(12) UK Patent Application (19) GB (11) 2 333 187 (13) A

(43) Date of A Publication 14.07.1999

(21) Application No 9820856.4

(22) Date of Filing 24.09.1998

(30) Priority Data
(31) 19742178 (32) 24.09.1997 (33) DE

(71) Applicant(s)
Siemens Aktiengesellshaft
(Incorporated in the Federal Republic of Germany)
Wittelsbacherplatz 2, D-80333 Munchen,
Federal Republic of Germany

(72) Inventor(s)
Josef Loibl
Ulf Scheuerer
Frank Franzen

(74) Agent and/or Address for Service
Haseltine Lake & Co
Imperial House, 15-19 Kingsway, LONDON,
WC2B 6UD, United Kingdom

(51) INT CL^6
H01R 11/01 , B29C 45/14 , H02G 3/08

(52) UK CL (Edition Q)
H2E EFAE
B5A AB19 A1R214G A1R314C1A A1R439H A1R439X A20T14
U1S S1990 S2020 S2181

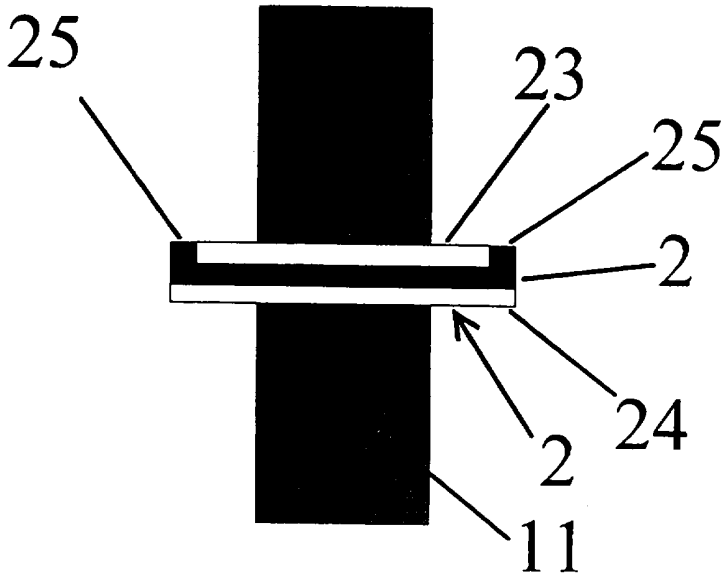
(56) Documents Cited
GB 2290420 A EP 0668147 A2 EP 0448876 A2

(58) Field of Search
UK CL (Edition Q) B5A AB19 AT14P A1R439H A1R439X A20T14 , H2E EBX EFAD EFAE EFAX
INT CL^6 B29C , H01R , H02G

(54) Abstract Title
Electrical cable leadthrough

(57) An electric cable leadthrough 2 through a plastics housing wall 11 takes place by means of strip conductors which are embedded in a strip-conductor carrier 24 and have electrical points of contact 25 on either side of the housing wall. The strip-conductor carrier is injected into the housing wall. When producing the tight electric cable leadthrough, a flexible foil which has a strip conductor is in each case clamped between the outside of the housing to be injection-moulded and the inside of the housing to be injection-moulded, between two halves of an injection-moulding tool. The carrier may be anular and leadthroughs may be moulded at different levels. The anular carrier may have apertures through which moulding compound may flow.

Fig. 2



GB 2 333 187 A

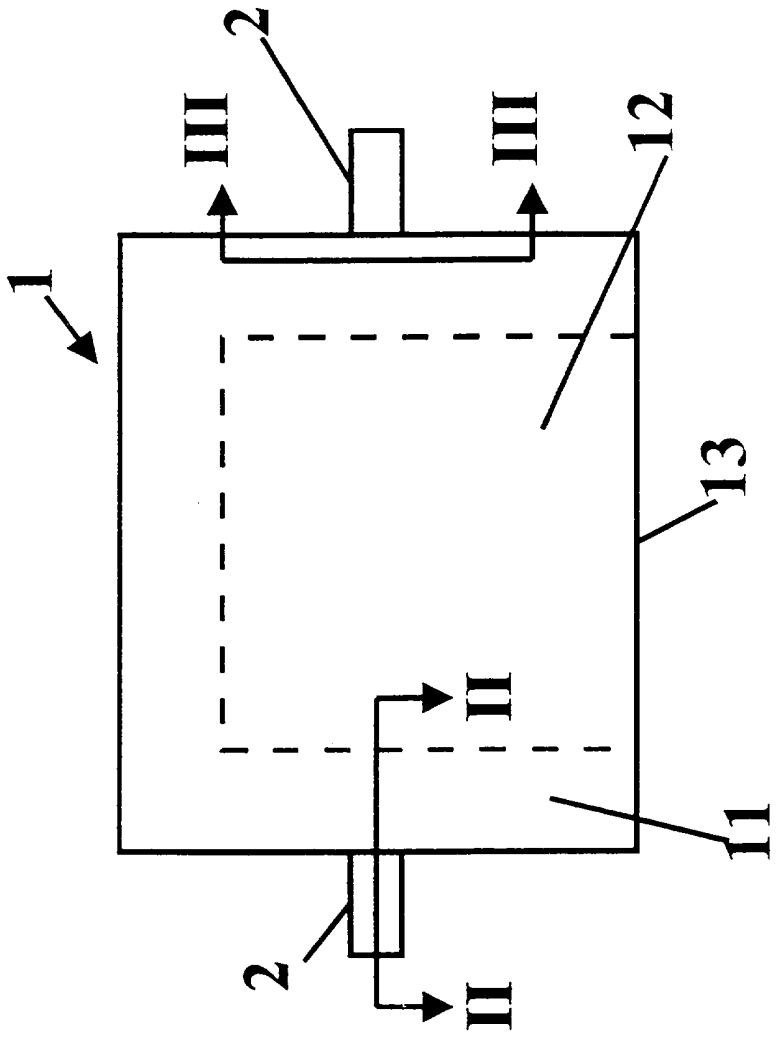


Fig. 1

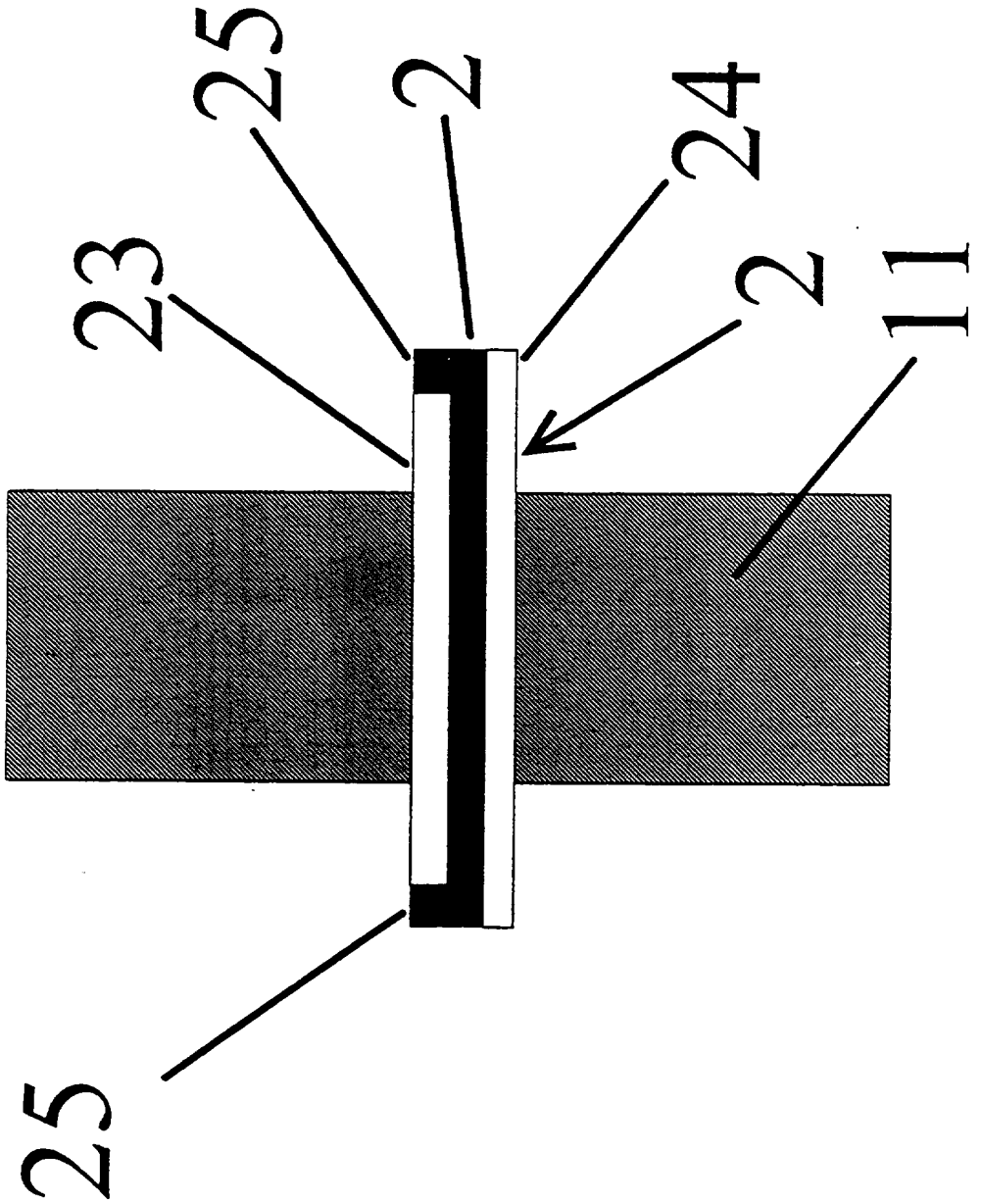


Fig. 2

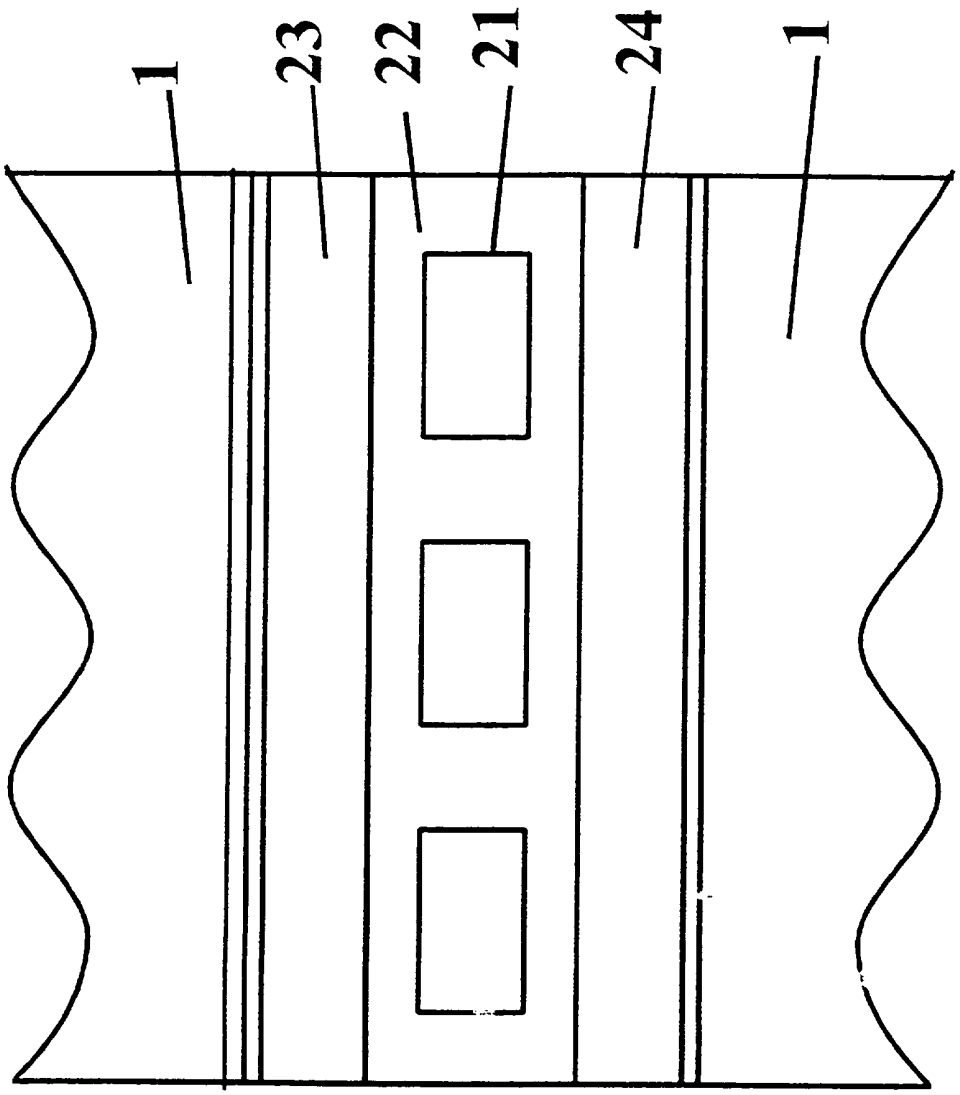


Fig. 3

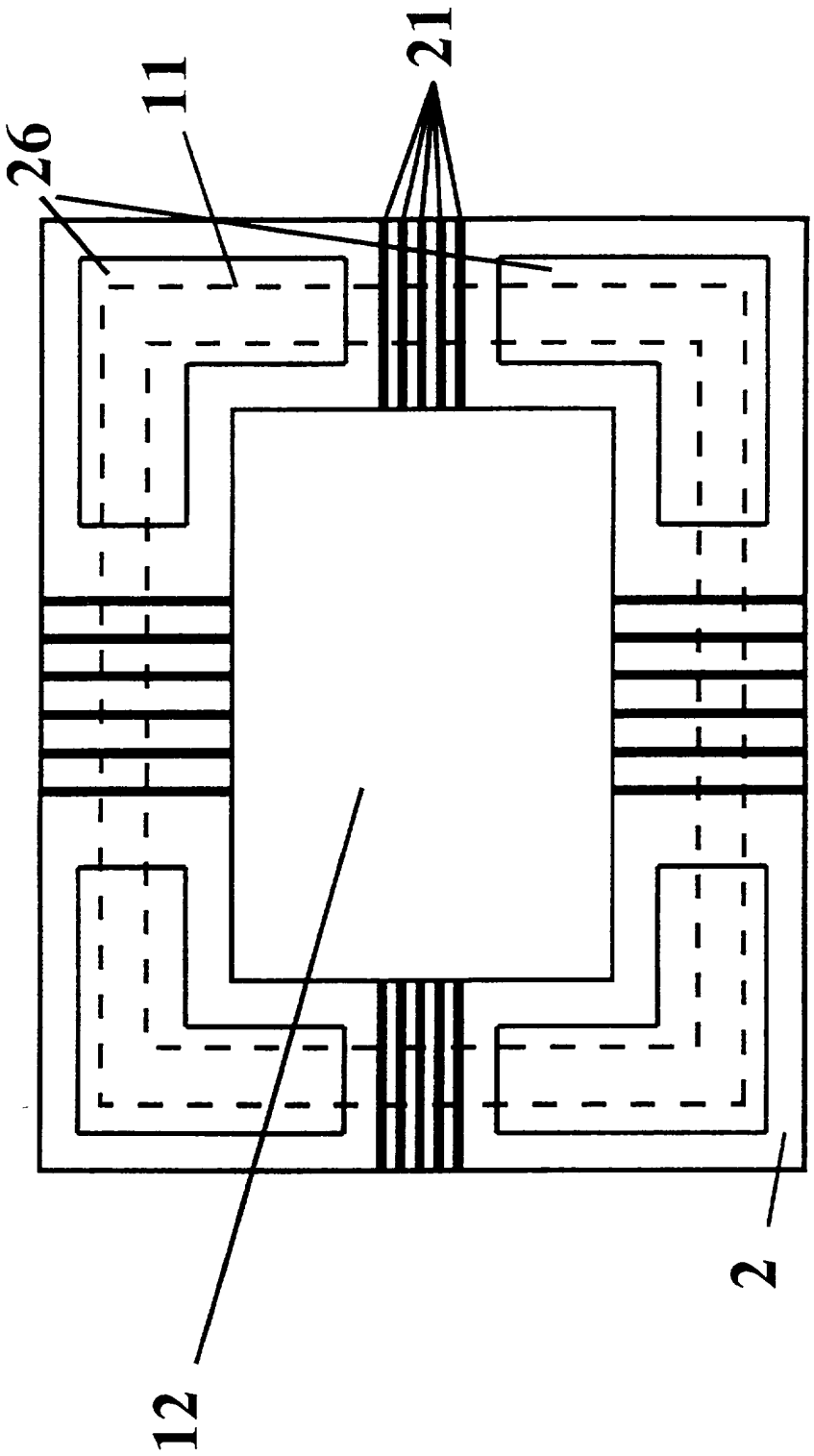


Fig. 4

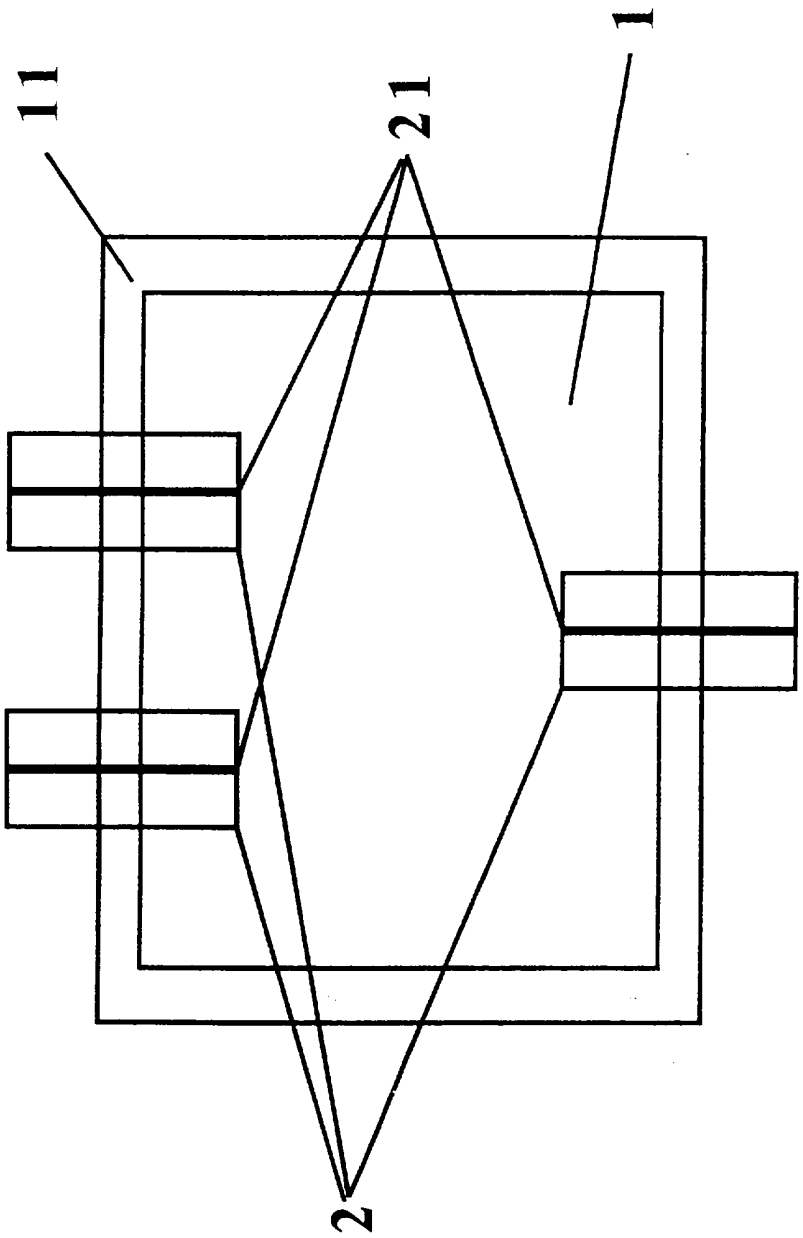


Fig. 5

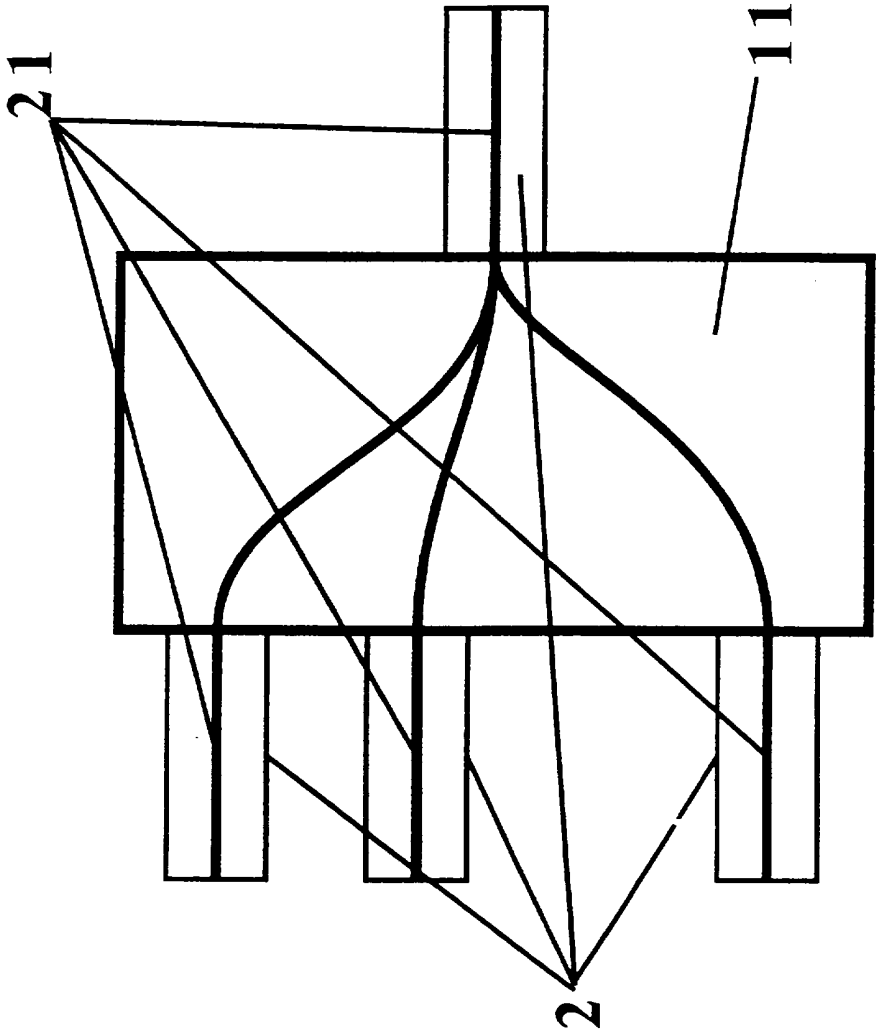


Fig. 6

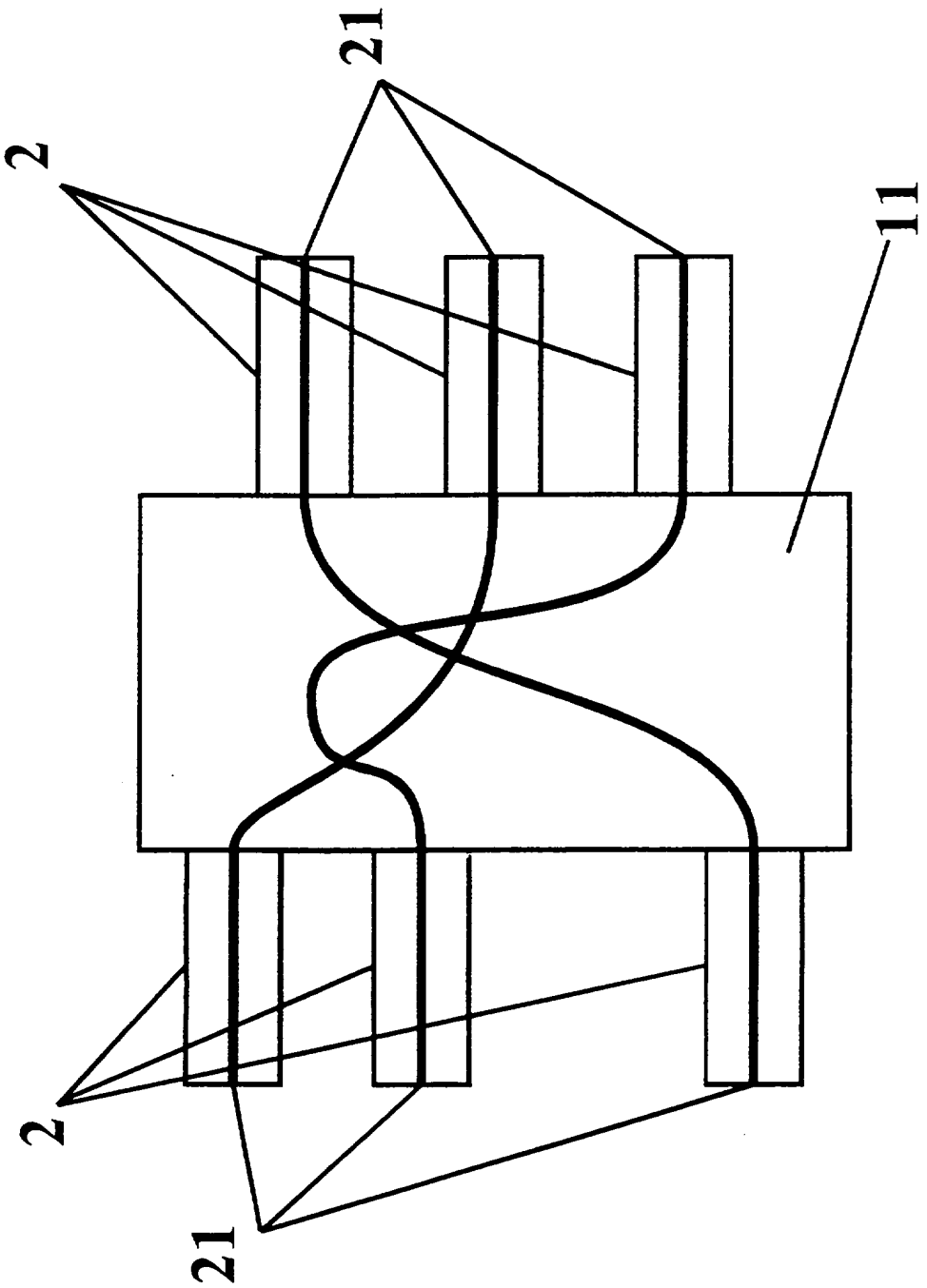


Fig. 7

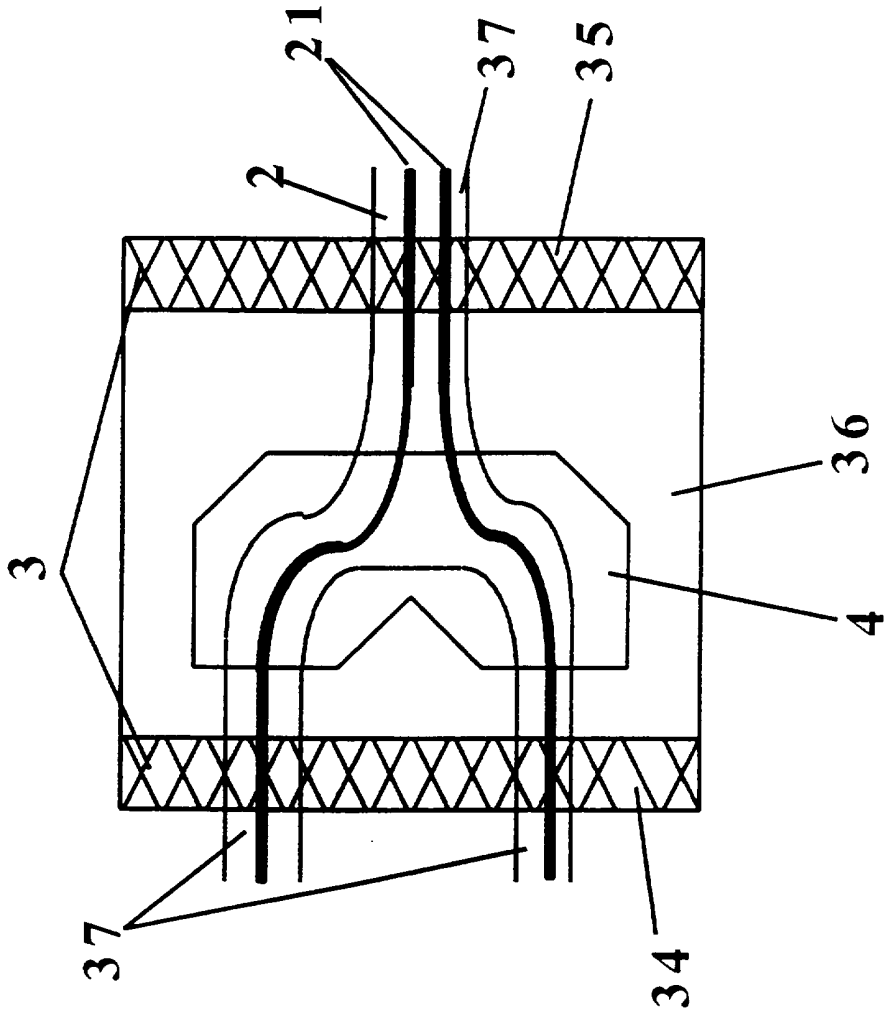


Fig. 8

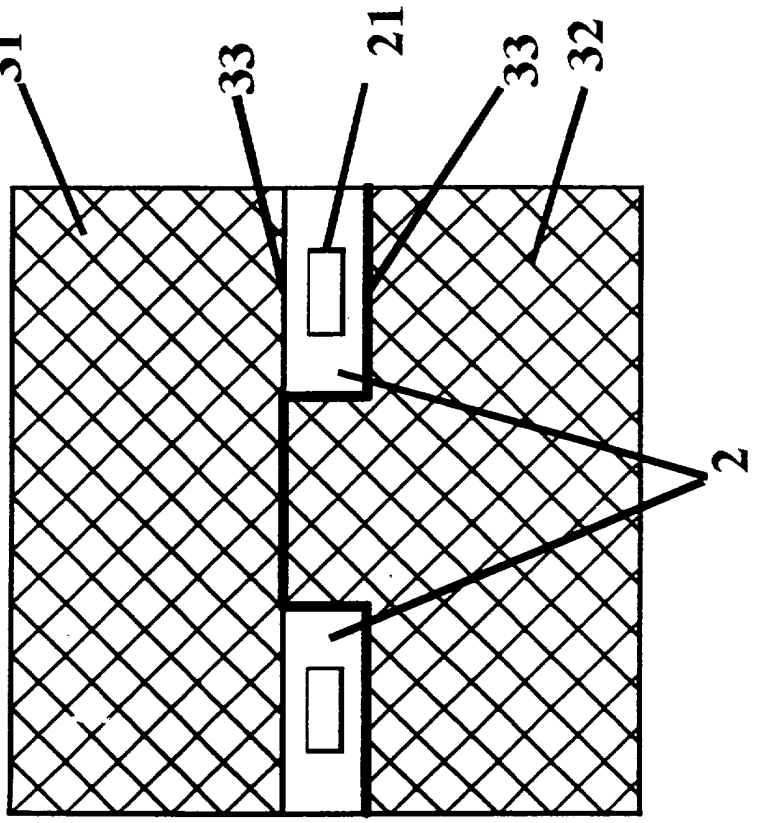


Fig. 9

ELECTRIC CABLE LEADTHROUGH

The invention relates to a sealed electric cable leadthrough through a plastics housing wall and to a method for producing a sealed electric cable leadthrough.

In motor vehicles, for example, there is increasingly a demand for integrating control electronics in the engine or in the gearbox. In order to do this, the control electronics, which are mounted on a circuit carrier, must be shielded with respect to the oils used in engines and gearboxes, which oils contain chemically highly aggressive additives. Additionally, however, electric cables must be led through the shield in order to be able to control components of an engine or a gearbox electronically.

A connection arrangement which is suitable for such conditions is known from the patent specification EP 0 513 263 B1. A flexible foil which carries strip conductors is led through between a sealing portion and a housing and produces an electrical connection between a component inside the housing and a component outside the housing. In order to achieve a seal between the flexible foil and the sealing portion or the housing, the flexible foil must be surrounded with a seal. The sealing of the sealing portion with respect to the housing and the flexible foil is relatively expensive. Additionally, the sealing portion and housing have to be fastened to each other in a defined manner in order reliably to effect a seal.

A gas-tight leadthrough of a conductor through a plastics fastening portion is known from the German laid open patent specification DE 195 17 455 A1, in which a shrink-on tube is glued on to the conductor. The shrink-on tube enters into a connection with the plastics of the fastening portion. If a plurality of conductors is to be led through the fastening portion,

a plurality of conductors has to be provided with shrink-on tubes and fixed for the extrusion-coating with plastics. Owing to the extrusion-coating with plastics, during which very high temperatures occur, the conductor has no insulation directly outside the housing. In addition a liquid-tight insulation cannot be achieved because of the soft and elastic properties of a shrink-on tube.

The patent specification US 5,491,300 relates to a through-housing which is used to introduce flexible strip-conductor carriers into a liquid-cooled supercomputer. The through-housing is inserted in the housing of the supercomputer.

The invention seeks to provide a simple and particularly reliable sealed electric cable leadthrough through a housing wall.

According to a first aspect of the invention, there is provided a sealed electric cable leadthrough through a plastics housing wall by means of strip conductors which are embedded in a strip-conductor carrier and have electrical points of contact on either side of the housing wall, wherein the strip-conductor carrier is extrusion-coated by the housing wall and strip conductors of a strip-conductor carrier are led at different levels in the housing wall.

According to a second aspect of the invention, there is provided a method for producing a sealed electric cable leadthrough through a housing wall of a plastics housing, wherein the method comprises the steps:

- a flexible foil which has a strip conductor is in each case fixed to the inside and outside of the housing wall to be injection-moulded, between two halves of an injection-moulding tool,
- the plastics housing is injection-moulded.

Advantageous developments are set out in the

subclaims.

Thus, in accordance with the invention, the production of the electric cable leadthrough through the housing wall is already integrated in the process of the manufacture of the plastics housing wall. No additional manufacturing steps are required, in addition to the injection-moulding of the housing wall, in order to create an electrical connection through the housing wall and achieve a seal between a conductor and the housing wall or between two halves of the housing wall. In accordance with the invention, a sealing with respect to liquids used in engines and gearboxes, such as oil and petrol, can be achieved in a particularly reliable way. This is significant if the electric cable leadthrough connects control electronics, which are integrated in an automatic gearbox and encapsulated with respect to the gearbox oil, to components outside the encapsulation, such as plugs, sensors or actuators. If the connection ceases to be sealed in the course of time, the control electronics are destroyed by penetration of oil. In order to replace the control electronics, the gearbox has to be dismantled, resulting in considerable costs.

It is particularly advantageous that the strip conductors which are to be led through the housing wall can be unplaited in the housing wall. In order to do this, the strip conductors only have to be fixed in each case with respect to the inside and the outside of the housing wall which is to be injection-moulded. The arrangement of the strip conductors or flexible foils inside the housing wall which is to be injection-moulded is unimportant.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 shows a front view of a housing, through the left and right walls of which is led in each case a strip-conductor foil;

Figure 2 shows a section through Figure 1 in the plane II-II;

Figure 3 shows a section through Figure 1 in the plane III-III;

Figure 4 shows a view from beneath of a plastics housing having a substantially circumferentially injected strip-conductor foil;

Figure 5 shows a view from beneath of a plastics housing having three injected strip-conductor foils;

Figure 6 shows a longitudinal section through a housing wall, in which strip conductors are led from one level into different levels;

Figure 7 shows a cross-section through a housing wall, in which strip conductors are unplaited from one level into different levels;

Figure 8 shows a plan view of one half of an injection-moulding tool; and

Figure 9 shows the front view of the half of the injection-moulding tool of Figure 8 and additionally the second half thereof.

Figure 1 shows a plastics housing 1 having a housing wall 11 which encloses a hollow space 12. The housing is accessible from underneath, as shown in Figure 1, through a housing opening 13. Two strip-conductor foils 2 are injected into the housing wall on opposing sides of the housing. Alternatively, a single continuous strip-conductor foil can also fulfil the same purpose as the two strip-conductor foils.

The section shown in Figure 2, in the plane II-II through Figure 1, illustrates the course of the strip-conductor foil 2 through the housing wall 11. A strip conductor 21 of the strip-conductor foil is covered by a cover foil 23 and a base foil 24. Both the cover

foil and the base foil consist of polyimide. On either side of the housing wall 11, the strip-conductor foil has points of contact 25 or pads. At the points of contact 25, an electrical connection to electronic components or circuits is produced.

Figure 3 shows a section through the housing wall that is rotated by 90° with respect to Figure 2. In this connection, it becomes clear that the strip-conductor foil 2 accommodates a plurality of strip conductors 21. The strip conductors are embedded in an adhesive 22 between the cover foil 23 and the base foil 24.

During the injection-moulding of the plastics housing, a type of fusion between the plastics of the housing wall 11 and the plastics of the cover foil 23 and of the base foil 24 results if the melting temperature of the base foil and cover foil is below the temperature of the injection-moulded plastics. Depending on the selection of temperature and material, it is possible to cause the materials of the strip-conductor foil and of the housing to fuse, be welded, or flow into each other. In this connection a physical and/or chemical connection between the plastics of the strip-conductor foil and of the housing wall results.

A fibre-reinforced polyamide is, for example, suitable as an oil-resistant plastics for the housing wall. On the basis of the binding or connection between the strip-conductor foil 2 and housing wall 11, an absolutely oil-tight and temperature-resistant leadthrough of the strip-conductor foil 2 through the housing wall 11 results. This sealing is not even impaired by the cooling of the housing wall after the injection-moulding or as a result of changes in temperature in the event of a later use in a gearbox or suchlike.

The view from underneath onto a housing that is

shown in Figure 4 shows a strip-conductor foil 2 which is injected substantially circumferentially over the whole cross-section of the housing wall 11. The strip-conductor foil has recesses 26, in order that plastics can flow through the latter during the injection-moulding. As a result of this, a connection between a lower portion and an upper portion of the housing results.

In the interior of the housing, a circuit carrier, in particular an LTCC substrate (Low Temperature Cofired Ceramics), can be glued onto the strip-conductor foil 2 using an electrically conductive contact adhesive in order to produce an electrical connection between the points of contact 25 of the strip-conductor foil 2 and the corresponding points of contact of the circuit carrier.

Such a circuit carrier is mounted beforehand on a metallic plate using a heat-conducting adhesive. The metallic plate with the circuit carrier is then led through the housing opening 13 in order to produce an electrical connection between the circuit carrier on the metallic plate, preferably an aluminium plate, and the strip-conductor foil 2. At the same time, the metallic plate can be used to seal the housing opening 13 with respect to the outside.

As shown in Figure 5, strip conductors 21 surrounded by a strip-conductor foil 2 can be injected at any position into the housing wall 11.

Figure 6 shows three strip conductors 21 which are led from a single level in the interior of the housing (right) into different levels outside the housing (left). In order to do this, the strip-conductor foil 2 is opened up in the housing wall 11 which is to be injection-moulded, so that the individual strip conductors 21 can be led into different levels towards the outside of the housing. In order to be able to

contact a circuit carrier in a simple way, it is regularly required that strip conductors are located on a single level.

Figure 7 shows a horizontal cross-section through a housing wall 11 and in a view from beneath from the housing opening 13. In the interior of the housing (right), a plurality of strip-conductor foils 2, which each cover a strip conductor 21, are arranged at a single level with respect to a circuit carrier in the interior of the housing but in a manner such that they are (horizontally) offset with respect to each other. The strip conductors cross in the housing wall 11 in order to be arranged in a desired sequence on the outside of the housing (left). In this connection, the strip conductors on the outside of the housing are in this example arranged at different vertical levels.

Figure 8 shows one half of a two-piece injection-moulding tool 3, onto which a flexible strip-conductor foil 2, which has been partially extrusion-coated with plastics, has been placed. Although this is not shown, the injection-moulding tool forms a closed, hollow ring into which plastics is injected. The ring is formed by a closed circumferential outer wall 34 and a closed circumferential inner wall 35.

An injection-moulded part 4 is formed by extrusion-coating a section of the flexible strip-conductor foil 2 with plastics, which injection-moulded part will later be placed inside the housing wall 11. In particular, the strip-conductor foil 2 is extrusion-coated with plastics at the places at which strip conductors 21 and the strip-conductor foil separate or a strip conductor 21 branches off. The injection-moulded part 4 prevents the strip-conductor foil 2 tearing when the housing wall 11 is injection-moulded. At the same time, the injection-moulded part 4 can be used during the fixing of the strip-conductor foil 2 by

the injection-moulding tool.

Figure 9 shows a front view of the injection-moulding tool 3 after the second half 31 of the injection-moulding tool has been placed on the first half 32. In this way, the strip-conductor foil 2 is fixed outside the housing wall to be injection-moulded, between the lower portion 32 and the upper portion 31 of the injection-moulding tool 3. The bearing surfaces 33 of the halves 32 and 31 of the injection-moulding tool rest on the strip-conductor foil 2. At places at which there is no strip-conductor foil, the halves rest against each other, as shown in the gap between the branched arms of the strip-conductor foil.

During the injection-moulding of the plastics housing 1, a hollow space 36 in the injection-moulding tool 3 is filled with melted plastics and the strip-conductor foil 2 is therefore extrusion-coated as well.

An unplaiting of strip conductors takes place in each case as a result of the fixing of a strip conductor, which is surrounded by a strip-conductor foil, at a fixing point 31 on the inside wall 35 of the injection-moulding tool 3 and a fixing point 31 on the outside wall 34 of the injection-moulding tool that is selected at any position with respect thereto. The strip conductors 21 can cross inside the injection-moulding tool in the hollow space 36 and later inside the housing wall 11.

If the strip conductors are to be arranged at different levels, as shown in Figure 6, this can take place by way of a step-like structure of the bearing surfaces 33 of the injection-moulding tool. The strip conductors 21 then rest on the inside wall 35 and/or on the outside wall 34 of the injection-moulding tool 3 in a manner on a plurality of steps and are thus distributed on a plurality of levels.

Claims

1. A sealed electric cable leadthrough through a plastics housing wall by means of strip conductors which are embedded in a strip-conductor carrier and have electrical points of contact on either side of the housing wall, wherein the strip-conductor carrier is extrusion-coated by the housing wall and strip conductors of a strip-conductor carrier are led at different levels in the housing wall.

2. The sealed electric cable leadthrough according to claim 1, wherein the strip-conductor carrier is a flexible foil having a cover foil and a base foil, between which are arranged strip conductors.

3. The sealed electric cable leadthrough according to one of the preceding claims, wherein the cover foil and the base foil are physically and/or chemically connected to the housing wall.

4. The sealed electric cable leadthrough according to one of the preceding claims, wherein the strip-conductor carrier is injected substantially circumferentially into a housing.

5. The sealed electric cable leadthrough according to one of the preceding claims, wherein a plurality of strip-conductor carriers are injected into the housing wall and are there unplaited into different planes.

6. Method for producing a sealed electric cable leadthrough through a housing wall of a plastics housing, wherein the method comprises the steps:

- a flexible foil which has a strip conductor is in each case fixed to the inside and outside of the housing wall to be injection-moulded, between two halves of an injection-moulding tool,
- the plastics housing is injection-moulded.

7. Method according to claim 6, wherein the plastics housing is injection-moulded at a temperature

which is above the melting temperature of the flexible foil.

8. Method according to one of claims 6 or 7, wherein before the plastics housing is injection-moulded, the flexible foil is extrusion-coated with plastics in a region which, after the plastics housing has been injection-moulded, lies inside a housing wall.

9. A housing having an electric cable leadthrough substantially as herein described with reference to the accompanying drawings.

10. A housing having a cable leadthrough as claimed in one of claims 1-5.

11. A motor vehicle engine or gear box incorporating a housing as claimed in one of claims 9 or 10.

12. A motor vehicle having an engine and/or gear box as claimed in claim 11.

Application No: GB 9820856.4 **Examiner:** Mr F J Fee
Claims searched: 1 to 12 **Date of search:** 4 May 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H2E [EBX, EFAD, EFAE, EFAX], B5A [A1R439H, A1R439X, A20T14, AB19R, AT14P]

Int Cl (Ed.6): H01R, B29C

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2290420 A	[WHIPP & BOURNE]	
A	EP 0448876 A2	[3M]	
A	EP 0668147 A2	[SUMITOMO]	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.