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(72) Inventor(s):
Dietrich Von Knorre
Goetz Roderer

(73) Proprietor(s):
Yazaki Systems Technologies GmbH
(Incorporated in the Federal Republic of Germany)
Im Gewerbepark, B32 93059 Regensburg, Germany

(74) Agent and/or Address for Service:
A.A. Thornton & Co.
15 Old Bailey, London, EC4M 7EF, United Kingdom

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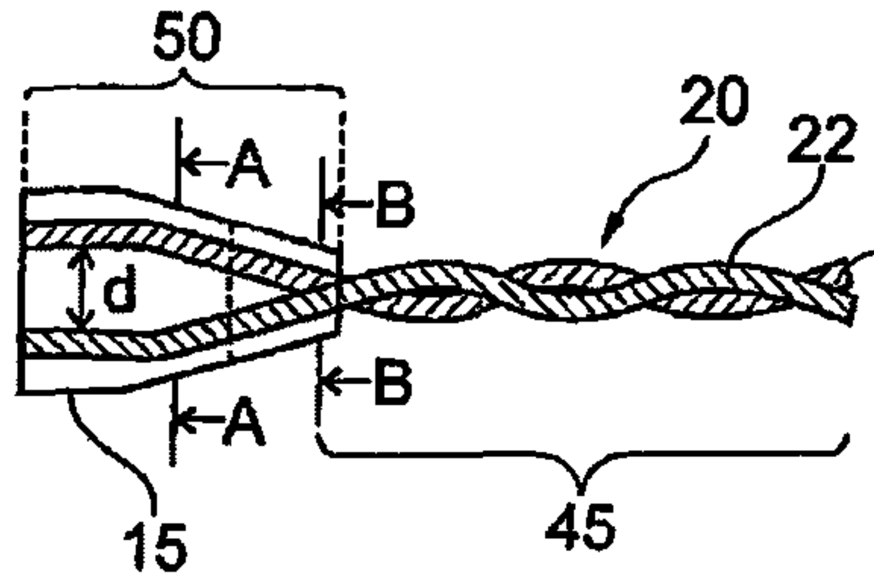

Fig. 1

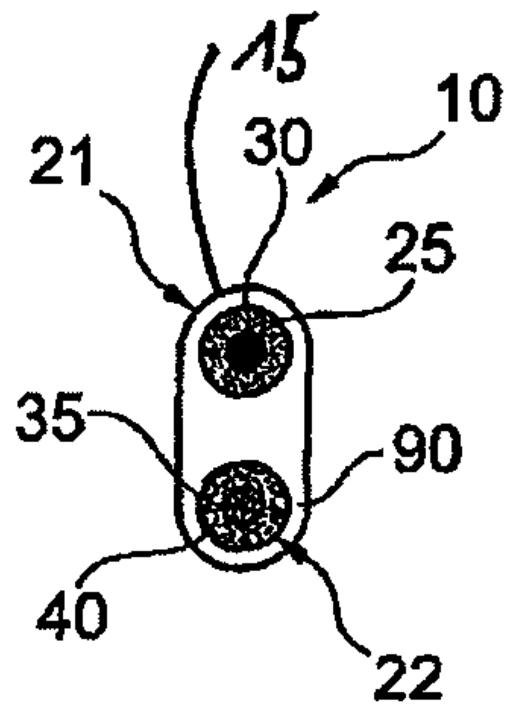

Fig. 2

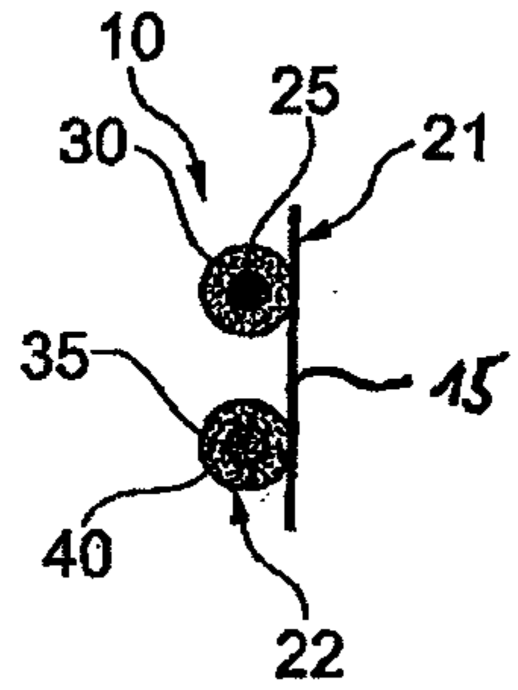

Fig. 3

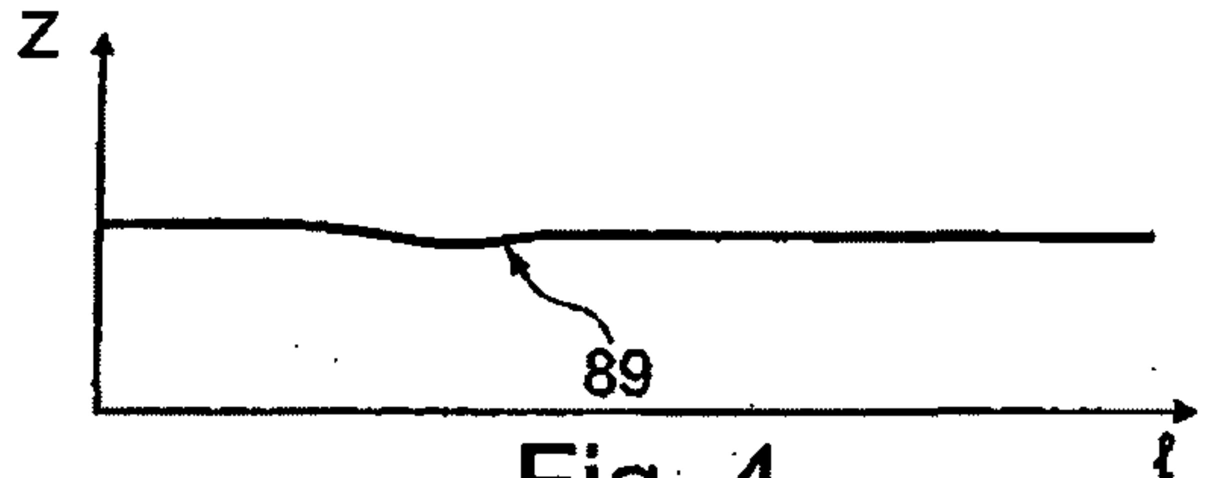

Fig. 4

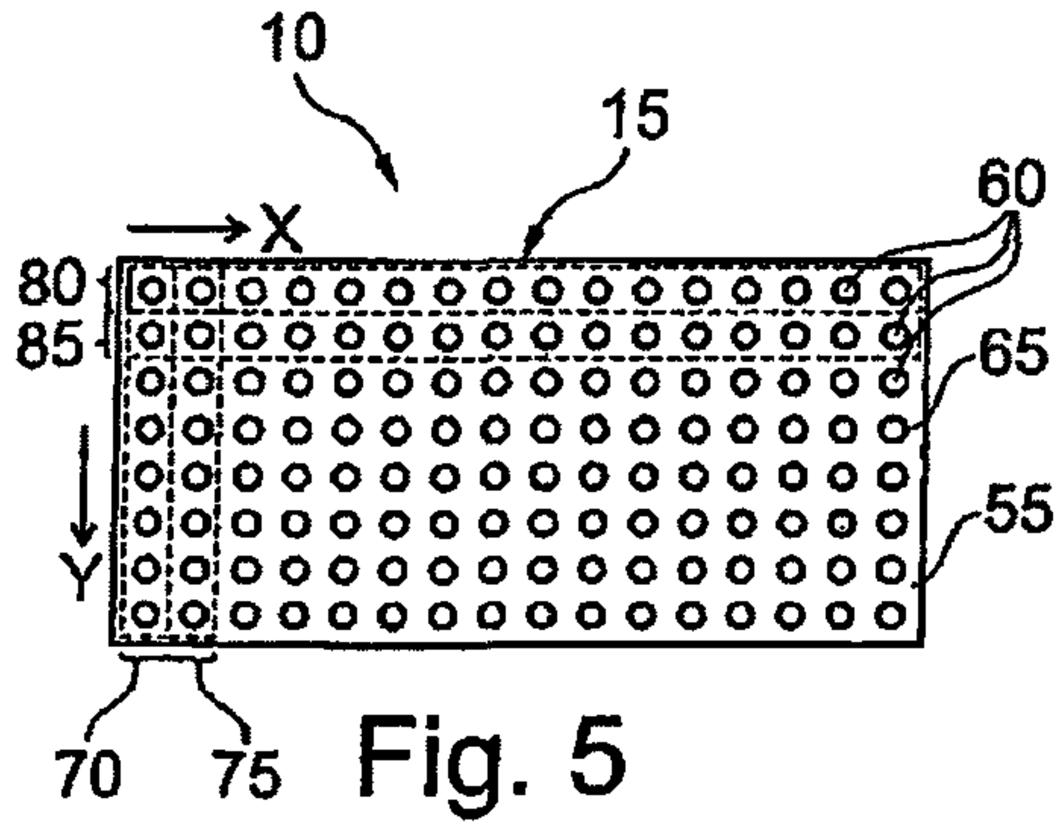

Fig. 5

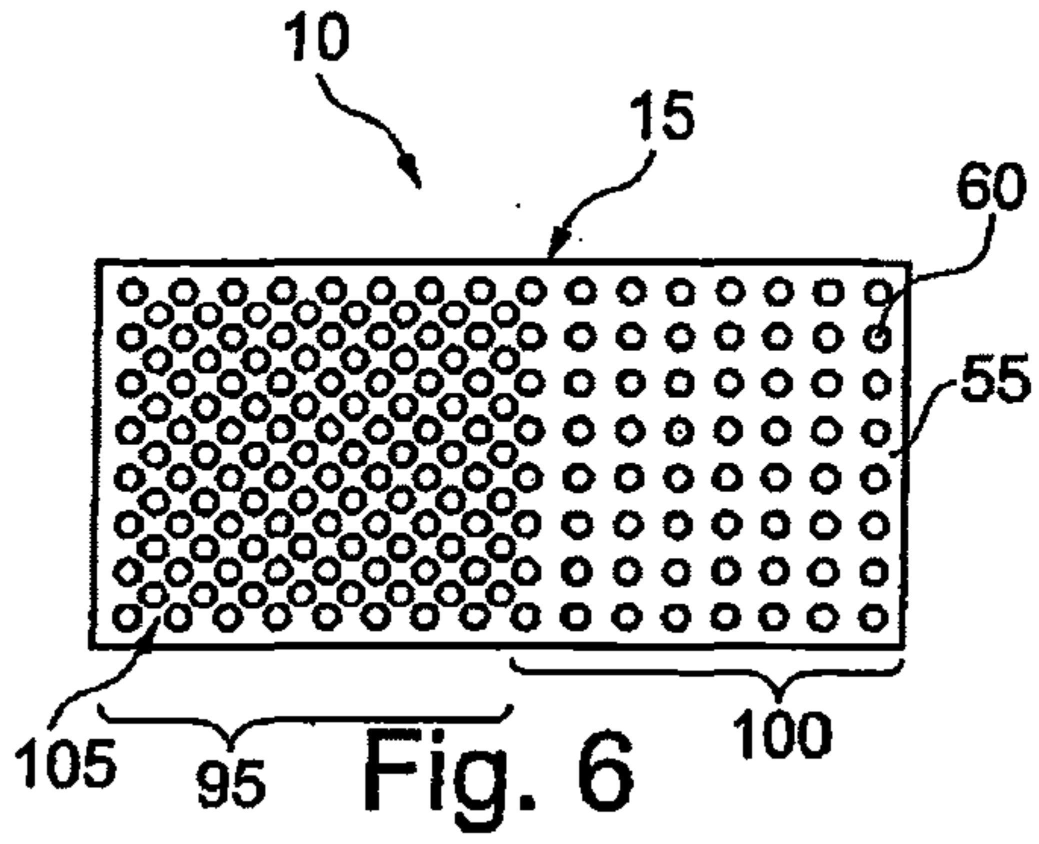

Fig. 6

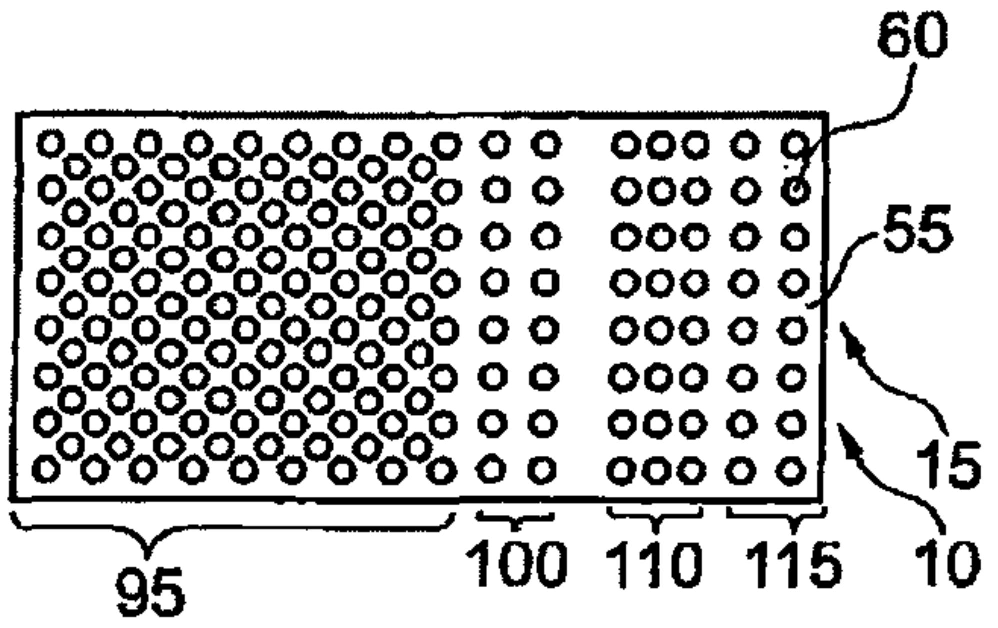

Fig. 7

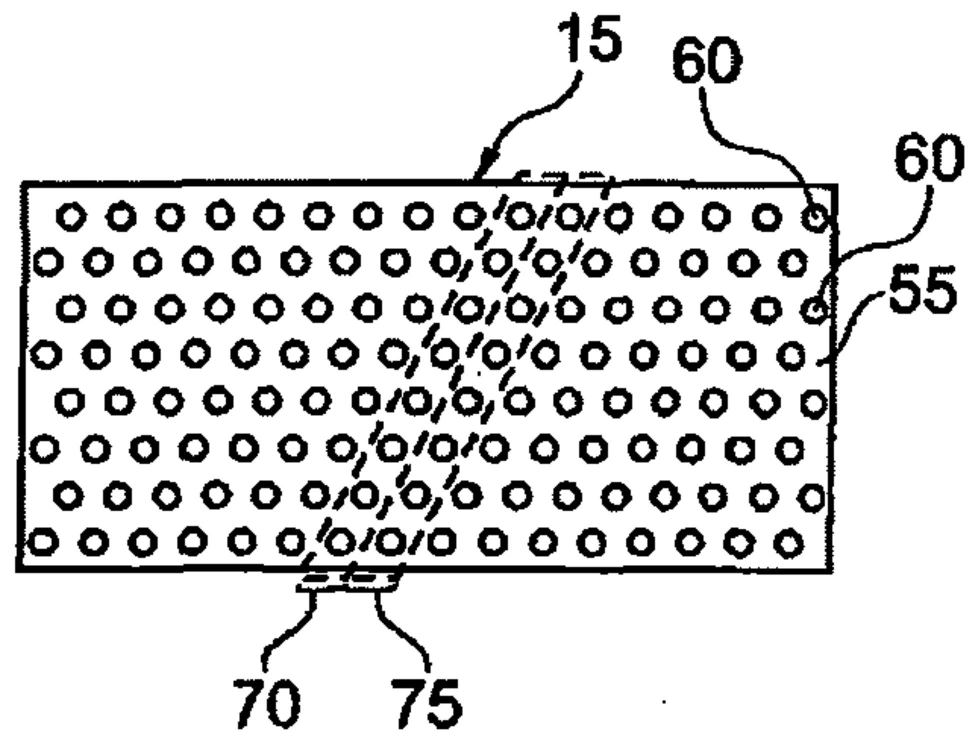

Fig. 8

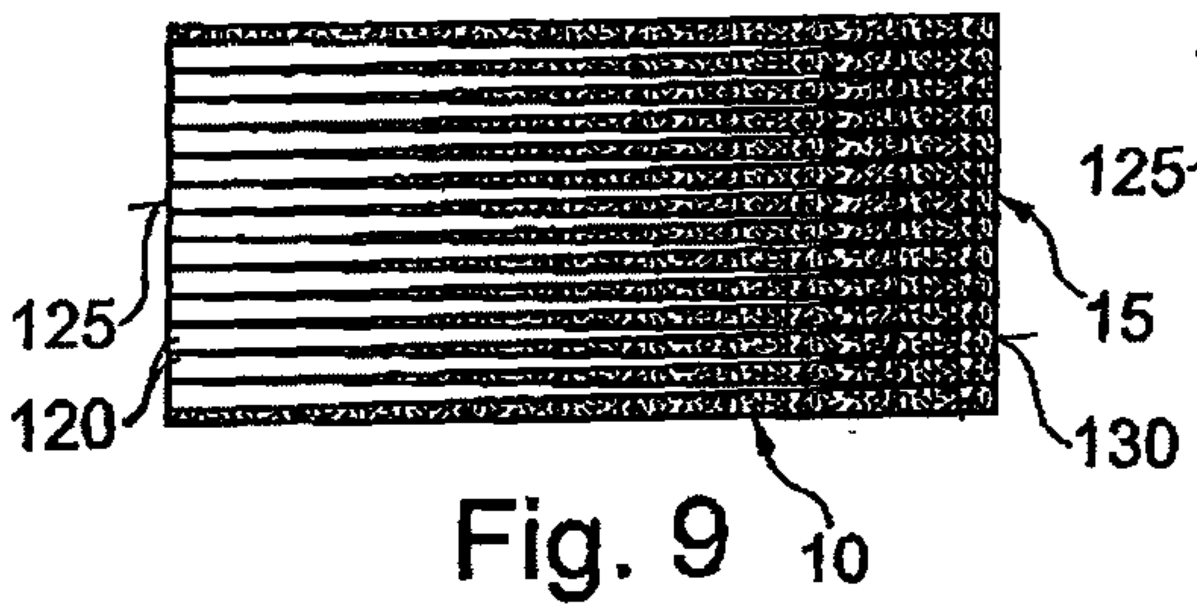

Fig. 9

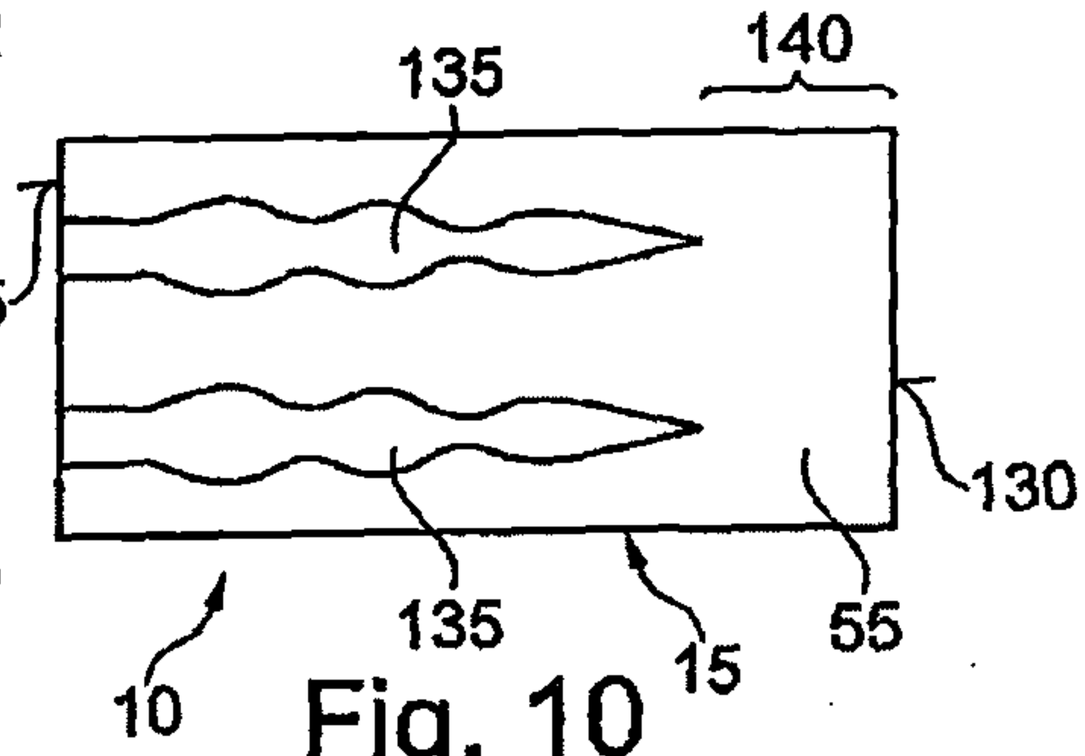

Fig. 10

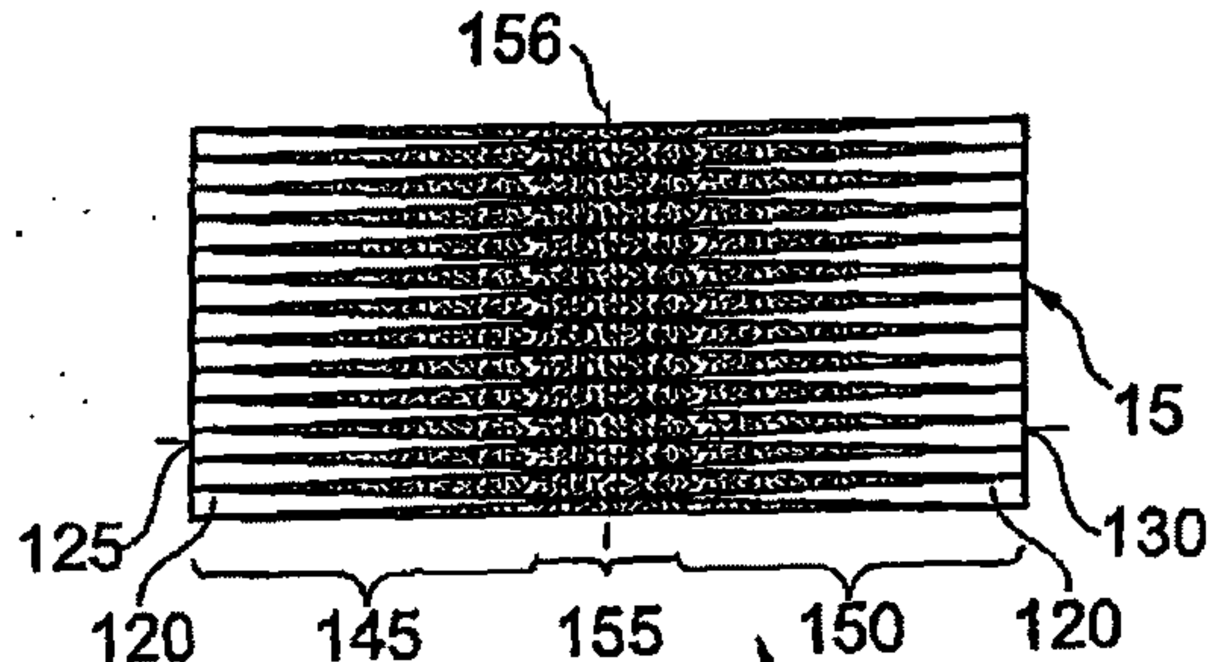

Fig. 11

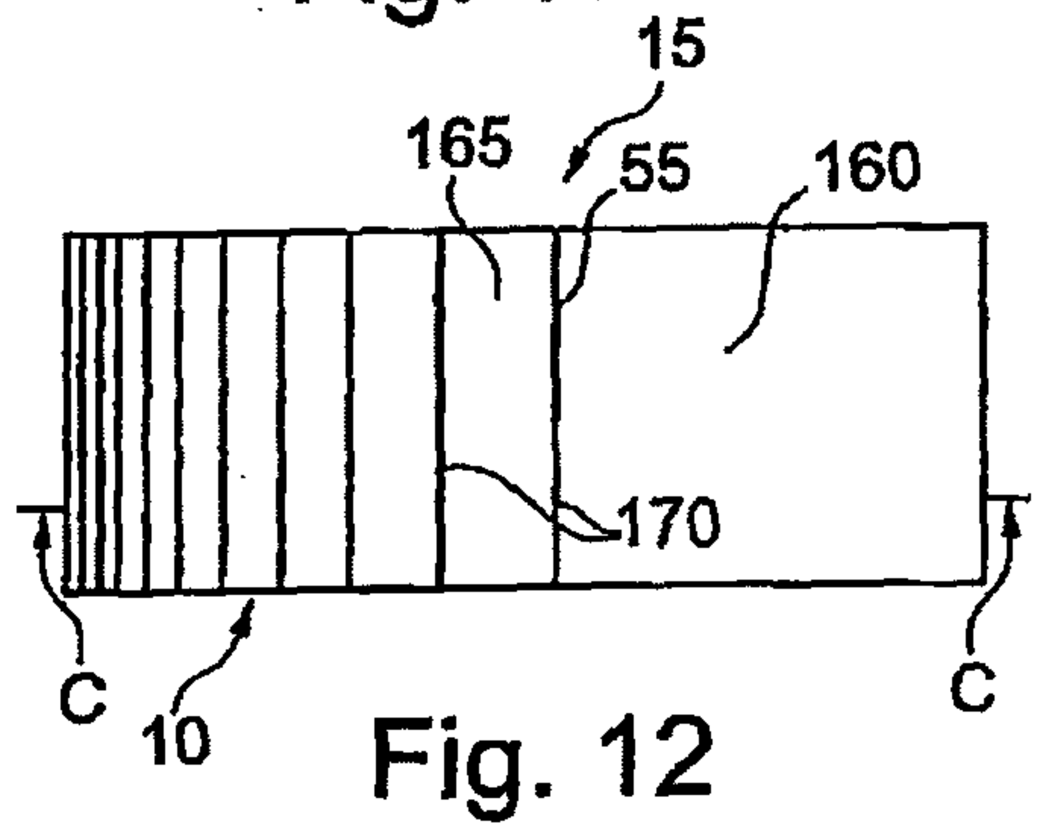

Fig. 12

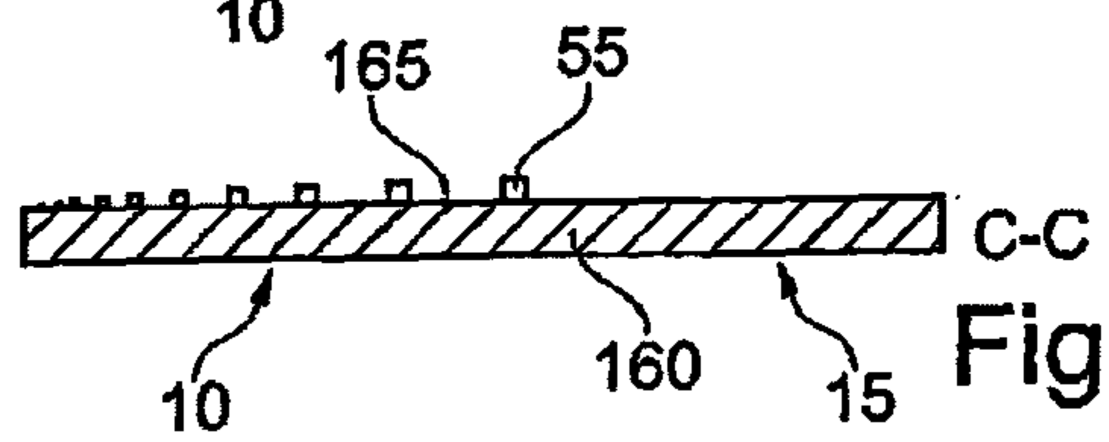

Fig. 13

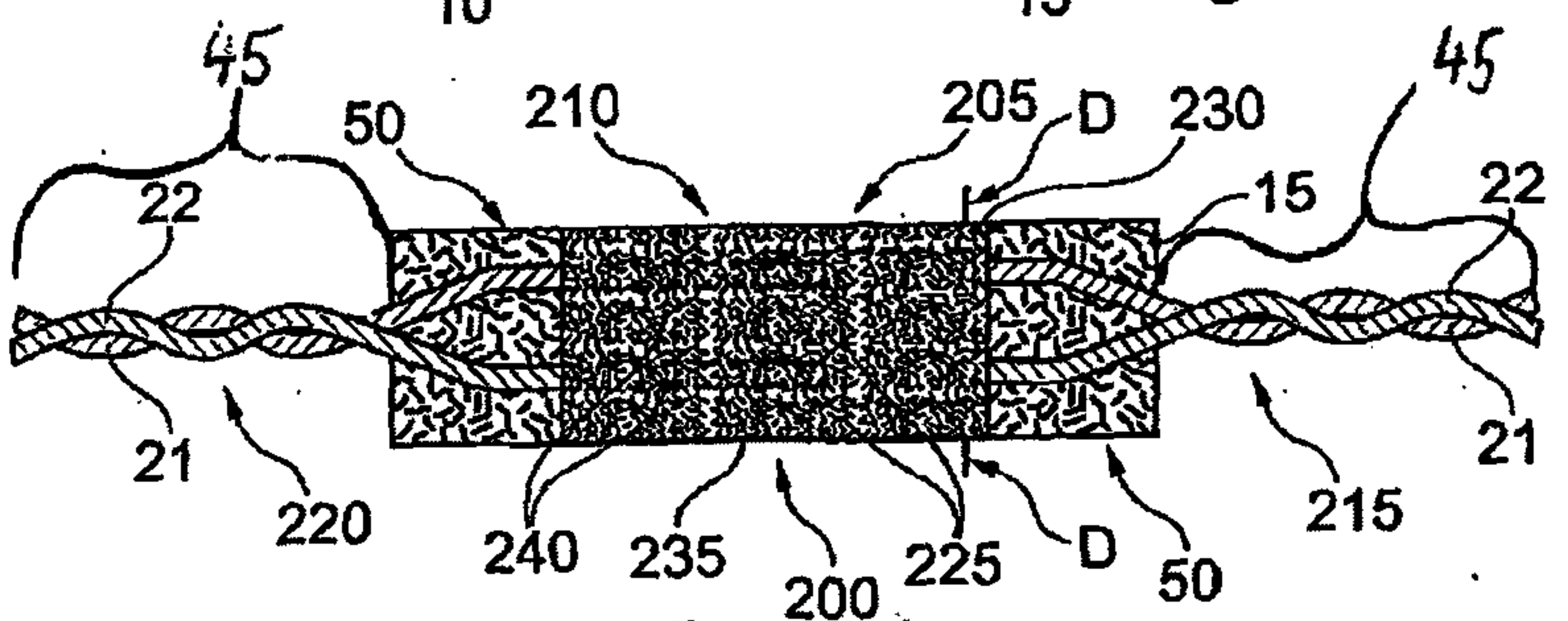

Fig. 14

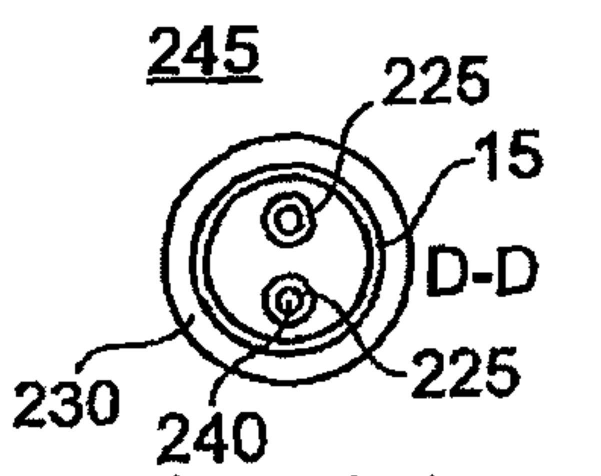

Fig. 15

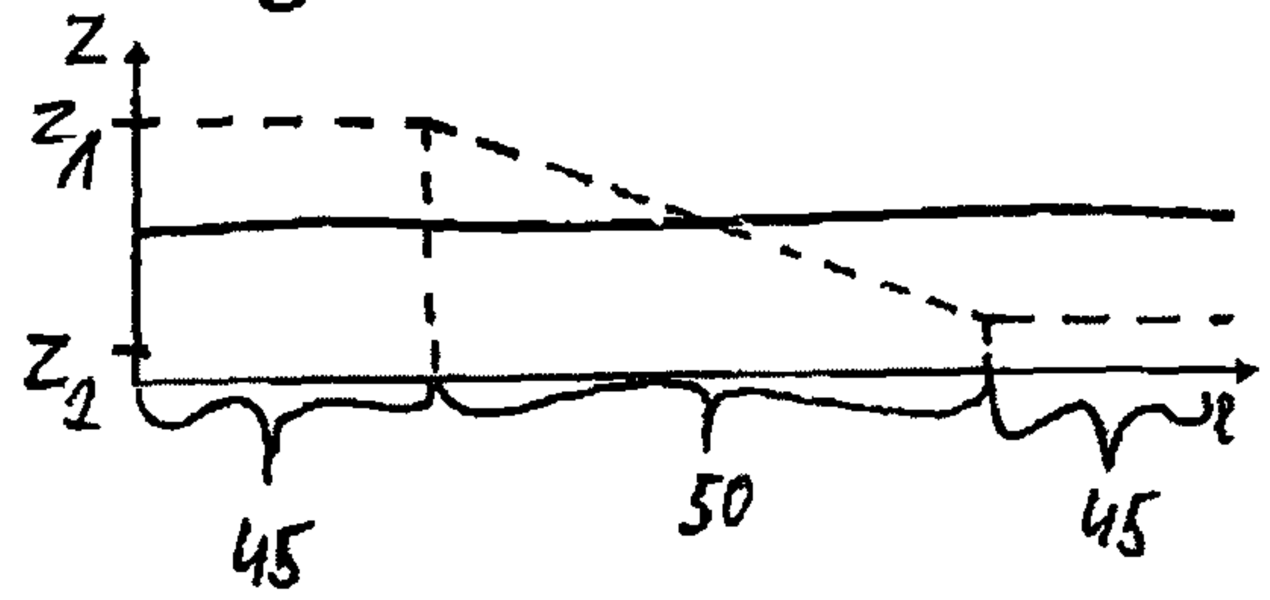

FIG. 16

Description

Impedance adaptation system and contacting system having such an impedance adaptation system

The invention relates to an impedance adaptation system as defined in claim 1 and a contacting system having such an impedance adaptation system as defined in claim 12.

A contacting system for a twisted pair cable is known from JP 2004-71404 A. The twisted pair cable has a first portion in which individual cables are wound around one another in a spiral shape and a second portion in which the cables of the twisted pair cable are run separately from one another. The second portion opens into a housing. A retaining system is also provided in the second portion to enable the cables in the second portion to be run parallel between the first portion and the contact housing. Due to the twisted arrangement of the two cables around one another across the twisted portion, an impedance of the twisted pair cable is kept essentially constant.

The objective of the invention is to propose an improved impedance adaptation system and an improved contacting system.

This objective is achieved by means of a shielding system as defined in claim 1. Advantageous embodiments are defined in the dependent claims.

For the purpose of the invention, it was realised that an improved impedance adaptation system could be obtained on the basis of an impedance adaptation system comprising at least a shielding and at least one signal line. The signal line comprises a first cable and a second cable. The first cable is twisted with the second cable in a first portion of the signal line. The shielding is disposed at least partially in a second portion of the signal line and the cables are disposed in a non-twisted arrangement. The shielding comprises a shielding wall at least partially surrounding the circumferential face of the signal line. The shielding further comprises at least one orifice and the orifice is disposed in the shielding wall. The orifice and the shielding wall are adapted to one another so that a transition between the first portion and the second portion has a predefined impedance curve.

The advantage of this design is that a signal transmission across the signal line is improved and interference, especially in the region of a connection of the signal line, in other words especially if the cables of the signal line have to be run in a non-twisted arrangement, does not cause a sudden increase in impedance and impair the signal transmission in this region.

In another embodiment, the shielding has a first end face facing the first portion of the signal line and a second end face facing away from the first portion, and the orifice has a differing width from the first end face in the direction towards the second end face. As a result, an impedance can be adapted flexibly and particularly exactly to a run of the cables of the signal line.

In this respect, it is of particular advantage if the orifice tapers from the first end face in the direction of the second end face.

In another embodiment, at least three orifices are provided and the orifices are arranged in a regular pattern and/or at a constant distance from one another in the shielding wall. This design is particularly easy to manufacture.

In another embodiment, the orifice is completely surrounded by a material of the shielding wall. This being the case, a particularly cost-effective shielding can be obtained which is especially resistant to tearing and thus advantageous in terms of the production equipment used to manufacture the shielding system.

In another embodiment, the shielding wall comprises a first wall portion and a second wall portion. The first wall portion preferably faces the first portion of the signal line. A plurality of orifices is provided in the first wall portion and in the second wall portion. A first distribution density of the orifices in the first wall portion is different from a second distribution density of the orifices in the second wall portion. This design also provides an easy way of preventing an impedance jump in the wave impedance in the signal line by means of the shielding system. In addition or as an alternative, a number of orifices in the first wall portion is greater than a number of orifices in the second wall portion.

In another embodiment, the orifice has a circular cross-section or an elliptical cross-section or a rectangular cross-section or a triangular cross-section. These designs have proved to be particularly simple and cost-effective in terms of producing the punching tools used to make the orifices in the shielding wall.

It is also of particular advantage if the shielding comprises at least one of the following materials: electrically conducting materials, aluminium, copper, electrically conducting plastic, ferrite, ferrite-filled plastic, sintered ferrite, film-type material, metamaterial, liquid/powdered coating material, material with a permittivity ε_r greater than 1, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 5, in particular greater than 10 and/or less than 1000, material with a permittivity ε_r of less than 1, in particular with a negative permittivity ε_r, and/or with a permittivity ε_r greater than -1000, material with a magnetic permeability μ of greater than 1.3, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 10, in particular greater than 100, and/or less than 1000, material with a permeability μ_r of less than 1, in particular with a negative permeability μ_r, and/or a permeability μ_r greater than -1000.

In another embodiment, the shielding is of a film type design. The advantage of this design is that the shielding can be run around the second portion of the signal line particularly easily by means of a winding process, thereby enabling an exactly defined impedance adaptation system to be obtained especially cheaply.

In another embodiment, each cable comprises an electrical conductor, and an electric signal with a wavelength can be transmitted by means of the electrical conductor, and the orifice has an orifice contour with a contour length, and a value of the contour length of the orifice contour is at least smaller than a fraction of the wavelength, preferably being a value of less than one tenth of the wavelength. This prevents electromagnetic fields from being radiated in or out through the openings, which would impair the shielding in terms of its effectiveness.

It is of particular advantage if the contour length has a value that is less than 150 mm, preferably less than 30 mm. These contour lengths ensure that the effects described above do not occur in the case of signals with a frequency of 100 MHz.

In another embodiment, the predefined impedance curve is substantially constant. Alternatively, the predefined impedance curve rises from a first impedance to a second impedance or the predefined impedance curve falls from the first impedance to the second impedance, and the rise or fall is preferably linear or degressive or progressive or regressive.

However, the objective is also achieved by means of a contacting system as defined in claim 13. Advantageous embodiments are defined in the dependent claims.

For the purpose of the invention, it was realised that an improved contacting system with an impedance adaptation system could be obtained on the basis of the impedance adaptation system described above and provided with a contacting system. The contacting system is configured to establish an electrical contact to another electrical component. The shielding at least partially surrounds the contacting system. This ensures that both a jump in impedance can be prevented in the second portion of the signal line and an improved signal transmission can be obtained by the signal line and contacting system.

In another embodiment, the contacting system comprises at least two contact elements and a housing, a contact element being respectively attached to one end of an electrical conductor of the cable. The contact elements are disposed in the housing. The shielding in this instance is disposed between the contact elements and the housing or at least partially around the circumferential face of the housing. This ensures that the shielding cannot undesirably be removed.

The properties, features and advantages of the invention described above as well as the way in which these are achieved will become clearer and more readily understood from the description of examples of embodiments given below, which will be explained in more detail with reference to the drawings.

The invention will be described in more detail with reference to the drawings.

Of these:

Figure 1 is a schematic side view of an impedance adaptation system;

Figure 2 is a view in section through the impedance adaptation system illustrated in Figure 1 along a section plane A-A indicated in Figure 1;

Figure 3 is a view in section through the impedance adaptation system illustrated in Figure 1 along a section plane B-B indicated in Figure 1;

Figure 4 is a diagram of an impedance, plotted along a length with respect to the impedance adaptation system illustrated in Figure 1;

Figure 5 illustrates a winding of a shielding illustrated in Figures 1 to 3, based on a first embodiment;

Figure 6 illustrates a winding of a shielding based on a second embodiment;

Figure 7 illustrates a winding of a shielding based on a third embodiment;

Figure 8 illustrates a winding of a shielding based on a fourth embodiment;

Figure 9 illustrates a winding of a shielding based on a fifth embodiment;

Figure 10 illustrates a winding of a shielding based on a sixth embodiment;

Figure 11 illustrates a winding of a shielding based on a seventh embodiment;

Figure 12 illustrates a winding of a shielding based on an eighth embodiment;

Figure 13 is a view in section along a section plane C-C indicated in Figure 12 through the shielding illustrated in Figure 12;

Figure 14 is a side view onto a contacting system having the impedance adaptation system illustrated in Figures 1 to 3;

Figure 15 is a view in section through the contacting system illustrated in Figure 14 along a section plane D-D indicated in Figure 14; and

Figure 16 is a diagram of an impedance Z, plotted across a longitudinal extension 1 of the contacting system illustrated in Figure 14.

Figure 1 shows a schematic side view of an impedance adaptation system 10. Figure 2 shows a view in section through the impedance adaptation system 10 illustrated in

Figure 1 along section plane A-A indicated in Figure 1 and Figure 3 shows a view in section through the impedance adaptation system 10 illustrated in Figure 1 along a section plane B-B indicated in Figure 1. Figures 1 to 3 will be explained jointly below.

The impedance adaptation system 10 comprises a shielding 15 and a signal line 20. The signal line 20 comprises a first cable 21 and a second cable 22. The first cable 21 comprises a first electrical conductor 25 and a first isolator 30. The first isolator 30 is disposed around the circumferential face of the first electrical conductor 25 and electrically isolates the electrical conductor 25 from the environment. The second cable 22 comprises a second electrical conductor 35, the circumferential face of which is electrically isolated from the environment by a second isolator 40 of the second cable 22. The signal line 20 is used for the high-frequency transmission of signals.

The signal line 20 comprises a first portion 45 and a second portion 50. By way of example, the first portion 45 in this instance is disposed to the right-hand side of the second portion 50 in Figure 1. The signal line 20 is provided in the form of a twisted pair cable in the first portion 45 so that the first cable 21 is twisted with the second cable 22. In the second portion 50, the first cable 21 is run spaced at a distance d from the second cable 22 and is non-twisted. This run may be necessary if the first cable 21 and the second cable 22 are run into a contacting system 200, for example, in order to obtain an electrical contact, for example to a circuit board or other signal lines.

As illustrated in Figure 2, the shielding 15 in the second portion 50 is run completely around the circumferential face of the cables 21, 22. Furthermore, in a part-portion of the second portion 50 adjoining the first portion 45, the shielding 15 is run only partially around the signal line 20 and one side of the signal line 20 is therefore covered by the shielding 15 and the other side is not covered by the shielding 15, as illustrated in Figure 3. In this respect, it would also be conceivable, as illustrated in Figures 2 and 3, for this complete coverage of the circumferential face to be combined with a partial coverage of the signal line 20 by the shielding 15 so as to obtain a substantially constant impedance curve across the length 1 of the signal line 20.

Naturally, it would also be conceivable for the shielding 15 to extend only partially around the signal line 20 in this manner across the entire second portion 50. It would also be conceivable for the shielding 15 to extend completely around the circumferential face of the signal line 20 across the entire second portion 50 of the signal line 20.

Figure 4 is a diagram showing an impedance Z plotted across a length 1 of the signal line 20.

Due to the design of the shielding 15 illustrated in Figures 1 to 3 and illustrated in the different embodiments, a constant impedance curve of the impedance Z can essentially be obtained across the length 1 of the signal line 20 both in the twisted first portion 45 and in the spaced apart portion 50. Accordingly, the shielding system 10 exhibits no jump in impedance at the transition between the first and the second portion 45, 50. By constant impedance curve within the meaning of the application is meant an impedance Z which deviates from a mean value of the impedance Z in the first portion 45 across the length l of the signal line 20 by less than 20%, preferably less than 5%.

Although the shielding system 10 illustrated in Figures 1 to 3 exhibits a change constituting a small drop 89 in the impedance curve at a transition between the first portion 45 and the second portion 50, the drop 89 is less than 20% relative to the mean value of the impedance Z in the first portion 45 so that the impedance curve based on the aforementioned definition is substantially constant.

Figure 5 illustrates a variant of the shielding 15 illustrated in Figure 1. The shielding 15 has a shielding wall 55. The shielding wall 55 is of a film-type design, for example. Several orifices 60 are provided in the form of end-to-end openings. The orifices 60 are arranged in a regular pattern and at a constant distance from one another in the shielding wall 55. The orifices 60 are completely surrounded by a material of the shielding wall 55.

In this embodiment, the shielding wall 55 comprises at least one of the following materials: electrically conducting materials, aluminium, copper, electrically conducting plastic, ferrite, ferrite-filled plastic, sintered ferrite, metamaterial, liquid/powdered coating material,

material with a permittivity ε_r greater than 1, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 5, in particular greater than 10 and/or less than 1000, material with a permittivity ε_r of less than 1, in particular with a negative permittivity ε_r, and/or with a permittivity ε_r greater than -1000, material with a magnetic permeability μ greater than 1.3, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 10, in particular greater than 100, and/or less than 1000, material with a permeability μ_r less than 1, in particular with a negative permeability μ_r, and/or a permeability greater than -1000, powder/powdered coating material, film-type material.

In this embodiment, the orifices 60 are provided with a circular cross-section. It would naturally also be conceivable for the orifices to have an elliptical cross-section, a rectangular cross-section or a triangular cross-section. It would also be conceivable for the orifices 60 to have any other geometry. Every orifice 60 has an orifice contour 65. The orifice contour 65 has a contour length l_U.

Electrical signals, in particular data signals, can be transmitted by means of the signal line 20. The transmitted signals have a wavelength λ corresponding to the transmission frequency accordingly. In this embodiment, the signal line 20 is designed for a transmission frequency of 100 MHz. Signals having a different signal frequency may naturally also be transmitted with the signal line 20. At a signal frequency of 100 MHz, the wavelength of the signal is approximately 3 m. In order to obtain a substantially constant impedance curve across the two portions 45, 50 of the signal line 20 as illustrated in Figure 4, the contour length l_U of the orifice contour 65 is selected so that it is less than a value of half the wavelength of the electrical signal to be transmitted by means of the signal line 20 ($l_U < \lambda/2$). A value of the contour length of the orifice contour 65 is preferably less than one tenth of the wavelength ($l_U < \lambda/10$) to be transmitted with the signal line 20.

As a result, during a signal transmission of an electrical signal with a signal frequency of 100 MHz, it is of particular advantage if the contour length l_U has a value that is less than 150 mm, preferably less than 30 mm.

In this embodiment, the orifices 60 are disposed in first rows 70, 75 extending parallel with one another (indicated by boxes in broken lines in Figure 5). Second rows 80, 85 are also formed by the orifices 60, and the second rows 80, 85 (indicated by boxes in broken lines in Figure 5) are disposed at a right angle to the first rows 70, 75. A different pattern layout would naturally also be conceivable.

Due to the orifices 60, the permittivity ε_r and/or a permeability μ_r can be locally varied in order to prevent the jump in impedance which occurs in the wave impedance between the first portion 45 and the second portion 50 in the prior art systems.

By preventing jumps in impedance at the transition from the first portion 45 of the signal line 20 to the second portion 50, signal reflections within the signal line 20 can be prevented to a significant degree, thereby ensuring a reliable signal transmission of the electrical signals by means of the signal line 20.

Due to the film-type design of the shielding 15, it is conceivable for the shielding 15 to be provided with an adhesive layer 90 disposed on the internal face (see Figure 2) in order to secure the shielding 15 reliably to the signal line 20. A self-adhesive shielding 15 can therefore also be obtained. It would also be conceivable for the shielding 15 to be run around the signal line 20 in several layers in the second portion 50, for example as a winding.

Figure 6 illustrates a variant of the shielding 15 based on a second embodiment. The shielding 15 is essentially identical to the embodiment illustrated in Figure 5. The difference is that the shielding 15 has a first wall portion 95 and a second wall portion 100. The first wall portion 95 is disposed on a side facing away from the first portion 45 of the signal line 20. The orifices 60 already illustrated in Figure 6 are provided in the first wall portion 95 and in the second wall portion 100. By contrast, a distribution density of the orifices 60 in the first wall portion 95 is higher than a distribution density in the second wall portion 100.

The advantage of this design is that the shielding 15 can be flexibly adapted to the distance d of the cables 21, 22 in the second portion 50 of the signal line 20 due to the distribution density in the respective wall portion 95, 100 in order to obtain the predefined impedance curve, in particular a substantially constant curve of the impedance Z, across the length l of the signal line 20.

In this embodiment, the first wall portion 95 is disposed on a side of the second portion 50 of the signal line 20 facing away from the first portion 45 and the second wall portion 100 is disposed on a side of the second portion 50 facing the first portion 45. Due to the lower distribution density in the second wall portion 100, the impedance Z is reduced to a lesser degree than it is by the higher distribution density in the first wall portion 95. This enables the drop 89 illustrated in Figure 4 to be prevented.

In the second wall portion 100, the orifices 60 are the same as those described with reference to Figure 5. In the second wall portion 100, additional rows 105 are provided between the rows 70, 75, 80, 85 already described, thereby increasing the distribution density in the first wall portion 95. In this embodiment, the orifices 60 are identical to one another. It would naturally also be conceivable for the orifices 60 to be of differing designs depending on the different wall portions 95, 100.

Figure 7 illustrates a variant of the shielding 15 based on a third embodiment. The shielding 15 is essentially the same as the design illustrated in Figure 6. The difference is that in addition to the first wall portion 95 and the second wall portion 100, a third wall portion 110 and a fourth wall portion 115 are provided. By contrast with the design illustrated in Figure 6, the second wall portion 100 in this instance is of a slimmer design and directly adjoins the first wall portion 95. On the right-hand side, the third wall portion 110 adjoins the second wall portion 100 in Figure 8. Disposed on the right-hand side of the third wall portion 110 is the fourth wall portion 115. The second wall portion 100 and the third wall portion 115 have the same distribution density of orifices 60. The distribution density of the third wall portion 110 is higher than that of the second wall portion 100 respectively the fourth wall portion 115. However, the third wall portion 110 has a lower distribution density than the first wall portion 95.

The third wall portion 110 and the fourth wall portion 115 are of essentially the same design as the second wall portion 100 in terms of the arrangement of orifices in rows. Again in these two wall portions 110, 115, the orifices are disposed in rows 70, 75 essentially parallel with and orthogonal to one another.

The advantage of this design is that the shielding 15 can be flexibly adapted to a cable run of the signal lines 20 in the second portion 50 in order to keep an impedance of the signal line 20 substantially constant right across the impedance adaptation system 10.

In the embodiment illustrated in Figure 7, the orifices 60 are disposed substantially identically to one another in the wall portions 95, 100, 110, 115. The advantage of this is that the orifices 60 can be produced in the shielding wall 55 in a particularly cost-effective manner in terms of manufacturing technology.

Figure 8 illustrates a variant of the shielding 15 based on a fourth embodiment. The shielding 15 is substantially identical to the design illustrated in Figure 6. The difference is that the orifices 60 are disposed in rows 70, 75 extending substantially diagonally (indicated by broken lines in Figure 8). As was the case in Figure 6, the orifices 60 in the shielding wall 55 are of an identical design to one another. It would naturally also be conceivable for the orifices 60 to be of different types and to be disposed at irregular distances from one another, for example.

Figure 9 illustrates a shielding 15 based on a fifth embodiment. As described with reference to Figures 5 to 8, the shielding 15 already has the shielding wall 55. Several orifices 120 are provided in the shielding wall 55 which are essentially wedge-shaped, being of a triangular shape in plan view. The shielding 15 in this instance has a first end face 125 facing the first portion 45. In Figure 10, the first end face 125 is disposed on the left-hand side. Lying opposite the first end face 125, a second end face 130 is provided, which is disposed on a side of the shielding 15 facing away from the first portion 45. The orifice 120 extends from the first end face 125 in the direction of the second end face 130. Due to its wedge-shaped design, the orifice 120 tapers from the first end face 125 towards the second end face 130. The orifice 120 extends across the entire longitudinal extension between the first end face 120 and the second end face 130. It would naturally also be conceivable for the orifice 120 to have a shorter extension so that the orifice 120 terminates to the left-hand side of the second end face 130 and a portion with no orifice 120 extending in it is provided in the shielding wall 55.

It would naturally also be conceivable for the orifice 120 to taper in the direction of the first end face 125 starting from the second end face 130.

The advantage of the design illustrated in Figure 9 is that a jump in impedance is prevented across the length of the impedance adaptation system 10 due to the constant slope of a cross-section of the shielding wall 55, thereby enabling the spacing of the two cables 21, 22 to be compensated as illustrated in Figure 1.

Figure 10 illustrates a variant of the shielding 15 based on a sixth embodiment. The shielding 15 is of a similar design to that illustrated in Figure 10. The difference is that the shielding 15 has an orifice 135 which extends in the shielding wall 55 from the first end face 125 in the direction of the second end face 130. The orifice 135 has a wave-shaped cross-section, which tapers out altogether at its end facing the second end face 130. The cross-section changes, becoming larger and smaller, across the longitudinal extension of the first end face 125 towards the second end face 130. As a result, a flexible adaptation to the run of cables 21, 22 of the signal line 20 can be obtained in the second portion 50 in order to ensure a substantially constant impedance Z across the entire longitudinal extension of the signal line 20.

To the right-hand side of a longitudinal end of the orifice 135, a wall portion 140 is provided in the shielding wall 55 in which no orifices are provided. It would naturally also be conceivable to dispense with the portion 140 so that the orifices 135 extend across the entire longitudinal extension of the shielding 15 as illustrated in Figure 10.

Figure 11 illustrates a variant of the shielding 15 based on a seventh embodiment. The shielding 15 is similar to the design of the shielding 15 illustrated in Figure 10. The difference is that the shielding 15 has a first portion 145 which is disposed adjoining the first end face 125. A second portion 150 is also provided at the second end face 130. A middle portion 155 is disposed between the first portion 145 and the second portion 150. The orifices 120 already described in connection with Figure 10 are respectively provided in the first portion 145 and the second portion 150, and the orifices 120 have a shorter longitudinal extension. Accordingly, the orifices 120 extend in the first portion 145 from the first end face 125 in the direction of the middle portion 155. The first orifices 120 terminate at the middle portion 155. No orifices 120 are provided in the middle portion 155 itself. However, the orifices 120 also extend from the second end face 130 towards the middle portion 155.

In this embodiment, the orifices 120 disposed on the left-hand side in the first portion 145 are symmetrical with respect to the orifices 120 disposed in the second portion 150 relative to a mid-axis 156 disposed in the middle portion

155. It would naturally also be conceivable to provide a non-symmetrical arrangement of the orifices 120 between the first portion 145 and the second portion 150. It would also be conceivable for the orifices 120 in the first portion 145 to have a different longitudinal extension from one another or to have a different longitudinal extension from the orifices 120 disposed in the second portion 150.

Figure 12 illustrates a plan view of the shielding 15 based on an eighth embodiment and Figure 13 illustrates a view in section of a section plane C-C indicated in Figure 13. The shielding 15 has a supporting layer 160 comprising a film-type material, for example, which has a permittivity ε_r greater than 1, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 5, in particular greater than 10, and/or a material with a permittivity ε_r of less than 1, in particular with a negative permittivity ε_r and/or a material with a magnetic permeability μ greater than 1.3, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 10, in particular greater than 100, a material with a permeability μ_r of less than 1, in particular with a negative permeability μ_r. In this respect in particular, it would be conceivable for the supporting layer 160 to be made from a plastic that is not electrically conducting. The shielding wall 55 is disposed on the top face of the supporting layer 160. The shielding wall 55 is vapour deposited onto the supporting layer 160 as another layer, for example. It would naturally also be conceivable for the shielding wall 55, especially if the shielding wall 55 is fashioned so that it forms a metamaterial, to also be applied to the preferably film-type supporting layer 160 by printing, laser sintering or in some other way and/or in addition vapour deposition.

The shielding wall 55 in this instance comprises the above-mentioned materials. Orifices 165 are provided between the shielding walls 55. The orifices 165 have a different longitudinal extension and are adjoined by strips of shielding wall 55 disposed in logarithmic patterns. The orifices 165 in this embodiment are therefore not provided in the form of end-to-end openings but as material-free zones without the material of the shielding wall 55.

Accordingly, the shielding wall 55 has various part-portions 170, each of a linear shape. The part-portions 170 are of identical width in the longitudinal extension of the shielding 15. It would naturally also be conceivable for the part-portions 170 to be of a differing width. In the longitudinal extension, however, the orifices 165 have a differing width. It would naturally also be conceivable for the orifices 165 to have the same width in the longitudinal direction.

In a direction extending transversely to the longitudinal extension, the shielding wall 55 has the same width as the orifices 165 so that the orifices 165 extend across the full width of the supporting layer 160, so to speak. Alternatively, it would naturally also be conceivable for the different part-portions 170 of the shielding wall 55 to be connected to one another in the direction of longitudinal extension so that at least some of the orifices

165 are completely surrounded by the shielding wall 55.

It would naturally also be conceivable for the designs of the shielding 15 illustrated in Figures 5 to 12 to be combined with the structure of the shielding illustrated in Figures 12 and 13 in terms of the supporting layer 160 and the orifices 165.

Figure 14 illustrates a schematic side view of a contacting system 200. Figure 15 is a view in section of the contacting system 200 illustrated in Figure 14 along a section plane D-D shown in Figure 15.

The contacting system 200 comprises a socket unit 205 constituting a first contacting system and a plug unit 210 constituting a second contacting system. The socket unit 205 is connected to a first signal line 215. The plug unit 210 is connected to a second signal line 220. The signal lines 215, 220 are of a design corresponding to signal line 20 illustrated in Figure 1.

The socket unit 205 comprises several socket elements 225 as the contact element and each socket element is connected respectively to one end of the cable 21, 22 and the electrical conductor 25, 35 of the first signal line 215 disposed in the cable 21, 22. The socket unit 205 further comprises a socket housing 230 in which the two socket elements 225 are disposed.

The plug unit 210 has a plug housing 235 which is disposed on the left-hand side of the socket housing 230 in Figure

14. Plug elements 240 constituting contact elements are provided in the plug housing 235, which are connected to a lengthwise end of the cables 21, 22 of the second signal line 220 respectively the electrical conductor 25, 35 disposed in the cable 21, 22. In the assembled state, the plug elements 240 extend into the socket elements 225 and are accommodated by the socket elements 225. As a result, an electrical connection is established between the plug element 240 and the socket element 225 respectively between the first signal line 215 and the second signal line 220.

In order to prevent a jump in impedance in the contacting system 200 and obtain the predefined impedance curve as explained above with reference to Figures 1 to 13, the shielding 15 is also provided. By way of example in this connection, the shielding 15 extends between the second portion 50 of the first signal line 215 and the second portion 50 of the second signal line 220. Not only are the non-twisted cables 21, 22 incorporated in the second portion 50 but also the socket elements 225 and plug elements 24 connected respectively to the cables 21, 22. By way of example, the shielding 15 is as explained in connection with figures 1 to 13.

The socket housing 230 has a circular cross-section, for example. Any other cross-section would naturally also be conceivable. The shielding 15 in this instance is disposed on the interior face of the socket housing 230 and shields the socket elements 225 respectively the plug elements 240 locating in the socket elements 225 from an environment 245. The shielding 15 inside the socket housing 230 may be vapour deposited, printed or applied in some other way to an electrically non-conducting material of the socket housing 230, for example.

In this embodiment, the socket housing 230 also extends in the longitudinal direction across the entire second portion 50 of the first signal line 215. It would naturally also be conceivable for the shielding 15 to be of a two-part design and be disposed in the region of the socket housing 230 on the socket housing 230, for example, and in the region of the second portion 50 to be provided in the form of a film and run around the second portion 50 of the first signal line 215.

It would naturally also be conceivable for the shielding 15 to be disposed on the circumferential face on the outside of the socket housing 230.

It should be pointed out that the description of the socket housing 230 in connection with the shielding 15 likewise applies to the plug housing 235 and the shielding 15 disposed on the plug housing 235. After connecting the socket unit 205 to the plug unit 210, it would also be conceivable to fit the shielding 15 over the socket unit 205 and plug unit 210, thereby simultaneously enabling the second portions 50 of the signal lines 215, 220 to be shielded from the environment 245 as well.

Figure 16 shows a diagram of an impedance Z plotted across the length l of the contacting system 200 illustrated in Figures 14 and 15. By providing the impedance adaptation system 10 in both the region of the non-twisted cables 21, 22 (second portion 50) and the contacting system 200, the impedance Z across the length l is also kept substantially constant in the region of the contacting system 200 (shown by a solid line in Figure 16).

This enables an improved signal transmission between the two signal lines 215, 220 to be obtained and cross-talk to be minimised. Due to the improved signal transmission, the line lengths of the signal lines 215, 220 may be made longer overall and/or the number of contacting systems 200 for transmitting signals between two points can be increased. The data rate can also be increased due to the improved signal transmission.

In terms of its impedance, the shielding 15 is usually adapted essentially to the impedance Z of the signal line 20, 215, 220. It would naturally also be conceivable for the signal line 20, 215, 220 to have a different impedance Z from that of the impedance adaptation system 10.

For example, it would be conceivable for the first signal line 215 in the first portion 45 to have a first impedance Z_1. Across the first portion 45 of the first signal line 215, the first impedance Z_1 is constant. The first impedance may be Z_1 = 100 Ohm, for example. The first portion 45 of the second signal line 225 has a second impedance Z_2 which is different from the first impedance. The second impedance Z_2 is constant across the first portion 45 of the second signal line 220. The second impedance may be Z_2 = 50 Ohm, for example. Other values for the first and/or second impedance Z_1, Z_2 would naturally also be conceivable. The shielding 15 of the impedance adaptation system 10 is configured so that the impedance Z in the second portion 50 has a predefined impedance curve. The predefined impedance curve of the shielding 15 is selected so that the impedance Z across the length l of the signal lines 215, 220 and the contacting system 200 drops from the first impedance Z_1 to a second impedance Z_2 (indicated by broken lines in Figure 16). Alternatively, it would also be conceivable for the impedance curve Z to rise from the first impedance Z_1 to the second impedance Z_2. In this respect, it is of particular advantage if the rise or fall of the predefined impedance curve is linear or degressive or progressive or regressive.

The particular advantage of this is that an impedance Z of the signal line 20, 215, 220 across the impedance adaptation system 10 can be adapted in a simple manner. For example, it would be conceivable to adapt a 50-Ohm signal line (second signal line 220) by means of the shielding 15 continuously to a 100-Ohm signal line application (first signal line 215) by adapting the impedance adaptation system 10 accordingly. This has a particular advantage in that when producing cable harnesses, in particular for automotive vehicles, the signal lines can be adapted to different applications in a simple manner, thereby reducing the number of parts needed.

The predefined impedance curve described with reference to the drawings can be obtained by adapting the shielding 15 and signal line 20, 215, 220 to one another accordingly on the basis of an impedance to be obtained or the predefined impedance curve of the impedance system. The adaptation can be achieved by selectively varying the geometric layout explained in connection with Figures 5 to 13 and the design of the orifices 60, 120, 135, 165 and an appropriate design of the shielding wall 55.

It should be pointed out that the features described with reference to the embodiments may naturally be combined with one another with a view to adapting the shielding system 10 to the respective application.

Although the invention was described and illustrated in detail on the basis of a preferred embodiment, the invention is not restricted to the examples described and the skilled person will be able to derive other variations without departing from the scope of the invention.

List of reference numbers

10	Cable shielding system
15	Shielding
20	Signal line
21	First cable
22	Second cable
25	First electrical conductor
30	First isolator
35	Second electrical conductor
40	Second isolator
45	First portion
50	Second portion
55	Shielding wall
60	Orifice
65	Orifice contour
70	First row
75	First row
80	Second row
85	Second row
89	Drop
90	Adhesive layer
95	First wall portion
100	Second wall portion
105	Additional row
110	Third wall portion
115	Fourth wall portion
120	Orifice
125	First end face
130	Second end face
135	Orifice

140 Wall portion
145 First portion
150 Second portion
155 Middle portion
156 Mid-axis
160 Supporting layer
165 Orifice
170 Part-portion
200 Contacting system
205 Socket unit
210 Plug unit
215 First signal line
220 Second signal line
225 Socket element
230 Socket housing
235 Plug housing
240 Plug elements
245 Environment

Claims

1. Impedance adaptation system (10)
- comprising at least a shielding (15) and at least one signal line (20),
- which signal line (20) comprises a first cable (21) and a second cable (22),
- the first cable (21) being twisted with the second cable (21) in a first portion (45) of the signal line (20),
- and the shielding (15) is disposed at least partially in the second portion (50) of the signal line and the cables (21, 22) are non-twisted,
- and the shielding (15) has a shielding wall (55) at least partially enclosing the circumferential face of the signal line (20),

characterised in that
- the shielding (15) has at least one orifice (60, 120, 135, 165),
- and the orifice (60, 120, 135, 165) is disposed in the shielding wall (55),
- and the orifice (60, 120, 135, 165) and the shielding wall (55) are adapted to one another so that a transition between the first portion (45) and the second portion (50) has a predefined impedance curve.

2. Impedance adaptation system (10) as claimed in claim 1, characterised in that
- the shielding (15) comprises a first end face (125) facing the first portion (45) of the signal line (20) and a second end face (130) facing away from the first

portion (45),

- and the orifice (120, 135) has a differing width from the first end face (125) in the direction of the second end face (130).

3. Impedance adaptation system (10) as claimed in claim 2, characterised in that the orifice (120) tapers from the first end face (125) in the direction of the second end face (130).

4. Cable shielding device (10) as claimed in one of claims 1 to 3, characterised in that at least three orifices (60, 120, 135, 165) are provided and the orifices (60, 120, 135, 165) are arranged in a regular pattern and/or at a constant distance from one another in the shielding wall (55).

5. Impedance adaptation system (10) as claimed in one of claims 1 to 4, characterised in that the orifice (60) is completely surrounded by a material of the shielding wall (55).

6. Impedance adaptation system (10) as claimed in one of claims 1 to 5, characterised in that

- the shielding wall (55) comprises a first wall portion (95) and a second wall portion (100, 110, 115),
- and the first wall portion (95) preferably faces the first portion (45),
- and a plurality of orifices (60) is provided in the first wall portion (95) and in the second wall portion (100, 110, 115),

- and a first distribution density of the orifices (60) in the first wall portion (95) is different from a second distribution density of the orifices (60) in the second wall portion (100, 110, 115), and/or
- a number of orifices in the first wall portion (95) is greater than a number of orifices in the second wall portion (100, 110, 115).

7. Impedance adaptation system (10) as claimed in one of claims 1 to 6, characterised in that the orifice (60) has a circular cross-section or an elliptical cross-section or a rectangular cross-section or a triangular cross-section.

8. Impedance adaptation system (10) as claimed in one of claims 1 to 7, characterised in that the shielding (15) comprises at least one of the following materials:
- electrically conducting materials,
- aluminium,
- copper,
- electrically conducting plastic,
- ferrite,
- ferrite-filled plastic,
- sintered ferrite,
- film-type material,
- material with a permittivity ε_r greater than 1, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 5, in particular greater than 10 and/or less than 1000,
- material with a permittivity ε_r of less than 1, in particular with a negative permittivity ε_r, and/or with

a permittivity ε_r greater than -1000,

- material with a magnetic permeability μ greater than 1.3, preferably greater than 1.5, in particular greater than 2, particularly advantageously greater than 10, in particular greater than 100, and/or less than 1000,
- material with a permeability μ_r of less than 1, in particular with a negative permeability μ_r, and/or a permeability greater than -1000,
- metamaterial,
- liquid/powdered coating material.

9. Impedance adaptation system (10) as claimed in one of claims 1 to 8, characterised in that the shielding (15) is a film-type material.

10. Impedance adaptation system (10) as claimed in one of claims 1 to 9, characterised in that every cable (21, 22) comprises
    - an electrical conductor (25, 35), and an electric signal with a wavelength (2) can be transmitted by means of the electrical conductor (25, 35),
    - and the orifice (60) has an orifice contour (65) with a contour length,
    - and a value of the contour length of the orifice contour (65) is at least smaller than a value of one half of the wavelength (λ), preferably less than one tenth of the wavelength (λ).

11. Impedance adaptation system (10) as claimed in claim 10, characterised in that the contour length has a

value that is less than 1.5 mm, preferably less than 30 mm.

12. Impedance adaptation system (10) as claimed in one of claims 1 to 11,
- in which the predefined impedance curve is substantially constant,

or

- in which the predefined impedance curve rises or falls from a first impedance (Z_1) to a second impedance (Z_2),
- and the rise or fall is preferably linear or degressive or progressive or regressive.

13. Contacting system (200) having an impedance adaptation system (10) as claimed in one of claims 1 to 12, and a contacting system (205, 210),
- which contacting system (205, 210) is configured to establish an electrical contact to another electrical component,
- and the shielding (15) extends at least partially around the contacting system (205, 210).

14. Contacting system (200) as claimed in claim 13, characterised in that
- the contacting system (205, 210) comprises at least two contact elements (225, 240) and a housing (230, 235),
- and a contact element (225, 240) is attached respectively to one end of an electrical conductor (25, 35) of the cable (21, 22),
- and the contact elements (225, 240) are disposed in

the housing (230, 235),

- and the shielding (15) is disposed between the contact element (225, 240) and the housing (230, 235) or at least partially around the circumferential face of the housing (230, 235).