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Description

The invention concerns an electrically operated surface heating system, in particular a surface heating system which can be used in conjunction with floor panels. The invention also concerns a connecting element and an insulating panel for use in a surface heating system according to the invention.

There are known in the art for example laminate panels which on their underside have an insulating material for damping the sound of footsteps and a heating film for heating the assembled floor. The panels with integrated heating function are rectangular, wherein provided at the respective ends are two plugs with which a panel is electrically connected to the panels adjacent at the ends. At their end and longitudinal sides the panels have mechanical snap-engagement or latching connecting elements so that the floor covering can be laid without adhesive. Because the electrical connection of the panels to each other is made at the ends by fitting together the plug connectors there are certain practical constraints in regard to the mechanical connecting elements for the panels. In the present case the electrical connectors of adjacent panels are assembled and then the mechanical connection is made at the ends of the previously electrically connected panels. That almost inevitably means that the panels are mechanically connected at the end by a relative displacement of the panels along their longitudinal edge, at the respective ends thereof, to their respectively adjacent panels. In that respect the options of making the mechanical connection between the panels with a heating function is limited in the state of the art by virtue of the electrical coupling which is necessary at the same time.

German Utility Model specification DE 202 18 331 U1 discloses a heated floor panel in which an electrical resistance heating film is laminated on to the underside of the panels. Electrical contacting of adjacent panels can be effected either at their ends or at their longitudinal sides. For electrically connecting adjacent panels they have electrically operative

pockets or plug portions which operate on the basis of the electrical socket-plug principle.

A heating arrangement is also known, as is described in German laid-open specification DE 198 49 432 A1. It has a surface heating system with
5 a layer for producing electromagnetic waves, wherein an oscillation spectrum in the range of monopolar natural frequencies is to be generated by means of a harmonics generator. Individual heating elements are used as surface heating elements and are connected to the harmonics generator in electrically interconnected relationship.

10 A surface heating system of the general kind set forth is proposed is US 2001/0010138 A1. In that case a floor panel includes a bamboo panel and an insulating panel. To electrically connect two floor panels the conductor strips are so provided that they can be contacted by way of a connecting element which can be plugged in.

15 The problem of the present invention is to provide a surface heating system which can be flexibly used, which is of a low structural height, which is simple to install and which in particular when used for adhesive-less laminate floor panels limits the possible mechanical connections between the panels to a lesser degree than is the case with known
20 systems.

That problem is already solved in a surprisingly simple manner with a surface heating system according to claim 1. Further advantageous subjects are recited in the appendant claims.

In that respect the surface heating system according to the invention
25 has a plurality of insulating panels which are to be arranged in mutually juxtaposed relationship and electrically interconnected, with a heating function, which can be used in particular for use as an underlay support for panels like laminate floor panels. In that case the insulating panel and the panels, unlike the above-described state of the art, are not connected to
30 each other but are separate from each other. In addition the system includes connecting elements for electrically connecting two adjacently arranged insulating panels and a power supply with which the necessary heating current is provided. An insulating panel of the system has at least

one layer of insulating material, to which there is fitted a heating film device which is in the form of resistance heating means and along two edges of which extends a respective conductor strip in such a way that the two conductor strips are spaced relative to each other. The connecting
5 elements have at least two spaced and electrically connected adhesive portions, wherein a respective contacting adhesive portion can be electrically connected to a conductor film of an insulating panel. Both conductor strips can extend along the longitudinal edge or along the narrow edge of the insulating panel if the latter is rectangular. It is also in
10 accordance with the invention for more than two conductor strips to be provided with conductive material disposed therebetween on the insulating panel, but ultimately that increases the manufacturing expenditure. In that case in the laid condition the conductor strips on an insulating panel are connected either to the operating potential or to a reference potential, in
15 that respect in such an embodiment only two electrical potentials must be passed from one insulating panel to an adjacent one by way of the connecting elements.

Particularly when the surface heating system according to the invention is used as an underlay support for floor panels the mechanical
20 coupling between the panels and the panel laying process is not restricted. For example it is now also possible to heat a panel floor in which adjacent panels are connected at the ends by being pushed in along the end edges, which is not possible with the known heating arrangements in the state of the art. In addition, the provision of electrical connecting elements which
25 are to be secured by adhesive means that the structural complication and expenditure in regard to the electrical coupling of adjacent heating elements can be reduced. As, by virtue of their structural configuration, just like the heating film itself, the connecting elements are of a small structural height the entire surface heating means can be very thin.

30 Advantageous configurations are recited in the appendant claims.

To provide a heating function over a large area on an insulating panel it can be provided that disposed between the conductor strips is a conductive material having a specific resistance greater than the sheet

resistance of the conductor film. That further provides that there is a uniform heating voltage over the entire extent of the heating arrangement and in that respect homogeneous heat production is implemented over substantially the entire extent of the heating arrangement. In that case the heating current flows between the two conductor strips of an insulating panel. In that respect the heating voltage then drops between the two conductor strips of the respective insulating panel while the electrical potential is substantially constant on a strip of a panel. In that case the conductive material with a specific resistance greater than that of the conductor strip can include for example a graphite, a carbon fibre or also another suitable conductive material. It is also possible to use composite materials. It is particularly advantageous if the conductive material can be applied to a suitable underlay support by a screen printing process.

It may be desirable if the connecting element includes a carrier with conductor film disposed thereon so that the connecting element provides particularly good conductivity and involves only a negligible voltage drop in the feed of current in the conductor strips.

To avoid short-circuits it can be provided that the conductor film and/or the conductive material with a higher specific sheet resistance in comparison with the conductor strips are covered with an insulating cover layer, in particular an insulating plastic layer. In that case the plastic layer is removed to provide a contact location in the region of an edge of the insulating panel, for example an end, so that the conductor film is exposed. That exposed region can then be used for contacting with a connecting element.

The conductor strips used on the insulating panel can comprise various, good-conducting materials, for example they can include metal or a conductive plastic. The same also applies to the conducting film of the connecting element, wherein in a particularly advantageous embodiment the connecting element can comprise a conductive and flexible plastic so that there is no longer any need for the provision of a composite material.

It may be desirable if the connecting element in the stated contacting adhesive portion includes an inner portion with an electrically

conductive adhesive which is completely enclosed by a water-tight adhesive in the main plane of the connecting element. In that respect the electrically conductive adhesive provided in the inner region serves for contacting with a freely accessible part of a conductor film of the heating film device of an insulating panel and the region which surrounds it and in which the water-tight adhesive is disposed serves for protecting the inner region from moisture. It is particularly desirable if the two adhesives are applied in pre-fabricated form to the respective regions of a connecting element, wherein those regions are protected with a protective film from environmental influences. Therefore the user only has to remove that protective film and then bring the connecting element into contact with the corresponding freely exposed conductor strip portion of the heating film device in order to achieve both electrically and mechanically a connection between the heating film device and the connecting element, wherein the electrical connection is protected from moisture and the mechanical connection of the insulating panels generally plays a subordinate part.

Depending on the respective configuration involved it is possible for example to use a wood fibre, rubber and/or foam as the material for the insulating panels, to which the heating film device can be mounted, for example by being laminated thereto. Other insulating materials are also possible insofar as they can provide the required insulating function, in particular sound insulation like insulation for the sound of footsteps.

Advantageously the surface heating system according to the invention includes a temperature sensor which detects the temperature of the heating film device or adjacent regions as in the insulating material. It is particularly desirable if the temperature sensor is arranged on the heating film so that the temperature can be detected at the location where heat is generated. In that respect it may be desirable if the system has a temperature control device which controls the power supply in response to an actual-target temperature comparison. In that respect the actual temperature can be a room temperature and the target temperature can be a desired room temperature. To avoid an accumulation of heat at the same time the temperature in the heating film and/or in the insulating material or

– in the case of a floor – the temperature of the floor panels can be monitored.

The surface heating system according to the invention can be operated both with an ac voltage, in particular with a mains-operated 50 Hz ac voltage and also with a dc voltage. That operating voltage in that case is the voltage which is applied between the two conductor strips of a panel. In that case for example the power supply device can be a mains-operated controllable dc voltage which is suitably controlled by the temperature control means. The power supply device in that case can be a transformer device as well as a rectifier device with under some circumstances a smoothing capacitor for providing the operating dc voltage.

A very uniform delivery of heat over the entire insulating panel is achieved if the conductive material with a specific resistance greater than and in particular more than 5 times greater than the sheet resistance of the conductor foil is distributed homogeneously between the conductor strips. Depending on the respective electrical factors, in particular in dependence on the specific resistance of the conductive material, it may also be desirable if the conductive material is arranged in strip form between the conductor strips of an insulating panel so that spaced strips of that material are present between the conductor strips. In general those strips extend perpendicularly to the conductor strips.

The surface heating system according to the invention can be used in particular both for the floor region and also for the wall region of rooms in buildings. Contacting of the individual panels with each other and a panel with the power supply device depends on the respective electrical factors involved. For example it may be that a certain number of panels are electrically connected in series before the connection to the power supply is made. Further series-connected panels can then be connected in the surface heating system according to the invention to the power supply in parallel relationship with the first-mentioned series connection.

The essential parts of the surface heating system according to the invention are accordingly the insulating panels which are to be arranged basically in any relationship with each other, with respect to a heating

surface, as well as the connecting elements for electrically contacting those panels with each other or with electrical connecting devices of the supply device. In addition those parts must be connected to a power supply by means of connecting devices, wherein a control device can be included, 5 which controls the heating current or the heating voltage in dependence on one or more temperature detection processes.

With a suitable configuration for the heating film device as well as the configuration and/or operation of the power supply it is also possible to use the surface heating system according to the invention for cooling 10 purposes. In that case the film device is then in the form of a cooling film device. Such a surface cooling system of that kind is preferably fitted to at least one wall of a room, that is to say the panels with cooling film device mounted thereto are fixed to a wall.

The invention is described hereinafter by the description of some 15 embodiments and further advantageous features with reference to the accompanying drawings in which:

Figure 1a shows an insulating panel of the surface heating system according to the invention,

Figure 1b shows a detail view of the insulating panel shown in Figure 20 1a,

Figure 2 shows two insulating panels connected by means of an electrical connecting element,

Figure 3a shows a side view of the connecting element shown in Figure 2, and

25 Figure 3b shows a plan view of the connecting element shown in Figure 2.

The invention is described hereinafter with reference to a surface heating system which is designed according to the invention and which can be used as an underlay support for a conventional laminate floor which is to 30 be laid in glue-free fashion. In that case the laminate panels can be of any desired configuration in regard to their connecting elements as they are laid on the surface heating system according to the invention. It will be

appreciated that the surface heating system described hereinafter is also suitable for use with a solid wood floor or a plastic floor covering.

The insulating panels included in the described system are rectangular and are of a length of between 1.0 and 1.2 m with a width of
5 between 30 and 80 cm. Figure 1a, b show a plan view of such an insulating panel on that side to which a heating film is applied by lamination. Of the insulating panel 10, the two spaced conductor strips 11, 12 which respectively extend at the edge of a longitudinal edge in mutually parallel relationship and which are here in the form of copper films are shown.
10 Those conductor strips are applied to a thin layer of a graphite composite 13 and electrically and mechanically connected to the homogeneous graphite composite. The drawing does not show a transparent insulating cover layer of a plastic which is applied to the surface of the insulating panel, that is visible in the Figure, to protect the graphite composite 13 and
15 the copper films or to avoid a short-circuit between the two conductor strips. In the region of the two end edges of which only one is shown in Figures 1a, b the plastic covering is removed over a portion of the copper strips in such a way that a respective rectangular region is exposed, which can be used for contacting purposes. In a further embodiment (not shown)
20 the exposed region can also be contoured otherwise, for example oval or circular. In Figures 1a, b that exposed region of the copper film is shown as white for clarification purpose and is denoted by references 14 and 15 respectively.

In another embodiment (not shown) the conductor strips are made
25 from a conductive material which includes carbon fibres.

Figure 2 shows a side view of the insulating panel 10, wherein the upper plastic covering on the heating film is not shown. The insulating panel includes a layer of insulating material 16, in the present case a wood fibre, on which the heating device produced in the form of a film is glued.
30 The heating device as essential components includes the graphite composite 13 with the two spaced films 11, 12, of which Figure 2 shows the copper film 11. The heating film not only has a plastic covering on the side shown in Figure 1, but also on the opposite underside, so that ultimately

this provides the specified heating film which is applied by lamination to the insulating material 16. Figure 2 now shows a side view of two such insulating panels which are disposed in opposite relationship in regard to their ends. The oppositely disposed copper films are now electrically
5 connected together by an electrical connecting element 20. For that purpose at its two longitudinal ends the connecting element 20 has a respective contact region which for contacting purpose is applied to the insulating panel in conforming relationship with the respective exposed regions 14 and 15 of the copper films and is glued thereto.

10 Figure 3a, b show the structure of the electrical connecting element for the described surface heating system according to the invention as a side view, see Figure 3a, and as a plan view, see Figure 3b. The connecting element 20 is in the form of band and has a flexible carrier comprising a plastic 23 to which a metal film 24 is applied by lamination. Provided at the
15 longitudinal ends of the connecting element 20 is an inside surface 21 of the metal film, which is coated with a conductive adhesive 21. That surface with conductive adhesive 21 is completely enclosed by a surface of the metal film, to which a water-resistant adhesive 22 is applied. The length of the connecting element and the arrangement of the regions with conductive
20 adhesive is matched to the laying spacing between two insulating panels in such a way that the region with the conductive adhesive 21 comes into contact with the exposed region 14 and 15 respectively of the copper film on the insulating panel 10 when two such insulating panels are laid in mutually juxtaposed relationship and the connecting element as shown in
25 Figure 2 is respectively placed with an end on one of the two insulating panels and pressed thereon so that the desired conductive adhesive contacting effect is afforded between the associated copper films 11 of the two insulating panels in opposite relationship at their ends, see Figure 2.

30 The size of the insulating panels can be matched to the floor laminate panels used, but it is advantageous if the insulating panels are arranged in displaced relationship with the floor panels to avoid the electrical connecting elements 20 being disposed in the region of the mechanical connections between the panels as otherwise the mechanical

loadings are unnecessarily high, in particular perpendicularly to the plane of the panels, at the connecting elements. To provide for rapid heat transfer to the panels it is provided that the insulating panels are disposed with the insulating material 16 on the support surface and the panels are disposed
5 directly on the heating device. That also simplifies adjustment of the connecting elements on the insulating panels, that is to say on the heating film.

The power supply in the described example provides a mains-operated dc voltage, wherein the electrical circuitry is such that a
10 respective one of the two potentials is applied to one of the conductor strips 11, 12 so that a current flows between the two conductor strips or copper film strips 11, 12. The electrical circuitry or contacting of the insulating panels with a heating function can be easily matched to the specific factors involved. Depending on the respective size of the room or room region to
15 be heated for example an individual row of insulating panels bearing against each other at their ends can be electrically connected in series by the above-described contacting arrangement and then connected to the power supply so that all rows are in parallel at the power supply. In addition however it is also possible for all insulating panels of a plurality of
20 rows to be connected in successive serial relationship.

In an embodiment (not shown) a temperature sensor is arranged on or in the graphite composite so that the instantaneous temperature of the heating means can be directly detected, whereby it is possible for example to avoid overheating of the surface heating system according to the
25 invention by suitable control of the power supply. In addition the desired temperature can be automatically set by detection of an actual temperature of a room to be heated and an input of a target temperature, by a corresponding control device.

List of references

	10	insulating panel
5	11, 12	conductor strip, copper film
	13	graphite composite
	14, 15	exposing of the conductor film
	16	insulating material
	17	heating film
10	18	plastic covering
	20	connecting element
	21	conductive adhesive
	22	water-resistant adhesive
	23	carrier
15	24	conductor strip, copper film

Patentkrav

1. Overfladeopvarmningssystem med flere, ved siden af hinanden anbragte og elektrisk forbundne isoleringsplader (10) med opvarmningsfunktion, især til anvendelse som underlag for paneler, såsom gulvlaminatpaneler, og med forbindelseselementer (20) til elektrisk forbindelse af to ved siden af hinanden anbragte isoleringsplader (10), samt en strømforsyning, hvor
- 5 - en isoleringsplade har mindst et lag (16) af isolerende materiale, **kendetegnet ved, at**
- 10 der på det isolerende materiale er anbragt en varmefolieindretning (17), der er udformet som modstandsopvarmning, langs med hvis langsgående kanter to lederstrimler (11, 12) forløber med afstand fra hinanden, at et forbindelseselement (20) har to med afstand fra hinanden anbragte og elektrisk forbundne kontaktklæbeafsnit (21), og at hvert kontaktklæbeafsnit er forbundet
- 15 elektrisk med en isoleringsplades lederstrimmel.
2. System ifølge krav 1, **kendetegnet ved, at** der mellem et forbindelseselements (20) lederstrimler (11, 12) er anbragt et ledende materiale med en specifik flademodstand, som er større end lederstrimlernes (11, 12) flademodstand.
- 20
3. System ifølge krav 1 eller 2, **kendetegnet ved, at** forbindelseselementet (20) omfatter en bærer (23) med en på denne anbragt lederstrimmel (24).
- 25
4. System ifølge krav 1, 2 eller 3, **kendetegnet ved, at** isoleringspladens lederstrimler (11, 12) hver især er overtrukket med et isolerende kunststoflag, som er fjernet med henblik på fastlæggelsen af et kontaktsted i området (14, 15) ved isoleringspladens endeflader, på en sådan måde, at lederstrimlen er blotlagt.
- 30
5. System ifølge et af kravene 1 til 4, **kendetegnet ved, at** isoleringspladens (10) lederstrimler (11, 12) omfatter metal eller ledende kunststof.
- 35
6. System ifølge et af kravene 1 til 5, **kendetegnet ved, at** forbindelseselementets (20) lederstrimmel (24) omfatter metal eller ledende kunststof.

- 5 7. System ifølge et af kravene 1 til 6, **kendetegnet ved, at** et forbindelses-
element (20) i klæbeafsnittet omfatter et indre afsnit med en elektrisk ledende
klæber (21), som i forbindelseselementets hovedplan er fuldstændigt inde-
sluttet af en vandtæt klæber (22).
- 10 8. System ifølge et af kravene 1 til 7, **kendetegnet ved, at** isoleringsmateria-
let (16) omfatter træfibre, gummi og/eller skummateriale.
- 10 9. System ifølge et af kravene 1 til 8, **kendetegnet ved, at** der er anbragt en
temperatursensor i i varmefolien.
- 15 10. System ifølge et af kravene 1 til 9, **kendetegnet ved, at** strømforsynings-
indretningen er en netværksdrevet, styrbar jævnspændingskilde.
- 15 11. System ifølge et af kravene 1 til 9, **kendetegnet ved, at** strømforsynings-
indretningen udsender en 50 Hz-vekselstrøm.
- 20 12. System ifølge et af kravene 1 til 11, **kendetegnet ved, at** det ledende
materiale (13) er fordelt ensartet mellem en isoleringsplades lederstrimler
(11, 12).
- 25 13. System ifølge et af kravene 1 til 11, **kendetegnet ved, at** det ledende
materiale er anbragt på en strimmellignende måde mellem en isoleringspla-
des (10) lederstrimler (11, 12), på en sådan måde, at der mellem lederstrim-
lerne er anbragt strimler med en på forhånd angivet bredde, hvilke forløber
vinkelret på lederstrimlerne og er anbragt med afstand mellem hinanden.
- 30 14. System ifølge et af kravene 1 til 13, **kendetegnet ved, at** materialet af
forbindelseselementets (20) bærer (23) er fleksibelt.
- 30 15. System ifølge et af kravene 1 til 14, **kendetegnet ved, at** forbindelses-
elementet (20) omfatter et ledende og fleksibelt kunststofmateriale.
- 35 16. System ifølge et af kravene 1 til 15, **kendetegnet ved, at** systemet har
en temperaturstyringsindretning, som styrer strømforsyningen som en reakti-

on på en sammenligning af den aktuelle temperatur og indstillingstemperaturen.

5 **17.** System ifølge et af kravene 1 til 16, **kendetegnet ved, at** forbindelselementets bærer (23) og lederfolie (24) er udformet integreret som et ledende kunststofbånd.

10 **18.** Forbindelselement til anvendelse i et overfladeopvarmningssystem ifølge krav 1, omfattende en lederstrimmel (24), **kendetegnet ved, at** lederstrimlen (24) er anbragt på en bærer (23), at der er tilvejebragt to elektrisk forbundne kontaktklæbeafsnit (21) med afstand fra hinanden, hvor kontaktklæbeafsnittene (21) er forsynet med et isolerende kunststoflag og har områder, som er blottet fra det isolerende kunststoflag med henblik på samvirkning med isoleringsplader (10), der omfatter lederstrimler (11, 12), hvilke isoleringspladers lederstrimler er overtrukket med et isolerende dæklag, som er fjernet i området ved en kant af isoleringspladen, hvor der ved hjælp af forbindelselementets (20) kontaktklæbeafsnit (21) og dertil beregnede områder af isoleringspladernes (10) lederstrimler (11, 12) kan etableres en elektrisk kontakt.

20 **19.** Isoleringsplade med opvarmningsfunktion til anvendelse i et overfladeopvarmningssystem ifølge krav 1, hvor isoleringspladen (10) har mindst et lag (16) af et isolerende materiale, på hvilket der er anbragt en varmemefolieindretning (24) udformet som en modstandsoptarmning, langs med hvis langsgående kanter der forløber to lederstrimler (11, 12) med afstand mellem hinanden, **kendetegnet ved, at** isoleringspladens (10) lederstrimler (11, 12) er overtrukket med et isolerende kunststoflag, hvor det isolerende kunststoflag er fjernet med henblik på fastlæggelsen af et kontaktsted (14, 15) i området ved isoleringspladens endeflader, på en sådan måde, at lederstrimlerne hver
25
30 især er blotlagt.

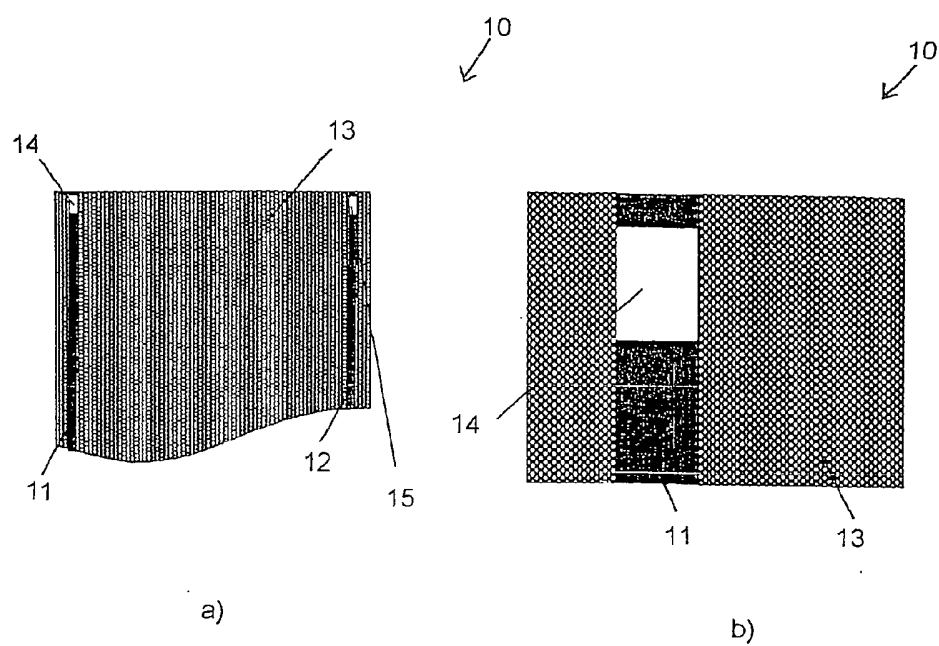


Fig. 1

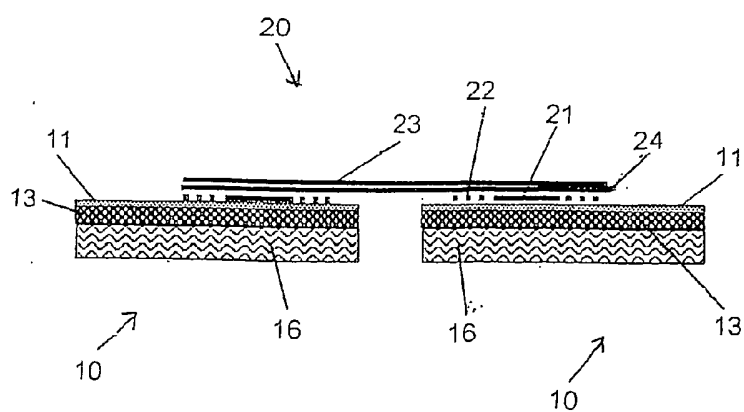
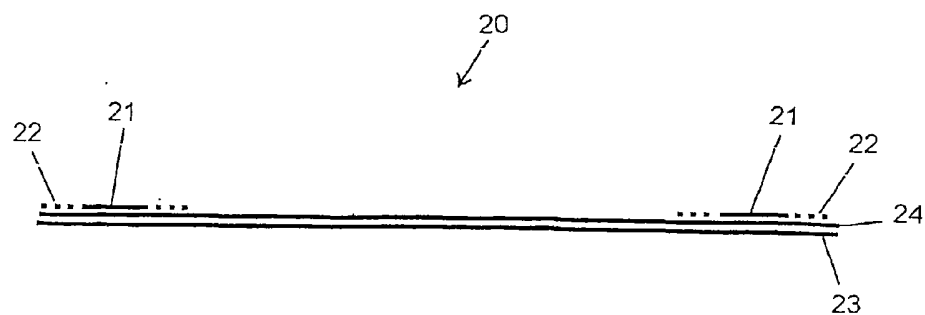
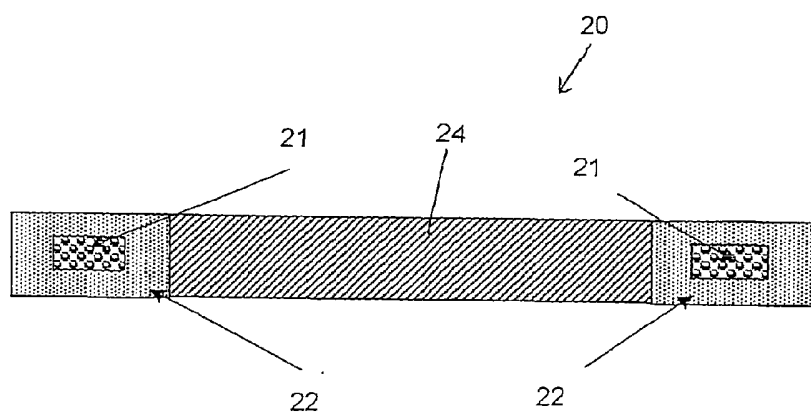


Fig. 2

Fig. 3



a)



b)