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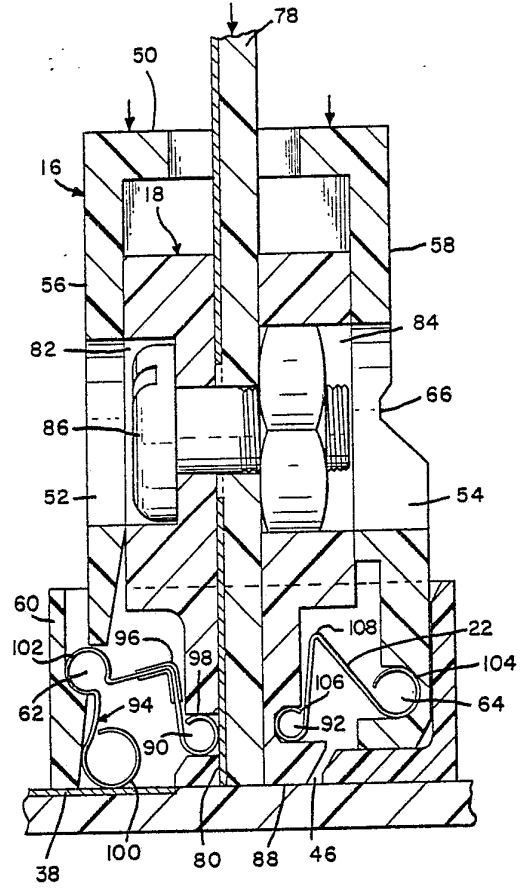
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(54) Title: CONNECTOR ASSEMBLY FOR MOUNTING A MODULE ON A CIRCUIT BOARD OR THE LIKE

(57) Abstract

A connector (10) for mounting a module (78) on a circuit board (36), includes a circuit board mounted header (12) at least partially enclosing an area of contact pads (38) and a plug assembly (14) secured to the mating module (78) and receivable in the header (12). The plug assembly (14) includes an inner housing (18) directly attached to the module (78) and movable within an outer housing (16). At least one series of spring terminals (20) are mounted with a first portion (102) engaging the outer housing and a second portion (98) bearing against the module (78). Spring bias means (22) are mounted in the outer housing (16) bearing against the opposite side of the inner housing (18) from the terminals (20). Both the terminals (20) and the bias spring (22) are profile to assume either a rest condition, or an over centered contacting position. When the plug assembly (14) is initially mated into the header (12) there is no contact force but subsequent insertion force drives the terminals (20) and the bias spring (22) into an over centered condition with the former making good contact between the module (78) and the circuit board (36).



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CONNECTOR ASSEMBLY FOR MOUNTING A MODULE ON A
CIRCUIT BOARD OR THE LIKE

The present invention relates to a connector assembly for interconnecting a module with a circuit board, for example, a mother/daughter board interconnect, and in particular to a system which obviates the need for anything other than a simple mechanical interconnect.

5 There are many known connectors to mate a first circuit board with a second circuit board, commonly known as a mother/daughter board interconnect. The known connectors generally require a header on the mother board and a plug on the daughter board with at least one of the header and plug being soldered to their respective boards. Examples of
10 such connector systems can be found in U.S. Patent Nos. 3,413,594; 3,651,444; and 3,966,290. These known systems have disadvantages, one being the cost of running the connector through a soldering operation. The need for such a soldering operation necessarily increases the manufacturing cost plus adds the possibility of damage to the connector
15 system either by the solder itself or by the heat of the soldering operation.

The present electrical connector effects mother/daughter circuit board interconnection and comprises a header member mounted on the mother circuit board to define a central cavity at least partially enclosing a plurality of contact pads on the mother circuit board, and a plug assembly
20 mounted on the daughter board. The plug assembly is formed by an outer housing defining a cavity and an inner housing mounted on the daughter board and movable within the outer housing. An array of spring terminals are mounted between the outer housing and at least one side of the daughter circuit board and at least one back-up spring member is mounted
25 between the inner and outer housings in opposition to the spring terminals.



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The connector is characterized by the configuration of the spring terminals each of which has an end portion profiled to make a wiping contact with the respective circuit board and a profiled center portion which produces an over centering snap action to bring the mother circuit board engaging end portion with engagement with the mother circuit board upon full mating of the connector.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is an exploded perspective view of the parts forming the subject connector;

FIGURE 2 is a perspective view of the plug portion of the present connector with a daughter circuit board exploded therefrom;

FIGURE 3 is a perspective view of the subject connector in a fully assembled and mated condition;

FIGURE 4 is a transverse vertical section through the connector of the present invention in an unmated condition;

FIGURE 5 is a section similar to Figure 4 showing the subject connector in an engaged and contacting condition;

FIGURE 6 is a detail view, partially in section, taken along line 7-7 of Figure 3 showing the subject connector in an unmated condition;

FIGURE 7 is a detail view similar to Figure 6 taken along line 7-7 of Figure 3 and showing an end portion of the subject connector in a mated condition;

FIGURE 8 is a transverse vertical section through an alternate embodiment of the subject invention in a mated but non-contacting condition; and

FIGURE 9 is a transverse vertical section through the alternate embodiment of Figure 8 in an engaged and contacting condition.

The subject connector 10 includes a header 12, and a plug assembly 14 formed by an outer housing 16 and inner housing 18, a spring terminal array 20, and a bias spring member 22.

The header 12 is an elongated member of rigid insulative material having at least one sidewall 24 and a pair of spaced end flanges 26, 28



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defining a central cavity 30. The end flanges 26, 28 each include means 32, 34 for mounting the header 12 on a mother circuit board 36 with the cavity 30 at least partially enclosing a plurality of contact pads 38 on the mother circuit board 36 (see Figure 4). The inner surfaces of the spaced end flanges 26, 28 each have a pair of profiled recesses 40, 42 (see Figures 4 and 6). The sidewall 24 can be provided with a strengthening flange 44 (see Figures 4 and 6).

The plug assembly 14 has an outer housing 16 which defines a cavity 46 extending from a mating face 48 to a rear surface 50. The outer housing 16 also includes at least one aligned pair of access apertures 52, 54 in spaced side walls 56, 58. The wall 56 has a strap portion 60 forming an inwardly directed terminal receiving slot 62. The wall 58 has an inwardly directed spring receiving groove 64 and an outwardly directed flexure groove 66. The end walls 68, 70 each have outwardly directed profiles 72, 74 aligned to be received in the recesses 40, 42, respectively of the header 12. The inner housing 18 is profiled to be received in the cavity 46 and has a central elongated slot 76 for receiving therein an edge portion of a daughter circuit board 78 having contact pads 80 thereon. The inner housing 18 also includes at least one pair of spaced aligned profiled apertures 82, 84 which receive mounting means 86 to secure the daughter circuit board 78 to the inner housing 18. The apertures 82, 84 are spaced to be positioned in alignment with apertures 52, 54 of the outer housing 16 to allow insertion of mounting means 86. The leading end 88 of the inner housing 18 is profiled to have a slot 90 opening above the pads 80 and have an oppositely directed groove 92 spaced from the leading end 88. Both the outer and inner housings 16, 18 are preferably formed from rigid insulative material.

The spring terminal array 20 is preferably formed in accordance with the disclosures of U.S.A. Patent Nos. 4,028,794 and 4,245,876. The terminal array 20 has a plurality of individual spring terminals 94 held in spaced alignment by at least one continuous web of insulative material 96 secured to each terminal. Each terminal 94 has a first curled end 98 adopted to be received in the slot 90 engaging pad 80 of the daughter



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circuit board 78 and a second curled end 100 adapted to make engagement with a pad 38 of mother circuit board 36. The intermediate portion 102 of each terminal 94 is profiled to be received in slot 62.

5 The back-up or bias spring 22 is a continuous elongated member of spring material having a first curled end 104 profiled to be received in the groove 64 of outer housing 16. The opposite curled end 106 of the spring 22 is profiled to be received in the groove 92 of inner housing 18. The spring 22 also has a formed intermediate portion 108.

10 The subject connector is assembled by first mounting the header 12 on the mother circuit board 36 with mounting means 34, 36 in a known fashion. As previously stated, the central cavity 30 of the header will enclose pads 38 of the mother circuit board 36.

15 The plug assembly 14 is attached to the daughter circuit board 78. The inner housing 18 is inserted to the cavity 46 of the outer housing 16 and the terminal array 20 inserted in one side of the assembly between the two housings. The back-up spring 22 is inserted opposite the terminal array between the two housings. It will be seen that the engagement of the respective ends 98 and intermediate portions 102 of the terminal array 20 and ends 104, 106 of the back-up spring 22 into the grooves 90, 62 and
20 recesses 64, 92 of the housing members 16, 18 will hold them in an assembled condition. The daughter board 78 is inserted into the slot 76 of the inner housing 18 and the fastening means 86 are applied through the respective apertures 52, 82, 84, 54 to secure the board 78 to the inner housing 18. The assembly will now be in the condition as shown in Figure
25 4.

30 Mating of the subject connector is accomplished by first applying the plug assembly 14 to the header 12 as shown in Figures 4 and 5. During this movement there will be relatively little initial insertion force required as only a sliding interfit of the outer housing 16 with the header 12 will be noted. Continued insertion force applied to the circuit board 78 will drive the leading end 88 of the inner housing 18 against the mother circuit board 36 with the relative movement between the inner and outer housings 18, 16 causing over-centering of the contact array 20 and the back-up spring 22



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as shown. The intermediate portions 102 of the terminals 94 and portion 108 of the back-up spring 22 are formed to allow this over-centering action while strip 60 and groove 66 provide the necessary flexure in the outer housing 16 to accomplish this action.

5 It will be noted from Figures 6 and 7 that as the outer housing member 16 is inserted fully into the header 12 that the profiled ends 72, 74 of the housing 16 engage in the recesses 40, 42 of the header 12 to lock the plug assembly 14 and header 12 together. This ultimate mating will cause an audible and tactile indication of full mating of the connector 10.

10 Figures 8 and 9 show an alternate embodiment of the subject invention which is designed for use with two-sided daughter boards. In this case the mother circuit board 110 has first and second pads 112, 114 enclosed by header 116 defining a cavity 118 over the pads. The header 116 is secured to the circuit board 110 by conventional means (not shown). The plug
15 assembly 120 has an outer housing 122 profiled to be received within cavity 118. The outer housing 122 defines a cavity 124 which slidably receives inner housing 126 therein. The inner housing 126 has an elongated slot 128 which receives daughter circuit board 130 therein. The daughter circuit board 130 has first and second circuitry 132, 134 on the opposite sides
20 thereof. The outer housing 122 and inner housing 126 are provided with at least one set of apertures 136, 138, 140, 142, aligned to receive fastening means 144 to secure the daughter board 130 to the inner housing 126. First and second spring terminal arrays 146, 148 are mounted between slots 150, 152 of the outer housing 122 and respective circuits 132, 134 of the
25 daughter circuit board 130. These terminal arrays are formed in the manner of terminal array 20.

The assembly of this embodiment is substantially the same as with the first embodiment and therefore need not be repeated. The operation is also substantially the same. The plug assembly 120 is inserted into the header
30 116, as shown in Figure 8, with little insertion force being required and no interconnection being effected. The daughter circuit board 130 and inner housing 126 are then driven into abutment with mother circuit board 110, as shown in Figure 9. This additional movement causes over-centering of



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terminal arrays 146, 148 bringing them into the interconnect position of Figure 9 engaging both the pads of the mother circuit board and the daughter circuit board. It should also be noted, from Figure 9, that the terminal arrays 146, 148 can project from slots 150, 152 to engage in recesses 154, 156 to hold and lock the plug assembly 120 into the header 116. This will also give the previously discussed audible and tactile indication of full mating.

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CLAIMS:

1. An electrical connector for effecting mother/daughter circuit board interconnections comprising a header member mounted on a mother circuit board, said header member having a central cavity at least partially enclosing a plurality of contact pads on said mother circuit board and a plug assembly mounted on a daughter circuit board, said plug assembly comprising an outer housing defining a cavity, an inner housing slidably received in said cavity, means for attaching said daughter circuit board to said inner housing, a spring terminal array mounted between said outer housing and said daughter circuit board, and at least one back-up spring member mounted between said inner and outer housings in opposition to said spring terminal array, characterized by each said spring terminal first and second contacting portions profiled to engage respective circuit boards and an intermediate portion formed to give over center action whereby relative movement of said inner housing with respect to said outer housing, after initial engagement of said plug assembly into said header, causes said terminal array to engage with said mother circuit board to interconnect said mother and said daughter circuit boards.

2. An electrical connector system according to claim 1 characterized in that said array of spring terminals comprises a web of insulative material, and a plurality of individual spring terminals each mounted on said web in fixed, spaced fashion, each said terminal having a mounting portion adapted to engage in said outer housing.

3. An electrical connector system according to claim 2 characterized by said mounting portion of each said terminal lies intermediate the ends thereof and said first and said second contacting portions are at said opposite ends.

4. An electrical connector system according to claim 1 characterized by latching means on said outer housing and corresponding latching means on said header member, said latching means engaging upon mating of said plug assembly into said header member to hold them in the mated condition.

5. An electrical connector system according to claim 1 characterized by relative movement of said inner housing with respect to said outer



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housing causes said spring terminal array to move from a first position contacting only the pads of said daughter circuit board to a second position contacting the pads of both said mother and said daughter circuit boards.

5 6. An electrical connector system according to claim 1 characterized
by said back-up spring member comprising a second array of spring
terminals mounted between the opposite side of said daughter circuit board
and an adjacent portion of said outer housing, whereby double sided
daughter circuit boards can be interconnected with a mother circuit board.

10 7. An electrical connector system according to claim 1 characterized
by said inner and said outer housings having limited flexibility to
accommodate the necessary movement of said terminal array to effect
interconnection.



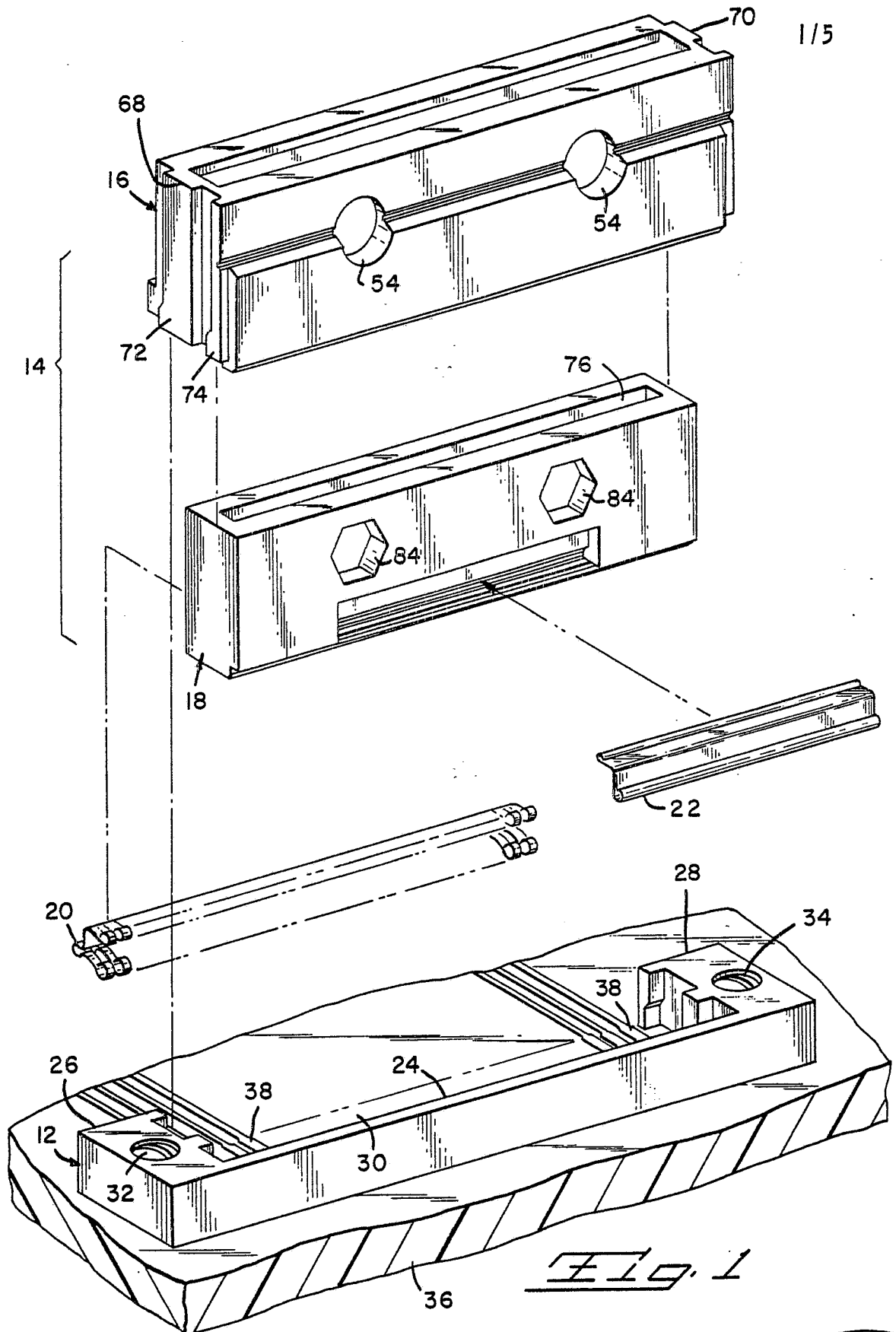


Fig. 1

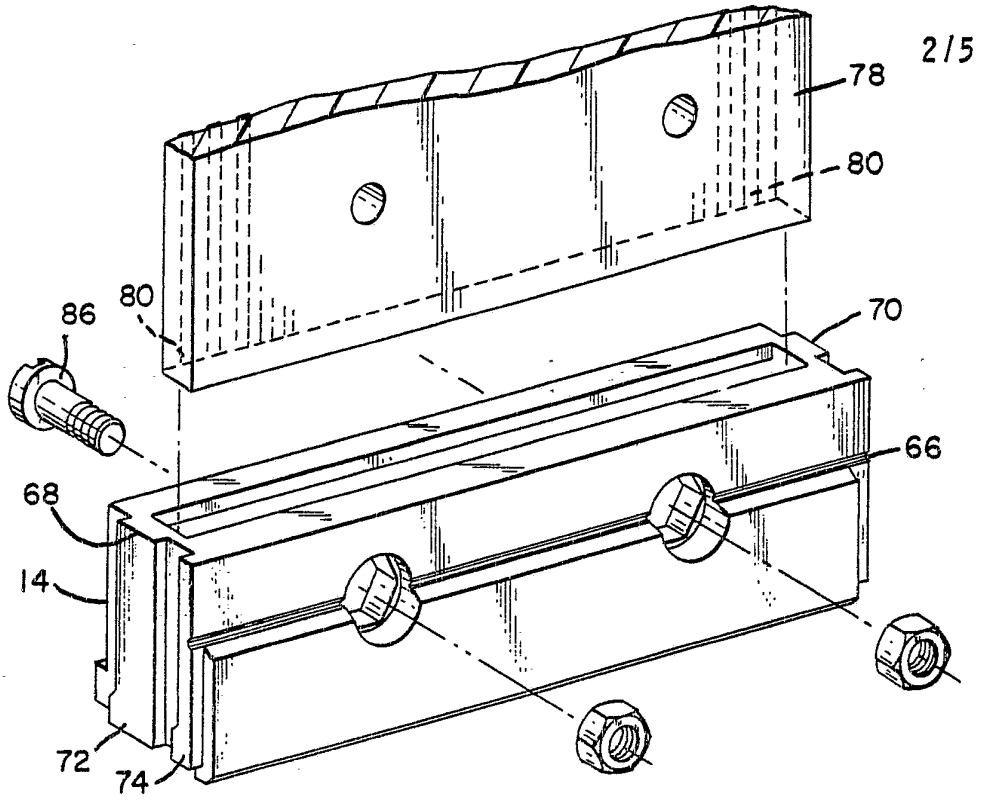


Fig. 2

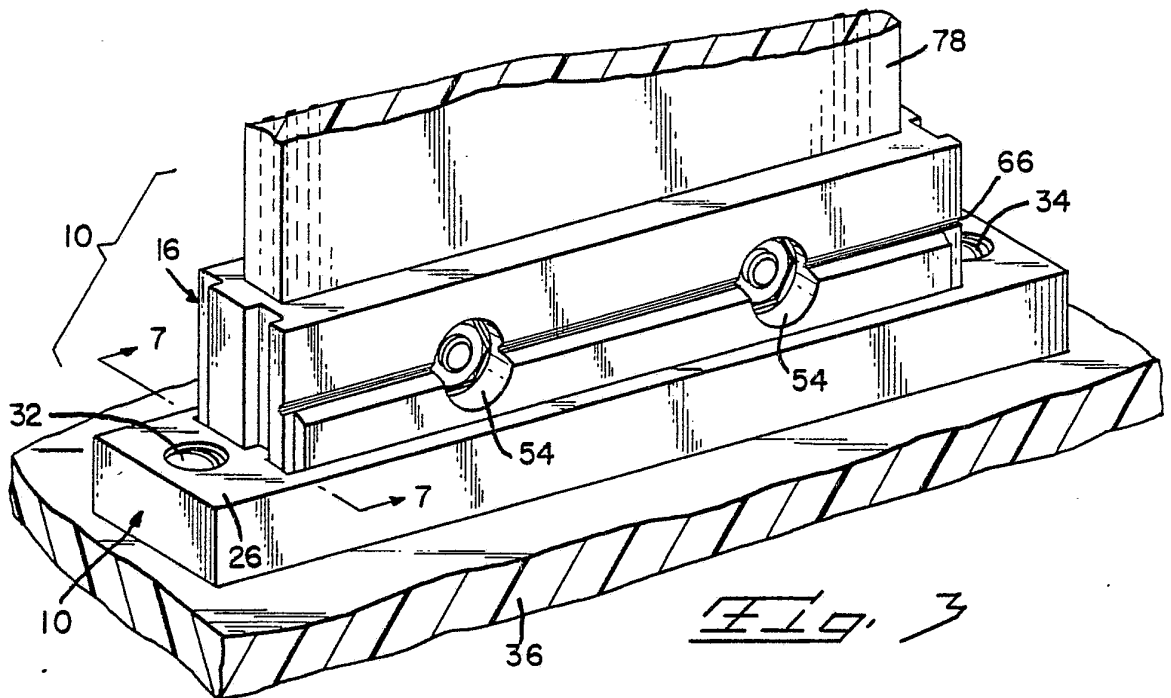
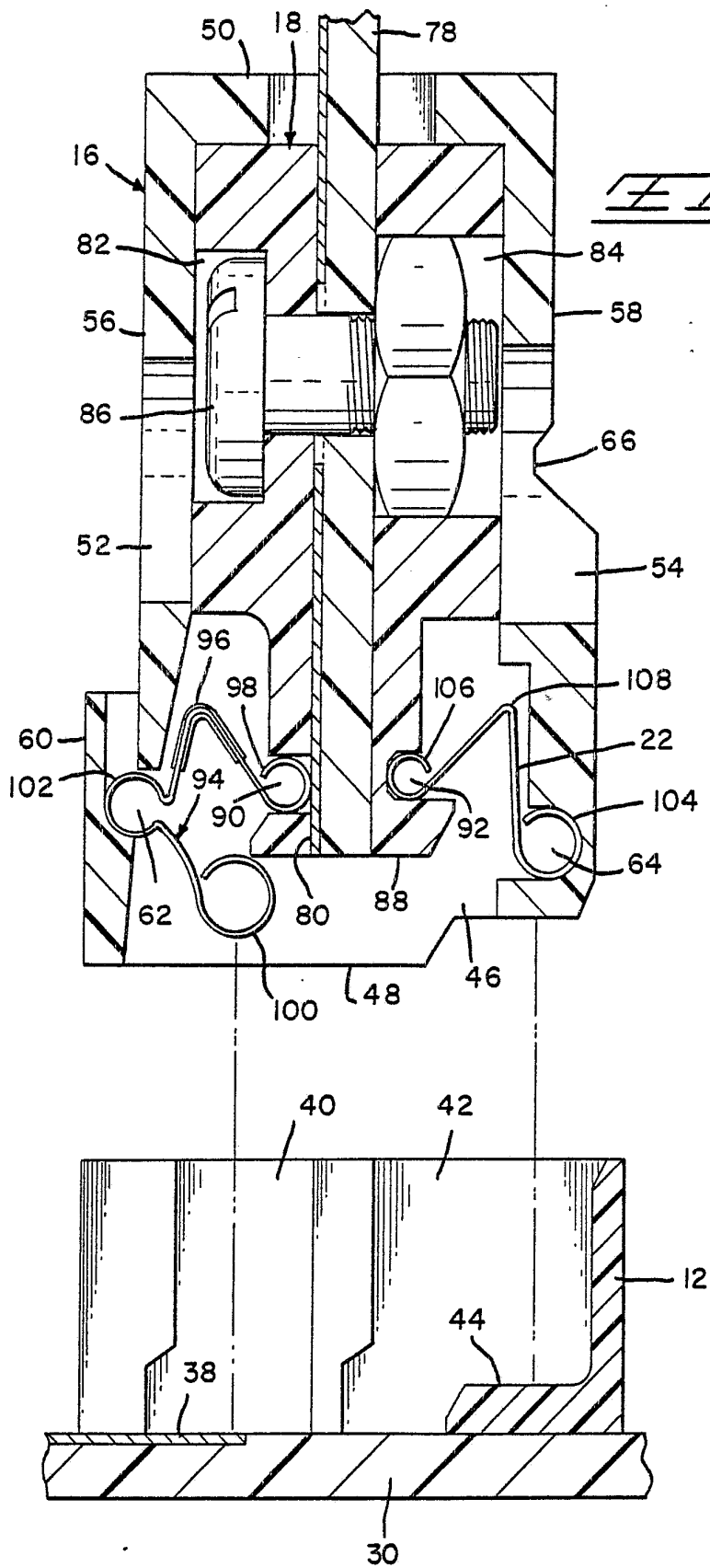
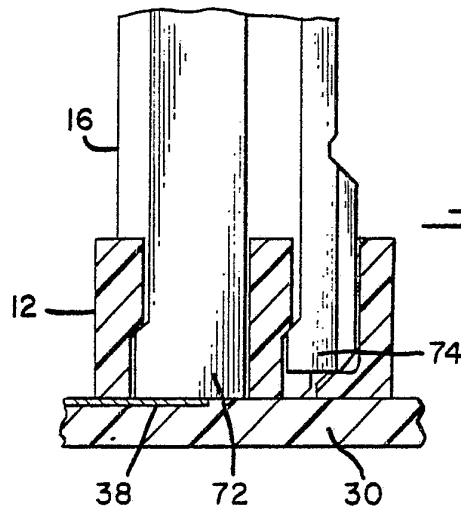
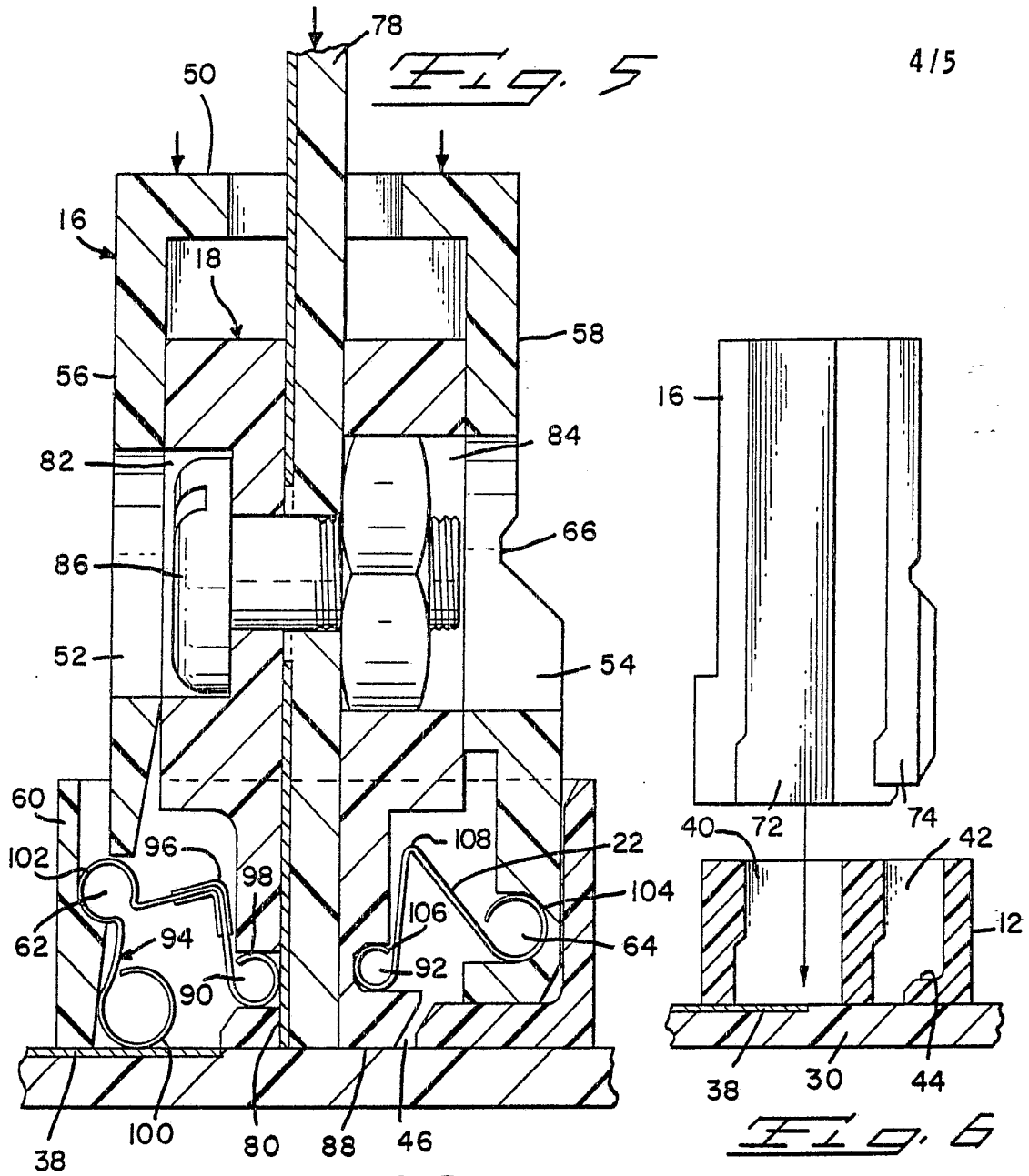
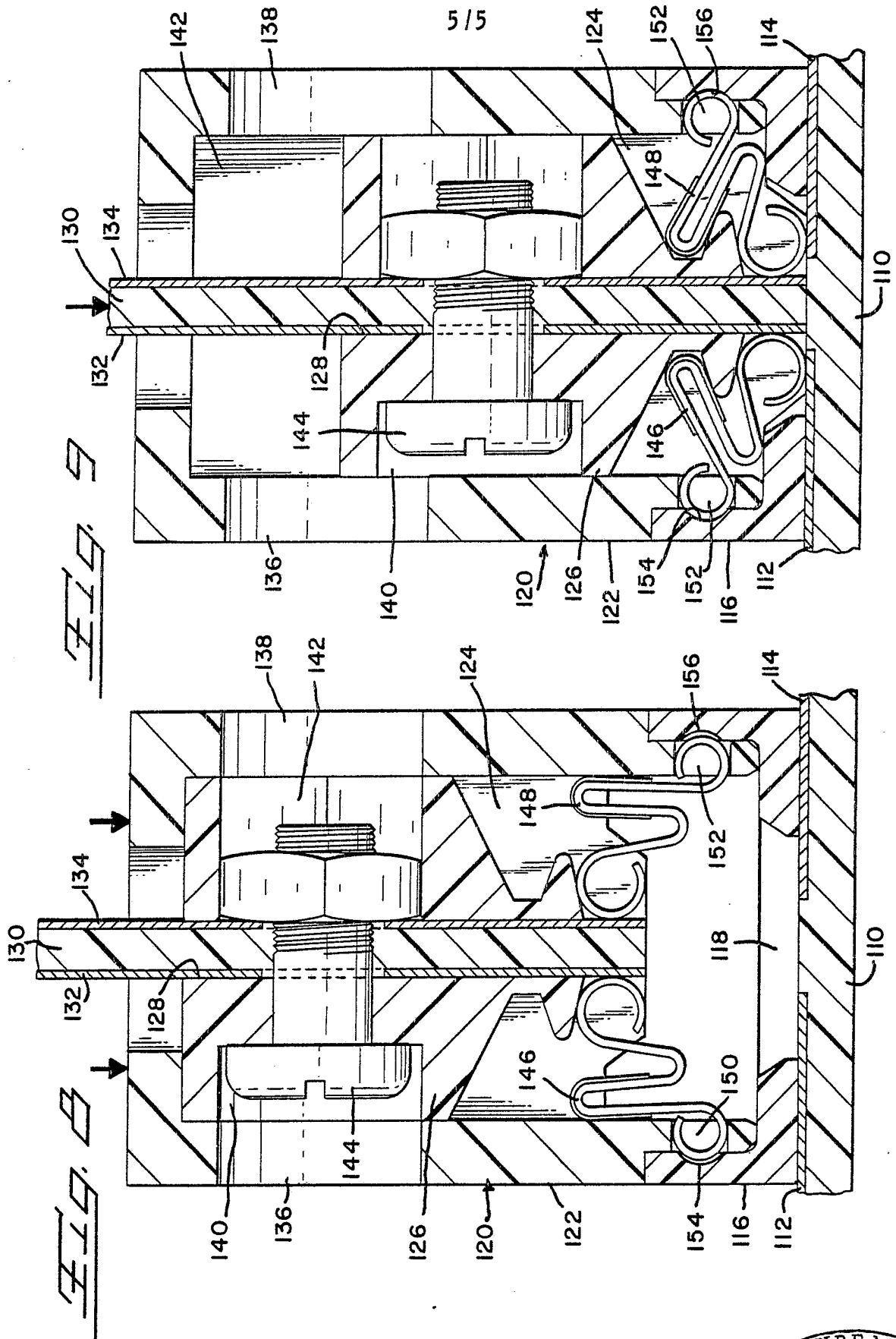


Fig. 3

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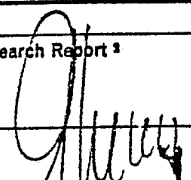






INTERNATIONAL SEARCH REPORT

International Application No PCT/US 83/00237

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|--|--|-------------------------------------|--|--|
| I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ³ | | | | |
| According to International Patent Classification (IPC) or to both National Classification and IPC | | | | |
| IPC ³ : H 01 R 23/68 | | | | |
| II. FIELDS SEARCHED | | | | |
| Minimum Documentation Searched ⁴ | | | | |
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| III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ | | | | |
| Category [*] | Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷ | Relevant to Claim No. ¹⁸ | | |
| A | US, A, 3215968 (A. HERRMANN) 2 November 1965 see figures -- | 1 | | |
| A | DE, A, 1948925 (BULL-GENERAL ELECTRIC) 21 May 1970 see figures -- | 1,2 | | |
| A | GB, A, 1490041 (AMP) 26 October 1977 see figures -- | 1,2 | | |
| A | GB, A, 1359671 (FERRANTI) 10 July 1974 see figures -- | 1 | | |
| A | FR, A, 2230150 (SOCAPEX) 13 December 1974 see figures ----- | 1,4 | | |
| <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> [*] Special categories of cited documents: ¹⁵ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "Z" document member of the same patent family </td> </tr> </table> | | | <ul style="list-style-type: none"> [*] Special categories of cited documents: ¹⁵ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed | <ul style="list-style-type: none"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "Z" document member of the same patent family |
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| IV. CERTIFICATION | | | | |
| Date of the Actual Completion of the International Search ¹ | Date of Mailing of this International Search Report ² | | | |
| 28th October 1983 | 29 NOV. 1983 | | | |
| International Searching Authority ¹ | Signature of Authorized Officer ³⁰ | | | |
| EUROPEAN PATENT OFFICE |  G.L.M. Kruidenberg | | | |

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/US 83/00237 (SA 4972)

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| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|--|------------------|---|--|
| US-A- 3215968 | | None | |
| DE-A- 1948925 | 21/05/70 | GB-A- 1233853 FR-A- 1604372 US-A- 3609463 BE-A- 739084 | 03/06/71 08/11/71 28/09/71 02/03/70 |
| GB-A- 1490041 | 26/10/77 | None | |
| GB-A- 1359671 | 10/07/74 | None | |
| FR-A- 2230150 | 13/12/74 | DE-A- 2423266 GB-A- 1466727 | 05/12/74 09/03/77 |

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