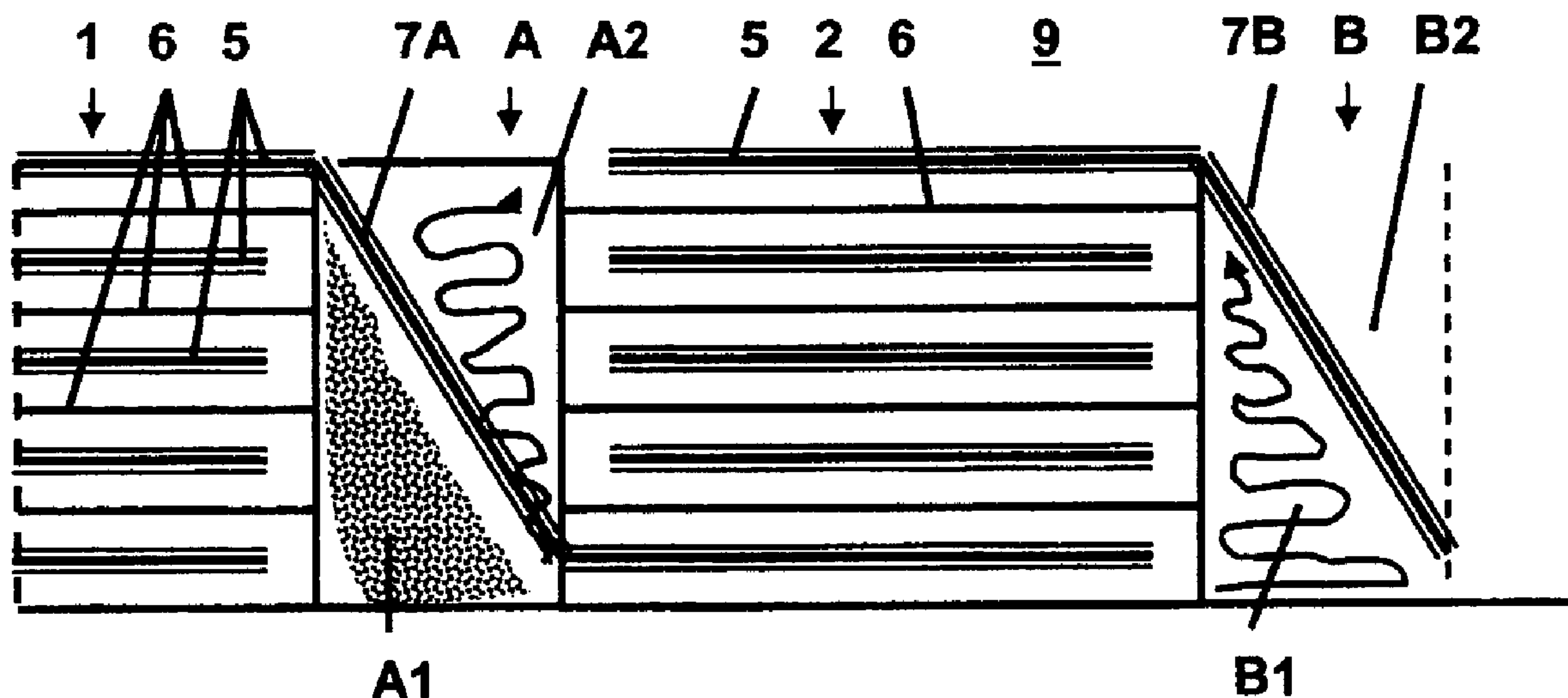




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(72) Inventeur/Inventor:
WEBER, BENJAMIN, DE
(73) Propriétaire/Owner:
ABB TECHNOLOGY AG, CH
(74) Agent: MARKS & CLERK

(54) Titre : PROCEDE DE FABRICATION D'UN ENROULEMENT EN DISQUE
(54) Title: METHOD FOR PRODUCING A DISK WINDING



(57) Abrégé/Abstract:

The invention relates to a method for producing a disk winding (9) comprising at least three disks (1, 2, 3) which are arranged adjacent to each other. An intermediate isolation (A, B) is produced at the same time as the winding between respectively two disks (1, 2, 3) during the winding process, a connection conductor (7, 7A, 7B) extends from the end of one of the disks to the beginning of the other disk in the form of a diagonal inside the intermediate isolation (A, B) and the intermediate isolation is divided into two partial areas, that is, a first intermediate isolation area (A1, B1) having a triangular cross-section which is formed below said diagonal and a second intermediate isolation area (A2, B2) having an inversed triangular cross-section which is formed above said diagonal, an isolation is placed in the second intermediate isolation area (A2) to the left of the disk (2) and an isolation is placed in the first intermediate isolation area (B1) to the right of the disk (2) during a disk winding which unwinds from left to right at the same time as the winding of the disk (2), and an isolation is placed in the second intermediate isolation area (A2) to the right of the disk (2) and an isolation is placed in the first intermediate isolation area (B1) to the left of the disk (2) during a disk winding which unwinds from right to left as the same time as the winding of the disk (2).



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09006511.1 14. Mai 2009 (14.05.2009) EP(71) Anmelder (für alle Bestimmungsstaaten mit Ausnahme von US): **ABB TECHNOLOGY AG** [CH/CH]; Affolternstr. 44, CH-8050 Zürich (CH).

(72) Erfinder; und

(75) Erfinder/Anmelder (nur für US): **WEBER, Benjamin** [DE/DE]; Ennertstr. 16, 59955 Winterberg (DE).(74) Anwälte: **PARTNER, Lothar** et al.; ABB AG, GF/IP, Postfach 1140, 68520 Ladenburg (DE).

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Erklärungen gemäß Regel 4.17:

- hinsichtlich der Berechtigung des Anmelders, ein Patent zu beantragen und zu erhalten (Regel 4.17 Ziffer ii)
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[Fortsetzung auf der nächsten Seite]

(54) Title: METHOD FOR PRODUCING A DISK WINDING

(54) Bezeichnung : VERFAHREN ZUR HERSTELLUNG EINER SCHEIBENWICKLUNG

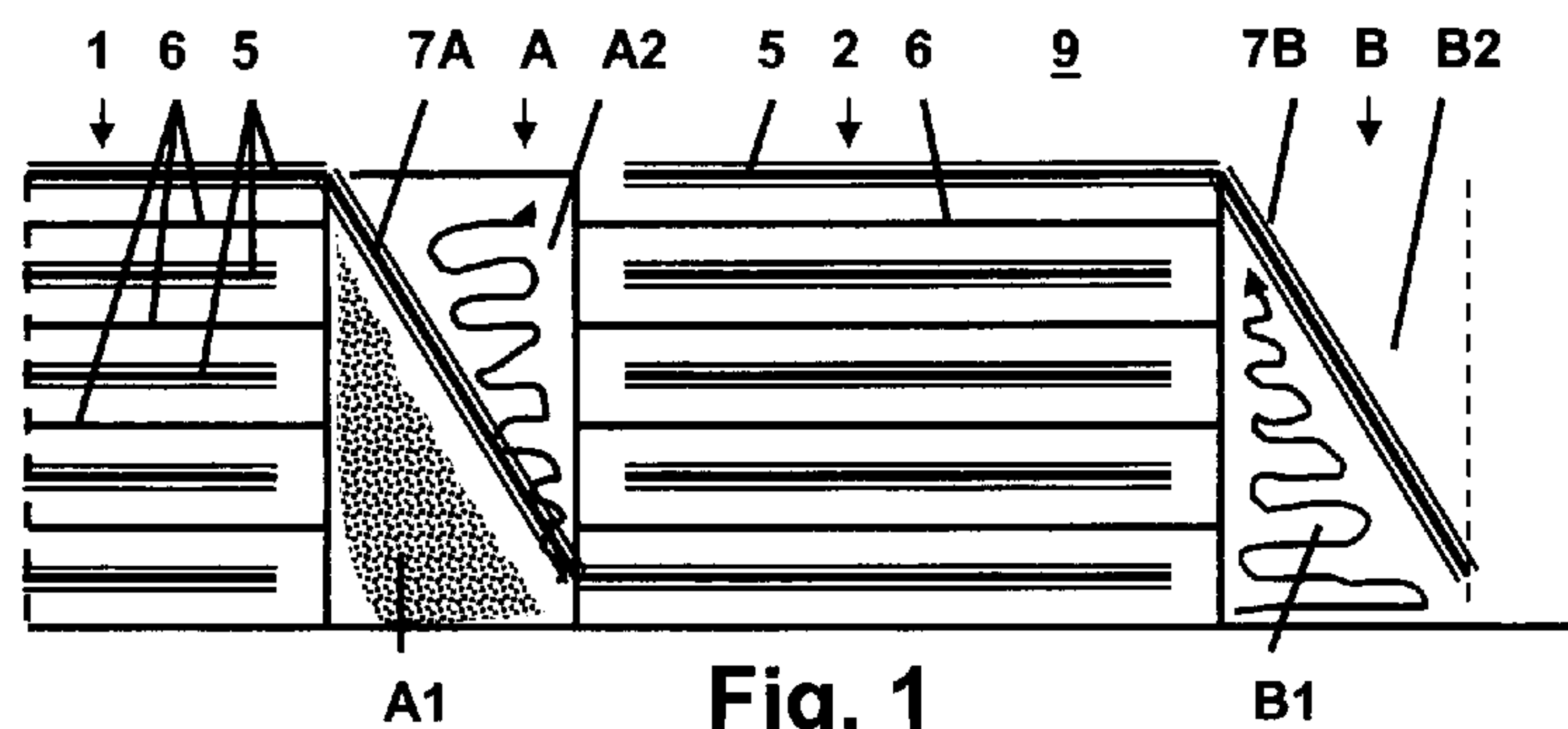


Fig. 1

(57) **Abstract:** The invention relates to a method for producing a disk winding (9) comprising at least three disks (1, 2, 3) which are arranged adjacent to each other. An intermediate isolation (A, B) is produced at the same time as the winding between respectively two disks (1, 2, 3) during the winding process, a connection conductor (7, 7A, 7B) extends from the end of one of the disks to the beginning of the other disk in the form of a diagonal inside the intermediate isolation (A, B) and the intermediate isolation is divided into two partial areas, that is, a first intermediate isolation area (A1, B1) having a triangular cross-section which is formed below said diagonal and a second intermediate isolation area (A2, B2) having an inversed triangular cross-section which is formed above said diagonal, an isolation is placed in the second intermediate isolation area (A2) to the left of the disk (2) and an isolation is placed in the first intermediate isolation area (B1) to the right of the disk (2) during a disk winding which unwinds from left to right at the same time as the winding of the disk (2), and an isolation is placed in the second intermediate isolation area (A2) to the right of the disk (2) and an isolation is placed in the first intermediate isolation area (B1) to the left of the disk (2) during a disk winding which unwinds from right to left at the same time as the winding of the disk (2).

(57) Zusammenfassung:

[Fortsetzung auf der nächsten Seite]

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— mit internationalem Recherchenbericht (Artikel 21 Absatz 3)

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Es wird ein Verfahren zur Herstellung einer Scheibenwicklung (9) mit mindestens drei nebeneinander angeordneten Scheiben (1, 2, 3) vorgeschlagen, • wobei innerhalb eines Wickelprozesses simultan mit der Wicklung eine Zwischenisolation (A, B) zwischen jeweils zwei Scheiben (1, 2, 3) gefertigt wird, • wobei ein Verbindungsleiter (7, 7A, 7B) vom Ende der einen Scheibe zum Anfang der weiteren Scheibe in Form einer Diagonalen innerhalb der Zwischenisolation (A, B) verläuft und die Zwischenisolation hierdurch in zwei Teilbereiche unterteilt, nämlich einen ersten Zwischenisolationsbereich (A1, B1) mit dreieckförmigem Querschnitt, welcher unterhalb dieser Diagonalen ausgebildet ist und einen zweiten Zwischenisolationsbereich (A2, B2) mit umgekehrt dreieckförmigem Querschnitt, welcher oberhalb dieser Diagonalen ausgebildet ist, • wobei bei einer von links nach rechts fortschreitenden Scheibenwicklung simultan mit der Wicklung der Scheibe (2) eine Isolation im zweiten Zwischenisolationsbereich (A2) links der Scheibe (2) und eine Isolation im ersten Zwischenisolationsbereich (B1) rechts der Scheibe (2) aufgebracht werden, • und wobei bei einer von rechts nach links fortschreitenden Scheibenwicklung simultan mit der Wicklung der Scheibe (2) eine Isolation im zweiten Zwischenisolationsbereich (A2) rechts der Scheibe (2) und eine Isolation im ersten Zwischenisolationsbereich (B1) links der Scheibe (2) aufgebracht werden.

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Method for producing a disk windingDescription

5 The invention relates to a method for producing a disk winding. One preferred application is for high-voltage windings of dry-type transformers.

10 Disk windings are used in particular in the field of the high-voltage coils of coils produced using the vacuum encapsulation technique. In this case, a conductor ribbon (dimensions for example 20 mm wide, 0.2 mm thick) is wound together with a turn insulator (for example 30 mm wide, 0.1 mm thick) onto one another
15 to form a "disk", with the winding start being located close to the winding core. After 100 turns, for example, the disk is ended, the conductor ribbon is folded through 90°, and is passed down in the direction of the winding core to form a new disk. There, it is
20 folded through 90° again, and a further disk is wound. A disk winding such as this may consist of a large number of such disks arranged adjacent to one another. After the disk winding has been completed, or the final disk of this winding, it is encapsulated using a vacuum
25 encapsulation method.

The invention is based on the object of specifying an optimized method for producing a disk winding.

30 According to the invention, this object is achieved by a method for producing a disk winding having at least three disks which are arranged alongside one another,

- wherein intermediate insulation is manufactured between in each case two disks simultaneously with
35 the winding within a winding process,
- wherein a connecting conductor runs from the end of one disk to the start of the further disk in the form of a diagonal within the intermediate insulation, and thus subdivides the intermediate

- insulation into two subareas, specifically a first intermediate insulation area which has a triangular cross section and is formed below this diagonal and a second intermediate insulation area which has an opposite triangular cross section and is formed above this diagonal,
- wherein, in the case of a disk winding which progresses from left to right, insulation is fitted in the second intermediate insulation area to the left of the disk and insulation is fitted in the first intermediate insulation area to the right of the disk simultaneously with the winding of the disk,
 - and wherein, in the case of a disk winding which progresses from right to left, insulation is fitted in the second intermediate insulation area to the right of the disk and insulation is fitted in the first intermediate insulation area to the left of the disk simultaneously with the winding of the disk.

The advantages which can be achieved by the invention are, in particular, that the desired profile of the connection of two disks to one another can be produced within one winding process without this resulting in cavities, which are difficult to wind with insulation, for example resin roving. This ensures good electrical characteristics for a high-voltage coil or transformer, with a compact, space-saving design.

Advantageous refinements of the invention are characterized in the dependent claims.

The invention will be explained in the following text with reference to the exemplary embodiments illustrated in the drawing, in which:

Figure 1 shows a side section through a section of a disk winding while a manufacturing step is being carried out for a disk winding which progresses from left to right,

5

Figure 2 shows a side section through a subarea of a completed disk winding,

Figure 3 shows a side section through a completed disk winding,

10

Figure 4 shows a disk winding which progresses from right to left.

Figure 3 shows a side section through a completed disk winding. The disk winding 9, which progresses from left to right in the illustrated example and surrounds a winding core 8, has four disks, with intermediate insulation being provided between each of the individual disks of the disk winding 9. In this context, reference is also made to the initial explanatory notes, which are also applicable to the invention. With respect to the intermediate insulation, this means in detail:

- first intermediate insulation A is arranged between a first disk 1 and a second disk 2,
- second intermediate insulation B is arranged between the second disk 2 and a third disk 3,
- third intermediate insulation C is arranged between the third disk 3 and a fourth disk 4.

25
30

The production of the intermediate insulation will be considered in more detail in the following text.

In this context, Figure 1 shows a side section through a section of a disk winding 9, which progresses from left to right, while a manufacturing step is being carried out. In the specifically illustrated

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manufacturing step that is being carried out, the first disk 1 has already been completed, while the second disk 2 is currently being wound. The intermediate insulation A is arranged between the disks 1, 2. Each disk has (or is intended to have) a predetermined number of turns which are composed of a conductor ribbon 5, with a turn insulator 6, which is likewise in the form of a ribbon, being located between each two turns. The conductor ribbon 5 is continuous from the end of the first disk 1 to the start of the second disk 2, in the form of a connecting conductor 7A. Within the intermediate insulation cross section, this connecting conductor 7A effectively corresponds to a diagonal of the intermediate insulation A, which subdivides the intermediate insulation A into two subareas, specifically

- into a first intermediate insulation area A1 having a triangular cross section, which is formed below this diagonal and in which insulation has already been applied in the previous manufacturing step while winding the first disk 1, and
- into a second intermediate insulation area A2 with an opposite triangular cross section, which is formed above this diagonal and in which insulation is applied simultaneously with the winding of the disk 2 during the manufacturing step that is being carried out, as is sketched by the meandering line profile.

Similar manufacturing measures apply to the intermediate insulation B between the disk 2, which is wound during the manufacturing step that is being carried out, and the disk 3, which is to be wound in the next manufacturing step, because the cross section of this intermediate insulation B is subdivided in the same manner into two subareas by the connecting conductor 7B, which effectively corresponds to a diagonal of the intermediate insulation B, specifically

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- into a first intermediate insulation area B1 having a triangular cross section, which is formed below this diagonal and in which insulation is applied simultaneously with the winding of the disk 2 during the manufacturing step that is being carried out, as is sketched by the meandering line profile, and
- into a second intermediate insulation area B2 having an opposite triangular cross section, which is formed above this diagonal and in which insulation is not intended to be applied until the next manufacturing step while winding the next disk 3.

15 In summary, the invention accordingly provides for a winding of a disk to be produced together with two subareas of the intermediate insulation which is required on both sides of the disk, for which purpose insulation is applied simultaneously, adjacent to the disk, with an opposite triangular cross section on the one (for example left-hand) side and with a triangular cross section on the other (for example right-hand) side during the winding of the conductor ribbon 5 and the turn insulator 6.

25 By way of example, this insulation may consist of one or more glass rovings which are impregnated with a resin. As an alternative to this, a pre-impregnated material can also be used. Particularly for the wet-winding method, it is also possible to ensure that the intermediate spaces between the conductor ribbon 5 and the turn insulator 6 are filled with a resin.

35 Figure 2 shows a side section through a subarea of a completed disk winding 9 (a disk winding which progresses from left to right) consisting of

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- the first disk 1, formed from the desired number of turns of the conductor ribbon 5 and the turn insulator 6,
- 5 • the second disk 2, formed from the desired number of turns of the conductor ribbon 5 and the turn insulator 6,
- 10 • the first intermediate insulation A between the disks 1 and 2, subdivided into the first intermediate insulation area A1 with a triangular cross section and into the second intermediate insulation area A2 with the opposite triangular cross section, with the connecting conductor 7A forming the diagonal boundary surface between the two intermediate insulation areas A1, A2,
- 15 • the third disk 3, formed from the desired number of turns of the conductor ribbon 5 and the turn insulator 6,
- 20 • the second intermediate insulation B between the disks 2 and 3, subdivided into the first intermediate insulation area B1 with a triangular cross section and into the second intermediate insulation area B2 with the opposite triangular cross section, with the connecting conductor 7B forming the diagonal boundary surface between the two intermediate insulation areas B1, B2,
- 25 • the fourth disk 4, formed from the desired number of turns of the conductor ribbon 5 and the turn insulator 6,
- 30 • the third intermediate insulation C between the disks 3 and 4, subdivided into the first intermediate insulation area C1 with a triangular cross section and into the second intermediate insulation area C2 with the opposite triangular cross section, with the connecting conductor 7C forming the diagonal boundary surface between the two intermediate insulation areas C1, C2.
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The above explanatory notes are, of course, intended in their entirety only to explain the intermediate insulation which is located between two disks, in the present case the intermediate insulation A, B, C. In contrast to this, in the case of the first disk 1, no intermediate insulation area with an opposite triangular cross section is manufactured (for example to the left of the disk winding in the case of a disk winding which progresses from left to right). In the case of the last disk, in this case the disk 4, no intermediate insulation area with a triangular cross section is likewise manufactured (for example to the right of the disk winding in the case of a disk winding which progresses from left to right).

15

The above explanatory notes also apply, of course, in their entirety to a disk winding which progresses from right to left, as is sketched in Figure 4.

List of reference symbols

	1	First disk	
	2	Second disk	
5	3	Third disk	
	4	Fourth disk	
	5	Conductor ribbon	
	6	Turn insulator	
	7	7A, 7B, 7C Connecting conductor	
10	8	Winding core	
	9	Disk winding	
	A	First intermediate insulation	
15	A1	First intermediate insulation area (with a triangular cross section)	
	A2	Second intermediate insulation area (with an opposite triangular cross section)	
	B	Second intermediate insulation	
20	B1	First intermediate insulation area (with a triangular cross section)	
	B2	Second intermediate insulation area (with an opposite triangular cross section)	
	C	Third intermediate insulation	
25	C1	First intermediate insulation area (with a triangular cross section)	
	C2	Second intermediate insulation area (with an opposite triangular cross section)	

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

1. A method for producing a disk winding having at least three disks which are arranged alongside one another,
 - wherein intermediate insulation is manufactured between adjacent pair of the disks simultaneously with the winding within a winding process,
 - wherein, for each adjacent pair of disks, a connecting conductor runs from the end of one disk to the start of the other disk in the form of a diagonal within the intermediate insulation, and thus subdivides the intermediate insulation into two subareas, specifically a first intermediate insulation area which has a triangular cross section and is formed below this diagonal and a second intermediate insulation area which has an opposite triangular cross section and is formed above this diagonal,
 - wherein, for each intermediate disk, in the case of a disk winding which progresses from left to right insulation is fitted in the second intermediate insulation area to the left of the disk and insulation is fitted in the first intermediate insulation area to the right of the disk simultaneously with the winding of the disk,
 - and wherein, for each intermediate disk, in the case of a disk winding which progresses from right to left, insulation is fitted in the second intermediate insulation area to the right of the disk and insulation is fitted in the first intermediate insulation area to the left of the disk simultaneously with the winding of the disk.

- 10 -

2. The method as claimed in claim 1, wherein, in the case of a disk winding which progresses from left to right, no intermediate insulation area is manufactured to the left of the left-most disk and, in the case of a disk winding which progresses from right to left, no intermediate insulation area is manufactured to the right of the left-most disk.

3. The method as claimed in claim 1, wherein, in the case of a disk winding which progresses from left to right, no intermediate insulation area is manufactured to the right of the right-most disk and, in the case of a disk winding which progresses from right to left, no intermediate insulation area is manufactured to the left of the right-most disk.

4. The method as claimed in any one of claims 1 to 3, wherein glass rovings impregnated with resin are used as insulation.

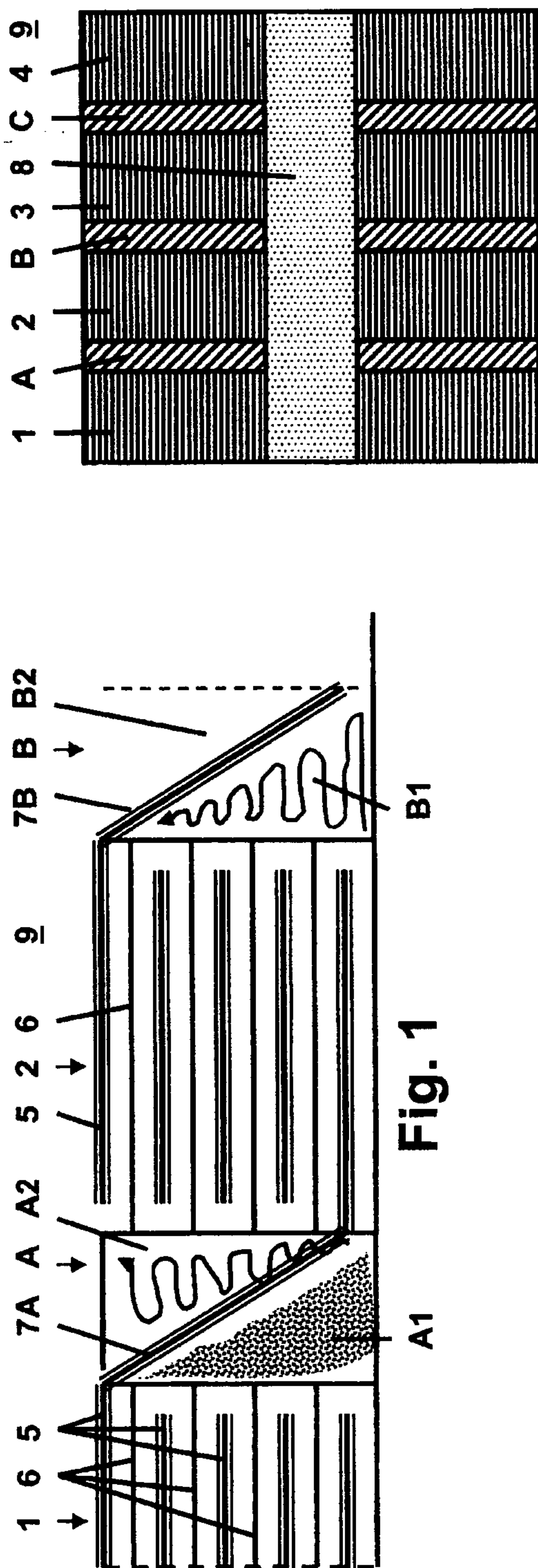


Fig. 1

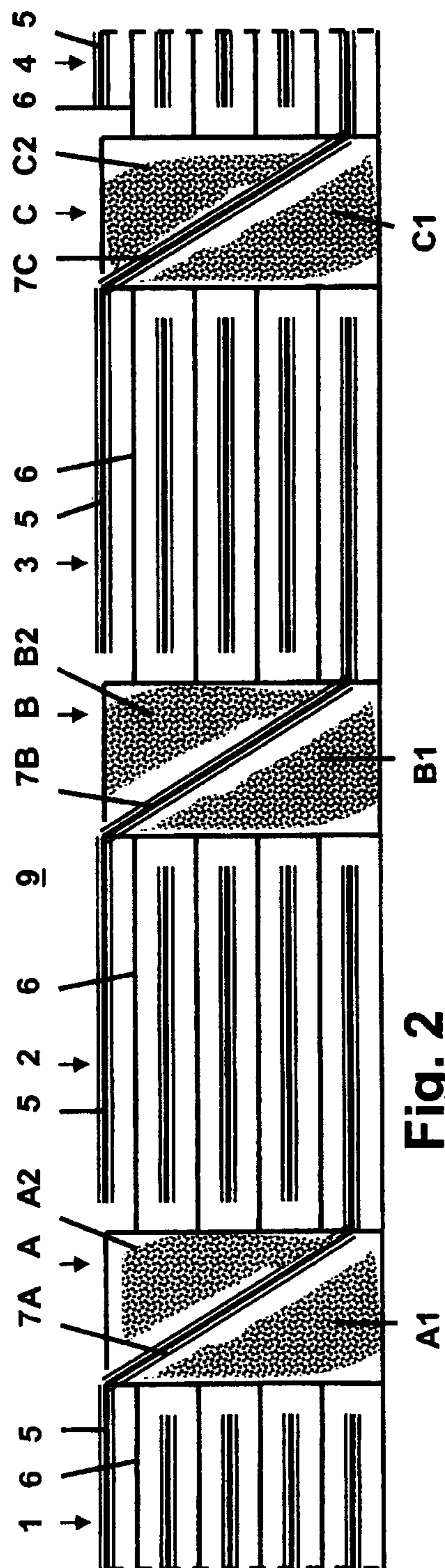
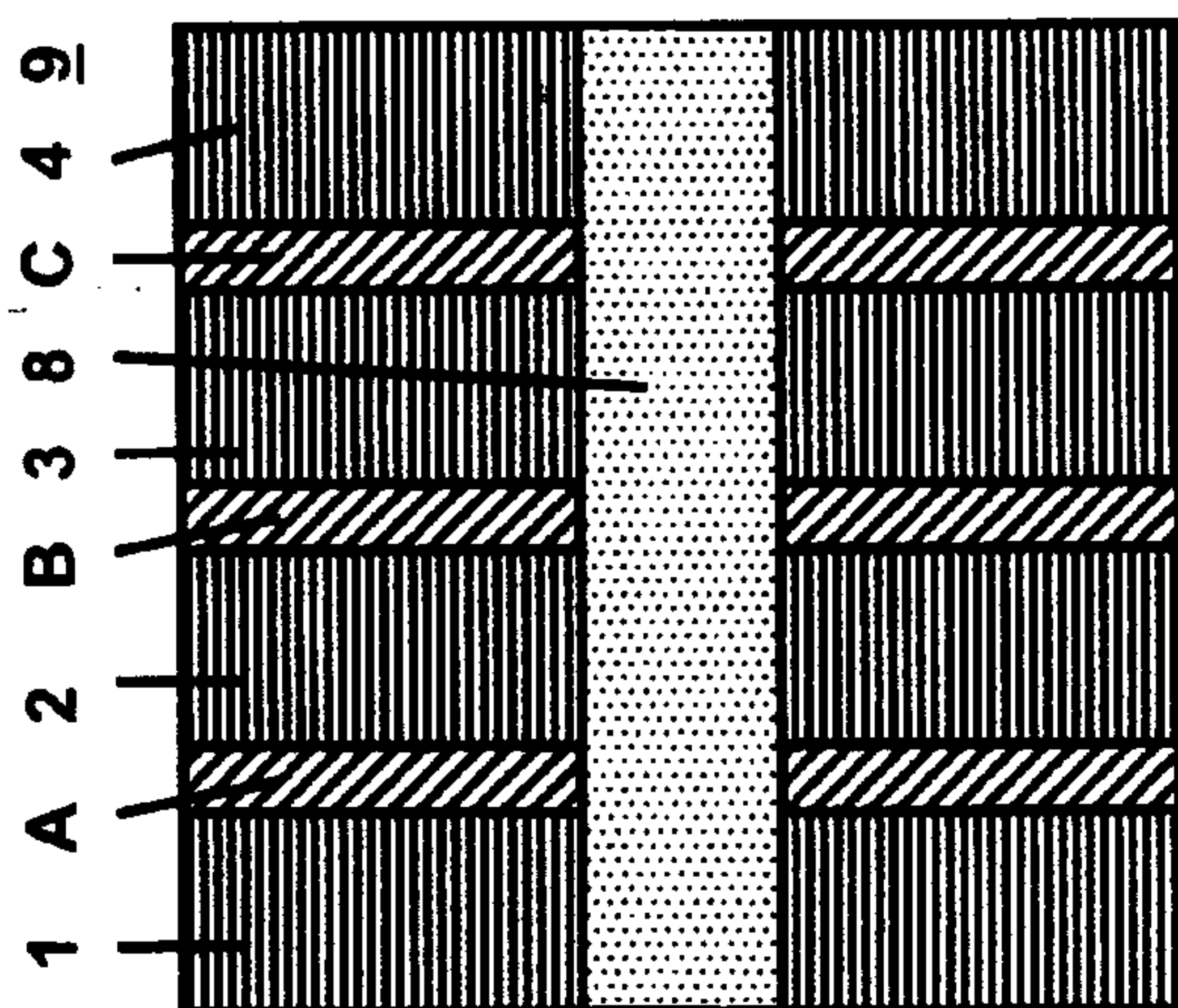


Fig. 2

Fig. 3



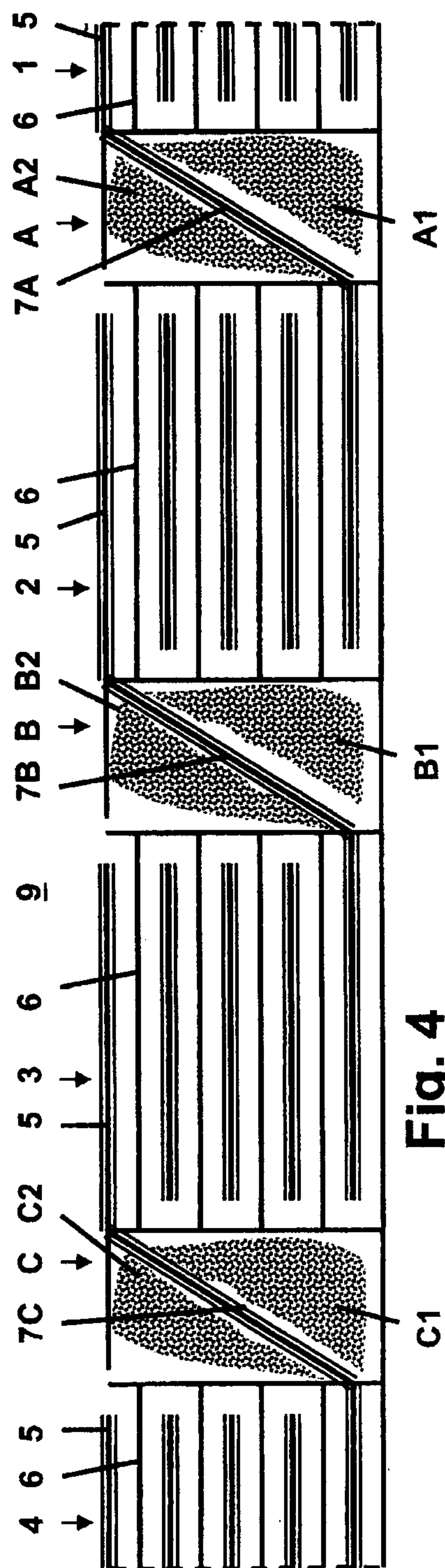


Fig. 4

