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

(11) Publication number: **0 028 436**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **80201048.8**

(51) Int. Cl.³: **H 01 R 13/26**

(22) Date of filing: **05.11.80**

(30) Priority: **06.11.79 NL 7908112**

(43) Date of publication of application:
13.05.81 Bulletin 81/19

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

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(54) **Connector for a printed circuit board.**

(57) Printed circuit board connector having resilient pins (2) as contact members and are electrically contacted to a nonresilient contact element (6) between the pin (2) and an upright side wall (4,5) of a connector housing (1).

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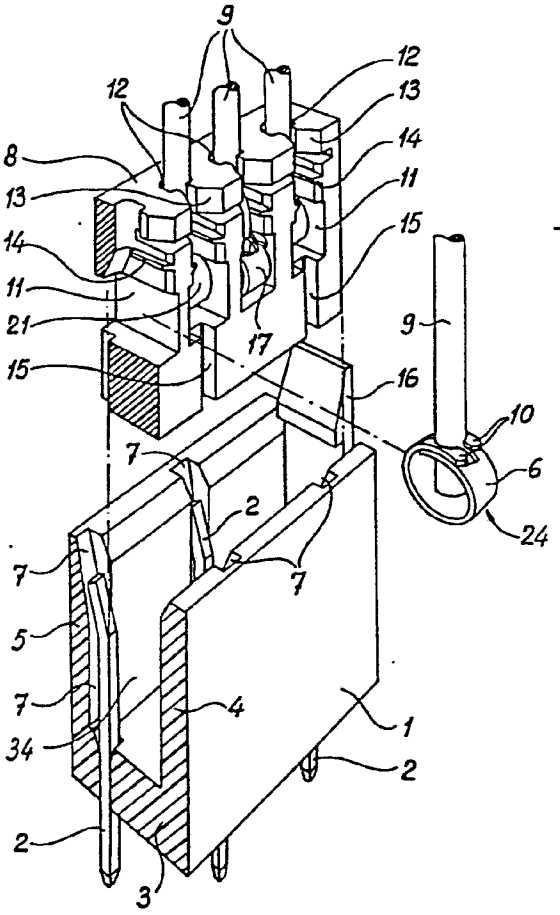

fig-1

Connector for a printed circuit board.

The invention relates to a connector for a printed circuit board, comprising a casing of insulating material with a contact groove between mainly parallel upright side walls said groove being open at the upper side for accepting contact elements, and a bottom interconnecting the side walls, said bottom being penetrated by contact members, the portions of which laying within the contact groove may contact contact elements to be inserted in the groove and extend next to but spaced apart from one of the upright side walls, and the portions of which extending through the bottom to the exterior of the casing may contact conductors on the printed circuit board.

Such contact devices are used in electronic apparatus, in particular those apparatus using modules, such as radio and television sets, data systems, such as electronic cash registers and the like. In said apparatus often several connecting cables have to be connected with a great number of conductors on a printed circuit board, which connection is established with the connector of the type mentioned above. Also sometimes several printed circuit boards have to be interconnected directly by means of such a connector.

With said known connectors it is usual to effect a resilient contact between the contact members and the contact elements by either using resilient contact elements connected with the cable core, or to provide the contact members of specific resilient means, such as leaf springs.

The object of the present invention is to provide a connector of the type mentioned above, having a more simple construction without detrimentally affecting the operation as a connector.

The connector according to this invention is characterized in that the contact members consist of resilient pins, which pins cooperate with non-resilient movable contact elements, which are slid and squeezed between a cooperating pin and the other opposite upright side wall furthest from said pin.

It appears that omitting the specific resilient means does not detrimentally affect the contact operation. The resilience which is inherent to every electrically conducting relatively

rigid pin-shaped material, has appeared to be sufficient to effect and maintain the electrical contact between the pinlike contact members and the contact elements to be slid into the contact groove. The lower elasticity of the pins compared to the usual elastic or resilient material, will even lead to a higher wiping action resulting in a lower transition resistance between the pins and the contact elements. A special surface treatment of the pins and the contact elements, such as coating with a gold layer, can be eliminated.

By omitting the specifically elastic members the connector of the present invention can be manufactured cheaper as far as the material cost as well as the number of manufacturing steps during assembling and mass application are concerned.

In a preferred embodiment of the connector according to the present invention the contact elements are inserted in a holder, which can be slid into the contact groove between the pins and the opposite upright side wall, said holder in this area being provided with recesses for receiving the contact elements.

In this case the pins preferably will be arranged in mutually staggered relationship such, that seen in the longitudinal direction of the contact groove the successive pins each are positioned next to the other of the two upright side walls of the contact groove. Such an arrangement of the pins leads to a better mechanical load of the holder, of the pins and of the casing.

Preferably the pins consist of rigid pin material and preferably have a progressive spring action seen in the slide-in direction of the contact elements into the groove.

For the contact elements specially manufactured members can be used. Also the solid conductor of a cable or a metal cylinder soldered to the conductor end, or another non-resilient member can be used. Preferably insulation piercing contacts are used. Said contacts can have the form of an open ring clamp with opposite fork-shaped insulating piercing contacts or of a U-shaped member with fork-shaped insulation piercing contacts in each of the upright legs. Said contact elements can be slid onto the cable, simultaneously with assembly in the holder.

The invention now will be further elucidated with respect

to the drawings in which four embodiments are shown.

Fig. 1 shows a first embodiment of a connector according to the invention with a ring-shaped contact element;

Fig. 2 shows a second embodiment of a connector according to the invention with a U-shaped contact element;

Fig. 3 shows a similar embodiment as shown in Figure 2, in which one of the legs of the U-shaped contact member acts as a clamp;

Figure 4 shows an embodiment of a connector according to the invention for interconnecting two printed circuit boards.

In Figure 1 which shows the connector according to the invention in exploded view, the U-shaped casing of insulating material is shown partly in cross section, partly in perspective view. The casing 1 consists of a bottom 3 and upright walls 4 and 5. The bottom 3 is penetrated by resilient pins 2 with rectangular or circular cross section, extending some distance within the groove 34 and further extending some distance beyond the bottom of the casing 1. The outer ends of the pins 2, extending out of the bottom 3, can be soldered in matching openings in a printed circuit board (not shown).

The pins 2 are positioned in staggered relationship such, that seen in the longitudinal direction of the groove 34 in the casing 1, these pins are located successively next to the one wall 4 and the other wall 5. Said pins 2, however, have to be positioned at a sufficient distance from the surface of the adjacent upright side walls 4 and 5 respectively, so that when inserting the contact elements 6 in the space between the respective pins 2 and the opposite walls 4 and 5 they can bend in the direction of the adjacent wall and away from the opposite wall.

The upper ends of the portions of the pins 2, extending into the groove 34 of the casing 1 are bent over a small angle in the direction towards the adjacent wall 4 or 5, which facilitates the insertion into the groove of the casing 8 of a contact element 24, shown in Figure 1 at the right side of the connector casing. In the walls adjacent to the pins 2, slots 7 are provided, which are made deeper towards their outer ends, closest to the bottom 3

such, that the bottom of each slot 7 remains approximately parellel to the bent outer ends of the pin. By means hereof the outer end of the pin can partially lie within the groove while retaining its bending possibility into the direction towards the wall which provides for a good support of the pins 2 into the longitudinal direction of the groove in the U-shaped casing 1.

In Figure 1 a holder 8 is shown above the U-shaped casing 1 to accomodate the contact elements 6. At the right side above the casing 1, next to the holder 8, a contact element 6 has been shown removed from the holder, with a connecting cable 9, electrically connected herewith and provided with an insulating sheath.

The contact element 6 consists of a ring-shaped bent metal strip, each end forming insulation piercing contacts 10 having two fork legs. The insulated cable 9 to be contacted has been slid and clamped in the shown manner between the fork legs of said contacts. During assembly, the inner edges of the legs cut the cable sheath insulation and said edges dig in themself at both sides of the cable core over a small distance into the material of said core. Both outer ends of the ring bent and turned to each other will contact the cable core, so that 2 x 2 contact surfaces are created. Preferably said contacting will be accomplished during the manufacturing step whereby the preshaped contact strip is bent into the final ring-shaped contact element 6. This kind of insulation piercing contact is known per se and forms a very good gas tight connection with the cable core.

The holder 8 for receiving and supporting the contact elements 6 may consist of a pressed synthetic resin component having a width which is a bit smaller than the width of the groove 3 between the walls 4 and 5 in the casing 1, so that said holder 8 slidingly fits into said groove 34. The length of the holder 8 in general will be approximately equal to the length of the mentioned groove 34.

The contact elements 6 can be housed in the holder 8 in open recesses or chambers 11, which extend completely through the width of the holder 8 and have such a depth and height that the ring-shaped contact elements 6 fit slidingly into said recesses. From said chambers 11 channels 12 extend upwardly for

accomodating the connecting cables 9. Said cables 9 can be pushed into the channel 12 by means of beveled edge 13 when bringing the contact elements 6 into chamber 11. Within said channels 12 and beveled edge 13, ribs 14 extend inwardly from opposite surfaces which ribs with respect to each other can be displaced in an upward direction to clamp said cables 9 and thus serve as a strain relief.

At the bottom, side channels 15 merge into the chambers 11 in which pins 2 are accomodated when sliding the holder 8 into the groove between the walls 4 and 5. Said channels 15 then are positioned opposite to corresponding slots 7 in the side walls 4 and 5 of the casing 1.

The depth of chambers 11 is larger than the diameter of the ring-shaped contact elements 6, which diameter is slightly larger than the distance between pins 2 and the side walls 4 or 5 of the casing, as the case may be located at the greatest distance from said pins. The contact elements 6 are squeezed between said pins and said wall.

As pins 2 are located in bottom 3 in a staggered relationship also contact elements 6 are correspondingly located with respect to the imaginary center surface in the longitudinal direction of the holder and the groove between walls 4 and 5 of the casing.

Consequently contact elements 6 are alternatedly displaced to the right or the left, seen in longitudinal direction of the holder, such that above channels 15 in the holder in the chambers there is space for admitting pins 2 in chambers 11. Contact elements 6 then on the one side rest against pin portions 2, which extend into the chambers, and on the other side against one of the side walls 4 and 5 of the casing 1. By the staggered lay out of the pins in the groove of the casing and the corresponding staggered position of the contact elements 6 in the chambers 11 a mechanically balanced loading is obtained.

At the outer ends, casing 1 has been provided with locking devices 16, of which only one is shown in Figure 1. Said locking devices resiliently grip behind a particular surface of the holder 8 when it is entirely slid into the groove of casing 1 and prevents the holder from falling out or accidentally pulling out.

In Figure 1 this is the upper surface of the holder but said surface may also be formed by a shoulder of a recess in the end wall of said holder.

Figure 2 shows a modified embodiment of the connector of the present invention. Insofar as it relates to the same portions the same reference numbers are used as in Figure 1. The position of the various exploded parts correspond to that of Figure 1.

Again the casing 1 consists of a bottom 3 and upright side walls 4 and 5. The bottom is penetrated by straight pins 2. The pins 2 are of a circular cross section and are not bent towards one of the walls as in Figure 1 within the groove between the side walls 4 and 5. Also slots 7 in walls 4 and 5 are not present. As in Figure 1 also here pins 2 preferably show a progressively increasing spring action into the insertion direction of the contact elements, for instance by increasing the pins' cross section towards bottom 3.

Because in this embodiment different contact elements 17 are used, also chambers 11 in holder 8 are different. These chambers now also accomodate the cable ends in a close-fit. The staggered position of pins 2 and contact elements 6 in holder 8 is maintained.

The contact elements 17 consist of a U-shaped bent metal strip, both legs of which are manufactured as fork-shaped insulation piercing contacts with legs 18, 19 and 20, as far as these are shown in Figure 2. Contact element 17 has been provided with a contact surface 21, which may consist of an outwardly deformation in the wall portion of the strip. Said strip further has been provided with stand offs 38 at the edge, which fit in recesses in holder 8 by means of which said contact elements 17 are fixed in chambers 11 of holder 8. In the same manner as shown by Figure 1 contact with the cable is obtained at 2 x 2 locations.

In contrast with the holder 8 of Figure 1 the chambers or recesses 11 of Figure 2 do not entirely run through the holder. However, the chamber walls do support the contact elements 17 and the cables 9 at all sides. The fork legs 18, 19 and 20 slidingly fit in transverse slots 22 and 23 in the holder. Beveled edge 13 and channel 12 are used for sliding in and receiving cable 9. Ribs 14 are used to squeeze the cable 9.

During manufacture preferably the cable first will be fed into channel 12 and recess 11. Subsequently the contact element 17 is slid onto the cable, whereby by means of the edges of legs 18, 19 and 20 the cable sheath insulation is cut and contact is made with the cable core.

As a matter of course in this embodiment channel 15 for pins 2 is made deeper, seen in the width direction of holder 8, because said pins are located further away from the adjacent side wall than in the embodiment of Figure 1. To the left of centre of holder 8 a contact element 17 has been shown being slid into position. Pin 2 slides through channel 15 along the contact surface 21 of contact element 17 and bends a bit into the direction of adjacent side wall 4 of casing 1.

Also in this embodiment latch 16 prevents the inserted holder 8 from being pulled out accidentally from the casing groove 34.

The embodiment of Figure 3 mainly corresponds with the one of Figure 2 with the exception that a contact element 24 of different construction has been used.
The further portions are indicated with similar reference numerals.

Contact element 24 is made of a strip one end of which being transversely bent and forming a forklike insulation piercing contact with two fork legs from which one has been indicated at 25. The other end of said strip is formed as a cable sheath clamp 26 which when assembling contact element 24 is wrapped around the cable 9 and serves as a strain relief.

The position of the contact elements 24 in holder 8 corresponds with the position in Figure 2. They are placed alternatedly from one of the sides of holder 8 in chambers 11. The contact surface 21 is formed by a portion of the contact element by outward deformation of the contact strip.

Because of the cable clamp 26 of contact element 24 the ribs in chamber 11 and channel 12 of holder 8 may be omitted. There is also only one transverse slot 23 taking up the contact and supporting it with fork leg 25.

The casing 1 has been provided at the ends with locking devices 16 for keeping the holder 8 in the groove.

In Figure 4 a connector according to the present invention

has been shown by means of which two printed circuit boards can be interconnected electrically. Similar portions are indicated with the same reference numbers as in Figures 1, 2 and 3.

The casing 1 consists of a bottom 3 and side walls 4 and 5. Pins 2 extend through the bottom and are of square cross section and run parallel to the adjacent wall surface. Here the outer ends of the casing are closed because locking devices can be omitted.

Contact elements 27 and holder 8 are of different shape and serve to establish an electrical connection between conductors on the one printed circuit board, in Figure 4 schematically indicated at the right side at 28, with conductors on the printed circuit board which may be connected with pins 2 in casing 1. The contact elements 27 may consist of a punched plate to which, for instance, pins 29 are formed integrally, fitting in holes 30 in the printed circuit board 28. Furthermore each contact element is provided with locking cams 31 for securing contact elements 27 in groove-shaped chambers 36 in holder 8, in which the contact elementsfit exactly. At the bottom sides the contact elements 27 at both sides are provided with integrally formed contact cams 32 and 33. The side edges at the bottom side of the contact elements 27 extend along the edges of channels 15 which may accept pins 2 when holder 8 is slid in the groove 34 in chamber 1. In this manner pins 2 come into contact with contact cams 32 and 33 respectively according to the staggered position of the pins in casing 1 and the corresponding channels 15 in holder 8.

Because the openings 30 in the printed circuit board 28 are fabricated in a staggered configuration, pins 29 have to project alternatively higher and lower out of the grooves 13 from the side wall of holder 8. Contact cams 32 and 33 are integrally formed at a different height at opposite edges in order to contact each pin 2 at the same height. It is advantageous to contact each pin at the same height to obtain an equal deflection of the pins 2 in the groove 34 in casing 1.

It is obvious that the invention has not been limited to the shown and described embodiments, but that additions and alterations are possible without departing from the scope of the invention.

- claims -

C L A I M S

1. Connector for a printed circuit board, comprising a casing of insulating material with a contact groove between mainly parallel upright side walls said groove being open at the upper side for accepting contact elements, and a bottom interconnecting the side walls, said bottom being penetrated by contact members, the portions of which laying within the contact groove may contact contact elements to be inserted in the groove and extend next to but spaced apart from one of the upright side walls, and the portions of which extending through the bottom to the exterior of the casing may contact conductors on the printed circuit board, c h a r a c t e r i z e d i n that the contact members consist of resilient pins, which pins cooperate with non-resilient movable contact elements, which are slid and squeezed between a cooperating pin and the other opposite upright side wall furthest from said pin.

2. Connector as claimed in claim 1, c h a r a c t e r i z e d i n that the contact elements are located in a holder, which can be slid into the contact groove up to between the pins and the other upright side wall, said holder in this area being provided with recesses for taking up the contact elements.

3. Connector as claimed in claim 1 or 2, c h a r a c t e r i z e d i n that the pins are arranged in the contact groove in mutually staggered relationship such, that seen in the longitudinal direction of the contact groove the successive pins each are positioned next to the other of the two upright side walls of the contact groove.

4. Connector as claimed in claims 1, 2 or 3, c h a r a c t e r i z e d i n that the pins consist of rigid pin material and preferably have a progressive spring action seen in the insertion direction of the contact elements into the groove.

5. Connector as claimed in claim 4, c h a r a c t e r i z e d i n that the pins are of a square cross section.

6. Connector as claimed in claim 4, c h a r a c t e r i z e d i n that the pins are of a circular cross section.

7. Connector as claimed in at least one of the foregoing claims, c h a r a c t e r i z e d i n that the ends of the pins

extending in the groove have been bent through in the direction towards the adjacent upright side wall.

8. Connector as claimed in at least one of the foregoing claims, c h a r a c t e r i z e d i n that the distance between the pins and the adjacent upright side wall is such, that upon cooperation with a contact element these pins do not bend as far as the side walls.

9. Connector as claimed in at least one of the foregoing claims, c h a r a c t e r i z e d i n that slots are provided in the upright side walls of the contact groove opposite to and parallel with each adjacent pin, which groove can accomodate a bent through pin.

10. Connector as claimed in claim 2, c h a r a c t e r i z e d i n that the holder is mainly of the same dimensions as the contact groove between the upwright side walls and the bottom of the casing and slidingly fits within this contact groove, said holder comprises at the position of the pins in the casing channels for accomodating these pins, which channels merge into recesses for accomodating the contact elements.

11. Connector as claimed in claim 10, c h a r a c t e r i z e d i n that the recesses in the holder extend completely through the width of the holder transversely to the sliding-in direction within the contact groove.

12. Connector as claimed in claim 10, c h a r a c t e r i z e d i n that the recesses in the holder are closed at alternative side walls of the holder, seen in the longitudinal direction of the holder, opposite to the merged positions of the channels for the pins in the recesses.

13. Connector as claimed in claim 10, c h a r a c t e r i z e d i n that further holder channels are provided for accomodating the connecting cables which are connected to the contact elements in the recesses, said further channels extending from said recesses opposite to the channels for accomodating the pins.

14. Connector as claimed in one of the foregoing claims, c h a r a c t e r i z e d i n that the ends of the casing are provided with resilient locking devices, gripping behind a shoulder of the holder when this holder is entirely slid into the groove of the casing.

15. Connector as claimed in one of the foregoing claims, c h a r a c t e r i z e d i n that the contact elements consist of non-resilient open ring-shaped clamps, the opposite open ends of which are provided with bifurcated core insulation piercing contacts.

16. Connector as claimed in at least one of the foregoing claims, c h a r a c t e r i z e d i n that the contact elements consist of a U-shaped terminal, the legs of which comprise bifurcated core insulation piercing contacts, the portion interconnecting said legs being provided with a contact surface for the pins.

17. Connector as claimed in at least one of the foregoing claims, c h a r a c t e r i z e d i n that the contact elements consist of an electrically conductive strip, one end of which has been bent for constituting a bifurcated core insulation piercing contact, the other end constituting a cable sheath clamp.

18. Connector as claimed in at least one of claims 1 through 14, c h a r a c t e r i z e d i n that each contact element consists of a solid, electrically conducting oblong and flat member, which is provided at one end with transversely extending integrally formed pins, which can be connected in holes in a printed circuit board and that the recesses for these contact elements in the holder consist of narrow slots, extending between mainly closed side walls of the holder and from the upper side of the holder in the insertion direction in the contact groove to the bottom of the contact groove, said holder having channels in alternative side walls for accomodating the pins mounted in the bottom of the casing and channels for leading pins out of the holder, said pins projecting transversely out of the holder at the upper side of the holder.

19. Connector as claimed in claim 18, c h a r a c t e r i z e d i n that the contact elements have integrally formed cams at both side edges of the contact elements opposite to the ends comprising the transverse integrally formed pins.

20. Connector as claimed in claim 19, c h a r a c t e r i z e d i n that each side edge comprises one contact cam and that the contact cams at one contact element are formed at a different

height, the arrangement being such that upon sliding in the contact elements a different depth in the holder, the contact cams remain at the same height above the bottom of the casing with respect to the pins in the casing.

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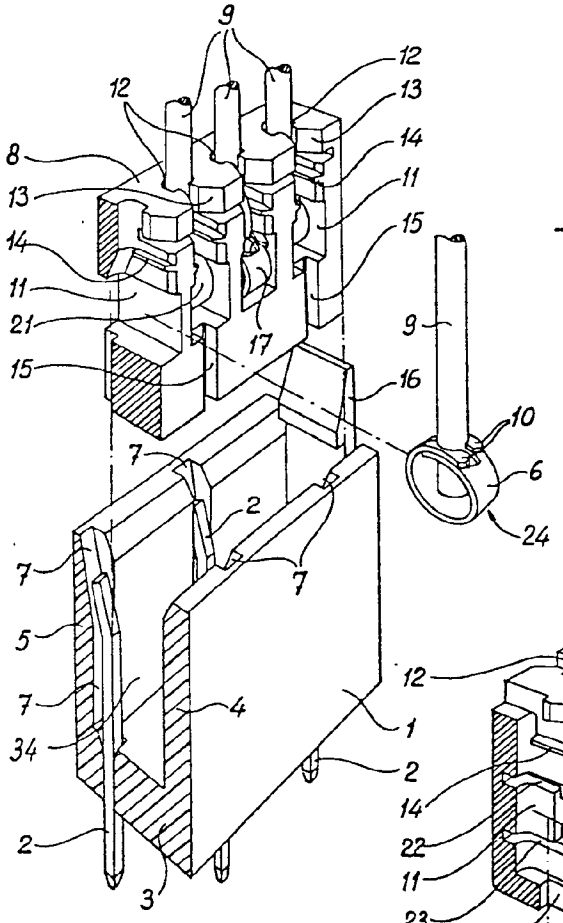
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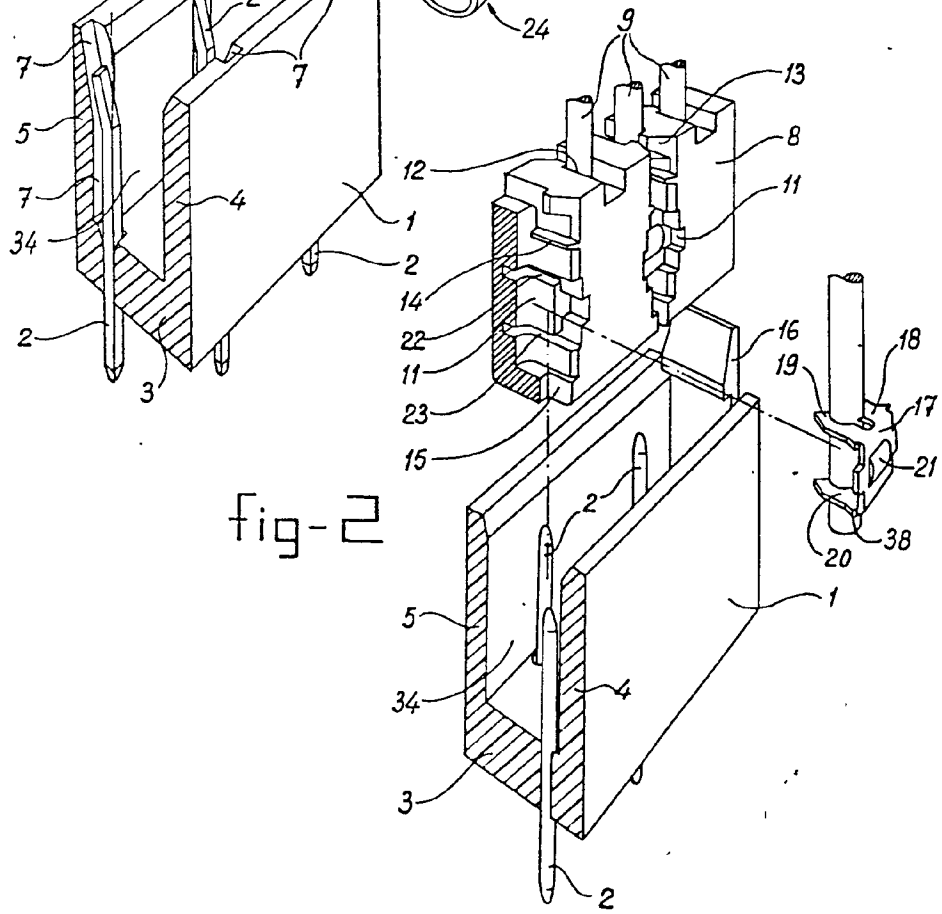
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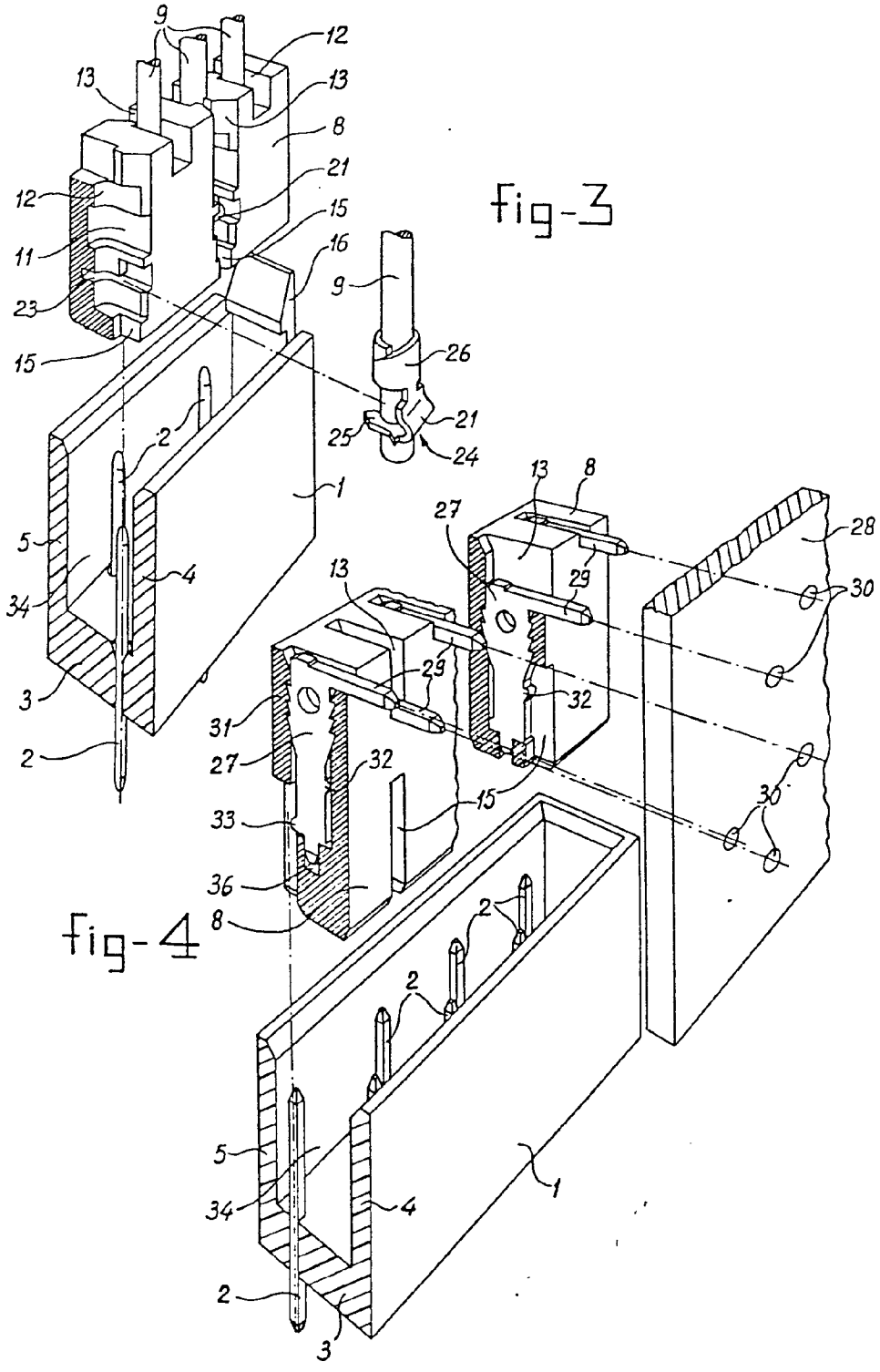
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Fig-3

Fig-4

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 20 [illegible]

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 3 107 961 (AMP) * column 3, lines 45-64; figures *	1,8
A	US - A - 3 697 926 (MOLEX) * column 3, lines 19-30; figures *	1,5
A	US - A - 3 569 790 (SIEMENS) * column 2, lines 13-36; figure 1 *	1
A	GB - A - 782 103 (HENRY & THOMAS) * page 2, lines 75-97; figures *	18
A	US - A - 4 002 392 (WESTERN ELECTRIC) * figure 13 *	18
A	US - A - 3 835 445 (WESTERN ELECTRIC) * figure 5 *	18
A	FR - A - 1 291 006 (AMP) * page 1, last 2 paragraphs; page 2, left-hand column, paragraph 5 *	

CLASSIFICATION OF THE APPLICATION (Int Cl.³)

H 01 R 13/26

TECHNICAL FIELDS SEARCHED (Int Cl.³)

H 01 R 13/04
13/05
13/26
13/33
23/02
23/68
23/70
23/72

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

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☒ The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15.01.1981	RAMBOER

EPO Form 1503.1 06.78