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Klee

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[54] **FLUID CONDUCTING SYSTEM**

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[73] Assignee: **Samson Apparatebau AG,** Frankfurt/M, Germany

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[30] **Foreign Application Priority Data**

Sept. 15, 1971 Germany 2146041

[52] **U.S. Cl.** **137/608,** 137/833

[51] **Int. Cl.** **F17d 1/00,** F15c 5/00

[58] **Field of Search** 137/561, 608, 833, 269, 137/271; 235/201

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Attorney, Agent, or Firm—Woodhams, Blanchard & Flynn

[57] **ABSTRACT**

A fluid conducting system having at least three substantially flat, superposable fluid conducting plates and a separating plate between each thereof. The fluid conducting plates and the separating plates are arranged in a stack. Each of the fluid conducting plates has elongated channel means therein arranged in a plurality of parallel columns. The channel means open outwardly on one side. The separating plates are made of a perforatable material and have markings at those locations wherein the longitudinal axes of the elongated channel means cross each other. Thus, a selective perforation of at least one of the separating plates will define a selected fluid conducting system within the stack.

9 Claims, 15 Drawing Figures

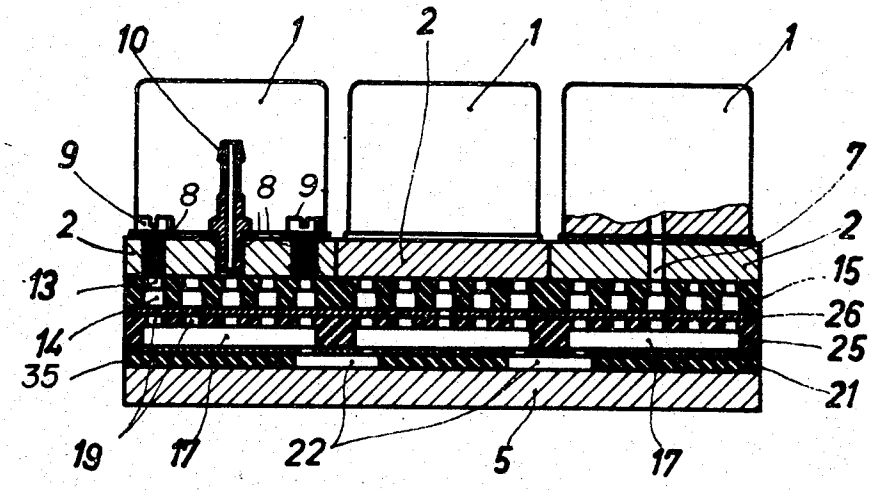


Fig.1

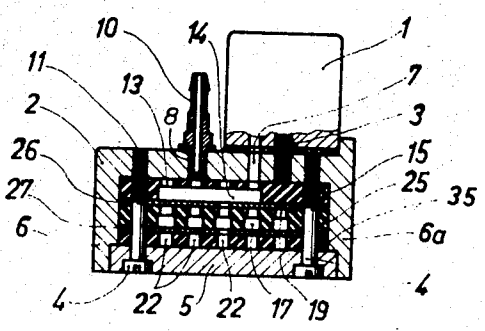


Fig.2

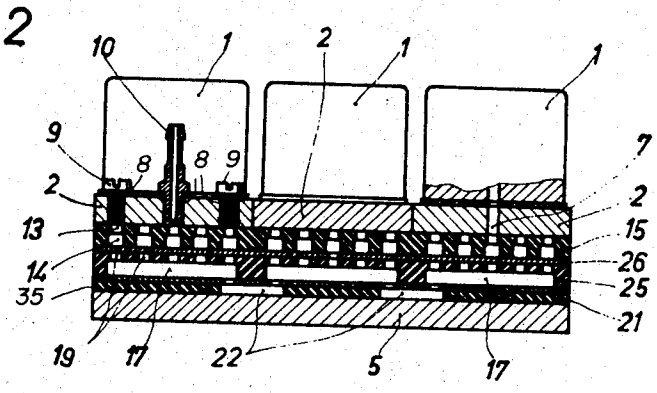


Fig.3

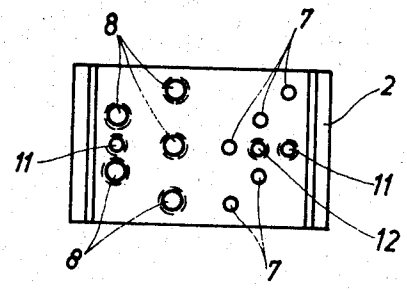


Fig.4

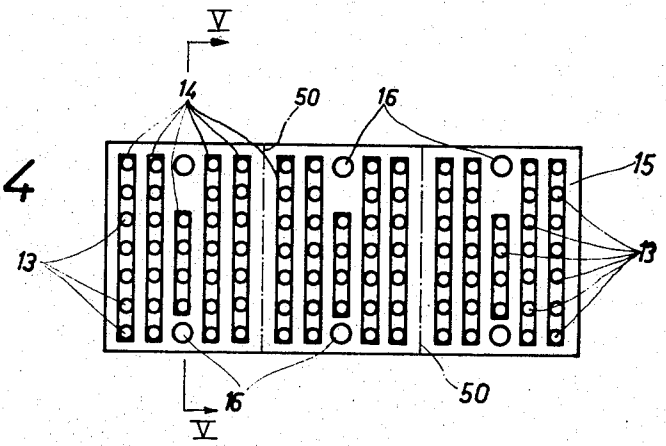


Fig.7

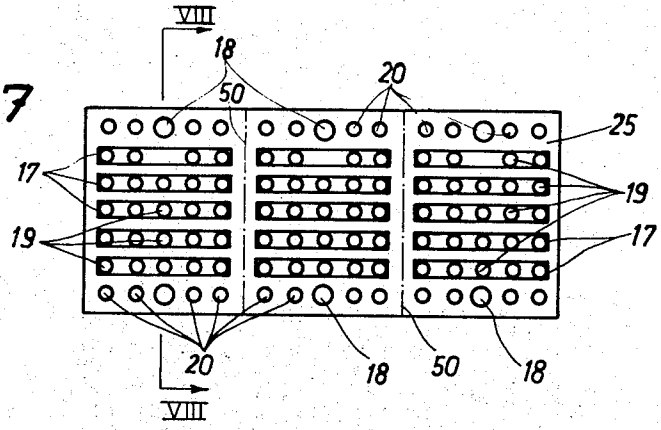


Fig.5

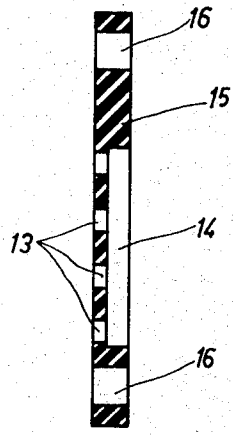


Fig.8

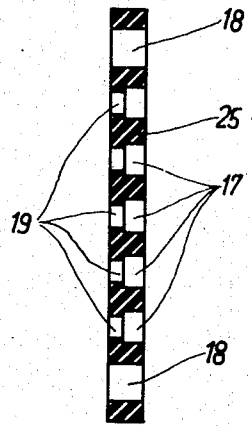


Fig.9

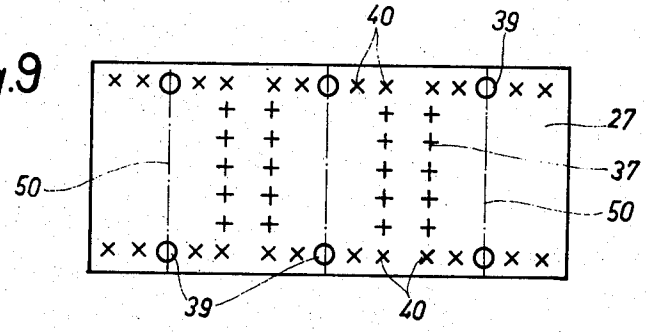


Fig.6

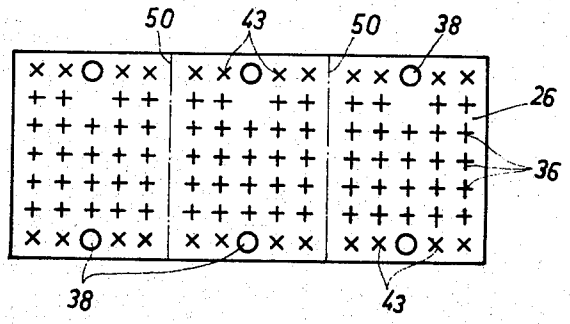


Fig.10

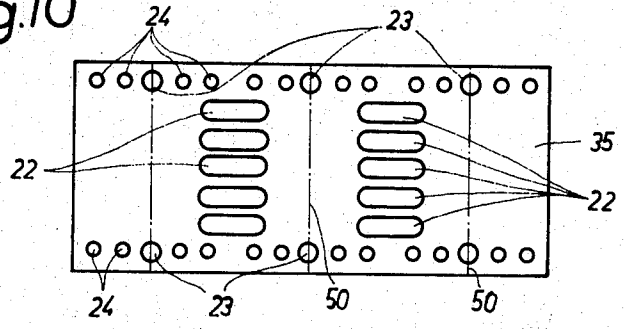


Fig.11

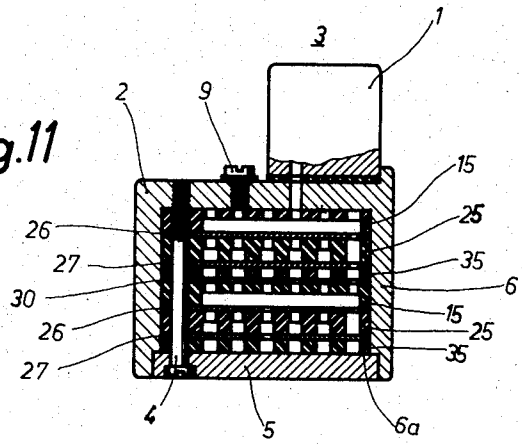


Fig.12

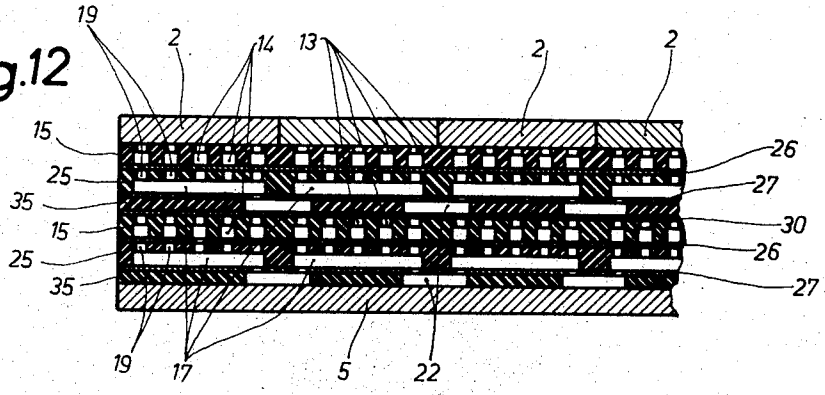


Fig.13

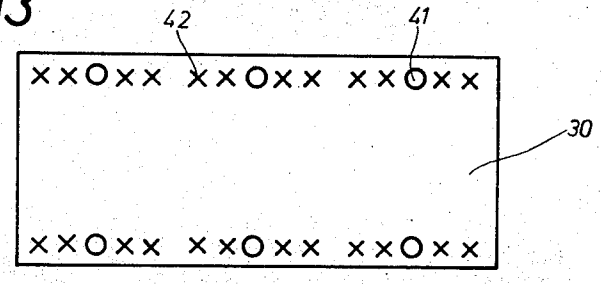


Fig.14

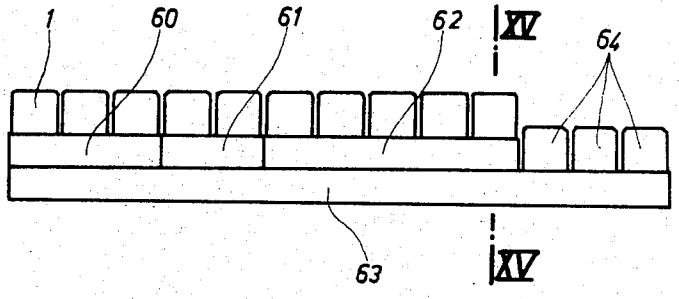
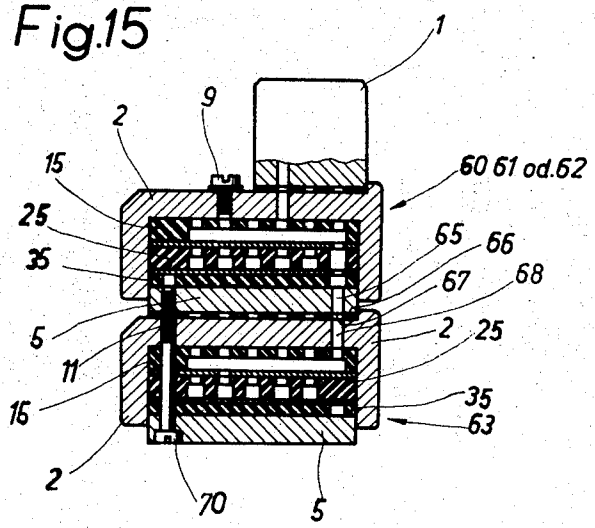

1
60
61
62
XV
64
63
XV

Fig.15


1
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2
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60 61 od.62
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66
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11
2
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16
35
63
2
70
5

FLUID CONDUCTING SYSTEM

FIELD OF THE INVENTION

The invention relates to a conductor system for pneumatically or hydraulically operating switch, control or regulating units and particularly to such a system comprising two cover plates which are held together by a screw connection, between which cover plates at least two conducting plates are inserted which have channels open on one side and serving as conduits in cooperation with one of the cover plates and an interposed separating plate. Thus, the pressure potential of one plane can be transferred into the other plane through multiple openings each of which connect with one another two superposed channels which are provided in the conducting plates and in the separating plate.

BACKGROUND OF THE INVENTION

In such a unitary conductor system the individual conducting connections for the switching elements to be connected through the conductor system are created through severing of webs of the channels of the conducting plates, which channels are open on one side.

Aside from the fact that it is difficult to sever the webs in conducting plates which consist of soft, elastic and effective sealing material, since the conducting plates often distort during severing and may become partly crushed, the arrangement of channels which form a repetitive geometric pattern, which arrangement as a rule is provided in only one plane, requires relatively much room in the conducting plate. If the conducting connection is arranged in two planes, then holes must be punched which additionally extend through conducting plates and separating plates. Furthermore the conducting plates are, in order to simplify their handling, connected to a fixed metallic base which is also complicated and expensive. Finally, considerable progress has been made in the miniaturization of the switching elements to be connected so that relatively small switching elements are connected through relatively large conductor systems. To avoid this disadvantage, in practice the previous technique is used to manufacture the channels which are required to a conducting connection individually within conducting plates which are referenced to dimensions and connections (compare also U.S. Pat. No. 3,407,834). In addition to the errors which are possible during the manufacture of the channels, this method is expensive and time consuming.

The basic purpose of the invention is to improve the known conductor systems which are built from logic elements, to substantially limit their requirement for space and to build their structural parts in such a manner that with a simple basic connection complex conducting connections can be inexpensively created solely by providing holes in relatively stiff structural parts.

Starting from a conductor system of the type mentioned above, which has channels open on one side and includes conducting plates, this purpose is attained by providing that the channels of the one conducting plate are offset 90° with respect to the channels of the other conducting plate and all channels lie in one common grid. At the points of intersection of such channels there are provided openings which penetrate through

the conducting plates, the separating plate being provided at the points of intersection of the grid with markings for providing the holes. The channels of the conducting plate are preferably connected respectively within the same conducting units and these are arranged to correspond in size to the switching elements to be connected. Finally, a third conducting plate is provided in a third plane and has slots lying in the same grid, which slots connect respectively the points of intersection of the last set of holes of the one conducting unit with the points of intersection of the first set of holes of the adjacent conducting unit, while a second separating plate which lies between the second and third conducting plates has only in these points of intersection markings for facilitating the making of the holes.

According to a further characteristic of the invention, the one cover plate of the conducting system is constructed as a planar rail and the other cover plate as a U-shaped profiled rail whose legs at least partly embrace the conducting plates.

According to a preferred embodiment of the invention, the profiled rail is the carrier of the switching elements to be connected and is divided to correspond with the conducting units of the conducting plates, which conducting units lie within the grid.

If the planar rail is divided in the same manner, then for each individual switching element, there is provided within itself a socket for receiving such switching element, which in a manner, which will yet be described, can be connected through a further conductor system according to the invention.

Certain individual parts of the profiled rail, which parts which are to be identified as caps, have openings which serve for the input and output of pressure medium. These openings are threaded holes which are also arranged in the points of intersection of the grid.

The construction of the conducting plates is especially advantageous if according to a further characteristic of the invention each conducting unit is formed of two conducting plates which have each as many parallel positioned channels as the structural part to be switched has inlets and outlets. These are, when the conducting plates are positioned one above the other, arranged in two planes crosswise one above the other.

The number of channels of the conducting unit of one conducting plate can, however, also be one whole multiple of the number of channels of the second conducting plate.

The conducting plates carrying the channels consist according to the invention of one soft nonmetallic material, while the plates which serve to create the conducting course and which are provided with markings, consist of a relatively thin hard metallic material.

Such a conductor system has a number of advantages. The conducting plates which consist of a soft elastic material are provided on the one side with channels which open on the one side and are positioned parallel to one another and on the other side with all of the passage holes required for creating the desired conducting connection, thus do not need any further treatment. The holes which are needed for providing a switching connection, and which conduct pressure potential from the one switching plane to the other, need to be provided only in the relatively thin separating

plates which consist of an easily punchable material, for example aluminum. The construction of the cover plates as a smooth plate and a profiled rail permit a simple and operation-safe structure of the conducting system since the sensitive conducting plates are protected through both rails from outside influences. The caps created by the division of the profiled rails simplify the mounting of the switching elements which are to be connected. These caps also have the holes for the inputs and outputs for the conductor system and have, of course, also the holes which connect the connections of the switching elements to the holes of the uppermost conducting plate. Holes which are not needed can be tightly closed by screws in a simple manner. The flat rail has only holes for introduction of the screws which connect it to the caps which are arranged in series in any desired number. It too can be divided. Particularly advantageous is the limiting of the length of channels arranged in the conducting plates to the size of the switching elements to be connected, thus to the cap width. In this manner, on the one hand, there can be created conducting plates which are still relatively stiff and easily handled and on the other hand, by repeating the one basic unit, conducting systems of any desired length can be created. The channels of two conducting plates of two side-by-side arranged switching units which channels are arranged similarly to a matrix and which permit any desired switching of a switching element, are each connected to one another through the slots in the third conducting plate so that - viewed in cross section - a meander-shaped conducting course over the length of a conductor system is created. Therefore conducting plates of a suitable length can be manufactured and can then be cut to the desired length without, however, because of this, limiting the length of the conductor system. Finally, all conducting connections of the conductor system can be illustrated in one plane in the plan of a switching diagram.

In case that more than five channels per conducting unit are needed for the switching of one switching element, according to a further characteristic of the invention, two conductor systems of the above-named type are arranged one above the other between the cover plates, between which a further separating plate is arranged and wherein further holes connecting the channels of the first conducting plates of the conductor systems are provided in the conducting plates.

The switching of several functional groups which are formed by means of the inventive conductor system to larger functional groups is particularly simple if according to a third exemplary embodiment of the invention two or more of the inventive conductor systems according to the first exemplary embodiment are assembled directly. For this purpose, the oppositely positioned cover plates of the conductor systems have fastening holes for mechanically connecting the conductor systems and openings for transferring the pressure potential from one conductor system to the other. Separating plates are again provided between each two conductor systems of the aforementioned type, which separating plates have also markings which lie in the points of intersection of the common grid for facilitating the creating of holes.

Even though the conducting plates are arranged one above the other in several planes, one does not lose the advantage of this conductor system that the switching diagram of a switch, control or regulating unit and the determination of the holes required for creating the actual conduction can be illustrated in one plane. In other conductor systems for logic elements, for example known from U.S. Pat. No. 3,516 436, the switching diagrams must be set up three-dimensionally because the holes needed for connection of the conduits are arranged within a three-dimensional system.

The invention is described in connection with three exemplary embodiments which are more or less schematically illustrated in the drawings, in which:

FIG. 1 is a cross-sectional view of a conductor system according to the invention;

FIG. 2 is a longitudinal cross-sectional view of the conductor system according to FIG. 1 for only three switching elements;

FIG. 3 is a front view of a portion of the cover plate which is constructed as a profiled rail;

FIG. 4 is a first conducting plate of the conductor system according to FIG. 1, viewed from the bottom thereof;

FIG. 5 is an enlarged cross-sectional view of the conducting plate taken along the line V—V in FIG. 4;

FIG. 6 is a top view of a first separating plate for a conductor system according to FIG. 1;

FIG. 7 is a second conducting plate for a conductor system according to FIG. 1, viewed from the bottom thereof;

FIG. 8 is an enlarged cross-sectional view of the conducting plate taken along the line VIII—VIII in FIG. 7;

FIG. 9 is a top view of a second separating plate of the conductor system according to FIG. 1;

FIG. 10 is a top view of a third conducting plate for the conductor system according to FIG. 1;

FIG. 11 is a cross-sectional view of a second exemplary embodiment of a conductor system according to the invention;

FIG. 12 is a longitudinal cross-sectional view of the exemplary embodiment of the conductor system according to FIG. 11;

FIG. 13 is a top view of a third separating plate for a conductor system according to FIGS. 11 and 12;

FIG. 14 is a side view of a third exemplary embodiment of the invention; and

FIG. 15 is a cross-sectional view along the line XIV—XIV of FIG. 14.

DETAILED DESCRIPTION

For reasons of simplicity the conductor system which connects the individual switching elements of a pneumatic switch, control or regulating unit is limited only to the connection of three switching elements 1 which for example illustrate microswitches.

The conductor system consists, as illustrated in FIG. 1, substantially of an upper U-shaped profiled rail 2 which is divided into individual cap-like sections, the size of which is chosen to correspond to the size of the switching elements, a flat rail, or base, 5 which is connected through screws 4 to the caps 2 and conducting plates 15, 25 and 35 which are held between said rails and which are separated by separating plates 26 and 27. The legs 6 of the profiled rail, thus of the individual caps, have shoulders which are arranged in such a manner that the smooth rail 5 which abuts there compresses the conducting plates, which are made of a soft elastic material, just enough to create safe sealing of the holes

and channels of the conducting plates against one another and against the atmosphere.

Each of the mentioned caps has five bores **7** which in their position correspond to the outputs and inputs of the switching elements, and five bores **8** which are threaded. Each one of the bores **7** corresponds with one bore **8** in a manner that one bore **7** and one bore **8** each can be connected through one of the channels, which will be described later, in the conducting plate **15.** The bores **8** can either be tightly closed on the side facing the outside by screws **9** or, alternatively, can be prepared by screwing in tubular nipples **10** for the connection of input conduits or output conduits.

Finally, threaded holes **11** are provided which are used to secure by means of the screws **3** each cap **2** on the rail **5** which serves as carrier. For purposes of completeness, reference is also made to the threaded hole **12** which is used for connecting each switching element **1** to a cap **2** by means of the screw **3.**

The upper conducting plate **15** has for each switching element and cap five channels **14** which are open on one side and are positioned vertically with respect to the drawings as shown in FIG. **4.** These channels are arranged in columns and in such a manner that they correspond with the five bores **7** and **8** of the cap **2.** To connect these bores in one column with the mentioned channels, openings **13** are used in the channels **14,** the axes of which are in alignment with the axes of the individual bores of the cap.

As illustrated in FIG. **4,** five channels each are provided in each column or conducting unit, the central channel of which in each unit is shorter in order to create room for holes **16** through which, in assembled state of the conductor system, the screws **4** extend. Each conducting unit or column is separated from the adjacent conducting unit by lines of weakness represented schematically by dash-dotted lines **50,** along which the conducting plate can be separated.

The second conducting plate **25** has also for each switching element **1** and cap **2** five channels **17** each of which are open on one side and are positioned horizontally with respect to the drawings, as shown in FIG. **7,** which channels are provided with openings **19** for connection to the channels **14** of the conducting plate **15.** Here too five channels each are arranged in one conducting unit and adjacent conducting units are separated by lines of weakness represented schematically by dash-dotted lines **50,** along which the conducting plate **25** can be separated.

In placing the conducting plates **15** and **25** one on top of the other, the channels of the one conducting plate are rotated or oriented, here 90°, with respect to the channels of the other conducting plate and all channels in each column are in one common grid in and at the intersection points are arranged openings **13** or **19** which extend through the conducting plates.

The conducting plate **25** has furthermore holes **18** which in assembled condition receive the screws **4.** Finally holes **20** which are positioned in the same grid are provided, which holes serve in a manner, yet to be described, to transfer pressure potential from one conductor system into a different conductor system of the type illustrated in FIG. **11.**

A separating plate **26** is arranged between the conducting plates **15** and **25** which separating plate **26** also has holes **38** for guiding fastening screws **4** therethrough and has markings **36** at the points of intersection of the grid, along which the channels of the aforementioned conducting plates are arranged. By providing holes at these points, for example by punching, conducting connections are created between the conducting plate **15** and the conducting plate **25.** Furthermore, markings **43** which are also positioned in the grid are provided which in cooperation with the holes **20** of the conducting plate **25** effect upon suitable punching the already mentioned transfer of pressure potential from one conductor system into a second system.

The conductor system is completed by a conducting plate **35,** (FIGS. **1** and **10**) which has holes **23,** positioned appropriately to receive screws **4,** and holes **24** for transferring the pressure potential of one conductor system into a different conductor system. Further, there are five slots **22** for connecting conducting units, said slots being positioned horizontally in relation to FIG. **10** and which slots upon assembly of the conducting plates **15, 25** and **35** cover the intersection points of the last set of holes of the one conducting unit of the conducting plates **15** and **25** with the intersection points of the first set of holes of the adjacent conducting unit of said conducting plates. The separating lines **50** are provided here also and are positioned in relation to the separating lines of the conducting plates **15** and **25** offset each by one half unit and thus intersect the holes **23.** The conducting plates can also be separated along said lines.

A second separating plate **27,** (FIG. **9**), is provided between the conducting plate **25** and the conducting plate **35,** which separating plate **27** is divided into multiple segments corresponding to the conducting plate **35** by the lines of weakness illustrated schematically by the dash-dotted lines **50.** Here too, holes **39** are provided for receiving fastening screws **4** and markings **37** are provided which lie in the points of intersection of the common grid. Openings or holes can be arranged in these points. Further, markings **40** are provided which upon suitable punching effect the transfer of pressure potential from one conductor system to a different such system according to the embodiment of the invention shown in FIG. **11.**

The conducting plates **15, 25** and **35** are made of a compressible, as elastomeric, plastic. The separating plates **26** and **27,** however, consist of a relatively thin material, for example, of aluminum sheet metal and can also be separated along the lines **50.** The U-shaped, profiled rail **2** which is advantageously divided into cap-shaped sections may be made of steel but is preferably, however, of plastic. The flat rail **5** which is constructed as an endless part is made of steel.

If the above-described conducting and separating plates are assembled to one conductor system of the type as illustrated in FIGS. **1** and **2,** then corresponding with the chosen punching of the separating plates **26** and **27** a conducting connection is created at the markings **36** and **37.** For example a passageway may be provided from the connection **10** (FIG. **1**) through the hole **13,** the channel **14** and the hole **7** to the switching element **1.** A further conducting connection may be provided to the next switching element (FIG. **2**) from the channel **14** through the hole **19,** the channel **17,** the slot **22** and thence through the channel **17,** the hole **19,** the channel **14** and the corresponding hole **13.**

A second exemplary embodiment of the invention is illustrated in FIGS. **11** and **12,** in which two of the described conductor systems are combined by means of

the rail **5** and the profiled rail **2.** Here too the profiled rail **2** is divided into individual cap-like sections which carry the individual switching elements **1.** Of course, the U-shaped legs **6** of the profiled rail **2** are constructed proportionately longer. All identical structural parts are identified with the same reference numberals as in the above-described first exemplary embodiment. For separating the two conductor systems, a further separating plate **30** is provided which is illustrated in FIG. **13.** It also has holes **41** for receiving the fastening screws **4** and markings **42** corresponding with the markings **40** and markings **43** of the separating plates **26** and **27,** respectively. The holes, which must be punched according to the desired switching, effect the already above mentioned transfer of the pressure potential from the one conductor system to the other, namely, by this means the channels **14** of the first conductor system (FIG. **11**) are connected to the channels **14** of the second conductor system.

A third exemplary embodiment of the conductor system is illustrated in FIGS. **14** and **15.** Here several functional units **60, 61** and **62,** consisting of several conductor systems according to FIGS. **1** and **2** and carrying switching elements **1,** are connected to a further conductor system **63** which is constructed in the manner as illustrated in FIG. **1** and also carries switching elements - here identified at **64.** The switching elements **1** and **64** can be microswitches, trimmer, capacity, signal transformers and similar elements. The opposingly positioned profiled rails, specifically profiled rail parts **2** and flat rails **5,** are provided with fastening holes **11** and holes **65** and **68** providing guidance for pressure medium. The pressure potential of the one conductor system **60, 61** or **62** is transferred into the other conductor system **63** through the holes **65** and **68.**

If all possible holes **65** and **68** are provided from the start in the rails **2** and **5,** then here too a separating plate **66** is provided which has, similar to the described separating plates **26** and **27** or **30,** markings which lie in the points of intersection of the common grid, for facilitating provision of holes **67** which in turn create the required connections between the conductor systems.

The conductor systems are connected by screws **70.**

In this manner it is possible to connect any desired number of functional units of different types, including units in more than two planes above one another (FIG. **15**) to larger functional groups to one integrated system and without requiring separate conduits.

As a result of the means above disclosed, the conductor system consists of layered conducting and separating plates, the channels and holes of which, serving to create the conducting connections, lie within a common grid similar to a matrix, whereby conducting units are formed according to the switching elements to be connected and which are repeated as desired. Thus through separation or assembly, conductor systems of any desired length can be created in a very simple manner. The actual conducting connection is created by punching holes into the separating plates, which can be done simply, quickly and cleanly. Conducting plans can, in spite of the layered construction, be provided in one plane. The construction of the one cover plate as a profiled rail and its division into cap-like sections simplifies the creation of the switching connection and considerably improves the handling and the lifetime.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a fluid conducting system having at least three substantially flat, superposable fluid conducting plates and a separating plate between each thereof, said conducting plates and said separating plates being arranged in a stack to form a system of fluid conducting channels, the improvement comprising:

a first one of said fluid conducting plates having a plurality of columns of parallel first elongated channel means therein on one side opening outwardly of said one side, said first elongated channel means in each of said columns being separate from each other, a plurality of first holes in the bottom of each of said first channel means opening outwardly to the opposite side of said first fluid conducting plate;

a second one of said fluid conducting plates having a plurality of columns of parallel second elongated channel means therein on one side opening outwardly of said one side thereof in the same direction as said first elongated channel means, said second elongated channel means in each of said columns being separate from each other, a plurality of second holes in the bottom of each of said second channel means opening outwardly to the opposite side of said second fluid conducting plate, the longitudinal axes of said first elongated channel means being arranged at 90° to the longitudinal axes of said second elongated channel means;

a first one of said separating plates directly contacting, on one side thereof, said one side of said first fluid conducting plate and, on the other side thereof, said opposite side of said second fluid conducting plate, said first separating plate being made of a perforatable material and having markings thereon at those locations wherein said longitudinal axes of said first elongated channel means in each of said columns cross said longitudinal axes of said second elongated channel means;

a third one of said fluid conducting plates having a plurality of columns of parallel third elongated channel means therein opening outwardly to one side thereof in the same direction as said second holes, the longitudinal axes of said third elongated channel means being parallel to the longitudinal axes of said second elongated channel means, each of said third elongated channel means being positioned on said third fluid conducting plate to overlap a pair of the mutually adjacent longitudinal end portions in a pair of side-by-side columns of said second elongated channel means;

a second one of said separating plates directly contacting, on one side thereof, said one side of said third fluid conducting plate and, on the other side thereof, said second fluid conducting plate, said second separating plate being made of a perforatable material and having markings thereon at those locations wherein said overlapped end portions are aligned with one of said second holes in each of said side-by-side columms whereby a selective perforation of at least one of said separating plates at said markings will define a selected system of fluid conducting channels; and

securing means for securing said superposable fluid conducting plates and said separating plates into said stack.

2. A fluid conducting system accordng to claim **1,** including a base plate and a U-shaped cover plate mounted on said base plate and at least partly encloses said stack.

3. A fluid conducting system according to claim **2,** including at least one switching element mounted on said cover plate and includes means connecting said switching element in fluid circuit with at least one of said columns of elongated channel means.

4. A fluid conducting system according to claim **3,** wherein said cover plate includes means defining openings which serve as the input or output ports for fluid medium, said openings being threaded and arranged in vertical alignment with at least some of said locations.

5. A fluid conducting system according to claim **4,** wherein a conducting unit is formed by the vertically aligned elongated channel means in two fluid conducting plates.

6. A fluid conducting system according to claim **5,** wherein the number of elongated channel means of said first conducting plate is one whole multiple of the number of elongated channel means of said second fluid conducting plate.

7. A fluid conducting system according to claim **6,** wherein said first, second and third conducting plates consist of a soft nonmetallic material, preferably plastic, while said first and second separating plates for selectively determining the conduction path consists of a hard and thin metallic material, preferably of aluminum.

8. A fluid conducting system according to claim **7,** including the combination of two or more fluid conducting systems having therebetween a further separating plate, said further separating plate having markings at those locations wherein said longitudinal axes of said fluid conducting plates cross each other.

9. A fluid conducting system according to claim **1,** including means for connecting at least one additional stack to said stack and means for connecting the fluid circuit in said stack with the fluid circuit in said additional stack.

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