



(11)

**EP 1 643 183 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**05.04.2006 Bulletin 2006/14**

(51) Int Cl.:  
**F21S 4/00 (2006.01) H01R 24/02 (2006.01)**  
**H01R 24/04 (2006.01)**

(21) Application number: **05256128.9**

(22) Date of filing: **30.09.2005**

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR**  
**HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI**  
**SK TR**  
Designated Extension States:  
**AL BA HR MK YU**

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(30) Priority: **30.09.2004 GB 0421772**

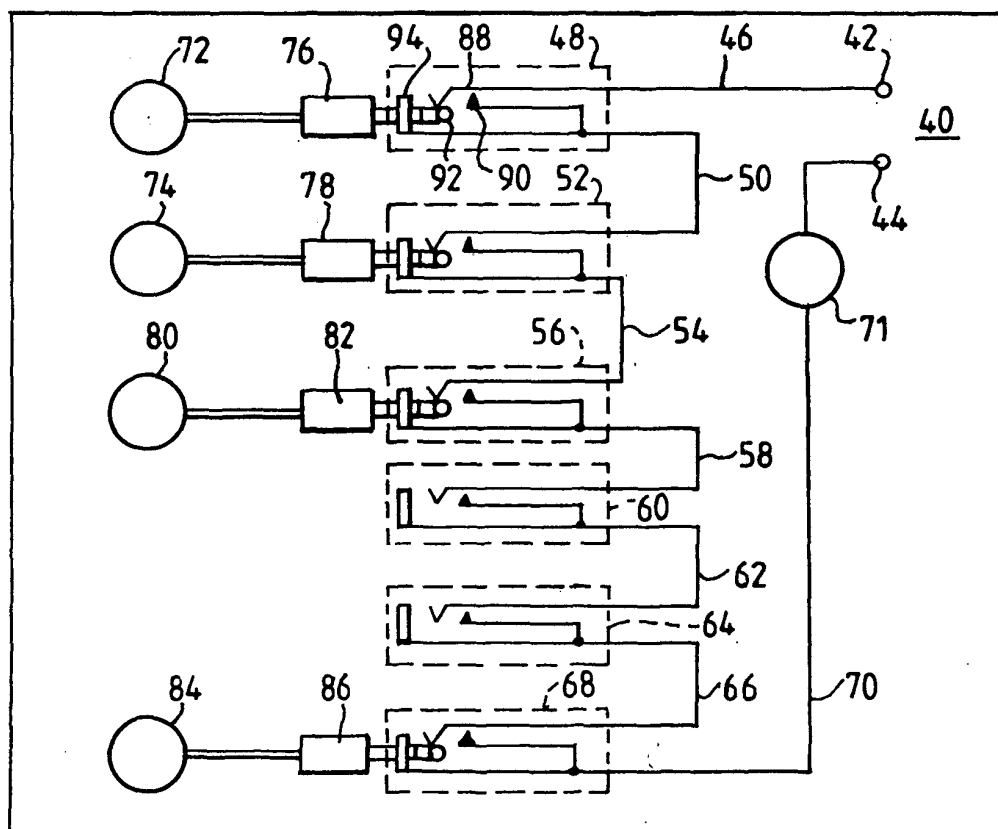
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**(54) Electrical circuit and connection method**

(57) An electrical circuit is disclosed in which a constant current is passed through a plurality of sockets connected in series. Selected ones of a corresponding plurality of plugs are insertable into and removable from the

sockets. The plugs are connected to LED light sources, and the sockets are arranged to form a short circuit when plugs are removed therefrom, thereby to allow remaining LEDs to be powered. The circuit may form part of a coloured lighting system.

**Fig.3**



## Description

**[0001]** This invention relates to an electrical circuit and to a connection method. The invention finds particular, though not exclusive, application in the connection of electrical light sources and also provides an electrical lighting system.

**[0002]** Conventionally, when light sources, such as filament lamps, are connected together to form larger groups to provide brighter lighting in one area or to be spread out so as to provide an even brightness over a large area, they are electrically connected in parallel. Figure 1 of the accompanying drawings shows a schematic representation of such an electrical circuit, in which a pair of conductors 2, 4 extend from respective terminals 6, 8 of a voltage supply 10. As shown, three lamps 12, 14, 16 are connected in parallel between the conductors 2, 4 and are thus each subjected to the same voltage thereacross. One, or two, of the lamps 12, 14, 16 may be individually switched into or taken out of the circuit without affecting operation of the remaining lamp(s). It will be appreciated that this operation is applicable to a greater number of parallel-connected lamps.

**[0003]** Some newer forms of light sources, for example high brightness light-emitting diodes (LEDs), however, need to be connected in series, as exemplified in the circuit of Figure 2 of the accompanying drawings, in order properly to manage the electrical characteristics and to maintain the rated life. In Figure 2, a conductive path 20 extends from one terminal 22 of a current supply 24 to a first lamp 24, thence to a second lamp 26, thence to a third lamp 28 and thence to the other terminal 30 of the supply 24. The lamps 24, 26 and 28 are thus connected in series, and a greater number of lamps may be likewise included in the circuit if required. The lamps, provided as LEDs, operate much more efficiently when the current, rather than the voltage, is controlled, that is to say, maintained at a constant value. However, in this arrangement, should any of the lamps be removed from or switched out of the circuit, then none of the other lamps can remain lit.

**[0004]** For many applications, a parallel arrangement is preferred, since a pair of conductors can be taken from the voltage source and deployed as a so-called track around an installation to be lit, with lamps connected therebetween at required locations when required. With a series arrangement, on the other hand, since each lamp must be connected to the adjacent one individually, it is not possible to employ just two lengths of conductors.

**[0005]** It is one object of the present invention to provide an electrical circuit and connection method having improvements over known arrangements.

**[0006]** In accordance with one aspect of the present invention, there is provided an electrical circuit comprising a source of electric current having two terminals, a conductive path extending from one terminal of the source to the other, a plurality of electrical sockets connected in series along the conductive path; and at least

one electrical load arranged to be connected to any one of the sockets by means of a respective plug; whereby insertion of a plug into a socket is effective to replace the series connection of the conductive path by a series connection through the load associated with that plug.

**[0007]** In accordance with another aspect of the present invention there is provided a method of selectively connecting and disconnecting loads in a series electrical circuit, wherein a conductive path is formed between two terminals of a source of electric current, a plurality of electrical sockets are connected in series along the path so as in one condition to complete the conductive path, and at least one electrical load is connected to one of the sockets by means of a respective plug thereby to switch the socket to another condition in which the or each load is connected in series in the conductive path.

**[0008]** Whilst the or each load may comprise a light source, advantageously an LED, it is envisaged that the present invention will also find application to other loads that require series connection, supplied from a constant current source.

**[0009]** Advantageously, the electrical circuit of the present invention includes means to protect it against a short circuit. Such means, in series with the current source, is arranged either to interrupt the flow of current completely in event of a short circuit, or at least to limit the current to a low, non-damaging level, typically being the rated current of the constant current driver of the circuit. Such means is particularly advantageous when the source is a constant current source. For example, in the preferred embodiment of the circuit having a constant current source, in the event of removal of all of the plugs, or the last of the plugs, thus entirely removing the electrical load on the circuit, damage to the circuit will be avoided by the inclusion of the short circuit protection means. It will be appreciated that the protection means may be incorporated with the current supply into a single unit.

**[0010]** Advantageously, the or each co-operating plug and socket may comprise a jack plug and corresponding socket, as commonly used in radio and hi-fi equipment.

**[0011]** The sockets, and their respective loads, for example light sources, may be provided as discrete components that are distributed around an area. Thus, for example, light sources may be located discretely around a room, for example on walls and/or ceilings, or over the surface of, or around, a display board or other object to be illuminated.

**[0012]** In another practical realisation of the circuit of the present invention, however, the sockets and associated wiring may be retained within a conduit that may be closed, except at the locations of the loads, for example light sources, by a cover plate. Thus, a lighting track system may be provided. The conduit may form part of an enclosure comprising a support member on which the sockets are mounted and a housing that carries the electrical load. The conduit and/or housing may be of plastics or metal material and may be extruded or moulded or

folded into the required shape. When made of metal, the component may be cast into shape.

**[0013]** An electrical circuit and connection method, each in accordance with the present invention, will now be described, by way of example, with reference to Figures 3 to 5 of the accompanying drawings, in which:

Figure 3 shows a series circuit of a plurality of light sources;

Figure 4 shows schematically an exploded view of components of a lighting system embodying the circuit of Figure 3; and

Figure 5 shows the lighting system of Figure 4 in its assembled configuration.

**[0014]** The electrical circuit of Figure 3 includes a constant current power supply 40 having two terminals 42 and 44. A conductive path leads via a first conductor 46 to a first electrical socket 48, via a second conductor 50 to a second socket 52, via a third conductor 54 to a third socket 56, via a fourth conductor 58 to a fourth socket 60, via a fifth conductor 62 to a fifth socket 64, and via a sixth conductor 66 to a sixth socket 68, and thence via a conductor 70 to a short circuit protection device 71 and thence back to the other terminal 44 of the current supply 40 to complete a series circuit. Although shown diagrammatically as a separate component, it is envisaged that the device 71 will be incorporated into the supply 40 to provide a single constant current protected driver unit.

**[0015]** Red coloured high intensity light-emitting diodes (LEDs) 72, 74, connected to respective jack plugs 76, 78, are associated with the sockets 48, 52 respectively; a high intensity green-coloured LED 80 connected to a jack plug 82 is associated with the socket 56, and a high intensity blue-coloured LED 84, connected to a jack plug 86 is associated with the socket 68. No load is connected to socket 60 or 64.

**[0016]** The sockets 48, 52, 56, 60, 64 and 68 are identical, as are the jack plugs 76, 78, 82 and 86. Any one of the jack plugs may be fitted into any one of the sockets, and the LEDs differ only in the colour of their light output. As can be seen, the arrangement of Figure 3 has an LED associated with four of the sockets, whilst leaving two of the sockets empty.

**[0017]** Referring to the empty socket 60 by way of example, the conductor 58 terminates in a spring-loaded contact 88 that, since the socket 60 has no load applied thereto, engages a fixed contact 90 that is connected to the conductor 62. Thus, current effectively flows along a short-circuited path through the empty socket 60 between the conductors 58 and 62.

**[0018]** The socket 48, by way of example, has a load, comprising the LED 72 and its jack plug 76, connected thereto. As can be seen, the effect of the insertion of the jack plug 76 into the socket 48 is to deflect its spring-loaded contact 88 away from its fixed contact 90, thus opening the direct, short circuit therethrough between the conductors 46 and 50. In place of the short circuit, a current

path is formed from the flexible contact 88, to a first contact 92 of the jack plug 76, thence through the LED 72 back through the jack plug 76 to an annular contact 94 of the socket 48, and thence to the circuit conductor 50.

**[0019]** It is thus seen, that irrespective of whether a load is applied to any one socket or not, the external series circuit path from one current supply terminal 42 to the other terminal 44 is completed. That is to say, LEDs may be fitted into sockets where required, whilst leaving some sockets empty if required, without interrupting the series electrical circuit from the current supply 40. Lighting can thus be provided at selective ones only of various fixed points over an area in which a lighting system is installed.

**[0020]** It will be appreciated that the circuit of Fig 3 allows each of the LEDs, such as the LEDs 72, 74, 80, 84, to be removed from each of the sockets 48, 52, 54, 56, 60, 64 and 68. In this case, the current supply 40 would still tend to maintain its rated constant current passing through the circuit. The short circuit protection device 71 then operates to interrupt the supply of current, thus avoiding damage to the circuit components. Upon subsequent insertion of at least one of the plugs, such as plugs 76, 78, 82, 86, into a respective socket, the device 71 again allows the supply 40 to pass its constant current.

**[0021]** Referring to Figures 4 and 5, a linear sequence of five sockets such as those described with reference to Figure 3, is mounted distributed along a printed circuit board (pcb) 98 connected, in the manner shown in Figure 3, to the supply conductors 46 and 70. The pcb 98 is fitted into a channelled base extrusion 100. A plurality of luminaires 102 (only one of which is shown) encloses an LED and is mounted on a cover 104 that carries an associated integral jack plug 106. The cover 104 is also a channel-shaped extrusion, and is arranged to be a snap fit over the base extrusion 100.

**[0022]** As indicated in Figure 5, the luminaire 102 is snapped on to the base extrusion 100 in the region of one of the sockets 96, and is slid along the extrusion 100 so as to have its jack plug 106 engage with the appropriate socket 96, thus completing the circuit as indicated with reference to Figure 3. It will thus be appreciated, that the luminaires 102 with their associated LEDs, can be mounted at required locations along the base extrusion 100, and can be de-mounted and replaced without affecting the lighting provided by the rest of the system.

**[0023]** Although in the exemplified embodiments the LEDs have been indicated as being of particular colours, it will be appreciated that other colours, including white, or clear, may be used.

## Claims

1. An electrical circuit comprising:

a source of electric current having two terminals;

- a conductive path extending from one terminal of the source to the other;  
a plurality of electrical sockets connected in series along the conductive path; and  
at least one electrical load arranged to be connected to any one of the sockets by means of a respective plug;  
whereby insertion of a plug into a socket is effective to replace the series connection of the conductive path by a series connection through the load associated with that plug.
2. An electrical circuit according to claim 1, wherein the or each co-operating plug and socket comprises a jack plug and corresponding socket.
  3. A lighting system comprising an electrical circuit according to claims 1 or 2, wherein the or each electrical load comprises a light source.
  4. A lighting system according to claim 3, wherein the or each light source comprises a light-emitting diode.
  5. An electrical circuit according to any one of the preceding claims, comprising short circuit protection means mounted in series with the source of electric current arranged to limit or interrupt the supply of current therefrom in the event of a short circuit.
  6. A method of selectively connecting and disconnecting loads in a series electrical circuit, wherein
    - (a) a conductive path is formed between two terminals of a source of electric current;
    - (b) a plurality of electrical sockets are connected in series along the path so as in one condition to complete the conductive path; and
    - (c) at least one electrical load is connected to one of the sockets by means of a respective plug thereby to switch the socket to another condition in which the or each load is connected in series in the conductive path.
  7. A method according to claim 6 wherein the or each load comprises a light source and a plug that mates with the sockets, whereby one or more light sources may be provided at selected ones of spaced apart locations along the conductive path.
  8. A method according to claim 6 or 7, wherein a constant current is supplied to the circuit.
  9. A method according to claim 8, wherein the current supplied to the circuit is limited or interrupted in the event of a short circuit.
  10. A lighting system comprising a plurality of electrical sockets spaced apart along a support member, the sockets having a first condition in which a conductive path is formed directly therethrough, the sockets being electrically connected in series with a pair of terminals for the supply of electric current thereto; and a housing for the sockets, wherein the housing comprises at least one electric light source terminated in a plug that co-operates with any one of the sockets, the plug being arranged to co-operate with the sockets such that when mechanically engaged therewith, the sockets adopt a second condition in which the associated light source forms part of the series connection with the current supply terminals.
  11. A lighting system according to claim 10, wherein the or each light source comprises an LED.
  12. A lighting system according to claim 10 or claim 11, wherein the sockets are arranged to be supplied from a constant current source.
  13. A lighting system according to claim 12, wherein the current is limited or interrupted in the event of a short circuit.
  14. A lighting system according to any one of claims 10 to 13, wherein the support member comprises a printed circuit board.
  15. A lighting system according to any one of claims 10 to 14, wherein the housing comprises:
    - a) a base conduit for receiving the support member with the sockets thereon, and
    - b) a plurality of co-operating covers each of which carries a light source and associated plug.
  16. A lighting system according to any one of claims 10 to 15, wherein the housing comprises an extruded or moulded component of metal or plastics material.
  17. An electrical circuit, or a connection method, or a lighting system, substantially as hereinbefore described with reference to Figures 3 to 5 of the accompanying drawings.

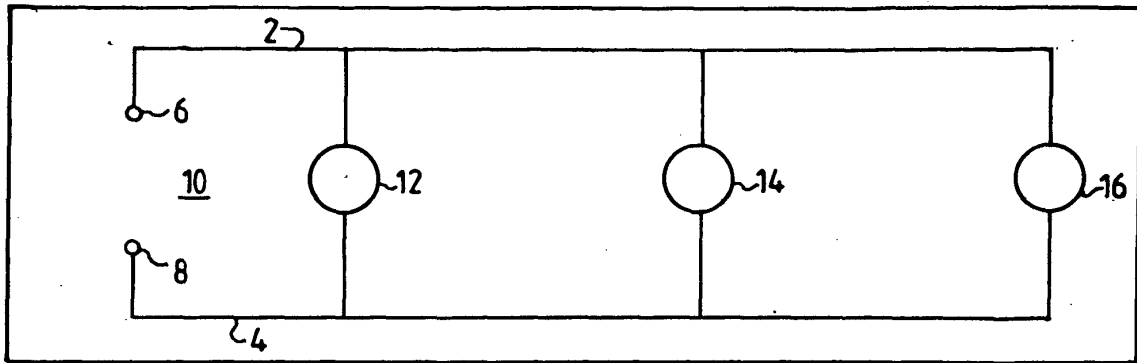


Fig.1 (PRIOR ART)

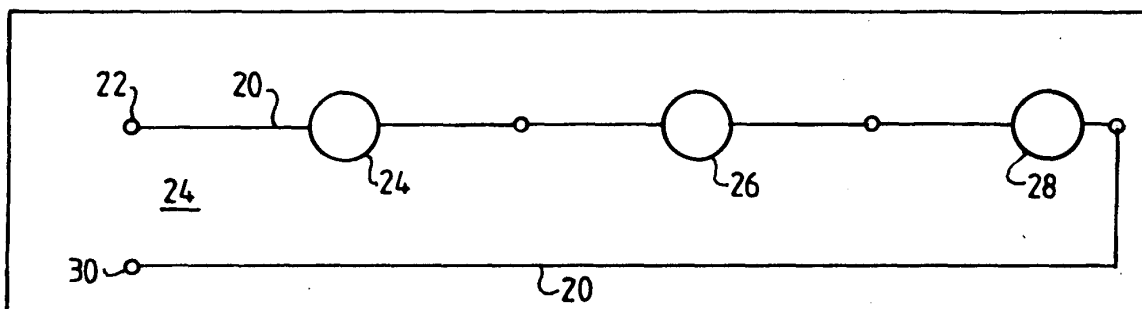
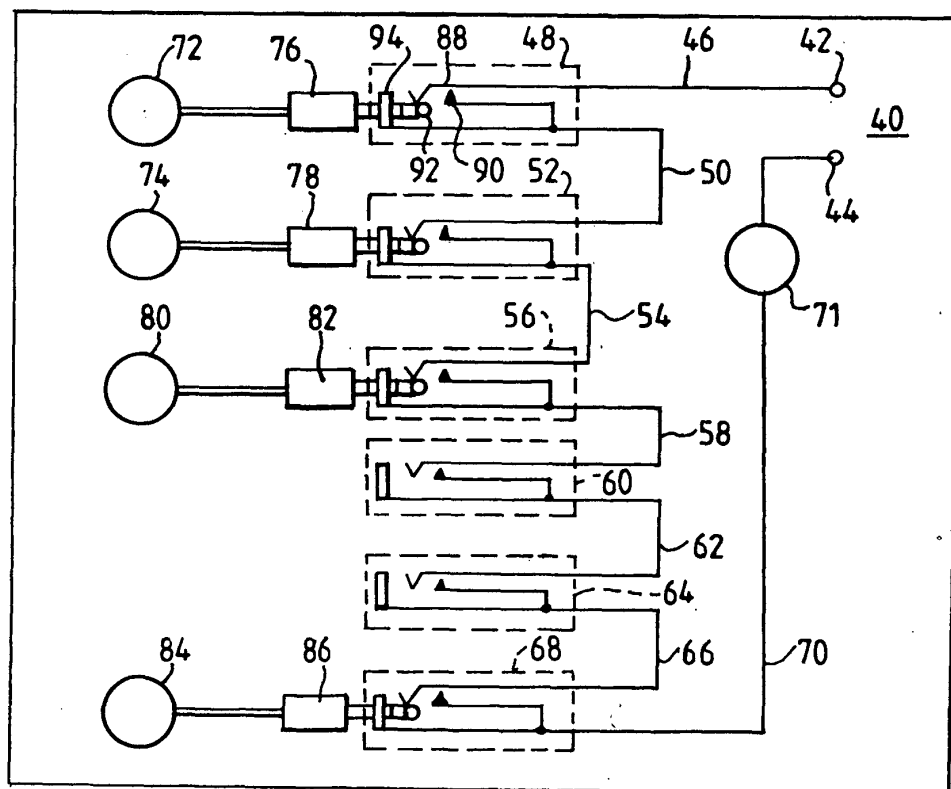
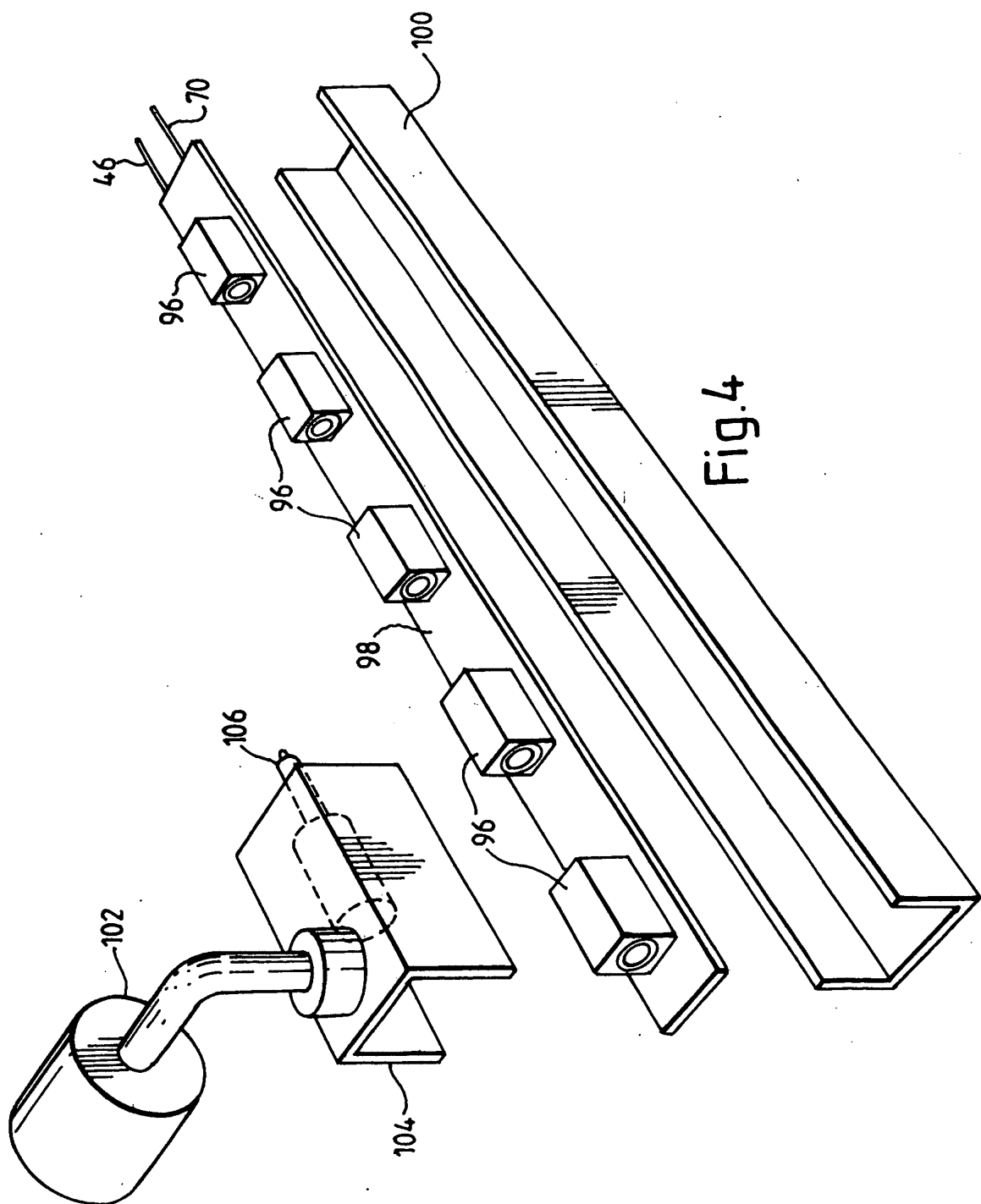


Fig.2 (PRIOR ART)

Fig.3





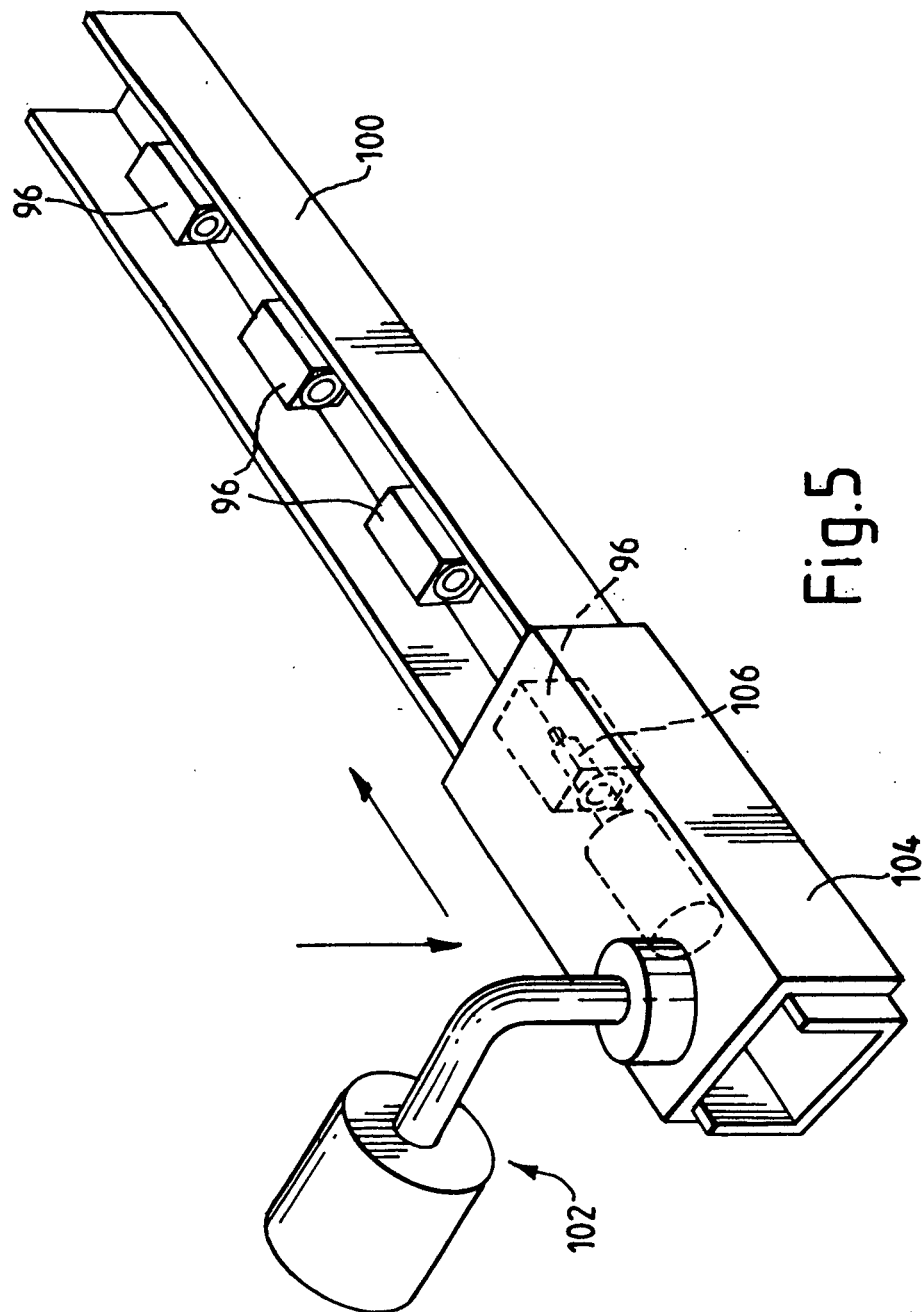


Fig. 5



European Patent  
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Application Number  
EP 05 25 6128

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Place of search Munich		Date of completion of the search 27 January 2006	Examiner Serrano Funcia, J
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			

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EPO FORM 1503 03.82 (P04C01)



**ANNEX TO THE EUROPEAN SEARCH REPORT  
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