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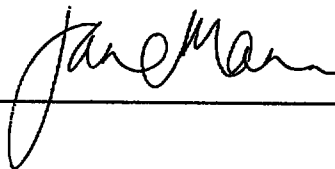
IN THE MATTER of a
Patent Application
by TIBURTIUS, Bernd

VERIFICATION OF TRANSLATION

Patent Application No.: PCT/DE97/00121

I, JANE ROBERTA MANN, B.A., of Frank B. Dehn & Co.,
179 Queen Victoria Street, London EC4V 4EL, am the
translator of the documents attached and I state that the
following is a true translation to the best of my
knowledge and belief of the specification as published of
International Patent Application No. PCT/DE97/00121 of
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Signature of translator



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Specification

The invention relates to an electrically screening housing for accommodating and electromagnetically screening assemblies which emit electromagnetic radiation or are sensitive to electromagnetic radiation, according to the preamble of claim 1.

It is known to make electrically screening housings from electrically non-conductive material, particularly plastics, by coating the prefabricated housing parts with a conductive material, e.g. by spraying them with conductive lacquer or applying aluminium by vapour deposition (cf. "Kunststoffgehäuse und EMV", elektronikindustrie 3 - 1992, p. 42). Such housings were generally provided with prefabricated seals made of conductive elastomer which were put in place during assembly. DE 38 12 943 A1 discloses an internally coated screening housing of fibre-reinforced plastics with a prefabricated seal of this kind placed between the groove and tongue.

Housings of the type described above - which have achieved particularly marked economic significance with the rapid proliferation of mobile telephones - are also known from EP 0 629 114 B1 and EP 0 654 962 A1.

The housings described therein are made up of two parts which consist of electrically conductive material or are coated with such for the purpose of electrically screening the inside of the housing (at least in parts) and in the assembled state form a Faraday cage. For electromagnetically screening the housing in the area of the join between the adjoining housing parts there is also a screening seal which consists of an electrically conductive and at the same time elastic material and adapts to surface tolerances and unevenness, so that a

very high quality screening of the inside of the housing can be ensured even with large-scale mass production. According to the specifications referred to above, this screening seal is produced directly on at least one of the housing parts, whilst an additional carrier may also be included in the construction.

By virtue of this construction the housing is easy to open, e.g. for maintenance purposes or for changing a battery in the housing, and is easily resealed afterwards whilst retaining the screening effect.

However, when producing a material for the screening seal, it is difficult for certain applications to achieve the best possible compromise between high elasticity, high conductivity and lowest possible material costs. A material which is advantageous from the physical point of view is a plastics composition filled with a high proportion of silver powder, but this is relatively expensive.

The aim of the invention is therefore to provide an electrically screening housing of the type mentioned hereinbefore which is cheap to manufacture.

The aim is achieved, starting from a housing according to the preamble of claim 1, with the characterising features of claim 1 and - in terms of the manufacturing process - with the features of claim 8.

The invention includes the technical teaching of not making the screening seal entirely from an electrically conductive and at the same time flexible material, in order to save costs, but of filling the join using an element formed on site from electrically substantially non-conductive but ductile (elastic) material and achieving the electrical screening in the area of the

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join by means of a layer of electrically conductive material adhering to this element and merging seamlessly into the screening of the substantially rigid walls of the housing.

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The sealing element primarily has the function of filling the interstice of the join so as, for example, to reliably protect the inside of the housing from moisture and dust, in the event of any mechanical play between the housing parts caused by manufacturing errors or surface unevenness, and to prevent relative movements between the housing parts. As a result of the improved mechanical properties of the sealing mass it is thus possible to provide a durable hermetic seal for the inside of the housing. At the same time the sealing element naturally carries part of the electromagnetic screening and ensures that it is sealed. It is particularly advantageous in this respect to use a high-grade elastic material and/or a flexibly shaped seal by means of which a prestress is built up between the housing parts during the assembly of the housing parts by the compression and/or bending of the sealing element, capable of preventing the undoing of a screw or clamp connection. However, the invention is not restricted to the use of carrier elements which are elastic by their material and/or shape, but can in principle also be performed with a plastically deformable sealing element.

30 In the preferred embodiment of the invention, the covering consisting of electrically conductive material is applied cohesively (and particularly in a single operation) to the surface of the sealing element and the rigid housing wall.

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In another alternative embodiment of the invention the screening is of a sandwich construction, the carrier

element consists of at least two layers of electrically non-conductive but flexible material between which is provided the layer of electrically conductive material which brings about the electromagnetic screening. The arrangement of the layer of electrically conductive material in a substantially deformation-free area between two deformable layers or strips of the elastic element advantageously counteracts cracking in the electrically conductive material, which is particularly important for constructions in which severe deformation of the screening element is supposed to occur or may occur when the housing parts are put together.

In another advantageous embodiment, it is proposed that the layer of electrically conductive material be made very thin in order to prevent cracking, since the bending stresses and hence the tendency to cracking increase as the layer thickness increases for a given amount of bending. The thickness of the layer of electrically conductive material is therefore substantially less (preferably by one to three orders of magnitude) than the width of the join.

The application of the screening layer to the sealing element or - in the case of a sandwich construction - to one layer or strip thereof may be effected by various methods. Suitable methods of achieving uniform layer thicknesses are the processes known per se of spraying with conductive lacquer or spraying with a pure metal, but particularly galvanic metallisation and the processes of gas phase deposition (known especially from the manufacture of electronic components) such as sputtering and CVD (chemical vapour deposition).

In an advantageous embodiment, within the scope of the processes mentioned above, the coating is produced by the controlled growth of crystallites in accordance with

the structurally predetermined directions of mechanical stressing of the substrate (especially the sealing element). Small lamellar surface elements may be formed on the surface - particularly in a multilayered structure - which cohere only loosely within the layer and are thus movable relative to one another to some extent during bending of the carrier element, which also counteract any cracking in the screening layer. It is particularly favourable if said crystallites are arranged in the manner of scales or roof-tiles, which can be achieved by angled spraying or sputtering of a suitable substrate with an appropriate choice of the coating parameters, i.e. apart from the orientation of the substrate, the substrate temperature, the flow rate of the gas, etc.

In another alternative embodiment of the invention the application of the electrically conductive layer to the carrier element is not carried out in the mechanically tension-free state but in a state of predetermined compression and/or bending of the sealing element. This ensures that cracking in the electrically conductive layer does not lead to a reduction in the electromagnetic screening action of the screening element. In this embodiment, the invention starts from the idea that cracking in the electrically conductive layer is difficult to prevent under all circumstances owing to the deformation of the screening element which occurs during the assembly of the housing, which means that it is important to minimise the negative effects of such cracking on the electromagnetic screening characteristics. As a result of the application of the electrically conductive layer in the deformed state of the sealing element cracks may possibly form subsequently when the tension is released, and these are substantially closed up again during the later deformation of the sealing element caused by the

assembly of the housing, as the sealing element will then assume substantially the same form as it does during the application of the conductive layer.

5 Other advantageous features are recited in the subordinate claims or described more fully hereinafter together with the description of the preferred embodiment of the invention, with reference to the drawings, wherein:

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Figure 1 shows, as a preferred embodiment of the invention, a housing made up of two housing parts for electromagnetically screening an electronic circuit, shown in exploded view,

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Figures 2a and 2b are cross sections through a part of the wall of the housing in Figure 1 in the region of the join between the housing parts according to two different embodiments,

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Figure 3 shows another embodiment of the housing in Figure 1, again viewed in cross section, and

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Figures 4a and 4b show a cross sectional view of a housing portion in another embodiment (a) with the sealing element tension-free and (b) with the housing in the assembled state.

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Figure 1 shows a housing 1 for an electronic circuit C which screens said circuit electromagnetically. On the one hand this prevents the circuit C from suffering interference from electromagnetic radiation coming in from outside, so that the circuit 1 can operate even in conditions subject to serious electromagnetic

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interference. On the other hand, the screening may prevent the electromagnetic radiation produced during operation from coming out of the housing, which might

cause interference in the environment or present the possibility of unauthorised knowledge of functions occurring in the circuit.

5 The housing consists of a tub-shaped lower part 2 having a rectangular cross section of opening and a plate-shaped cover 3 for closing off the lower part 2 and comprises a seal 4 formed directly ("dispensed") on the lower part 2 to seal the join between the lower part 2
10 and the cover 3. The cover 3 is attached to the lower part 2 by screwing, with four screws 5.1 to 5.4 passing through corresponding bores in the corners of the cover 3 and screwed into screw threads in the lower part 2.

15 Both the lower part 2 and the cover 3 are injection moulded from plastics, and all the inner surfaces - including the surface of the fitted seal 4 - are provided with a conductive coating 6.1 or 6.2 (which is cohesive for each housing part). The coatings 6.1 and
20 6.2 are in electrical contact with one another when the housing 1 is screwed together, and form an electromagnetically screening Faraday cage.

Thus, as is apparent from the cross sectional view shown
25 in Figures 2a, the screening seal consists of a resilient sealing element 4 made of a conventional elastic plastics material (such as unfilled silicon or neoprene) adhesively attached to the lower part 2, and the associated portion 6.1a of the conductive coating
30 6.1 (e.g. of sprayed on aluminium, copper or Cr-Ni or a one- or multi-component galvanic coating). As shown in Figs. 4a and 4b, a layer of adhesion promoter known *per se* but matched in its physical properties to the resilient sealing material may also be provided.

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Fig. 2b shows as the housing 1' a modification of this housing in which both housing parts 2', 3' have a

galvanic coating 6.1' or 6.2' all over them, and enclose the seal 4' previously pressed onto the lower part 2' and hardened thereon, while adhering thereto, by the flow of air or by hot vulcanisation.

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In another modification (not shown) the seal is extruded, together with one of the housing parts, from two different polymers, the monomers used being matched particularly in terms of the extrusion parameters and their thixotropic qualities as well as the temperature and rate of cross-linking.

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Fig. 3 shows as another embodiment a housing 1" which externally resembles the housing in Fig. 1, and which also has a lower part 2" consisting of an extrusion moulded plastics material, but the cover 3" of which is made from solid aluminium sheet. Therefore, there is only a metal coating 6" on the lower part. This coating also covers a sealing strip 4.1" mounted in the region of the outer surface of the lower part. A second sealing strip 4.2" dispensed close to the inner edge of the lower part in a separate application step after the application of the metal layer completes the seal 4". The seal thus has a sandwich structure in which the conductive coating is substantially freed from the tensile forces resulting from the deformation of the seal as the housing is closed and therefore the risk of cracking in the screening layer is largely eliminated. The arrangement of the conductive section 6a" of the layer in the centre between the two strips 4.1", 4.2" of the sealing element is advantageous inasmuch as the mechanical bending stress of the coating in this case is minimal under the monaxial compressive stress which occurs as the housing is screwed together, thereby reducing the danger of cracking. Cracking is made even more unlikely by the mechanical fixing of the electrically conductive layer between the two layers of

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the sealing element.

5 This objective can be achieved - at least to a certain extent - in the simpler structures of Figs. 2a and 2b by keeping the thickness of the metal coating to a minimum compared with the dimensions of the seal. Depending on the size of the housing, the manufacturing tolerances which have to be taken into consideration and the screening action required, it may advantageously be
10 fixed at as little as a few tens of microns or even just a few microns. This also shortens the process - particularly when producing a very pure and, advantageously, highly conductive layer by a vapour or vacuum process - and reduces the costs.

15 A special layered structure with a reduced tendency to cracking is shown in Figs 4a and 4b (in the tension-free state and in the assembled and hence deformed state, respectively).

20 Here, a lower housing part 20 as well as a lip-like elastic sealing element 40 comprises an adhesion-promoting layer 61 and a metallic coating 62, the latter being produced, for example, by the oriented growth of
25 crystallites on the surface in a vacuum process. The crystal growth is controlled so that, on the surface of at least the sealing element 40, small scale-like surface elements are formed which overlap with one another to cover the surface almost completely and are
30 movable relative to one another to some extent (cf. the enlarged diagrammatic detail "A" in Fig. 4a). This prevents the electrically conductive coating 62 from tearing apart when the housing is assembled as a result of the deformation of the seal 40 caused by assembly,
35 which would lead to a deterioration in the electromagnetic screening action. Rather, the layer elements are monaxially oriented in overlapping manner

under the pressure of the metal cover 30 and the action of the tensile force resulting from the bending of the cross sectional profile when the cover is closed, and form a continuous layer (cf. detail "B" in Fig. 4b).

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The lip-like shape of the sealing element 40 which is subjected primarily to bending stress during the assembly - as shown in Fig. 4b - is specially chosen in view of the structure of the layer 62 mentioned above.

10 This layer structure does, however, develop a similarly beneficial effect on a substantially circular or semicircular sealing profile subjected primarily to compression, since once again the circumference will be enlarged as a result of the deformation, and the scale-
15 like structure expanded as a result will then ensure that the coating remains sealed even in the assembled position of the housing.

The invention is not restricted in practice to the
20 preferred embodiments described above. Rather, a number of alternatives are possible, making use of the solution described even if the embodiments are of a fundamentally different nature.

25 Thus, in technologically simple manner, a thin lip standing in a C-shaped configuration in cross section (as in Fig. 4a) on the housing part and typically formed by injection moulding of a plastics housing part may act
as both the sealing element and the gap screening means,
30 by virtue of its elasticity of shape, if it is left on the housing part and provided with a metal coating together with said housing part. The sealing lip need not necessarily be formed without a break along the edge of the housing part.



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Claims

- 1: Electrically screening housing (1) for
accommodating and electromagnetically screening
components or assemblies (C) which emit electromagnetic
radiation or are sensitive to electromagnetic radiation,
5 having at least two housing parts (2, 3) with
electrically screening walls, a screening element (4)
being adheringly provided on at least one housing part
(2) in the region of a join with another housing part
10 (3), characterised in that the sealing element (4) and
at least one portion of the housing part (2) which bears
it are made from substantially non-conductive material
and are covered, for electromagnetic screening purposes,
with a cohesive electrically conductive layer (6.1)
15 extending over the full width of the join and adhering
to the sealing element (4) and the housing part.
2. Housing according to claim 1, characterised in that
the electrically conductive layer (6) is a layer of
20 metal or a metal-filled layer which is thin by
comparison with the dimensions of the sealing element
(4).
3. Housing according to claim 1 or 2, characterised in
25 that the electrically conductive layer (6) substantially
covers a surface of the housing part (2) bearing the
sealing element.
4. Housing according to one of the preceding claims,
30 characterised in that the electrically conductive layer
is applied by spray coating, galvanising or by a vacuum
or gas phase process.
5. Housing according to one of the preceding claims,
35 characterised in that the electrically conductive layer
(6) has a combination of a plurality of preferably
overlapping lamellar coating elements which

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substantially completely cover at least the surface of the sealing element (4) on the inside or outside of the housing, these coating elements being movable relative to one another along the surface in order to prevent the
5 coating (6) from breaking off during deformation of the screening element (4) caused by the assembly process.

6. Housing according to one of the preceding claims, characterised in that the sealing element (4") is of a
10 sandwich construction in which at least two layers or strips (4.1", 4.2") of sealing material are provided between which the layer (6a") of electrically conductive material is arranged.

7. Housing according to one of the preceding claims, characterised in that all the housing parts (2, 3) consist of plastics, particularly injection moulded plastics, and have an electrically conductive coating on the inside and/or outside for electromagnetically
15 screening the interior of the housing.

8. Process for producing a housing according to one of the preceding claims, characterised by the steps of:
moulding at least two housing parts, at least one
25 of which is formed, at least in parts, of non-conductive material,

forming a strip-shaped sealing element of a predetermined cross section and a predetermined shape on an edge region of at least the housing part made of non-
30 conductive material,

applying a cohesive, conductive coating to the non-conductive housing part and the sealing element formed thereon, and

assembling the housing parts with the sealing
35 element and the conductive coating therebetween.

9. Process according to claim 8, characterised in that

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the strip-shaped sealing element is formed by spraying a paste-like composition on to the housing part and subsequently hardening it thereon on site.

- 5 10. Process according to claim 8, characterised in that the sealing element is formed, together with the housing part bearing it, especially from a single material or by one-step injection moulding of different materials.
- 10 11. Process according to one of claims 8 to 10, characterised in that the conductive coating..[sic]
- 15 12. Process according to claim 11, characterised in that the vapour deposition or sputtering is carried out with the surface of the sealing element at an angle to the source of material such that the conductive layer formed has a scale-like structure.
- 20 13. Process according to one of claims 8 to 12, characterised in that, before the application of the conductive layer, the sealing element (4) is shaped into a predetermined configuration, particularly such that the shape of the sealing element (4) in the deformed state is substantially the same as the shape which it
- 25 assumes in the assembled state of the housing.

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