

This invention concerns electronic appliances intended to be worn on the wrist of a user. More precisely, the invention concerns an electrical connection arrangement between parts of a circuit located respectively in the case and the bracelet of an electronic appliance intended to be worn on the wrist, in which in each electrical path between said parts there is inserted a set of separable mating contacts which are however maintained applied to one another by an elastic latching effect, each set of contacts exhibiting at least partially a rotation symmetry defining an axis.

Such a connection arrangement has been described in patent document GB-A-1 555 848. This arrangement comprises a block provided with holes in which are placed contact springs. The bracelet, provided with conductors, includes an end which is accommodated within the case and which is in contact with a face of the block in a manner such that each spring may come into contact with a conductor in the bracelet. The opposite face of the block is in contact with an insulating part in which are found complementary conductors leading to interior circuits of the electronic arrangement. The case of the latter is in two parts assembled together, this arrangement enabling clamping the block with the springs between the end of the bracelet and the insulating part.

This arrangement exhibits several difficulties. Thus, it may not be readily disassembled since, in order to remove the bracelet, it is necessary to take the case apart. Furthermore, such disassembly being effected, one is faced with several separated parts, in particular the small contact springs which may readily be lost, for instance. Finally, the contact pressure depends on the force of the springs and the degree of clamping with which the two parts of the case are assembled.

The invention has as its purpose to overcome these difficulties.

It has thus as an objective an arrangement of the type defined hereinabove which is characterized in that the contacts are applied to one another by a latching force directed along said axis and in which they are surrounded by two complementary abutment surfaces provided one on the bracelet and the other on the case and applied to one another by virtue of the presence of said latching force in order to protect the contacts from damaging influences present at the exterior and in that one of the contacts of the set is a conductive foot anchored within the case or the bracelet and penetrating into an opening of the bracelet or, respectively, the case, the latter, or the latter and said conductive foot, exhibiting complementary angular surfaces to assure the latching.

Thanks to these characteristics, the bracelet may easily be disassembled and reassembled without there being a risk of poor contact or deterioration of the sealing quality protecting the contacts against the harmful effects present at the exterior.

It is thus possible to assure always a perfect sealing of the case and a total insulation of the electrical contacts relative to the exterior. This latter property of the connection arrangement according to the invention thus protects the contacts from all harmful influence which might cause corrosion due for instance to the proximity of the skin of the user. The longevity of the contacts is thus assured.

According to patent document FR-A-2 284 149, there is known a watch having insertable functional modules in which the modules are assembled by elements assuring elastic latching. At the same time in this case the pressure of

the electrical contact between two modules is not directed along the latching force whereby the good quality of the electrical contact may not be always guaranteed, above all following disassembly and reassembly of the watch.

There is furthermore known according to patent document EP-A-0 125 930 a connection arrangement for watches in which the bracelet includes an antenna formed by a conductive strip. A contact piece bears on this strip under the action of a locking system of the watch case which is articulated on a bracelet strand. In this arrangement there is thus found no set of contacts associated with an elastic engagement in which the latching force acts in the sense of the best contact pressure.

Patent document US-A-3 977 176 describes a watch, the battery of which is housed in a case separated from a second case bearing the timekeeper. Contact tongues assure the coupling between the two elements. There is in this arrangement no latching system and the two elements may be separated from one another only following disassembly of the second case.

The invention will be better understood following reading of the description to follow of several embodiments thereof, this description being given uniquely by way of example and made in referring to the attached drawings in which:

Figure 1 is a perspective view of an electrical connection arrangement in accordance with the invention in conformity with the preferred embodiment thereof;

Figure 2 is an axial cross-section of a connection arrangement in accordance with the invention corresponding to that

of figure 1;

Figure 2A shows an enlarged cross-section of the connection arrangement;

Figure 3 is a plan view of one of the tongues of the bracelet showing in particular the conductive tracks intended to be coupled to the connection arrangement shown on figures 1 and 2;

Figures 4 and 5 show axial cross-sections of two other embodiments of the invention;

Figure 6 is a partial perspective view of a variant of the connection arrangement in accordance with the invention.

Without intending to limit in any manner the invention as described, the example as now set forth making reference to figures 1, 2 and 2A concerns a case B associated with a bracelet BR between which there are to be established several assured electrical paths at the point of separation between these two elements, by connection arrangements in accordance with the invention, these arrangements being designated together by reference 1. Case B encloses the electrical or electromechanical circuit of a timepiece but it should be emphasized that the invention may be applied in all cases where an electronic appliance is associated with a bracelet which bears one or several components which are to be associated with a circuit located in case B.

On figure 2 it will be seen that the case contains a printed electrical circuit CI provided with an integrated circuit (not shown) and a display arrangement DA, the case being closed by a crystal G.

The connection arrangement comprises sets of contacts 2 composed of a rigid conductive element 3 and an elastic conductor 4. The first of these contacts is here a conductive foot of a generally cylindrical form having an axis X-X.

This foot exhibits an exterior surface including several portions which comprise, as seen from top to bottom on figure 2A, a support 5 separated from a support 6 by a radial shoulder 7, a tapered portion 8 followed by a cylindrical portion 9, a support 10 separated from the cylindrical portion 9 by a shoulder 11, a portion 12 exhibiting in particular two inclined surfaces 12a and 12b between which is provided a cylindrical surface 12c, a cylindrical portion 13 and finally a point 14 of generally conical form.

This relatively complex form of the external surface of the foot is intended, in the zone where such foot is fixed in the case B, to assure total sealing in order to insulate the internal cavity of such case from the exterior. As may be well understood, the case includes a cavity 15 with surface portions complementary to those of the corresponding portion of the foot a detailed description of which is superfluous. It is sufficient to note that the definitive form of cavity 15 in the case through which the foot 3 extends, is obtained in the course of setting into place such foot which preferably is effected by the application of ultrasonic vibrations. Additionally, one may complete the sealing by pouring around the top of the foot 3 a small quantity of a polymerizable material after the setting into place, such material being drawn in by capillarity around the support 5 in order to close all interstitial gaps remaining around the body after insertion into case B.

Portions 12a, 12b and 12c are intended to assure the rigidity of the coupling arrangement by elastic latching. To this effect the end of the bracelet BR is formed in a manner so as to define a cavity 16 into which the lower portion of the foot 3 may penetrate.

Before examining in greater detail this portion of the coupling arrangement, it may be useful to refer to figures 1 and 3 which show the construction of the bracelet.

In the example described here, the part of the coupling arrangement lodged in the bracelet includes four function keys designated generally by references Ta to Td capable of setting off in the circuit CI the functions "Time", "Alarm", "Chronograph" and "Countdown".

The half-bracelet shown comprises two strips 17a and 17b of a flexible plastic material, strip 17b fitting into a recess 18 provided in the end portion of strip 17a proximate case B. This recess has a thickness which is approximately equal to the half of the total thickness of strip 17a. The latter is solidly coupled with strip 17b, by gluing for instance, an adhesive being provided to this effect (at 19) over the entire periphery of strip 17b.

Such strip 17b is likewise provided with a set of conductors 20 which may be fixed thereto by silkscreening for instance. Such set of conductors is provided on the surface of strip 17b turned towards strip 17a.

Figure 3 shows that the set of conductors defines four fixed contacts, each taking the form of two combs 21a to 21d respectively associated with movable contacts formed by metallization 22 (only the metallization of key Td is clearly shown on figure 1). Each set of a fixed

and movable contact forms a switch which is closed when, through pressure of a finger, the zone corresponding to a given key is deformed and the metallization 22 brought to bear on the embedded combs corresponding thereto. To increase the flexibility of strip 17a in the zones where the keys Ta to Td are located, there is provided proximate each of these keys a cavity 23 opening towards strip 17d and on the bottom of which is the metallization 22.

On figure 3 is likewise clearly seen that the pairs of combs 21a to 21d are coupled to conductors 24a to 24e, it being well understood that conductor 24a is common to all the pairs of combs 21a to 21d. Each of conductors 24a to 24e is extended towards the end of strip 17b to end in a terminal 25.

It will thus be understood that when a zone of strip 17a corresponding to one of keys Ta to Td is pressed in, the metallization 22 couples the two combs corresponding to this key to one another which establishes a short-circuit between conductor 24a on the one hand and one of conductors 24b to 24e on the other hand, the two corresponding terminals 25 being then coupled to one another.

Strip 17a includes moreover a thickened zone 26 of convex form, in which there is provided a transversal opening 27 intended to receive an axis 28 by means of which the bracelet is articulated to case B, this latter comprising to this effect a form adapted to the hump 26 (see in particular figure 2). It is to be noted that the articulation between case B and bracelet BR is only partially shown, its form moreover being standard.

In the zone of strip 17a situated beyond hump 26, i.e. the end of such strip, are provided elements which assure the latching of the connection arrangement and in order to examine these elements, reference will again be

had to figure 2.

Since in the embodiment shown five terminals 25 are provided to be connected to the circuit CI in case B, it is evident that five sets of contacts must be provided.

Each of these arrangements thus includes, centered on axis X-X, an annular rib 29 having a tapered exterior surface 30 to which corresponds a complementary tapered surface 31 provided in case B and which constitutes thus a portion of the wall of the cavity 15 of the latter. It will be seen hereinafter that these two surfaces have great importance for assuring protection of the contacts of each of the connection arrangements.

The annular rib 29 thus bounds the cavity 16 described hereinabove, the opening of which is formed by a collar 32. The radial section of the latter takes a V form of which the point is directed towards axis X-X. Preferably one of the branches of this V, i.e. that which is closest to the free end of foot 3, is inclined relative to the radial plane passing through the point of the V by 30° , the other branch being 60° . To these angles moreover corresponds the slope of surfaces 12a and 12b of foot 3.

From this it will be understood that, considering the fact that the portion 13 of foot 3 exhibits a diameter clearly greater than the smallest diameter of collar 32, the insertion of the foot into the cavity 16 provides initially a deformation of the rib 29 during the passage of portion 13, then an elastic latching when collar 32 penetrates into the groove bounded by the portions 12a to 12c of the foot 3. The dimensions of these parts have been chosen in a manner such that surfaces 30 and 31 are tightly applied to one another with the rib 29 being drawn

axially upwards (force F shown on figure 2A). To this may be added that the tapered surfaces 30 and 31 are narrowed in a sense corresponding to that of the latching force. On the other hand, since the contact sets are provided in a zone of the bracelet which is situated at an extremity extending beyond the articulation of the bracelet relative to its principal portion, such force is in a certain manner increased by the force which results from the couple created about the axis 27 by the natural curvature of the bracelet when the electronic appliance is worn on the wrist. There thus results therefrom that the cavity 16 in which the electrical contact is to be established is perfectly insulated from the outside.

Figures 1 and 2 show clearly that terminals 25 are in contact with a connection block 33 which constitutes an elastomeric connector composed of zones alternatively conducting and insulating and provided in a flexible material such as a silicone, the conductive zones being loaded with carbon particles. It will be understood thus that these conductive zones may establish an electrical connection between terminals 25 and the ends of feet 3, the latter deforming slightly the contact block 33 in the regions where they are applied. It is to be noted that the elasticity of block 33 contributes to a good contact pressure thanks to the deformation which this block undergoes at the time of the assembly of the connection arrangements.

It is to be noted that the abutment surfaces 30 and 31 have a tapered form coaxial to axis X-X, their taper being turned in a manner such that they are applied to one another with a force which increases as the retaining force of the foot in the cavity 16 is greater.

Hereinafter there will be described several other possible methods of practising the invention through

reference more particularly to figures 4 to 6. In these figures identical or equivalent elements of the connection arrangement corresponding to the preceding example have the same reference numbers.

On figure 4, the connection arrangement comprises conductive feet 34, the ends of which instead of presenting a concave profile, have a greater diameter than the remainder of the foot in order to assure latching in an interior annular groove 35 with which the rib 29 is provided. One may readily see that this arrangement has the same effects as those resulting from the switching arrangements previously described, the surfaces 30 and 31 being applied to one another in the same manner.

In the case of figure 5 this concerns an inverted arrangement in the sense that there is provided a foot 36 of conductive material which is anchored by a flange 37 in a cavity 38 provided in the rib 29 of the strip 17a. This foot is fixed moreover by strip 17b which as previously described is glued to strip 17a. The upper portion of the foot 36 exhibits a boss 39 of circular section having a profile almost identical to that of the end of the foot 34 in figure 4, such boss being inserted in an opening 40 provided in the case, the elastic latching being obtained by the fact that boss 39 exhibits a diameter greater than that of the opening 40. Likewise in this case, surfaces 30 and 31 provided respectively on rib 29 of the bracelet BR and on the case B are applied to one another by the force generated by the elastic latching. In the case of figure 5, the boss 39 is applied against a contact block 41 which is lodged in the case rather than being so lodged in the bracelet.

The variant shown on figure 6 is different from the preceding embodiment through the fact that the sealing surfaces 30 and 31 are not individually provided for each

connection arrangement but rather are common to all of the latter. To this effect there is provided a rib 50 which surrounds a row of holes 51 aligned along the edge of the end of strip 17a of the bracelet BR, a complementary arrangement being provided on case B. The elastic latching however is individually present for each foot.

It will be understood that the arrangements of figure 6 may be inverted, i.e. with the hollow foot on the bracelet and the rib on the case.

Finally, as concerns the bracelet and as visible on figure 1, strip 17b exhibits reinforcement zones 55 separated by transversal grooves 56 and intended to reinforce the bracelet opposite keys Ta to Td, so as to avoid the risk of unforeseen contact due to the curvature of the bracelet.



CLAIMS

1. An electrical connection arrangement between the parts (CI; Ta to Td) of a circuit located respectively in the case (B) and the bracelet (BR) of an electronic appliance intended to be worn on the wrist, in which, in each electrical path between said parts there is inserted a set of mating contacts (3,4) which are separable but kept applied to one another, each set of contacts (3,4) at least partially exhibiting a rotational symmetry defining an axis (X-X), characterized in that the contacts (3,4) are applied to one another by a latching force (F) directed along said axis (X-X) and in that they are surrounded by two complementary abutment surfaces (30, 31) one of which is provided on the bracelet (BR) and the other on the case (B) and applied to one another by virtue of the presence of said latching force (F) in order to protect the contacts from damaging influences from the exterior, and in that one of the contacts from the set of contacts is a conductive foot (3, 34; 36) anchored in the case (B) or the bracelet (BR) and penetrating into an opening in the bracelet (BR) or respectively in the case (B), the latter or the latter and said conductive foot (3, 34; 36) exhibiting complementary annular surfaces to assure the latching.

2. An arrangement according to claim 1 characterized in that said complementary abutment surfaces (30, 31) are tapered and are narrowed in a sense which corresponds to that along which the latching force (F) acts.

3. An arrangement according to either of claims 1 and 2 characterized in that the set or sets of electrical contacts (3,4) are provided in a part of the bracelet (B) which, relative to the main strand thereof, is located beyond the pivot axis (27) around which such strand is articulated on the case (B) and in that said axis of sym-



metry (X-X) is perpendicular to this pivot axis.

4. An arrangement according to any of the preceding claims characterized in that one of the contacts of said set of contacts (3,4) is a conductive foot (3; 34) mounted in a sealed manner in said case (B) whilst projecting beyond the outer surface of the latter and in that such foot coacts with an annular rib (29) arranged on the bracelet into which it penetrates to be latched thanks to the complementary annular surfaces (12a to 12c, 32) provided on the foot and the rib.

5. An arrangement according to claim 4 characterized in that the other contact of the set of contacts (3,4) is an elastic block of conductive plastic material which is partially deformed by said foot (3) when the connection arrangement is assembled and which is electrically coupled to the part of the circuit located in the bracelet (Ta to Td, 20).

6. An arrangement according to any of the preceding claims characterized in that several contact sets being arranged in a row, said abutment surfaces (30, 31) are common to all of such contact sets (Fig. 6).