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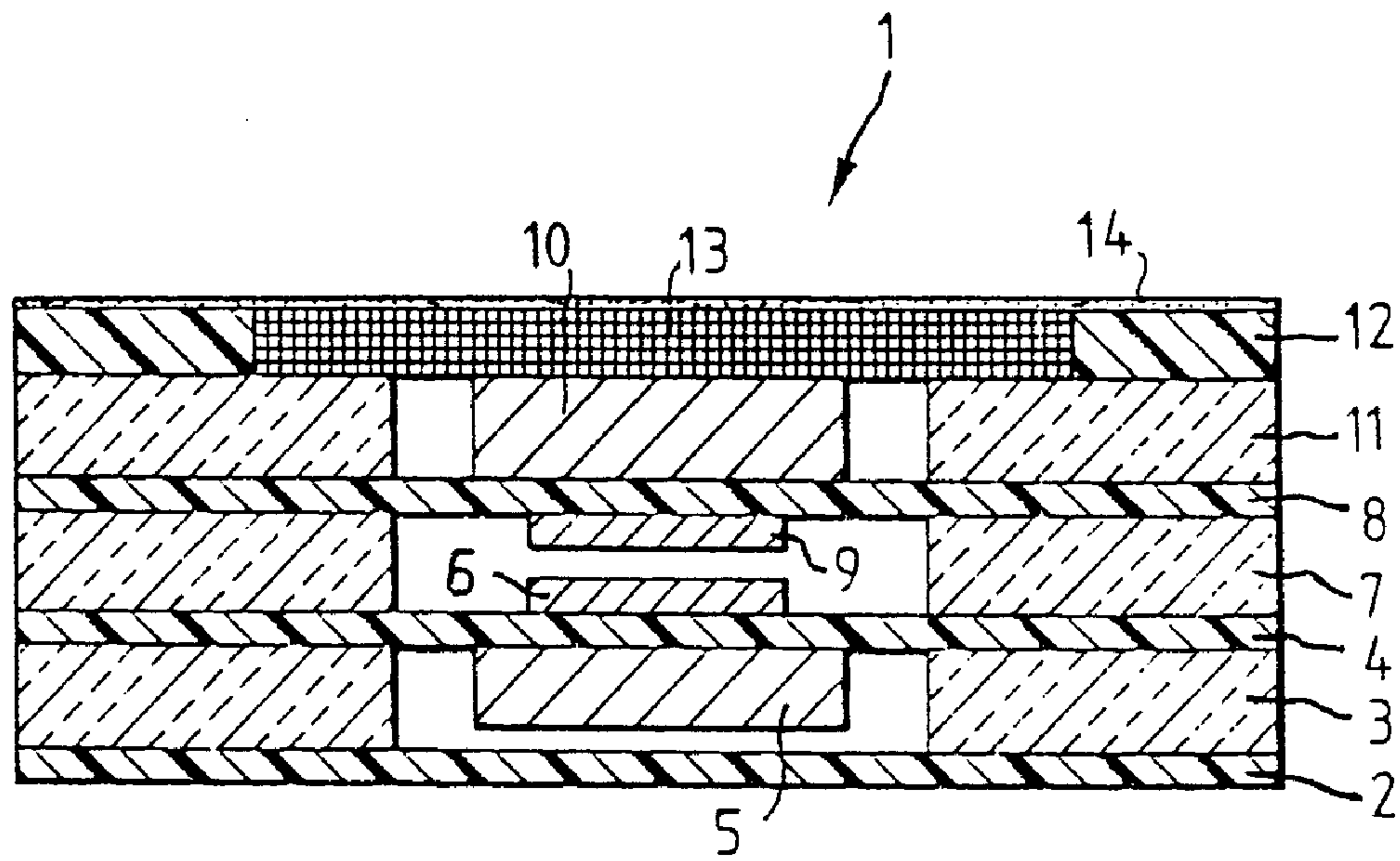


(57) Abrégé/Abstract:
The present invention relates to a switching field for switching electrical signal lines, in particular for communications and data processing. The switching field has a multitude of crosspoints, preferably in a matrix arrangement. A permanent magnet is associated with one contact-surface member of each crosspoint, and a ferromagnetic material with a coil means is associated with a respective opposed contact-surface member. A signal-independent robust switching field is thereby achieved, which field can be manufactured in a compact and cost-effective manner. A particularly high compactness is possible when the invention makes use of membrane technology.

ABSTRACT

The present invention relates to a switching field for switching electrical signal lines, in particular for communications and data processing. The switching field has a multitude of crosspoints, preferably in a matrix arrangement. A permanent magnet is associated with one contact-surface member of each crosspoint, and a ferromagnetic material with a coil means is associated with a respective opposed contact-surface member. A signal-independent robust switching field is thereby achieved, which field can be manufactured in a compact and cost-effective manner. A particularly high compactness is possible when the invention makes use of membrane technology.

SWITCHING FIELD

The present invention relates to a switching field for switching electrical signal lines.

Switching fields are preferably used when a large number of lines are to be switched in communications and data processing.

Generally, electronic switching fields are employed that are designed in a space-saving manner as integrated circuits. These have a drawback, however, of being able to switch only specific kinds of signals. Also, electronic switching fields are sensitive to electromagnetic interferences (EMC) and large temperature variations. Switching fields that are not limited to a specific kind of signal are based on electrodynamic, thermal or electrostatic properties. They have very complex configurations that result in high manufacturing costs. Similar considerations apply to micromechanical switching fields.

Another kind of signal-bound switching field is the well-known electromechanical switching field. It is composed of individual relays that are wired with wires or printed-circuit boards to form switching fields. This type of switching field has problems when configured with a large number of crosspoints, since the crosspoints have to be arranged in different planes. For this purpose, large numbers of connection cables and various control modules must be employed. Further, without self-holding relays, current must continuously flow through the relay coils to keep the contacts closed. This leads to undesired high-power consumption, particularly since in many applications the individual crosspoints are only rarely switched.

WIPO Patent Publication WO 92/22919 discloses a three-dimensional galvanic switch in which ball-shaped connection means are moved on three positioning axes. The ball-shaped connection means are alternately designed as conductive or isolating, so that the respective crosspoint is either closed or open, respectively. This prior art switching field permits a compact, self-holding construction but has the disadvantage of its complex and costly mechanical portion.

It is therefore the object of the invention to provide a robust, signal-independent switching field that can be manufactured in an economic and compact manner.

According to one aspect of the present invention, there is provided a switching field for electromechanically switching electrical signal lines with crosspoints, wherein parts forming the crosspoints comprise membranes at which, and between which, further parts of the circuit are disposed, the crosspoints each also being comprised of at least two contact-surface members that are movable relative to each other, a permanent magnet being associated with a first one of the at least two contact-surface members, and a ferromagnetic material with a coil means being associated with a second one of the at least two contact-surface members.

The switching field may comprise crosspoints disposed in a matrix shape and signal lines assigned to individual ones of the crosspoints. In this regard, another aspect of the present invention provides a switching field for switching electrical signal lines for communication and data transfer applications, comprising crosspoints disposed in a matrix, said crosspoints including two contact surfaces, said contact surfaces being movable relative to each other;a permanent magnet connected with one of said contact surfaces; and a ferromagnetic material with a coil connected with another of said contact surfaces.

A further aspect of the present invention provides a switching field for electromechanically switching electrical signal lines with crosspoints, comprising membranes defining the crosspoints and circuit means disposed between said membranes wherein said membranes include a mechanically flexible membrane serving as a base; a mechanically stable membrane with an opening in an area of said crosspoints, said mechanically stable membrane being applied to said mechanically flexible membrane; another flexible membrane applied to said mechanically stable membrane, said another flexible membrane having a lower side to which a permanent magnet is attached and having an upper side to which one of one of two contact surfaces is attached; another mechanically stable membrane with an opening in the area of said crosspoints, said another mechanically stable membrane being applied to said another flexible membrane; a further mechanically flexible membrane applied to said another mechanically stable membrane, said further mechanically flexible membrane having a lower side with an opposed contact surface of said two contact surfaces attached, and having an upper side to which a ferromagnetic material is provided; a further mechanically stable membrane with an opening in the area of the crosspoints, said further mechanically stable membrane being disposed on said further mechanically flexible membrane; and an additional membrane carrying coils disposed in the area of the crosspoints, said additional membrane being applied on said further mechanically stable membrane.

The switching field may have first, second and third mechanically-stable membranes, as well as first, second and third mechanically-flexible membranes. The first mechanically-stable membrane, open in the area of the crosspoints, is applied onto the first mechanically-flexible membrane serving as a base. Onto the first mechanically-stable membrane is applied the second mechanically-flexible to which, in the area of the crosspoints, is attached on a lower side a permanent magnet and on an upper side a first one of at least two contact-surface members. The second mechanically-stable member, open in the area of the crosspoints, is applied onto the second mechanically-flexible membrane. Onto the second mechanically-stable membrane is applied a third mechanically-flexible membrane to which, in the area of the crosspoints, is attached on a lower side a second one of the at least two contact-surface members and on an upper side a ferromagnetic material. A third mechanically-stable membrane, open in the area of the crosspoints, is applied onto the third mechanically-flexible membrane. Onto the third mechanically-stable membrane is applied a further membrane carrying a coil means in the area of the crosspoints.

Adjacent membranes may be glued to each other, and individual membranes may be laminated. The coil means may be embedded or etched in the further membrane. Electrical signal lines may be configured, towards the edges of the switching fields, as circuit tracks on the mechanically-flexible membranes. Leads to the coil means may have a matrix configuration towards the edges of the switching field. The switching field may be applied as a signal-independent, remote-controlled distributor for communications and data processing.

By associating a permanent magnet with the one contact-surface member and associating a coil having a ferromagnetic material with the other contact-surface member of each crosspoint, a particularly simple and robust switching field design is achieved. By selectively exciting the coil of a crosspoint, the associated ferromagnetic material is magnetized. With suitable polarity of the excitation, a magnetic attraction force results between the permanent magnet and the ferromagnetic material, and thus between the opposed contact-surface members. The crosspoint is thereby closed. This condition is maintained even after the excitation of the coil has been switched off. By changing the polarity of the excitation, the crosspoint can be re-opened. By designing the switching field to use membranes a specially-compact construction of the switching field is possible. Further, utilizing membranes permits a cost-effective manufacture of the switching fields, since the correspondingly-prepared membranes can be further processed and a high throughput is achievable.

The invention will next be more fully described by means of a preferred embodiment, utilizing the accompanying drawing in which:

Figure 1 is a cross-sectional view of a crosspoint of the switching field.

The switching field is composed of a multitude of crosspoints 1, preferably in a matrix configuration. A mechanically-flexible membrane 2 preferably serves as a base of the switching field. Onto the mechanically-flexible membrane 2 is applied a mechanically-stable membrane 3. The two membranes 2 and 3 can be glued to each other or can be later laminated with the other membranes. The mechanically-stable membrane 3 is opened in the area of each crosspoint 1. This can be achieved for example by punching or other methods known in the membrane technology. Onto the mechanically-stable membrane 3 is applied a mechanically-flexible membrane 4, on the lower side of which permanent magnets 5 are attached in the area of the crosspoints 1, and on the upper side of which are provided contact-surface members 6. Attachment of the permanent magnets 5 and of the contact-surface members 6 is preferably achieved by gluing them to the mechanically-flexible membrane 4. The dimensions of the permanent magnet 5 are slightly smaller than those of the opening within the mechanically-stable membrane 3. Onto the mechanically-flexible membrane 4 is applied a mechanically-stable membrane 7 that is open in the area of each crosspoint 1. The mechanically-stable membrane 7 is basically constructed in the same way as the mechanically-stable membrane 3. On the mechanically-stable membrane 7 is applied a mechanically-flexible membrane 8, on the lower side of which contact-surface members 9 are attached in the area of the crosspoints, and on the upper side of which is provided a ferromagnetic material 10. Attachment of the contact surfaces 9 and of the ferromagnetic material 10 is preferably achieved by gluing. The contact-surface members 6 and 9 are of identical shape, and it is possible to have multiple such members. Onto the mechanically-flexible membrane 8 is applied a mechanically-stable membrane 11 that is open in the area of the crosspoints 1. The mechanically-stable membrane 11 is basically of the same construction as the mechanically-stable membranes 3 and 7 described above. The height dimension of the ferromagnetic material can be smaller than, or identical to, the height dimension of the mechanically-stable membrane 11. Onto the mechanically-stable membrane 11 is applied a preferably mechanically-flexible membrane 12. Coils 13 are embedded or etched in the membrane 12 in the area of the crosspoints 1. Electrical leads 14 of the coils 13 are disposed on the membrane 12, preferably in a matrix-shape, towards the edges of the switching field.

The function of the switching field is next explained.

When the coil 13 of a crosspoint 1 is excited with suitable polarity, a magnetic field for magnetizing the ferromagnetic material 10 is generated. A magnetic attraction force between the permanent magnet and the ferromagnetic material 10 thereby results. The mechanically-flexible membranes 3 and 7 are deflected so far by this force that the contact-surface members 6 and 9 contact each other and switch the crosspoint on. When the excitation of the coil 13 is interrupted, the ferromagnetic material 10 remains in its magnetized condition, and the crosspoint 1 remains switched on. If the contact is to be interrupted, the coil 13 is excited in reversed polarity. The electrical signal lines, which are connected or interrupted by the contact-surface members 6 and 9, are preferably configured as circuit tracks on the mechanically-flexible membranes 4 and 8, towards the edges of the switching field. The distances between the individual crosspoints 1 have to be selected sufficiently large that, on the one hand, magnetic influences are prevented, and on the other hand, the mechanically-flexible membranes 4 and 8 are sufficiently clamped down in the area of the crosspoint 1 that the curvature of the membranes 4 and 8 at one of the surrounding crosspoints 1 is not affected. In principle it is also possible to use the permanent magnet 5 as a contact-surface member 6, or to arrange the permanent magnet 5 immediately underneath the contact-surface member 6. The compactness of the switching field can thereby be additionally improved. As indicated above, the individual membranes can be glued to each other or laminated. By fabrication utilizing membranes, for example processed from a roll, a particularly economic manufacture with high throughput is possible. A preferred field of application of the switching field is its use as a signal-independent, remote-controlled distributor for communications and data processing.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A switching field for electromechanically switching electrical signal lines with crosspoints, wherein parts forming the crosspoints comprise membranes at which, and between which, further parts of the circuit are disposed, the crosspoints each also being comprised of at least two contact-surface members that are movable relative to each other, a permanent magnet being associated with a first one of the at least two contact-surface members, and a ferromagnetic material with a coil means being associated with a second one of the at least two contact-surface members.

2. A switching field for switching electrical signal lines in accordance with claim 1, in particular for communications and data processing, the switching field further comprising the crosspoints being disposed in a matrix shape and signal lines are assigned to individual ones of the crosspoints.

3. A switching field according to claim 1, wherein:

a) a first mechanically-stable membrane, open in the area of the crosspoints, is applied onto a first mechanically-flexible membrane serving as a base;

b) onto the first mechanically-stable membrane is applied a second mechanically-flexible membrane to which, in the area of the crosspoints, is attached on a lower side the permanent magnet and on an upper side the first one of at least two contact-surface members;

c) a second mechanically-stable membrane, open in the area of the crosspoints, is applied onto the second mechanically-flexible membrane;

d) onto the second mechanically-stable membrane is applied a third mechanically-flexible membrane to which, in the area of the crosspoints, is attached on a lower side the second one of the at least two contact-surface members and on an upper side the ferromagnetic material;

e) a third mechanically-stable membrane, open in the area of the crosspoints, is applied onto the third mechanically-flexible membrane; and

f) onto the third mechanically-stable membrane is applied a further membrane carrying the coil means in the area of the crosspoints.

4. A switching field according to claim 2, wherein:

a) a first mechanically-stable membrane, open in the area of the crosspoints, is applied onto a first mechanically-flexible membrane serving as a base;

b) onto the first mechanically-stable membrane is applied a second mechanically-flexible membrane to which, in the area of the crosspoints, is attached on a lower side the permanent magnet and on an upper side the first one of the at least two contact-surface members;

c) a second mechanically-stable membrane, open in the area of the crosspoints, is applied onto the second mechanically-flexible membrane;

d) onto the second mechanically-stable membrane is applied a third mechanically-flexible membrane to which, in the area of the crosspoints, is attached on a lower side the second one of the at least two contact-surface members and on an upper side the ferromagnetic material;

e) a third mechanically-stable membrane, open in the area of the crosspoints, is applied onto the third mechanically-flexible membrane; and

f) onto the third mechanically-stable membrane is applied onto a further membrane carrying the coil means in the area of the crosspoints.

5. A switching field according to any one of claims 1 to 4, wherein adjacent membranes are glued to each other.

6. A switching field according to any one of claims 1 to 4, wherein individual membranes are laminated.

7. A switching field according to any one of claims 1 to 4, wherein adjacent membranes are glued to each other, and wherein individual membranes are laminated.

8. A switching field as in claim 3 or claim 4, wherein the coil means is embedded in the further membrane.

9. A switching field as in claim 3 or claim 4, wherein the coil means is etched in the further membrane.

10. A switching field as in any one of claims 1 to 4, wherein electrical signal lines to the contact-surface members are configured, towards the edges of the switching field, as circuit tracks on the mechanically-flexible membranes.

11. A switching field as in any one of claims 1 to 4, wherein leads to the coil means have a matrix configuration towards the edges of the switching field.

12. A switching field as in any one of claims 1 to 4, wherein the switching field is applied as a signal-independent, remote-controlled distributor for communications and data processing.

13. A switching field for switching electrical signal lines for communication and data transfer applications, comprising:

crosspoints disposed in a matrix, said crosspoints including two contact surfaces, said contact surfaces being movable relative to each other;

a permanent magnet connected with one of said contact surfaces; and a ferromagnetic material with a coil connected with another of said contact surfaces.

14. A switching field according to claim 13, further comprising:

a first mechanically flexible membrane serving as a base, said first mechanically flexible membrane having a lower side to which said permanent magnet is attached and having an upper side to which one of said contact surfaces is attached;

a first mechanically stable membrane with an opening in an area of said crosspoints, said first mechanically stable membrane being applied to said first mechanically flexible membrane;

a second mechanically flexible membrane applied to said first mechanically stable membrane, said second mechanically flexible membrane having a lower side with an opposed contact surface of said contact surfaces attached, and having an upper side to which said ferromagnetic material is provided;

a second mechanically stable membrane with an opening in the area of the crosspoints, said second mechanically stable membrane being disposed on said second mechanically flexible membrane; and

an additional membrane carrying said coils disposed in the area of the crosspoints, said additional membrane being applied on said second mechanically stable membrane.

15. A switching field according to claim 13, further comprising:

a flexible membrane with a lower side with an attached one of said contact surfaces, and having an upper side to which said ferromagnetic material is provided; and

another flexible membrane with a lower side to which said permanent magnet is attached and having an upper side with an attached one of said contact surfaces.

16. A switching field according to claim 13, further comprising:
signal lines assigned to the individual crosspoints.

17. A switching field according to claim 13, further comprising:
a first mechanically flexible membrane serving as a base;
a first mechanically stable membrane with an opening in an area of said crosspoints, said first mechanically stable membrane being applied to said first mechanically flexible membrane;
a second mechanically flexible membrane applied to said first mechanically stable membrane, said second mechanically flexible membrane having a lower side to which said permanent magnet is attached and having an upper side to which one of said contact surfaces is attached;
a second mechanically stable membrane with an opening in the area of said crosspoints, said second mechanically stable membrane being applied to said second mechanically flexible membrane;
a third mechanically flexible membrane applied to said second mechanically stable membrane, said third mechanically flexible membrane having a lower side with an opposed contact surface of said contact surfaces attached, and having an upper side to which said ferromagnetic material is provided;
a third mechanically stable membrane with an opening in the area of the crosspoints, said third mechanically stable membrane being disposed on said third mechanically flexible membrane; and
a further membrane carrying said coils disposed in the area of the crosspoints, said further membrane being applied on said third mechanically stable membrane.

18. A switching field according to claim 17, wherein said individual membranes are glued to each other.

19. A switching field according to claim 17, wherein the individual membranes are laminated.

20. A switching field according to claim 17, wherein the coils are embedded in the further membrane.

21. A switching field according to claim 17, wherein the coils are etched in the further membrane.

22. A switching field according to claim 17, wherein electrical signal lines of said contact surfaces are configured as circuit tracks on the mechanically flexible membranes towards the edges of the switching field.

23. A switching field according to claim 17, wherein the leads to the coils are configured in a matrix-shaped manner towards the edges of the switching field.

24. A switching field for electromechanically switching electrical signal lines with crosspoints, comprising:

membranes defining the crosspoints; and

circuit means disposed between said membranes wherein said membranes include:

a mechanically flexible membrane serving as a base;

a mechanically stable membrane with an opening in an area of said crosspoints, said mechanically stable membrane being applied to said mechanically flexible membrane;

another flexible membrane applied to said mechanically stable membrane, said another flexible membrane having a lower side to which a permanent magnet is attached and having an upper side to which one of one of two contact surfaces is attached;

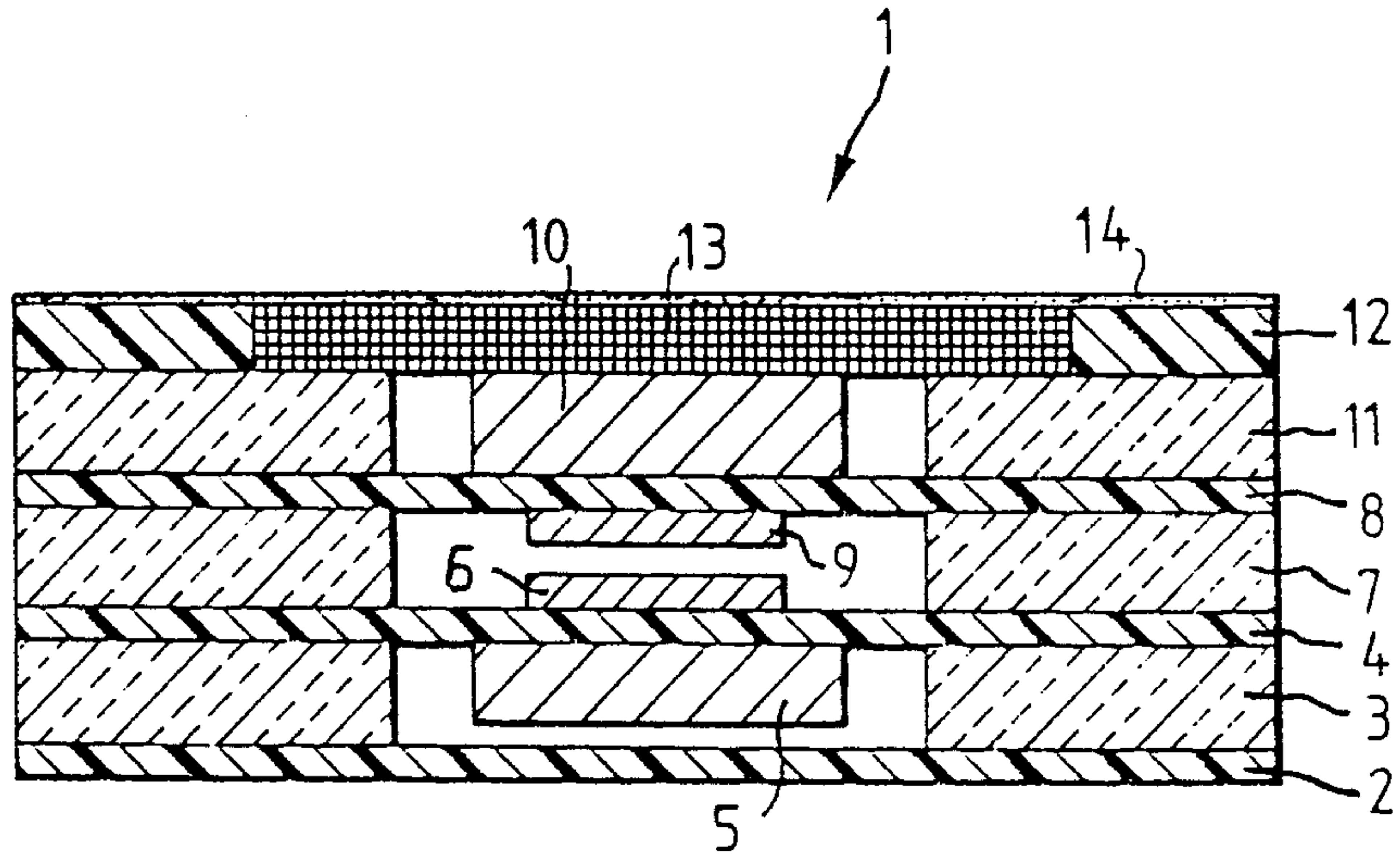
another mechanically stable membrane with an opening in the area of said crosspoints, said another mechanically stable membrane being applied to said another flexible membrane;

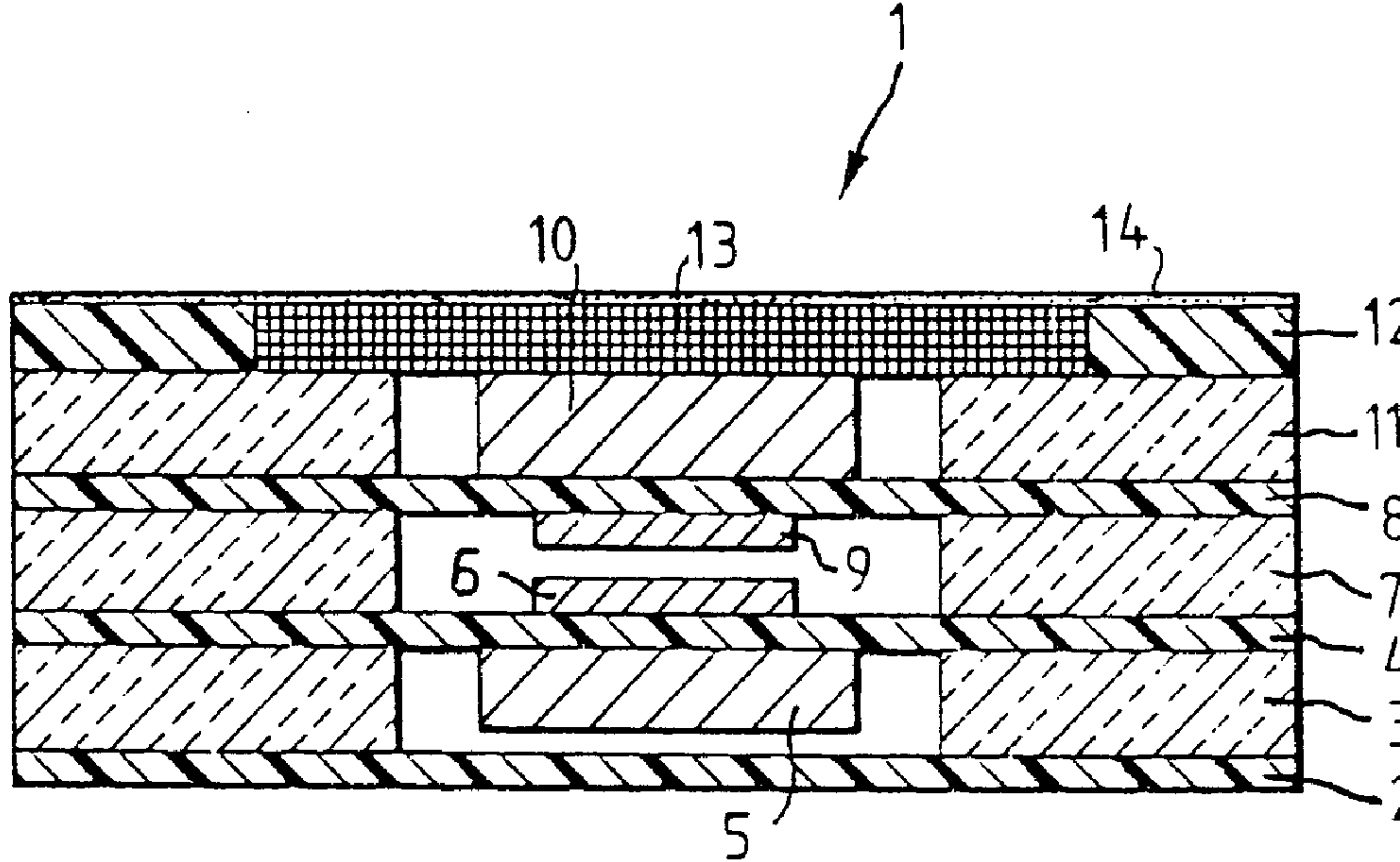
a further mechanically flexible membrane applied to said another mechanically stable membrane, said further mechanically flexible membrane having a lower side with an opposed contact surface of said two contact surfaces attached, and having an upper side to which a ferromagnetic material is provided;

a further mechanically stable membrane with an opening in the area of the crosspoints, said further mechanically stable membrane being disposed on said further mechanically flexible membrane; and

an additional membrane carrying coils disposed in the area of the crosspoints, said additional membrane being applied on said further mechanically stable membrane.

Figure 1





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