(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 112 075**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **83307141.8**

(51) Int. Cl.³: **H 01 R 9/03**

(22) Date of filing: **22.11.83**

(30) Priority: **24.11.82 DE 3243384**

(43) Date of publication of application:
27.06.84 Bulletin 84/26

(84) Designated Contracting States:
BE CH DE FR GB IT LI NL SE

(71) Applicant: **MINNESOTA MINING AND MANUFACTURING COMPANY**
3M Center, P.O. Box 33427
St. Paul, MN 55133(US)

(72) Inventor: **El-Kordi, Taeb c/o 3M Electrical Lab. GmbH**
Georg-Wilhelm-Strasse 183
D-2102 Hamburg 93(DE)

(72) Inventor: **Rosenthal, Bernd c/o 3M Electrical Lab. GmbH**
Georg-Wilhelm-Strasse 183
D-2102 Hamburg 93(DE)

(74) Representative: **Baillie, Iain Cameron et al,**
c/o Ladas & Parry Isartorplatz 5
D-8000 München 2(DE)

(54) **Electrical multiphase branch connector.**

(57) An electrical multiphase branch connector in which the contact element 21 has an elongated contact edge 23 is forcibly inserted in a guide 25 and cuts essentially tangentially through the insulation on the conductors and into the conductors to electrically interconnect the conductor cores.

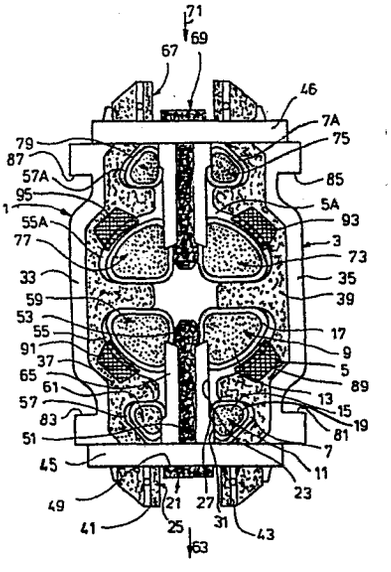

Fig. 1

EP 0 112 075 A1

0112075

ELECTRICAL MULTIPHASE BRANCH CONNECTOR

Technical Field

The invention relates to an electrical multiphase branch connector.

Background Art

Prior art branch connectors include that of German Offenlegungsschrift 2,612,291, that has a contact element in a pair of clamping bodies which has toothed edges that project into conductor receiving recesses in the bodies so that upon assembly of the clamping bodies, the conductors in the recesses will become engaged by the teeth. By pressing together the clamping bodies, the teeth then can be driven through the conductor insulations essentially simultaneously and essentially radially with respect to the conductors and brought into electrical contact with the conductor cores. A similar design is disclosed in German patent letter 1,924,964.

The mode of operation found in the prior art branch connectors, with an essentially simultaneous radial penetration of the insulations of the main and branch conductors, requires very high forces for the establishment of the connection. This not only is inconvenient but also makes it difficult to determine during the clamping process when the clamping bodies have been sufficiently moved towards each other to ensure a sufficiently high contact force without a permanent deformation of the toothed edges.

With the branch connectors of German Auslegeschrift 1,223,009 and German Auslegeschrift 2,062,304, a contact edge for the penetration of the conductor insulation is provided only for the main conductor, so that in use the branch conductor has to be prestripped. While in this way the forces to be applied during assembly are reduced, and the clamping is directly limited by the stripped branch conductor, the prestripping of the branch con-

ductor is cumbersome and time consuming and requires care. The same is also true for the simpler prior art branch connectors in which tooth-like edges for the penetration of the insulation are provided only for the main conductor, and the branch conductor must be prestripped, and clamped and contacted by means of a screw clamp or the like and in German Auslegeschrift 2,335,654, German Offenlegungsschrift 2,251,214, German Offenlegungsschrift 2,444,440 and German Auslegeschrift 1,790,050.

Disclosure of Invention

The present invention provides a branch connector of simple construction which can be conveniently and in a reliable manner applied to non-prestripped main and branch conductors.

In the branch connector according to the invention, the contact edge is not essentially radially pierced into the conductors but cuts like a knife essentially tangentially into the conductor. It has been found that this will require only a small force compared to the prior art branch connectors employing radial piercing. This force can be conveniently provided by means of simple tools, for example a hammer or a simple inserting device. Since the contact edge is moved tangentially across the conductors, there is no such problem as how to determine a limit for a piercing movement. In addition, the diameter of the branch connector can be smaller, as compared to branch connectors having contact elements piercing radially into the conductors. In the branch connector according to the invention, the contact force is derived from the resilient displacement of the conductor and/or the contact edge perpendicularly to the direction of insertion of the contact edge. This will provide a substantially greater useful spring path than with radial piercing, and thus a sufficient contact force can be ensured over long periods of time.

Brief Description of the Drawings

The invention will be subsequently described in more detail by means of an example embodiment, in connection with the drawings. In the drawing:

Figure 1 is a cross-sectional view of a branch connector according to the invention connecting a four conductor cable to four branch conductors.

Figure 2 is a sectional view, corresponding to Figure 1, of the connector prior to its assembly.

Figure 3 is a sectional view, corresponding to Figure 1, of the connector in an intermediate stage of assembly.

Figure 4 is a sectional view, corresponding to Figure 1, of the connector in a stage of the assembly beyond that of Figure 3.

Figure 5 is an exploded perspective view of the branch connector illustrated in Figures 1 to 4.

Detailed Description

Figure 1 shows an electrical multiphase branch connector having two assemblable clamping bodies 1 and 3 in which is provided at least one set of recesses 5 and 7 for receiving an insulated main conductor 9 and at least one insulated branch conductor 11 to be electrically connected to the main conductor 9. Each conductor has a conductor core 13 and 15, respectively, and insulation 17 and 19, respectively. A contact element 21 is associated with the recess 5 and 7 which electrically interconnects the conductor cores of the main conductor 9 and the branch conductor 11 while penetrating the insulations 17 and 19, respectively, when the clamping bodies 1, 3 are assembled around the conductors 9, 11. The recesses 5 and 7 are preferably designed for receiving conductors having essentially section-shaped cross-sections, as in the embodiment illustrated.

The contact element 21 has an elongated contact edge 23 designed to penetrate the insulations 17 and 19

and electrically interconnect the conductor cores 13 and 15, which is forcibly insertable into the interior of the connector in a guide 25 provided in the connector in its assembled condition. The recesses 5 and 7 are positioned and shaped with respect to the shape of the cross-sections of the conductors 9 and 11 to be interconnected, and to the insertion path of the contact edge 23, as essentially determined by the guide 25, so that with the insertion of the contact element 21, the contact edge 23 cuts essentially tangentially into the conductors 9, 11 to be interconnected.

The contact edge 23 may extend somewhat obliquely with respect to the direction of insertion so that the edge will continuously cut deeper into the conductor as the insertion proceeds.

The recesses 5 and 7 are preferably arranged, as shown in the embodiment illustrated, so that the conductors to be interconnected are contacted one after the other. It has been found that in this way the insertion force is minimized.

If the cross-sections of the main and branch conductors differ significantly, for instance as shown in the embodiment illustrated, it may be appropriate that the contact edge 23 comprise two edge portions 29 and 31 which are set off against each other through a step 27, as illustrated. Then, the conductors can be arranged to save space, and moreover, the advantage will be obtained that the step can facilitate the cutting into the insulation of the conductor arranged further outward.

It is advantageous to design the branch connector to be resilient so that the inserted contact element 21 will resiliently expand the connector, and a permanent contact force will be obtained from this expansion. Generally, standard materials have sufficient elasticity to permit the described resilient expansion of the connector. Of course, this effect can be amplified by using resilient materials for the clamping bodies and/or the

recesses. In the embodiment illustrated, a particularly high resiliency is obtained by constructing the clamping bodies as an outer metallic base body 33 and 35, respectively, and an attached insulating body 37 and 39, respectively. Usually the metallic base bodies 33, 35 will have a resiliency which is sufficient for the described purpose, and can maintain a high contact force which will remain essentially constant over long periods of time.

For the assembly of the clamping bodies to the branch connector, a variety of constructions will be suitable. Particularly simple are self-locking constructions which will be tightened and locked by the introduction of the contact element. This is possible in a particularly simple manner, as illustrated, by providing the guide 25 with opposing portions 41 and 43 of the clamping bodies 1 and 3, respectively, and by assembling the clamping bodies by means of at least one, preferably frame-like, coupling element 45 which can be applied at a position where an expansion and a subsequent clamping is achieved by the insertion of the contact element 21. In the illustrated embodiment, the two clamping bodies 1 and 3 are held together in the insertion area of the contact element by means of a frame-like coupling element 45 which will be locked in latching grooves upon the insertion of the contact element 21, the latching grooves being provided on the clamping bodies 1 and 3. A second coupling element 46 is provided in the same manner at the other end of the connector.

It is also advantageous if the contact element 21 and the guide 25 are provided with snap-in means which will snap into engagement upon reaching the fully inserted position of the contact element (as shown in Figure 1), whereby the contact element will be locked in the fully inserted position. In the embodiment illustrated, the snap-in means are simply formed in that small rounded protrusions 47 (Fig. 5) are provided close to the outer end of the contact element 21 in the lateral edges of

the contact element, which protrusions will, upon the insertion of the contact element 21, pass through the frame-like coupling element 45 while resiliently deforming the latter, and will become locked behind the coupling element when the latter snaps back upon complete insertion of the contact element. It will be appreciated that numerous other embodiments of such snap-in means 47 will be possible.

In order to also prevent an excessive insertion of the contact element, it is preferrable to provide the contact element 21 with an abutment 49 for limiting the insertion of the contact element. In the embodiment illustrated, the abutment 49 is formed by noses which project from the outer end of the contact element and will abut the coupling element 45 upon complete introduction.

In the embodiment illustrated, the contact element 21 can be driven into the guide in an essentially linear direction of insertion. This simplifies the structure and facilitates the insertion. Moreover, the contact element thereby can be easily designed so that it will make contact simultaneously with a plurality of pairs of main and branch conductors.

In the embodiment illustrated, the contact element 21 comprises an insulator core 51 on which a metallic contact edge 23 is provided. This construction makes it possible to use the contact element 21 simultaneously as an insulating means; accordingly, in the embodiment illustrated, a knob 53 is formed at the interior end of the insulator core 51, which knob will become positioned as an insulating spacing element in front of non-contacted circumferential areas of the main conductor 9.

In order to increase the contact area the contact element 21, as shown in Figure 5 is formed with a plurality of electrically interconnected contact edges 23A to 23E for contacting a plurality of areas distributed along the conductor.

It is preferrable that the contact element be symmetrical with respect to the contact forces and thus

in the illustrated embodiment it has two sets of recesses, each for receiving a set of main and branch conductors, arranged opposed to each other with respect to the direction of insertion of the contact element. In addition to the already described set or recesses 5 and 7 a second set of recesses 55 and 57 is provided for receiving a further set of main conductor 59 and a branch conductor 61, respectively. In this embodiment, the contact element 21 has two mutually electrically insulated sets of contact edges, namely the already described contact edge 23 and a similar second contact edge 65, the sets of contact edges being oppositely arranged with respect to the direction of insertion 63. In this embodiment as shown in the Figures, thus two sets of main and branch conductors are simultaneously electrically interconnected by the insertion of a single contact element 21, and simultaneously, a mechanical locking will be obtained, and a high permanent contact force generated, by the symmetrical expansion of the connector.

As a matter of principle, it is possible to provide any desired number of further guides and associated therewith, sets of recesses, each for a set of main and branch conductors, and contact elements therefor. In this manner, branch connectors can be obtained which include a relatively high number of branching connections in a single housing. In order that with such a construction, the expansion effects required for the generation of the contact force will disturb each other as little as possible, it is appropriate to provide pairs of mutually aligned guides for contact elements with opposite directions of insertion; associated with those guides are two sets of recesses for each set of main and branch conductors. In the embodiment illustrated, such a pair of mutually aligned coaxial guides are provided, with the branch connector being designed symmetrically also in the direction of insertion 63. In an end area of the connector

opposite to the direction of insertion 63, a second guide 67 is provided which is axially aligned with the already described guide 25 and serves to introduce a second contact element 69 which can be inserted at a direction of insertion opposite to that of the contact element 21. Associated with the second contact element 69 are, completely in correspondence with the contact element 21, sets of recesses for each set of main and branch conductors, namely in the embodiment illustrated, again two sets of recesses 5A, 7A; 55A, 57A for each set of main conductors 73, 75 and branch conductors 77, 79, the sets of excavations being opposed to each other with respect to the opposite direction of insertion 71. It will be readily appreciated that this symmetrical embodiment with two contact elements 21 and 69 offers particular advantages for a four-conductor cable. The structure is very simple, and with only two contact elements, four reliable permanent electrical connections can be established conveniently. Moreover, this embodiment can readily be designed also in the manner already described so that the contact elements will contact the conductors associated therewith in a plurality of areas mutually set off in the direction of the conductor.

In most cases, the contact element can be inserted by means of a simple tool, such as a hammer, However, it will be appropriate particularly for larger conductor cross-sections, to provide a special device for the introduction of the contact element. In order that this can be done in a simple manner, the branch connector comprises anchoring elements for a device for the introduction of the contact element, the device being adapted to be attached to the connector. In the embodiment illustrated, these anchoring elements are provided in the form of grooves 81, 83 and 85, 87 formed in the outer surface of the clamping bodies 1 and 3.

In order that the branch connector can be conveniently adapted to various conductor cross-sections, an adapter insert for the adaptation to various cross-sections

of the conductor is insertable at least into the recess for the main conductor. In the embodiment illustrated, such adapter inserts 89, 91, 93, 95 are provided in the recesses for the main conductors. The adapter insert may consist of insulating material, and can be designated to snap into and out of the recesses.

The assembly of the described branch connector is illustrated in Figures 2 to 4.

Figure 2 shows a first stage in which the main and branch conductors have been inserted into the associated recesses of the two clamping bodies which are not yet coupled together.

Figure 3 shows a further stage of the assembly, at which the two clamping bodies have been already coupled and interlocked to each other by means of the coupling elements 45, 46 and by the contact elements 21 and 69 being introduced onto a stand by position. Figure 4 shows a further stage in which the contact element 21 which is the lower one in Figure 4, already has been fully inserted into its final position, whereas the contact element 69 which is the upper one in Figure 4 has not yet been fully inserted. A device 97 for introducing the contact element 69 has been inserted into the already described grooves 85 and 87. This device contains a yoke 99 with a screw plunger 101 which by rotating the same can be advanced at a high force against the contact element 69. After having the contact element completely inserted the device can be easily removed again after having screwed back the screw plunger 101.

0112075

CLAIMS

1. An electrical multiphase branch connector having two assemblable clamping bodies (1, 3) in which at least one set of recesses (5, 7) is provided for receiving an insulated main conductor (9) and at least one insulated branch conductor (11) to be electrically connected to the main conductor, each conductor having a conductor core (13, 15) and an insulation (17, 19), a contact element (21) associated with each set of recesses (5, 7), which contact element electrically interconnects the conductor cores of the main and branch conductors by penetrating the insulations when the clamping bodies are assembled together around the conductors, and the recesses preferably being adapted to receive conductors having essentially sector-shaped cross-sections,

characterized in that the contact element (21) comprises an elongated contact edge (23) adapted to penetrate through the insulations and electrically interconnect the conductor cores, and is forcibly insertable, in a guide (25) provided in the connector, into the interior of the connector in its assembled condition and in that the recesses (5, 7) are positioned and shaped with respect to the shape of the cross-sections of the conductors to be connected and to the insertion path of the contact edge (23) as essentially determined by the guide (25) so that upon the insertion of the contact element (21) the contact edge (23) thereof will cut essentially tangentially into the conductors (9, 11) to be interconnected.

2. The branch connector according to claim 1, characterized in that the recesses (5, 7) are arranged so that the conductors (9, 11) to be interconnected will be contacted one after the other.

3. A branch connector according to claim 1 or 2, characterized in that the contact edge (23) comprises

two edge portions (29, 31) set off from each other through a step (27).

4. A branch connector according to any of the preceding claims, characterized in that it is designed to be resilient so that the inserted contact element (21) will resiliently expand the connector, and a permanent contacting force will be produced from the resilient expansion.

5. A branch connector according to any of the preceding claims, characterized in that portions (41, 43) of the guide (25) are formed in opposite portions of the clamping bodies (1, 3), and in that the clamping bodies are assemblable by means of at least one, preferably frame-like, coupling element (45) which is applicable at a location of the branch connector where the latter is expansible by the insertion of the contact element (21), and which is adapted to be locked in place by the introduction of the contact element.

6. A branch connector according to any of the preceding claims, characterized in that the contact element (21) is designed to snap into its fully introduced position.

7. A branch connector according to any of the preceding claims, characterized by an abutment (49) for limiting the insertion of the contact element (21).

8. A branch connector according to any of the preceding claims, characterized in that the contact element comprises an insulator core (51) and a metallic contact edge (23) provided thereon.

9. A branch connector according to any of the preceding claims, characterized in that the contact element

(21) comprises a set of a plurality of electrically interconnected contact edges (23A to 23E) for contacting a plurality of areas distributed along the conductors.

10. A branch connector according to any of the preceding claims, characterized in that it comprises two sets of recesses (5, 7; 55, 57) in mutually opposed relation with respect to the direction of insertion (63) of the contact element (21), for receiving a set each of main and branch conductors, and in that the contact element (21) comprises two contact edges (23, 65) oppositely arranged with respect to the direction of insertion (63), the edges being electrically insulated from each other.

11. The branch connector according to any of the preceding claims characterized in that it comprises at least one pair of substantially mutually aligned guides (25, 67) for contact elements (21, 69) with opposite directions of insertion (63, 71), and associated to the guides, two sets of recesses for at least one set each of main and branch conductors.

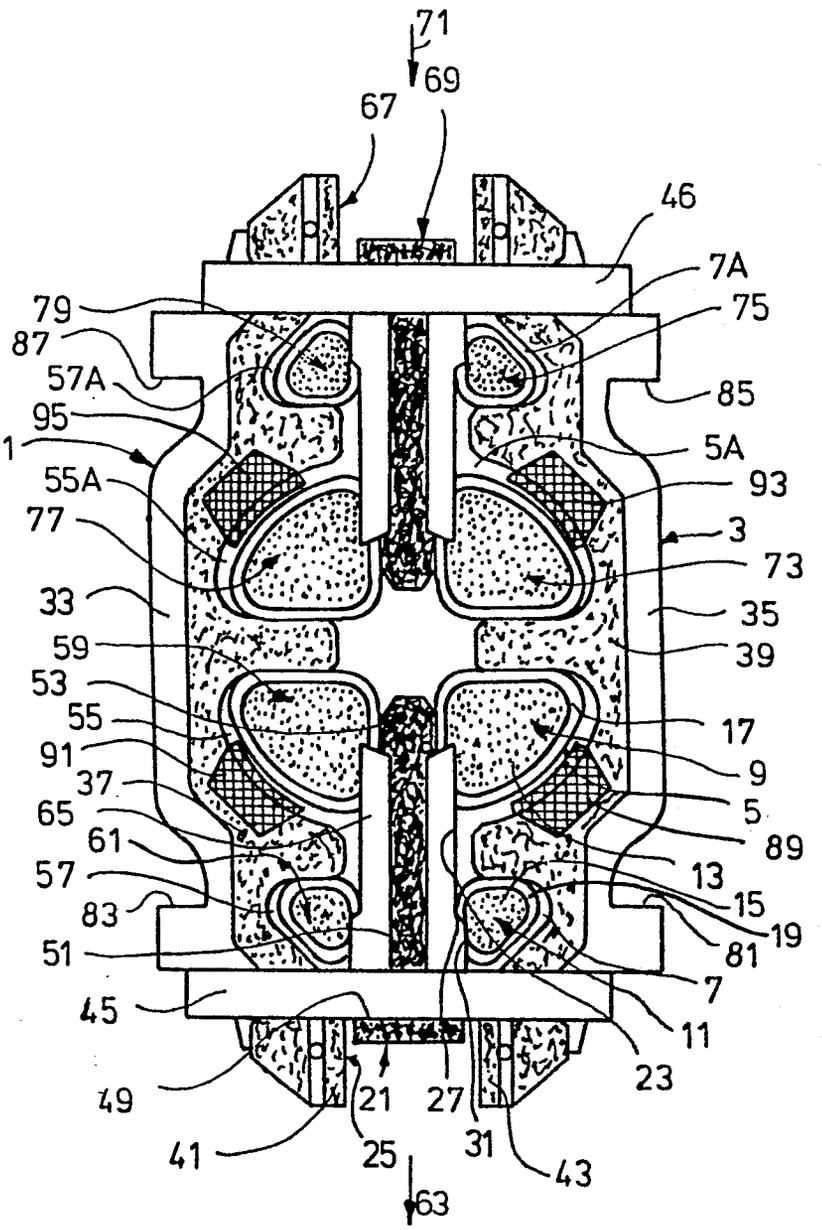
71
69
67
46
7A
79
75
87
57A
85
95
5A
1
55A
93
77
3
73
33
35
59
39
53
55
17
91
9
37
5
65
89
61
13
57
15
83
19
51
81
7
45
11
23
49
21
27
31
41
25
43
63

Fig. 1

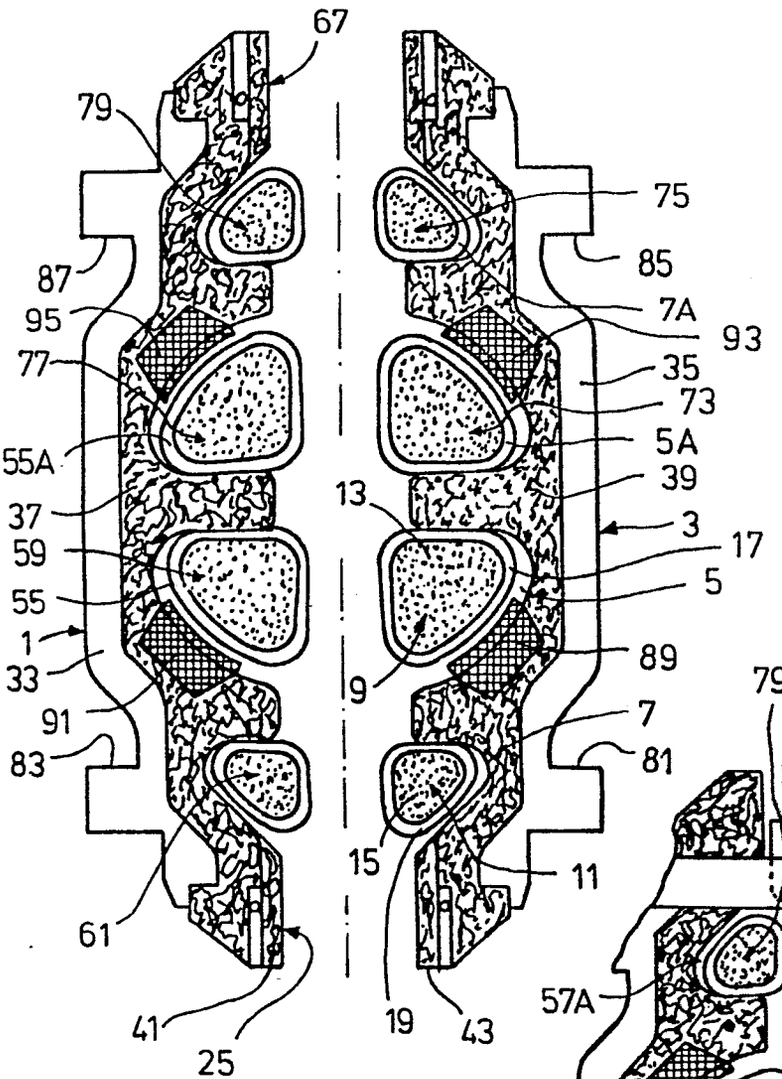
67
79
87
95
77
55A
37
59
55
1
33
91
83
61
41
25
75
85
7A
93
35
73
5A
39
3
17
5
89
7
81
11
13
9
15
19
43

Fig. 2

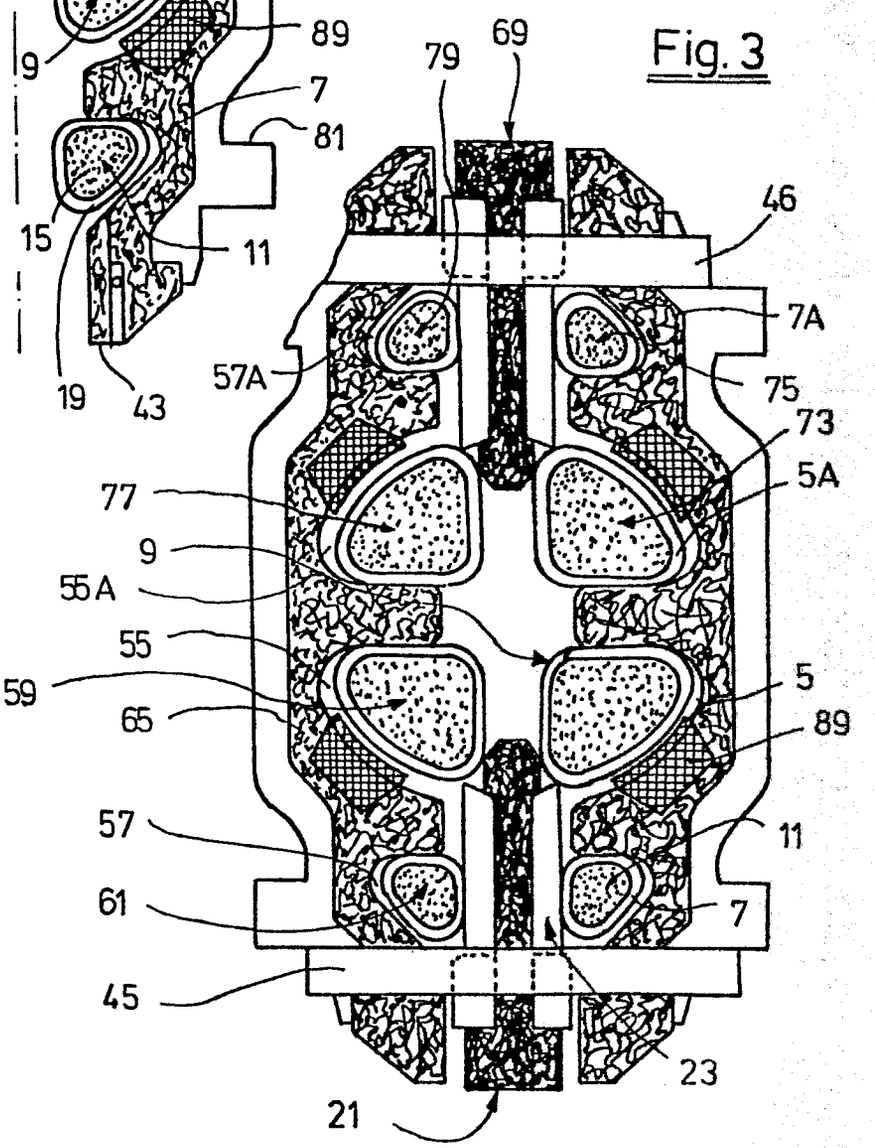
79
69
46
7A
57A
75
73
5A
77
9
55A
55
59
65
5
89
57
11
61
7
45
23
21

Fig. 3

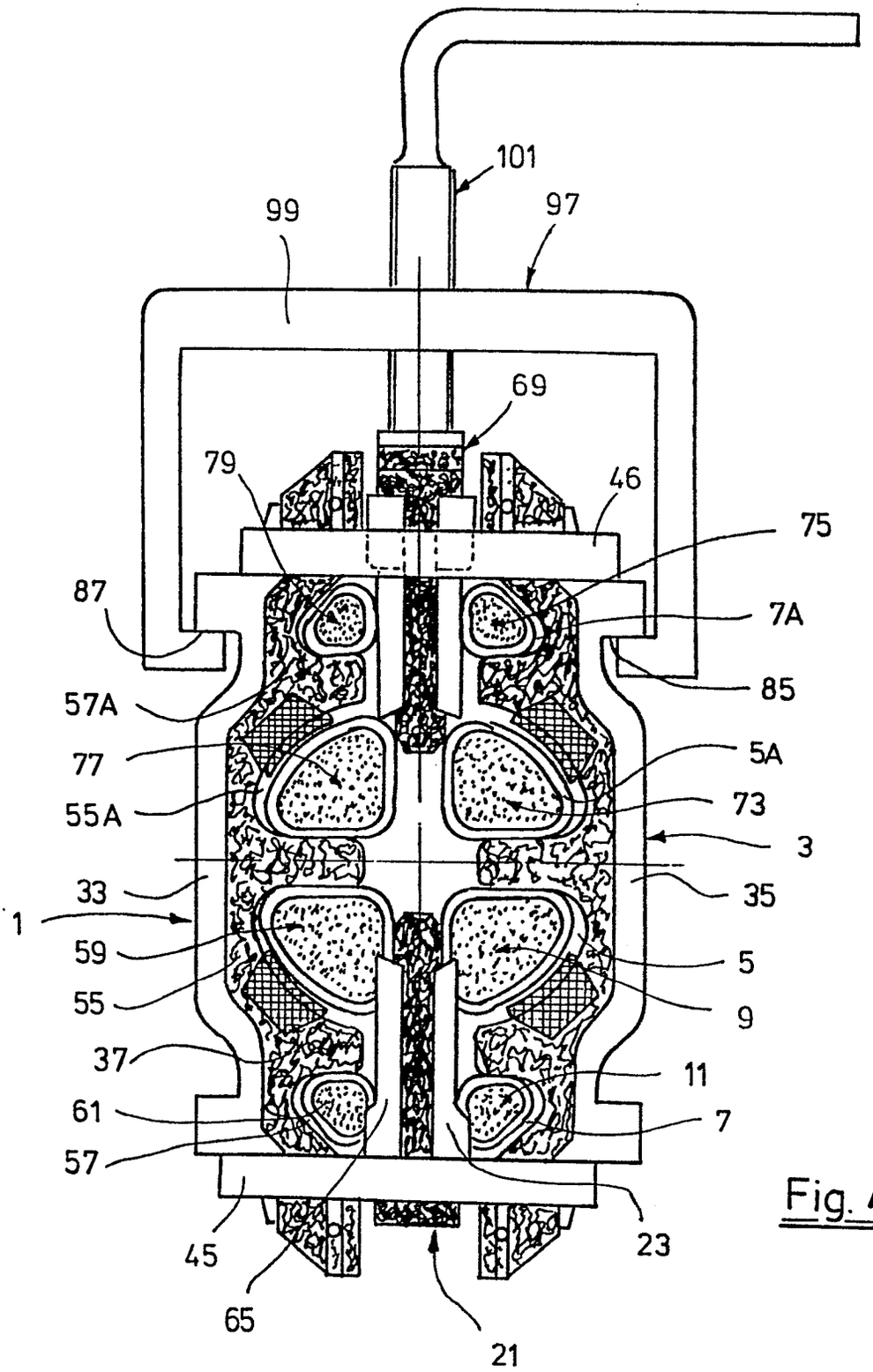
101
99
97
69
79
46
75
87
7A
85
57A
77
5A
55A
73
3
33
35
1
59
5
55
9
37
11
61
7
57
45
23
65
21

Fig. 4

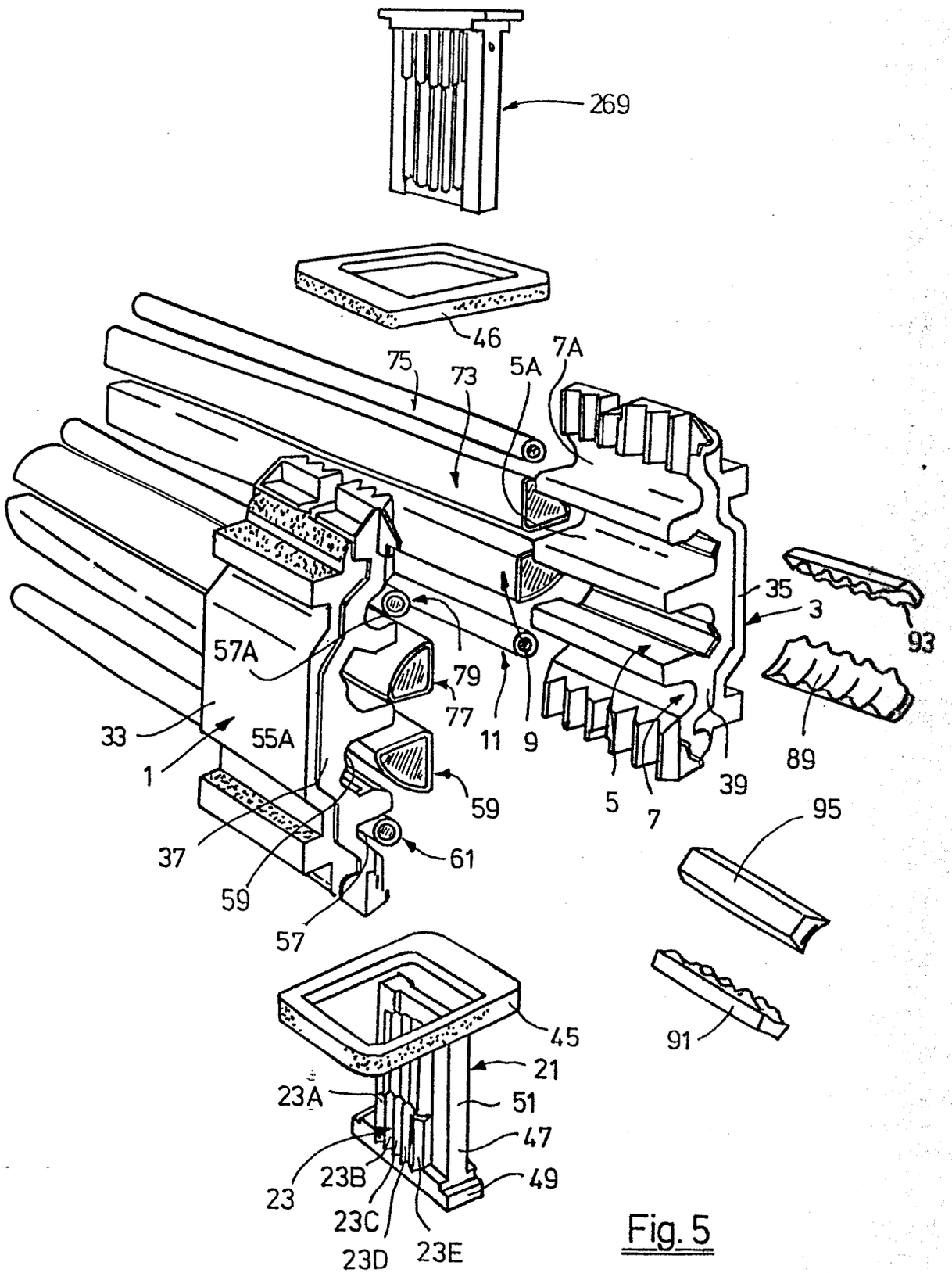
269
46
75
73
5A
7A
35
3
93
57A
79
77
11
9
33
55A
1
59
5
7
39
89
95
37
61
59
57
91
45
21
23A
51
47
23
23B
49
23C
23D
23E

Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

0112075
Application number

EP 83 30 7141

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	EP-A-0 021 550 (N.V. ELECTRICITEITS-MAATSCHAPPIJ IJSSELCENTRALE) * Page 4, line 27 - page 5, line 6; page 6, lines 3-17; figures *	1,7-9	H 01 R 9/03
D,A	DE-B-1 790 050 (SCHIFFMANN) * Column 2, lines 9-36; figures *	1,8,9	
A	CH-A- 493 112 (KRONE) * Figures *	3-7	
A	GB-A-2 084 813 (WAGO) * Page 1, lines 118-124; page 3, lines 3-127; figures *	2-6	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

H 01 R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06-03-1984	RAMBOER P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82