(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 June 2009 (04.06.2009)

PCT

(10) International Publication Number
WO 2009/069112 A1

(51) International Patent Classification:
A61M 37/00 (2006.01) *A61K 9/00* (2006.01)
A61M 31/00 (2006.01)

(21) International Application Number:
PCT/IE2008/000115

(22) International Filing Date:
28 November 2008 (28.11.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
S2007/0861 28 November 2007 (28.11.2007) IE
S2008/0884 4 November 2008 (04.11.2008) IE

(71) Applicant *(for all designated States except US)*: **JANISYS LIMITED** [IE/IE]; Galway Business Park, Dangan, Galway (IE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **O'DEA, John** [IE/IE]; 1 The Hawthorns, Truskey West, Bearna, Galway (IE). **BAMBURY, Eoin** [IE/IE]; Cluain, Dublin Road, Navan, County Meath (IE).

(74) Agent: **F.F. GORMAN & CO.**; 15 Clanwilliam Square, Dublin 2 (IE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:
— *with international search report*

(54) **Title:** A DELIVERY DEVICE FOR ADMINISTERING AN ACTIVE SUBSTANCE TO A SUBJECT

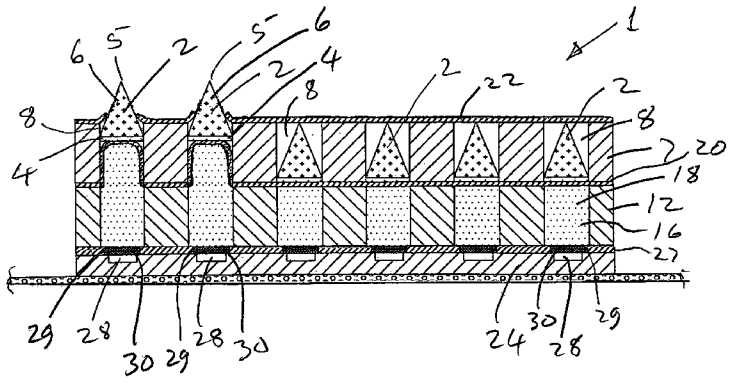

FIG 5

(57) **Abstract:** A delivery device (1) for administering an active substance to a subject transdermal^ comprises a first plate member (7) having a plurality of first chambers (8) formed therein. Solid form structures (2) comprising the active substance and of conical shape having a pointed skin penetrating tip (5) are located in the first chambers (8). A second plate member (12) having a plurality of second chambers (16) comprising a driving substance (18) is secured to the first plate member (7) with a first membrane (20) of an expandable material sealably located between the respective first and second plate members (7,12). Expansion of the driving substance (18) in the second chambers (22) urges the first membrane (20) into the corresponding first chambers (8) for in turn urging the solid form structures (2) to penetrate through a second membrane (22) into the skin of the subject. A third plate member (24) comprises a plurality of electrically powered heating elements (28) aligned with the second chambers (22) for heating the driving substance (18) in the second chambers (16) for in turn expanding the driving substances (18) therein.

WO 2009/069112 A1

A DELIVERY DEVICE FOR ADMINISTERING AN ACTIVE SUBSTANCE TO A SUBJECT

The present invention relates to a delivery device for administering an active substance to a subject, and the invention also relates to an injectable element for administration to a subject. The invention further relates to a method for administering an active substance to a subject.

Delivery devices for delivering an active substance to a subject are known. One type of delivery device which is currently gaining acceptance is commonly referred to as a micro-delivery device. Such micro-delivery devices are particularly suitable for delivering an active substance transdermally, transcutaneously and intradermally, and comprise a laminated structure, which typically comprises three or four layers which are separated by respective membranes. A first layer which is located between a second layer and a third layer is provided with a plurality of first chambers for storing the active substance to be administered transdermally to the subject. The first chambers typically are formed by bores extending through the first layer and are arranged in a matrix in the first layer and sealed by respective first and second membranes located at respective opposite major surfaces of the first layer.

The second layer typically comprises a plurality of second chambers formed by bores extending through the second layer and arranged in a matrix and aligned with the corresponding first chambers. The first membrane is located between the first and second layers for sealably isolating the first and second chambers from each other. A driving medium is located in each of the second chambers for urging the first membrane into the first chambers for discharging the active substance from the corresponding first chambers. Typically, the driving medium comprises an expandable medium which expands in response to an increase in temperature.

The third layer is located on the opposite side of the first layer to that of the second layer and comprises a plurality of micro-needles extending therefrom for penetrating the skin of a subject. A bore extends through each micro-needle for accommodating the active substance therethrough from the corresponding first chamber. The

second membrane is located between the first layer and the third layer, which sealably isolates the first chambers from the bores of the respective micro-needles. The second membrane is of a burstable material which bursts in response to an increase in pressure in the first chambers resulting from expansion of the first membrane into the first chambers for in turn communicating the first chambers with the bores through the corresponding micro-needles for delivering the active substance transdermally to the subject.

In such micro-delivery devices a fourth layer is provided which comprises a plurality of heating elements which are formed on the fourth layer for raising the temperature of the driving medium. The fourth layer with the heating elements thereon may be secured directly to the third layer, or secured to the third layer through a third membrane which sealably isolates the second chambers from the corresponding heating elements. By appropriately activating the heating elements to raise the temperature of the driving medium, the driving medium expands, thereby urging the first membrane into the first chambers and raising the pressure of the active substance in the first chambers. The rise in pressure in the first chambers results in the second membrane bursting at locations adjacent the first chambers, thereby communicating the first chambers with the bores in the corresponding micro-needles. The action of the first membrane on the active substance urges the active substance from the first chambers through the bores in the micro-needles, and in turn transdermally into the subject.

Typically the heating elements are activatable individually sequentially or in groups sequentially for delivering the active substance to the subject in specific doses to comply with a predefined treatment regime. Such a treatment regime may require a dose of the active substance to be administered to the subject three times per day during a treatment period, which could be a period of five days or more. This requires the micro-delivery device to be attached to the subject for the duration of the treatment period with the micro-needles continuously penetrating the skin of the subject. This is undesirable, since it can lead to irritation and infection of the skin, which leads to and in many cases considerable discomfort.

There is therefore a need for a delivery device for administering an active substance to a subject which addresses this problem.

The present invention is directed towards providing such a delivery device and the invention is also directed to a method for administering an active substance to a subject, and the invention is also directed towards providing an injectable element for administering an active substance to a subject.

According to the invention there is provided a delivery device for administering an active substance to a subject, the device comprising a plurality of first chambers, a solid form structure located in each first chamber, the solid form structure having a pointed tip and comprising the active substance, and an urging means for urging the solid form structures through the first chambers to penetrate the skin of the subject with the pointed tips thereof.

In one embodiment of the invention each solid form structure comprises a support material for supporting the active substance therein.

Preferably, the support material of each solid form structure is configured as a scaffolding structure, and the active substance is in solid form supported by the scaffolding structure. Advantageously, the scaffolding structure is of lattice construction.

In another embodiment of the invention the support material of each solid form structure is porous and the active substance is impregnated therein.

Alternatively, the active substance is coated onto the support material of each solid form structure.

In another embodiment of the invention the support material of each solid form structure is adapted for facilitating slow release of the active substance therefrom.

Preferably, the support material of each solid form structure comprises a

biodegradable material. Advantageously, the support material of each solid form structure comprises a polymer material.

In another embodiment of the invention each solid form structure comprises a mixture comprising the active substance and an excipient.

In another embodiment of the invention each solid form structure is slideable in the corresponding first chamber for penetrating the skin of a subject.

In a still further embodiment of the invention each solid form structure is slideable in the corresponding first chamber from a position entirely within the first chamber to a position whereby at least a portion of the solid form structure extends outwardly of the first chamber for penetrating the skin of a subject.

In one embodiment of the invention each solid form structure is a sealable sliding fit within the corresponding first chamber, and the urging means acts directly on the solid form structure for urging the solid form structure through the first chamber.

Preferably, the maximum transverse cross-sectional dimension of each solid form structure lies in the range of 0.1mm to 2mm. Advantageously, the axial length of each solid form structure lies in the range of 0.1mm to 2mm.

Preferably, each solid form structure comprises a tapering portion terminating in the pointed tip. Advantageously, each solid form structure comprises a portion of constant transverse cross-section, the tapering portion thereof extending axially from the portion of constant transverse cross-section. Ideally, the tapering portion of each solid form structure is of conical shape. Preferably, each solid form structure is of circular transverse cross-section.

In one embodiment of the invention the first chambers are configured in a matrix.

Preferably, the maximum transverse cross-sectional dimension of each first chamber lies in the range of 0.1mm to 2mm. Advantageously, the axial length of each first

chamber lies in the range of 0.1mm to 2mm.

In one embodiment of the invention a first housing is provided, and the first chambers are located in the first housing. Preferably, the first housing comprises a first plate member defining opposite first and second major surfaces, and each first chamber is formed by a corresponding first bore extending through the first plate member from the first major surface thereof to the second major surface. Preferably, the first plate member is of thickness in the range of 0.1mm to 2mm. Advantageously, each first bore is of circular transverse cross-section.

In one embodiment of the invention a second chamber is provided for housing the urging means.

In another embodiment of the invention a second housing is provided, and the second chamber is located in the second housing. Preferably, a plurality of second chambers are located in the second housing. Advantageously, one second chamber is provided corresponding to each first chamber, the second chambers being aligned with the respective corresponding first chambers.

Preferably, the maximum transverse cross-sectional dimension of each second chamber lies in the range of 0.1mm to 2mm.

In one embodiment of the invention the second housing comprises a second plate member having opposite first and second major surfaces, and each second chamber is formed by a corresponding second bore extending through the second plate member from the first major surface thereof to the second major surface. Preferably, the second plate member is of thickness in the range of 0.1mm to 2.0mm. Advantageously, each second bore is of circular transverse cross-section.

Advantageously, the second chambers are configured in a matrix.

In one embodiment of the invention a first membrane is located between the first and second chambers for sealably isolating each first chamber from the second

chamber. Preferably, the first membrane comprises a material impermeable to the urging means. Advantageously, the first membrane comprises a material impermeable to the active substance. Ideally, the first membrane is deformable into each first chamber under the action of the urging means for urging the corresponding solid form structure through the first chamber. Preferably, the first membrane is of an expandable material.

In one embodiment of the invention at least one pair of interengageable complementary formations is provided for locating the first and second plate members relative to each other with each first chamber aligned with the corresponding second chamber, one of the interengageable complementary formations being located on the second major surface of the first plate member adjacent one of the first chambers, and the other of the pair of interengageable complementary formations being located on the first major surface of the second plate member, the respective interengageable complementary formations of the pair thereof being co-operable with each other for entrapping the first membrane therebetween. Preferably, the interengageable complementary formation of the pair thereof located on the first plate member extends around the corresponding one of the first chambers. Advantageously, the interengageable complementary formation of the pair thereof located on the first plate member extends completely around the corresponding one of the first chambers. Preferably, the interengageable complementary formation of the pair thereof located on the second plate member extends around the corresponding one of the second chambers. Advantageously, the interengageable complementary formation of the pair thereof located on the second plate member extends completely around the corresponding one of the second chambers.

In one embodiment of the invention one of the interengageable complementary formations of the pair thereof comprises a projection extending from the corresponding one of the first and second plate members. Preferably, the projection comprises an annular projection. Advantageously, the other of the interengageable complementary formations of the pair thereof comprises a recess extending into the corresponding one of the first and second plate members for engaging the projection

extending from the other of the first and second plate members. Preferably, the recess is configured as an annular recess.

In one embodiment of the invention a plurality of pairs of interengageable complementary formations are provided, one of the pairs of interengageable complementary formations being provided corresponding to each first chamber.

In another embodiment of the invention one urging means is provided in each second chamber.

In another embodiment of the invention a second membrane is provided for sealably closing each first chamber adjacent the pointed tip of the corresponding solid form structure. Preferably, the second membrane is adapted to be penetrable by the pointed tip of each solid form structure.

In another embodiment of the invention at least one activating means is provided for activating the urging means to urge at least one of the solid form structures through the corresponding first chamber to penetrate the skin of a subject. Preferably, a plurality of activating means are provided, each activating means being provided for activating the urging means in a corresponding one of the second chambers.

Advantageously, the respective activating means are aligned with corresponding ones of the second chambers. Advantageously, the activating means are configured in the form of a matrix.

In one embodiment of the invention each activating means comprises a heating means. Preferably, each heating means comprises an electrically powered heating means. Advantageously, each heating means comprises a thin film resistor.

Preferably, the activating means are formed on a third plate member.

In one embodiment of the invention the third plate member comprises a material selected from one of silicon, ceramics, polyimide and FR4.

In another embodiment of the invention the third plate member comprises a flexible material.

In a further embodiment of the invention a third membrane is located between the activating means and the at least one second chamber for sealably closing the second chamber.

In a still further embodiment of the invention a plurality of openings are formed through the third membrane adjacent respective corresponding ones of the second chambers, and each opening is sealably closed by a corresponding heat conducting element for conducting heat to the urging means in the corresponding second chamber. Preferably, the third membrane comprises a heat insulating material.

In one embodiment of the invention each urging means comprises an expandable driving substance.

In another embodiment of the invention the driving substance is in the form of a liquid, the liquid being responsive to one of temperature change and chemical activation for converting from a liquid phase to a gaseous phase for urging the solid form structure through the first chamber.

In another embodiment of the invention the driving substance comprises a solid responsive to one of temperature change and chemical activation for transitioning directly from a solid phase to a gaseous phase for urging the solid form structure through the first chamber. Preferably, the driving substance comprises Azobisisobutylonitrile (AIBN).

In another embodiment of the invention the driving substance comprises a plurality of gas filled microspheres responsive to temperature change for expansion thereof for urging the solid form structure through the first chamber. Preferably, the driving substance comprises gas filled microspheres sold under the Trade Mark EXPANCEL.

In a further embodiment of the invention the driving substance comprises a porous material, the pores of which are gas filled.

In one embodiment of the invention the porous material is responsive to temperature change for expansion thereof.

In another embodiment of the invention the gas in the porous material is responsive to temperature change for expanding out of the porous material.

In a further embodiment of the invention the porous material of the driving substance comprises a porous polymer material.

In one embodiment of the invention a securing means is provided for securing the delivery device to a site on a subject.

The invention also provides an injectable element for administering an active substance to a subject, the injectable element comprising a solid form structure having a pointed tip for penetrating the skin of the subject and comprising the active substance.

Additionally, the invention provides a delivery device for administering an active substance to a subject in the form of a solid form structure, the device comprising a plurality of first chambers for accommodating respective ones of the solid form structures, and an urging means for urging the solid form structures through the corresponding first chambers to penetrate the skin of the subject.

The invention further provides a method for administering an active substance to a subject, the method comprising configuring the active substance as a solid form structure having a pointed tip, locating the solid form structure in a first chamber, attaching the first chamber to the subject adjacent a site at which the active substance is to be administered, and urging the solid form structure through the first chamber to penetrate the skin of the subject by the pointed tip thereof.

Preferably, the method further comprises providing a first housing, providing a plurality of the first chambers and locating the first chambers in the first housing, and locating one solid form structure in each first chamber.

The advantages of the invention are many. A particularly important advantage of the invention is that the skin of the subject is not continuously penetrated by a plurality of micro-needles, as has been the case with such devices known heretofore. Thus, the risk of irritation, infection and discomfort to the subject is minimised, and in most cases is eliminated. Since the active substance is delivered to the subject by urging the solid form structures into penetrating engagement with the skin of the subject, the skin of the subject is only penetrated by those solid form structures which are urged out of the first chambers. Thus, where the solid form structures are provided to be of a biodegradable material, the solid form structures dissolve into the skin of the subject, and once dissolved, no longer penetrate the skin to cause irritation, discomfort and possible infection. It is envisaged, in general, that each solid form structure would be of a material which would biodegrade substantially simultaneously as the last of the active substance in the solid form structure is being released into the subject. It is envisaged that the release rate of the active substance from each solid form structure and the dissolve rate of each solid form structure could be substantially matched, and would be such that the active substance would be released at a relatively constant rate over the period while the solid form structure is dissolving.

A further advantage of the invention is that the solid form structures containing the active substance are stored within the first chambers which are sealed by the first and second membranes, and accordingly, the solid form structures can be stored in sterile conditions.

The invention will be more clearly understood from the following description of some preferred embodiments thereof, which are given by way of example only, with reference to the accompanying drawings which are not to scale, in which:

Fig. 1 is a perspective view of a delivery device according to the invention for administering an active substance to a subject,

Fig. 2 is an exploded perspective view of the delivery device of Fig. 1,

Fig. 3 is a perspective view of the delivery device of Fig. 1 illustrated with portions of the device in a different position to that of Fig. 1,

Fig. 4 is a transverse cross-sectional side elevational view of the delivery device of Fig. 1,

Fig. 5 is a view similar to Fig. 4 illustrating the delivery device of Fig. 1 in use,

Fig. 6 is a perspective view of an injectable element also according to the invention for use in the delivery device of Fig. 1,

Fig. 7 is an enlarged transverse cross-sectional view of a detail of the delivery device of Fig. 1,

Fig. 8 is a perspective view of another detail of the delivery device of Fig. 1,

Fig. 9 is a top plan view of a detail of a portion of the delivery device of Fig. 1,

Fig. 10 is a transverse cross-sectional view of the detail of Fig. 9 of the delivery device of Fig. 1,

Fig. 11 is a block representation of an electronic circuit of the delivery device of Fig. 1,

Fig. 12 is a perspective view similar to Fig. 1 of a delivery device according to another embodiment of the invention for administering an active substance to a subject,

Fig. 13 is a transverse cross-sectional side elevational view similar to Fig. 4 of the delivery device of Fig. 12,

Fig. 14 is a perspective view similar to Fig. 1 of a delivery device according to another embodiment of the invention for administering an active substance to a subject,

Fig. 15 is a transverse cross-sectional side elevational view of a portion of the delivery device of Fig. 14,

Fig. 16 is a perspective view of another portion of the delivery device of Fig. 14,

Fig. 17 is a transverse cross-sectional view of a detail of the portion of Fig. 16 of the delivery device of Fig. 14,

Fig. 18 is a perspective view of another portion of the delivery device of Fig. 14,

Fig. 19 is a transverse cross-sectional side elevational view of a detail of the portion of Fig. 18 of the delivery device of Fig. 14,

Fig. 20 is a perspective view similar to Fig. 1 of a delivery device according to a further embodiment of the invention for administering an active substance to a subject,

Fig. 21 is a transverse cross-sectional side elevational view of a portion of the delivery device of Fig. 20,

Fig. 22 is a perspective view of another portion of the delivery device of Fig. 20,

Fig. 23 is a transverse cross-sectional side elevational view of a detail of the

portion of Fig. 22 of the delivery device of Fig. 20,

Fig. 24 is a perspective view of another portion of the delivery device of Fig. 20,

Fig. 25 is a transverse cross-sectional side elevational view of a detail of the portion of Fig. 24 of the delivery device of Fig. 20,

Fig. 26 is a transverse cross-sectional side elevational view similar to Fig. 4 of a delivery device according to another embodiment of the invention, and

Fig. 27 is a perspective view of an injectable element also according to the invention.

Referring to the drawings and initially to Figs. 1 to 11, there is illustrated a micro-dimensioned delivery device according to the invention, indicated generally by the reference numeral 1, for administering an active substance transdermally to a subject. The active substance is provided as an injectable element which is also according to the invention and is provided in the form of a solid form structure indicated generally by the reference numeral 2, which in this embodiment of the invention is formed by a scaffolding structure 3 of a biodegradable polymer material into which the active substance is impregnated. The scaffolding structure 3 is configured as a lattice structure of the biodegradable polymer material, which when impregnated with the active substance forms a substantially solid structure of circular transverse cross-section comprising a base portion 4 of constant transverse cross-section of diameter *d*, and a tapering portion 6 of conical shape extending axially from the base portion 4 and terminating in a pointed tip 5 for penetrating the skin of the subject. The lattice structure of the biodegradable material is constructed to facilitate slow release of the active substance. The active substance may be any medicament or other solution which it is desired to administer transdermally to a subject.

The device 1 is adapted for securing to the subject adjacent the site at which the

active substance is to be administered to the subject, as will be described below.

The device 1 comprises a first housing provided by a first plate member 7 of a polymer material in which a plurality of first chambers 8 are formed for containing respective ones of the solid form structures 2 of the active substance. The first plate member 7 defines a first major surface 9 and an opposite second major surface 10. The first chambers 8 are formed by respective bores of circular transverse cross-section extending through the first plate member 7 from the first major surface 9 to the second major surface 10, and the diameter of the first chambers 8 and the diameter *d* of the base portion 4 of the solid form structures 2 are such that the base portion 4 of the solid form structures 2 are a sliding fit in the first chambers 8.

A second housing provided by a second plate member 12 also of a polymer material and having a first major surface 14 and a second major surface 15 is provided with a plurality of second chambers 16 also arranged in a matrix, and aligned with the first chambers 8 of the first plate member 7. The second chambers 16 are formed by respective second bores of circular transverse cross-section which extend through the second plate member 12 from the first major surface 14 to the second major surface 15. Each second chamber 16 houses an urging means, which in this embodiment of the invention is provided by a temperature responsive expandable driving substance 18, which is described below, for urging the solid form structures 2 through the corresponding first chambers 8 for penetrating the skin of the subject by the pointed tip 5, for in turn delivering the active substance transdermally to the subject.

A first membrane 20 of an expandable material, which is impermeable to both the active substance and the driving substance 18, is located between and sealably secured to the first plate member 7 and the second plate member 12 for sealably closing the adjacent ends of the first and second chambers 8 and 16 adjacent the second major surface 10 and the first major surface 14 of the first and second plate members 7 and 12, respectively, and for isolating the second chambers 16 from the corresponding first chambers 8. The expandability of the first membrane 20 is such as to permit expansion thereof into the first chambers 8 on expansion of the driving

substance 18 in the corresponding second chambers 16, for in turn urging the corresponding solid form structures 2 through the first chambers 8 to penetrate the skin of the subject.

A second membrane 22 is sealably secured to the first major surface 9 of the first plate member 7 for sealably closing the ends of the first chambers 8 adjacent the first major surface 9 of the first plate member 7 so that the solid form structures 2 are maintained in the first chambers 8 in a sterile environment. The second membrane 22 is of a penetrable material which is penetrable by the pointed tips 5 of the solid form structures 2 as the solid form structures 2 are being urged through the first chambers 8 for in turn penetrating the skin of the subject.

A third plate member 24 having a first major surface 25 and a second major surface 26 is secured to the second plate member 12 with a third membrane 27 located therebetween. The third plate member 24 may be provided as a printed circuit board, or may be of a polymer material, and may be flexible or rigid. Alternatively, the third plate member 24 may be of a semiconductor material or a ceramics material. A plurality of activating means, in this embodiment of the invention provided by thin film resistor heating elements 28 are arranged in a matrix on the first major surface 25 of the third plate member 24 for raising the temperature of the expandable driving substance 18 in the respective second chambers 16 for expansion thereof. The heating elements 28 are aligned with the respective second chambers 16. The thin film resistors forming the heating elements 28 may be formed by any suitable process, which will be dependent on the material of the third plate member 24.

The third membrane 27 is sealably secured to the second major surface 15 of the second plate member 12 for sealably closing the ends of the second chambers 16 adjacent the second major surface 15. The third membrane 27 is of a heat insulating material, which is impermeable to the driving substance, and is provided with a matrix of openings 29 which are sealably closed by a plurality of heat conductive elements, namely, heat conductive discs 30 of metal material for facilitating heat transfer between the heating elements 28 and the driving substance

18 in the corresponding second chambers 16. The provision of the third membrane 27 as a heat insulating material minimises heat transfer between each heating element 28 and the second chambers 16 other than the corresponding adjacent second chamber 16, so that activation of each heating element 28 causes the driving substance in the corresponding second chamber 16 only to expand.

An electronic circuit 31 is also formed in or on the third plate member 24, and depending on whether the third plate member 24 is provided as a printed circuit board or as a semiconductor substrate, the circuit 31 may be formed on the first and/or second major surfaces 25 and 26, and/or within layers as will be understood by those skilled in the art. However, in a case where the third plate member 24 is provided as a semiconductor substrate, the circuit 31 may be formed as an integrated circuit on layers 32 of the substrate of the plate member 24, as illustrated in Fig. 8. The circuit 31 comprises a plurality of transistor switches 34, one transistor switch 34 being provided for each heating element 28 through which an electrical power supply is provided to the respective heating elements 28 for facilitating independent addressing of the respective heating elements 28. The heating elements 28 are powered through the transistors 34 and in turn through corresponding fuses 35 which are formed by thin film elements. Each thin film element which forms a fuse 35 is sized so that after conducting current to the corresponding heating element 28 for a predetermined time period, the fuse 35 goes into a permanent open circuit state, thereby preventing further activation of the corresponding heating element 28. The fuses 35 are rated so that the predetermined time period during which each fuse 35 conducts a current prior to going into an open circuit state is sufficient to raise the temperature of the driving substance 18 in the corresponding second chamber 16 for in turn urging the corresponding solid form structure 2 into penetrating engagement in the skin of a subject.

A programmable logic circuit 37 is also provided for operating the heating elements 28 in a desired sequence for urging the solid form structures 2 individually or in groups into penetrating engagement with the skin of the subject in accordance with a predefined treatment regime. For example, the programmable logic circuit 37 could

be programmed to operate the heating elements 28 in groups, so that the respective groups would be sequentially operated at predefined time intervals over a predefined treatment period. The predefined time intervals could be such as to facilitate administration of a dose of the active substance three times per day, for example, in the morning, afternoon and evening, and the predefined treatment period could be a period over a number of days, for example, five days, seven days or the like. The number of heating elements 28 in each group would be dependent on the dose size, and in cases where the required dose size could be supplied by a single one of the solid form structures 2, the heating elements 28 would be individually operable. Depending on the material of the third plate member 24, the programmable logic circuit 37 may be formed as an integrated circuit on the third plate member 24, or may be provided separately for attachment to the device 1, for example, for attachment to the third plate member 24.

A monitoring circuit 38 is also provided for monitoring the state of the fuses 35 for in turn determining the first chambers 8 from which the solid form structures 2 have already been urged into penetration with the skin of the subject. Depending on the material of the third plate member 24, the monitoring circuit 38 would be provided in a similar manner to that in which the programmable logic circuit 37 is provided.

A power supply, in this embodiment of the invention provided by a battery 40, may be integrally formed with the delivery device 1 or independently thereof for coupling to the delivery device 1. In this embodiment of the invention the battery 40 is formed in one or more of the first and/or second chambers 8 and 16 by placing an electrolyte in the appropriate ones of the first and/or second chambers 8 and 16. Suitable electrodes 41 are provided in the appropriate ones of the first and/or second chambers 8 and 16 to co-operate with the electrolyte to in turn provide electrical power to the integrated circuit 31 and to the heating elements 34 through the transistors 34 and the fuses 35. An input/output interface 42 is provided on the third plate member 24 for facilitating programming of the programmable logic control circuit 37. The input/output interface 42 may be adapted to facilitate wireless programming of the programmable logic circuit 37.

It is also envisaged that the programmable logic control circuit may be programmable to be responsive to externally applied signals, for example, an external signal from an external monitoring device, which would be provided for monitoring a particular characteristic of the subject. On the monitoring device indicating an abnormal situation, one or more of the heating elements 28 corresponding to one or more solid form structures 2 would be activated for urging those solid form structures 2 into penetrating engagement with the skin of the subject. The programmable logic circuit may also be programmable to be responsive to environmental sensors, which could be worn on the body of a subject, so that in the event of a change or an occurrence in the environment the heating elements 28 corresponding to appropriate ones of the solid form structures 2, which would be provided with a suitable active substance would be activated for administering the active substance to the subject. For example, such an environmental change could be an increase in the pollen count in the atmosphere, which would necessitate administering an antihistamine substance to the subject, and in which case the active substance in the appropriate ones of the solid form structures would be an antihistamine substance.

It is also envisaged that the device 1 may button operated manually by the subject. In which case, a manual button operated switch would be provided on the device 1, for example, on the third plate member 24, and the button switch would be coupled to the programmable logic circuit 37, so that on operating the button switch, the programmable logic circuit 37 would operate the appropriate one or ones of the heater elements 28 in order to activate the driving substance 18 for in turn urging the corresponding solid form structure or structures 2 to penetrate through the skin of the subject.

Returning now to the driving substance 18, the driving substance 18 may be any suitable solid, liquid or gas which has a relatively high coefficient of expansion. In this embodiment of the invention expansion of the driving substance is in response to a temperature increase, and is provided by a plurality of gas filled microspheres located in the respective second chambers 16. The microspheres are of the type supplied under the Trade Mark EXPANCEL. Further particulars of these

microspheres are available on the website www.expancel.com. The microspheres are small gas filled spherical particles of plastics material. The shells of the microspheres are of a thermoplastic polymer which softens in response to a rise in temperature, resulting in a dramatic increase in the volume of the microspheres as the gas contained therein expands also in response to the rise in temperature. When in an unconfined space, such microspheres can expand to a volume which is forty times their original size.

Ideally, the driving substance should be such that expansion of the driving substance takes place relatively rapidly at a relatively low temperature. In the case of the gas filled microspheres, depending on their temperature rating, it has been found that by raising the temperature of the microspheres to temperatures in the range of 70°C to 130°C, adequate expansion is achieved for driving the corresponding solid form structure 2 through the corresponding first chamber 8 for penetrating the skin of the subject.

Alternatively, the driving substance may be a solid which on being subjected to heat converts directly to a gas, such as Azobisisobutylonitrile (AIBN). Needless to say, the driving substance may be a liquid which on being heated converts to a gas, or the driving substance may be a gas with a high coefficient of expansion.

As mentioned above, the delivery device 1 is of micro-dimensions, and the first plate member 7 is of thickness t_1 of approximately 0.6mm, see Fig. 2. The second plate member 12 is of thickness t_2 of approximately 1.0mm. Each first chamber 8 is of circular transverse cross-section and is of diameter of approximately 0.5mm, and each second chamber 16 is of circular transverse cross-section and of diameter of approximately 0.5mm. The base portion 4 of each solid form structure 2 is of constant circular transverse cross-section of diameter d just less than 0.5mm, so that the base portion 4 of each solid form structure 2 is a smooth sliding fit in the corresponding first chamber 8 from a position within the first chamber 8 to a position projecting through the second membrane 22 for penetrating the skin of a subject. The axial thickness t_3 of the base portion 4 is approximately 0.07mm. The tapered portion 6 of each solid form structure 2 is of conical shape and the overall axial

length *l* of each solid form structure 2, including the thickness t_3 of the base portion 4 is approximately 0.5mm. The thickness of the third plate member 24 will depend on the material thereof, but typically, will be of the order of 2.0mm.

An adhesive patch 44 having an adhesive surface 45 is bonded to the second major surface 26 of the third plate member 24, and an outer peripheral portion 46 of the adhesive patch 44 is provided for bonding the adhesive patch 44 with the delivery device 1 attached thereto to the skin of a subject with the second membrane 22 abutting the skin of the subject.

In use, with the first, second and third plate members 7, 12 and 24 and the first and third membranes 20 and 27 assembled, and with the solid form structures 2 located in the first chambers 8 and the second membrane 22 sealably secured to the first major surface of the first plate member 7, and with the programmable logic control circuit 37 appropriately programmed, the delivery device 1 is attached to the skin of the subject at the appropriate site by the patch 44. At the appropriate programmed or otherwise timed predefined time intervals during the predefined treatment period, the appropriate one or ones of the heating elements 28 are powered up for expanding the driving substance 18 in the corresponding second chamber or chambers 16, for in turn urging the corresponding one or ones of the solid form structures 2 to penetrate through the second membrane 22, and in turn to penetrate the skin of the subject for transdermally delivering the active substance to the subject. Depending on the volume of the active substance to be administered to the subject in each dose, either one or an appropriate number of the heating elements are activated. On penetrating the skin of the subject, the scaffolding structure 3 of each solid form structure 2 may serve to facilitate a slow release of the active substance or otherwise from the corresponding solid form structure 2. Additionally, as the active substance is being slowly delivered to the subject, the scaffolding of the solid form structure gradually dissolves.

Thus, depending on the volume of the active substance to be administered to the subject in each dose, the heating elements 28 individually are sequentially activated at the appropriate predefined intervals over the predefined treatment period during

which the doses of the active substance are to be administered to the subject, or alternatively, respective groups of the heating elements are sequentially activated at the appropriate predefined time intervals over the predefined treatment period.

It is envisaged that the solid form structures of the delivery device may each comprise the same active substance, or alternatively, respective groups of the solid form structures may comprise different active substances. This would facilitate the administration of more than one active substance to a subject over a predefined treatment period. Different ones of the active substances may be administered to the subject simultaneously, or at different times during the predefined treatment period.

Referring now to Figs. 12 and 13, there is illustrated a micro-dimensioned delivery device according to another embodiment of the invention, indicated generally by the reference numeral 50 for administering an active substance transdermally to a subject. The delivery device 50 is substantially similar to the delivery device 1, and similar components are identified by the same reference numerals. In this embodiment of the invention the second and third plate members are formed by a single integral plate member 51, which typically comprises a polymer material. The second chambers 16 are formed in the plate member 51 and extend into the plate member 51 from a first major surface 52 thereof. The activating means are provided by electrically powered heating elements 53 formed as thin film resistors in respective bases 54 of the corresponding second chambers 16. The heating elements 53 formed by thin film resistors, and are powered through an electronic circuit similar to the circuit 31 described with reference to the device 1. Wires (not shown) or other suitable electrically conductive tracks through the polymer material of the plate member 51 supply electrical power to the heating elements 53. If the plate member 51 is provided as a semiconductor substrate, the heating elements may be formed on the bases 54 of the second chambers 16 by a suitable integrated circuit forming process, for example, by chemical vapour deposition. Typically, an insulating layer, for example, a silicon oxide layer (not shown) would be provided over the heating elements 53. An integrated circuit (not shown) but substantially similar to the circuit 31 would also be provided in the plate member 51.

Otherwise, the delivery device 50 is substantially similar to the delivery device 1, and its use and operation are also similar to the delivery device 1.

Referring now to Figs. 14 to 19, there is illustrated a micro-dimensional delivery device 60 according to another embodiment of the invention for administering an active substance transdermally to a subject. The delivery device 60 is substantially similar to the delivery device 1, and similar components are identified by the same reference numerals. In this embodiment of the invention a locating means is provided for locating the first and second plate members 7 and 12 relative to each other, so that the first and second chambers 8 and 16 are aligned with each other, and the locating means comprises respective pairs of interengageable complementary formations. One of the formations of each pair of formations comprises an annular projection 61 extending from the second major surface 10 of the first plate member 7, and the other of each pair of formations comprises a recess formed by an annular groove 62 extending into the first major surface 14 of the second plate member 12 for engaging the corresponding projection 61. Each annular projection 61 is of circular shape and extends from the second major surface 10 of the first plate member 7 completely around the corresponding first chamber 8 and slightly radially spaced apart therefrom. Each annular groove 62 extends completely around the corresponding second chamber 16 and slightly radially spaced apart therefrom. The annular projections 61 and the annular grooves 62 are dimensioned for accommodating the first membrane 20 therebetween as the first and second plate members 7 and 12 are brought into engagement with the first membrane for entrapping the first membrane between the annular projections 61 and the corresponding grooves 62.

Otherwise, the delivery device 60 is similar to the delivery device 1 and its use and operation are also similar to the delivery device 1.

Referring now to Figs. 20 to 25, there is illustrated a micro-dimensioned delivery device 70 according to another embodiment of the invention for administering an active substance transdermally to a subject. The delivery device 70 is substantially

similar to the delivery device 1, and similar components are identified by the same reference numerals. The main difference between the delivery device 70 and the delivery device 1 is in the provision of a locating means between the first and second plate members 7 and 12 for locating the first and second plate members 11 and 12 with the first and second chambers 8 and 16 aligned. In this embodiment of the invention the locating means comprises respective pairs of interengageable complementary formations, one of which formations is formed by an annular projection 71 extending from the second surface 10 of the first plate member 7 and a corresponding annular recess 72 formed in the first major surface 14 of the second plate member 12. The annular projections 71 are similar to the annular projections 61 of the delivery device 60, with the exception that the inner diameter of each annular projection 61 is similar to the diameter of the corresponding first chamber 8. In other words, the annular projections 71 are not spaced apart from the first chambers 8. The annular recesses 72 in this embodiment of the invention are formed into the second chambers 16 adjacent the first major surface 12 of the second plate member 12. The annular recesses 72 and the projections 71 are dimensioned for accommodating the first membrane 20 therebetween when the first and second plate members 7 and 12 are brought into engagement with each other with the first membrane 20 entrapped by the co-operating action of the annular projections 71 with the corresponding annular recesses 72.

Otherwise, the delivery device 70 and its use and operation are similar to the delivery device 1.

Referring now to Fig. 26, there is illustrated a micro-dimensioned delivery device 80 according to another embodiment of the invention for administering an active substance transdermally to a subject. The delivery device 80 is substantially similar to the delivery device 1, and similar components are identified by the same reference numerals. The main difference between the delivery device 80 and the delivery device 1 is that in this embodiment of the invention the third membrane has been omitted, and the third plate member 24 is provided as a flexible polymer sheet which is sealably secured to the second major surface 15 of the second plate member 12 for sealing the second chambers 16. Electrical heating elements 28,

which are formed by thin film resistors, are formed on the first major surface 25 of the third plate member 24. An electronic circuit (not shown, but similar to the circuit 31 of the device 1) is provided on the second major surface 26 of the third plate member 24. Electrically conductive wires or suitable electrically conductive tracks couple the heating elements 28 to the circuit provided on the second major surface 26 of the third plate member 24 through vias (not shown) through the third plate member 24.

Otherwise, the delivery device 80 and its use and operation is similar to the delivery device 1.

Referring now to Fig. 27, there is illustrated an injectable element according to another embodiment of the invention, which is provided by a solid form structure indicated generally by the reference numeral 90, for use in any of the delivery devices 1, 50, 60, 70 or 80 already described. In this embodiment of the invention the solid form structure 90 comprises a mixture of an active substance and an excipient. The active substance and the excipient are mixed together with an appropriate binder to set to form the solid form structure in the form of a solid. In this embodiment of the invention a lattice scaffolding structure is not required.

It is also envisaged that when preparing the injectable elements, whether they be prepared in the form of the solid form structure 2 or in the form of the solid form structure 90, the injectable element may be prepared with the active substance located in the tapering portion 6 towards the tip 5, in order to ensure that when the solid form structure penetrates through the skin of the subject to the site beneath the skin of the subject, the active substance is concentrated at the appropriate site. In which case, the remainder of the tapering portion 6 and the base portion 4 would not include any active substance.

It is envisaged that in cases where the programmable logic control circuit is programmable in a wireless manner, the electronic circuit 31 of the relevant devices would be provided with wireless connectivity and would be programmable by, for example, Bluetooth.

In certain cases, it is envisaged that the power to the delivery device may be supplied by kinetic movement, as for example in an automatic watch, whereby the kinetic movement may be converted to electrical energy for charging a battery, or for charging a capacitor or other suitable electrical energy storing device.

While the urging means for urging the solid form structures 2 to penetrate the skin of the subject has been described as being provided by gas filled microspheres sold under the Trade Mark EXPANCEL, any other suitable gas filled microspheres may be used. Needless to say, other suitable driving substance may be used, and such other driving substances may, for example, be an expandable liquid, an expandable solid or an expandable gas. It is also envisaged that the driving substance may be a solid which would convert directly from the solid phase to the gaseous phase. Additionally, it is envisaged that other suitable urging means besides a driving fluid may be used. In certain cases, it is envisaged that the driving substance may comprise two chemicals, such that when mixed, the chemicals would expand to urge the first membrane into the corresponding first chamber. In which case, the two chemicals would be maintained separated from each other until the corresponding solid form structure is to be urged from the corresponding first chamber. The two chemical substances could be maintained separated from each other by a suitable membrane, which would be burstable by a suitable activating means.

Needless to say, while the driving substance has been described as being provided by gas filled microspheres which expand at a relatively low temperature, in certain cases, it is envisaged that a driving substance which converted from the liquid phase to a gaseous phase at a higher temperature, and indeed, at a relatively high temperature, may also be suitable.

Further, it is envisaged that the driving substance may be a porous material which would be impregnated with a gas of high co-efficient of expansion or a liquid which would convert to a gaseous phase at an appropriate temperature, and when subjected to the appropriate temperature the gas would expand or the liquid would convert to the gaseous phase. The expanding gas would cause expansion of the

porous material, which would in turn urge the first membrane into the corresponding first chamber. Alternatively, the expanding gas may expand out of the porous material to directly act on the first membrane to urge the first membrane into the corresponding first chamber.

Additionally, each urging means may be provided by a piston which would be sealably located in the corresponding second chamber, and would be sealably slideable into and through the corresponding first chamber in response to expansion of a driving substance. It is also envisaged that the solid form structures may be sealably slideable longitudinally in the first chambers, and the driving substance would act directly on the solid form structures for urging the solid form structures through the first chambers for penetrating the skin of the subject.

While the delivery devices have been described for administering an active substance transdermally to a subject, the delivery devices may be adapted for delivering an active substance to a subject subcutaneously, intradermally, or to any other depth beneath the skin of the subject. This would be achieved by providing the solid form structures to be of an appropriate axial length.

Additionally, it will be appreciated that while the active substance has been described as being incorporated in a solid form structure which is formed by a scaffolding structure of a biodegradable polymer material, the scaffolding structure may be provided by any suitable type of biodegradable lattice structure, indeed, a non-biodegradable material, polymer or otherwise, or indeed any other suitable bio-compatible material may be used for forming a lattice structure which would be suitable for being impregnated with the active substance. Additionally, in certain cases, it is envisaged that the active substance may itself be formed into the solid structure without any other ingredients or components in the structure, or the active substance may be formed into the solid form structure in a mixture comprising only the active substance and an excipient as described with reference to Fig. 27.

It is also envisaged that the delivery devices may be supplied without the solid form structures, and in which case, the solid form structures would be placed in the first

chambers subsequently, which would then be sealed with the second membrane. The subsequent assembly of the solid form structures into the first chambers could be carried out by a user of the device, or alternatively, could be carried out under factory sterile conditions.

It is also envisaged that the second membrane may be omitted or may be provided to be peeled off just prior to use, so that the first major surface of the first plate member would be in direct engagement with the skin of the subject.

It is also envisaged that the solid form structures may be bonded to the first membrane, and in which case, it is envisaged that the driving substance in the second chambers would be of a type that once expanded would remain in the expanded state.

It will be appreciated that the delivery devices according to the invention may be of any size, and may comprise any number of first and second chambers and any number of solid form structures. In general, the size and the number of the first and second chambers will depend on the size and number of the solid form structures. Additionally, the number of solid form structures will be determined by the number of solid form structures required to provide each dose of the active substance, and the number of doses of the active substance in a treatment regime. Needless to say, while the first and second chambers and the solid form structures have been described as being of specific dimensions, the first and second chambers and the solid form structures may be of any suitable dimensions.

While the delivery devices have been described as having a second chamber corresponding to each first chamber, it is envisaged in certain cases that a number of first chambers may be provided to a single chamber. For example, in cases where a single dose of the active substance requires a number of solid form structures to be simultaneously delivered from the first chambers, a single second chamber may be provided corresponding to the appropriate number of first chambers in order to supply the single dose of the active substance. Indeed, in certain cases, it is envisaged that where the delivery device is to be provided as a

single dose device, the delivery device may be provided with only one single second chamber which would be operated to simultaneously discharge the solid form structures from all the first chambers.

While the activating means have been described as being specific types of electrically powered heating elements, any suitable type of heating elements may be used. Additionally, other suitable types of activating means besides heating elements may be used. In general, it is envisaged that the number of activating means will be similar to the number of second chambers, although, not necessarily.

Claims

1. A delivery device for administering an active substance to a subject, the device comprising a plurality of first chambers, a solid form structure located in each first chamber, the solid form structure having a pointed tip and comprising the active substance, and an urging means for urging the solid form structures through the first chambers to penetrate the skin of the subject with the pointed tips thereof.

2. A delivery device as claimed in Claim 1 in which each solid form structure comprises a support material for supporting the active substance therein.

3. A delivery device as claimed in Claim 2 in which the support material of each solid form structure is configured as a scaffolding structure, and the active substance is in solid form supported by the scaffolding structure.

4. A delivery device as claimed in Claim 3 in which the scaffolding structure is of lattice construction.

5. A delivery device as claimed in any of Claims 2 to 4 in which the support material of each solid form structure is porous and the active substance is impregnated therein.

6. A delivery device as claimed in any of Claims 2 to 4 in which the active substance is coated onto the support material of each solid form structure.

7. A delivery device as claimed in any of Claims 2 to 6 in which the support material of each solid form structure is adapted for facilitating slow release of the active substance therefrom.

8. A delivery device as claimed in any of Claims 2 to 7 in which the support material of each solid form structure comprises a biodegradable material.

9. A delivery device as claimed in any of Claims 2 to 8 in which the support material of each solid form structure comprises a polymer material.

10. A delivery device as claimed in any preceding claim in which each solid form structure comprises a mixture comprising the active substance and an excipient.

11. A delivery device as claimed in any preceding claim in which each solid form structure is slideable in the corresponding first chamber for penetrating the skin of a subject.

12. A delivery device as claimed in Claim 11 in which each solid form structure is slideable in the corresponding first chamber from a position entirely within the first chamber to a position whereby at least a portion of the solid form structure extends outwardly of the first chamber for penetrating the skin of a subject.

13. A delivery device as claimed in Claim 11 or 12 in which each solid form structure is a sealable sliding fit within the corresponding first chamber, and the urging means acts directly on the solid form structure for urging the solid form structure through the first chamber.

14. A delivery device as claimed in any preceding claim in which the maximum transverse cross-sectional dimension of each solid form structure lies in the range of 0.1mm to 2mm.

15. A delivery device as claimed in any preceding claim in which the axial length of each solid form structure lies in the range of 0.1mm to 2mm.

16. A delivery device as claimed in any preceding claim in which each solid form structure comprises a tapering portion terminating in the pointed tip.

17. A delivery device as claimed in Claim 16 in which each solid form structure comprises a portion of constant transverse cross-section, the tapering portion thereof extending axially from the portion of constant transverse cross-section.

18. A delivery device as claimed in Claim 16 or 17 in which the tapering portion

of each solid form structure is of conical shape.

19. A delivery device as claimed in any preceding claim in which each solid form structure is of circular transverse cross-section.

20. A delivery device as claimed in any preceding claim in which the first chambers are configured in a matrix.

21. A delivery device as claimed in any preceding claim in which the maximum transverse cross-sectional dimension of each first chamber lies in the range of 0.1mm to 2mm.

22. A delivery device as claimed in any preceding claim in which the axial length of each first chamber lies in the range of 0.1mm to 2mm.

23. A delivery device as claimed in any preceding claim in which a first housing is provided, and the first chambers are located in the first housing.

24. A delivery device as claimed in Claim 23 in which the first housing comprises a first plate member defining opposite first and second major surfaces, and each first chamber is formed by a corresponding first bore extending through the first plate member from the first major surface thereof to the second major surface.

25. A delivery device as claimed in Claim 24 in which the first plate member is of thickness in the range of 0.1mm to 2mm.

26. A delivery device as claimed in Claim 24 or 25 in which each first bore is of circular transverse cross-section.

27. A delivery device as claimed in any preceding claim in which a second chamber is provided for housing the urging means.

28. A delivery device as claimed in Claim 27 in which a second housing is

provided, and the second chamber is located in the second housing.

29. A delivery device as claimed in Claim 28 in which a plurality of second chambers are located in the second housing.

30. A delivery device as claimed in Claim 28 or 29 in which one second chamber is provided corresponding to each first chamber, the second chambers being aligned with the respective corresponding first chambers.

31. A delivery device as claimed in any of Claims 28 to 30 in which the maximum transverse cross-sectional dimension of each second chamber lies in the range of 0.1mm to 2mm.

32. A delivery device as claimed in any of Claims 28 to 31 in which the second housing comprises a second plate member having opposite first and second major surfaces, and each second chamber is formed by a corresponding second bore extending through the second plate member from the first major surface thereof to the second major surface.

33. A delivery device as claimed in Claim 32 in which the second plate member is of thickness in the range of 0.1mm to 2.0mm.

34. A delivery device as claimed in Claim 32 or 33 in which each second bore is of circular transverse cross-section.

35. A delivery device as claimed in any of Claims 29 to 34 in which the second chambers are configured in a matrix.

36. A delivery device as claimed in any of Claims 27 to 35 in which a first membrane is located between the first and second chambers for sealably isolating each first chamber from the second chamber.

37. A delivery device as claimed in Claim 36 in which the first membrane

comprises a material impermeable to the urging means.

38. A delivery device as claimed in Claim 36 or 37 in which the first membrane comprises a material impermeable to the active substance.

39. A delivery device as claimed in any of Claims 36 to 38 in which the first membrane is deformable into each first chamber under the action of the urging means for urging the corresponding solid form structure through the first chamber.

40. A delivery device as claimed in any of Claims 36 to 39 in which the first membrane is of an expandable material.

41. A delivery device as claimed in any of Claims 36 to 40 in which at least one pair of interengageable complementary formations is provided for locating the first and second plate members relative to each other with each first chamber aligned with the corresponding second chamber, one of the interengageable complementary formations being located on the second major surface of the first plate member adjacent one of the first chambers, and the other of the pair of interengageable complementary formations being located on the first major surface of the second plate member, the respective interengageable complementary formations of the pair thereof being co-operable with each other for entrapping the first membrane therebetween.

42. A delivery device as claimed in Claim 41 in which the interengageable complementary formation of the pair thereof located on the first plate member extends around the corresponding one of the first chambers.

43. A delivery device as claimed in Claim 41 or 42 in which the interengageable complementary formation of the pair thereof located on the first plate member extends completely around the corresponding one of the first chambers.

44. A delivery device as claimed in any of Claims 41 to 43 in which the interengageable complementary formation of the pair thereof located on the second

plate member extends around the corresponding one of the second chambers.

45. A delivery device as claimed in any of Claims 41 to 44 in which the interengageable complementary formation of the pair thereof located on the second plate member extends completely around the corresponding one of the second chambers.

46. A delivery device as claimed in any of Claims 41 to 45 in which one of the interengageable complementary formations of the pair thereof comprises a projection extending from the corresponding one of the first and second plate members.

47. A delivery device as claimed in Claim 46 in which the projection comprises an annular projection.

48. A delivery device as claimed in Claim 46 or 47 in which the other of the interengageable complementary formations of the pair thereof comprises a recess extending into the corresponding one of the first and second plate members for engaging the projection extending from the other of the first and second plate members.

49. A delivery device as claimed in Claim 48 in which the recess is configured as an annular recess.

50. A delivery device as claimed in any of Claims 41 to 49 in which a plurality of pairs of interengageable complementary formations are provided, one of the pairs of interengageable complementary formations being provided corresponding to each first chamber.

51. A delivery device as claimed in any of Claims 27 to 50 in which one urging means is provided in each second chamber.

52. A delivery device as claimed in any preceding claim in which a second

membrane is provided for sealably closing each first chamber adjacent the pointed tip of the corresponding solid form structure.

53. A delivery device as claimed in Claim 52 in which the second membrane is adapted to be penetrable by the pointed tip of each solid form structure.

54. A delivery device as claimed in any preceding claim in which at least one activating means is provided for activating the urging means to urge at least one of the solid form structures through the corresponding first chamber to penetrate the skin of a subject.

55. A delivery device as claimed in Claim 54 in which a plurality of activating means are provided, each activating means being provided for activating the urging means in a corresponding one of the second chambers.

56. A delivery device as claimed in Claim 54 or 55 in which the respective activating means are aligned with corresponding ones of the second chambers.

57. A delivery device as claimed in Claim 55 or 56 in which the activating means are configured in the form of a matrix.

58. A delivery device as claimed in any of Claims 54 to 57 in which each activating means comprises a heating means.

59. A delivery device as claimed in Claim 58 in which each heating means comprises an electrically powered heating means.

60. A delivery device as claimed in Claim 58 or 59 in which each heating means comprises a thin film resistor.

61. A delivery device as claimed in any of Claims 54 to 60 in which the activating means are formed on a third plate member.

62. A delivery device as claimed in Claim 61 in which the third plate member comprises a material selected from one of silicon, ceramics, polyimide and FR4.

63. A delivery device as claimed in Claim 61 or 62 in which the third plate member comprises a flexible material.

64. A delivery device as claimed in any of Claims 54 to 63 in which a third membrane is located between the activating means and the at least one second chamber for sealably closing the second chamber.

65. A delivery device as claimed in Claim 64 in which a plurality of openings are formed through the third membrane adjacent respective corresponding ones of the second chambers, and each opening is sealably closed by a corresponding heat conducting element for conducting heat to the urging means in the corresponding second chamber.

66. A delivery device as claimed in Claim 64 or 65 in which the third membrane comprises a heat insulating material.

67. A delivery device as claimed in any preceding claim in which each urging means comprises an expandable driving substance.

68. A delivery device as claimed in Claim 67 in which the driving substance is in the form of a liquid, the liquid being responsive to one of temperature change and chemical activation for converting from a liquid phase to a gaseous phase for urging the solid form structure through the first chamber.

69. A delivery device as claimed in Claim 67 in which the driving substance comprises a solid responsive to one of temperature change and chemical activation for transitioning directly from a solid phase to a gaseous phase for urging the solid form structure through the first chamber.

70. A delivery device as claimed in Claim 69 in which the driving substance

comprises Azobisisobutylonitrile (AIBN).

71. A delivery device as claimed in Claim 67 in which the driving substance comprises a plurality of gas filled microspheres responsive to temperature change for expansion thereof for urging the solid form structure through the first chamber.

72. A delivery device as claimed in Claim 71 in which the driving substance comprises gas filled microspheres sold under the Trade Mark EXPANCEL.

73. A delivery device as claimed in Claim 67 in which the driving substance comprises a porous material, the pores of which are gas filled.

74. A delivery device as claimed in Claim 73 in which the porous material is responsive to temperature change for expansion thereof.

75. A delivery device as claimed in Claim 73 in which the gas in the porous material is responsive to temperature change for expanding out of the porous material.

76. A delivery device as claimed in Claim 73 to 75 in which the porous material of the driving substance comprises a porous polymer material.

77. A delivery device as claimed in any preceding claim in which a securing means is provided for securing the delivery device to a site on a subject.

78. An injectable element for administering an active substance to a subject, the injectable element comprising a solid form structure having a pointed tip for penetrating the skin of the subject and comprising the active substance.

79. An injectable element as claimed in Claim 78 in which the solid form structure comprises a support material for supporting the active substance therein.

80. An injectable element as claimed in Claim 79 in which the support material of

the solid form structure is configured as a scaffolding structure, and the active substance is in solid form supported by the scaffolding structure.

81. An injectable element as claimed in Claim 80 in which the scaffolding structure is of lattice construction.

82. An injectable element as claimed in any of Claims 79 to 81 in which the support material of the solid form structure is porous and the active substance is impregnated therein.

83. An injectable element as claimed in any of Claims 79 to 81 in which the active substance is coated onto the support material of the solid form structure.

84. An injectable element as claimed in any of Claims 79 to 83 in which the support material of the solid form structure is adapted for facilitating slow release of the active substance therefrom.

85. An injectable element as claimed in any of Claims 79 to 84 in which the support material of the solid form structure comprises a biodegradable material.

86. An injectable element as claimed in any of Claims 79 to 85 in which the support material of the solid form structure comprises a polymer material.

87. An injectable element as claimed in any of Claims 78 to 86 in which the solid form structure comprises a mixture comprising the active substance and an excipient.

88. An injectable element as claimed in any of Claims 78 to 87 in which the maximum transverse cross-sectional dimension of the solid form structure lies in the range of 0.1mm to 2mm.

89. An injectable element as claimed in any of Claims 78 to 88 in which the axial length of the solid form structure lies in the range of 0.1mm to 2mm.

90. An injectable element as claimed in any of Claims 78 to 89 in which the solid form structure comprises a tapering portion terminating in the pointed tip.

91. An injectable element as claimed in Claim 90 in which the solid form structure comprises a portion of constant transverse cross-section, the tapering portion thereof extending axially from the portion of constant transverse cross-section.

92. An injectable element as claimed in Claim 90 or 91 in which the tapering portion of the solid form structure is of conical shape.

93. An injectable element as claimed in any of Claims 78 to 92 in which the solid form structure is of circular transverse cross-section.

94. A delivery device for administering an active substance to a subject in the form of a solid form structure, the device comprising a plurality of first chambers for accommodating respective ones of the solid form structures, and an urging means for urging the solid form structures through the corresponding first chambers to penetrate the skin of the subject.

95. A delivery device as claimed in Claim 94 in which the first chambers are configured in a matrix.

96. A delivery device as claimed in Claim 94 or 95 in which the maximum transverse cross-sectional dimension of each first chamber lies in the range of 0.1mm to 2mm.

97. A delivery device as claimed in any of Claims 94 to 96 in which the axial length of each first chamber lies in the range of 0.1mm to 2mm.

98. A delivery device as claimed in any of Claims 94 to 97 in which a first housing is provided, and the first chambers are located in the first housing.

99. A delivery device as claimed in Claim 98 in which the first housing comprises a first plate member defining opposite first and second major surfaces, and each first chamber is formed by a corresponding first bore extending through the first plate member from the first major surface thereof to the second major surface.

100. A delivery device as claimed in Claim 99 in which the first plate member is of thickness in the range of 0.1mm to 2mm.

101. A delivery device as claimed in Claim 99 or 100 in which each first bore is of circular transverse cross-section.

102. A delivery device as claimed in any of Claims 94 to 101 in which each first chamber is adapted for slideably accommodating the corresponding solid form structure therethrough.

103. A delivery device as claimed in any of Claims 94 to 102 in which a second chamber is provided for housing the urging means.

104. A delivery device as claimed in Claim 103 in which a second housing is provided, the second chamber being located in the second housing.

105. A delivery device as claimed in Claim 104 in which a plurality of second chambers are located in the second housing.

106. A delivery device as claimed in Claim 103 or 104 in which one second chamber is provided corresponding to each first chamber, the second chambers being aligned with the respective corresponding first chambers.

107. A delivery device as claimed in any of Claims 104 to 106 in which the maximum transverse cross-sectional dimension of each second chamber lies in the range of 0.1mm to 2mm.

108. A delivery device as claimed in any of Claims 104 to 107 in which the second

housing comprises a second plate member having opposite first and second major surfaces, and each second chamber is formed by a corresponding second bore extending through the second plate member from the first major surface thereof to the second major surface.

109. A delivery device as claimed in Claim 108 in which the second plate member is of thickness in the range of 0.1mm to 2.0mm.

110. A delivery device as claimed in Claim 108 or 109 in which each second bore is of circular transverse cross-section.

111. A delivery device as claimed in any of Claims 103 to 110 in which the second chambers are configured in a matrix.

112. A delivery device as claimed in any of Claims 103 to 111 in which a first membrane is located between the first and second chambers for sealably isolating each first chamber from the second chamber.

113. A delivery device as claimed in Claim 112 in which the first membrane comprises a material impermeable to the urging means.

114. A delivery device as claimed in Claim 112 or 113 in which the first membrane comprises a material impermeable to the active substance.

115. A delivery device as claimed in any of Claims 112 to 114 in which the first membrane is deformable into each first chamber under the action of the urging means for urging the corresponding solid form structure through the first chamber.

116. A delivery device as claimed in any of Claims 112 to 115 in which the first membrane is of an expandable material.

117. A delivery device as claimed in any of Claims 112 to 116 in which at least one pair of interengageable complementary formations is provided for locating the

first and second plate members relative to each other with each first chamber aligned with the corresponding second chamber, one of the interengageable complementary formations being located on the second major surface of the first plate member adjacent one of the first chambers, and the other of the pair of interengageable complementary formations being located on the first major surface of the second plate member, the respective interengageable complementary formations of the pair thereof being co-operable with each other for entrapping the first membrane therebetween.

118. A delivery device as claimed in Claim 117 in which the interengageable complementary formation of the pair thereof located on the first plate member extends around the corresponding one of the first chambers.

119. A delivery device as claimed in Claim 117 or 118 in which the interengageable complementary formation of the pair thereof located on the first plate member extends completely around the corresponding one of the first chambers.

120. A delivery device as claimed in any of Claims 117 to 119 in which the interengageable complementary formation of the pair thereof located on the second plate member extends around the corresponding one of the second chambers.

121. A delivery device as claimed in any of Claims 117 to 120 in which the interengageable complementary formation of the pair thereof located on the second plate member extends completely around the corresponding one of the second chambers.

122. A delivery device as claimed in any of Claims 117 to 121 in which one of the interengageable complementary formations of the pair thereof comprises a projection extending from the corresponding one of the first and second plate members.

123. A delivery device as claimed in Claim 122 in which the projection comprises

an annular projection.

124. A delivery device as claimed in Claim 122 or 123 in which the other of the interengageable complementary formations of the pair thereof comprises a recess extending into the corresponding one of the first and second plate members for engaging the projection extending from the other of the first and second plate members.

125. A delivery device as claimed in Claim 124 in which the recess is configured as an annular recess.

126. A delivery device as claimed in any of Claims 117 to 125 in which a plurality of pairs of interengageable complementary formations are provided, one of the pairs of interengageable complementary formations being provided corresponding to each first chamber.

127. A delivery device as claimed in any of Claims 103 to 126 in which one urging means is provided in each second chamber.

128. A delivery device as claimed in any of Claims 99 to 127 in which a second membrane is provided for sealably closing each first chamber adjacent the first major surface of the first plate member.

129. A delivery device as claimed in Claim 128 in which the second membrane is adapted to be penetrable by a pointed tip of each solid form structure.

130. A delivery device as claimed in any of Claims 94 to 129 in which at least one activating means is provided for activating the urging means to urge at least one of the solid form structures through the corresponding first chamber to penetrate the skin of a subject.

131. A delivery device as claimed in Claim 130 in which a plurality of activating means are provided, each activating means being provided for activating the urging

means in a corresponding one of the second chambers.

132. A delivery device as claimed in Claim 130 or 131 in which the respective activating means are aligned with corresponding ones of the second chambers.

133. A delivery device as claimed in Claim 131 or 132 in which the activating means are configured in the form of a matrix.

134. A delivery device as claimed in any of Claims 130 to 133 in which each activating means comprises a heating means.

135. A delivery device as claimed in Claim 134 in which each heating means comprises an electrically powered heating means.

136. A delivery device as claimed in Claim 134 or 135 in which each heating means comprises a thin film resistor.

137. A delivery device as claimed in any of Claims 130 to 136 in which the activating means are formed on a third plate member.

138. A delivery device as claimed in Claim 137 in which the third plate member comprises a material selected from one of silicon, ceramics, polyimide and FR4.

139. A delivery device as claimed in Claim 137 or 138 in which the third plate member comprises a flexible material.

140. A delivery device as claimed in any of Claims 130 to 139 in which a third membrane is located between the activating means and the at least one second chamber for sealably closing the second chamber.

141. A delivery device as claimed in Claim 140 in which a plurality of openings are formed through the third membrane adjacent respective corresponding ones of the second chambers, and each opening is sealably closed by a corresponding heat

conducting element for conducting heat to the urging means in the corresponding second chamber.

142. A delivery device as claimed in Claim 140 or 141 in which the third membrane comprises a heat insulating material.

143. A delivery device as claimed in any of Claims 94 to 142 in which each urging means comprises an expandable driving substance.

144. A delivery device as claimed in Claim 143 in which the driving substance is in the form of a liquid, the liquid being responsive to one of temperature change and chemical activation for converting from a liquid phase to a gaseous phase for urging the solid form structure through the first chamber.

145. A delivery device as claimed in Claim 143 in which the driving substance comprises a solid responsive to one of temperature change and chemical activation for transitioning directly from a solid phase to a gaseous phase for urging the solid form structure through the first chamber.

146. A delivery device as claimed in Claim 145 in which the driving substance comprises Azobisisobutylonitrile (AIBN).

147. A delivery device as claimed in Claim 143 in which the driving substance comprises a plurality of gas filled microspheres responsive to temperature change for expansion thereof for urging the solid form structure through the first chamber.

148. A delivery device as claimed in Claim 147 in which the driving substance comprises gas filled microspheres sold under the Trade Mark EXPANCEL.

149. A delivery device as claimed in Claim 143 in which the driving substance comprises a porous material, the pores of which are gas filled.

150. A delivery device as claimed in Claim 149 in which the porous material is

responsive to temperature change for expansion thereof.

151. A delivery device as claimed in Claim 149 in which the gas in the porous material is responsive to temperature change for expanding out of the porous material.

152. A delivery device as claimed in Claim 149 to 151 in which the porous material of the driving substance comprises a porous polymer material.

153. A delivery device as claimed in any of Claims 94 to 152 in which a securing means is provided for securing the delivery device to a site on a subject.

154. A method for administering an active substance to a subject, the method comprising configuring the active substance as a solid form structure having a pointed tip, locating the solid form structure in a first chamber, attaching the first chamber to the subject adjacent a site at which the active substance is to be administered, and urging the solid form structure through the first chamber to penetrate the skin of the subject by the pointed tip thereof.

155. A method as claimed in Claim 154 in which the method further comprises providing a first housing, providing a plurality of the first chambers and locating the first chambers in the first housing, and locating one solid form structure in each first chamber.

156. A method as claimed in Claim 154 or 155 in which each solid form structure comprises a support material for supporting the active substance therein.

157. A method as claimed in Claim 156 in which the support material of each solid form structure is configured as a scaffolding structure, and the active substance is in solid form supported by the scaffolding structure.

158. A method as claimed in Claim 157 in which the scaffolding structure is of lattice construction.

159. A method as claimed in any of Claims 156 to 158 in which the support material of each solid form structure is porous and the active substance is impregnated therein.

160. A method as claimed in any of Claims 156 to 158 in which the active substance is coated onto the support material of each solid form structure.

161. A method as claimed in any of Claims 156 to 160 in which the support material of each solid form structure is adapted for facilitating slow release of the active substance therefrom.

162. A method as claimed in any of Claims 156 to 161 in which the support material of each solid form structure comprises a biodegradable material.

163. A method as claimed in any of Claims 156 to 162 in which the support material of each solid form structure comprises a polymer material.

164. A method as claimed in any of Claims 154 to 163 in which each solid form structure comprises a mixture comprising the active substance and an excipient.

165. A method as claimed in any of Claims 154 to 164 in which each solid form structure is slideable in the corresponding first chamber for penetrating the skin of a subject.

166. A method as claimed in Claim 165 in which each solid form structure is slideable in the corresponding first chamber from a position entirely within the first chamber to a position whereby at least a portion of the solid form structure extends outwardly of the first chamber for penetrating the skin of a subject.

167. A method as claimed in Claim 165 or 166 in which each solid form structure is a sealable sliding fit within the corresponding first chamber, and the urging means acts directly on the solid form structure for urging the solid form structure through the

first chamber.

168. A method as claimed in any of Claims 154 to 167 in which the maximum transverse cross-sectional dimension of each solid form structure lies in the range of 0.1mm to 2mm.

169. A method as claimed in any of Claims 154 to 168 in which the axial length of each solid form structure lies in the range of 0.1mm to 2mm.

170. A method as claimed in any of Claims 154 to 169 in which each solid form structure comprises a tapering portion terminating in the pointed tip.

171. A method as claimed in Claim 170 in which each solid form structure comprises a portion of constant transverse cross-section, the tapering portion thereof extending axially from the portion of constant transverse cross-section.

172. A method as claimed in Claim 170 or 171 in which the tapering portion of each solid form structure is of conical shape.

173. A method as claimed in any of Claims 154 to 172 in which each solid form structure is of circular transverse cross-section.

174. A method as claimed in any of Claims 154 to 173 in which the first chambers are configured in a matrix.

175. A method as claimed in any of Claims 154 to 174 in which the maximum transverse cross-sectional dimension of each first chamber lies in the range of 0.1mm to 2mm.

176. A method as claimed in any of Claims 154 to 175 in which the axial length of each first chamber lies in the range of 0.1mm to 2mm.

177. A method as claimed in any of Claims 154 to 176 in which a first housing is

provided, and the first chambers are located in the first housing.

178. A method as claimed in Claim 177 in which the first housing comprises a first plate member defining opposite first and second major surfaces, and each first chamber is formed by a corresponding first bore extending through the first plate member from the first major surface thereof to the second major surface.

179. A method as claimed in any of Claims 154 to 178 in which a second chamber is provided for housing the urging means.

180. A method as claimed in Claim 179 in which a second housing is provided, and the second chamber is located in the second housing.

181. A method as claimed in Claim 180 in which a plurality of second chambers are located in the second housing.

182. A method as claimed in Claim 180 or 181 in which one second chamber is provided corresponding to each first chamber, the second chambers being aligned with the respective corresponding first chambers.

183. A method as claimed in any of Claims 180 to 182 in which the second housing comprises a second plate member having opposite first and second major surfaces, and each second chamber is formed by a corresponding second bore extending through the second plate member from the first major surface thereof to the second major surface.

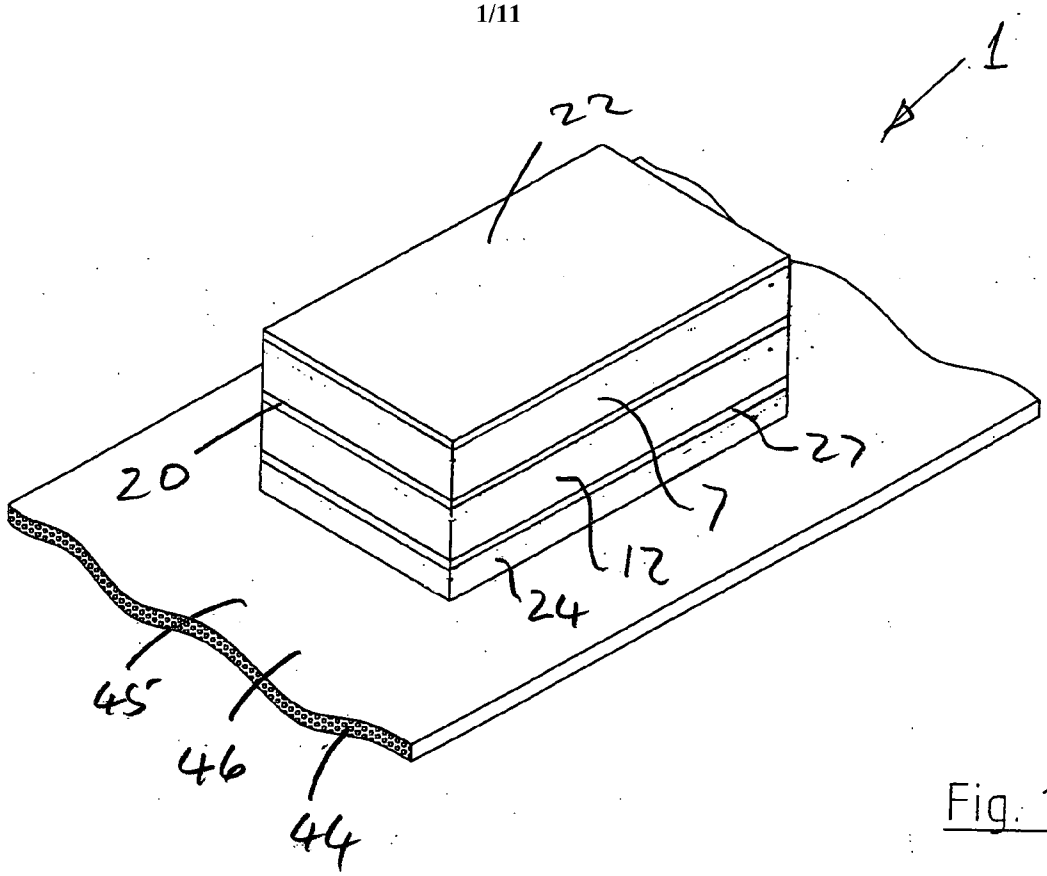
1
22
20
27
7
12
24
45
46
44

Fig. 1

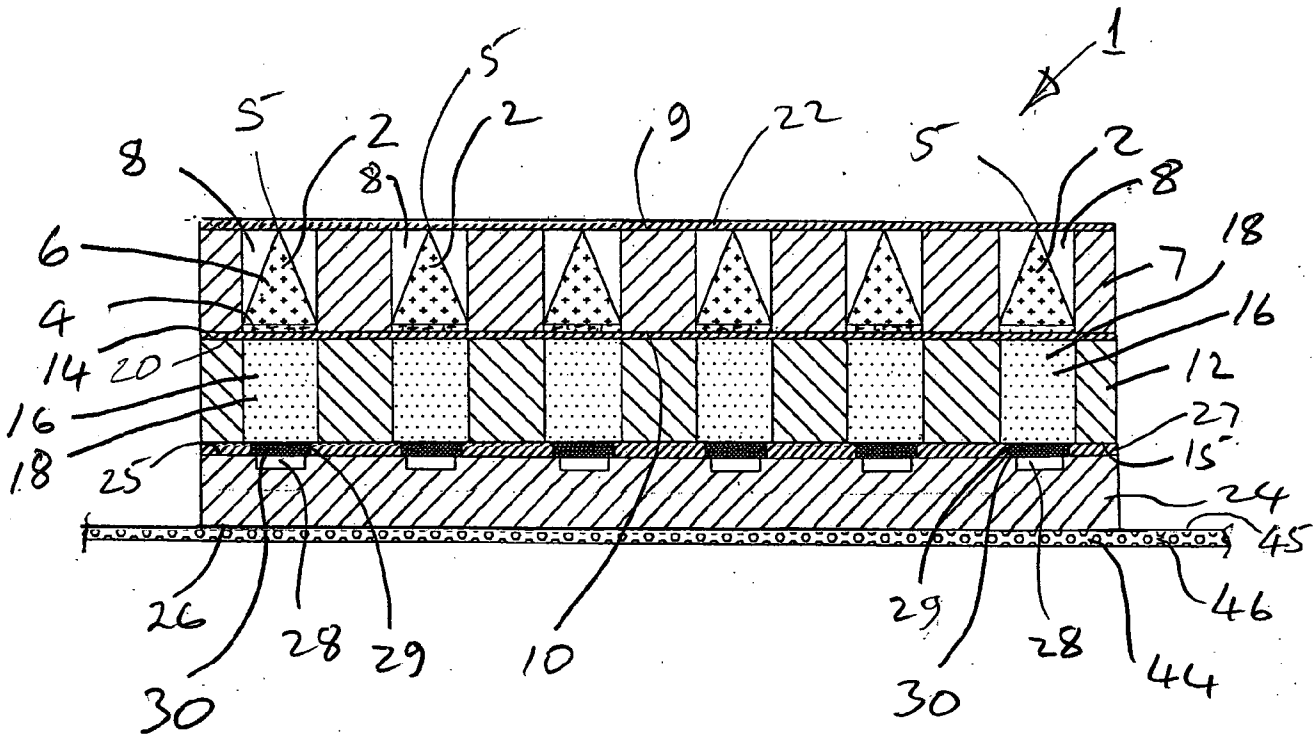
1
5
5
2
2
9
22
5
2
8
8
8
6
4
14
20
16
18
25
18
7
16
12
27
15
24
45
26
28
29
10
29
28
44
46
30
30

FIG 4

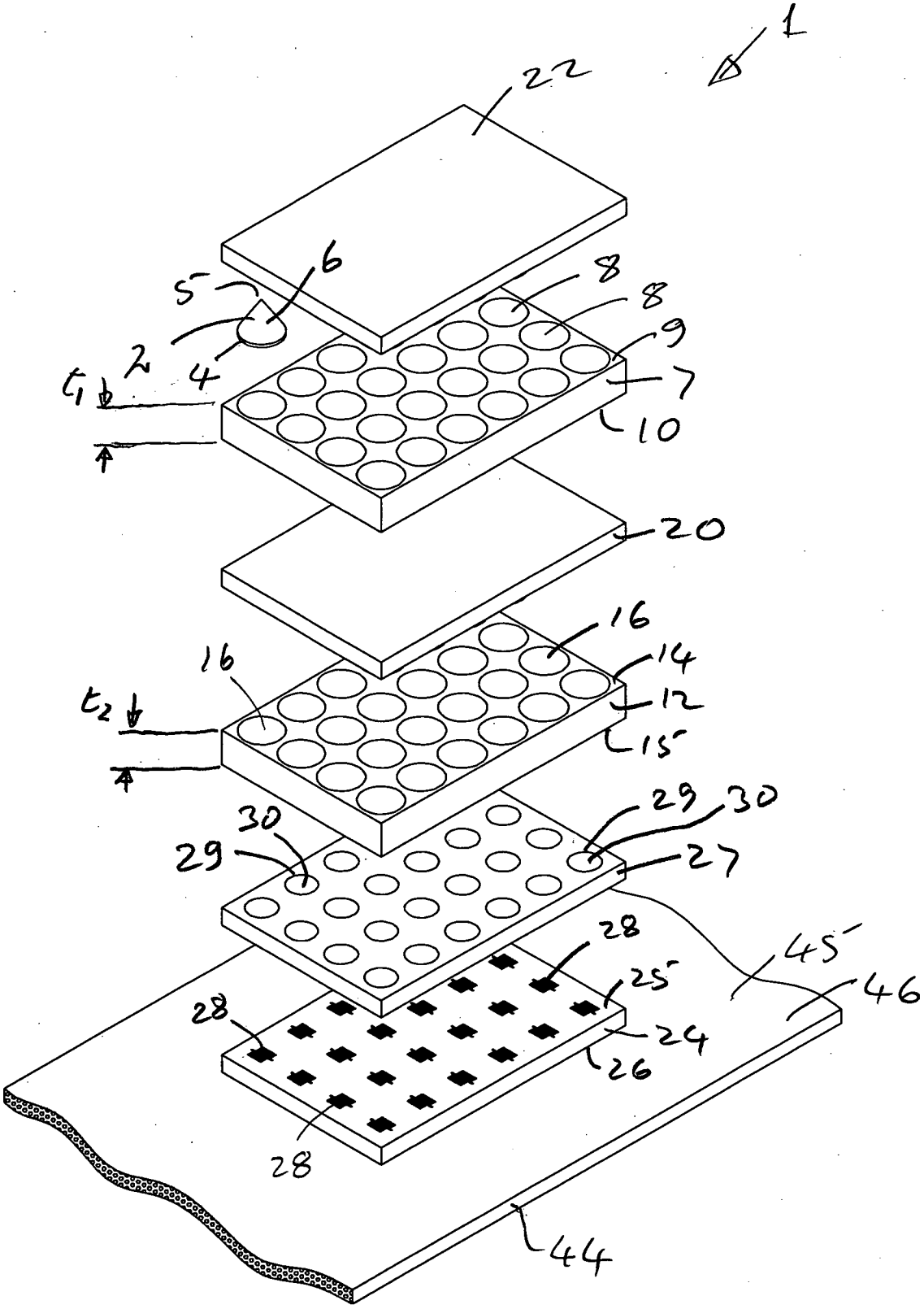
1
22
5
6
8
8
9
2
4
7
10
20
16
16
14
12
15
29
30
30
29
27
28
45
25
46
28
24
26
28
44

Fig. 2

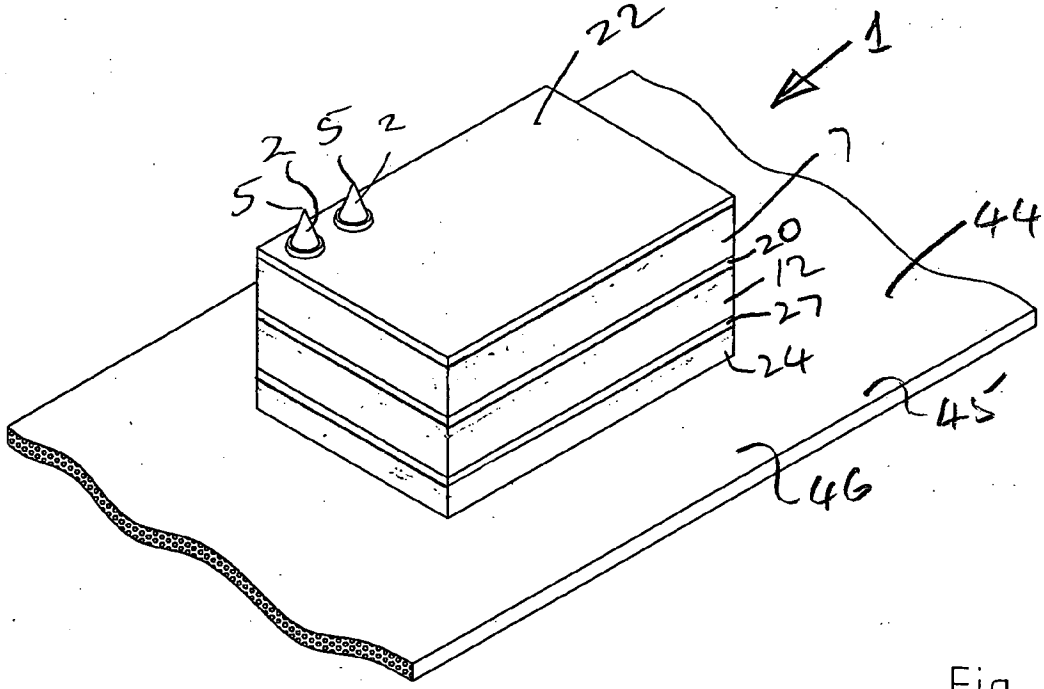

Fig. 3

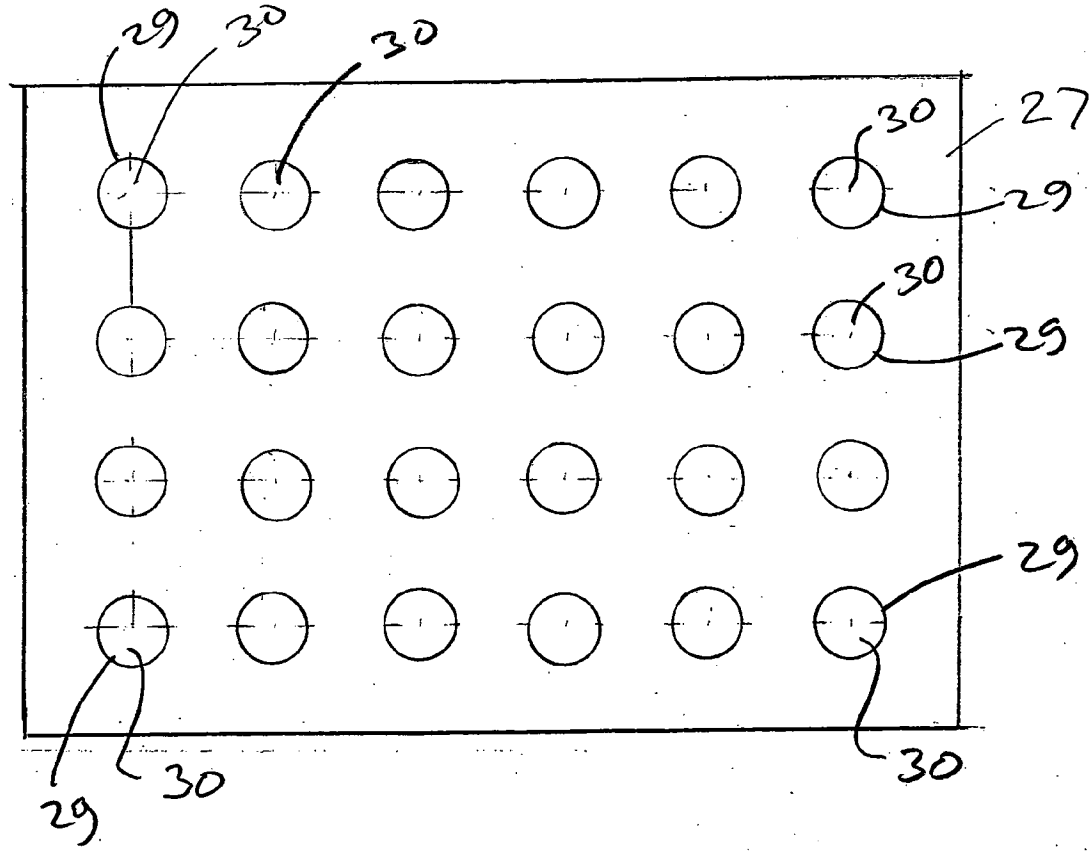

FIG 9

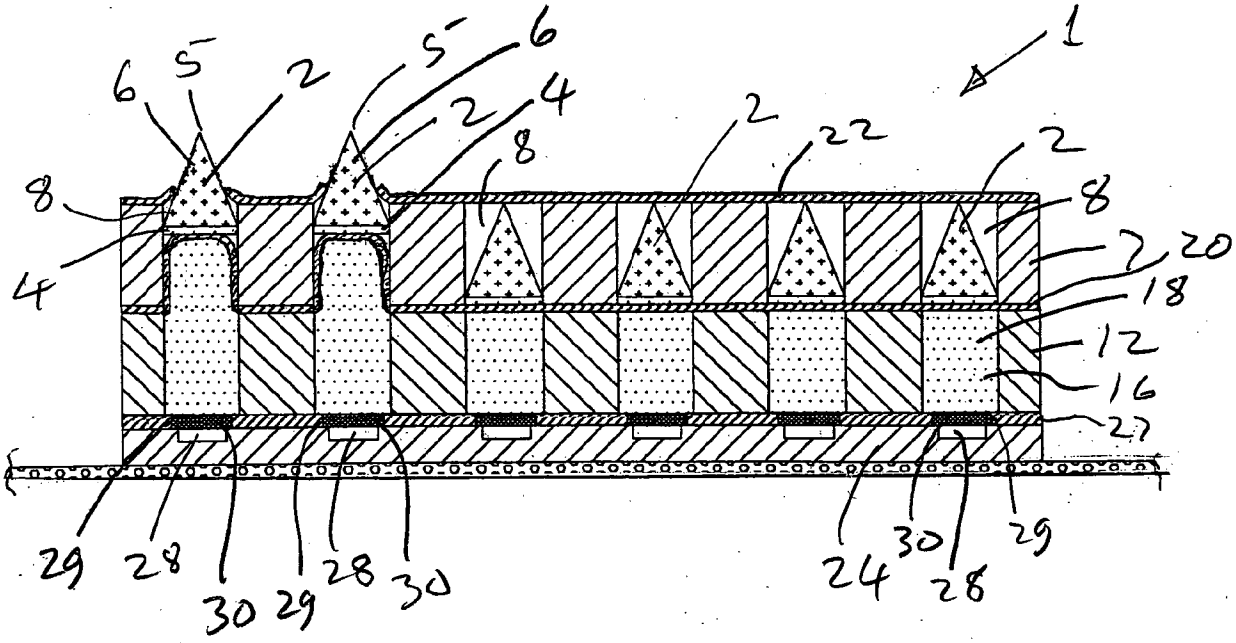

FIG 5

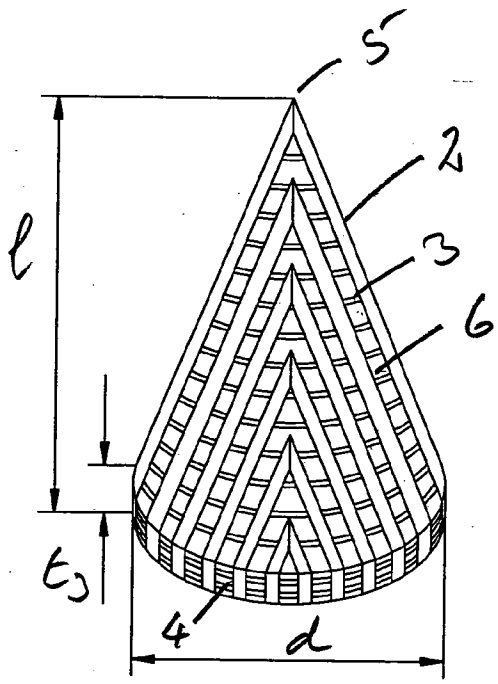

Fig. 6

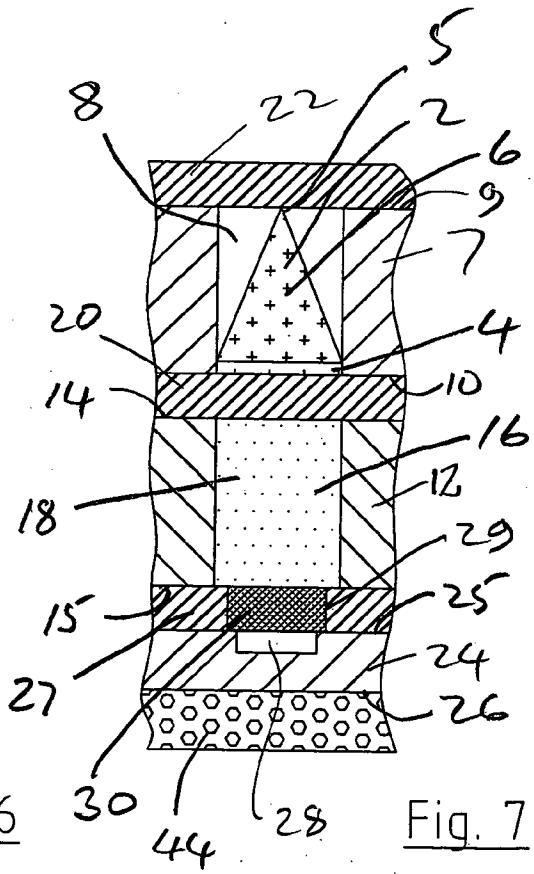

Fig. 7

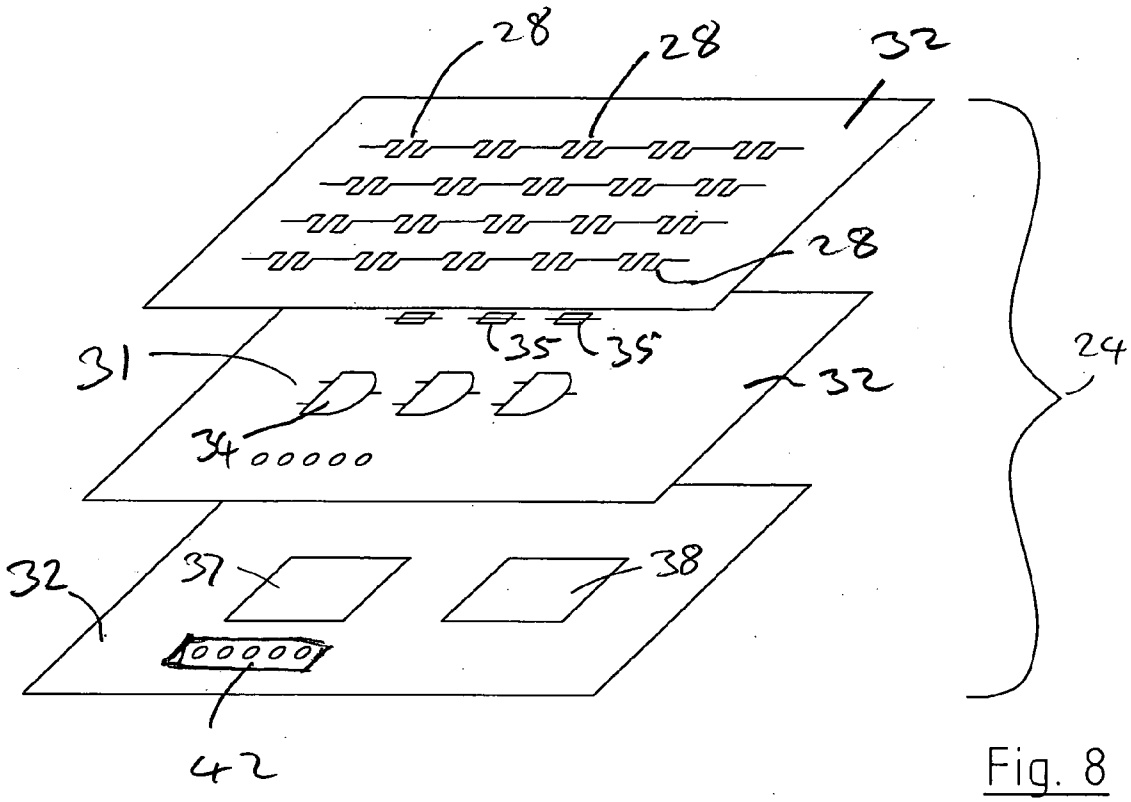

Fig. 8

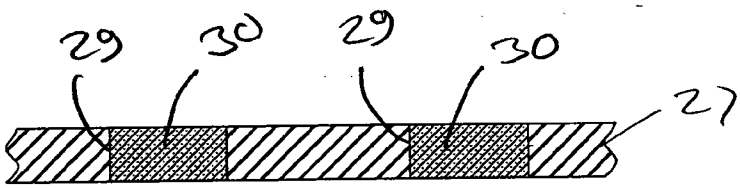

Fig. 10

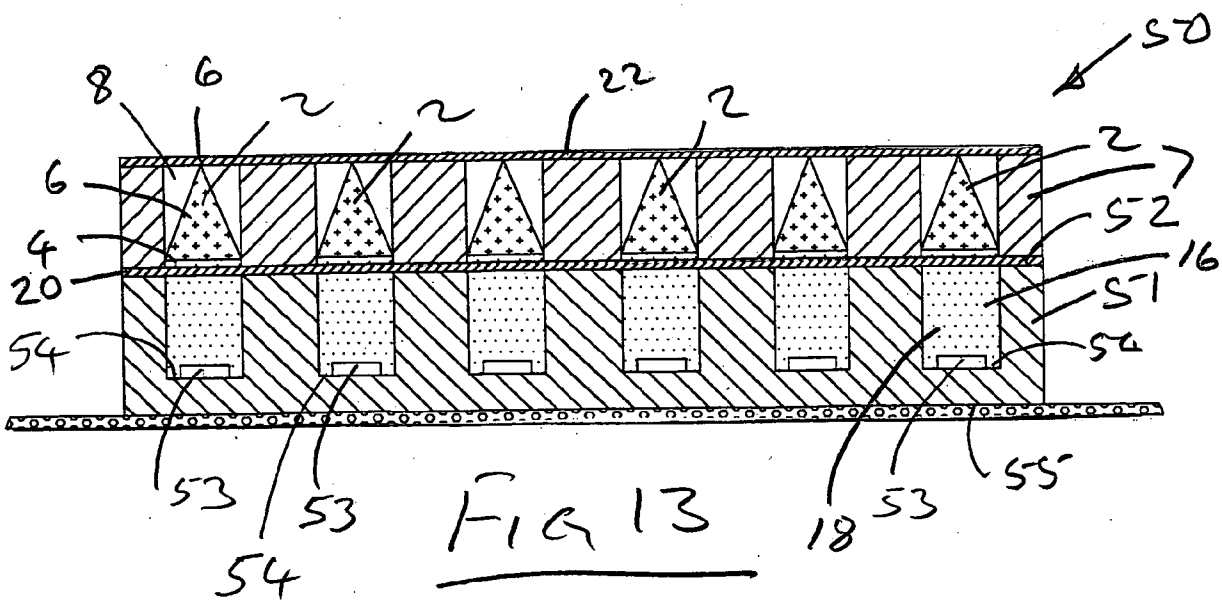

Fig 13

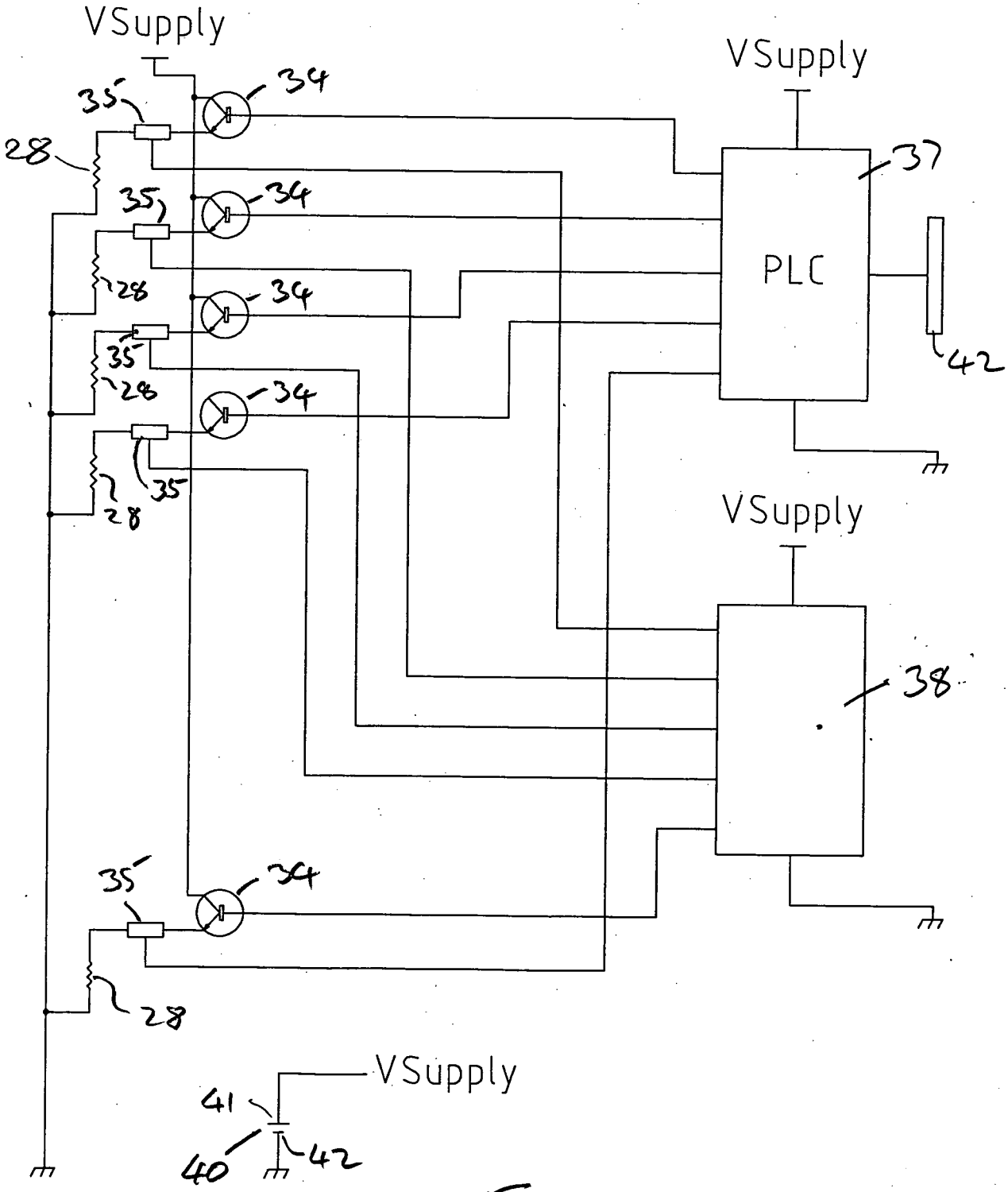

FIG 11

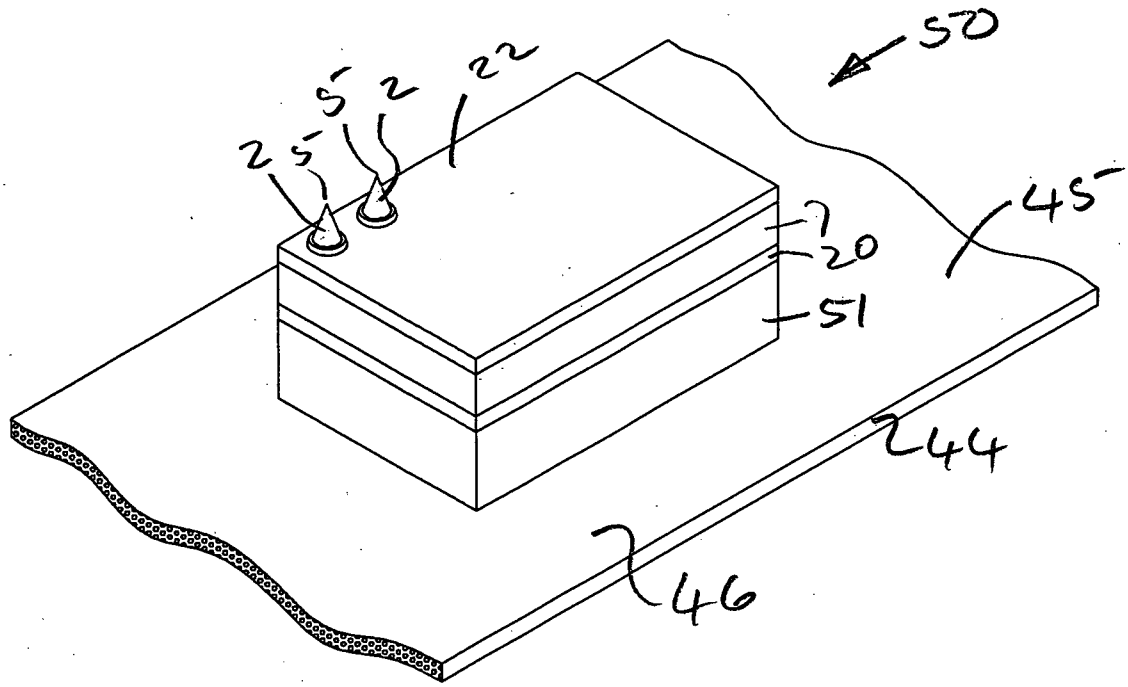

Fig. 12

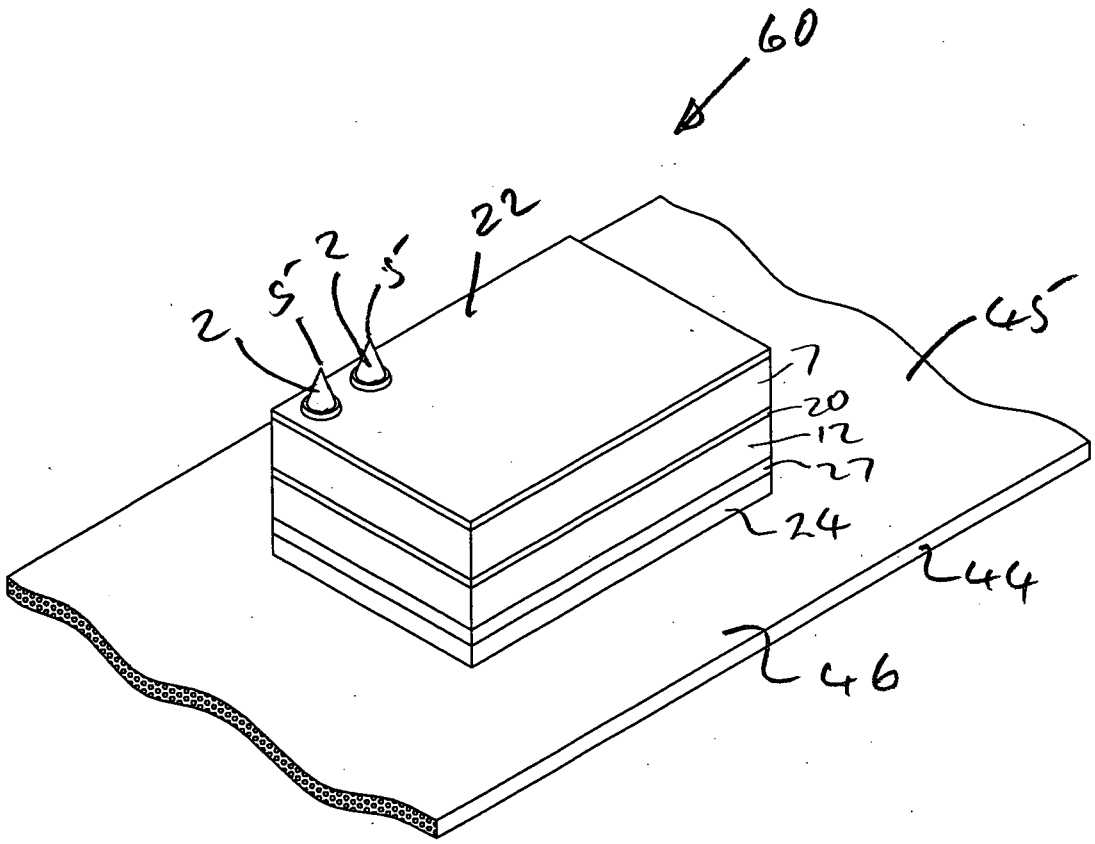

Fig. 14

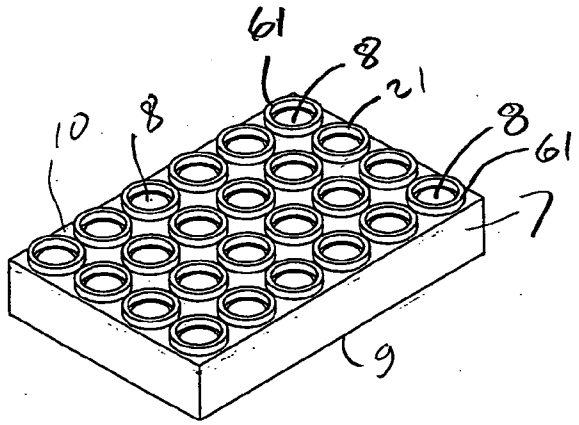

FIG 16

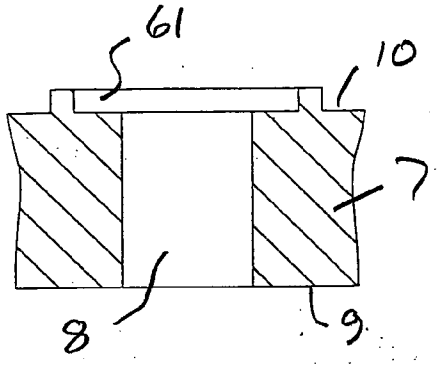

FIG 17

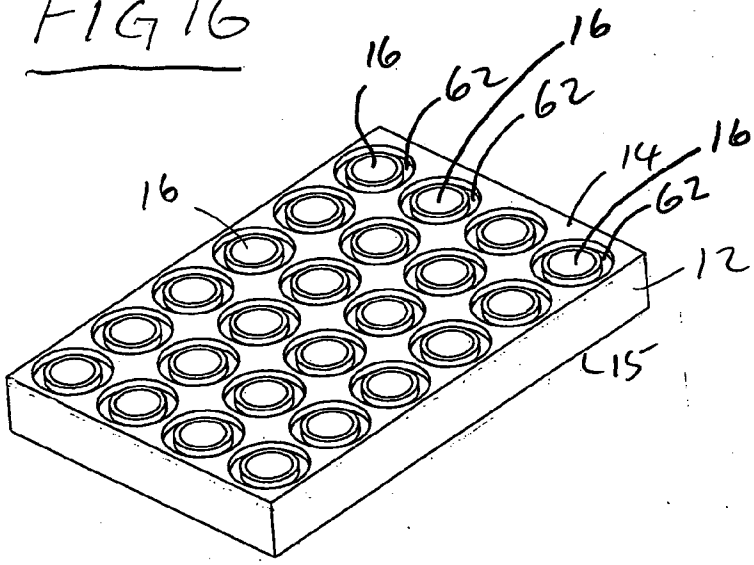

FIG 18

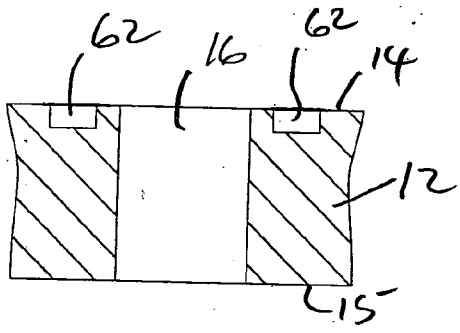

FIG 19

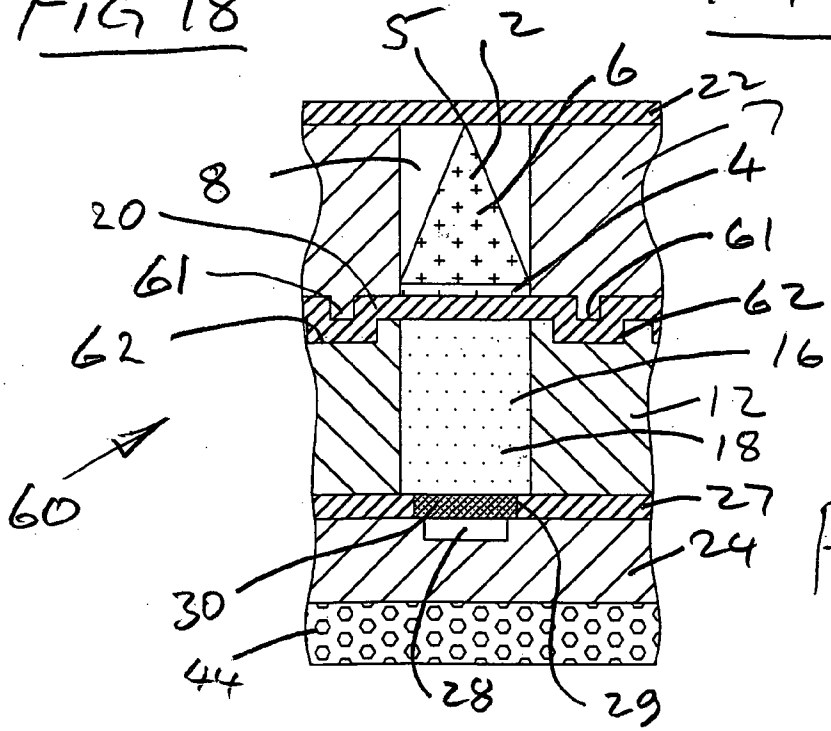

FIG 15

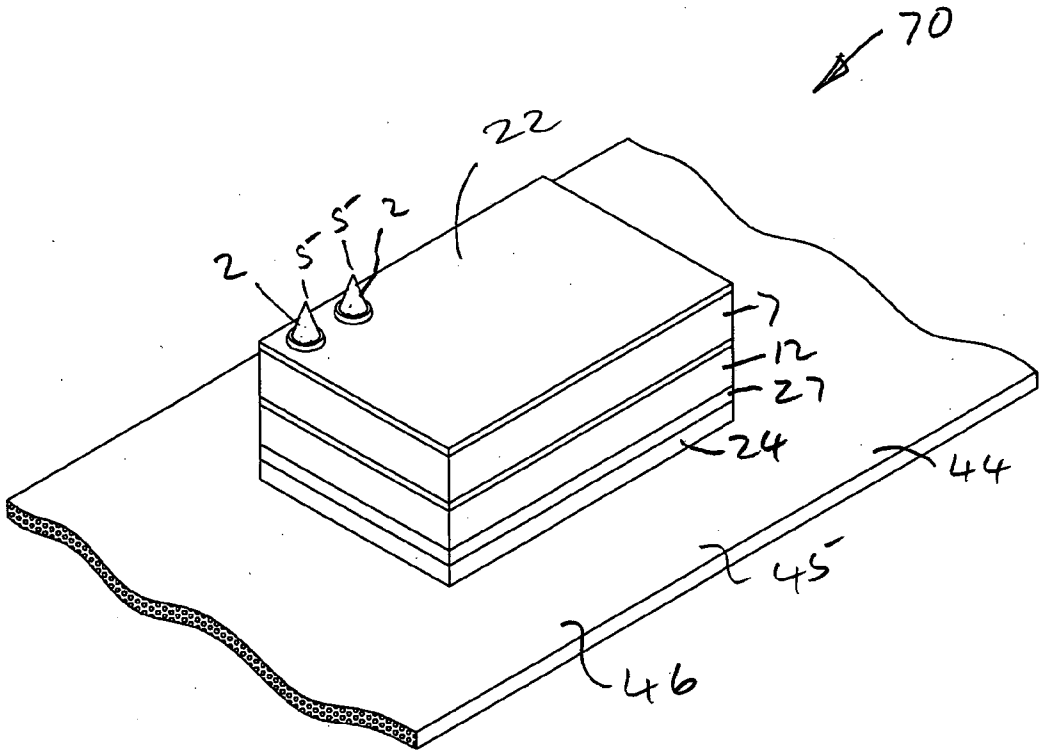
70
22
2
5'
5'
2
7
12
27
24
44
45'
46

Fig. 20

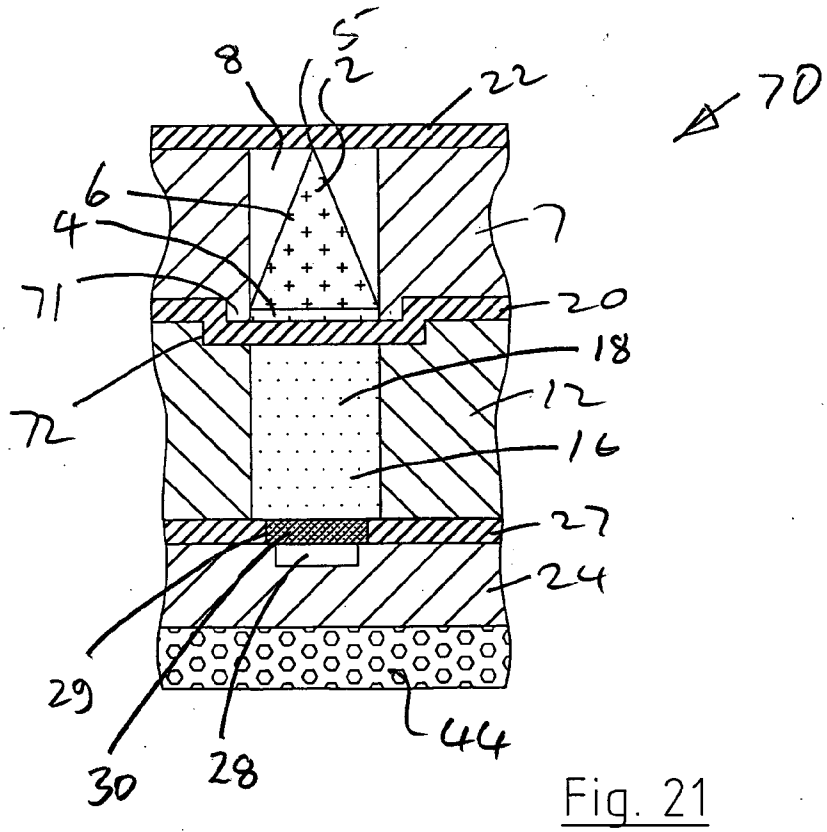
8
5'
2
22
70
6
4
7
71
20
18
72
12
16
27
24
29
30
28
44

Fig. 21

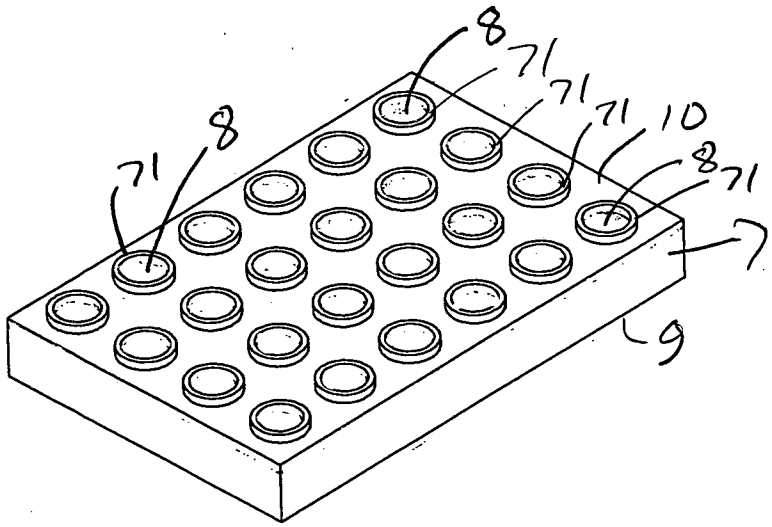

FIG 22

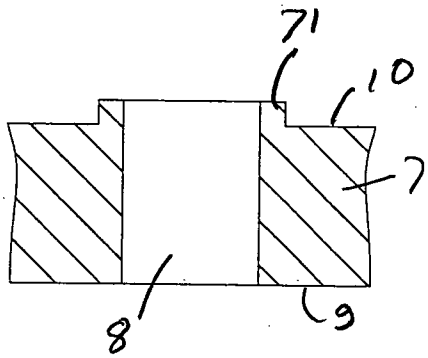

FIG 23

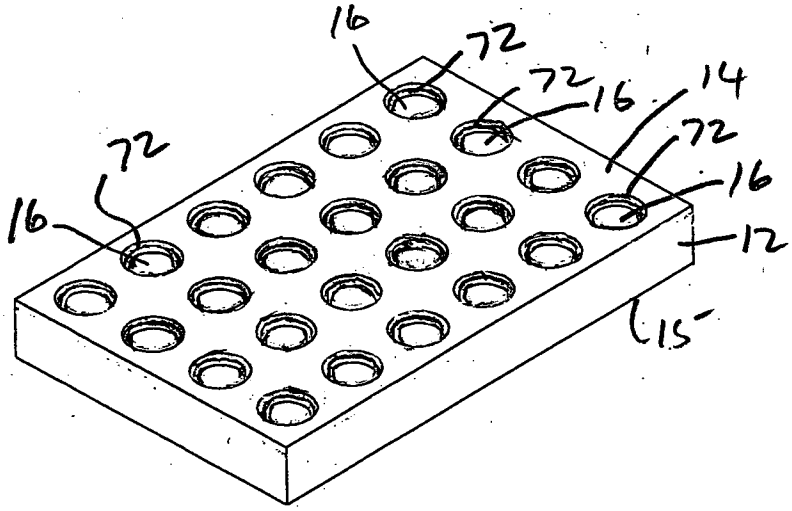

FIG 24

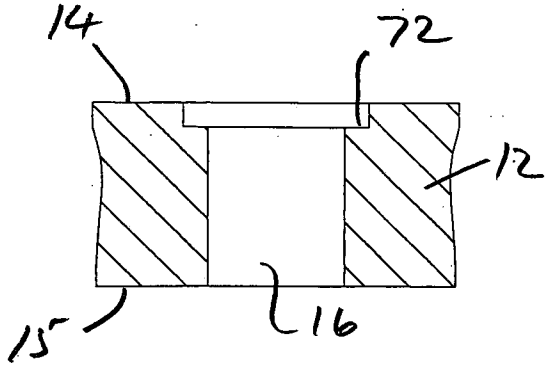

FIG 25

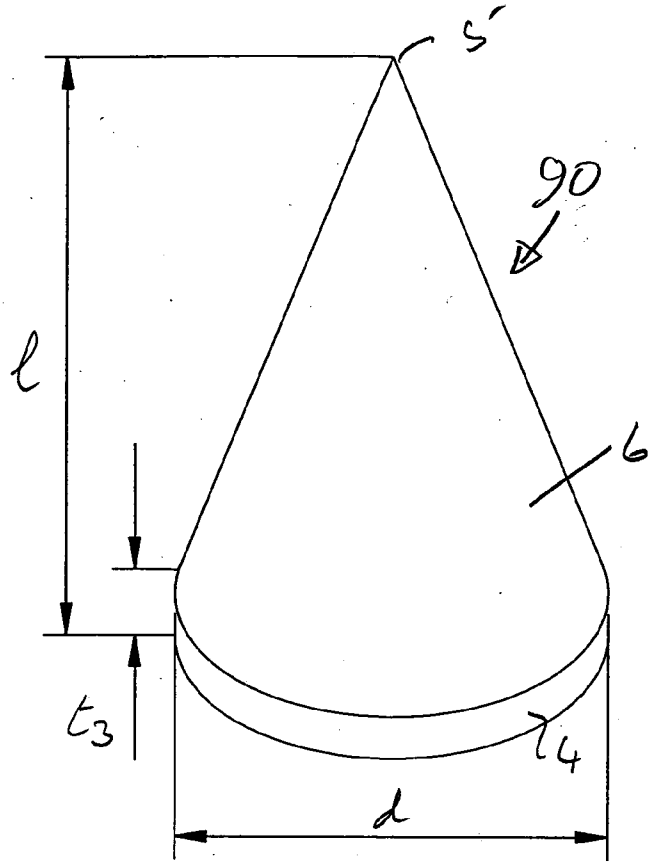

Fig. 27

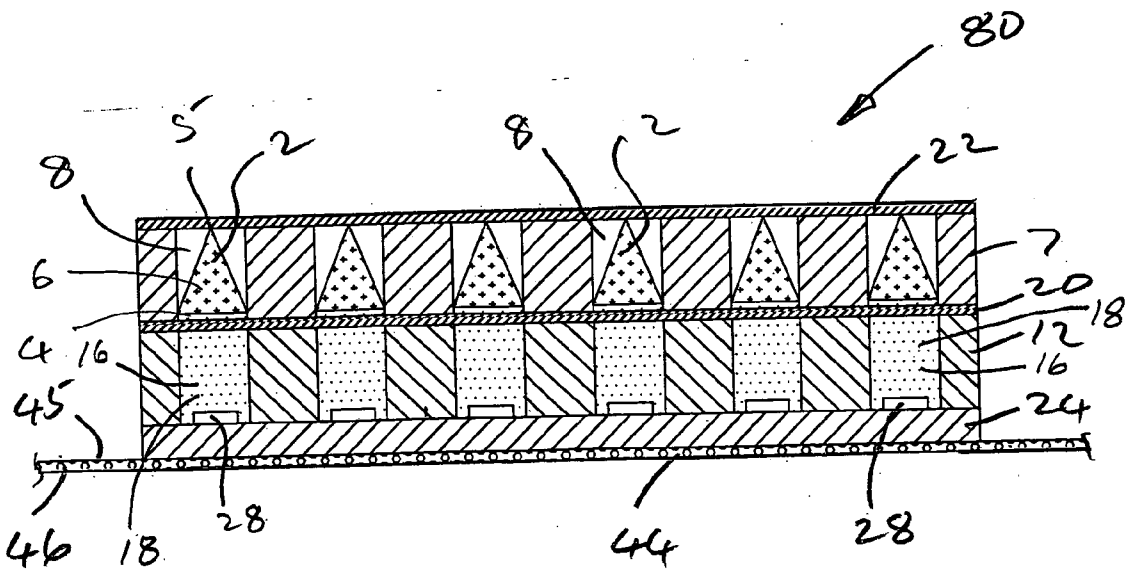

FIG 26

INTERNATIONAL SEARCH REPORT

International application No
PCT/IE2008/000115

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M37/00 A61M31/00 A61K9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 542 920 A (CHERIF CHEIKH ROLAND [FR]) 6 August 1996 (1996-08-06)	1,11,12, 14-19, 21,23, 24, 26-28, 54,67, 78, 88-90, 92,94, 96,98, 99, 101-104, 130,143
Y	the whole document	2-10

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 March 2009	18/03/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Jameson, Patricia

INTERNATIONAL SEARCH REPORT

International application No
PCT/IE2008/000115

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 2008/008557 A (INFOTONICS TECHNOLOGY CT INC [US]; MIR JOSE [US]; ZANDER DENNIS ROLAND) 17 January 2008 (2008-01-17) paragraphs [0033] - [0037]; figures 1-2a paragraph [0059] - paragraph [0065]; figures 3a-8 paragraph [0067] - paragraph [0073]; figures 10a-12e	1,2,6, 11,12, 14-16, 18,52,53
X	US 2005/251088 A1 (KWON SUNG-YUN [US]) 10 November 2005 (2005-11-10)	78-86, 88-93
A	the whole document	1,94
X	EP 1 844 763 A (BIOSERENTACH CO LTD [JP]) 17 October 2007 (2007-10-17)	78-82, 84-86, 88-93
A	paragraphs [0065] - [0103]; figures 1-15	1,94
X	WO 01/36037 A (VELCRO IND [NL]; KINGSFORD HOWARD A [US]) 25 May 2001 (2001-05-25)	78,86, 88-92
A	page 3, line 3 - page 4, line 24; figures 1-5	1
X	EP 1 216 721 A (BARDANI FRANK M [US]) 26 June 2002 (2002-06-26)	78,88, 90-92
A	paragraphs [0028] - [0032]; figures 1-4	1
X	WO 2004/084857 A (MPATHY MEDICAL DEVICES LTD [GB]; BROWNING JAMES [GB]) 7 October 2004 (2004-10-07)	78-87, 90-93
Y	page 19, lines 6-24 page 22, line 19 - page 25, line 11; figure 1	2-10
X	WO 2004/026281 A (MICROCHIPS INC [US]) 1 April 2004 (2004-04-01)	94-100, 103, 112-116, 127,128, 130,131, 134-138, 140-143, 145,153
A	page 19, line 11 - page 24, line 16 page 13, line 1 - page 17, line 23; figures 6a-12b	1-7,9, 10,20, 22-35, 37,51, 54-60, 67,69,77

-/--

INTERNATIONAL SEARCH REPORT

International application No
PCT/IE2008/000115

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 782 799 A (JACOBSEN STEPHEN C [US] ET AL) 21 July 1998 (1998-07-21)	94,95, 98,99, 103,106, 111-116, 127,128, 130-135, 137,143, 145,153
A	column 5, line 6 - column 7, line 61; figures 2,3	1
X	WO 2006/015299 A (MICROCHIPS INC [US]; SANTINI JR JOHN T [US]; STAPLES MARK ANDREW [US];) 9 February 2006 (2006-02-09)	94,95, 98,99, 103,104, 111,128, 130,131, 134-137, 153
A		1-4, 7-10,20, 23,24, 26,27, 35,52, 54,55, 58-61,77

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IE2008/000115

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 154-183, 72, 148
because they relate to subject matter not required to be searched by this Authority, namely:

Rule 39.1(iv) PCT - Method for treatment of the human or animal body by therapy

2. [X] Claims Nos.: 72, 148
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

see FURTHER INFORMATION sheet PCT/ISA/210

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search reportcovers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.1

Claims Nos.: 154-183, 72, 148

Rule 39.1(iv) PCT - Method for treatment of the human or animal body by therapy

---

Continuation of Box II.2

Claims Nos.: 72, 148

The use of trademarks in the claims is generally not allowable.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2)PCT declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IE2008/000115

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5542920 A	06-08-1996	AT 173941 T	15-12-1998
		AU 705266 B2	20-05-1999
		AU 4454299 A	21-10-1999
		BR 9508830 A	03-11-1998
		CA 2199516 A1	21-03-1996
		DE 69506428 D1	14-01-1999
		DE 69506428 T2	02-06-1999
		DK 782465 T3	16-08-1999
		EP 0782465 A1	09-07-1997
		ES 2125657 T3	01-03-1999
		WO 9608289 A1	21-03-1996
		JP 10505526 T	02-06-1998
		JP 2006320736 A	30-11-2006
		KR 100261580 B1	15-07-2000
		US 2003082216 A1	01-05-2003
		US 6117443 A	12-09-2000
		US 6120786 A	19-09-2000
WO 2008008557 A	17-01-2008	WO 2008008558 A1	17-01-2008
US 2005251088 A1	10-11-2005	NONE	
EP 1844763 A	17-10-2007	AU 2006209421 A1	03-08-2006
		CA 2595894 A1	03-08-2006
		WO 2006080508 A1	03-08-2006
		KR 20070100820 A	11-10-2007
		US 2008262444 A1	23-10-2008
WO 0136037 A	25-05-2001	AU 3081601 A	30-05-2001
		CA 2390252 A1	25-05-2001
		CN 1390148 A	08-01-2003
		CN 101238998 A	13-08-2008
		DE 60022540 D1	13-10-2005
		DE 60022540 T2	14-06-2006
		EP 1235611 A2	04-09-2002
		ES 2248165 T3	16-03-2006
		JP 2003513765 T	15-04-2003
		MX PA02004863 A	28-01-2003
		US 2005118388 A1	02-06-2005
EP 1216721 A	26-06-2002	US 2002082565 A1	27-06-2002
WO 2004084857 A	07-10-2004	EP 1608334 A1	28-12-2005
		GB 2416129 A	18-01-2006
		US 2007020311 A1	25-01-2007
WO 2004026281 A	01-04-2004	AU 2003278881 A1	08-04-2004
US 5782799 A	21-07-1998	AU 5705398 A	26-08-1998
		WO 9834672 A1	13-08-1998
		US 6056734 A	02-05-2000
		US 6010492 A	04-01-2000
WO 2006015299 A	09-02-2006	NONE	