

[54] ELECTROMAGNETIC RELAY

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3,811,102 5/1974 Ash 335/106

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 306,112, Nov. 13, 1972, abandoned.

[52] U.S. Cl. 200/246; 200/283; 335/106

[51] Int. Cl.² H01H 1/24; H01H 1/26

[58] Field of Search 200/246, 283; 335/106,
335/151; 29/622, 628, 629

[57]

ABSTRACT

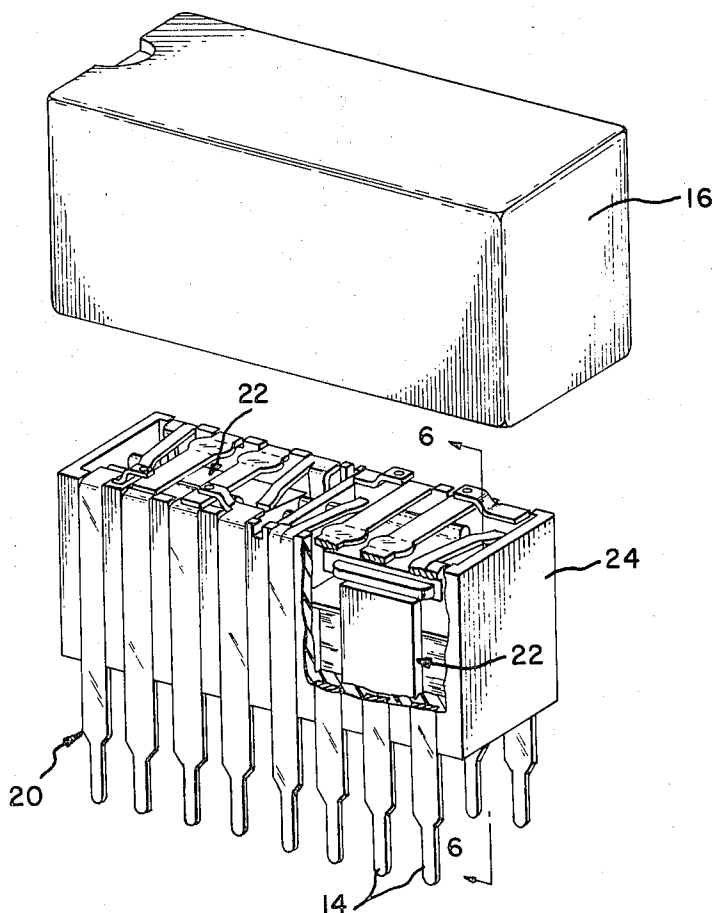
An electromagnetic relay assembly and more particularly to the fixed and movable contacts, pins and leads which are fashioned from a single sheet of flat stock by stamping and forming.

9 Claims, 12 Drawing Figures

[56] **References Cited**

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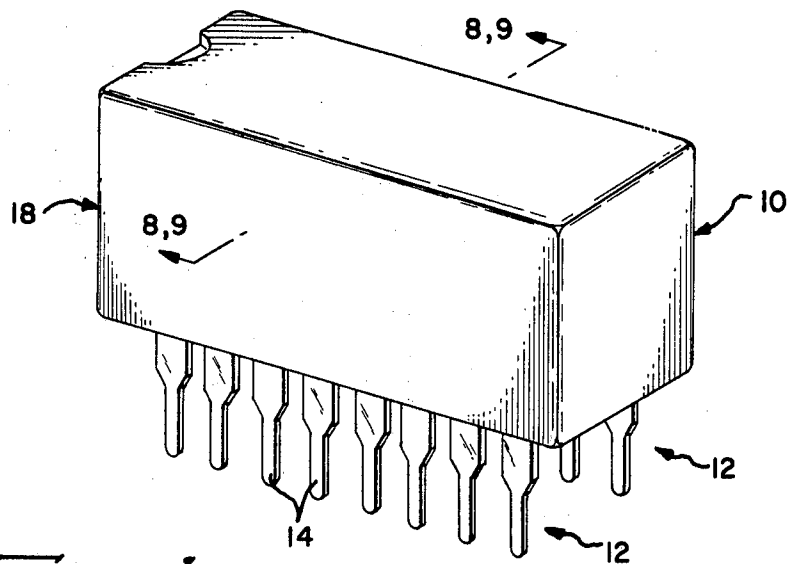


Fig. 1

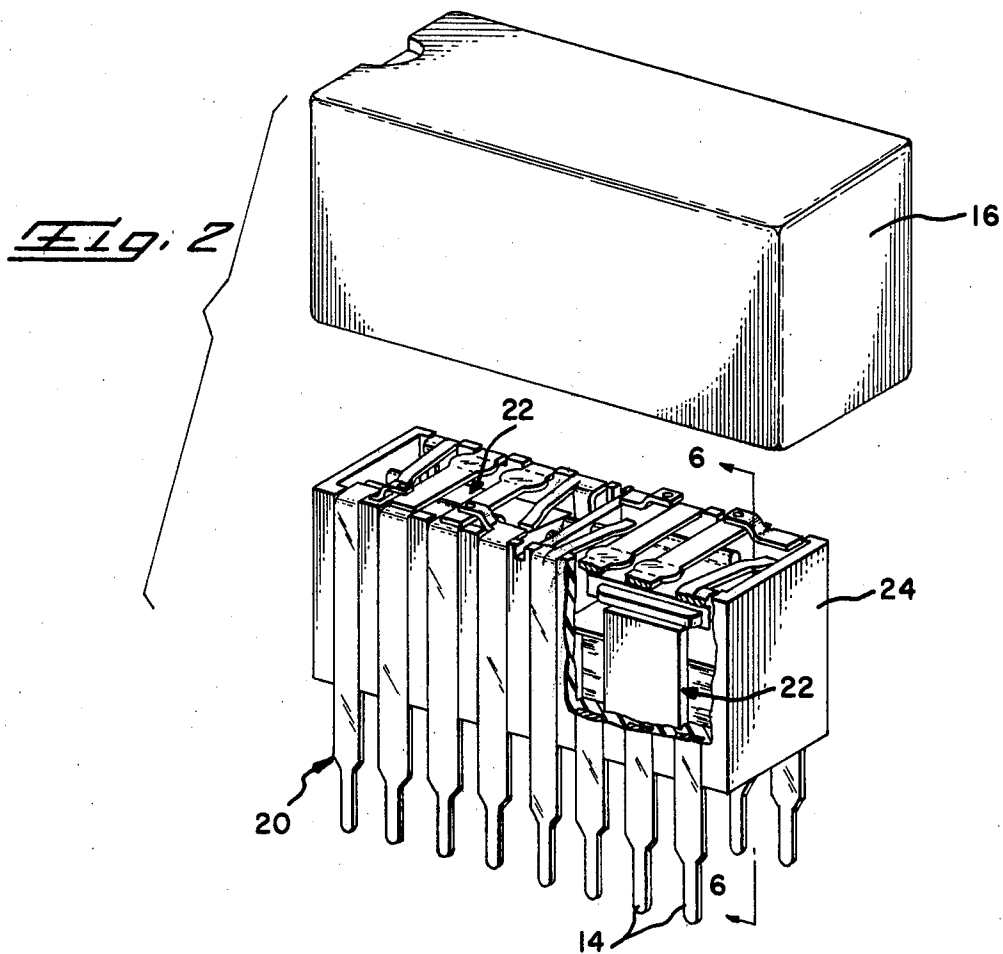


Fig. 2

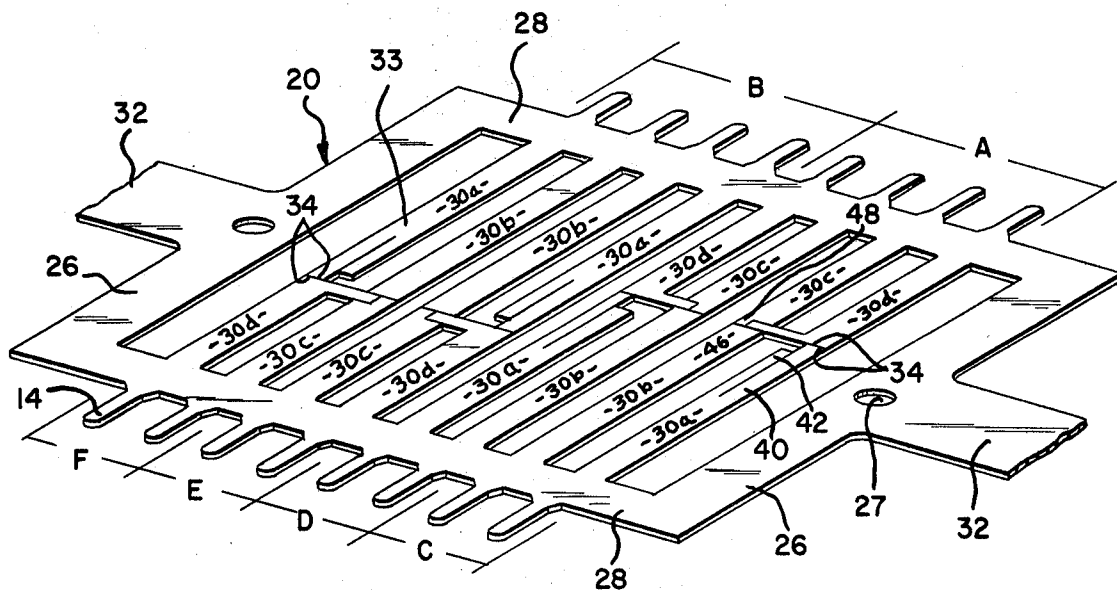


FIG. 3

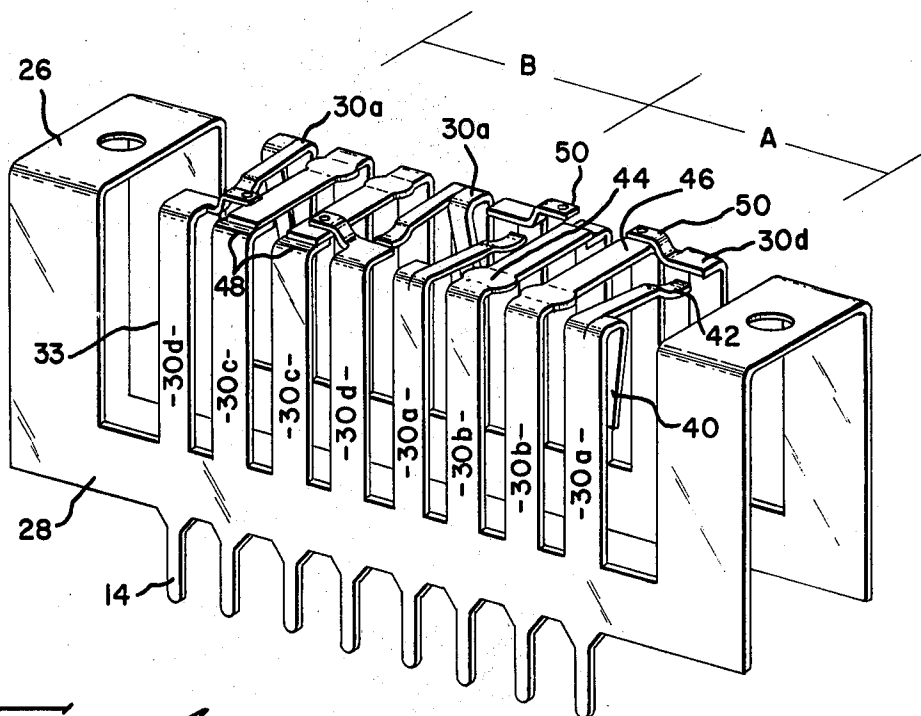
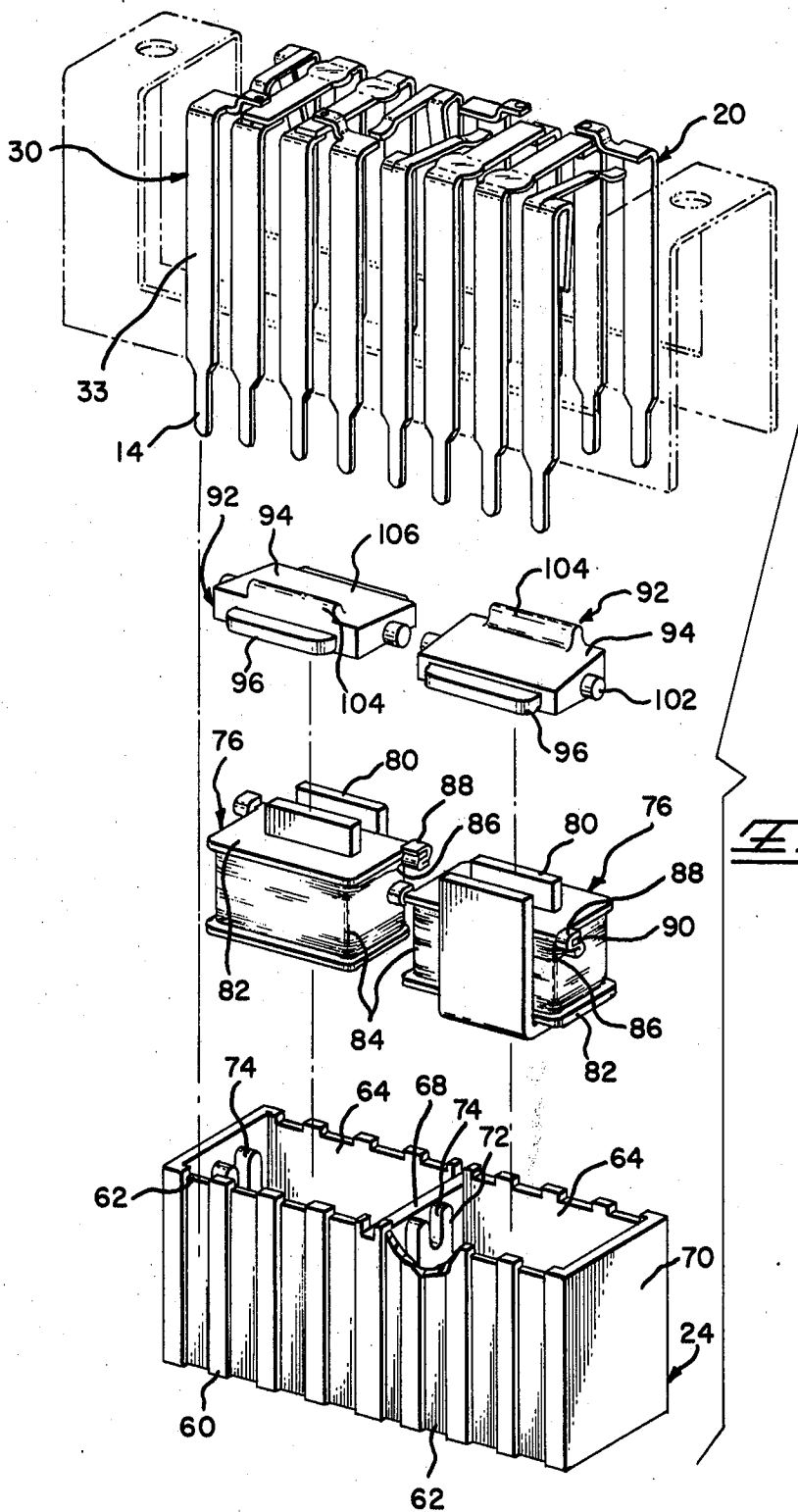


FIG. 4



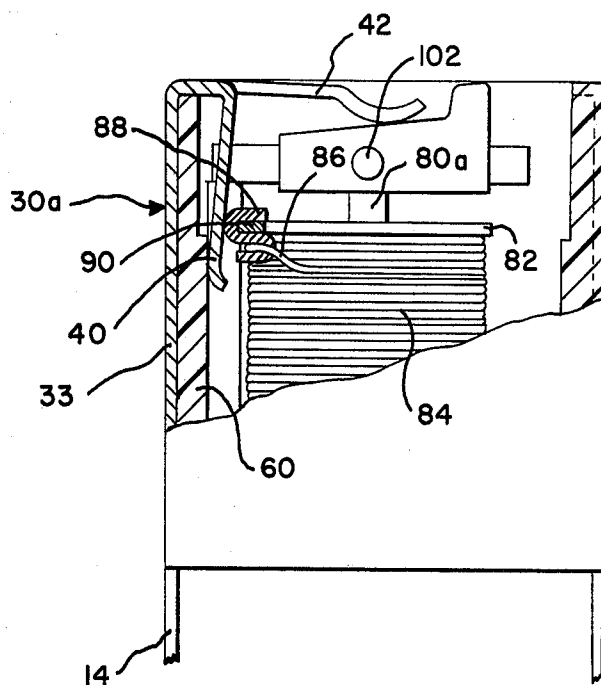


Fig. 6

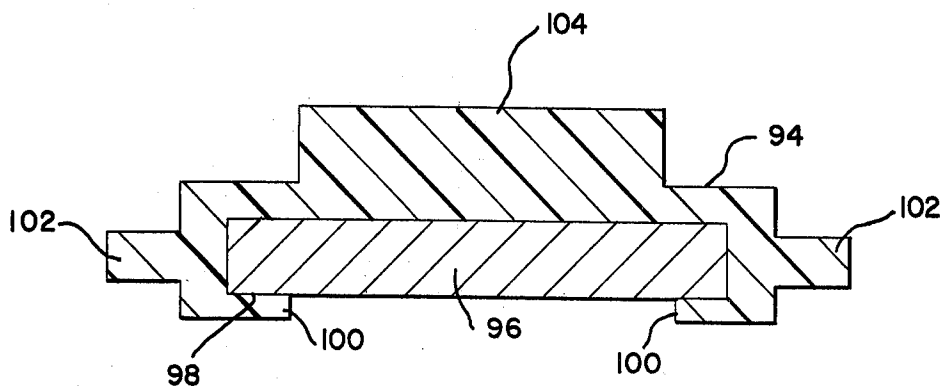


Fig. 7

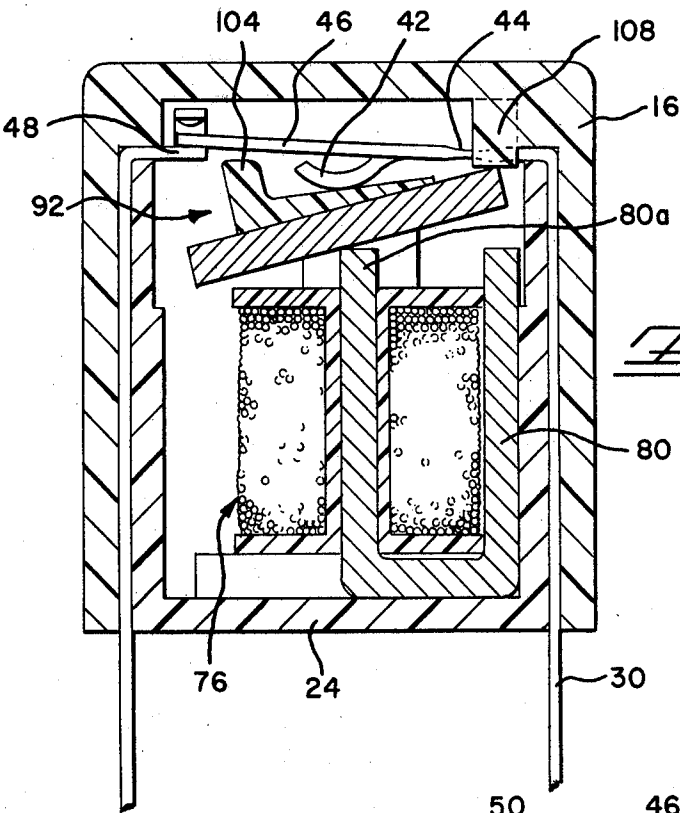
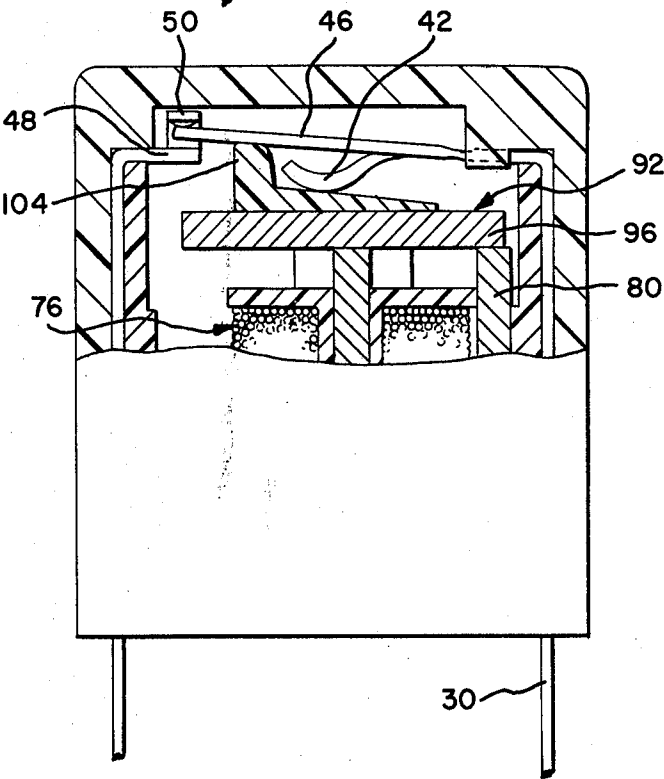


Fig. 8

Fig. 9



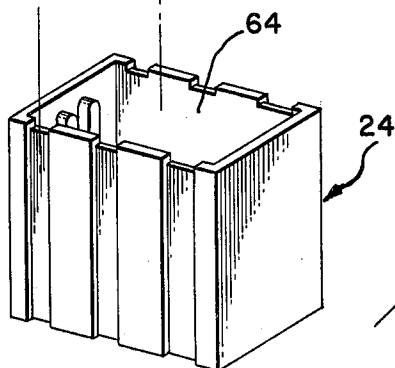
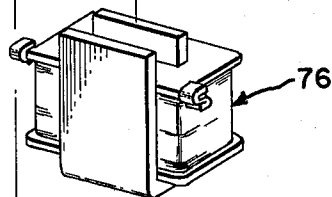
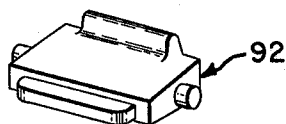
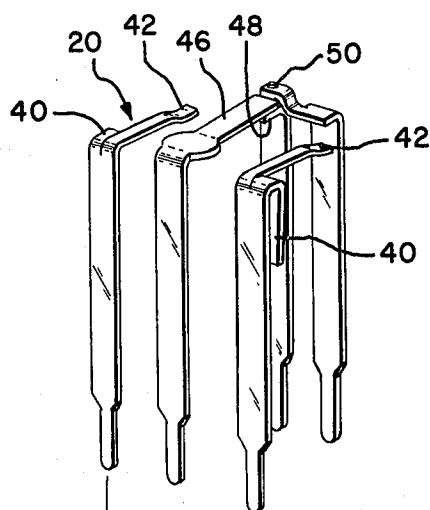
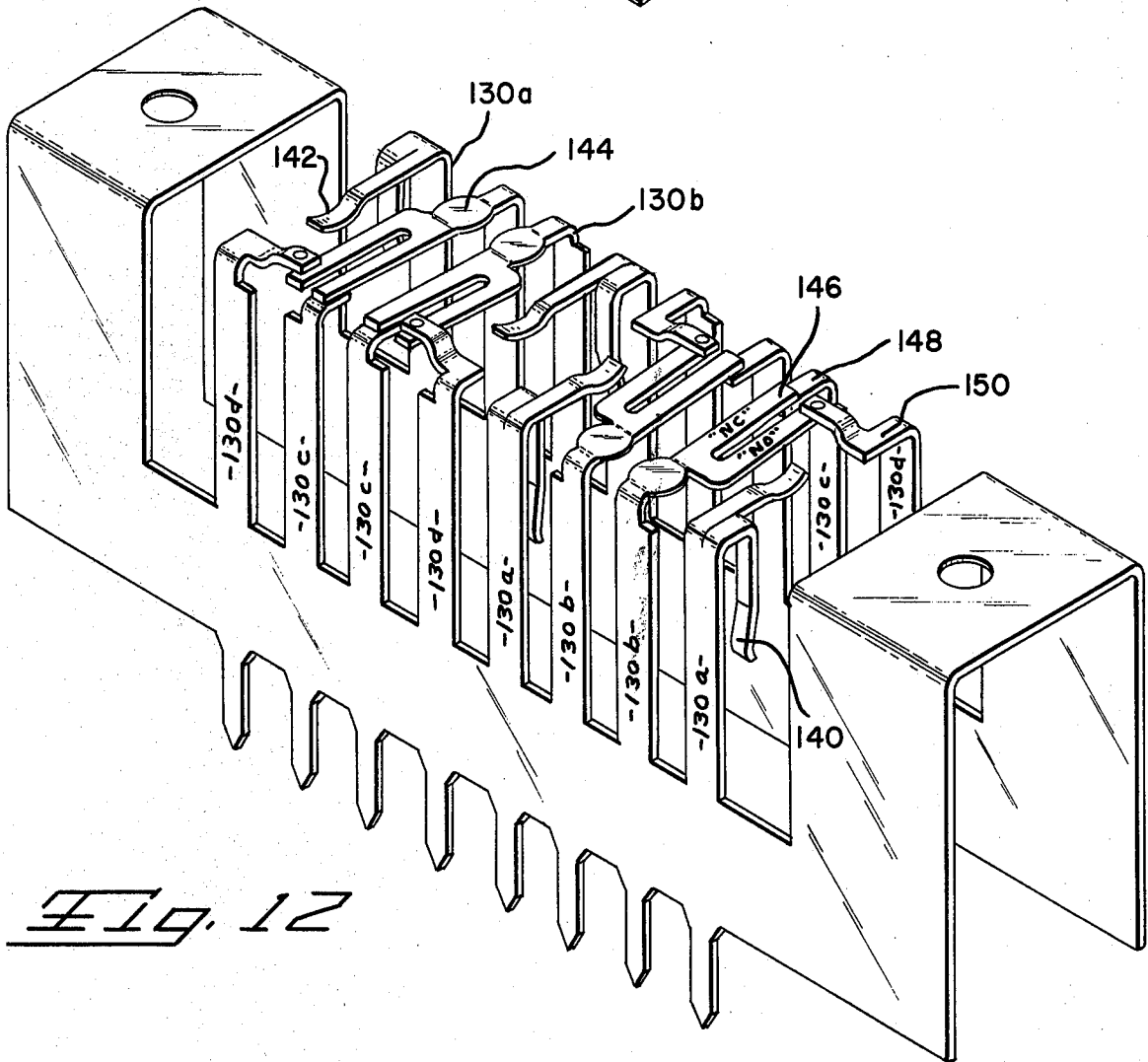
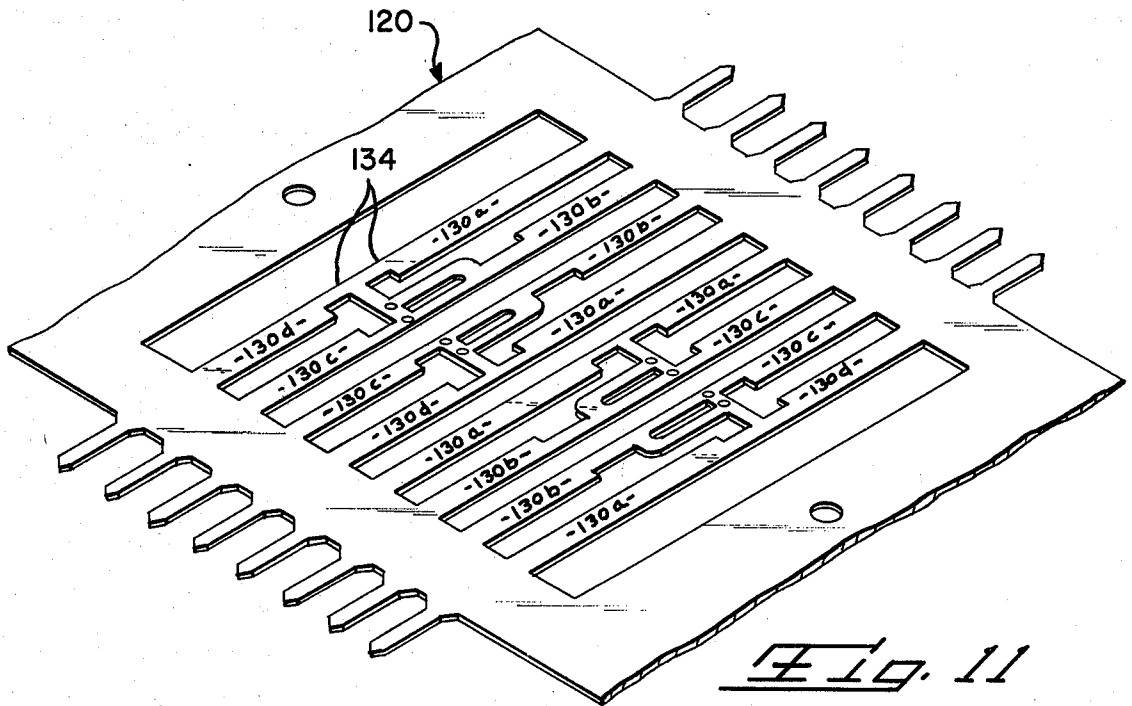


Fig. 10



ELECTROMAGNETIC RELAY

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of Ser. No. 306,112, filed Nov. 13, 1972 now abandoned.

BACKGROUND OF THE INVENTION

Electromagnetic relays have been known and used for many years in a variety of ways. In more recent years the demands of modern technology have required unusually high degrees of performance under extreme environmental conditions; e.g., space exploration, and further have required along with such performance miniaturization.

Of the several components within currently popular electromagnetic relays, the contact systems and switches are quite complex, and contain a relatively large number of diverse parts wherein the mechanical connections thereinbetween are subject to failure from rough handling and use.

Accordingly, a primary object of the invention is to construct a dual in-line package containing an electromagnetic relay assembly in a novel manner which reduces the complexity and number of parts thereof to an absolute minimum.

Another object of the invention is to construct electric contacts and switches used in an electromagnetic relay from a single strip of metal solely by stamping and forming operations.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a completed electromagnetic relay package incorporating the novel features of the present invention;

FIG. 2 is a perspective and partially sectioned view of the package of FIG. 1 with the cover removed to show the internal features;

FIG. 3 is a perspective view of the novel contact-lead frame subsequent to the stamping operation;

FIG. 4 is a perspective view of the novel contact-lead frame of FIG. 3 subsequent to the forming operation;

FIG. 5 is an exploded view of FIG. 2;

FIG. 6 is an enlarged cross-sectional end view taken along lines 6—6 of FIG. 2 showing in detail the novel electrical termination of the electromagnet;

FIG. 7 is a cross-section view of the armature assembly;

FIG. 8 and 9 are a cross-sectional view taken along lines 8—8 of FIG. 1;

FIG. 10 is another embodiment of the invention; and

FIG. 11 and 12 illustrate another contact-lead frame.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An electromagnetic relay for switching electrical circuits is enclosed within package 10 seen in FIG. 1. Two rows 12 of eight pins or connecting posts 14 depend downwardly therefrom, such posts being conventionally spaced to fit into a socket or printed circuit board (not shown).

FIG. 2 shows housing cover 16 of housing 18 (FIG. 1) removed from package 10 to reveal the positioning

of the stamped and formed contact-lead frame 20 and the two electromagnet assemblies 22 relative to each other and to the housing base 24 of housing 18.

As is well known in the art of stamping and forming, a roll of mill stock of a spring tempered conductive material such as phosphor bronze or beryllium copper and having suitable width and thickness dimensions is fed into a fabricating die (not shown) to produce a continuous strip of frames 20. FIG. 3 illustrates a contact-lead frame 20 at the conclusion of this stamping operation. The frame includes two end strips 26 with positioning holes 27 therein, and a number of web portions 28 which connect contact members 30 to each other and to end strips 26. The fragmentary pieces 32 extending from both ends and along the longitudinal axis of the frame are the connections between adjacent frames 20 (not shown) in the roll of mill stock.

The sixteen contact members 30 are in two rows 12 of eight members each where the outer ends have been hereinabove designated as pins 14. In addition, contact members 30 include an intermediate portion 33 and inner ends 34. The sixteen members, as is apparent from FIG. 3, consist of two major groups of eight members, four of each group being on one side and the other four of the same group being on the opposite side of the longitudinal axis. The two groups have been designated by capital letters A and B. The members of each group can be separated into two sets of four members each where two of the members oppose the other two relative to the longitudinal axis. These sets have been designated by the letters C, D, E, and F where set C is the mirror image of set D and set E is the mirror image of set F. Thus it can be seen that the pattern of the inner ends 34 of set C is repeated in each of the other three sets. Note also, that the inner ends 34 of each member 30 in Group A terminates on the right side of the longitudinal axis while the ends in Group B terminate on the left side. This can also be seen in FIG. 4 which shows frame 20 after it has been formed but before assembly and severing of the web portions 28 and end strips 26.

The forming operation bends the frame into the inverted U-shape shown in FIG. 4 and further forms the contacts and leads which will now be discussed. The contact members 30 in each set are designated by the addition of small letters a, b, c, and d to the reference numeral 30.

Making reference to both FIGS. 3 and 4, the inner end of each member 30a is split in two legs. Upon forming (FIG. 4) one leg is bent downwardly to become coil contact lead 40 (see also FIG. 6) and the other leg is curved or dimpled at its free end to become retention and adjusting spring 42.

The inner end of each member 30b has been swaged at hinge point 44 (FIG. 4) to extrude the inner end so that it is lengthened and also to reduce that area which as will be seen becomes a hinge. Member 30b, so formed, becomes movable contact arm 46.

The inner ends of each member 30c have a linear projection thereon (formed as a result of forming member 30d) which is plated to form a contact which is hereinafter designated as the fixed, normally closed contact 48. As a result of extruding the inner end of member 30b, contact arm 46 overlaps contact 48 (see FIG. 8).

The inner ends of each member 30d have a lateral projection or tab thereon which has been bent up-

wardly so that it is spaced above the end of the aforementioned movable contact 46. This tab is hereinafter designated as the fixed, normally opened contact 50.

The swaging of members 30b, as noted above, extrudes or elongates the free portions thereof so that contacts 46 protrude in between the fixed contacts 48 and 50. Also, the swaging conditions the metal at point 44 so as to increase the ability of movable contact arm 46 to flex.

The result of the above described stamping, forming and swaging operations is the formation of two double pole-double throw contact switches, one such combination being in Group A and the other being in Group B (FIG. 4).

The utilization of this unique contact arrangement which is shown in FIG. 2 has been exploded in FIG. 5 to which reference is now made.

The outside and top of each of the two side walls 60 of base 24 contain eight spaced, grooves 62 which receive the intermediate portions 33 of contact members 30.

The inside of base 24 is separated into two compartments 64 by partition 68. Each side or partition 68 and the inside of each of the two end walls 70 contains a bracket 72 each of which contain a slot 74 opening upwardly.

Each of the two identical electromagnets 76 shown above base 24 is positioned in one of the two compartments 64, orientated therein as shown in FIG. 5; i.e., one electromagnet is turned 180 degrees relative to the other. Each electromagnet 76 includes a conventional U-shaped iron core 80, the bobbins 82, the wire windings 84 and a means for connecting the lead wires 86 originating from windings 84, to the contact lead leg 40. As this arrangement constitutes one of the important and novel features of the present invention, it is illustrated in detail in FIG. 6 which is a cross-sectional view taken at one end of compartment 64 after assembly such as seen in FIG. 2.

Reference is now made to FIG. 6 where, for reasons of clarity, some components are omitted and only a center leg 80a of iron core 80 is shown. One convolute of S-shaped metal clip 88 is pressed onto lateral ears 90 (see also FIG. 5) projecting laterally from bobbin 82. The second or lower convolute of the clip is squeezed together with the free end of lead wire 86 coming from windings 84, positioned therebetween. Leg 40 is positioned inbetween the inside of wall 60 and clip 88 in an interference fit so that a firm and reliable electrical contact is made between the leg and clip 88. Contributing to the firmness of the fit is the force derived from the bending of the leg to approximately 100° from the horizontal. This degree of deformation puts leg 40 in continuous stress in the general direction of clip 88.

It is apparent from FIGS. 3, 4, and 5 that the arrangement illustrated in FIG. 6 occurs twice for each electromagnet 76 to complete the electrical circuit there-through.

For each electromagnet 76 there is provided means which, upon being actuated by electromagnets 76, cams movable contacts 46 from the normally closed contacts 48 to the normally opened contacts 50. These means are the armature assemblies 92 seen in FIG. 5 to which reference is again made. Armature assemblies 92 consist of a molded plastic carrier 94 carrying a soft iron or other magnetically susceptible metal flat plate 96 underneath. Referring now to FIG. 7 as well as FIG.

5, one sees that the carrier 94 is basically plate-shaped with lateral depending flanges 98. The flanges have inwardly facing ears 100 which hold metal plate 96 by interference fit. Stub shafts 102 project outwardly from each flange 98 and are integral therewith. A lobe 104 extends across upper surface 106 at one end of carrier 94.

The armature assemblies 92 fit above electromagnets 76 in compartments 64 with the stub shafts 102 fitting into slots 74 of brackets 72. The location and designs of the components are such that the assembly is fully supported by iron plate 96 resting on the top of the center leg 80a of iron core 80. The slots do not support the assemblies but only serve to retain them in the position shown.

Referring to FIGS. 2, 5, 7, and 8, contact-lead frame 20 is placed onto base 24 so that pins 14 extend below the base and intermediate portions 33 are positioned in grooves 62. Inner portions 40 extend across the top of compartments 64. Movable contacts 46, which are biased against contacts 48, are directly over lobes 104 and as discussed above, lead legs 40 are positioned inbetween the inside of wall 60 and clip 88 to make electrical contact with electromagnets 76. Retention and adjusting springs 42 abutt the upper surface 106 on either side of lobes 104 with the point of contact thereon being precisely over the point of contact between plate 96 and center leg 80a.

After frame 20 has been put in position over base 24 as above described, cover portion 16 of housing 18 is positioned over the frame and base, and bonded to the base to form an environmentally sealed package. Thereafter the excess parts of frame 20; i.e., end strips 26 and web portions 28, which are shown in phantom in FIG. 5, are severed so that contact-lead members 30 are electrically isolated one from the other except as provided for through contacts 46, 48, and 50.

FIGS. 8 and 9, cross-sectional views taken normal to the longitudinal axis of package 10, illustrate further the position of the several components and also illustrate the operation of the relay.

In FIG. 8, electromagnet 76 is not energized and armature assembly 92 is firmly retained against center leg 80a by spring leg 42. This biasing permits an extremely intimate contact between iron core 80 and plate 96. As noted above, movable contact 46 is strongly biased against normally closed contact 48. FIG. 8 clearly shows the swaged hinge point 44 on movable contact 46, part of the hinge point being in phantom behind armature assembly stop 108. Stop 108 is an integral part of housing cover 16 and functions to limit the travel of armature assembly 92.

FIG. 9 shows the relation of the several components while electromagnet 76 is energized. Armature assembly 92 has been pivoted clockwise by the attraction of iron plate 96 to core 80. As the assembly pivots about, lobe 104 contacts and lifts movable contact 46 away from the normally closed contact 48 and into contact with normally opened contact 50.

When electromagnet 76 is de-energized, armature assembly 92 is pivoted counter clockwise by contact arm 46 returning to its biased position abutting contact 48.

FIG. 10 illustrates an exploded perspective view of a relay assembly having a single pole, double throw construction. The assembly contains a base member 24 having a single compartment 64, a single electromagnet

76, a single armature assembly 92 and a frame 20 having a single movable contact arm 46, two fixed contacts 48 and 50, two coil contact leads 40 and two retention and adjusting springs 42. The cover which is now shown, would of course, be sized proportionally. The assembly and operation of this relay assembly is identical with that shown in FIGS. 1 through 9. Although not illustrated, it would be apparent to one skilled in the art to whom the instant invention has been disclosed and construct a single pole, single throw relay. By the same token, one could have a relay containing any number of poles and throws. Yet, another embodiment which can be constructed is a relay having two positions for the poles; i.e., a normally closed, or a normally opened position and an "off" position. This modification simply requires the cutting off of the unwanted throw.

FIG. 11 and 12 illustrates contact-lead frame 120 which differs from the contact-lead 20 illustrated and described in FIGS. 2 through 5. The difference between the two lie in the contact members and more particularly in the inner ends 34 in frame 20 and 134 in frame 120. As the other parts of the two frames are the same, reference to such in FIGS. 11 and 12 will not be made. Further, as has probably been noted already, corresponding parts in contact-lead frame 120 are differentiated from contact-lead frame 20 by adding 100 to such parts reference numerals.

The inner end of contact member 130a of FIG. 11 is split in-two to form a downward depending coil contact lead 140 and a retention and adjusting spring leg 142 seen in FIG. 12.

The outer part of the inner end of contact member 130b is swaged to form a hinge 144. Further, the swaging elongates the inner end by extrusion. The inner end is formed into a U-shaped double arm contact 146 which is movable in a vertical plane by virtue of swaged-in hinge 144. The extreme ends of each arm is provided with a contact area.

The inner end of contact member 130c is punched at its extremity to provide a contact area and as such becomes the fixed, normally closed (NC) contact 148. As a result of the aforementioned swaging of contact member 130b one arm of the double arm contact 146 overlaps contact 148. This arm then will be referred to as contact arm 146—NC.

The inner end of contact member 130d has a lateral projection or tab on which a contact area is provided to form a fixed, normally opened (NO) contact 150. Further, the lateral tab is displaced by a double bend to space it above but not overlying contact 148 as in the case of contact-lead frame 20. Contact with contact 150 is made by means of the second arm of the U-shaped double arm contact 146, this arm being referred to as contact arm 146—NO.

The assembly of contact-lead frame 120 is the same as with contact-lead frame 20.

The operation of contact-lead frame 120 is basically the same as with frame 20; i.e., movable contact 146 is biased downwardly by spring leg 142 so that contact arm 146—NC is in contact with fixed contact 148. Upon energizing the electromagnet, lobe 104 on the armature lifts double arm contact 146 upwardly so that contact is broken between contact arm 146—NC and made between contact arm 146—NO and fixed contact 150.

Having two contact arms on the movable contact 146 increases heat dissipation. Further, alignment between

the movable contact arms and fixed contacts is easy to maintain. Other advantages to a double arm design include a reduction in initial force required to break the normally closed contact. Also contact arm 146—NO bends more readily as it comes in contact with fixed contact 150. This bending improves the wiping action between the two contact areas.

One of the several novel features of the present invention is the armature assembly which is dynamically balanced and mechanically isolated from the contacts to make the relay shock resistant.

Another novel feature is the retention and adjusting spring which retains the armature assembly in slots 74 and further which adjust the pivoting speed of the assembly by the amount of bend placed in the spring.

Still another feature herein is the swaging operation performed on the movable contact arm so that it overlaps the two fixed contacts on the opposite side of the frame.

An advantage of the instant invention is that the intricate contact members are made from a single sheet of metal by stamping and forming. This method insures consistency in quality and high, reliable performance. Further, assembly of the relay is greatly simplified and lends itself readily to automation.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as some modifications will be obvious to those skilled in the art.

What is claimed is:

1. A contact-lead frame stamped and formed from a coplanar sheet of conductive material, comprising:
 - a. a plurality of contact members positioned on one or another of two parallel, spaced apart elongated side strips, said members including,
 - i. a first contact member having an inner end forming a first fixed contact;
 - ii. a second contact member positioned on the same side strip as the first contact member and having an inner end consisting of a laterally projecting tab forming a second fixed contact, said second fixed contact being spaced above the plane of the first fixed contact, and
 - iii. a movable contact member positioned on the other side strip opposite said first and second contact members and having an inner end forming a movable contact arm extending to and adapted for contacting said first and second fixed contacts; and
 - b. means for connecting said contact members to electrical circuits.
2. The contact-lead frame of claim 1 wherein said side strips are connected at either end to an end strip, said end strips being formed in a U-shape.
3. A contact-lead frame stamped and formed from a coplanar sheet of conductive material for use in an electromagnet relay assembly comprising:
 - a. two parallel, spaced apart end strips formed in a U-shape;
 - b. a first and second elongated side strips perpendicular to and integral with said end strips;
 - c. a plurality of contact members integral with the side strips and parallel to the end strips, and including
 - i. a first contact member with an inner end forming a first fixed contact,

- ii. a second contact member being positioned adjacent to the first contact member and having a laterally projecting tab forming a second fixed contact, said tab being spaced above the plane of the first fixed contact, and
 - iii. a movable contact member positioned opposite said first and second contact members and having a movable contact arm extending to and capable of contacting said first and second fixed contacts.
4. A frame stamped and formed from a planar sheet of conductive material for use in an electromagnet relay assembly comprising:
- a. two parallel, spaced apart end strips formed in a U-shape,
 - b. a first and second side strips perpendicular to and integral with said end strips and joining said end strips at the ends thereof; and
 - c. five contact members integrally attached to said side strips, each member having intermediate portions with posts at one end, said intermediate portions and post being in the same plane as said side strips, said contact members further having inner ends bent into substantially the same plane as the bight of said U-shaped end strips, said inner ends being formed to include,
 - i. a first fixed contact,
 - ii. a second fixed contact, said second fixed contact being positioned adjacent said first fixed contact and including a laterally projecting tab extending across and spaced above said first fixed contact,
 - iii. a movable contact arm formed from a contact member positioned on a side strip opposite said first fixed contact, said movable contact arm extending inbetween said first and second fixed contacts, and
 - iv. two coil contact lead legs and two armature assembly biasing legs, one of each of said lead and biasing legs being formed from a split free end of an inner end positioned on either side of said movable contact arm, said lead leg being adapted to electrically engage an electromagnet in said relay assembly.

5. A contact-lead frame stamped and formed from a coplanar sheet of conductive material for use in an electromagnet relay assembly comprising:

- a. two parallel, spaced apart end strips formed in a U-shape;
 - b. a first and second elongated side strips perpendicular to and integral with said end strips;
 - c. a plurality of contact members integral with the side strips and parallel to the end strips, and including
 - i. a first contact member with an inner end forming a first fixed contact,
 - ii. a second contact member being positioned adjacent to the first contact member and having a laterally projecting tab forming a second fixed contact, said tab being spaced above the plane of the first fixed contact, and
 - iii. a movable contact member positioned opposite said first and second contact members and having an inner end formed into a U-shaped, double arm contact with a first arm being in overlying relation to the first fixed contact and a second arm being in underlying relation to the second fixed contact so that when the movable contact member is in a downward position electrical contact is made only with the first fixed contact and when the movable contact member is pushed upwardly, electrical contact is made only with the second fixed contact.
6. The contact-lead frame of claim 5 wherein said movable contact member is swaged to form a hinge.
7. The contact-lead frame of claim 6 further including biasing means for biasing an armature in the electromagnet relay assembly.
8. The contact-lead frame of claim 7 wherein said biasing means and said first and second contact members and said movable contact member forms a unit and there are a plurality of such units.
9. The contact-lead frame of claim 8 wherein said plurality of units are arranged on the frame so that adjacent units are orientated in an opposite direction.

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