Nov. 29, 1966 U. TUCHEL 3,289,146

CONTACT ARRANGEMENT

Filed April 29, 1964 2 Sheets-Sheet 1

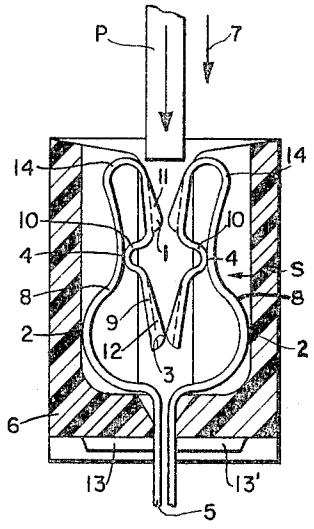

FIG. 1.

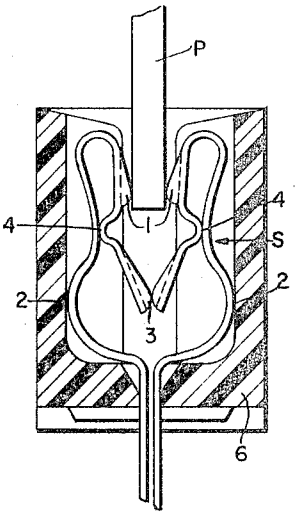

FIG. 2.

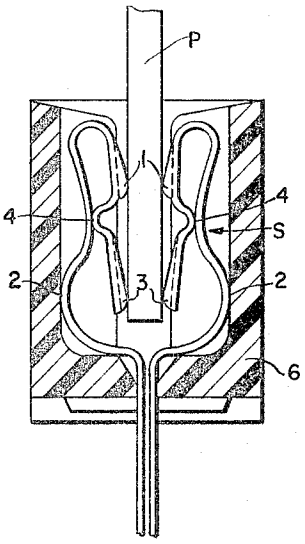

FIG. 3.

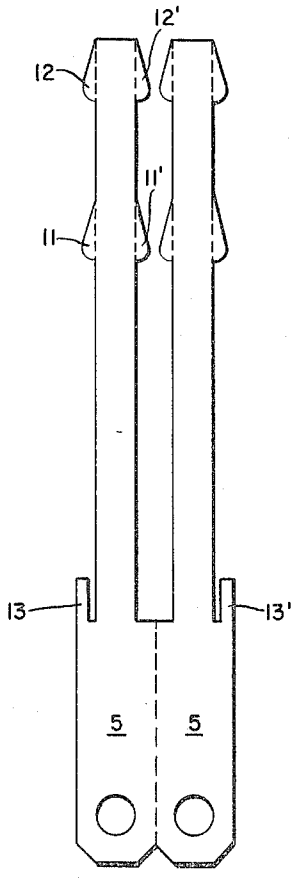

FIG. 6.

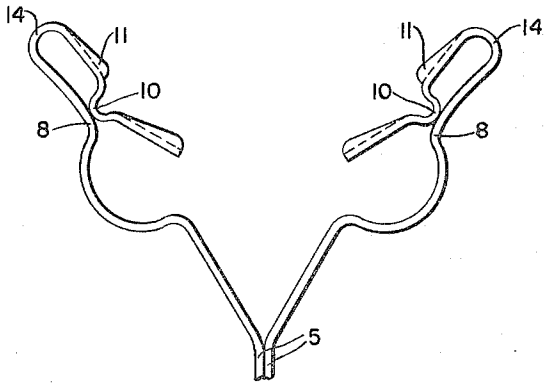

FIG. 4.

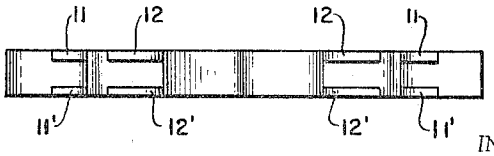

FIG. 5.

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CONTACT ARRANGEMENT

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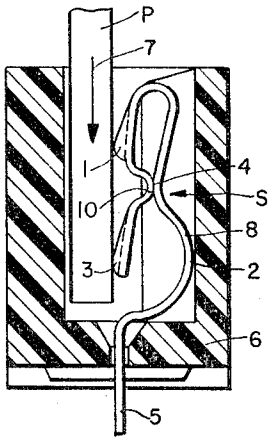

FIG. 7.

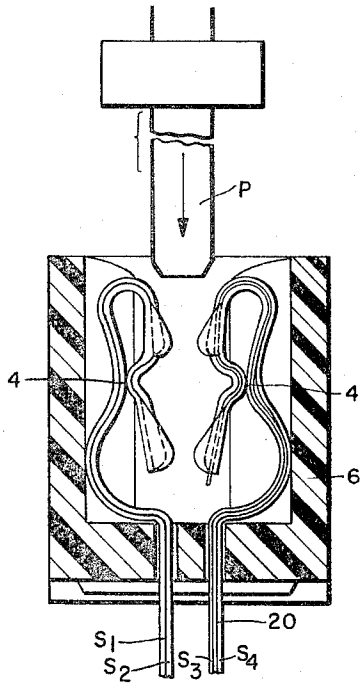

FIG. 8.

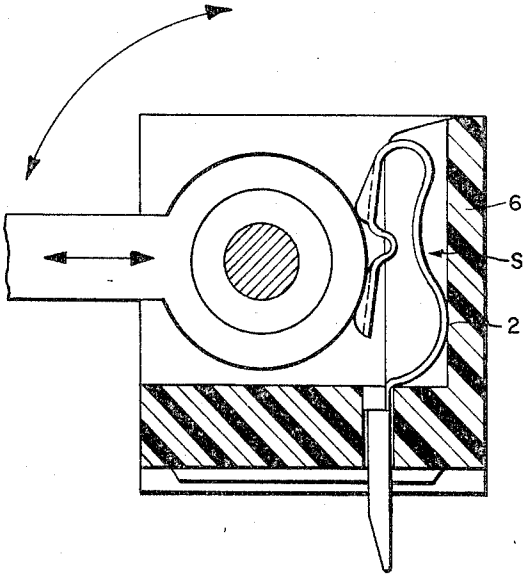

FIG. 9.

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United States Patent Office 3,289,146 Patented Nov. 29, 1966

3,289,146

CONTACT ARRANGEMENT

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Filed Apr. 29, 1964, Ser. No. 363,433
Claims priority, application Germany, Apr. 29, 1963, T 23,927
18 Claims. (Cl. 339—176)

The present invention relates to a resilient electric contact arrangement which is provided with springs which serve to receive and make contact with a male connector or plug, these springs being so bent as to form two or more pairs of contact-making points which pairs are arranged one behind the other in the direction in which the plug is inserted, and that these pairs of contact-making points, in rest position of the springs, are in contact with each other, or nearly so.

It is the primary object of the present invention so to fashion the contact spring means that the contact pressure which is exerted on the plug by the actual contact-making portion is lower in the first stage and higher in the second, i.e., the contact-making portions which first physically engage and electrically contact the plug as the same is inserted exert less pressure than do the contact-making portions which engage the plug as the same is inserted more deeply into the contact arrangement which serves, in effect, as a socket. As a result, the plug can first be introduced gently into the spring socket, whereas after the plug has reached the second stage, a greater force is exerted thereon, thereby guaranteeing a reliable contact which will remain constant at all times. Consequently, the surfaces of the plug are protected or conserved while the plug is in the process of being inserted, which is of particular importance in the case of very thin layer-type contact surfaces, e.g., printed circuits.

Various attempts have been made to solve the above problem, and previously proposed contact arrangements incorporate variously curved and bent springs. None, however, has so far proven satisfactory. According to the present invention, however, the problem is solved by providing a contact arrangement having two springs for receiving a plug, which springs are bent to form two pairs of contact-making portions which pairs are arranged one behind the other in the direction in which the plug is to be inserted. The contact-making portions of each pair, in rest position of the springs when no plug is in contact therewith, are in contact with each other, or almost so. That arm of each spring which extends from the first contact-making portion to a first support point which takes up the inserting pressure and which, already in rest position of the springs, is constituted by a wall of a housing in which the springs are located, is softer, i.e., more yieldable, preferably by being longer, than that arm of the spring which extends from the second contact-making portion to a second point which takes up the inserting pressure and which, already in rest position of the spring, is constituted by a portion of the first-mentioned arm of the spring which extends between the second-mentioned arm and the wall of the housing. The second arm has exerted on it, by the mentioned portion of the first arm, a progressively increasing supporting pressure during the transition of the spring from rest position to stressed position in which the springs receive the plug.

According to one embodiment of the present invention, each spring has an end attached to the housing, and each first arm which engages the inner surface of the housing at the first support point extends from the attached end in a direction opposite to that in which the plug is to be inserted. The spring includes a section which is a continuation of the first arm and which is bent back to extend in the direction in which the plug is to be inserted. The

section includes the second arm as well as the two contact-making portions of the respective spring and has intermediate these last-mentioned two contact-making portions a bend which is looped convexly toward the first arm. The bend is in contact with the first arm, with the point of engagement therebetween constituting the second support point.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a sectional view showing a contact arrangement according to the present invention in its rest position, i.e., the position which the parts occupy when no plug has as yet been inserted.

FIGURE 2 is a sectional view showing the position of the parts after the plug has been partly inserted, namely, when the plug has been inserted into what is hereinafter termed the first stage.

FIGURE 3 is a sectional view showing the position of the parts after the plug has been fully inserted, namely, when the plug has been inserted to occupy what is hereinafter termed the second stage.

FIGURE 4 is a side view showing the double spring by itself, i.e., outside of the housing and in its wholly unstressed condition.

FIGURE 5 is a plan view of the double spring shown in FIGURE 4.

FIGURE 6 is a development of the double spring shown inside the housing in FIGURES 1 through 3 and by itself in FIGURES 4 and 5, i.e., FIGURE 6 shows the double spring in flat form.

FIGURES 7, 8 and 9 show further embodiments of the present invention.

Referring now to the drawings and first to FIGURE 1 thereof in particular, the same shows a symmetrical spring, indicated generally at S, arranged within a generally block-shaped housing **6**. The region at which contact is first established when a plug, such as is indicated at P, is inserted into the contact arrangement in the direction of arrow **7**, is indicated at **1**. The configuration which the spring assumes, in the rest position depicted by FIGURE 1, is fixed, i.e., determined by the internal configuration of the housing **6**. Thus, the spring will be seen to touch the inner surface of the housing **6** at each of two points **2**, these points, too, being determined by the rest position of the spring S and the internal configuration of the housing **6**. The points **2** are those points of the housing **6** which take up the pressure when the plug is first inserted and the two contact-making portions **1** press against the plug P. The second region at which the spring S makes contact with the plug is indicated at **3**, and the bearing or supporting points pertaining to this region and taking up the pressure when the plug is inserted further, i.e., advanced into its second stage, are indicated at **4**.

The symmetrical spring S, being, in effect, a double spring, is so configured that, when it occupies its rest position in the housing **6**, whose internal configuration is likewise configured and dimensioned to be generally rectangular, the points **2** lie firmly against the inner surface of the concavity provided at the interior of the housing and the end portions **5** of the two spring halves are firmly anchored at the bottom of the housing, i.e., the end of the housing which is opposite to the end of the housing through which the plug is inserted. This already assures that the spring S is reliably centered within the housing **6**. Also assured is that a very long stretch or length of spring is available for pressing the spring against the plug while the latter is in its first stage, namely, a portion extending from the initial point of contact **1** to the point **2**. Consequently, when the plug P is inserted in the direction of the arrow **7**, the spring S will yield readily or "softly" as

the plug first makes contact with the spring. This is shown in FIGURE 2.

The arrangement of the spring S in the housing 6 also assures that the two contact points 3 at which the plug, as the same is advanced from its first to its second stage, next engages the spring, will prior to such second engagement, contact each other under an initial stress. This initial stress or bias is obtained by a looping bend 10 with which the free end section 9 of each half of the spring S is provided. Each section 9 is bent back at 14 and extends in the direction in which the plug is inserted. These bends 10 bear, under stress, against a portion of arm 8 of the corresponding spring half which lies against the inner surface of the housing and engages the same at point 2. Each arm 8 is, at that portion of its length at which it is engaged by the looping bend 10, curved convexly toward the free end section 9. Each section 9 will be seen to include, within its own length, the two contact-making portions 1 and 3 and, consequently, the arm extending from the second contact-making portion 3 to the second support point 4.

When the plug P is next pushed in further to its second stage, shown in FIGURE 3, the two free end sections 9 are spread apart, so that the initial stress of those arms of the end portions which extend from the contact-making point 3 to the bend 10 is progressviely increased. As a result, the plug P is ultimately clamped very tightly by the spring S, at the points 3. Furthermore, the short length or stretch of each spring half between points 3 and 4, as well as the reinforcement flanges 12 with which each spring half is provided in the region of point 3, brings about an increased stiffening of the free end of the spring which, in the same manner as the progressively increasing stress, leads to a firm clamping of the plug by the spring S at the points 3. As shown in FIGURES 1 to 3, the second pair of contact-making portions 3 is at least approximately at the same level, as seen in the direction in which the plug is inserted, as the first support points 2 at which the springs engage the inner surface of the housing 6.

The spring halves are also provided with upstanding flanges 11, 11' located in the region of the points 1. These reinforcements, however, do not decrease the resiliency or yieldability of the spring when the plug P is first introduced because the long stretch of spring, extending from bend 14 at the top of each spring half (as viewed in FIGURES 1 to 3) to the point 2, is available to take up the pressure exerted by the plug P being introduced.

Thus, it is a salient feature of the present invention that that arm of the spring S which extends between the first contact-making portion 1 and the first support point 2 is "softer" i.e., yields more readily, than that arm of the spring S which extends between the second contact-making portion 3 and the second support point 4. This greater softness is most readily obtained by making the first-mentioned arm longer than the second-mentioned arm.

The spring S is additionally secured to the housing 6 by means of flanges 13 and 13'.

As is best seen from FIGURES 4 through 6, the entire double spring, including the locking flanges 13 and 13' and the flanges 11, 11', and 12, 12', consists of a single leaf spring which has been stamped or punched to have the requisite configuration. The spring surfaces extend, preferably throughout the entire piece, at right angle to the direction of the elastic pressure forces. The projecting flanges 11, 11' and 12, 12', are provided at the two ends of the leaf spring strips. As a result, there are a plurality of points of actual contact between the plug and the spring which, whenever the plug is inserted or withdrawn, clean themselves and which maintain reliable contact because, should the plug tilt or cant, the spring will twist to adjust itself and establish firm contact with the twisted plug. This is of special significance, if as stated above, the plug is constituted by a flat blade.

It will be understood that the above description of the present invention is susceptible to various modifications,

changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims. For example, the spring can be configured to provide more than two contact-making regions. Furthermore, the spring S need not be double spring, in that but one-half of the full spring shown in the drawings can be used to establish reliable contact with a plug, as shown in FIGURE 7. On the other hand, the spring can be provided with more than two opposite symmetrical spring halves, for example, there can be three or four crossed, preferably non-symmetrical angularly displaced spring halves. One such arrangement is shown in FIGURE 8 in which there are two sets of opposite spring pairs S_1, S_2, and S_3, S_4, each of which makes contact with the plug P, so that there will be a total of eight contact-making portions. In the illustrated embodiment, springs S_1 and S_2 are electrically connected to each other so as to form, in effect, a double-layered spring, while the springs S_3 and S_4 have an insulating layer 20 between them so that these two springs coact to form a switch when the plug is inserted. In the embodiment of FIGURE 9, the carrier for the contact cooperating with the spring is not rectilinear but radial, thereby to absorb and to bring about rotary movement of the two coacting contacts. In FIGURE 9, the straight double arrow shows that the radial carrier body can be moved with respect to the spring. Actually, FIGURE 9 does not illustrate the rest position of the spring, which will be attained when the carrier body is moved rightwardly even further until the bend between the two contact-making portions of the spring engages the arm of the spring which itself touches the interior of the housing 6, thereby to establish a second support point comparable to point 4 described above.

It will be appreciated that a spring incorporated in a contact arrangement according to the present invention not only provides very reliable contact but also is susceptible to very economic mass-production techniques. As is best seen from FIGURE 6, the double spring can be made from a symmetrical stamped blank, which need simply be folded about its axis of symmetry—shown in dashed lines—and then be bent into its final configuration. When the spring is then inserted into the housing, which, in practice, may be made of plastic, it will automatically be given its pre-stressed condition. The assembly of the contact arrangement, i.e., the insertion of the spring into the housing, can easily be accomplished either by machine or by unskilled labor.

What is claimed is:

1. An electric contact arrangement for receiving a plug, said contact arrangement comprising a housing and two springs arranged in said housing, said springs being bent to form first and second pairs of contact-making portions which pairs are arranged one behind the other in the direction in which the plug is to be inserted, the contact-making portions of each pair being, in rest position of said springs when no plug is in contact therewith, at least nearly in contact with each other, each spring having a first arm which extends from the first contact-making portion of the respective spring to a first support point at which the respective spring, already in its rest position, engages an interior surface of said housing at which point said housing takes up the inserting pressure as the plug is inserted, each spring further having a second arm which extends from said second contact-making portion of the respective spring to a second support point at which the respective spring, already in its rest position, engages a portion of the first arm of the respective spring which arm portion extends between said second arm and said interior surface of said housing, said first arm being longer than said second arm, and said portion of said first arm exerting on said second arm a progressively increasing pressure during the transition of each spring from rest position to a stressed position in which said springs contact the plug.

2. A contact arrangement as defined in claim 1 wherein said second pair of contact-making portions is at least approximately at the same level, as seen in the direction in which the plug is inserted, as said first support points at which said springs engage said housing.

3. A contact arrangement as defined in claim 1 wherein said springs are identical and are configured symmetrically relative to each other.

4. A contact arrangement as defined in claim 1 wherein said springs are constituted by leaf springs whose surfaces are at right angles to the direction of the elastic pressure forces.

5. A contact arrangement as defined in claim 4 wherein said leaf spring surfaces are at right angles to the direction of the elastic pressure forces throughout the entire lengths of the leaf springs.

6. A contact arrangement as defined in claim 1 wherein said two springs are made of a single punched leaf spring, said springs being symmetrical with respect to each other and being folded about an axis of symmetry of said single punched leaf spring.

7. A contact arrangement as defined in claim 1 comprising a plurality of sets of springs each set including two springs.

8. A contact arrangement as defined in claim 7 wherein the springs of each set are symmetrical with respect to each other.

9. A contact arrangement as defined in claim 1 wherein each spring has an end attached to said housing, and wherein said first arm which engages said inner surface of said housing at said first support point extends from said attached end in a direction opposite to that in which the plug is to be inserted, said spring including a section which is a continuation of said first arm and which is bent back to extend in the direction in which the plug is to be inserted, said section including said second arm as well as the two contact-making portions of the respective spring and having intermediate said last-mentioned two contact-making portions a bend which is looped convexly toward said first arm, said bend being in contact with said first arm, the point of engagement between said bend and said first arm constituting said second support point.

10. A contact arrangement as defined in claim 9 wherein said first arm is convexly looped toward said section.

11. A contact arrangement as defined in claim 9 wherein each attached end extends through said housing at that end of said housing which is opposite to the end thereof through which the plug is inserted.

12. A contact arrangement as defined in claim 9 wherein said section is provided with projections at at least one of said contact-making portions.

13. A contact arrangement as defined in claim 12 wherein said spring is constituted by a single stamped leaf spring and wherein said projections are flanged at right angles to the spring surface.

14. A contact arrangement as defined in claim 13 wherein said projections are provided at each edge of the leaf spring.

15. A contact arrangement as defined in claim 13 wherein said spring further comprises integral attaching flanges extending in opposite directions.

16. A contact arrangement as defined in claim 7 wherein one spring of one set is superimposed on one spring of another set, said two superimposed springs being electrically connected to form, together, a double-layered spring.

17. A contact arrangement as defined in claim 7 wherein one spring of one set is superimposed on one spring of another set, there being a layer of insulation between said superimposed springs.

18. An electric contact arrangement having two springs for contacting a plug, each of said springs being constituted by a single stamped leaf spring, said springs being bent to form two pairs of contact-making portions which pairs are arranged one behind the other in the direction in which the plug is to be inserted, the contact-making portions being provided with flanges projecting at right angles to the spring surface, the contact-making portions of each pair, in rest position of said springs when no plug is in contact therewith, being at least nearly in contact with each other, that arm of each spring which extends from the first contact-making portion to a first support point which takes up the inserting pressure and which, already in rest position of the springs, is constituted by a wall of a housing in which said springs are located, being softer than that arm of the spring which extends from the second contact-making portion to a second point which takes up the inserting pressure and which, already in rest position, is constituted by a portion of the first-mentioned arm of said spring which extends between the second-mentioned arm and the wall of the housing, said second arm having exerted on it, by said portion of said first arm, a progressively increasing supporting pressure during the transition of the spring from rest position to stressed position in which said springs contact the plug.

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