MINIATURE POTENTIOMETER AND PROCESS OF AUTOMATIC SEQUENTIAL PRODUCTION THEREOF

This invention relates to a miniature potentiometer of the type including:

a) an insulating vessel-shaped casing made of thermoplastic resin molded on a first subassembly comprising an electrically insulating support which supports an electro-resistive track having an incomplete annular shape with two extensions of electrically conductive material linked to a pair of connection terminals and extending outwardly from said casing and a collector plate having at least one connection terminal extending therefrom;

b) a second subassembly housed in said casing and including a wiper integral with a wiper-holder having notches to facilitate rotation of said second subassembly, said first and second subassemblies being attached to one another by a tubular shaft of electrically conductive material which thereby establishes electrical contact between said wiper and said collector plate.

The invention refers likewise to a process for automatically producing miniature potentiometers of the above cited type which proposes:

a) for forming the first subassembly, a first metallic laminar band, providing connection terminals and a collector plate and an electro-resistive track associated to said band, on which assembly the casings are molded;

b) to perform the second subassembly, a second metallic continuous band, including the wipers, on which the wiper-holders are molded;

c) to perform the mechanical connection between the two subassemblies and the electrical contact between the collector plate and the wiper, a third band including connection parts in the form of a metallic tubular shaft.

As backgrounds of the invention we can mention following patents:

GB 1.367.839 which deals with a process which comprises the steps of:

- advancing a continuous metallic laminar band hauled by a longitudinal conveying line with a step by step forward movement, in which the terminals are initially shaped using dies, and further molding a casing about portions of the terminals members at predetermined distances of the band while leaving resilient contact portions of some contact fingers and portions of the terminals protruding from the

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casings and integral with the band;

– producing rotors with conductive and resistive members thereon, and producing casing cover members;

– assembling a rotor and a cover member to respective casings and severing the potentiometers from the band by shearing the terminal members adjacent to said band.

US 2.958.839 which describes a potentiometer embodying a resistor in the form of an incomplete annular shape, with two low resistance extensions, connected through stapling to two terminals, which extend outwardly the casing, the potentiometer having a limiting stop of rotation integral with the driving shaft;

US 4.951.378 which deals with a process of production of potentiometers which proposes:

– forming a first fixed subassembly including a casing, a resistive track, and terminals, in the form of a first continuous metallic laminar band, hauled by a linear conveyer, with a step by step forward movement, in which the terminals are initially shaped using dies and they are attached to the casing through stapling (fold of the connection terminal ends);

– forming a second movable subassembly including a wiper, a wiper–holder and a collector, the mechanical connection of the said elements to one another being performed by thermo–forming, and said assembly being supported on a second step by step advancing continuous band;

– coupling both subassemblies as a to define a third continuous step by step advancing band, and

– mechanically and electrically checking each potentiometers connected to said third continuous band.

ES 462.632 represented in Fig 17 which describes a part in the form of a tubular shaft of electrically conductive material constituting a wiper and at the same time the attachment member of two subassemblies:

– a first subassembly including an annular resistor supported on an electro–insulating plate, with two extensions of electrically conductive material linked to a pair of connecting terminals, and

– a second subassembly substantially including a collector plate,

said piece which establishes electrical contact with the collector plate, being obtained

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from a metallic plate using dies, and comprising an extension being connected to a bottom of said shaft, said extension terminating in an annular portion which is folded 180 degrees against the bottom of said shaft, said crown–shaped part having cross grooves formed therein allowing to rotate said wiper by a screwdriver.

The invention has the aim to produce a potentiometer according to the general structure above described and to carry out a process which essentially provides:

a) a reduction in the production cost simplifying above operations, namely:

– using a same casing for the horizontal or vertical mounting potentiometers;

– firmly securing the resistive track to the connection terminals before said casing is molded;

b) increasing the performances of the potentiometers with:

– a best elastic and anchoring performance of the wiper attached to the wiper–holder by a molding operation, and submitted to some subsequent shaping operations;

– a greater stiffness of the moving stop of the tubular shaft as well as the use of a reinforced double wall.

The invention will be further illustrated, by way of example, with reference to the accompanying drawings in which:

– Fig. 1 is a top plan–view of the potentiometer;

– Fig. 2 is a cross sectional view of the potentiometer through Fig 1 on the sectional plane II–II;

– Fig. 3 is a cross sectional view of the potentiometer through Fig 1 on the sectional plane III–III;

– Fig. 4 is a sectional view of the potentiometer through Fig 1 on the sectional plane IV–IV;

– Fig. 5 is a top plan–view of a portion of the metallic laminar band providing the connection terminals and the collectors;

– Fig. 6a is a partial perspective at a larger scale, of the sector VIa of Fig. 5, showing lateral appendages of the connecting terminals after it sustained a first fold thereof;

– Fig. 6b is a partial view, of the area VIb which appears in Fig. 5, showing in thicker dotted line the positioning of the casing with respect to the collector plate;

– Fig. 7 is a top plan view of the electro–resistive track and its supporting plate used in this potentiometer;

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– Fig. 8 is a sectional view according to the sectional plane VII–VII of Fig. 5, of the collector and terminal band with a casing already molded on said band;

– Fig. 9 is a plan–view of a portion of the band holding the connection shafts;

– Fig. 10 is a sectional view of the connection terminal band;

– Fig. 11 is a plan–view of a portion of the terminal band;

– Fig. 12 is a sectional view of a part of the wiper band including a molded wiper–holder;

– Fig 13 is a bottom view of the wiper and wiper holder, with a half part of said wiper member omitted in the left side showing the anchorage portion;

– Fig. 14 is a cross sectional view of the wiper after the part aimed to slide over the resistive track being folded.

– Fig. 15 is a side elevation view showing the horizontal mounting of a potentiometer according to the invention;

– Fig. 16 is a side elevation view showing the vertical mounting of a potentiometer according to the invention.

– Fig 17 is a cross sectional view showing a potentiometer according to the state of the art as per ES 462.632 document.

The miniature potentiometer shown in the figures as previously cited is of the type essentially including an electrically insulating casing (10) made of thermoplastic resin molded on a first subassembly comprising an electrically insulating support (11) which supports an electro–resistive track (12) having an incomplete annular shape with two extensions (13) of electrically conductive material linked to a pair of connection terminals (14) and (15) extending outwardly from the casing and a collector plate (16) having at least one connection terminal (17) extending therefrom, and the potentiometer further comprising a second subassembly housed in said casing (10) and defined by a wiper (18) integral with a wiper–holder (19) having notches (20) to facilitate rotation of said second subassembly.

These first and second subassemblies are attached to one another by a tubular shaft (21) of electrically conductive material which establishes electrical contact between said wiper (18) and said collector plate (16).

The potentiometer according to the invention is characterized namely in that:

– the portions (14a), (15a) of the connection terminals (14), (15) inserted in the body of the casing (10), as well as the body of the collector , in the form

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of a plate (16) with a central hole (22) are coplanar;

– said collector (16) embodies two terminals in opposition (17a) and (17b) which have been foreseen to provide at least two different mounting positions using one or the other of said terminals (17a) or (17b) as terminal of the potentiometer collector, in each case (see figures 15 and 16);

– the tubular shaft (21) connecting the two mentioned subassemblies embodies close to its section immediately in contact with the collector plate, a folded portion providing a double wall (23) which embodies grooves (24) for driving in rotation said shaft (21), and said portion (23) folded form at least a radial protrusion (25), which constitutes a moving stop limiting the rotation of said shaft (21);

– the two collector plate (16) terminals (17a), (17b) extend outwardly the casing (10) by two areas directly opposite, and one of said terminals (17b) includes a 90 degrees elbow extending parallel to the rotation shaft (21) of the potentiometer forming a fixed stop with respect of the moving stop (25) of the portion (23) of the tubular shaft (21);

– the double wall (23) of the tubular shaft (21), has a part extending outwardly the edge of the tubular section of the shaft (21) and having the shape of a laminar plate with a portion (26a) in the form of a crown with grooves (24) which form said driving configuration, and a narrow strip (26b) which connects said part (26a) to the mouthpiece (27) of the tubular body (21), the portion (26a) being arranged against said mouthpiece (27) by fold of the band (26b) and in correspondence inserted into the deepened area (28) central to said portion (26a) including the grooves (24) in the interior of said mouthpiece (27) at the bottom of the shaft (21), which is funnel–shaped;

– the wiper (18) comprises a first part defined by an annular plate (29) to which said wiper–holder (19) is securely molded and said second part (33), extending radially out from said annular plate (29), said second part having a distal edge and an arcuate trough groove (34) provided proximate said distal edge, said arcuate groove forming two resilient arms (35, 36) having central protuberances (35a, 36a) for frictionally resting on the resistive track (12), said second part (33) being folded 180 degrees against the bottom of said wiper–holder (19) thus defining a blunt edge length (38), said second part (33)

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further comprising a slightly angular medially located cross fold (33) having two planes in a very open dihedral angle α (see Fig 14) to said length (38) and at a distance thereof, which causes said second part to partially separate from said bottom and creates a gap between said cross fold (33) and said folded length (38), said fold also causing said distal edge to diverge away from the bottom, in such a way that said protuberances (35a, 36a) of said second part (33) being supported on said resistive track (12);

– the annular plate (29) of said wiper (18) has several radial, peripheral protuberances (30) adapted to keep the wiper (18) connected to a band (40) during the mounting process, said peripheral protuberances being easily shearable by applying a perpendicular stress to said band (40) thus facilitating separation at the moment said wiper (18) is incorporated into the potentiometer;

– the ends (13) of the electro–resistive track are connected to the terminals (14), (15) by two folded lateral appendages one of them (14b, 15b) of contact and the other (14c, 15c) of retention, said appendages starting from portions (14a), (15a) of said terminals, inserted in the casing body (10), in order to secure the locking of the resistive track to the terminals before the casing molding, as it is shown in Fig. 1, sectional portion, and Fig. 4.

As it can be seen in Figs 12, 13 and 14 the annular plate (29) of the wiper (18) includes a large central opening (31) and through–holes (32) which allow plastic to flow therethrough to thus firmly secure said wiper (18) to said wiper–holder (19), during a molding operation, in particular providing an annular retention rib (49).

The location of the casing (10) body with respect to the collector plate (16), before positioning the electro–resistive track is shown in Fig. 6b. The position of the appendages of the connection terminal (14), after they have been severed from the band (39) and two lateral appendages of them have sustained a first fold, is shown in Fig. 6a. In the event of terminal (15) the appendages which top out it sustain an equivalent folding. The appendage (14b) is longer to exert a sufficient pressure on the end (13) of the resistive track (12) and the appendage (14c) is shorter to secure the locking of the connection. The appendage (14b) can comprise a protuberance to best secure the electric contact as disclosed in patent US 2958839 above mentioned.

The support (11) of the resistive track (12) embodies at least an anchoring

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appendage (11a) for its clamping in the molded casing. The ends (13) of the resistive track (12) embody a conductor portion, for example a silver–plated coated one.

The bands (39) of the connection terminals (40) of the wipers and (41) of the connection shafts, are hauled and guided by means of holes mentioned with numerals (42), (43) and (44).

The mounting patterns of the horizontal potentiometer – Fig. 15 – and vertical – Fig. 16 – are obtained as follows:

– horizontal: terminals (14) and (15) are folded as shown in the figure; the terminal (17a) exits in orientation perpendicular to the collector plate (16) is kept and the terminal (17b) has been eliminated during the production, advantageously at the step of die cut shown by Fig. 5;

– vertical: terminals (14) and (15) are folded as shown in the figure, keeping the terminal (17b), terminal (17a) having been eliminated during the production.

The potentiometer according to the prior art document ES 462.632 includes a shaft (50) with a part (51) acting as a wiper and attachment member to an insulating plate (53) of an annular resistor (52) linked to a pair of connection terminals (54) and a collector (58) both supported on said plate (53). The member (50) has a folded extension (55) which ends in an annular portion (56) with cross grooves (57) folded so that the annular portion (56) overlaps concentrically the bottom of the shaft (50), the grooves (57) providing a driving engagement by a screwdriver.

The process for production of said potentiometer comprises:

a) an initial shaping of the terminals from a first metallic laminar band (39), hauled by a longitudinal conveying line with step by step forward movement, in which the terminals are shaped using dies on which band the casing will be molded and including before molding the casing, cutting two pairs of appendages (14b, 14c) (15b, 15c) in opposite areas at both sides of a section of the terminals (14, 15) which remains embedded in the casing (10) at a point proximate to a side wall thereof, one of said appendages being longer than the other, folding both appendages to a forklike shape to accommodate within it extensions of the resistive track (12), folding the longer appendage (14b) thereafter, under pressure, onto the extensions and folding the second appendage (14c) onto the first appendage (14b), thereby tightly locking the appendages;

b) a step of coupling two subassemblies: a first subassembly fixed including

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a casing (10), a resistive track (12), a collector plate (16) and terminals (17), on the continuous metallic laminar band (39) and a second one movable including a wiper (18) and a wiper–holder (19) on the second band (40), obtained using the third metallic continuous band (41), and comprising the steps of gradually cutting the third metallic band to form a shaft (21) having an extension (26a), the extension being connected to the bottom of the shaft (21) and said extension (26a) comprising a narrow strip–like portion (26b) which terminates in an annular portion (26a) with cross grooves (24); and producing a fold in approximately the middle of said strip–like portion (26b), so that said annular portion (26a) overlaps concentrically with the bottom of the shaft (21) and providing a radial extension of double wall with two contacting sections of the strip–like portion (26b), the process further comprising the steps of attaching the three bands (39, 40, 41), by superpositioning of said second and third bands (40) and (41) on opposite sides of the casing (10) and connecting the bands using the tubular shafts (21)

According to the process of the invention the wipers (18) are obtained from the second continuous band (40), using dieing out and cutting operations and the wiper–holders are formed by molding an annular plate of said wipers of the body of said wiper holder (19), and wherein an annular extension (33) of said wipers terminates in two arcuate arms (35), (36) having central protuberances (35a, 36a) to slidably rest on the resistive track (12), and further comprising the steps of:

folding the annular extension (33) concentrically over the annular plate (29), and

providing a slight medial fold (33a) to said extension (33) so that the two arcuate arms (35, 36) project outwardly from the center of the annular plate, said steps of folding being conducted while the plate (29) and annular extensions (33) remain connected to the second band (40).

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CLAIMS

1.– A miniature potentiometer including an insulating vessel–shaped casing (10) made of thermoplastic resin molded on a first subassembly comprising an electrically insulating support (11) which supports an electro–resistive track (12) having an incomplete annular shape with two extensions (13) of electrically conductive material linked to a pair of connection terminals (14) and (15) extending outwardly from said casing and a collector plate (16) having at least one connection terminal (17) extending therefrom; said potentiometer further comprising a second subassembly housed in said casing (10) and defined by a wiper (18) integral with a wiper–holder (19) having notches (20) to facilitate rotation of said second subassembly, said first and second subassemblies being attached to one another by a tubular shaft (21) of electrically conductive material which thereby establishes electrical contact between said wiper (18) and said collector plate (16),

characterized in that said wiper (18) comprises a first part defined by an annular plate (29) to which said wiper–holder (19) is integral by molding and a second part (33), extending radially apart from said annular plate (29), said second part having a distal edge and an arcuate through groove (34) located proximate to said distal edge, said through groove forming two resilient arms (35, 36) having centrally located protuberances (35a, 36a) for frictionally resting on said resistive track (12), said second part (33) being folded 180 degrees against the bottom of said wiper–holder (19) thus defining a blunt fold length (18), said part (33) further comprising a slight, medially located cross fold (33a) in opposite sense to said length (38) and at a distance thereof, which causes said second part to partially separate from said bottom and creates a gap between said cross fold and said folded length (38), said cross fold also causing said distal edge to diverge away from the bottom, said protuberances (35a, 36a) of said second part (33) being supported on said resistive track (12).

2.– A miniature potentiometer according to claim 1, characterized in that said annular plate (29) of said wiper (18) has several radial, peripheral protuberances (30) adapted to keep said wiper (18) connected to said band (40) during a mounting process, said peripheral protuberances (30) being easily shearable by applying perpendicular stress to said band (40) thus facilitating separation at the moment said wiper (18) is incorporated into the potentiometer

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3.– A miniature potentiometer, according to claim 2, characterized in that said annular plate (29) of said wiper (18) includes a large central opening (31) and through–holes (32) which allow plastic material to flow therethrough to thus firmly secure said wiper (18) to said wiper–holder (19), during a molding operation.

4.– A miniature potentiometer, according to claim 1, characterized in that said at least said connection terminal (17a, 17b) of said collector plate (16) comprises two terminals (17a, 17b) extending outwardly from said casing (10) in opposite directions, and wherein one of said terminals (17a or 17b) includes a 90–degree elbow extending parallel to said tubular shaft (21) to thereby define a fixed stop which faces a moving stop (25) radially protruding from the bottom of said shaft (21).

5.– A miniature potentiometer, according to claim 4 characterized in that said moving stop (25) comprises a double wall portion (23) obtained by folding a strip–like portion(26b) of a laminar plate connected to the bottom of said tubular shaft (21), said portion (26b) ending in a crown–shaped part (26a), against the bottom of said shaft (21), said crown–shaped part having grooves (24) formed therein.

6.– A miniature potentiometer, according to claim 1, characterized in that said extensions (13) of said electro–resistive track are connected to said pair of connection terminals (14), (15) using two folded lateral appendages (14b, 14c, 15b, 15c), each appendage being folded around both sides of said pair of connection terminals (14, 15), one end of said appendages (14b, 15b) being in contact with said resistive track (12) while the other end of each appendage (14c, 14d) being in contact superimposed on said appendage ends (14b, 15b) provides retention, to thereby firmly secure said resistive track (12) to said pair of connection terminals before said casing (10) is molded.

7.– A process for automatically producing miniature potentiometers, comprising the steps of:

– forming a first fixed subassembly including a casing, a resistive track, a collector and terminals, in the form of a first metallic laminar band, hauled by a longitudinal conveying line, with a step by step forward movement, in which said terminals are initially shaped using dies;

– configurating a second movable subassembly including a wiper and a wiper–holder,on a second step–by–step advancing continuous band;

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– coupling both subassemblies as a to define a third step by step advancing band, and

– mechanically and electrically checking potentiometers connected to said third continuous band,

characterized in that

a) said initial shaping of the terminals on said first band (39), includes before molding said casing, cutting two pairs of appendages (14b, 14c) (15b, 15c) in opposite areas at both sides of a section of said terminals (14, 15) which remains embedded in said casing (10) proximate to a side wall thereof, one of said appendages (14b) being longer than the other, bending both appendages to a forklike shape to accommodate extensions of said resistive track (12), folding the longer appendage (14b) thereafter, under pressure, onto said extensions and folding said second appendage (14c) onto said first appendage (14b), locking the appendages in place; and

b) said step of coupling said two subassemblies is obtained using a third metallic continuous band (41), and further comprises the steps of gradually dieing out and cutting said third metallic band to form a tubular shaft (21) having an extension (26a), said extension being connected to a bottom of said shaft (21), said extension (26a) comprising a narrow strip–like portion (26b) which terminates in an annular portion (26a) with cross grooves (24); and producing a fold in approximately the middle of said strip–like portion (26b), so that said annular portion (26a) overlaps concentrically with the bottom of said shaft (21) giving rise to a radial extension of double wall with two contacting sections of said strip–like portion (26b), said process further comprising the steps of attaching the three bands (39, 40, 41), by superpositioning of said second and third bands (40) and (41) on opposite sides of said casing (10) and connecting the bands using said tubular shafts (21).

8.– A process, according claim 7, characterized in that said wipers (18) are obtained from said second continuous band (40), using dieing out and cutting operations and said wiper–holder are integrally formed by molding an annular plate of said wiper on the bottom of said wiper–holder (19), and wherein an annular extension (33) terminates in two arcuate arms (35), (36) having centrally located

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protuberances (35a, 36a) for frictionally resting on said resistive track (12), and further comprising the steps of:

folding said annular extensions (33) concentrically over said annular plate (29), and

providing a slight medial fold (33a) in said annular extension (33) so that the two arcuate arms (35, 36) project outwardly from the center of said annular plate, said steps of folding being conducted while said plate (29) and annular extension (33) remain connected to said second band (40).

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