple to be inserted by ordinary stapling machinery must be the same length and they must be short enough so as to have the necessary rigidity so that a blow on the back side of the staple will punch the legs through the material in which they are to be inserted and not bend them. Likewise, gluing a coil to the face of the material between the staples is a time consuming and therefore an expensive operation. The glue must be applied, the coil deposited on the glued patch, and the assembly thereupon set aside to dry for a certain period of time. The gluing operation calls for a substantial number of steps, the drying time is expensive, and the glued construction is generally unsuited to automation.

SUMMARY OF THE INVENTION

The coil form of the invention is directed to the improvement of this structure to avoid these disadvantages. The form of the invention requires no symmetry of terminal wire ends and imposes no limitations on the length thereof. It avoids a gluing operation for cementing the coil to the form. The form of the invention is highly versatile and capable of mounting many circuit components in different configurations to meet various purposes. Its adaptation to these various configurations is simple and easy.

Many materials may be employed in the construction of forms incorporating the invention and, with these different materials, the invention is capable of several embodiments, all of which, however, enjoy the same advantage as that described above, of unsymmetrical terminal wires, an indefinite length of terminal wires, accuracy of terminal wire location for purposes of automated circuit board insertion, and exceedingly low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevation of a completed mounted coil illustrating one embodiment of the invention;

FIG. **2** is a section taken along the line **2—2** of FIG. **1**, looking in the direction of the arrows;

FIG. **3** is a front elevation of a mounted coil illustrating another embodiment of the invention;

FIG. **4** is a section taken along the line **4—4** of FIG. **3** looking in the direction of the arrows;

FIG. **5** is a front elevation of another form of coil mount;

FIG. **6** is a plan view of the mount of FIG. **5** taken from the line **6—6** of FIG. **5**, looking in the direction of the arrows;

FIG. **7** is a front elevation of another form of coil mount;

FIG. **8** is a side elevation of the mount of FIG. **7** taken from the left side thereof;

FIG. **9** is a section through an appropriate set of dies whereby the mount of FIG. **7** is formed showing a terminal wire in elevation on top of a mount board in section;

FIG. **10** is a view similar to FIG. **9** showing the first step in the formation of the mount;

FIG. **11** is a section along the line **11—11** of FIG. **10** showing the stage of operation of FIG. **10**;

FIG. **12** is a view similar to FIG. **11** showing a second stage in the formation;

FIG. **13** is a view similar to FIG. **11** showing the concluding stage in the formation;

FIG. **14** is a front elevation of one form of mounting board adapted for the attachment of a coil thereto;

FIG. **15** is a similar view of the board of FIG. **14** showing a high inductance coil, partly in section, mounted thereto;

FIG. **16** is a section taken along the line **16—16** of FIG. **15**;

FIG. **17** is a view similar to FIG. **16** showing a low inductance coil mounted therein;

FIG. **18** is a front elevation of a mounting board adapted for the attachment of a medium inductance, universally would coil;

FIG. **19** is a section taken along the line **19—19** of FIG. **18** looking in the direction of the arrows showing a coil mounted therein;

FIG. **20** is a front elevation of a mounting board having an alternative form of coil attaching means;

FIGS. **21, 22** and **23** are sections taken along the line **21—21** of FIG. **20** showing optional ways of attaching coils to the board of FIG. **20**;

FIG. **24** is a front elevation of a mounting board incorporating a third provision for coil retention;

FIG. **25** is a section taken along the line **25—25** of FIG. **24** looking in the direction of the arrows showing a coil mounted thereto;

FIG. **26** is a side elevation of the mount of the invention used in a four terminal context;

FIG. **27** is a section along the line **27—27** of FIG. **26** looking in the direction of the arrows;

FIG. **28** is a modified form of a mount adapted substantially for full enclosure of a coil or circuit element and, optionally, for six terminal connection;

FIG. **29** is a section through a mounted coil employing the mount of FIG. **28** and may be considered generally as being taken along the line **29—29** of FIG. **28** looking in the direction of the arrows; and

FIG. 30 is a front elevation of a coil wherein the mounting board itself serves as a coil form.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As will be apparent from the drawings viewed collectively and referring particularly to FIG. 1, the mounted coil of the invention consists first of a generally square mounting board 10 having two relatively stiff terminal wires 12 adjacent opposite edges of the board and extending beyond the board at one end 14 only a short distance and at the other end 16 a substantial distance. A material which we have used for the mounting board which meets our purposes excellently is an electrical grade vulcanized fibre known in the trade as fish paper. Such a material is sold under the trademark Armite, a mark of the Spaulding Fibre Company of Tonawanda, New York. This paper is a dense relatively stiff composition board. Other cardboard-like insulating materials may be employed however as long as they possess a certain minimum degree of stiffness.

A coil or other circuit element 18 is secured to the center of the mounting board. In the case of FIGS. 1, 3 and 17 this circuit element is a single layer coil 20 wound on a tubular form 22 which is pressed into a window 24 formed in the mounting board 10. The leads 26 of the coil are wrapped tightly around the short ends 14 of the terminal wires immediately above the mounting board, and the coil as thus mounted is dipped into a bath of a suitable protective coating 28 to protect and insulate the circuit element, to bind all parts firmly together and to impart rigidity to the mounted coil. Desirably the dip will be such as to immerse the mounting board totally but leave the lower long ends 16 of the terminal wires 12 uncoated. A phenol formaldehyde coating composition identified in the trade as Durez (a trademark of the Durez Plastics & Chemicals Co.) has been found to be highly satisfactory. The Durez comes as an uncured powder. A thick solution or suspension in alcohol or acetone is made, the mounted coils dipped and permitted to dry and then baked to cure the resin. The Durez forms a hard and strong coating over the entire mounting board, coil, and adjacent areas of the terminal wires, encapsulating the entire unit and fixing the relative positions of the various parts and making rigid the mounting board. It will be appreciated that, with the Durez encapsulation, the assemblage of the coils prior to dipping may be weak or fragile. Strength only sufficient to hold the members in place in the successive steps of wire insertion, coil mounting, coil lead connection, dipping, etc. and incidental handling is needed.

Although the Durez coating is shown only in FIGS. 1 and 2, it will be appreciated that it may be employed to obtain the several advantages in any of the modifications illustrated, and its omission from the illustrations of other modifications is simply to make clear the internal structure of the mounted coils.

As stated above, the method of inserting the terminal wires employed in the art has been by a conventional stapling step wherein the wire is bent into a U-shape and the free ends of the wire are then driven through the mounting board and the feet thereafter splayed out. This imposes two limitations; first, that the legs of the staple must be equal in length and second, that the legs of the staple cannot be long. It also imposes a limitation corollary to the second limitation that the mounting board material must be easily penetrated.

As an improvement over this construction we have devised the coil mount illustrated particularly in FIGS. 7 and 8 and a method of making it in FIGS. 9 through 13. In FIG. 7, we show a mounting board 30 as described above with terminal wires 32 attached thereto, short ends 34 projecting from one side of the board and long ends 36 beyond the opposite side. As in conventional stapling, the end portions 34 and 36 of the wires lie on one side of the board and a central portion or bight 38 lies on the other side of the board. The method which makes possible the disparity of terminal wire end lengths is the step of driving the bight of the terminal wire through the board to effect this relation rather than driving the ends of the terminal wire through the board.

In this construction the use of the fish paper or equivalent paper stock is highly desirable. It has stiffness and strength sufficient to effect a good retention of the terminal wires. The mounting board may be slotted as at 40 for the reception of the wire bights or the central portion of the wire may be driven through the unslotted board material to break its own way. In either case the fish paper has sufficient resilience to snap back into plane after the passage of the bight of the terminal wire therethrough and so effect the desired retention of the terminal wire.

Illustrative mechanism is shown in FIGS. 9 through 13. In these figures we show upper and lower clamping members 42 and 44 which are adapted to engage substantially the entire surface of the mounting board aside from the line of operation involved in the terminal wire insertion. The upper clamping member is centrally vertically slotted for the reception of a tongue 46 about equal in thickness to the diameter of the terminal wire. The tongue is movable up and down relative to the upper clamping member. The upper clamping member is likewise grooved at 48 on its bottom face in line with tongue 46 for the reception of a terminal wire.

The bottom clamp 44 likewise has a slot therein in alignment with and wider than the slot in the upper clamping member for the reception of a vertically reciprocable die member 50 somewhat wider than the tongue 46.

The mounting board 30 is placed on the lower clamping member and a terminal wire 32 placed thereon. The upper clamping member is then brought down to clamp securely the mounting board and retain the terminal wire in its proper position across the mounting board. Thereafter the tongue 46 is moved downward to drive the central portion or bight 38 of the terminal wire through the mounting board. As stated, the mounting board may be slotted for the passage of the wire bight or the bight may tear its own way through. In either case the configuration will be generally as shown in FIGS. 10 and 11. The tongue 46 is then retracted to permit the bent-down edges of the torn or preformed slot in the fish paper to return to a position near their original plane behind the bight 38 of the terminal wire as shown in FIG. 12. Thereafter the lower die 50 is raised to flatten the bight of the terminal wire against the under side of the slot in the fish paper.

Although we have illustrated the insertion of a single wire only, it will be evident that the mechanism of FIGS. 9–13 may be duplicated to insert both wires simultaneously or even further multiplied for the inser-

tion of several wires, as with some modifications described below. Simultaneously with this operation, appropriate dies can be used to shape the exterior outline of the mounting board, to score the paper as desired, and to fashion windows therein as will be later described. Following completion, the upper clamping member **42** is raised to release the completed coil mount.

The mechanism described here is purely illustrative, but it is well suited to automatic and rapid operation. The fish paper may be supplied in strips and the terminal wires supplied from coils mounted transversely to the line of travel of the strips. The cutting to length of the ends of the terminal wires can likewise be performed simultaneously with the assembly procedure. Thus, the wire could be fed against a stop **49,** and a shear **51** acting against an anvil **53** could move with the upper clamping member **42** to do the cutting.

A coil or circuit element will then be attached to the mounting board in a fashion to be described later, the leads thereof secured to the short ends **14** of the terminal wires, these ends soldered as by a dip, and the whole mounting board then immersed in Durez and cured to obtain a mounted coil like that of FIG. **1.**

It will be appreciated that the attachment of the terminal wires to the mounting board is not inherently as secure as the attachment of the staple in the above described coil mount of the art. By deliberate effort the terminal wires can be pulled out from behind the slot edges **52.** On the other hand the assembly is as strong as it need be. The retention of the terminal wires is ample to permit a wrapping of the coil leads thereabout without danger of displacement, and after the Durez dip and baking, the entire structure is cemented together into a unit which possesses ample characteristics of strength.

This limited strength requirement imposed on the terminal wire and mounting board connection during the mounted coil assembly suggests other modes of attachment of the terminal wires to the mounting board. FIGS. **1** and **2** show another possible assembly technique. In this case the terminal wires **12** are fed transversely between two strips of appropriate paper **54** having tacky gummed surfaces which face each other. Thereafter in a simultaneous pressing and blanking operation the wire may be cut to length, the paper pressed so that the gummed surfaces thereof engage each other encompassing the wires, and such punching and shearing done as may be desired of the double paper layer. Thereafter the coil will be inserted, leads secured and the whole Durez-dipped as described before.

FIGS. **3** and **4** illustrate another modification of the coil mount wherein the terminal wires are adhesively secured to a single sheet of the fish paper. The paper may have a gummed side on which the terminal wires may be laid transversely of the strip. Again the wires may be cut, pressed into the gummed surface of the strip for firm connection and the paper shaped as desired. The rest of the assembly then follows in order. Such a procedure will serve well where the adhesive employed is a curable strong type such as epoxy or polyester. Polyester and epoxy adhesives however are expensive and require a separate operation and time for curing.

To permit the use of ordinary contact cements we have devised the mount illustrated in FIGS. **3** and **4.** It should be appreciated that the bond of Durez to a cement coated surface is no stronger than the adhesion of the cement to that surface. Durez bonds much more strongly directly to the paper than to ordinary contact cements. Therefore in the modification of FIG. **3,** rather than coating one entire side of the paper strip, we print lines **56** of contact cement where the terminal wires are to be placed and form windows **58** through the paper in the center of these lines, for instance, slightly wider than the wire. The terminal wires, as before, are deposited on the glued strips. In the operation of cutting them to length, the wires are dented down into the windows **58** as at **60.** The glue retention will be sufficient to hold the terminal wires for the manipulations to be performed thereon in the course of assembling the mounted coil. Thereafter the Durez coating bonds the wires closely to bare paper surfaces. There will be leakage of Durez through the windows **58** and through the coil window **24** to bond the coatings of Durez on each side of the paper together and to encase the terminal wire dents. The Durez between the dents **60** and the window edges imposes manipulative loads thereon upon the paper of the window edges thereby preventing longitudinal shift of the wires within the Durez casing, and the Durez between the dents and the sides of the windows **58** prevents rotational displacement of the terminal wires. It will be appreciated that this modification demands that the dents **60** extend only into and not through the windows **58,** and the coil mount may thus have an absolutely flat side.

FIGS. **5** and **6** illustrate another method of temporary terminal wire attachment to a mounting board which has particular advantages of its own. In this modification we use a mounting board **10** of corrugated paper having the usual outer plies **63** and a corrugated middle ply **65** supporting and spacing the outer plies. The corrugations leave through-apertures **67** that snugly receive the terminal wires **12.** We find the frictional engagement of the wires within the apertures normally sufficient to resist manipulation. Where the handling is particularly vigorous, however, it may be advantageous to swage a flat **69** on the wires after their insertion to anchor them more securely. The cardboard restores itself substantially after the swaging.

The advantage of this structure is that the mounting board is flat and that the terminal wires are spaced from the planes of either of the faces thereof. As a consequence, the entire face or faces of the board is available for coil mounting and coils of substantially greater diameter can be accommodated. This should be compared with the mount of FIGS. **7** and **8** where the coil is limited in diameter to the space between the bights **38** or to the diagonal distance between the inside of the short end **34** of one wire and the inside of the long end **36** of the other.

In FIG. **3** it should be noted that the short terminal wire ends **14** are pinched off rather than sharply sheared off so as to leave a flattened pointed tip **62.** This tip provides a shearing edge for the relatively fine wire of the coil leads **26** so that the leads may be cut off after wrapping on the terminal wire without the necessity for picking up another tool. A detail such as this contributes greatly to speed of assembly.

It should be further noted that the top and bottom edges **71** and **73** of the boards are notched as at **75.** Both the short and long terminal wire ends are usually immersed in a solder bath, the short ends to solder the coil leads thereto and the long ends to tin them. Such

dips present the possibility of charring the top and bottom edges of the boards and creating a conductive carbon path between the terminal wires. The notches **75** interrupt the continuity of these edges.

The remaining figures all relate to various ways in which a circuit element such as a coil may be retained by the mounting board in preference to the simple glue attachment as described above. As indicated before the glued attachment has several disadvantages. First it is slow. Second, the strength of the Durez coating is reduced in that it is not bonded to the whole surface of the mounting board.

FIGS. **13** through **19** illustrate a first form of temporary coil attachment prior to the Durez dip. In all of these figures, the mounting board is shown without the terminal wires. It will be appreciated that the terminal wires may be attached in any of the fashions indicated in FIGS. **2, 3, 5,** or **7.**

In the structures of FIGS. **14** through **19,** a window **64** is formed centrally in the board wherein two opposite edges have inwardly projecting central bulges or tongues **66.** We contemplate that whatever use this structure may have in mounting other circuit elements, it will have particular utility in mounting an entire range of inductors. FIGS. **15** and **16** illustrate the mounting of a high inductance coil **68.** The coil consists of a dumbbell shaped core **70,** the central portion **72** of less diameter having a winding **74** thereon. The core is contained within a sleeve **76** of ferromagnetic material to complete the magnetic circuit. The sleeve **76** is somewhat longer than the core. The fit of the core within the sleeve is loose enough so as to permit the winding leads **78** to extend out between one of the dumbbell ends and the inside wall of the sleeve **76.** The assembly is easy and rapid. The wound core is inserted in the sleeve and the sleeve then snapped into the window, the tongues **66** engaging the ends of the sleeve **76.** The tongues and window generally are fitted to the longitudinal central section of the sleeve so that the sleeve extends out from the mounting board half on one side and half on the other. The tongues **66** extend a short distance into the open ends of the sleeve and bear against the ends of the core to center it longitudinally within the sleeve. Thus a complete mounted coil may be provided by snapping the high inductance coil into the window of the mounting board, the terminal wires being already attached, twisting the coil leads **78** to the short ends of the terminal wires, solder-dipping the short terminal wire ends, dipping the entire mounting board in a Durez dip and baking.

The same general type window may be employed for mounting a low inductance coil as illustrated in FIG. **17** and largely described above. Here, the coil **18** consists of a single layer winding **20** on a tubular cardboard form **22.** The coil **18** is snapped into the window so that the tongues **66** extend into the open form ends **86** and support the coil firmly within the window. Again the coil leads are attached to the terminal wires, solder-dipped, and the whole Durez coated.

FIGS. **18** and **19** illustrate the same general concept as applied to a medium inductance coil. Here the coil **88** is a universally wound, washer shaped coil without a core. Again the window **64** is formed to conform to the cylinder sides or central longitudinal section of the coil, and tongues **66** are provided in the opposite windows sides conforming to the ends of the coil. Again, the coil is snapped into the window so that the tongues **66** extend into the central aperture **92** of the coil **88** to anchor it into the window. The mounting coil is then finished as described.

FIGS. **20** through **23** illustrate another window whereby a variety of circuit elements may be variously contained in a mounting board without the necessity of gluing. In this form, the mounting board is cut centrally across its top and bottom ends as at **94** and a center connecting cut **96** is made between them so as to define a pair of flaps **98.** The flaps **98** may be appreciably longer than the coil to be contained. In FIG. **21** is shown a universally wound coil **100** like that in FIG. **19** inserted between the flaps **98** to spring them out so that the flap edges bear against the ends of the coil. The material of the mounting board is stiffly resilient and will support the coil firmly.

If the lateral extension of the coil of FIG. **21** is not wanted, the flaps **98** can be opened oppositely and the coil **100** inserted between them as particularly illustrated in FIG. **22.** The opposite opening of the flaps likewise serves to mount tubular form wound coils **102** as best seen in FIG. **23.**

All of these mounting configurations illustrated in FIGS. **14** through **23** possess the advantages, first, of exceedingly quick assembly; second, the use of no glue to retard manufacture and to impair the adhesion of the Durez to the mounting board material; and third, of permitting leakage of the Durez suspension around the coil or circuit element between opposite sides of the mounting board to integrate the Durez coatings on the two sides of the board.

FIGS. **24** and **25** illustrate a method of using the mount of the invention for supporting and connecting a tunable coil. To this end we form a central circular aperture **104** in the center of the mounting board which is smaller in diameter than the coil itself. The edges of the aperture are slit or broken as at **106** to provide a ring of infacing tongues. The coil **108,** on a tubular form, may be inserted into the aperture, the tongues holding the coil firmly so as to extend transversely of the mounting board with the bore of the form and consequently the exposed tuning slug **110** readily accessible. If a Durez coating is desired, the core ends may be capped for dipping.

FIGS. **26** and **27** illustrate the use of the coil mount of the invention in a four terminal context. In this situation we provide two coil mounts **111,** each having a central bore **112** therein. The coil or transformer **114** proper may be wound on a tubular form **116** having an interior diameter equal to the diameter of the bores **112.** The mounts thus will be butted up against the ends of the form. A tubular sleeve **118** somewhat longer than the form **116** is contained in the form and extends beyond it at either end through and beyond the mounts **111** and is rolled over outwardly at its ends to provide flanges **120** which secure the assembly together. It will be appreciated that since two mounts are employed, there will be four terminal wires thus adapting the structure to such four terminal purposes as the mounting of transformers, etc. The sleeve **118** is open throughout and therefore adapted to receive a metal core or slug if desired.

FIGS. **28** and **29** illustrate a six terminal structure. In this instance, the mount **124** consists of alternating narrow **126** and wide **128** elements connected together but scored as at **129** for folding.

The board can thus be folded into a rectangular configuration as illustrated in FIG. **29**, the narrow sections **126** constituting the ends and the wide sections **128** constituting the sides. The narrow sections **126** each have a central terminal wire **130** mounted therein and the wide or side sections **128** have a pair of spaced terminal wires **131** in the fashion of the simple mounts. The terminal wires may be attached to the mount board in any of the fashions described above, although that method shown in FIG. **7** is illustrated. The six terminal element **132**, possibly in the form of a universally wound coil, will be glued to one of the wide members of the mount and the other sides folded thereabout. The opposite wide side should also have adhesive applied thereto in order to maintain the shape of the folded mount and further support the element.

It will be appreciated here that while the windowed mounting boards illustrated in FIGS. **14** through **25** have definite advantages in the speed and inexpensiveness of assembly, there may be instances where the additional expense and time consumption of the gluing operation are justified. It is not our invention, therefore, to exclude necessarily a glued attachment of the circuit element to any of the board structures illustrated in FIGS. **1** through **8**, although for most purposes the windowed structures will be preferred.

FIG. **30** illustrates a coil mount **132** of the invention serving also as a form for a low inductance coil. Here the mounting board **134** is formed to be generally rectangular with shoulders **136** extending above and below the board on each side thereof. The terminal wires **138** will be centered in the shoulders. Thereafter the appropriate number of turns of coil wire **140** are wrapped around the central portion of the mounting board between the shoulders **136** and secured to the short terminal wire ends **142** in the fashion described. The shoulders serve to space the coil wire from the terminal wires and avoid unwanted shorting. The shoulders also define an index to the solder dip and the tinning dip so that the coil wire **140** on the board will not be exposed to solder immersion.

It will be appreciated from the foregoing description of the many modifications of the invention that we have devised a coil mount and a mounted coil suitable for insertion into electric circuits, particularly of the printed circuit kind, which represents a notable advance over anything known in the art. It is simple, inexpensive, occupies little space, and is exceedingly flexible in its application. The speed and ease of manufacture of such circuit components embodying the invention are notable. It will be further appreciated that although we have described several specific embodiments of the invention it is not to be regarded as being limited only to those shown. Others undoubtedly will suggest themselves and we desire, therefore, that out invention be regarded as being limited only as set forth in the claims hereof.

In the claims, the term "untrimmed" is used as defining terminal wire lengths. As described above, the staple insertion of the terminal wires into a mounting board limits the ends of the terminal wires to relatively short lengths and demands that they be of equal length. It will be appreciated that an unequal length of leg could be obtained subsequently by cutting one of the legs of each of the staples even shorter. This is, however, wasteful of terminal wire, requires an additional operation, and still does nothing to extend the possible length of the other leg. The legs of the terminal wires of the invention could be defined as "long" to distinguish over the staple type, and in some instances are, but this is a characterization lacking in definiteness. More definite is the characterization of the terminal wires being unequal initially or without a subsequent trimming or shortening operation.

We claim:

1. An inductive circuit element comprising a winding having at least three leads for independent circuit connection, stiff insulating parallel panels mounted on opposite sides of said winding, each of said panels having a pair of stiff terminal wires extending thereacross adjacent opposite edges thereof and beyond said panels at each end, all of said wires being parallel, the ends of said wires extending in one direction being adapted for insertion in a printed circuit board, said leads being secured to the other ends of said wires.

2. The combination as set forth in claim **1** wherein said winding incorporates a coil form and said panels are mounted to said coil form beyond opposite ends of said winding.

3. An inductive circuit element comprising a winding having at least three leads for independent circuit connection, a strip of relatively stiff insulating material folded about at least three sides of said winding to define at least parallel side portions and an end portion embracing and supporting said winding, means securing said side portions against said coil, said strip having at least three relatively stiff terminal wires extending transversely thereacross and beyond the edge of said strip at both ends, said terminal wires occupying at least two of said portions, the ends of said wires extending from one side of said strip being adapted for circuit connection and the leads of said winding being secured to the other ends of said terminal wires.

* * * * *