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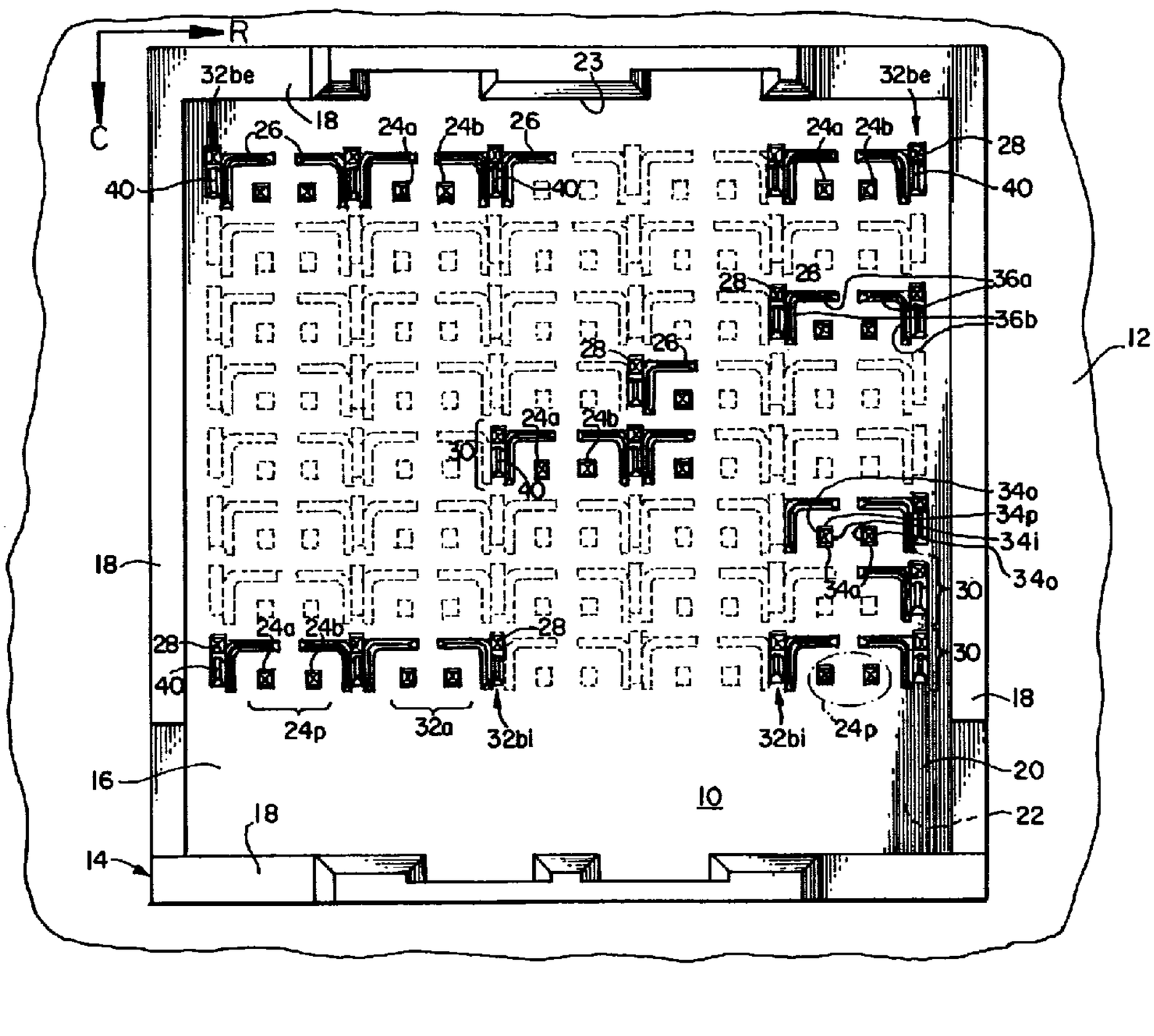
(54) **BARRETTE DE CONTACT A MONTER SUR UN SUBSTRAT DE CIRCUIT**

(54) **HEADER ASSEMBLY FOR MOUNTING TO A CIRCUIT SUBSTRATE**



(57) A header assembly is mounted to a backplane and receives a complementary electrical connector. The header assembly has an insulating shroud having a base with backplane and connector sides and a primary edge, and differential signal pin pairs, ground shields, and ground pins mounted to the base. The signal pin pairs are arranged into rows extending in a first direction along the base and along the base primary edge, and columns extending in a

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perpendicular second direction along the base. The signal pins in each pair are adjacently arranged into a sub-row extending in the first direction. Each signal pin in a pair has an inner side facing the other pin in the pair, an opposing outer side, and primary and non-primary sides facing toward and away from the base primary edge, respectively. One ground shield is associated with each signal pin. Each ground shield extends through the base between the connector side and the backplane side, and includes first and second attached wings arranged at right angles. The first wing extends along the first direction adjacent and along either the primary or non-primary side of the associated signal pin, and the second wing extends along the second direction adjacent and along the outer side of the associated signal pin. The ground shields in combination substantially electromagnetically isolate within the base each signal pin pair from all others. Each ground pin electrically contacts at least one ground shield at the second wing thereof.

Abstract of the Disclosure

A header assembly is mounted to a backplane and receives a complementary electrical connector. The header assembly has an insulating shroud having a base with backplane and connector sides and a primary edge, and differential signal pin pairs, ground shields, and ground pins mounted to the base. The signal pin pairs are arranged into rows extending in a first direction along the base and along the base primary edge, and columns extending in a perpendicular second direction along the base. The signal pins in each pair are adjacently arranged into a sub-row extending in the first direction. Each signal pin in a pair has an inner side facing the other pin in the pair, an opposing outer side, and primary and non-primary sides facing toward and away from the base primary edge, respectively. One ground shield is associated with each signal pin. Each ground shield extends through the base between the connector side and the backplane side, and includes first and second attached wings arranged at right angles. The first wing extends along the first direction adjacent and along either the primary or non-primary side of the associated signal pin, and the second wing extends along the second direction adjacent and along the outer side of the associated signal pin. The ground shields in combination substantially electromagnetically isolate within the base each signal pin pair from all others. Each ground pin electrically contacts at least one ground shield at the second wing thereof.

Title of the Invention

Header Assembly For Mounting to a Circuit Substrate

Cross-Reference to Related Application

This application contains subject matter related to the subject matter disclosed in U.S. Patent Application No. 08/942,084, filed October 1, 1997 and entitled CONNECTOR FOR ELECTRICAL ISOLATION IN A CONDENSED AREA; U.S. Patent Application No. 09/045,660, filed March 20, 1998 and entitled CONNECTOR FOR ELECTRICAL ISOLATION IN A CONDENSED AREA; and U.S. Patent Application No. 09/___,___ (Attorney Docket No. BERG-2466 (C2355)), filed April 21, 1999 and entitled CONNECTOR FOR ELECTRICAL ISOLATION IN A CONDENSED AREA, each of which is hereby incorporated by reference.

Field of the Invention

The present invention relates to a header assembly for mounting to a circuit substrate and for receiving a complementary electrical connector. In particular, the present invention is for a high density header assembly for use in, for example, a motherboard in a backplane / back panel application.

Background of the Invention

In a typical electrical interconnection system, a first removably insertable circuit board includes a complementary electrical connector that is to be mated with a header assembly or header which is mounted to a second circuit board. As should be understood, when the first circuit board is coupled to the second circuit board by way of the electrical connector and header and when the first circuit board is in operation, a number of signals enter or leave the first circuit board through conductive paths defined by the electrical connector on the first circuit board and the header on the second circuit board. In many instances, the second circuit board has other circuit boards coupled thereto by other respective headers and complementary electrical connectors, and the aforementioned signals can originate from or be destined for such other circuit boards. Of course, the aforementioned signals can also originate from or be destined for other locations remote from the second circuit board by way of appropriate interconnections.

If it is desirable to suppress signal noise and/or crosstalk, it is known that a signal may be transmitted over a pair of differential (positive and negative) signal lines that travel together in close proximity. Typically, in such pair of differential lines, the signal itself (+V) is transmitted on the positive line, and the negation of the signal (-V) is transmitted on the negative line. Since both lines travel together in close proximity, any noise encountered by the lines should appear in a generally identical form on both lines. Accordingly, the subtraction (by appropriate circuitry or other means) of the negative line (-V + noise) from the positive line (+V + noise) should cancel out such noise ((+V + noise) - (-V +noise) = 2V), thus leaving the original signal, perhaps with a different amplitude.

Oftentimes, in a high frequency environment, most every signal passing to and from a circuit board travels as a pair of differential signals on a pair of differential signal lines. Accordingly, the electrical connector on the circuit board and the header on the backplane must accommodate all such pairs of differential signal lines. Moreover, with increased contact density on a circuit board, there has been a corresponding increase in signal lines associated with such circuit board. As a result, the number of individual lines running through the electrical connector of the circuit board and the associated header can be quite large. At the same time, since it is desirable to increase the number of circuit boards that can be coupled to the backplane, the 'real estate' on the backplane used by the

header must be kept small. Therefore, the 'density' of individual signals that pass through the electrical connector and header must be increased.

With such increased density, however, the issue of susceptibility to noise and/or crosstalk again arises, even in electrical connectors and headers that transmit pairs of differential signals. To combat such density-based noise, the header in particular has been modified to include ground shielding which substantially electromagnetically isolates within the header each pair of differential signal lines from every other pair of differential signal lines.

Accordingly, a need exists for a header that can have multiple differential signal pairs in relatively high density, and that has ground shielding for the signal pins, where the header is practical and relatively easily manufactured.

Summary of the Invention

The present invention satisfies the aforementioned need by providing a header assembly for being mounted to a circuit substrate such as a backplane and for receiving a complementary electrical connector secured to a daughter-board. The header assembly has an insulating shroud, a plurality of signal pins, a plurality of ground shields, and a plurality of ground pins, all mounted to the base of the shroud.

Such base has a backplane side for facing toward the backplane, a connector side for facing toward the mating connector, and a primary edge. The signal pins are arranged into a plurality of rows extending in a first direction along the base and along the primary edge of the base, and a plurality of columns extending in a second direction along the base generally perpendicular to the first direction. In differentially paired signal pins, such signal pins in each pair are adjacently arranged into a sub-row extending in the first direction. Each signal pin in a pair has an inner side facing toward the other pin in the pair, an outer side opposite the inner side, a primary side extending between the inner side and the outer side and facing toward the primary edge of the base, and a non-primary side extending between the inner side and the outer side and facing away from the primary edge of the base.

One ground shield is associated with each signal pin. Each ground shield generally extends through the base between the connector side and the backplane side, and

includes first and second attached wings arranged at about right angles. The first wing extends generally along the first direction adjacent and along one of the primary side and the non-primary side of the associated signal pin, and the second wing extends generally along the second direction adjacent and along the outer side of the associated signal pin. The plurality of ground shields in combination substantially electromagnetically isolate within the base of the shroud each pair of signal pins from every other pair of signal pins. Each ground pin electrically contacts at least one ground shield at the second wing thereof.

Brief Description of the Drawings

The foregoing summary, as well as the following detailed description of preferred embodiments of the present invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there are shown in the drawings embodiments which are presently preferred. As should be understood, however, the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

Fig. 1 is a plan view of a connector side of a header in accordance with one embodiment of the present invention, and shows such header mounted to a backplane;

Fig. 2 is a perspective view of a portion of the pins and ground shields of the header of Fig. 1, with the shroud of Fig. 1 removed for clarity;

Fig. 3 is the same perspective view of Fig. 2, but shows only the pair of differential signal pins of Fig. 2;

Fig. 4 is the same perspective view of Fig. 2, but shows only the ground pins of Fig. 2;

Fig. 5 is the same perspective view of Fig. 2, but shows only the ground shields of Fig. 2;

Fig. 6 is a perspective view showing a ground pin and a pair of ground shields in accordance with a second embodiment of the present invention;

Fig. 7 is a perspective view similar to that of Fig. 2, but from a different angle, and shows a third embodiment of the present invention which is similar to the first embodiment as shown in Figs. 1-5, wherein primary and secondary headers share common pins and sandwich the backplane therebetween;

Fig. 7A is an exploded perspective view showing the primary header, backplane, and secondary header of Fig. 7; and

Fig. 7B is a perspective view showing a securing contact employed in connection with the secondary header of Fig. 7.

Detailed Description of Preferred Embodiments

Certain terminology may be used in the following description for convenience only and is not considered to be limiting. The words "left", "right", "upper", and "lower" designate directions in the drawings to which reference is made. The words "inwardly" and "outwardly" are further directions toward and away from, respectively, the geometric center of the referenced object. The terminology includes the words above specifically mentioned, derivatives thereof, and words of similar import.

Referring to the drawings in detail, wherein like numerals are used to indicate like elements throughout, there is shown in Fig. 1 a header assembly or header 10 in accordance with one embodiment of the present invention. As seen, the header 10 is mounted to a circuit substrate such as a backplane 12 in a position to receive a complementary electrical connector (not shown) on a circuit board (not shown) to be coupled to the backplane 12 by way of the electrical connector and header 10.

As seen, the header 10 includes an insulating shroud 14 which has a base 16. As should be understood, when the header 10 is mounted to the backplane 12, the base 16 of the shroud 14 of the header 10 is generally parallel to such backplane 12. Typically, although not necessarily, the shroud 14 of the header 10 also has walls 18 that extend away from the base 16 at generally right angles thereto. Accordingly, the walls 18 form a well within which the electrical connector is inserted while mating to the header 10. Typically, the walls 18 align and guide the electrical connector as it is being inserted so as to ensure a proper connection and so as to prevent damage that may occur from mis-alignment. The walls 18 may include one or more keying elements (the slots shown, for example) that mate to corresponding keying elements in the electrical connector to further ensure a proper connection and for polarization.

As should be understood, and as seen in Fig. 1, the base 16 of the shroud 14 has a connector side 20 that faces toward the mating connector, and a backplane side 22

that faces toward the backplane 12. The base 16 of the shroud 14 also has a primary edge 23, which as will be explained below is designated as such for purposes of being a fixed reference in the present disclosure. As seen in Fig. 1, the primary edge 23 runs along the top of the base 16.

Header 10 includes signal contacts, ground contacts, and ground shields. In a differential pair application such as that shown in Fig. 1, the header 10 has a plurality of pairs 24p of differential signal pins 24a, 24b, a plurality of ground shields 26, and a plurality of ground pins 28. As should be understood, for purposes of clarity, only a few of the elements 24a, 24b, 24p, 26 and 28 are shown in detail, while the remainder of such elements are shown in phantom. As seen, each pair 24p of signal pins 24a, 24b, each ground shield 26, and each ground pin 28 is mounted to the base 16 of the shroud 14. Each signal pin 24a, 24b and each ground pin 28 extends away from the base 16 from both the connector side 20 and the backplane side 22 in opposing directions generally perpendicular to such base 16, as can be seen in and/or appreciated from Figs. 1-4.

As can be seen in Fig. 1, the pairs 24p of signal pins 24a, 24b are arranged into a plurality of rows 30 extending in a first direction (as indicated by the arrow R) along the base 16 and along the primary edge 23 of the base 16. That is to say, the rows 30 and the first direction run along the surface of the base 16, and generally parallel to the primary edge 23. Additionally, the pairs 24p of signal pin 24a, 24b are further arranged into a plurality of columns 32a that extend in a second direction (as indicated by the arrow C) along the base 16 generally perpendicular to the first direction. Again, that is to say, the columns 32a and the second direction run along the surface of the base 16, and generally perpendicular to the primary edge 23. To summarize, then, the pairs 24p of signal pins 24a, 24b are arranged generally rectilinearly.

Still referring to Fig. 1, the signal pins 24a, 24b in each pair 24p are adjacently arranged into a sub-row that extends in the first direction (arrow R). Accordingly, each row 30 has X pairs 24p of signal pin 24a, 24b and 2X individual signal pins 24a, 24b. Correspondingly, each column 32 has Y pairs 24p of signal pins 24a, 24b, and 2Y individual signal pins 24a, 24b.

As seen in Figs. 1-3, each signal pin 24a, 24b in a pair 24p has an inner side 34i that faces toward the other signal pin 24a, 24b in the pair 24p, an outer side 34o

opposite the inner side 34i, a primary side 34p that extends between the inner side 34i and the outer side 34o and that faces toward the primary edge 23 of the base 16, and a non-primary side 34a that extends between the inner side 34i and the outer side 34o and that faces away from the primary edge 23 of the base 16.

Each signal pin 24a, 24b (and each ground pin 28 as well) as shown in the drawings is generally rectilinear in transverse cross-section, and accordingly the sides 34i, 34o, 34p, 34a of each signal pin 24a, 24b (and the sides of each ground pin 26) are generally flat as shown. However, it will be appreciated that the signal pins 24a, 24b (and the ground pins 26) can have other configurations in transverse cross-section, including but not limited to circular, oblong, and multi-sides other than four. Nevertheless, the sides 34i, 34o, 34p, 34a of each signal pin 24a, 24b as designated above are still applicable even if such sides do not correspond to flat surfaces in transverse cross-section.

Although the present invention is described in terms of pairs 24p of differential signal pins 24a, 24b, it will be recognized that other arrangements or types of signal pins may be employed without departing from the spirit and scope of the present invention. For example, and depending on the particular application, the signal pins may be individually grouped (in a single-ended arrangement), or may be grouped into threes, fours, fives, etc.

Referring now to Figs. 1, 2, and 5, in the embodiment of the present invention shown, at least one ground shield 26 is associated with each signal pin 24a, 24b. Preferably, each ground shield 26 generally extends through the base 16 between the connector side 20 and the backplane side 22, and more preferably from about the surface of the connector side 20 to about the surface of the backplane side 22. Accordingly, each ground shield 26 preferably has a depth that generally corresponds to a thickness of the base 16 of the shroud 14. As a result, though not shown in Figs. 2-5, it should be apparent where the base 16 of the shroud 14 is positioned in relation to the signal pins 24a, 24b, ground shields 26, and ground pins 28.

Preferably, each ground shield is generally L-shaped and includes first and second attached wings 36a, 36b that are arranged at about right angles with respect to each other. The first wing 36a of each ground shield 26 may extend generally along the first direction (arrow R) adjacent and along the primary side 34p or the non-primary side 34a of

the associated signal pin 24a, 24b. Of course, to achieve shielding of each pair 24p of signal pins 24a, 24b, it is necessary that some order be provided with regard to which side (primary 34p or non-primary 34a) each first wing 36a extends. As but one example, each ground shield 26 associated with a signal pin 24a (to the left in Fig. 1) may extend along the primary side 34p thereof, and each ground shield 26 associated with a signal pin 24b (to the right in Fig. 1) may extend along the non-primary side 34a thereof.

Preferably, the first wings 36a of all the ground shields 26 extend adjacent and along one or the other of the primary side 34p and the non-primary side 34i of the respective associated signal pins 24a, 24b. As shown, the first wings 36a of all the ground shields 26 extend adjacent and along the primary side 34p of the respective associated signal pins 24a, 24b. However, and as was discussed above, in certain circumstances an alternate arrangement may be useful.

As seen in Figs. 1, 2, and 5, the second wing 36b of each ground shield 26 generally extends along the second direction (arrow C) adjacent and along the outside 34o of the associated signal pin 24a, 24b. With the plurality of ground shields 26 thus arranged with respect to the pairs 24p of signal pins 24a, 24b, then, and as best understood by viewing Fig. 1, the plurality of ground shields 26 in combination substantially electromagnetically isolate within the base 16 of the shroud 14 each pair 24p of signal pins 24a, 24b from every other pair 24p of signal pin 24a, 24b.

Preferably, for each pair 24p of signal pins 24a, 24b, the first wings 36a of the associated ground shields 26 extend toward each other and reside generally in a single plane. Preferably, such first wings 36a do not actually contact each other, and the distal end of each second wing 36b does not extend so far as to directly contact another ground shield 26. Accordingly, portions of the material forming the base 16 separate the ground shields 26 from one another, and in doing so provide structurally integrity to such base 16. Due to the lack of direct connections between ground shields 26, and as can be appreciated from Figs. 1, 2, and 5, unshielded gaps exist between the ground shields. Such gaps should be minimized so that the pairs 24p of signal pins 24a, 24b are adequately shielded.

As shown in Fig. 1, except for the pairs 24p in the bottom-most row 30, each pair 24p of signal pins 24a, 24b is substantially surrounded on all sides by ground shields 26. In particular, the outer sides 34o and primary sides 34p of the signal pins 24a,

24b are substantially surrounded by the first and second wings 36a, 36b of the associated ground shields 26, and the non-primary sides 34a of the signal pins 24a, 24b are surrounded by the ground shields 26 associated with the pair 24p of signal pin 24a, 24b immediately below. Since differential pairing is used, shielding between each signal pin 24a, 24b in each pair 24p is not believed to be necessary. If a single-ended arrangement is used, however, shielding between each row of signals may be used. The pairs 24p of signal pin 24a, 24b in the bottom-most row do not have shielding in the direction of the non-primary sides 34a. However, no other signal pins 24a, 24b are in the immediate vicinity in such un-shielded direction to create noise and/or cross-talk in the pairs 24p of signal pin 24a, 24b in the bottom-most row.

Preferably, and as can be seen from Figs. 1, 2, and 5, each ground shield 26 is generally identical to every other ground shield 26. Moreover, each ground shield 26 is symmetrical such that it can be placed adjacent a signal pin 24a or 24b. Accordingly, only one type of such ground shield 26 is necessary in constructing the header 10 of the first embodiment of the present invention. As best seen in Figs. 2 and 5, each ground shield 26 is of a relatively simple design and in fact may be stamped from an appropriate sheet of conductive material into a final form by known forming and/or stamping processes. Alternatively, each shield 26 may be molded or extruded by known processes.

Preferably, the shroud 14 of the header 10 is molded from a suitable insulative material such as a high temperature plastic into a final form by known processes, where such final form includes defined apertures for each signal pin 24a, 24b, each ground shield 26, and each ground pin 28. Also preferably, each ground shield 26 is inserted into the base 16 of the shroud 14 from either the connector side or backplane side 22, preferably by mechanical means, and such ground shield 26 maintains an interference fit with such base 16 of such shroud 14. Preferably, the first or second wing 36a, 36b (the first wing 36a in Figs. 2 and 5) of each ground shield 26 includes a bump 38a at a surface thereof to assist in maintaining the aforementioned interference fit of the ground shield 26 with the base 16 of the shroud 14.

Alternatively, each signal pin 24a, 24b, each ground shield 26, and/or each ground pin 28 may be over-molded in situ during formation of the base 16 and shroud 14.

However, it is presently believed that such in situ over-molding may be excessively complicated when compared to other available manufacturing techniques.

Preferably, each ground pin 28 electrically contacts at least one ground shield 26 at the second wing 36b thereof. More preferably, and as shown in Figs. 1 and 2, such contact occurs at the outer surface (the surface away from the associated signal pin 24a, 24b) of such second wing 36b. Preferably, every ground shield 26 electrically contacts a ground pin 28. Presumably, at some location, either in the complementary electrical connector, the mother board, or in another circuit, each ground pin 28 is electrically grounded. Accordingly, the ground shields 26 electrically contacted by the ground pins 28 are also grounded and are electrically coupled to one another. Although described up to now as rigid bumps 38a, 38b, other types of retention features may be employed without departing from the spirit and scope of the present invention. For example, one or both wings 36a, 36b in each ground shield 26 could include a compliant section (not shown) to retain such ground shield 26 in the base 16 of the shroud 14 and/or to retain an associated ground pin 28 in such base 16 of such shroud 14.

Preferably, and as best seen in Figs. 2 and 4, each ground pin 28 includes a generally planar fin 40 that generally resides within the base 16 of the shroud 14 and that extends generally laterally from the main body of the ground pin 28. As seen in Fig. 1, the fin 40 extends generally in the second direction (arrow C), and has generally opposing planar sides 42 (Figs. 2, 4). Accordingly, each ground shield 26 is electrically contacted by a ground pin 28 at a planar side 42 of the fin 40 of such ground pin 28.

Preferably, the ground pins 28 are arranged into a plurality of rows 30 that extend in the first direction (arrow R), and a plurality of columns 32be, 32bi that extend in the second direction (arrow C). As seen in Fig. 1, each row 30 of ground pins 28 corresponds to a row 30 of signal pin 24a, 24b, and each column 32be, 32bi of ground pins 28 alternates with a column 32a of pairs 24p of signal pins 24a, 24b. As seen, columns 32be of ground pins 28 are a pair of exterior or outer-most columns (left and right) and columns 32 bi of ground pins 28 are at least one interior column (four are shown in Fig. 1) positioned between such exterior columns 32be. Preferably, each ground pin 28 in each interior column 32bi is positioned between and electrically contacts first and second ground shields 26 on either lateral side of such ground pin 28. As will be described below,

each ground pin 28 in each interior column 32bi preferably contacts bumps 38b on wings 36b of such first and second ground shields 26. Also preferably, each ground pin 28 in each exterior column 32be is positioned adjacent and electrically contacts only a single ground shield 26 on one lateral side thereof.

In the case of a ground pin 28 in one of the interior columns 32bi, it is seen from Fig. 1 that the first ground shield 26 corresponding to such ground pin 28 is associated with a signal pin 24a, 24b of a first pair 24p of signal pins on one side of the ground pin 28 (the left side, for example), the second ground shield 26 is associated with a signal pin 24a, 24b of a second pair 24p of signal pin 24a, 24b on the other side of the ground pin 28 (the right side, to continue the example), and the first and second ground shields 26 electrically contact the ground pin 28 at either planar side of the fin 40 thereof. As seen, then, the first and second pairs 24p of signal pins 24a, 24b both reside in a row 30 that corresponds to the row 30 of the ground pin 28 at issue; more precisely, such ground pin 28 and such first and second pairs 24p of signal pin 24a, 24b can be considered to reside in a single row 30 (although not necessarily linearly aligned within the row 30). As also seen, such first and second pairs 24p of signal pins 24a, 24b respectively reside in immediately adjacent columns 32a on either side of the column 32bi of the ground pin 28 at issue.

In the case of a ground pin 28 in one of the exterior columns 32be, it is also seen from Fig. 1 that the single ground shield 26 corresponding to such ground pin 28 is associated with a signal pin 24a, 24b of a single pair 24p of signal pins on one side of such ground pin 28, and the single ground shield 26 electrically contacts the ground pin 28 at one planar side of the fin 40 thereof. Similar to the previous case, the single pair 24p of signal pins 24a, 24b resides in a row 30 corresponding to the row 30 of such ground pin 28. In this case, the single pair 24p of signal pins 24a, 24b resides in an immediately adjacent column 32a on only one side of the column 32be of such ground pin 28.

In either case, each ground pin 28 is preferably inserted into the base 16 of the shroud 14 from either the connector side or backplane side 20, 22 thereof, as with the ground shields 26. Such operation may be performed by appropriate automatic insertion machinery. Preferably, each ground pin 28 in the interior columns 32bi maintains an interference fit between contacted second wings 36b of the first and second ground shields

26, and more preferably between contacted bumps 38b on such second wings 36b. Correspondingly, it is preferable that each ground pin 28 in the exterior columns 32be interference fits between the contacted second wing 36b of the single ground shield 26 and with an interior surface of the base 16 (not shown) where such interior surface is opposite the contacted second wing 36b of the single ground shield 26. Preferably, and as best seen in Figs. 2 and 5, each second wing 36b of each ground shield 26 includes a bump or bumps 38b at a contact surface thereof (the outer surface as shown in Figs. 1, 2, and 5) to assist in electrically contacting the ground pin 28 at the fin 40 thereof, and to assist in maintaining the aforementioned interference fit.

As with the ground pins 28 and ground shields 26, each signal pin 24a, 24b is preferably inserted into the base 16 of the shroud 14 from either the connector side or backplane side 20, 22 thereof, and preferably maintains an interference fit with such base 16. Such insertion operation may be performed by appropriate automatic insertion machinery. More preferably, all of the aforementioned elements are inserted into the base 16 of the shroud 14 from the backplane side 22. As should be understood, the backplane side 22 is more readily accessible since it is not obstructed by any walls 18. Moreover, insertion from the backplane side 22 locks pins 24a, 24b, 28 in place upon securing the header 10 to the backplane 12. Preferably, and as seen in Figs. 2 through 4, each signal pin 24a, 24b and each ground pin 28 preferably includes various contact surfaces that assist in maintaining an interference fit directly with the base 16 of the shroud 14.

Preferably, each signal pin 24a, 24b and each ground pin 28 includes a compliant section 44 exterior from the base 16 adjacent the backplane side 22 thereof, as best seen in Figs. 2-4. As should be understood, each compliant section 44 maintains an interference fit with plated through holes in the backplane 12 when the header 10 is mounted thereto. As should be appreciated, it is undesirable to insert the compliant sections 44 into the base 16 of the shroud 14. Such compliant portions 44 may deform or likely would not easily fit through such base 16 during such insertion.

In one embodiment of the present invention, and referring again to Fig. 1, each signal pin 24a, 24b and each ground pin 28 in transverse cross-section is approximately 0.4 mm by 0.4 mm in width and height, in the region of the main pin portions that are received by the complementary electrical connector. Additionally, in

such embodiment, each ground shield 26 has a main thickness of about 0.2 mm. Accordingly, if each signal pin 24a, 24b and each ground pin 28 in a row 30 is spaced about 1.0 mm in the first direction (arrow R), each signal pin 24a, 24b may be separated from its corresponding ground shield 26 by about 0.4 mm. Such distance is sufficient to provide a reasonable degree of structural integrity to the base 16 of the shroud 14.

Referring now to Fig. 6, it is seen that in a second embodiment of the present invention, each ground pin 28' does not have the fin 40 of the ground pin 28 (Figs. 2 and 4), and each ground shield 26' does not have the contacting bump(s) 38b of the ground shield 26 (Figs. 2 and 5). Instead, each ground shield 26' includes an integral tab 46 that contacts a contact portion 48 of the ground pin 28', where the contact portion 48 is generally in-line with respect to the longitudinally extending ground pin 28'. Preferably, the tab 46 is formed within the ground shield 26' by an appropriate stamping or molding operation, and the tab 46 is inclined slightly away from the main body of the ground shield 26' and toward the ground pin 28'. Accordingly, the tab 46 is urged into good electrical contact with the contact portion 48 when the ground pin 28' and the ground shield 26' are mounted to the base 16 of the shroud 14 (not shown in Fig. 6). As shown, the ground pin 28' is for an interior column 32bi since two ground shields 26' flank such ground pin 28'. Of course, only one ground shield 26' would flank the ground pin 28' if such ground pin 28' were in an exterior column 32be.

Referring now to Fig. 7, it is seen that in a third embodiment of the present invention which is similar to the first embodiment as shown in Figs. 1-5, a primary header 10a has pairs 24p of signal pins 24a, 24b and ground pins 28 that extend a relatively longer distance (as compared with the header 10 of Figs. 1-5) beyond the backplane 12 than the header 10 shown in Figs. 1-5. In addition, a secondary header 10b is positioned on the other side of the backplane 12 and generally opposite the primary header 10a such that the secondary header 10b receives and includes the extended portions of the pairs 24p of signal pins 24a, 24b. Accordingly, the backplane 12 is sandwiched between the primary and secondary headers 10a, 10b, each header 10a, 10b shares the pairs 24p of signal pins 24a, 24b and the ground pins 28, and a circuit board mounted to the primary header 10a is directly interfaced through the backplane 12 to another circuit board mounted to the secondary header 10b. Each header 10a, 10b has its own ground shields 26 (the ground

shields 26 for the primary header 10a are not shown in Fig. 7). Unlike the primary header 10a, the secondary header 10b includes a plurality of securing contacts 50, where each securing contact 50 electrically contacts a respective ground pin 28 and secures such ground pin 28 to such header 10b. As seen, each securing contact 50 also electrically contacts at least one ground shield 26 within the secondary header 10b through bumps 38b, thereby electrically connecting the contacted ground shield(s) 26 with the contacted ground pin 28.

In particular, the primary header 10a of Fig. 7 is substantially identical to the header 10 of Figs. 1-5, except that the pairs 24p of signal pins 24a, 24b and ground pins 28 extend a relatively longer distance as compared with the header 10 of Figs. 1-5 to allow for rear plug-up. For example, in the header 10 of Figs. 1-5, such pins 24a, 24b, 28 extend about 4.3 mm through and beyond the backplane 12, while in the primary header 10a of Fig. 7, such pins 24a, 24b, 28 extend about 19 mm through and beyond the backplane 12.

Preferably, each pin 24a, 24b, 28 is formed such that the distal end thereof (i.e., the end associated with the secondary header 10b) is substantially identical to the proximal end thereof (i.e., the end associated with the primary header 10a). Accordingly, the secondary header 10b is instantiated by way of a second shroud 14 substantially identical to the shroud 14 of the primary header 10a, where the second shroud 14 is slipped over the distal end of each pin 24a, 24b, 28 (Fig. 7A) after such pins are inserted through the backplane 12. As should be understood, the second shroud 14 is then moved toward the backplane 12 until the base 16 of such second shroud 14 is generally parallel to and in contact with such backplane 12. As viewed from their respective connector sides 20, then, the primary header 10a and the secondary header 10b each present substantially the same profile, pin arrangement, and 'footprint'. In fact, it is preferable that the primary header 10a and the secondary header 10b each be able to receive the same type of complementary electrical connector in their respective wells. Preferably, the primary edge 23 of the secondary header 10b is directly opposite the primary edge 23 of the primary header 10a, with respect to the backplane 12.

As was discussed above, and as similarly shown in Figs. 2 and 4, each ground pin 28 in the primary header10a includes a generally planar fin 40 that generally

resides within the base 16 of the shroud 14 of the primary header 10a and that extends generally laterally from the main body of the ground pin 28. As seen, each fin 40 has generally opposing planar sides such that each ground shield 26 in the primary header 10a is electrically contacted by a ground pin 28 at a planar side of the fin 40 of such ground pin 28. As was also discussed above, each ground pin 28 is preferably inserted into the shroud 14 of the primary header 10a such that the fin 40 maintains an interference fit therewith.

However, and as should be understood, the insertion of each ground pin 28 through the backplane 12 prevents such ground pin 28 from having a second fin on the distal end thereof. Accordingly, and as was discussed above, it is preferable that the secondary header 10b include a plurality of securing contacts 50, where each securing contact 50 contacts a respective ground pin 28, secures such ground pin 28 to such header 10b, electrically connects such ground pin 28 to at least one ground shield 26 (through bumps 38b), and in effect performs the same function as a fin 40.

In particular, it is preferable that, prior to being mounted to the backplane 12 and the pins 24a, 24b, 28, the second shroud 14 be fitted with a plurality of conductive securing contacts 50, where one contact 50 is in each space in the base 16 of the second shroud 14 where a second fin of a ground pin 28 would otherwise reside. The insertion of contacts 50 is generally similar to the insertion of shields 26 into the base 16. As seen in Fig. 7B, each such securing contact 50 has generally opposing planar sides, and as positioned in the second shroud 14 of the secondary header 10b is electrically contacted on at least one side by a ground shield 26 in the secondary header 10a at a planar side of such securing contact 50.

When the second shroud 14 is slipped over the distal end of each pin 24a, 24b, 28 and moved toward the backplane 12, then, each securing contact 50 in such second shroud 14 securingly electrically contacts the side of a respective ground pin 28 and maintains an interference fit therewith. Preferably, each securing contact 50 includes a compliant or spring portion 52 in facing relation to the side of the respective ground pin 28 to assist in securingly electrically contacting the respective ground pin 28 and maintaining the interference fit therewith. As with the fin 40, each securing contact 50 engages bumps 38b on the contacted-to ground shields 26. However, any other appropriate mechanism

may be employed to perform such functions without departing from the spirit and scope of the present invention.

With such securing contacts 50, the ground shields 26 in the second shroud 14 are electrically coupled to the ground pins 28. In addition, the entire second shroud 14 is secured to the backplane 12. The interference fit between the securing contacts 50 and the ground pins 28 secures the second shroud 14 to the backplane 12.

In the foregoing description, it can be seen that the present invention comprises a new and useful header 10 for being mounted to a circuit substrate such as a backplane 12. The header 10 can have multiple differential signal pairs 24p in relatively high density, and ground shields 26 for each pair 24p such that each pair 24p of signal pins 24a, 24b is shielded from every other pair 24p of signal pins 24a, 24b by such ground shields 26. Moreover, the header is practical and relatively easily manufactured. It should be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the inventive concepts thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed, but it is intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.

CLAIMS

1. An electrical connector body, comprising:

a base;

a plurality of apertures in said base for securing contacts to said base;

a plurality of ground shields residing within said base;

wherein adjacent ground shields are disposed in opposite orientations.

2. The electrical connector body as recited in claim 1, wherein said ground shields reside entirely within said base.

3. The electrical connector body as recited in claim 1, in combination with ground pins and signal pins disposed within corresponding apertures in said base to form a header connector.

4. The electrical connector body as recited in claim 3, wherein said ground pins have a fin for engaging said ground shield.

5. The electrical connector body as recited in claim 3, wherein one of said ground pins engages adjacent ground shields.

6. The electrical connector body as recited in claim 5, wherein each of said adjacent ground shields have a projection extending towards the other adjacent ground shield.

7. The electrical connector body as recited in claim 6, wherein the projection is a protuberance on a surface of said ground shield.

8. The electrical connector body as recited in claim 6, wherein the projection is a tab extending from said ground shield.

9. The electrical connector body as recited in claim 1, further comprising a plurality of intermediate ground shields, each of said intermediate ground shields disposed between said adjacent ground shields.

10. The electrical connector body as recited in claim 1, wherein adjacent ground shields are arranged in mirror image.

11. A header, comprising:

a body;

a plurality of signal pins extending from said body; and

a plurality of generally L-shaped ground shields within said body, each ground shield associated with a corresponding one of said signal pins.

12. The header as recited in claim 11, wherein said signal pins are arranged in columns, said ground shields are arranged in columns, and at least one column of said ground shields resides between adjacent columns of said signal pins.

13. The header as recited in claim 12, wherein at least two columns of said ground shields reside between adjacent columns of said signal pins.

14. The header as recited in claim 13, wherein two columns of said signal pins are flanked on both sides by two columns of said ground shields.

15. The header as recited in claim 11, further comprising ground pins extending through said body, each ground pin corresponding to at least one of said ground shields.

16. The header as recited in claim 15, further comprising a plurality of intermediate ground shields within said body, each intermediate ground shield contacting a corresponding one of said ground shields and a corresponding one of said ground pins to connect said ground pin to said ground shield.

17. The header as recited in claim 15, wherein said ground pins comprise a fin for contacting said ground shields.

18. The header as recited in claim 15, wherein at least some of said ground pins correspond to two ground shields.

19. The header as recited in claim 18, wherein said ground pins are interstitially arranged relative to said signal pins.

20. The header as recited in claim 18, wherein two adjacent ground shields each have a projection extending towards the other ground shield.

21. A header, comprising:

a body;

a plurality of ground shields in said body;

a plurality of receiving areas located between adjacent ground shields;

a plurality of ground pins extending through said body, each having a longitudinal portion generally offset from said receiving area; and

a plurality of conductive elements, each disposed within said receiving area for connecting a corresponding one of said ground pins to a corresponding one of said ground shields.

22. The header as recited in claim 21, wherein said conductive element is a part of said ground pin extending transverse to said longitudinal portion.

23. The header as recited in claim 21, wherein said conductive element is an intermediate ground shield.

24. A header system mountable to a circuit substrate having first and second opposed sides, comprising:

a first header positionable on said first side of said circuit substrate and including:

a body;

a plurality of ground shields in said body; and

a plurality of apertures in said body; and

a second header positionable on said second side of said circuit substrate and including:

a body;

a plurality of ground shields in said body;

a plurality of intermediate ground shields in said body, each corresponding to and contacting at least one of said ground shields; and

a plurality of apertures in said body; and

a plurality of ground pins, each extending through a corresponding one of said apertures in said first and second header bodies and contacting at least one of said ground shields in said first header and said intermediate ground shield in said second header and adapted to pass through said circuit substrate.

25. The header system as recited in claim 24, further comprising signal pins, each extending through corresponding through a corresponding one of said apertures in said first and second header bodies.

26. The header system as recited in claim 25, wherein said signal pins are arranged in columns, said ground shields are arranged in columns and said columns of said ground shields are positioned between adjacent columns of said signal pins.

27. The header system as recited in claim 26, wherein two columns of signal pins flank each side of two columns of ground shields.

28. The header system as recited in claim 27, wherein said ground pins each comprise:

a longitudinally extending section for contacting said intermediate ground shield in said second header; and

a transverse section extending from said longitudinally extending section for contacting said ground shield in said first header.

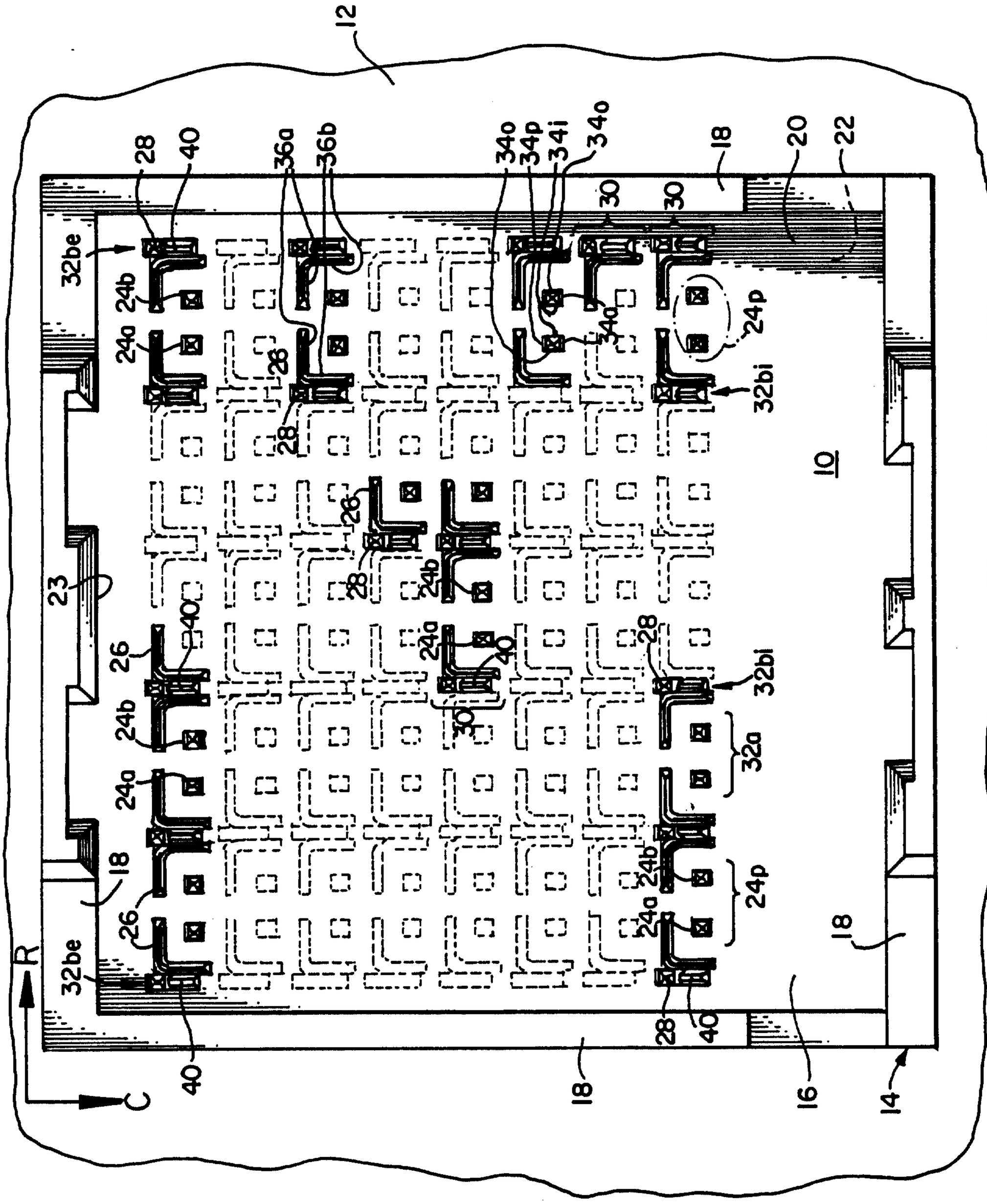
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FIG. 1

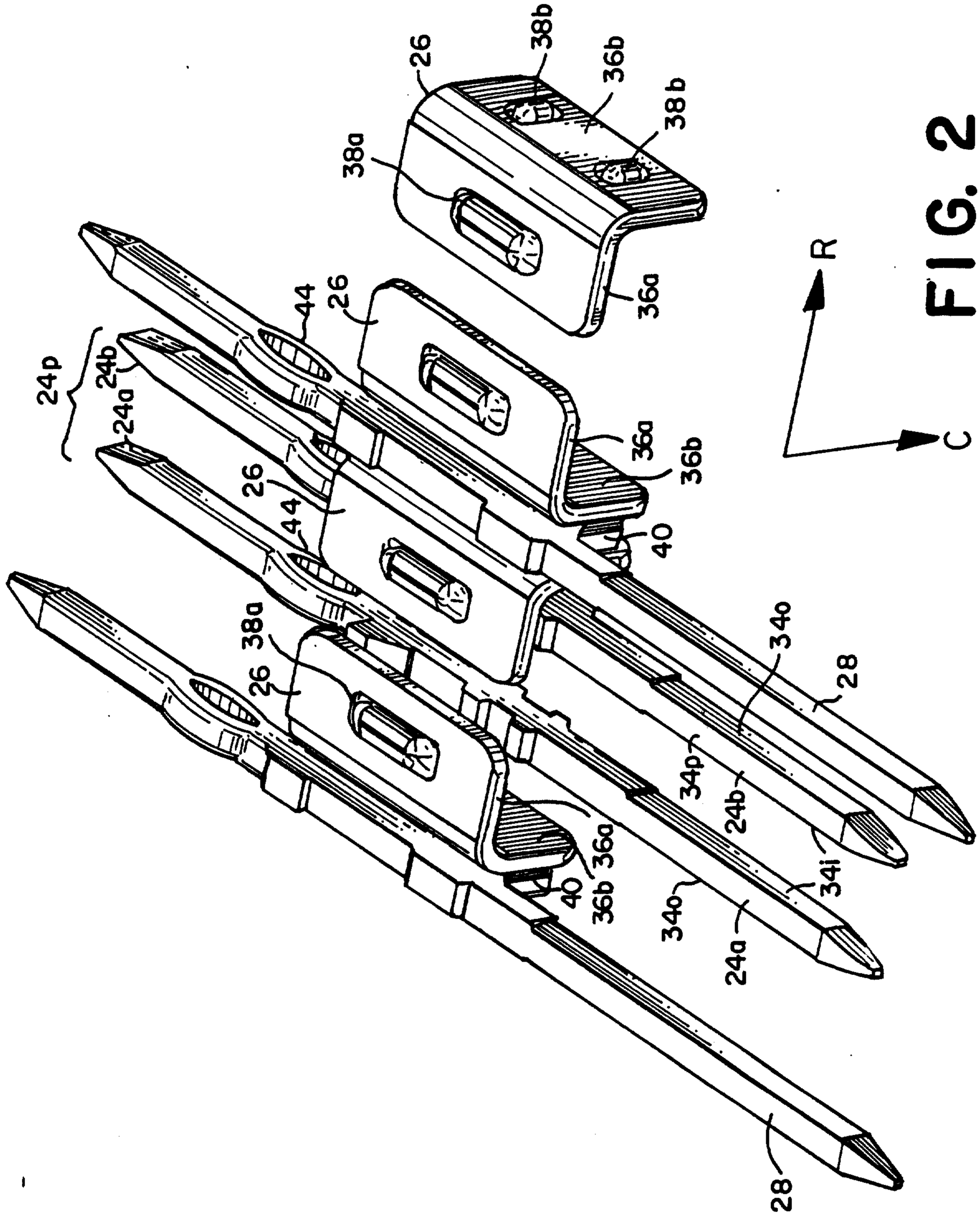
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FIG. 2

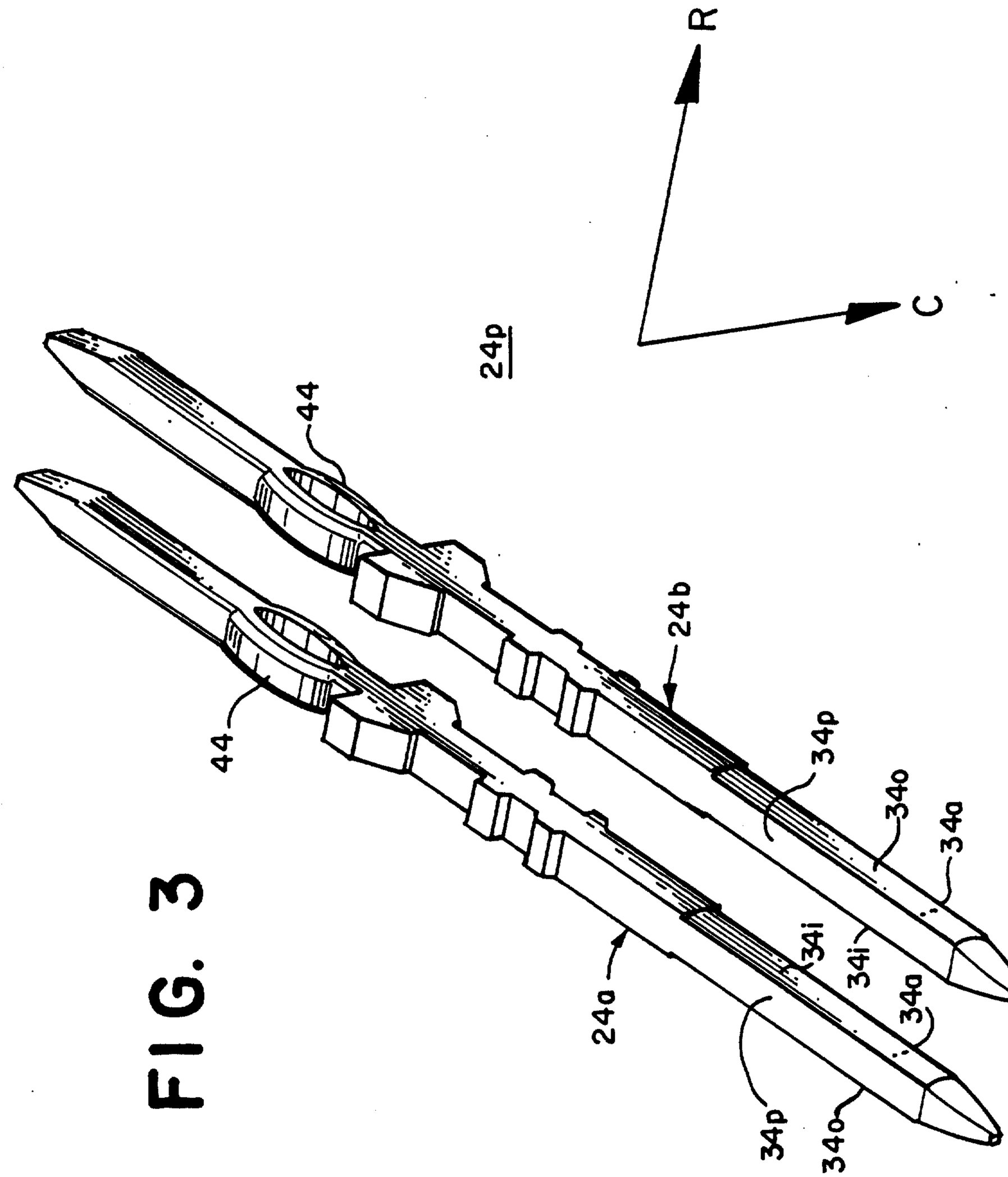

FIG. 3

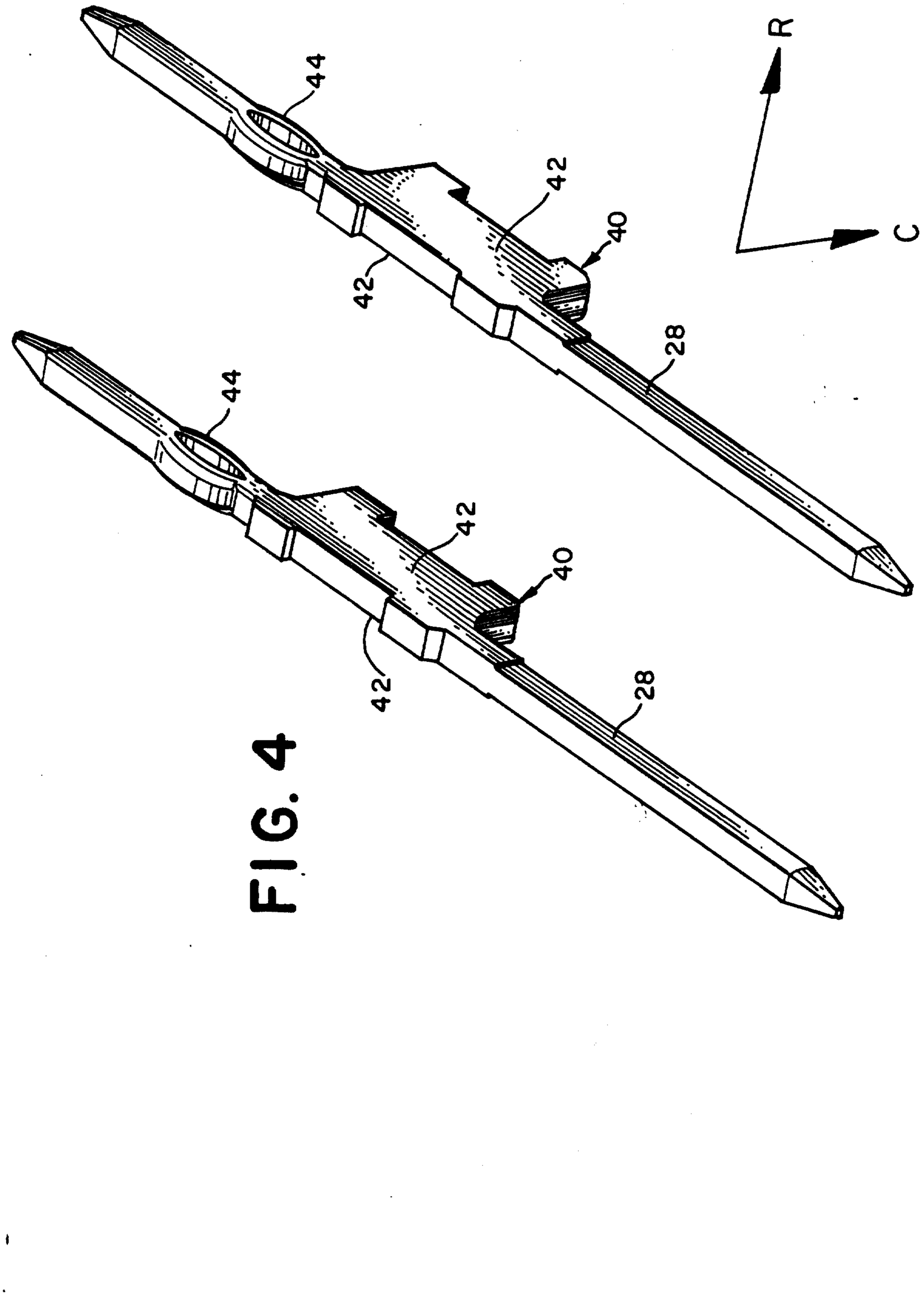

FIG. 4

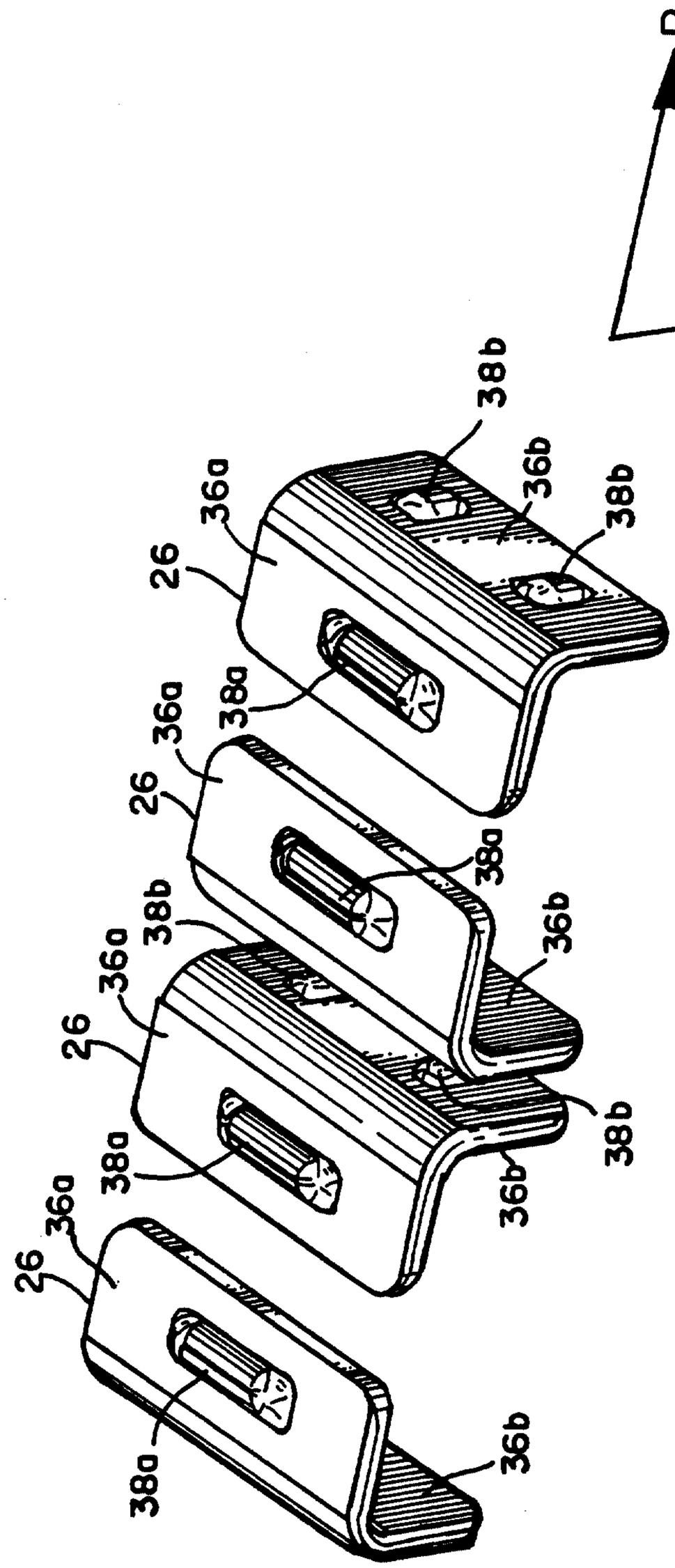
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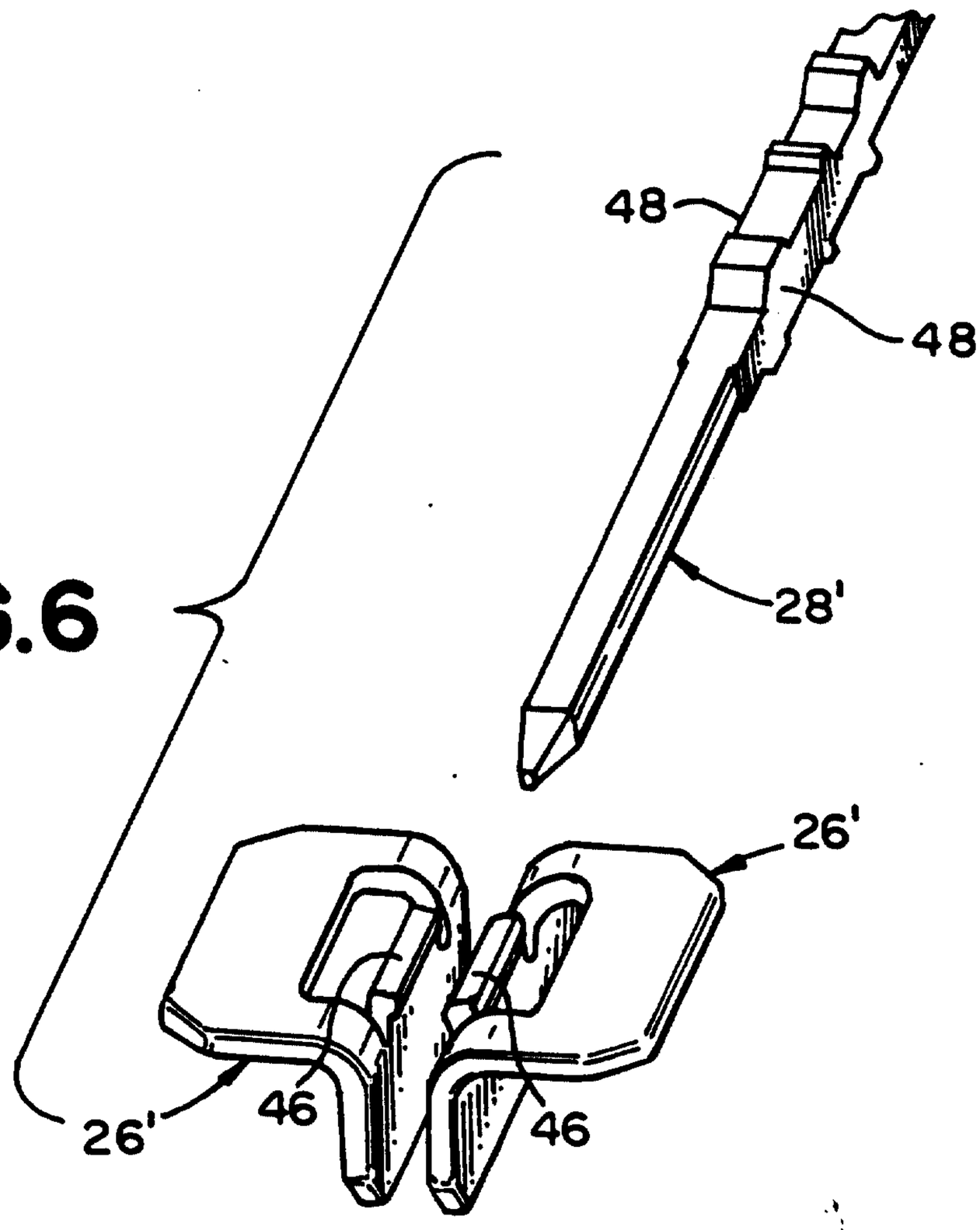
FIG. 5

FIG.6



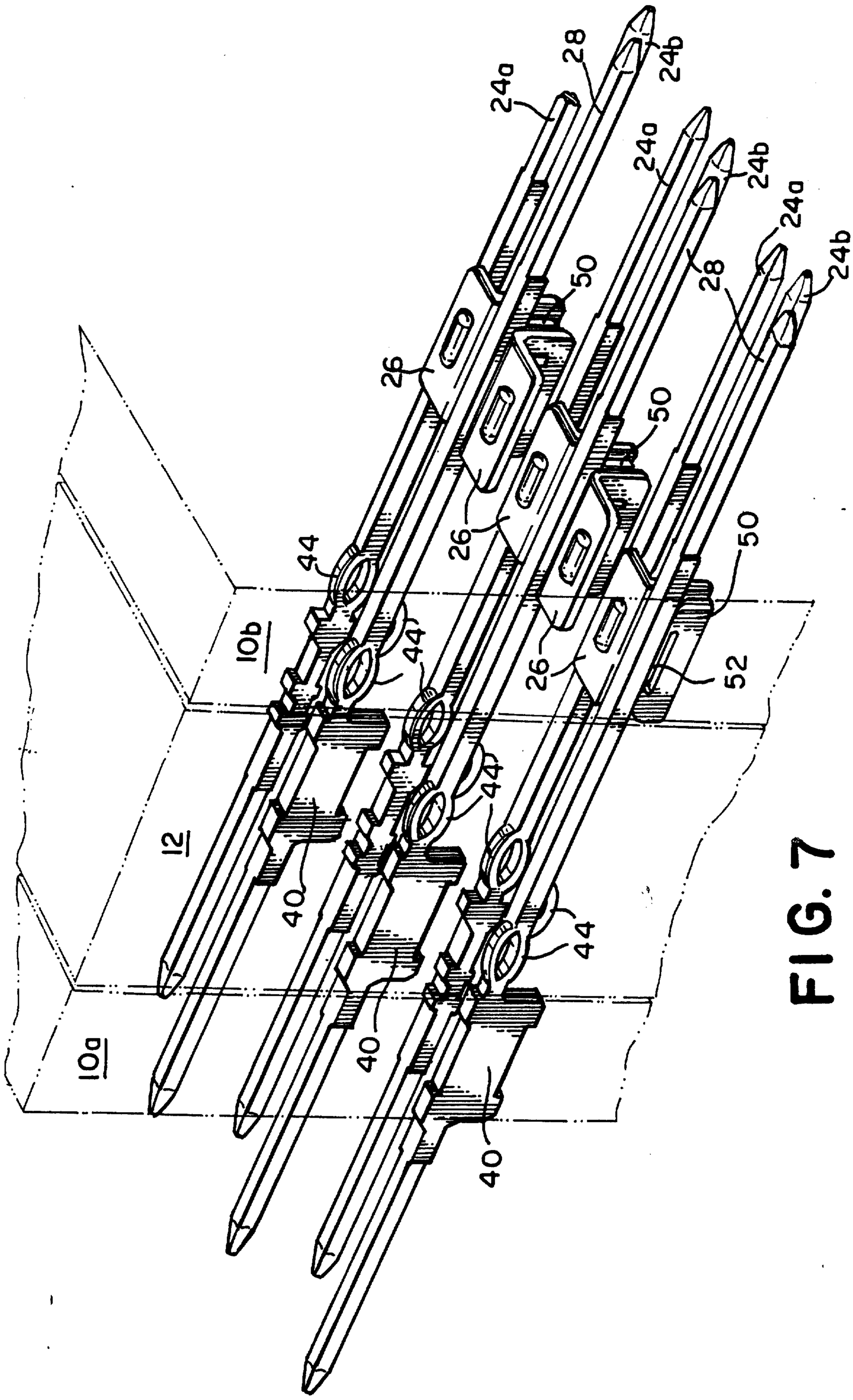

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FIG. 7

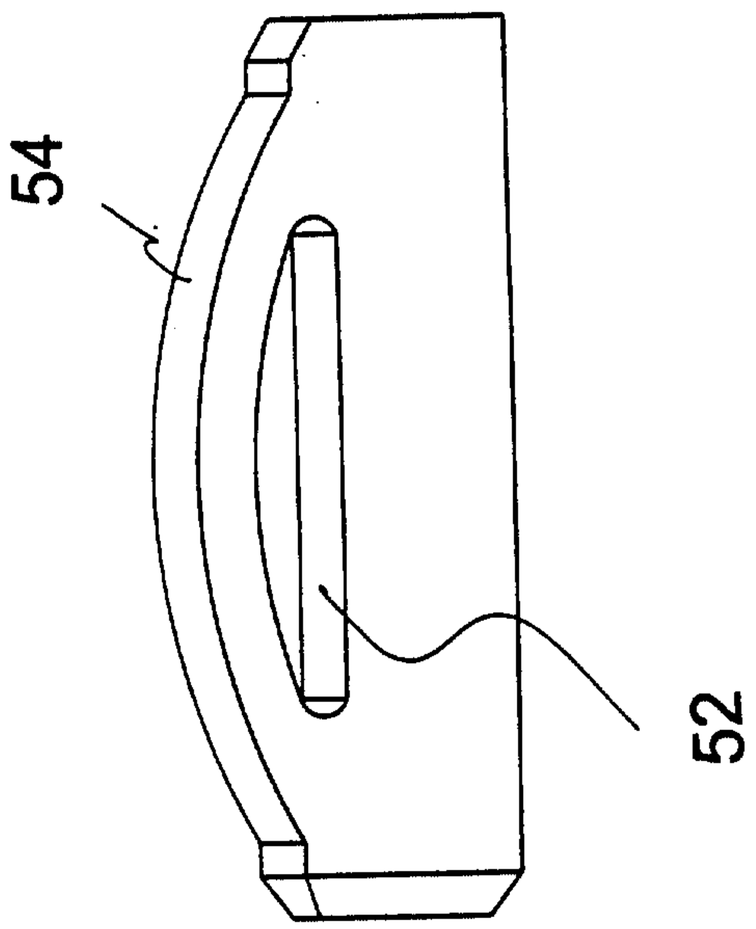


Fig. 7B

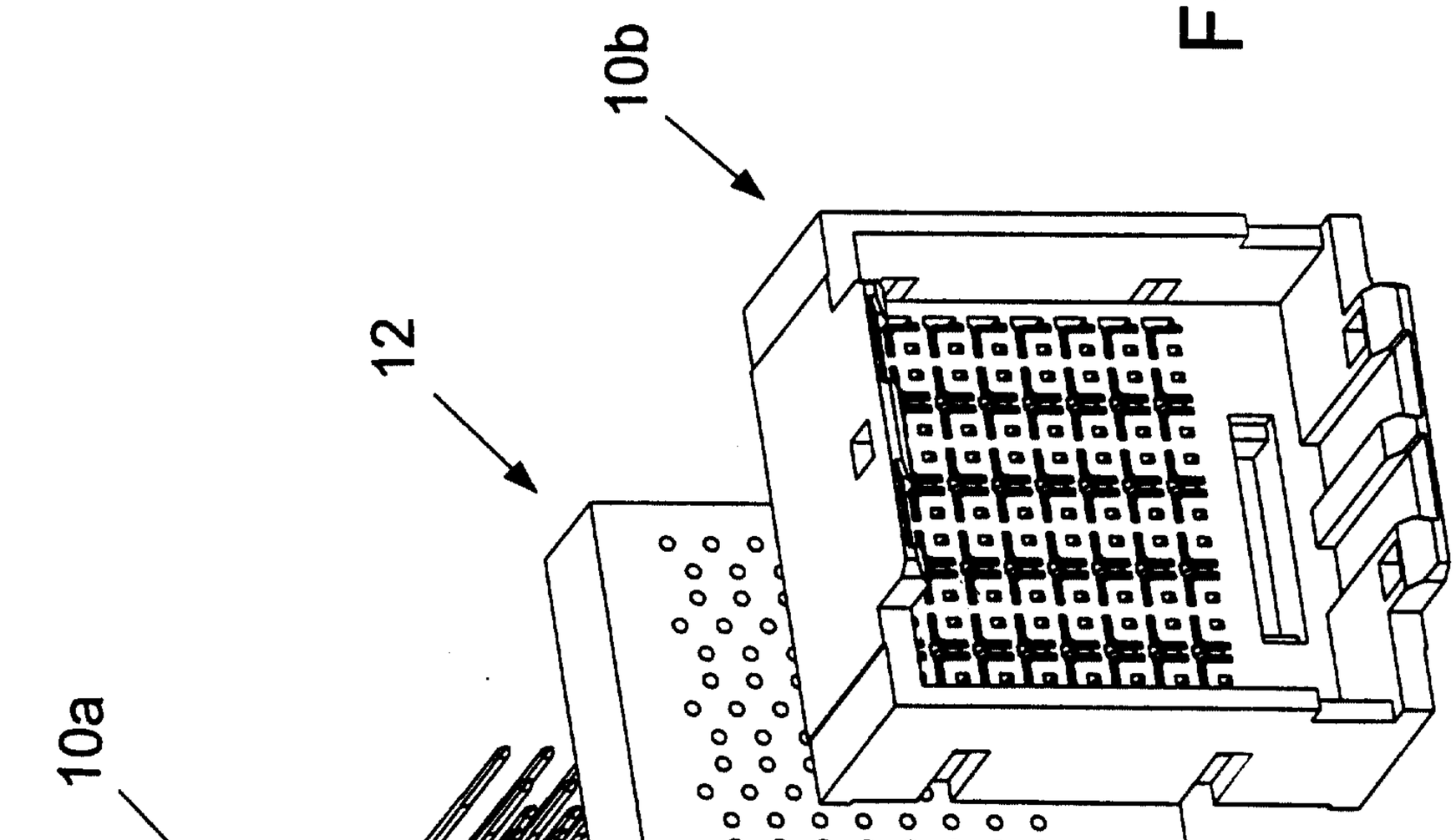
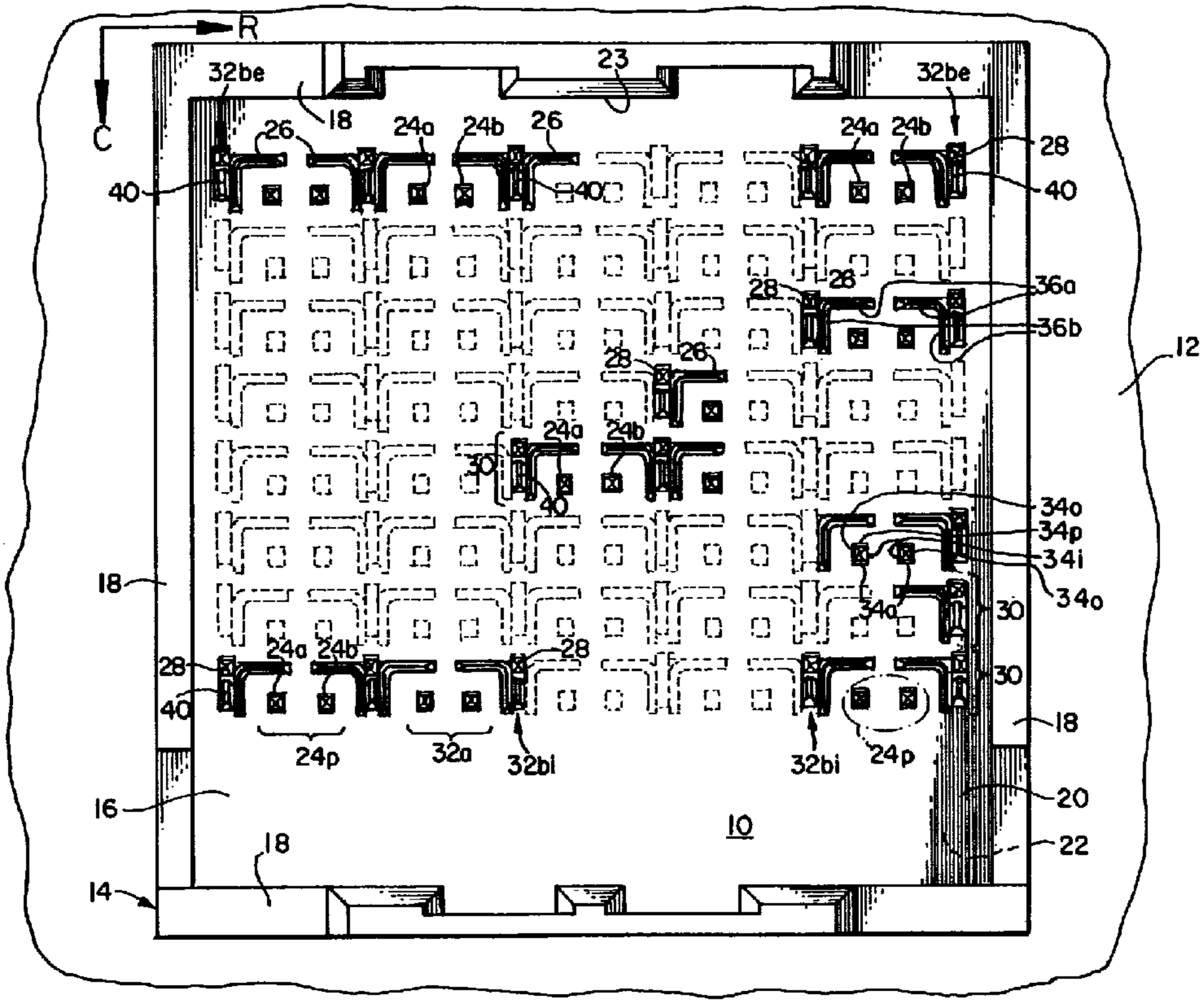


Fig. 7A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