

AN ELECTROMECHANICAL CLOCK-WORK

The invention relates to an electro-mechanical clock-work.

5

German Gebrauchsmuster No. 1 961 988 discloses a contact tongue which is rivetted securely on a plinth-shaped projection of a plastics works-housing, in the form of a wheel-work plate; and the one end
10 of the tongue serves as a battery connection and the other end thereof serves to contact a printed circuit board, to form part of a clock-work driving circuit.

From United States Patent No. 3 986 334 it is
15 known, upon the construction of an electronic digital clock, for the time-keeping and display control, to cast a conventional circuit together with connection conductor tracks in plastics material, but in so doing to provide recesses for the insertion and
20 electro-mechanical connection of non-integrated components. From German Auslegeschrift No. 25 22 981 it is, in addition to this, known upon such casting to form-in or respectively cast-in also plate bearing points for the wheel-work of the clock mechanism.

25

In contrast, the problem underlying the invention is to further develop a circuit carrier assembly in which conductor tracks are fixed on an insulating carrier, more especially for use in large
30 clock-works, to the effect that the production-technology expenditure and the space requirement for the mechanical installation and electrical connection of the circuit components of an electro-mechanical clock is markedly reduced without having directly to
35 incur production-technology complications and functional risks, such as those which occur upon the

complete integration of cast-in electronic-chip connections and wheel-work mounting-plate functions. In this respect, with a view to the interests, knowledge and technical capabilities of the traditional clock specialised trade, it is to be
 5 ensured that the clock-makers can check the operation of the works, and, by simple exchange of mechanically fixed individual parts, even those in the vicinity of the electrical controls of the electro-mechanical clock-work, readily eliminate any malfunction.

10 To solve this problem the present invention generally provides a method of making an electro-mechanical clock-work assembly comprising a wheelwork plate supporting wheelwork which is drivable by an
 15 electric motor, and electrical circuitry for conducting electrical power from a power source to the motor; wherein said circuitry is provided by a circuit carrier assembly formed by:-

(a) separately forming a carrier of insulating
 20 material to provide cavities therein, and forming at least one conductor track network of electrically conductive material;

(b) securing said network or networks to the carrier by mechanical interengagement therewith
 25 so that bridging portions thereof overlies the cavities; and

(c) forcing the bridging portions into the cavities to sever the network or networks into a plurality of individual conductor tracks at
 30 least some of which integrally incorporate flexible resilient portions which project from the carrier to serve as spring contact arms for contacting the motor and the power source; and thereafter

(d) mounting said circuit carrier assembly releasably upon said wheelwork plate to cooperate functionally with said wheelwork.

The invention also provides an electro-mechanical clock-work assembly comprising a wheelwork plate supporting wheelwork which is drivable by an electric motor, and an electrical circuitry for conducting electrical power from a power source to the motor; wherein said circuitry is provided by a circuit carrier assembly comprising a circuit carrier of insulating material and individual conductor tracks secured upon the circuit carrier by mechanical interengagement therewith; wherein at least some of the individual conductor tracks have been formed from a conductor tracks have been formed from a conductor track network or networks in which these tracks are joined by bridging portions of the network or networks and are formed integrally with flexible resilient portions, the bridging portions having been severed by being forced into punching cavities formed in the carrier so that the tracks are separated by gaps at the punching cavities, wherein said flexible resilient portions provide spring contact arms for at least the motor and the power source; and wherein said carrier assembly is releasably mounted on said wheelwork plate.

In accordance with this solution therefore, the path of the integration of the chip connection with plate functions is not further followed, but nevertheless the previous requirement of a costly printed circuit board, to be separately produced, fitted out and incorporated, with a laminated on electrical circuit is avoided. Instead, at least one conductor-track network, punched out or press in one piece, is fixed on a plastics circuit carrier, which

is cheap to produce, and individual electrical circuit conductor tracks are realised by severing mechanical connections in the pre-formed network. The fixing of the conductor tracks on the plastics circuit carrier can be effected by local hot deformation using positioning pins and/or depression wheels. To exchange individual conductor tracks, e.g. for repairing a damaged assembly, only these deformed regions need to be cut open and replacement conductor tracks be inserted. The electrical components are, for example for retention on the circuit carrier, soldered onto the conductor tracks or simply inserted in these so as to be clampingly retained. Cranked, or respectively freely projecting, portions of the conductor-track parts of the networks serve as resilient contact springs and like arms for the formation, for example, of a battery holder or of a signal switch; in which respect the flexibility harmonisation can be effected by appropriate selection of the cross-sectional dimensions and the geometrical shape of the bendable springs and arms. It is particularly expedient to provide at least two conductor-track networks made from different materials, and in so doing to provide the flexurally-resiliently-stiffer material for that of the conductor-track networks which has the simpler geometrical structure, but is equipped with projecting spring arms; whilst the conductor-track network having the geometrically more complicated structure of its conductor tracks or respectively with conductor tracks that are to be separated from one another for the mutual electrical isolation (particularly if their tracks have only small spring arms or have few or substantially no self-supporting or cantilever portions and are enclosed areally in retention depressions of the circuit carrier) is punched out or otherwise formed from a sheet-metal

strip of softer, more pliant material.

Additional alternatives and further developments as well as further features and advantages of the invention will become apparent from the following description of preferred examples of an assembly in accordance with the invention which are shown in the accompanying diagrammatic drawings which are simplified but approximately true-to-scale.

FIGURE 1 shows in plan view a circuit carrier assembly in which conductor track networks have been fixed on a circuit carrier, to provide conductor tracks, and on which a signal switch and battery contact springs are fashioned;

FIGURE 2 shows, in enlarged sectional representation, a preferred embodiment of the contact point of the signal switch from FIGURE 1;

FIGURE 3 shows, in greatly enlarged representation, a components connection region in one of the conductor tracks; and

FIGURES 4a and 4b show the obtaining of conductor-track overlaps upon the punching out of two networks from a one-piece starting material.

The circuit carrier assembly shown in FIGURE 1 is designed for being arranged between the plates of the works of an alarm which is operated by means of a quartz-controlled stepping motor, in such a way that the alarm escapement wheel of the wheel-work for its height-controlling switch actuation co-operates with a movable contact 2 of a signal switch 3, as will be explained hereinafter in more detail.

The assembly comprises a plastics injection-moulded circuit carrier 1 into which are formed grooves or furrow-shaped depressions 4 for the

reception and form-locking fixing of conductor-track networks 5, 6, which are preferably secured by cold or hot swaging or deformation of individual edge regions of the depressions 4 on the circuit carrier 1 to trap the networks in the depressions.

5

The course of the conductor-path networks 5, 6 and thus of the depressions 4 on the circuit carrier 1 is selected in such a way that on the one hand the openings 7, provided therein, for the passage of shafts of the wheel- and hands-work remain free and, on the other hand, the electrical components for the works drive can be contacted directly (without further lead connections). These components may include a stator coil 8 of the motor (not shown in the drawing) fastened to one of the works plates; an integrated circuit 9 for the time-keeping control of the stator coil 8 and possibly for the audio-frequency control of a signal transmitter (not shown in the drawing); as well as power source in the form of a dry cell battery 10 having a negative pole 11 butting against the one conductor-track network 5 and a positive pole 12 butting against the other conductor-track network 6. In crossing or overlapping regions, the two conductor-track networks 5 and 6 are conducted, by appropriate crankings 13 and possibly supporting pillars 28 on the circuit carrier 1, in different planes, in order to avoid electrical short-circuits. Edge portions 14 bent at right angles to the main plane of the conductor-track networks 5 and 6 end in freely projecting spring arms 15, 16 for the contacting of the battery poles 11 and 12 and for resilient clamping retention of the battery 10. In this respect provision can be made for supporting the spring arm 15 dimensioned with

35

weaker spring force, relative to the pole 11, for example against a housing part of the clock (not shown in the drawing).

If the electrical function for the co-operation of the components, such as of the circuit 9 with the coil 8, necessitates conductor tracks which are separated from one another electrically and thus also mechanically, it is expedient, as taken into account in the drawing by the uniform hatching, nevertheless initially to punch out a coherent conductor-path network 6 from electrically conductive material and to secure as an integral part on the circuit carrier 1. The circuit carrier 1 has formed-in depressions 17 located where connection bridges or webs are fashioned between the conductor tracks 6' in order to be able to handle the individual conductor tracks initially as a coherent conductor-track network 6. After the insertion of the initially still coherent conductor-track network 6, these webs or bridges can then be easily broken, by applying a punch above these depressions 17; whereby the conductor tracks 6' are now, whilst maintaining their mechanical securing on the circuit carrier 1, separated electrically from one another.

25

Provision can even be made for punching out from the sheet-shaped initial material only a single homogeneous conductor-track network, equivalent to the combined networks 5 and 6, and position and securing this single network on the circuit carrier 1; and only then appropriately punching-out the connecting webs or bridges to separate this network into conductor-track networks such as the networks 5 and 6 associated with the different poles 11/12 and if need be separating individual electrically

35

separated conductor tracks 6' likewise by punching out webs or bridges initially provided for the mechanical inter-connection thereof.

As is evident in detail from the simplified
 5 basic representations of FIGURES 4a and 4b, in this respect even conductor-path overlaps can be obtained, as are needed for instance for the switch contacts 3, 2 and 24. The conductor regions initially lying side-by-side, which are intended later to represent
 10 the contacts 2, 24, are separated from one another by punching away of their connecting web or bridge above a punching depression 17 in the carrier 1; then, in at least one path of the network 5, a cranking 13 is introduced in the course of a contact-spring-arm
 15 (adjacent a portion or region 27 of the path which is secured to the carrier) in order to bend up the movable contact 2 above a plane of the counter-contact 24 and in so doing at the same time to displace the contact 2, in the direction of the
 20 longitudinal extent of this connection cranking 13, to over the counter-contact 24.

The components that are to be connected for the electrical control to the conductor-track networks 5
 25 and 6 can, for example, be soldered with their connections 18 resting flat on the surfaces of the conductor tracks 5 and 6', as taken into account in the drawing for the example of the circuit 9. This circuit 9 can, however, also be directly (in known
 30 manner) onto the conductor-track networks 5 and 6 and thus be secured mechanically on the carrier 1. On the other hand, more especially the components (for example the coil 8 or a signal-emission buzzer not shown in the drawing) for the electrical as well as
 35 mechanical connection to the conductor-track networks 5 and 6, and thus to the circuit carrier 1, can be

equipped with plug-in pins 19 for engagement into connection holes 20 (see FIGURE 3), which are provided in track to carrier connection regions of the conductor-track networks 5 and 6, for example above free recesses 34 provided in the circuit carrier 1 to save material or beyond the edge of the carrier 1. The connection holes 20 have a periphery 21 which extends projecting in a toothed or sharp edged manner and the tips 22 or edges of which describe points on or lie on a free inner circle 23 the diameter of which is somewhat smaller than the diameter of the plug-in pins 19. Upon the pressing-in of the plug-in pins 19, the tips 22 are moved elastically somewhat in the insertion direction to make barb-like abutment against the outer surface of the plug-in pins 19; in order, in the fashion of a quicklock fastening, to make good electrical contact therewith and to prevent the plug-in pins 19 from sliding out again, thereby mechanically securing the components equipped with these plug-in pins 19 (by way of the track to carrier connection regions of the conductor-path networks 5 and 6) on the circuit carrier 1.

Preferably the tips 22 are at the narrow part of a conical depression 35 in the conductor-path networks, which depression diverges in a direction away from the carrier and serves as a pin insertion aid to facilitate alignment and pressing-in of the component pin 19.

30

The signal switch 3 supplies the supply voltage from the battery 10, at a signalling instant, to that part of the circuit 9 which serves, for example, for the audio-frequency control of a signal transmitter in the form of an electro-acoustic transducer. The signal switch 3 has a counter-contact 24, secured on

the circuit carrier 1 and fashioned on the conductor-track network 6 under the movable contact 2. Serving as movable contact 2 (see FIGURE 2) is a projection 25, bent to extend transversely to the main plane of the conductor-path network 5, on a spring arm 26 of the track 5 which is, in its track to carrier connection region 27, towards the remainder of the conductor-track network 5, secured on a supporting pillar 28, in order not to stress, warp or flex the adjacent remainder of the conductor-track network 5, whereby to prevent the risk of a tearing out of the remainder from the displaced edging of the carrier which retains the remainder in the circuit-carrier depression 4, in other words to restrict the resilient bending region substantially to the spring arm and cranking 13. This spring arm 26 is equipped with a biasing in the direction of the fixed counter-contact 24, so that the signal switch 3 is normally closed by way of the contacts 2-24 to trigger the signalling when an alarm escapement wheel (not shown in the drawing), on which the spring arm 26 is supported, can be moved axially - namely related to the drawing out of the plane of representation downwards - until the movable contact 2 rests on the counter-contact 24. In order, irrespective of the wheel-work position (in other words of the possibility of an axial shifting of the alarm escapement wheel) to be able to prevent this contacting in the "alarm-off" switching position of an alarm clock, without having to provide additional switching tracks for a circuit connecting the circuit 9 and the signal transmitter in an additional switching section, provision can be made for a shut-off slider to be engaged under the spring arm, in order to raise the movable contact 2 from the counter-contact 24 again or respectively to keep it raised irrespective of the axial position of the

alarm escapement wheel. For this under-engagement by a shut-off slider preferably, as taken into account in FIGURE 1, fashioned on the spring arm 26 is a protruding finger 29 which projects about as far as the edge of the circuit carrier 1 for engagement by the slider. The slider may be of ramp form so as to be movable under the finger to raise or lower the finger 29.

In the interests of a large specific contact pressure for the reliable contacting of the signal switch 3, the free front end of the movable contact 2 can be triangularly edges, so that it bears on the counter-contact 24 by means of an apical tip or edge. It can be more expedient, as taken into account in FIGURE 2, to provide, as the contacts, two gold or gold-plated wire pieces 30, mutually transverse, which are arranged in an electrically conductive manner, for example welded, on the counter-contact track 24 and on the movable contact arm, for example, under a frontal cranking 31 of the projecting part 25 of the arm 26.

If, as taken into account in the case of the exemplified embodiment shown in the drawing, two conductor track networks 5 and 6 or one network 6 and a separate track 5 are separately punched and separately secured to the carrier, it is advantageous, for the geometrically complicated conductor-path network 6 (from which also by severing of initially provided connection webs or bridges electrically mutually separated conductor tracks 6' are to be detached) to provide a relatively soft material; whilst the geometrically less complicated conductor-track or network 5, on which also the battery-pole spring arm 15 that is to be designed for greater spring arm length, is punched out from

mechanically more highly stressable initial material having better or stiffer spring-resilience-mechanical properties. Instead, or in addition, a coordination of the spring properties can be effected by way of the cross-sectional dimensioning in the resilient bending or flexing portions or regions, in other words on the one hand by way of the material thickness of the conductor-track network 6 as a whole and then also by way of the respective track width in the spring region. If, on the other hand, a maximum spring force is functionally prescribed for the actuation of the switch 3, in other words for the raising of the contact spring arm 26 out of the clock wheel-work, advantageously the spring stiffness of the material of the relevant network 5 is orientated thereat, and the necessary spring stiffness possibly higher for a battery-contact spring arm 16 realised in the other network 6 by choice of material or thickness of material. Furthermore the arrangement of the individual tracks in the networks may be varied, e.g. the contact arm 16 and associated track may be formed as part of the network 5 and separated therefrom by severance of a bridge or bridges therebetween, to take advantage of the material stiffness of the network 5.

To assemble the circuit carrier assembly, thus merely the preformed, e.g. punched-out, conductor-track networks 5,6, bent at their appropriate edge regions 14 and contact projections 25, need to be inserted, for example into the depressions 4, and secured to the carrier 1, and need be separated electrically from one another were required, e.g. at or above the punching depressions 17, by severing of the connecting webs or bridges. Then the circuit 9 and possibly a driver transistor for the electro-acoustic signal transmitter or signaller are inserted

into recesses 32 and connected, for example, by way of solder connections, to the conductor-tracks or networks 5, 6 or 6'.

The thus partly or completely equipped circuit carrier assembly is placed, by means of its positioning holes 33, onto retention pins on a clock-work plate (not shown in the drawing), after which it can also exercise supporting intermediate-plate functions for the construction of the wheel-hands-work. The plug-in pins 19 of, for example, the stator coil 8 and an electro-acoustic signal transmitter, are thrust into the associated connection holes 20 in the conductor-path networks 5, 6 either when the assembly is being made or possibly thereafter during assembly of the clock mechanism. Thus, a completely fitted-out circuit carrier 1 is produced with minimum assembly expenditure from a few individual parts, which assembly, by reason of a low number of electro-mechanical contact points, has a high functional reliability.

25

30

35



CLAIMS

1. An electro-mechanical clock-work assembly comprising a wheelwork plate supporting wheelwork
5 which is drivable by an electric motor, and an electrical circuitry for conducting electrical power from a power source to the motor; wherein said circuitry is provided by a circuit carrier assembly comprising a circuit carrier of insulating material
10 and individual conductor tracks secured upon the circuit carrier by mechanical interengagement therewith; wherein at least some of the individual conductor tracks have been formed from a conductor track network or networks in which these tracks are
15 joined by bridging portions of the network or networks and are formed integrally with flexible resilient portions, the bridging portions having been severed by being forced into punching cavities formed in the carrier so that the tracks are separated by
20 gaps at the punching cavities, wherein said flexible resilient portions provide spring contact arms for at least the motor and the power source; and wherein said carrier assembly is releasably mounted on said wheelwork plate.
- 25
2. An assembly as claimed in Claim 1 wherein the conductor tracks are held in retention grooves or recesses in the circuit carrier.
- 30
3. An assembly as claimed in Claim 1 or 2, wherein fashioned on the conductor tracks are regions which project over the edge of the circuit carrier or over free recesses in the circuit carrier, and which regions are provided with connection holes for the
35 reception of component plug-in pins.



(24)

4. An assembly as claimed in Claim 3, wherein the connection holes have a toothed, serrated or sharp edged periphery, the tips or edges of which describe parts of a free inner circle the diameter of which is somewhat smaller than the diameter of the plug-in
5 pins.

5. An assembly as claimed in Claim 3 or 4, wherein the connection holes are formed at the bottom of pin insertion aids in the form of conical depressions in
10 the conductor tracks.

6. An assembly as claimed in any one of the preceding claims, wherein at least one of the conductor tracks has an edge region which projects
15 beyond the boundary of the circuit carrier and which is bent at right angles to a main plane of the circuit carrier and has a free end portion which is angled to form a battery-connection one of the spring contact arms.

20 7. An assembly as claimed in any one of the preceding claims, wherein one of the spring contact arms carries or forms a movable contact, and is connected by way of a cranked portion to a carrier
25 held portion of one of the conductor-tracks; and wherein a flexibly projecting portion of this spring contact arm is bent so that the movable contact is disposed above a counter-contact fixed on the circuit carrier.

30 8. An assembly as claimed in Claim 7, wherein a pillar formed on the carrier extends through a fixed portion of the conductor track from which the cranked portion of the spring contact arm extends, so as to
35 mechanically interengage with said fixed portion.



9. An assembly as claimed in Claims 7 or 8, wherein the movable contact comprises a piece of wire secured to the flexibly projecting portion; and wherein the counter-contact comprises a further piece of wire, orientated transversely of and below the movable
5 contact, which further piece of wire is fastened to one of the conductor tracks.

10. An assembly as claimed in Claim 7, 8 or 9, wherein the flexibly projecting portion of said one
10 spring contact arm is connected to a protruding finger of said one spring contact arm, which finger is arranged to permit mechanical locking of the movable contact in a predetermined position.

15 11. An assembly as claimed in any preceding claim wherein at least one of the tracks has a projecting portion which overlaps another track which has been formed alongside the projecting portion in the network or the same one of the networks and has been
20 joined to the projecting portion by one of the bridging portions; and wherein said projecting portion has been cranked after severance of the bridging portion to extend over in spaced apart relationship with the overlapped track.

25

12. An assembly as claimed in any one of the preceding claims in which the tracks are or have been provided by a plurality of the conductor-path networks punched out from initial materials which are
30 different with respect to their mechanical properties, such as stiffness, material thickness type of material, in accordance with the required bending spring stiffness of the spring contact arms.

35



13. An assembly as claimed in Claim 12, wherein the conductor-track network of simpler geometrical configuration is or has been pressed, stamped or punched from more highly stressable or stiffer flexurally resilient material, whilst the
- 5 geometrically more complicatedly configured conductor-track network is or has been pressed, stamped, punched from a comparatively more flexurally-soft or less stiff material.
- 10 14. An assembly as claimed in any one of Claims 1 to 11, wherein one or more of the conductor tracks is individually formed to provide one or more spring contact arms, which track or tracks is or are formed from a material which is stiffer than the material
- 15 from which the or one of the networks is or have been formed.
15. An assembly as claimed in any preceding claim wherein said circuit carrier assembly provides
- 20 support for said wheelwork.
16. An electro-mechanical clock-work assembly comprising a circuit carrier assembly substantially as hereinbefore described with general reference to
- 25 FIGURE 1 or FIGURE 1 as modified by FIGURE 2, 3 or 4a and b of the accompanying drawings.
17. A method of making an electro-mechanical clock-work assembly comprising a wheelwork plate supporting
- 30 wheelwork which is drivable by an electric motor, and electrical circuitry for conducting electrical power from a power source to the motor; wherein said circuitry is provided by a circuit carrier assembly formed by:-



- (a) separately forming a carrier of insulating material to provide cavities therein, and forming at least one conductor track network of electrically conductive material;
- 5 (b) securing said network or networks to the carrier by mechanical interengagement therewith so that bridging portions thereof overlies the cavities; and
- 10 (c) forcing the bridging portions into the cavities to sever the network or networks into a plurality of individual conductor tracks at least some of which integrally incorporate flexible resilient portions which project from the carrier to serve as spring contact arms for contacting the motor and the power source; and
- 15 thereafter
- (d) mounting said circuit carrier assembly releasably upon said wheelwork plate to cooperate functionally with said wheelwork.
- 20 18. A method as claimed in Claim 17 wherein the circuit carrier assembly is mounted to provide intermediate plate functions for the wheelwork.
- 25 19. A method as claimed in Claim 17 or 18 wherein the carrier is formed to provide grooves or recesses in which the or each network is inserted, and wherein said securing is performed by displacement of portions of the insulating material to trap the network or networks in said grooves or recesses.
- 30 20. A method as claimed in Claim 17, 18 or 19 wherein said network or at least one of said networks is formed to provide at least one socket to receive a pin or like connector, the socket having an internal
- 35 edge, tooth or point for engaging and retaining said pin or like connector.



21. A method of making a clock-work assembly substantially as hereinbefore described with reference to the accompanying drawings.

5



10

15

20

25

30

35