May 1, 1962 U. TUCHEL 3,032,739

CONTACT ASSEMBLY

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FIG. 1

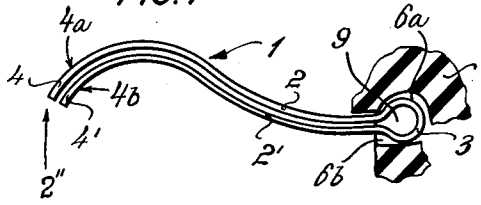


FIG. 1a

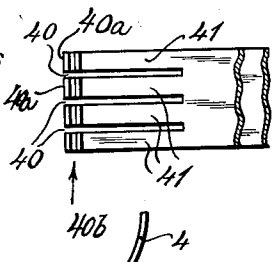


FIG. 2

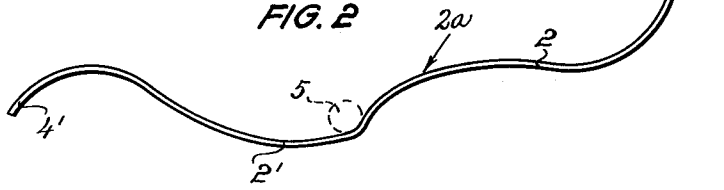


FIG. 3

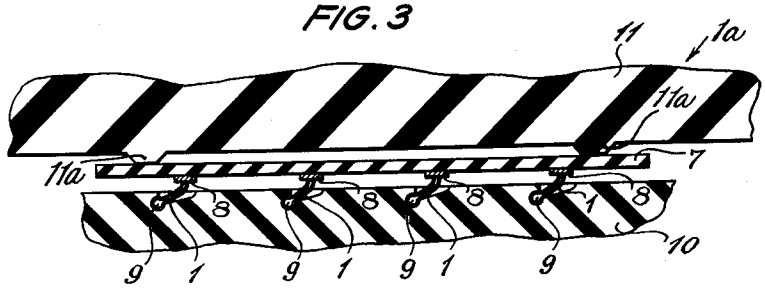


FIG. 4

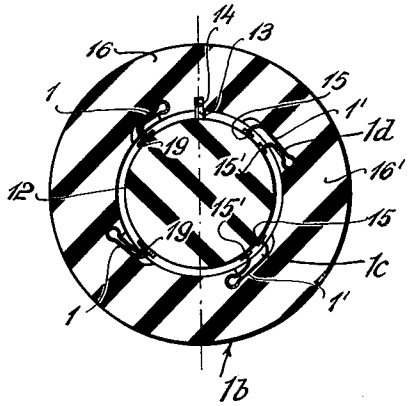
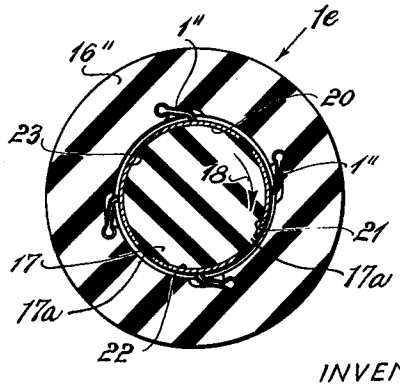


FIG. 5



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FIG. 6

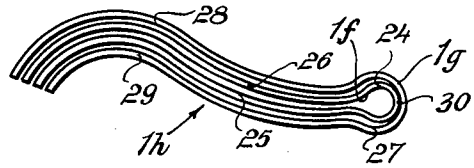


FIG. 7

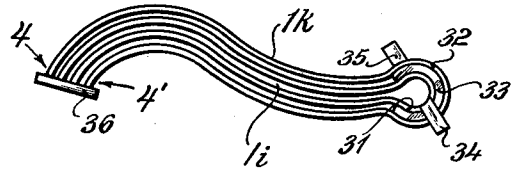


FIG. 8

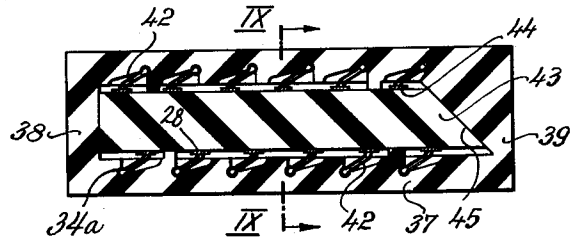
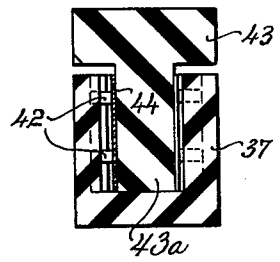


FIG. 9



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CONTACT ASSEMBLY

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Filed Oct. 8, 1957, Ser. No. 688,884
Claims priority, application Germany Jan. 23, 1957
6 Claims. (Cl. 339—176)

The present invention relates, in general, to a contact assembly of the type having a rigid back or counter contact element and a flexible contact element which cooperates with said rigid element to make an electrical circuit and, in addition to a special formation of said flexible contact element construction.

It is one of the primary objects of the present invention to provide means conducive to a very efficacious self-cleaning action in a contact assembly of the described type beyond the extent of such action heretofore obtained in the prior art.

It is another object of the present invention to provide means contributing to a uniform and constant good contact between the contact elements by reducing the contact resistance to a minimum.

It is another object of the present invention to provide means affording the structure of a flexible contact element which can be readily secured to a support and which element can be mass-produced at relatively low cost.

In this connection a more specific object of the invention is to provide means achieving the aforesaid highly desirable result, even where the back or contact element forms a portion of a printed electric circuit.

Still a further object of the present invention is to provide means offering the possibility of enlarging or reducing the area of the end contact surface of an electric contact element and to control said surface area commensurate with the area or areas of the counter contact means.

Yet a further object of the invention resides in the provision of means contriving the nesting of a plurality of resilient contact elements and the connection of the latter with each other to a unitary contact assembly, whose springiness may be easily predetermined in accordance with the respective practical requirements.

It is still another object of the invention to provide means aiming at a particular configuration of the flexible arms of the contact elements, so that the latter may be securedly held in operative position or may be readily replaced or interchanged in order to comply with or to be adjusted to the respective type of counter contacts with which said contact element or elements cooperate.

It is a further object of the present invention to provide means facilitating an efficient and highly improved structure of a flexible contact element which is adaptable for use not only with back contacts which are formed as metallic layers or insulation plates, but also with back contacts of switching devices of other types.

A still further object of the present invention is to provide a flexible contact element which has a relatively low resistance to current flow established between the contact elements.

These and other objects and advantages of the present invention will become further apparent from the following detailed description, reference being made to the accompanying drawing showing preferred embodiments of the invention.

In the drawings:

FIG. 1 is a top plan view of a flexible contact element in operative position and constructed pursuant to the present invention with parts of the insulative support being shown in section;

FIG. 1*a* is a fragmentary view taken in the direction of the arrow 2'' in FIG. 1;

FIG. 2 is an end view of a strip, illustrating an intermediate stage in the formation of the contact element of FIG. 1;

FIGS. 3, 4 and 5 are sectional detail views, each of which illustrates a different embodiment of a contact assembly utilizing the concepts of the present invention;

FIGS. 6 and 7 are top plan views similar to that of FIG. 1 and illustrate modifications of the structural parts of the flexible contact elements;

FIG. 8 is a horizontal sectional view of a contact post provided with contact assemblies pursuant to the present invention; and

FIG. 9 is a sectional view taken on line IX—IX of FIG. 8.

Referring now to FIGS. 1, 1*a*, and 2 of the drawing in detail there is shown a flexible contact element **1**, pursuant to the present invention. The element **1** is formed from a strip **2***a* of suitable sheet metal having a desired degree of resiliency. The strip **2***a* is first bent to form two undulating end resilient portions **2** and **2'**. The strip is then bent about a pin **5**, placed intermediate the ends of this strip **2***a*, into the shape as shown in FIG. 1, wherein it will be noted that the portions **2**, **2'** form parallel fingers or claws which extend from a hollow cylindrical end portion or loop **3**. The fingers retain their undulating form and the clearance or space therebetween is sufficient to allow each finger to flex independently of the other.

The end faces or marginal edges **4**, **4'** of the free ends **4***a*, **4***b*, respectively, of the fingers **2**, **2'**, respectively, constitute the contact making surfaces of the flexible or resilient contact element **1** and are adapted to engage a back or counter contact to effect an electrical engagement therebetween. Said contact making faces have a longitudinal extent which is perpendicular to the plane of the drawing, the contact making surface of the back contact being movable in said perpendicular direction, as hereinafter explained to make contact with element **1**.

The hollow end portion **3** is used to retain or fix the element **1** in position in a suitable insulated holder or support **6**. A suitable extension provided on the end portion **3** can be utilized as a terminal or connector for effecting electrical connection with the contact element. Such extensions are illustrated in FIG. 7 and are hereinafter described. As shown, the holder **6** is provided with a recess **6***a* having an elongated or oblong entrance slot **6***b* through which the fingers **2**, **2'** protrude. The slot is wider than the distance between the outer surfaces of the fingers so that the element **1** has a defined movement about the axis of its cylindrical end **3**, whereby said element can be adjusted to the position of the associated back contact.

If required, lugs, such as shown at **34** and **35** in FIG. 7, can be punched from the end **3** for fastening purposes, or in order to secure the element **1** against displacements in axial and/or circumferential directions.

Due to the resilience of the various portions of the element **1** from the shape imparted to them during the formation thereof, these lugs snap into recesses or holes provided for them in a holder or support when an elastically compressed element **1** is introduced into a suitable bearing or aperture **34***a*. In a similar manner, lugs can be provided and bent in the strip **2***a*, or the latter can be cut with corresponding lug projections, to serve as soldering or connecting lugs so as to constitute terminal connectors for effecting electrical connection to the contact element **1**.

As is well known a wiping action by one contact surface along an opposing contact end surface results in the

cleansing of the contact surfaces by removing oxidation, grime, dirt, etc. In order to increase said contact-making and clean wiping action to provide an improved self-cleaning action, the free ends 4, 4' of the flexible arms 2, 2' are subdivided by slits 40 into several flexible tongues 41 as best shown in FIG. 1*a*. The front marginal edges 40*a* of said tongues are arranged behind each other in the closing direction of the contact assembly, as indicated by the arrow 40*b*.

FIG. 3 illustrates the application of several flexible contact elements 1 in an apparatus 1*a* wherein rigid back or counter-contacts 8 are formed by metallic layers or coats formed on an insulating base 7, as in the case of a printed circuit. It will be understood that the various electrical components (not illustrated) which are to be connected to the printed circuit, are mounted in known manner on the insulating base member 7, and are connected to the circuit in a conventional fashion.

As shown, four contact elements 1 have their respective flexible ends 3 secured in associated recesses 6*a* defined in a fixed insulation member 10. A fixed guide member 11 is mounted in spaced opposition to the member 7 and is provided with guide projections 11*a*. The insulating member or plate 7 slides along said projections when it is introduced into the device 1*a* to effect electrical contact between the rigid back contact elements 8 and the associated flexible contact elements 1, each having the hollow or gap 9. It will be understood that in order to effect contact, or to make an electrical circuit, the plate member 30 is moved in a direction perpendicular to the plane of the drawing, and the end faces 4, 4' of the flexible contact arms 2, 2', respectively, wipe the counter-contact surfaces 8 during said motion to clean the latter of foreign matter and the like, that might impair an efficient transfer of current between the associated contact elements.

Referring now to FIG. 4, in detail, there is shown a contact device 1*b* having an outer hollow fixed cylinder 16 and an inner movable cylinder 12. The left-hand portion shows a contact assembly arrangement similar to FIG. 3 with the exception that the counter or back contacts 19 are provided on the cylindrical insulated body 12. The flexible contact elements 1 are secured in the same manner as in FIG. 3. In order to prevent rotary motion when the contact elements 1, 19 are brought into engagement, a nose 13 is provided on the cylindrical body 12 and is guided in a complementary groove 14 defined in the hollow cylinder 16. In effecting contact, the inner cylinder 12 is moved in a direction perpendicular to the plane of the drawing, to effect a wiping engagement of the contacts, which increases with the depth of penetration of the inner cylindrical element 12 into the outer element 16 and which increases with an increase in contact cross-section.

The right-hand portion of FIG. 4 shows an arrangement wherein the flexible contact elements 1' serve as switch bridging elements. Each counter-contact is constituted by a pair of back contact elements 15, 15' mounted in spaced side-by-side relation on the surface of inner cylinder 12 and separated by insulation material. The arms 1*c*, 1*d* of each flexible contact element 1' are spaced so that the marginal edges 4, 4', respectively, thereof are adapted to engage the associated pair of back contact elements 15, 15', so that the latter are bridged by the associated flexible element 1' to provide a switch action.

Referring now to FIG. 5 in detail, there is shown a contact device 1*e*, also provided with an outer hollow cylindrical contact holder 16'' and with an inner cylindrical contact holder 17. The flexible contact elements 1'' are mounted on the outer holder in the same manner as in FIGS. 3 and 4. The rigid counter contacts are constituted by shells 20, 21, 22 and 23 which are separated by respective portions 17*a* of the insulated holder 17. Each contact shell extends substantially over one quarter of the circumference of cylinder 17. When an electrical connection has been established, the marginal edges of the contact elements 1'' abut the surfaces of the contact shells.

In the present embodiment, the holder 17 of the rigid back contacts is movable helically so that it performs simultaneously a partial rotation in the direction of the arrow 18 and a movement perpendicular to the plane of the drawing. In this helical movement, there is at least one component of movement or motion in the direction of the marginal edges 4, 4' of the elements 1'', as in the previous embodiments, so that the above described advantages and results are obtained. In addition, the partial rotation of the counter-contact base 17 can also be utilized to obtain a mechanical inter-lock with the contact base 16'', as in the manner of a bayonet joint.

In the embodiment illustrated in FIG. 6 a first contact element 1*f* is disposed within a second contact element 1*g* which is complementary thereto so that the flexible undulating arms 28, 29 of the outer element 1*g* are parallel to and spaced from the inner flexible undulating arms 25, 26, respectively, of the inner element 1*f*. The two end parts of said elements are electrically connected at 30. Consequently, the telescoped elements 1*f*, 1*g* are telescoped to form a single structural unit 1*h*. It will be apparent that three or more such contact elements may be similarly telescoped or interlaced and connected.

The embodiment illustrated in FIG. 7 differs from that shown in FIG. 6 in that the two flexible contact elements 1*i* and 1*k* are not electrically interconnected. In the present embodiment the hollow ends 31 and 32 are separated by an insulation layer 33 interposed therebetween. A connecting lug 34 is bent from the hollow end 31 of the inner element and extends through the insulation layer and outer element, as shown. The free marginal edges 4, 4' of the elements cooperate with a back contact element 36, which can be mounted in any suitable manner on an insulation base, so as to electrically interconnect the elements 1*i* and 1*k*.

In the embodiment illustrated in FIGS. 8 and 9, there is shown a supporting element or body 37 for a contact post 43. The body 37 is substantially U-shaped in cross-section and is closed at its opposite ends, or at 38 and 39. Flexible contact elements 42 are mounted on the legs of the U-shaped member 37 in the same manner, as in FIG. 3. Between the legs of this U-shaped member there can be inserted the web 43*a* of the counter contact base 43 which is essentially a T-section post. Counter contacts 28 are mounted on the opposite faces of the web 43*a*. Said counter contacts are electrically connected to each other or they may be separately connected to individual conductors, as desired. The web 43*a* is chamfered, at one end thereof, as at 45, so that it can be inserted into member 37 in only one position. It will be apparent that means other than chamfering can be provided to ensure the correct insertion of the web into the contact post.

When the flexible contact elements are manufactured, they flex upon removal from the forming device so that they obtain a natural mechanical initial stress when compressed against such flexing thereof, this effect being aided by the spring metal material of which said elements are formed. Furthermore, if said elements are provided, preferably at their hollow ends 9, with punched out projections or lugs, such lugs can be utilized, in connection with the resilience of said elements, to effect automatically the mechanical support of said elements, on a suitable base, preferably formed of insulation material.

If the flexible contact elements are to be insulated at the hollow ends thereof, this can be achieved with an insulating clamp engaged on the outer surface of the hollow end. The hollow ends can also be provided with a detachable or fixed pin to provide for electrical connection thereto, which pin can serve as a soldering, clamping or screw joint.

It can thus be seen that there has been provided in accordance with the invention a contact assembly which consists of a rigid counter contact element and a flexible contact element operatively associated with said rigid element, said flexible element having a pair of unidirectionally curved parallel, laterally spaced arms, said arms terminating in free contact end surfaces adapted to engage said rigid element, one of said elements being movable in the direction of said end surfaces to effect said engagement of said end surfaces, said free contact end surfaces being shaped to extend parallel to said direction of movement.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. A contact assembly comprising first and second contact carrying members interengageable by relative movement in a selected direction; said first member including a contact element in the form of a strip of resilient metal bent to form a bight intermediate its ends and a pair of substantially parallel relatively elongated legs extending from said bight; said bight being nested in a recess in said first member with said legs extending from said recess transversely of said selected direction; said legs undulating in a plane perpendicular to their major surface areas and with their free ends forming a pair of contact making surfaces; said second member including a countercontact elongated in said selected direction and engageable with said contact making surfaces upon interengagement of said members; whereby there is a relative wiping action between said contact making surface and said countercontact upon engagement and disengagement of said members.

2. A contact assembly, as claimed in claim 1, wherein said contact making surfaces are substantially parallel to each other and elongated in said selected direction.

3. A contact assembly, as claimed in claim 1, including plural contact elements in said first member positioned in the path of movement of countercontacts carried by said second member.

4. A contact assembly, as claimed in claim 1, in which said first member is formed with a substantially cylindrical recess elongated in such selected direction, and with a slit extending laterally from said recess and opening through a surface of said first member; said contact element having its bight disposed in said recess and with its legs extending outwardly through said slit.

5. A contact assembly, as claimed in claim 4, wherein said slit restrains rotational movement of said contact element of the axis of said recess, whereby to insure a spring action of said contact making surfaces and said legs on said counter-contact when said members are intergaged.

6. A contact assembly, as claimed in claim 1, wherein each of said legs is formed with at least one slit extending inwardly thereof from its contact making surface longitudinally of the respective leg, to form separate fingers each having a contact making surface.

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