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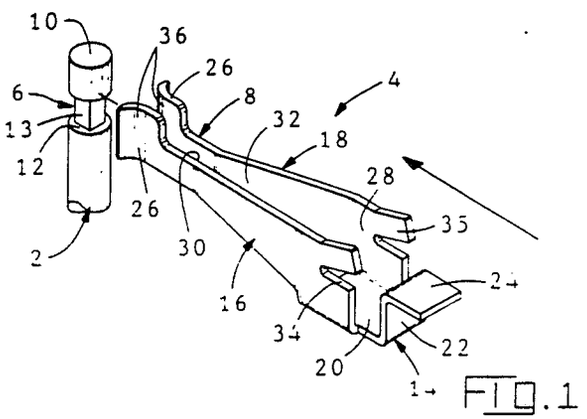
(54) Low wear contact system.

(57) A low wear contact system, which allow for numerous insertions and withdrawals, comprises a female terminal (4) which has resilient members (16,18) having contact sections (30) provided proximate an end thereof. Wing means (36) are provided at the free end of the resilient members (16,18), such that as the terminal (4) is mated with the matable terminal (2), the wing means cooperate with the terminal (2) to force the resilient members to move apart. This motion insures that contact sections (30) of the resilient members will not slidably engage the contact areas of the matable terminal (2) as insertion occurs, thereby insuring that only minimal wear is effected on the contact areas of the terminals.



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LOW WEAR CONTACT SYSTEM

The invention is directed to an electrical contact system which allows for many insertions and withdrawals of a first electrical contact with respect to a second electrical contact. The electrical contact system is configured such that as the first electrical contact is inserted and withdrawn from the second electrical contact, only minimal wear occurs on the surfaces of the contact areas of the contacts.

In this age of pluggable computers, pluggable power supplies, and the like, it is important to provide an electrical contact system having electrical contacts which can be inserted and withdrawn many times without causing wear to the contact areas of the contacts. It is also essential to provide a system which is relatively inexpensive and reliable.

U.S. Patent Numbers 3,836,947 and 4,030,804 are representative of what is available in the market place today. Both of these connectors are directed to a system in which the male terminal is plugged into the female terminal. As the insertion occurs, the contact section of the female terminal engages the contact surface of the male terminal. This results in the contact sections of the male terminal being slidably engaged with the contact section of the female terminal, This sliding engagement of the surfaces of the contact sections results in wear of the surface of the contact sections. This wear also results during withdrawal of the male terminal from the female terminal. As the insertion and withdrawal are repeated many times, the wear of the surfaces of the contact sections become significant, which could result in the contacts not being placed in electrical engagement as insertion occurs. This problem is magnified due to the plating of the surfaces of the contact sections. As the surfaces are slid across each other, the plating is quickly worn away. Consequently, if the electrical characteristics of the contact section are to be enhanced by plating, the plating material must be placed on the contact sections in thick layers in order to withstand the sliding engagement.

As described in U.S. Patent Number 4,514,032, less noble plating; e.g. tin, wears away quickly under sliding motion, including such motion induced by thermal expansion and contraction, and the resulting fretting corrosion causes reduced electrical contact between the abutting surfaces. Accordingly, such plating, although relatively inexpensive, is unacceptable for many contact surface which are slid across each other during insertion. Therefore, a plating material such as gold is required on the contact surfaces of the contact sections. The gold plating provides a tough surface capable of withstanding sliding motion between the two abutting surfaces. However, even a plating material such as gold must be thick in order to withstand a great number of insertions and withdraws, without showing signs of wear.

Consequently, if the terminals are to be inserted and withdrawn frequently, a thick layer of plating material must be used in order to insure that a reliable electrical connection will be made with each insertion. If a thick layer of plating material is to be applied, the price of the plating becomes significant with respect to the overall cost of the terminal. This is an unsatisfactory result.

In an attempt to reduce wear of the contact sections and provide a low insertion force connector, many low or zero insertion force connectors have been devised. These connectors generally required the use of some type of camming mechanism which when activated cams the terminals into engagement with mating terminals. This type of arrangement reduces wear. However, the use of a camming member is impractical and prohibitively expensive in many situations.

One type of low insertion connector which does not require a camming member is described in U.S. Patent 4,655,528. In this connector cantilever arms of the terminals are prestressed by ribs of the connector. However, the use of zero insertion force connectors described requires a housing member to cooperate with the terminals in order to provide the zero insertion force and low wear characteristics desired. This is not always practical, as individual terminals require low wear characteristics.

The invention is directed to an electrical terminal having a base plate which has resilient members extending therefrom. Each resilient member has a first major surface and an oppositely facing second major surface. A fixed end of each resilient members is adjacent the base plate and a free end of each resilient members has a contact sections provided proximate thereto. The contact sections are provided to cooperate with a matable electrical terminal.

The electrical terminal is characterized by wing means which are provided at the free end of the resilient members, adjacent the contact sections. The wing means extend at an angle from the contact section. The wing means are provided such that as the electrical terminal is mated with the matable electrical terminal, the wing means engage the matable terminal, causing the wing means to spread apart. This in turn causes the resilient members to spread apart. As insertion is continued, the wing means cooperates with the surface of

the matable electrical contact to prevent the first major surfaces of the contact sections from engaging contact surfaces of the matable terminal until the wing means are moved past the matable terminal. As the wing means are moved past the matable terminal, the resilient members are urged to resiliently return toward their undeformed position, causing the contact sections to engage the contact surfaces of the matable terminal, thereby placing the electrical terminal in electrical engagement with the matable terminal.

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

FIGURE 1 is a perspective view showing a female terminal of one embodiment of the present invention just prior to insertion onto a male terminal;

FIGURE 2 is a perspective view similar to that of Figure 1, showing wings of the female terminal in engagement with the male terminal;

FIGURE 3 is a perspective view similar to that of Figure 1, showing a contact section of the female terminal in engagement with a contact section of the male terminal;

FIGURE 4 is a perspective view of an alternative embodiment of the present invention, showing a female terminal just prior to insertion onto a male terminal;

FIGURE 5 is a perspective view similar to that of Figure 4, showing wings of the female terminal in engagement with the male terminal;

FIGURE 6 is a perspective view similar to that of Figure 4, showing a contact section of the female terminal in engagement with a contact section of the male terminal;

FIGURE 7 is a perspective view of a second alternative embodiment of the present invention, showing a female terminal just prior to insertion onto a male terminal;

FIGURE 8 is a perspective view similar to that of Figure 7, showing wings of the female terminal in engagement with the male terminal; and

FIGURE 9 is a perspective view similar to that of Figure 7, showing a contact section of the female terminal in engagement with a contact section of the male terminal.

Figures 1 through 3 show one embodiment of an electrical connection system which has a male terminal 2 and a female terminal 4. The system allows for many insertions and withdrawals of female terminal 4 from male terminal 2 with only minimal wear occurring at contact sections 6, 8 of terminals 2, 4 respectively.

Male terminal 2 has a cylindrical configuration, as shown in Figures 1 through 3. Proximate a top end 10 of male terminal 2 is a recessed section 12. Recessed section 12 has a rectangular cross section as viewed from top end 10. Opposed side surfaces 13 of recessed section 10 defines contact section 6 of male terminal 2. A bottom end (not shown) of terminal 2 is placed in electrical engagement with a circuit board or the like in a manner well known in the industry.

Female terminal 4 is stamped and formed from a piece of sheet metal having the desired resilient and electrical characteristics. Female terminal 4 has a base plate 14 and two resilient arms 16, 18. A support portion 20 of base plate 14 extends from one resilient arm 16 to the other resilient arm 18, thereby providing the support necessary to maintain resilient arms 16, 18 in position. A curved portion 22 of base plate 14 extends from support portion 20 outwardly. A mating portion 24 is provided at the end of curved portion 22 which is opposite support portion 20. Mating portion 24 is provide to allow a mating connector or the like to be placed in electrical engagement with female terminal 4.

Positioned on either side of support portion 20 of base plate 14 and integrally attached thereto, are resilient arms 16, 18. Resilient arms 16, 18 extend in a plane which is essentially perpendicular to the plane of support portion 20 of base plate 14. Resilient arms 16, 18 also extend from support portion 20 in the opposite direction as does mating portion 24. However, resilient arms 16, 18 are not parallel to each other. Free ends 26 of resilient arms 16, 18 are positioned closer to each other than the ends of resilient arms 16, 18 which are integrally attached to support portion 20. Resilient arms 16, 18 have wide sections which are positioned proximate to support portion 16 of base plate 14. Narrow contact sections 30 are provided on resilient arms 16, 18 proximate free ends 26 thereof. Gradual transition sections 32 are provided between wide sections 28 and narrow contact sections 30.

Slots 34 are provided in wide sections 28, proximate mating portion 24. Slots 34 are provided to cooperate with a mating connector (not shown). The mating connector is inserted onto mating portion 24 and maintained in position by the frictional engagement of the mating connector with surfaces of slots 34. It should be noted that the other mating connectors may be attached to mating portion 24 in any number of different ways.

Wing members 36 extend from narrow contact sections 30, in the opposite direction as wide sections 28. Wing members 36 are wider than narrow contact sections 30, and extend at an angle from narrow contact sections 30. This angle allows wing members 36 to act as a lead in surface when female terminal 4 is inserted onto male terminal 2, as will be discussed. It should be noted that wing members 36 are wider than recessed section 12 of

male terminal 2.

Each narrow contact section 30 has a first major surface 38 and a second major surface 40. Resilient arms 16, 18 of a respective female terminal 4 has first major surface 38 of narrow contact sections 30 facing each other. Plating is performed on first major surface 38 of each narrow contact section 30, the plating providing the enhanced electrical characteristics required to insure a reliable electrical connection. These plated first major surfaces 38 define contact sections 8 of female terminals 4.

The operation of the connector system is shown in Figures 1 through 3. As is shown in Figure 1, female terminal 4 is positioned proximate male terminal 2, such that narrow contact sections 30 of female terminal 4 are essentially in alignment with recessed section 12 of male terminal 2. A force is then applied to female terminal 4, causing female terminal 4 to engage male terminal 2. As shown in Figure 2, wing members 36 of female terminal 4 engage the outside circumference of male terminal 2. Consequently, as wing members 36 are wider than recessed section 12, wing members 36 do not engage side surfaces 13 of recessed section 12 as insertion of female terminal 4 onto male terminal 2 occurs.

The force on female terminal 4 is continued, causing wing members 36 to slide over the outside surface of male terminal 2. As the diameter of male terminal 2 is larger than the distance between first major surfaces 38 of wing members 36, wing members 36 are forced to move away from each other as wing members 36 are slid over male terminal 2. Consequently, narrow contact sections 30, which are integrally attached to wing members 36 are forced to move away from each other. As the insertion occurs, the alignment of sections 30 with recessed section 12 of male terminal 2 insures that major surfaces 38 of narrow contact sections 30 and side surfaces 13 of recessed section 12 will not engage each other or any other surfaces. This is because wing members 36 prevent first major surfaces 38 from entering into recessed section 12. It is important to prevent these surfaces from engagement during insertion, as these surfaces are plated to enhance the electrical characteristics of the terminals.. As the plated surfaces do not slidably engage other surfaces, the wear of the plating is essentially eliminated, allowing the plating on these surfaces to be provided in thin layers. Consequently, the cost of manufacture of the terminals is reduced, and the reliability of the terminals is increased.

As the force applied to female terminal 4 is continued, wing members 36 are slid past the surface of male terminal 2. The resilient nature of resilient arms 16, 18 forces wing members 36 to spring back toward their original position, as shown in Figure 3. As female terminal 4 is returned toward its original position, the external force applied to female terminal 4 is removed. The resilient nature of resilient arms 16, 18 insures that first major surfaces 38 of narrow contact sections 30 are positioned in electrical engagement with side surfaces 13 of recessed section 12 of male terminal 2. Wing members 36 are positioned proximate recessed section 12, but do not engage any surface of male terminal 2. Therefore, narrow contact section 30 and the surfaces of recessed section 12 are placed in electrical engagement. The cooperation of wing members 36 with the outside surface of male terminal 2 allows female terminal 4 to be easily inserted onto male terminal 2. However, even more important is the fact that nothing slidably engages narrow contact surfaces 36 or the surfaces of recessed section 12. As these are the only plated surfaces, this lack of engagement prevents wear to the plated areas, allowing reliable use of this system over many cycles.

Upon withdrawal from male terminal 2, female terminal 4 is retracted in the opposite manner as it is inserted. Wing members 36 again cooperate with the outside surface of male terminal 2, in order to disengage narrow contact sections 30 from the surfaces of recessed section 12. Consequently, neither the narrow contact section 30 nor the surfaces of recessed section 12 slidably engage any surface as withdrawal occurs.

Consequently, the present invention provides a connection system which is capable of withstanding 10,000 insertions/withdrawals without the need for a thick layer of very costly plating material.

Figures 4 through 6 show an alternative embodiment of the invention. The configuration of female terminal 104 is essentially the same as the embodiment previously described. However, when viewed from above, male terminal 102 has a square shape rather than a round shape, as was previously described. The insertion of female terminal 104 onto male terminal 102 is essentially identical to the operation described above. It is, therefore, deemed unnecessary to explain this embodiment in detail. For ease of understanding, the references numerals used in Figures 4 through 6 are identical to those used in the previous description, with the exception that one hundred has been added to each numeral.

Figures 7 through 9 show a slightly different embodiment. As is shown in the drawings, the connection system has a male terminal 202 and a female terminal 204. The overall operation is very similar to that previously described. However, differences are present.

Female terminal 204 is essentially identical to female terminal 4 described previously. However,

wing members 236 extend from narrow contact portion 230 in a different direction as wing member 36. As shown in Figure 7, wing members 236 also extend inward, toward each other, rather than away from each other. Resilient arms 216, 218 have the same configuration as was previously describe, except that in this embodiment, resilient arms 216, 218 are essentially parallel to each other.

Male terminal 202 has many differences to male terminal 2 previously described. Male terminal 202 of this embodiment has a right angle provided therein. Contact surfaces 231 are provided proximate an end 215 of male terminal 202. Contact surfaces 213 are not of reduced width, but rather are positioned below a cavity 212 positioned in a top surface 210 of male terminal 202. Positioned between cavity 212 and end 215 are wing engagement surfaces 217. Wing engagement surfaces 217 have lead in surfaces 219 provided at the end thereof.

In operation, female terminal 204 is positioned proximate male terminal 202, as shown in Figure 7. A force is applied to female terminal 204, causing wing members 236 to engage lead in surfaces 219 of wing engagement surfaces 217. As the force is continued, wings slide along the surfaces of wing engagement surface causing wing members 236 and resilient arms 216, 218 to open, as shown in Figure 8.

Continued insertion of female terminal 204 onto male terminal 202 results in wing members 236 moving past wing engagement surfaces 217 and into cavity 212, thereby allowing the resilient nature of resilient arms 216, 218 to force resilient arms 216, 218 back toward their original position, such that resilient arms 216, 218 are essentially parallel with each other. This causes first major surfaces 238 of narrow contact sections 230 to engage contact surfaces 213 of male terminal 202. Insertion is complete, as narrow contact sections 230 of female terminal 204 is in electrical engagement with contact surfaces 213 of the male terminal 202.

Although the various embodiments may vary some what in physical appearance, the principal of each is the same. The insertion and removal process of the terminals insures that only a very small amount of sliding motion occurs in the contact areas of the terminals. The lack of sliding motion across the contact areas significantly reduces the amount of wear in these areas. Low wear allows thin layers of plating to be used in the contact areas, even if many insertions and removals are planned for the terminals. This is a significant cost savings, as current terminals have a large portion of the cost associated with the thick plating layers which must be used in order to insure a positive electrical connection in the high wear contact areas.

Claims

1. An electrical terminal (4) having a base plate (14) which has resilient members (16,18) extending therefrom, each resilient member (16,18) has a first major surface and an oppositely facing second major surface, the resilient members (16,18) have fixed ends (28) adjacent the base plate (14) and a free end which has contact sections (30) provided proximate thereto, the contact sections (30) cooperate with a matable electrical terminal (2), the electrical terminal (4) being characterized in that:
wing means (36) are provided at the free end of the resilient members (16,18), adjacent the contact sections (30), the wing means (36) extend at an angle from the contact section (30), the height of the wing means (36) being greater than the height of the contact sections (30);
whereby as the electrical terminal (4) is mated with the matable electrical terminal (2), the wing means (36) cooperates with the matable electrical terminal (2) to prevent the contact sections (30) of the terminal (4) and a contact surface (13) of the matable terminal (2) from contact until the wing means (36) is moved beyond the matable electrical terminal (2).

2. An electrical terminal (4) as recited in claim 1 characterized in that two resilient members (16,18) are provided in each electrical terminal (4).

3. An electrical terminal (4) as recited in claim 2 characterized in that the first major surfaces of the resilient members (16,18) of a respective terminal (4) are positioned to face each other.

4. An electrical terminal (4) as recited in claim 2 characterized in that the resilient members (16,18) are essentially perpendicular to the plane of the base member (20).

5. An electrical terminal (4) as recited in claim 1 characterized in that the contact sections (30) have plating on the first major surface thereof, the plating provided to enhance the electrical characteristics of the terminal (4).

6. An electrical terminal (4) as recited in claim 1 characterized in that the contact sections (30) of the resilient arms (16,18) are positioned closer together than the fixed ends (28) of the resilient arms.

7. An electrical terminal (4) as recited in claim 6 characterized in that each wing means (36) extends from the contact section (30) in a direction away from the opposed resilient arm (16,18), thereby allowing the wing means (36) to act as a lead in surface as the electrical terminal (4) is inserted onto the matable electrical terminal (2).

8. An electrical terminal (204) as recited in claim 1 characterized in that the resilient arms (216,218) are essentially parallel to each other.

9. An electrical terminal (204) as recited in claim 8 characterized in that each wing means (236) extends from the contact section (230) in a direction toward the opposed resilient arm (216,218), thereby allowing the wing means (236) to cooperate with a lead in surface (219) of the matable electrical terminal (202), as the electrical terminal (204) is inserted onto the matable electrical terminal (202).

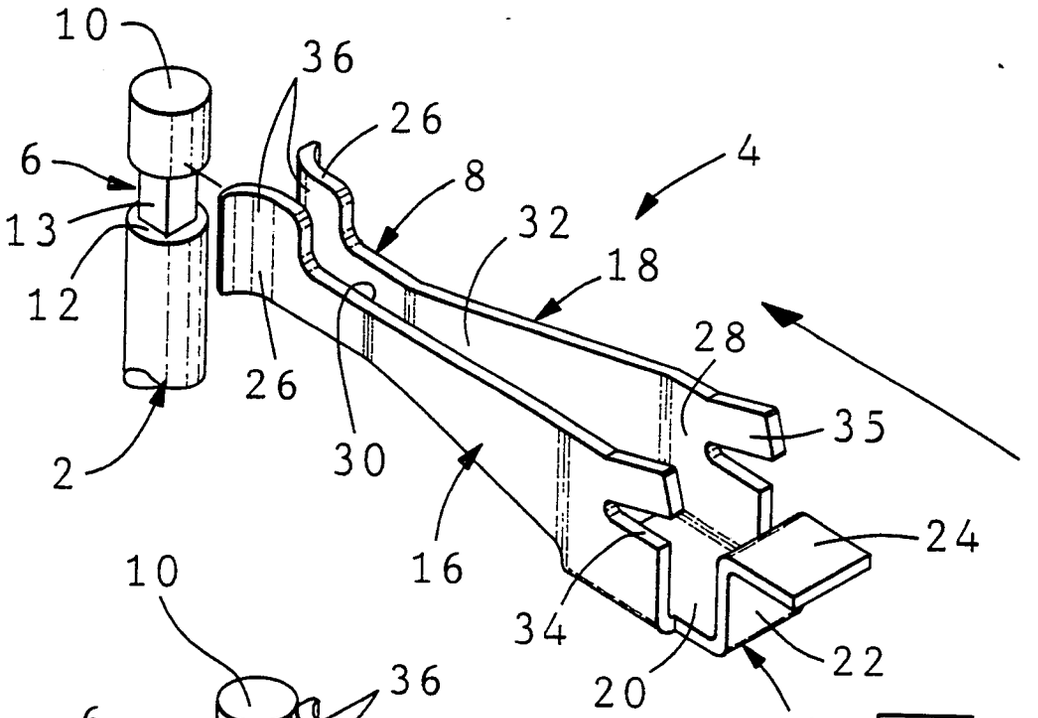


FIG.1

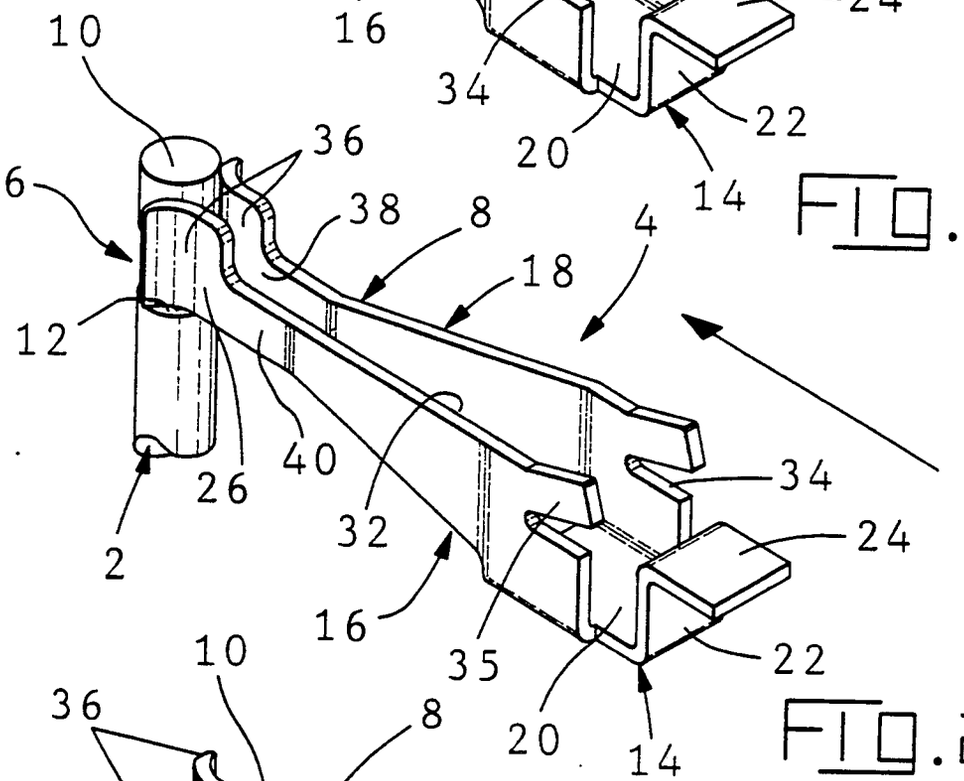


FIG.2

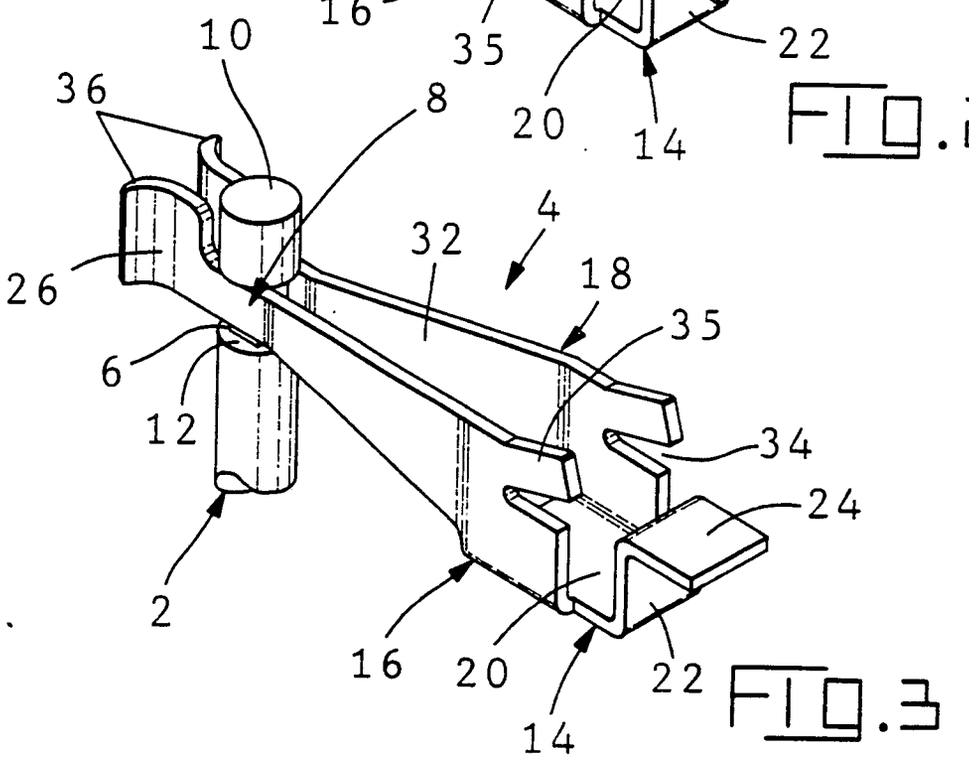


FIG.3

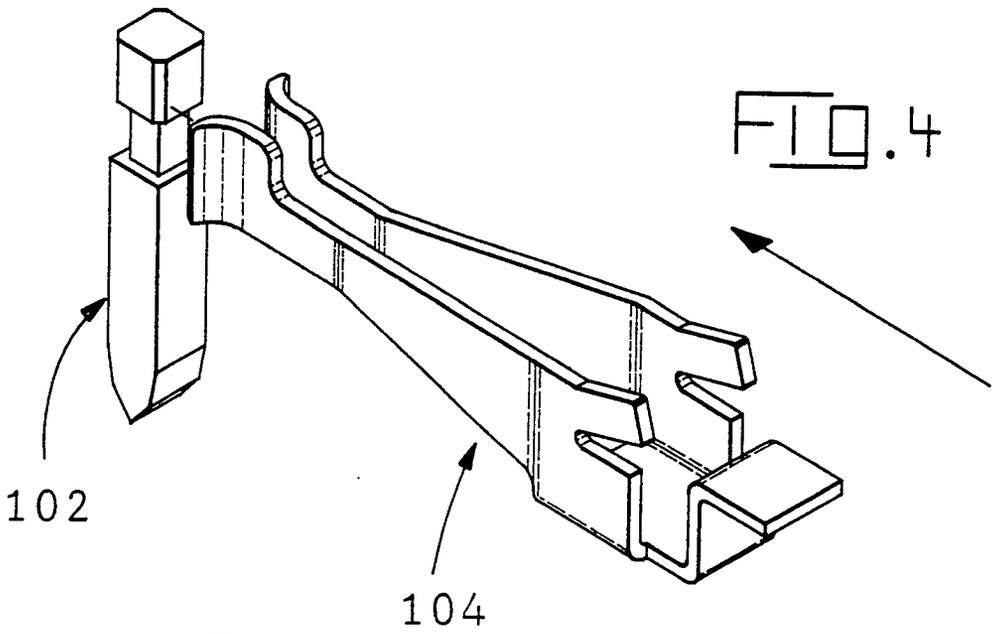


FIG.4

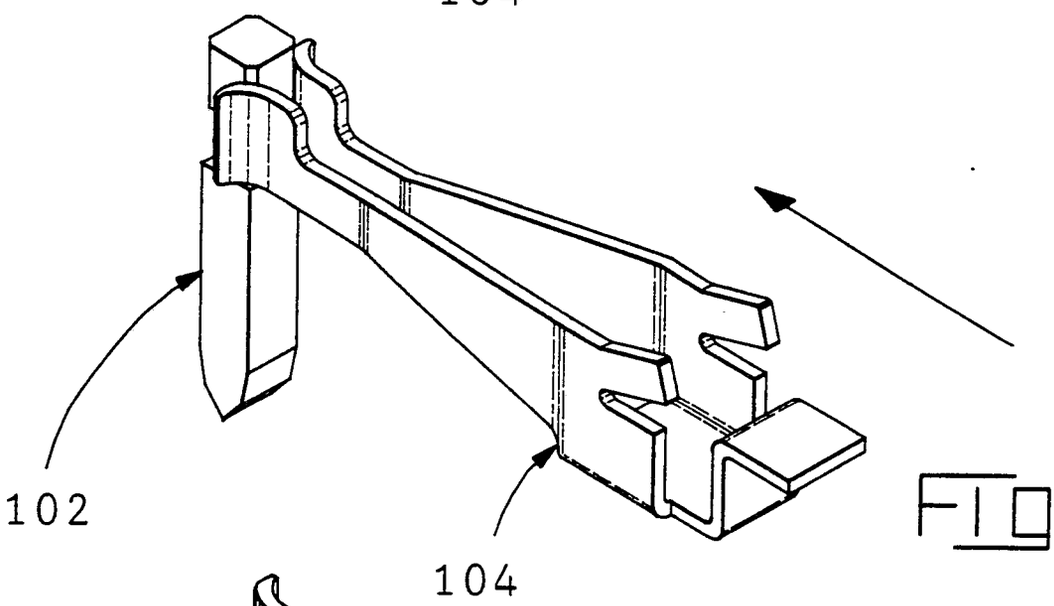


FIG.5

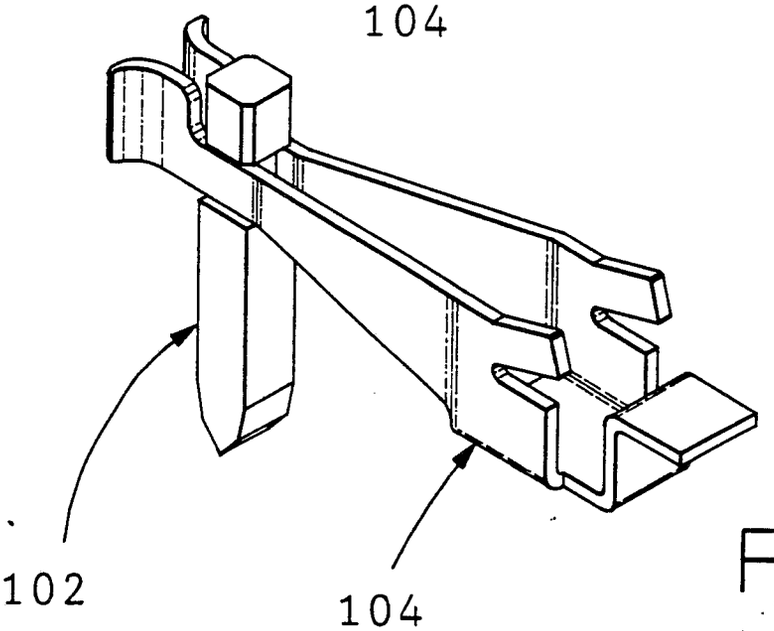
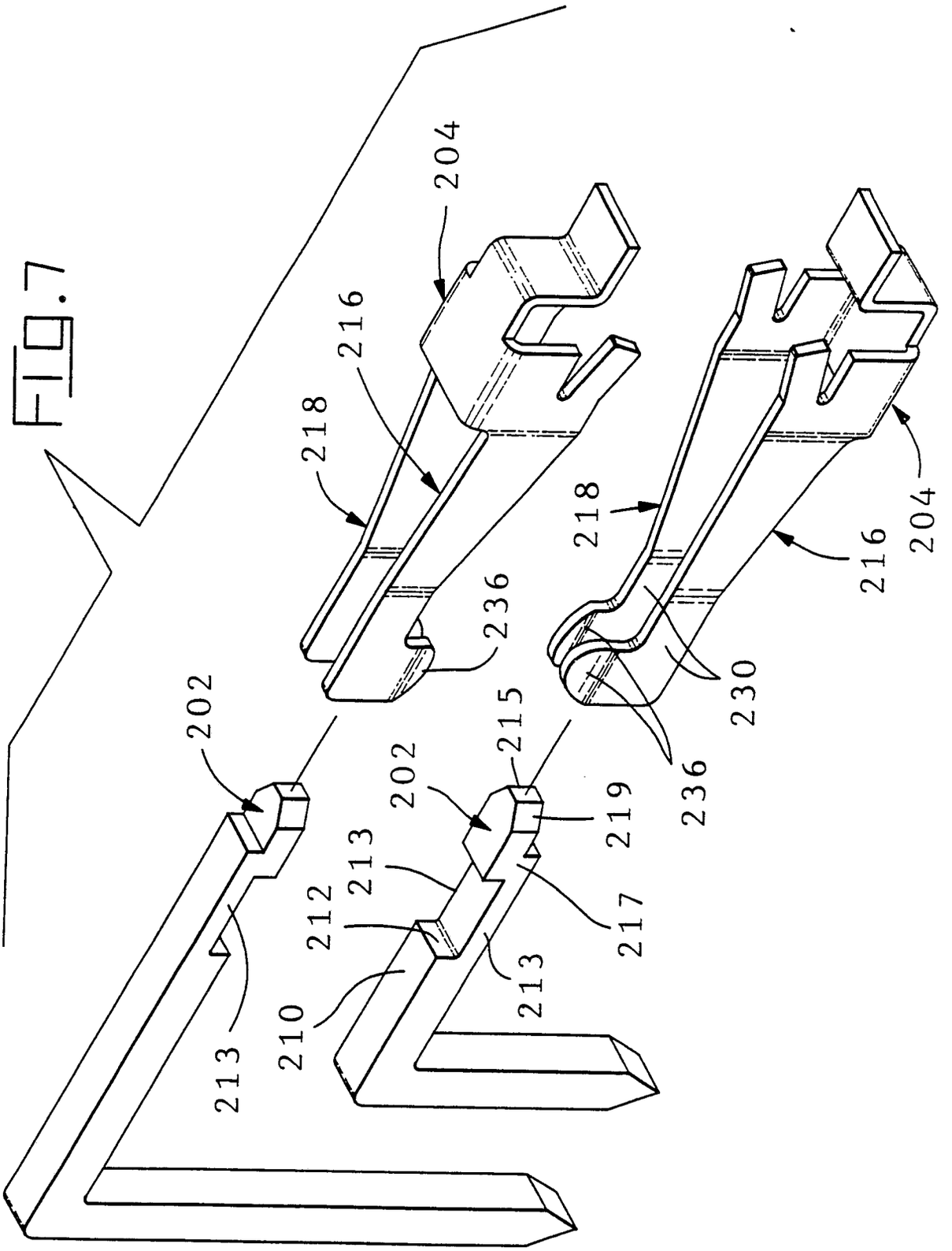


FIG.6

FIG.7



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EUROPEAN SEARCH REPORT

Application Number

EP 88 30 7553

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.4)
A	DE-U-8 207 036 (RAMEL) * Page 12, lines 19-29; figures 1-3 *	1-9	H 01 R 13/11
A	DE-A-3 110 609 (SIEMENS) * Page 6, lines 11-25; page 7, lines 29-37; figures 1-7 *	1-9	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

H 01 R 13/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21-09-1988	CERIBELLA G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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