Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2493681 A1 2006/07/21

(21) 2 493 681

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2005/01/21

(41) Mise à la disp. pub./Open to Public Insp.: 2006/07/21

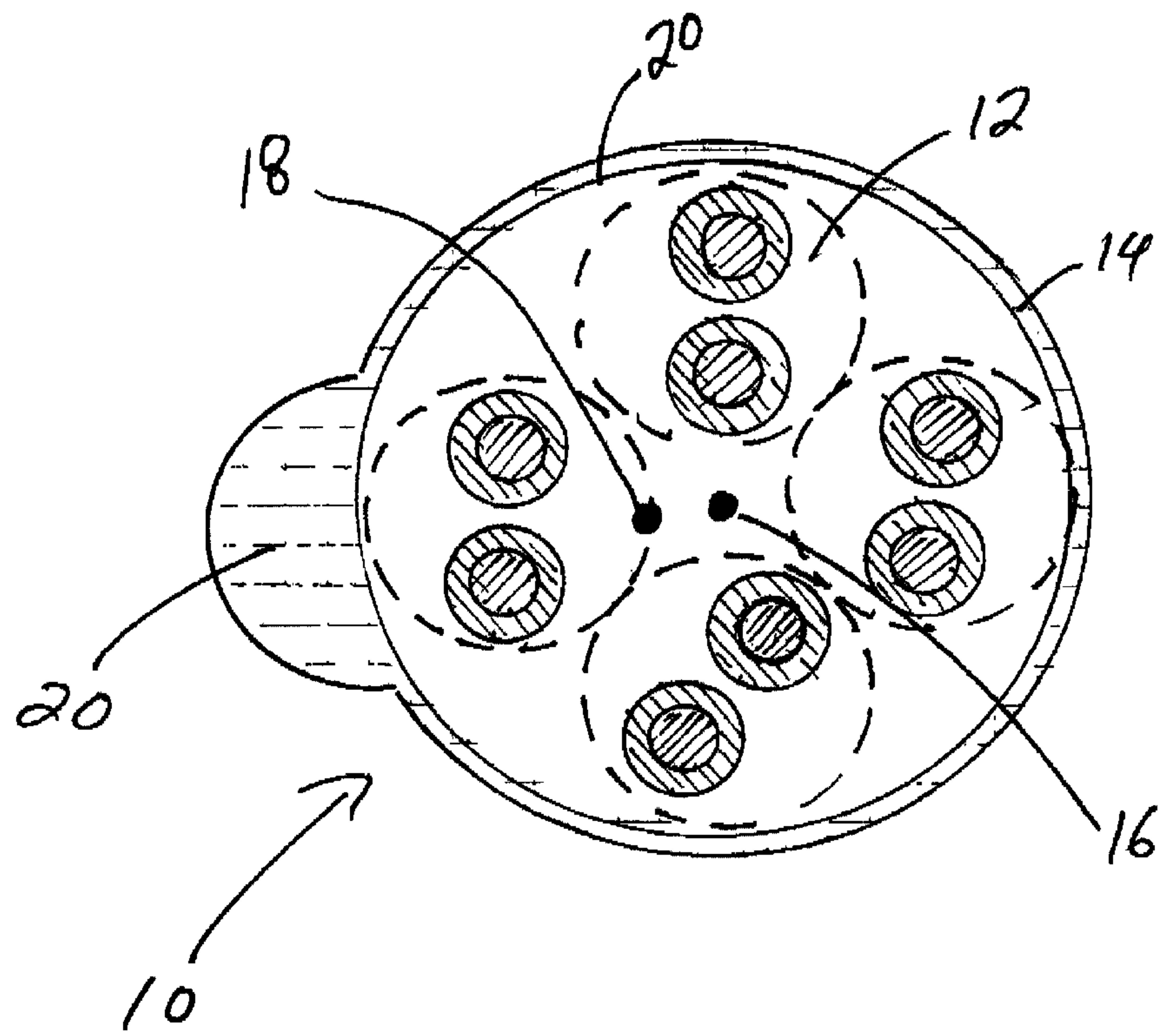
(51) Cl.Int./Int.Cl. *H01B 11/02* (2006.01), *H01B 11/04* (2006.01)

(71) Demandeur/Applicant:
NORDX/CDT, INC., CA

(72) Inventeurs/Inventors:
VEXLER, GAVRIEL, CA;
BOHBOT, MICHEL, CA;
DION, YVES, CA;
HUMPHREY, ERIC, CA;
RICHARD, MICHEL, CA

(74) Agent: GOUDREAU GAGE DUBUC

(54) Titre : SYSTEME DE CABLAGE A HAUT RENDEMENT
(54) Title: HIGH PERFORMANCE CABLING SYSTEM



TITLE OF THE INVENTION

High Performance Telecommunications Cable

FILED OF THE INVENTION

[001] The present invention relates to a high performance telecommunications cable. In particular the present invention relates to a staggered asymmetric cross web as well as a cable design including a rod wound around the cable core improving PSANEXT.

BACKGROUND OF THE INVENTION

[002] The introduction of a new IEEE proposal for 10G (Gigabit per second) transmission speeds over copper cable has spearheaded the development of new copper Unshielded Twisted Pair (UTP) cable designs capable to perform at this speed.

[003] As known in the art, such UTP cables typically consist of four twisted pairs of conductors each having a different twist lay. In many installations, a number of UTP cables are arranged in cable runs such that they run side by side in parallel. In particular, in order to simplify the installation of UTP cables in cable runs, EMC conduit, patch bays or the like, a number of UTP cables are often bound together using twist ties or tape or the like. A major technical difficulty in such installations is the electromagnetic interference between the twisted pair conductors of a "victim" cable and the twisted pair conductors of other cables in the vicinity of the victim cable (the "offending" cables). This electromagnetic interference is enhanced by the fact that, in 10G systems where all twisted pairs of the UTP cable are required to support the high speed transmission, all conductors in a first cable are the "victims" of the twisted pair

conductors of all other cables surrounding that first cable. These like pairs, having the same twisting lay, act as inductive coils that generate electromagnetic interference into the conductors of the victim cable. The electromagnetic interference, or noise, generated by each of the offending cables into the victim cable is generally known in the art as Alien Cross Talk or ANEXT. The calculated overall effect of the ANEXT into the victim cable is the Power Sum ANEXT or PSANEXT.

[004] Alien NEXT and PSANEXT are important parameters to minimise as active devices such as network cards are unable to compensate for noise external to the UTP cable to which it is connected. As a result, active systems at receiving and emitting ends of 10G Local Area Networks are able to cancel internal Cross Talk (or NEXT) but cannot do the same with ANEXT. This is also due to some degree in the relatively high number of calculations involved if it is wished to compensate for ANEXT (24 emitting pairs in ANEXT calculations vs. 3 emitting pairs in NEXT calculations).

[005] In order to reduce the PSANEXT to the required IEEE draft specification requirement of 60 dB at 100 MHz, cable designers typically manipulate a few basic parameters that play a leading role in the generation of electromagnetic interference between cables, namely:

- Geometry: (1) The distance between pairs, longitudinally, in adjacent cables; (2) the axial X-Y asymmetry of the pairs a cable cross-section; and (3) the thickness of the jacket; and
- Balance: improved balance of the twisted pairs and of the overall cable is known to reduce emission of electromagnetic interference and increase a cable's immunity to electromagnetic interference.

[006] Currently, the only commercial design of a 10G cable incorporates a

design that creates an asymmetry along one axis with a special asymmetric cross web that separates the four (4) pairs in the cable (see Figure 1). This cable incorporates twisted pairs with very short twisting lays and stranding lays that are known to enhance the balance of the twisting lays.

SUMMARY OF THE INVENTION

[007] To address the above and other drawbacks of the prior art there is disclosed a telecommunications cable for improving both internal and external NEXT. This is done in part using an asymmetric cable. that is a cable having consecutive multiform cross sections along its longitudinal axis, dimensioned as such to reduce alien cross talk. Additionally, random twist and strand lays may also be used to reduce alien cross talk.

[008] There is disclosed a telecommunications cable comprising a plurality of twisted pairs of insulated conductors arranged around and running generally along a first axis and a cable jacket surrounding the twisted pairs. The jacket comprises an outer surface having a second axis at the cable centroid. The second axis and centroid travel helicoidally down the cable length about the first axis.

[009] In a first embodiment. a twist and strand lay of the twisted pairs and cable respectively are randomized.

[010] In a second embodiment, the cable jacket is of uneven thickness and further comprises an inner wall having an axis substantially coaxial to the first axis.

[011] In a third embodiment, the cable further comprises a filler material wound helicoidally around the twisted pairs within the cable jacket.

[012] In a fourth embodiment, the cable further comprises a filler material wound helicoidally around the twisted pairs within the cable jacket, the filler material being wound according to a fixed lay, a variable lay or a random lay.

[013] In a fifth embodiment, the cable further comprises a rod wound helicoidally around the twisted pairs inside the cable jacket.

[014] In a sixth embodiment, the plurality of twisted pairs are helicoidally twisted around the first axis in a direction opposite to a direction of the second axis.

[015] In a seventh embodiment where the cable comprises four twisted pairs of conductors, the cable further comprises a cross web separating the twisted pairs.

[016] In a eighth embodiment, the cross web comprises a first dividing strip and a second dividing strip intersecting the first dividing strip and substantially perpendicular to the first dividing strip. A point of intersection between the first dividing strip and the second dividing strip varies helicoidally along the cable relative to an axis of an outer surface of the cable jacket.

[017] There is also disclosed a telecommunications cable comprising a plurality of twisted pairs of conductors arranged around and running generally along a first axis, a cable jacket surrounding the twisted pairs, and a protrusion arranged around and running generally along an outer surface of the jacket. The protrusion is arranged helicoidally around the first axis.

[018] In a first embodiment of the cable, the plurality of twisted pairs are helicoidally twisted around the first axis in a direction opposite to a direction of

twist of the protrusion.

[019] In a second embodiment, the protrusion is formed by varying a thickness of the cable jacket.

[020] In a third embodiment, the protrusion is formed by winding a rod around the twisted pairs inside of the cable jacket.

[021] In a fourth embodiment, the protrusion is formed by winding a rod outside of the cable jacket.

[022] In a fifth embodiment, the protrusion is formed by winding a rod within the cable jacket.

[023] Additionally, there is disclosed a telecommunications cable comprising a first set of two twisted pairs of conductors arranged on opposite sides of and running generally along an axis . and a second set of two twisted pairs of conductors on opposite sides of and running generally along the axis. A distance between each twisted pair of the first set and the axis is substantially the same and a distance between each twisted pair of the second set and the axis is substantially the same. A distance between the first set of twisted pairs is less than a distance between the second set of twisted pairs.

[024] In a first embodiment, the first and second sets of twisted pairs are twisted helicoidally around the axis.

[025] In a second embodiment, a twist lay of each of the twisted pairs of the first set is greater than a twist lay of each of the twisted pairs of the second set.

[026] In a third embodiment, a distance between a first twisted pair of the first

set and a first twisted pair of the second set is greater than a distance between the first twisted pair of the first set and a second twisted pair of the second set.

[027] There is also disclosed a cross web for use in a telecommunications cable, the cross web comprising a principal dividing strip comprised of a middle strip and first and second outer strips, and first and second subsidiary dividing strips attached longitudinally along the principal strip and on opposite sides thereof. A point of attachment of the first subsidiary strip is between the middle strip and the first outer strip and a point of attachment of the second subsidiary strip is between the second outer strip and the middle strip.

[028] In a first embodiment, a width of the middle strip is substantially constant.

[029] In a second embodiment, a width of the first and second outer strips is substantially constant.

[030] In a third embodiment, the subsidiary strips are attached substantially at right angles to the principal strip (of course, they could also be attached at an angle which is not a right angle).

[031] In a fourth embodiment, a width of the first and second outer strips is substantially the same.

[032] In a fifth embodiment, a width of the principal strip is greater than a width of the subsidiary strips combined.

[033] In a sixth embodiment, a width of the principal strip is substantially constant.

[034] In a seventh embodiment, a thickness of the principal strip is substantially the same as a thickness of the subsidiary strips.

[035] In an eighth embodiment, a thickness of the principal strip is greater than a thickness of the subsidiary strips.

[036] In a ninth embodiment, a thickness of the first subsidiary strip is greater than a thickness of the second subsidiary strip.

[037] In a tenth embodiment, the strips are manufactured from a material selected from a group consisting of a flexible dielectric material, a flexible electromagnetic shielding material and a flexible flame retardant material or combinations thereof.

[038] In an eleventh embodiment, the cross web further comprises a first filler element attached along a first edge of the principal strip and a second filler element attached along a second edge of the principal strip.

[039] In a twelfth embodiment, the first and second filler elements are attached substantially at right angles to the principal strip.

[040] In a thirteenth embodiment, a point of attachment of each of the filler elements to the principal strip is located towards a centre of the filler elements.

BRIEF DESCRIPTION OF THE DRAWINGS

[041] Figure 1 is a cross section of a prior art cross web;

[042] Figures 2A, 2B and 2C are cross sections of a cable in accordance with illustrative embodiments of the present invention;

[043] Figures 3 and 4 are cross sections of a cable having a cross web therein in accordance with alternative illustrative embodiments of the present invention;

[044] Figure 5A presents a side view of a cable in accordance with an illustrative embodiment of the present invention;

[045] Figures 5B, 5C and 5D are subsequent cross sections of the cable of Figure 5A;

[046] Figure 6 is a cross section of a cable having a cross web in accordance with an alternative illustrative embodiment of the present invention;

[047] Figure 7 is a cross section of a cable having a cross web and a protruding rod therein in accordance with an illustrative embodiment of the present invention; and

[048] Figure 8 is a cross section of a cable having an asymmetry cross web therein in accordance with an alternative illustrative embodiment of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

[049] Referring now to Figures 2A, 2B and 2C, a cable, generally referred to using the numeral 10, is disclosed. The cable 10 is generally comprised of a set of twisted pairs, as in 12 and a cable jacket 14. The twisted pairs 12 are generally helically disposed about a primary cable axis 16, generally according to a standard fixed, variable or random strand lay, whereas the cable jacket 14 is generally disposed about a secondary axis 18, such secondary axis 18 generally defined by the geometrical center or centroid of the cable cross

section, that is helically twisted or wound about the primary axis 16. Consequently, thought the inner surface 20 of the jacket 14 remains substantially parallel and collinear with the primary axis 16, the outer surface of the jacket 14 provides a helically variable jacket thickness along the cable 10. This feature allows the cable 10 to provide a rotating asymmetric cross section that reduces Alien NEXT between adjacent cables, namely by varying the distance between twisted pairs of adjacent cables. As will be discussed further hereinbelow, such cable constructions also allow to reduce nesting between cables, providing additional performance with regards to ANEXT.

[050] In the first illustrative embodiment of Figure 2A, the twisted pairs 12 are conventionally disposed about the first cable axis 16, whereas the cable jacket 14 is manufactured such that jacket material is asymmetrically distributed around the jacket defining a second axis 18 at the cable's geometrical center or centroid that is offset from the first axis 16. The uneven distribution of the jacket 14, and thereby the second axis 18, is helicoidally wound about the primary axis 16, which results in providing a cable as described above that reduces the effects of Alien NEXT with adjacent cables.

[051] In Figure 2B, a second embodiment of the present invention is presented. The cable 10 is comprised of the usual four (4) twisted pairs 12 disposed conventionally about a first axis 16, and an eccentric jacket 14 defining a protuberance 20 at its outer surface. In this embodiment, the protuberance or ridge 20 is added to the outer surface of the jacket 14, either externally coupled thereto or directly manufactured therein, thereby again defining a secondary axis 18 centered at the geometrical center or centroid of the cable 10 offset from the primary axis 16. The protuberance 20, and consequently the secondary axis 18, are wound helicoidally about the primary axis of the cable 10 thereby again generating the desired effect.

[052] In Figure 2C, a third embodiment of the present invention is presented. In this embodiment, the twisted pairs 12 are disposed about the primary axis 16, and a solid rod or filler material 22 is disposed helically about the twisted pairs 12. A cable jacket 14 confines the twisted pairs 12 and the rod or material 22 therein. By winding the rod or material 22 about the twisted pairs 12, a helically rotating protuberance 20 is generated on the outer surface of the jacket 14, defining once again a helically rotating secondary axis 18 centered a the helicoidally rotating geometrical center or centroid of the cable. This third embodiment thus also produces the desired effect by providing a helically rotating cable cross section that reduces nesting and Alien NEXT between adjacent cables. Illustratively, the round rod 22 is manufactured from a non-conductive dielectric material such as plastic, or the like, in either a solid or stranded form.

[053] Consequently, cable cross section asymmetry is attainable using various jacket constructions. As illustrated in Figures 2A to 2C, adequate spacing between adjacent cables 10 may be attained to reduce nesting, and consequently Alien NEXT by using helically rotating jacket asymmetries in cable manufacture. Necessarily, other such embodiments may be developed to produce a same effect. Namely, the protuberances 20 of Figures 2A and 2B may be produced by a solid rod or filler material wound directly around the twisted pairs 12 inside the cable jacket 14, within the cable jacket 14 or again on the outer surface of the cable jacket 14. Furthermore, protuberances of various cross sections, such as the illustrated circular, semi-circular and crescent cross sections of Figure 2A, 2B and 2C respectively, and other like protuberances of substantially square, rectangular, triangular or multiform cross section may also be considered.

[054] In addition, in order to increase the potential benefits of such techniques, the secondary axis 18 and the twisted pairs 12 of the above illustrative

embodiments should be wound and twisted in opposite directions. Namely, a right-handed helical disposition of the twisted pairs around the first axis 16 should be coupled with a left-handed helical disposition of the jacket protuberance or asymmetry. Furthermore, by randomizing or varying the helicity of these asymmetries and protuberances, rather than maintaining a fixed lay, nesting and Alien NEXT is further reduced between adjacent cables 10.

[055] Referring now to Figure 3, an alternative illustrative embodiment of the present invention, where a cable 10 comprised of four (4) twisted pairs of insulated conductors as in 12 is surrounded by a cable jacket 14 and separated by a cross web 24, is disclosed. The cross web 24 comprises a principal dividing strip 26 comprised of a middle strip 28 and first and second outer strips 30 and 32 respectively. The cross web 24 is further comprised of a first subsidiary dividing strip 34 and second subsidiary dividing strip 36 attached longitudinally along the principal strip 26 and on opposite sides thereof for maintaining a prescribed separation between twisted pairs 12_{1A}, 12_{1B}, 12_{2A}, 12_{2B} and the cable jacket 14 covering the cross web 24 and twisted pairs as in 12. The first point of attachment 38 of the first subsidiary strip 34 is between the middle strip 28 and the first outer strip 30, and the second point of attachment 40 of the second subsidiary strip 36 is between the middle strip 28 and the second outer strip 32. The cross web 12 improves the geometry of the cable 10 by creating an asymmetry on both the X and Y-axes that translates into a helical pattern of the pairs in the Z direction, i.e. along the length of the cable 10.

[056] The addition of such a cross web provides various performance benefits with regards to reduction of Alien NEXT between adjacent cables. Firstly, the incorporation of cross web 24 allows for the generation of a helically varying

cable cross section, as discussed above with reference to the Figures 2A to 2C, that allows greater separation between the twisted pairs of adjacent cables. Though the cable cross section remains centrally symmetric, that is the primary axis 16 and the secondary axis 18 as defined above remain substantially overlaid, by controlling the strand lay, whether keeping it fixed, variable or randomized, the non-circular cable cross section will still be helically rotated about the primary axis, thereby producing a helically rotating cable cross section that can ultimately reduce nesting and Alien NEXT.

[057] In addition, cross web 24 also provides the ability to control the internal and external juxtaposition of twisted pairs 12. For instance, twisted pairs with longer twist lays are generally more susceptible to NEXT and Alien NEXT. Though NEXT may be substantially balanced out and compensated for using appropriate connectors and compensation techniques, Alien NEXT generally remains harder to address. Consequently, it is often appropriate to keep twisted pairs with longer twist lays closer together within a same cable, to allow twisted pairs with shorter twist lays to be further out in the cable, the latter generating reduced Alien NEXT in adjacent cables than the former. Therefore, as illustrated in Figure 3, the twisted pairs 12_{1A} and 12_{1B}, generally at a closer distance D_1 to the primary axis 16 of the cable 10 and forming a first pair of twisted pairs, should have longer twist lays than twisted pairs 12_{2A} and 12_{2B} at a further distance D_2 to the primary axis 16 of the cable 10 and forming a second pair of twisted pairs. As such, Alien NEXT can be reduced since the twisted pairs 12_1 with longer twist lays are kept at a further distance from long twist lay pairs of adjacent cables.

[058] Referring now to Figure 4, an alternative cross web 41 in accordance with an alternative embodiment of the present invention is disclosed. In Figure 4, the cross web 41 is again defined by five (5) dividing strips. Contrarily to the staggered disposition of cross web 24, cross web 41 is defined by the end-to-

end juxtaposition of two Y-shaped dividers. In other words, a middle dividing strip 42 branches off into two angled subsidiary strips 44 and 46 at a first end 48 thereof and branches off into two opposing subsidiary strips 50 and 52 at a second end 54 thereof, thereby again providing four (4) compartments or channels within which may be disposed the individual twisted pairs 12. As illustrated in Figure 3, the twisted pairs 12_{1A} and 12_{1B} of longer twist lays are again at a generally closer distance D_1 to the primary axis 16 of the cable 10, and the twisted pairs 12_{2A} and 12_{2B} of shorter twist lays are again at a generally further distance D_2 to the primary axis 16 of the cable 10. Consequently, Alien NEXT can again be reduced since the twisted pairs 12_1 with longer twist lays are kept at a further distance from long twist lay pairs of adjacent cables.

[059] Referring now to Figures 5A to 5D in conjunction with Figure 3, and in accordance with an alternative illustrative embodiment of the present invention, the cable 10 is manufactured such that the lengths of the various strips (28, 30, 32) of cross web 24 may vary along the length of the cable 10. This will not only allow the cable to maintain isolation of the twisted pairs 20, but will also provide a means for generating an asymmetric distribution of the twisted pairs between adjacent cables, improving Alien NEXT effects therebetween. Illustratively, if a cross section of the cable 10 of Figure 5A is taken at subsequent steps 42, 44 and 46 along the cable, one observes, as correspondingly illustrated in Figures 5B to 5D that the length and position of the individual strips may vary along the length of the cable 10. Namely in Figure 5B, the outer strip 32 of principal strip 26 is longer than the outer strip 30 of same. In Figure 3C, both outer strips 32 and 30 are substantially equal, and in Figure 3D, outer strip 32 is now shorter than outer strip 30. In the illustrated example of Figures 5A to 5D, only the lengths of the outer strips 30 and 32 vary such that a secondary axis 18, defined by the geometrical center or centroid of the cable, will propagate longitudinally on the main strip 26 along the length of the cable 10.

[060] In this simplified illustrative embodiment, the cable is not twisted during manufacturing to simplify the illustration of a secondary axis 18 oscillating about the primary axis 16. Generally, cables as in 10 are twisted within the jacket 14 according to a fixed, variable or random strand lay. Consequently, the illustrated cable would ultimately present a secondary axis 18 rotating helicoidally about the primary axis 16. Necessarily, a similar affect could be obtained using a static asymmetric cross web 24 defining an extruding outer strip, such as strip 30 in Figure 5B. Furthermore, an extruding element could be coupled to the extremity of such a cross web to amplify the protuberance. Yet, by utilising a generally asymmetric cross web 24, such as illustrated in Figure 5B, and varyingly adjusting the length of the various strips, as illustrated successively in Figures 5B to 5D, a combined effect is obtained. Namely, not only does the cable exhibit a helicoidally rotating cross section asymmetry, the twisted pairs most exposed to external perturbations, i.e. the twisted pairs disposed about the shortest dividing strip (12_{1B} and 12_{2A} in Figure 5B, 12_{2B} and 12_{1A} in Figure 5D), varies with the cross web's variable dimensions, which may vary fixedly, variably, or randomly.

[061] Alternatively, the lengths of the strips may vary helicoidally rather than linearly, the lengths of the outer strips 30 and 32 and subsidiary strips 34 and 36 each cyclically becoming shorter and longer in a helical fashion as the cable 10 is laid. As above, the secondary axis 18 will helicoidally travel along the cable length with a fixed, variable or random helicity defined by a combination of the strip shortening and lengthening rates and the cable strand lay. As the cable is laid, the helicoidally rotating asymmetry will again lead to reduced nesting and improved Alien NEXT ratings while providing the additional feature presented hereinabove, that is to vary the positioning of twisted pairs within the cable with regards to the extrusion or protuberance generated by the asymmetric cross web.

[062] Ultimately, the above mechanism is not unlike winding a rod 22 or jacket protuberance 20 about the cable primary 16 axis as discussed herein with reference to Figures 2A to 2C. As presented in the illustrative embodiments of Figures 2A to 2C, the helicity of the induced protuberance of the embodiment of Figure 5 may oppose the helicity of the strand lay. Namely, the length of the individual dividing strips may be helicoidally varied in a rotational direction opposite to the rotational direction of the strand lay. Randomizing the dividing strip length variation and the strand lay will ultimately produce a fully randomized cable for reducing nesting and Alien NEXT.

[063] Necessarily, though the illustrated embodiments described above with reference to Figures 5A to 5D benefit from the configuration of a staggered cross web as in 24, other such cross webs, namely alternative cross web 41 of Figure 4 may also provide beneficial improvements when variable strip lengths are applied thereto. For instance, a simple X-shaped cross web comprising two intersecting dividing strips, the intersection being possibly defined by right angles or by any angles suitable to provide separate compartments for the individual twisted pairs, could also be used in this cabling process. For example, the intersection point between the two dividing strips provides a primary axis and the centroid or geometrical center of the cross-web or cable again provides a secondary axis as defined hereinabove. By sequentially varying the lengths of the individual segments of the X-shaped cross web along the length of the cable, the secondary axis will rotate helicoidally about the primary axis thereby generating a helicoidally varying cable cross section asymmetry that reduces cable nesting and Alien NEXT between adjacent cables.

[064] Referring now to Figures 6A and 6B, in another alternative illustrative the cross web 24 includes first and second filler elements 62, 64, illustratively attached at right angles towards the ends of the first outer strip 30 and the

second outer strip 32. These filler elements can be either solid, as shown in Figure 6A, or be comprised of a series of segments 66 as in Figure 6B.

[065] Referring now to Figure 7, in yet another alternative illustrative embodiment of the present invention, and in order to further improve PSANEXT reduction, the four twisted pairs of conductors as in 12 are separated by a cross web as in 24 and wound with a round rod 22 (or filler material). The assembly is covered in a cable jacket 14. Illustratively, the round rod 22 is again manufactured from a non-conductive dielectric material such as plastic, or the like, in either a solid or stranded form. As a consequence, the cable 10 of Figure 6 benefits from the incorporation of the cross web 24 and all its attributes (discussed extensively hereinabove with reference to Figures 3 to 5) as well as benefits from the helicoidally rotating asymmetry provided by the coiled filler or rod 22 and all its attributes (discussed extensively hereinabove with reference to Figures 2A to 2C). The combination of some or all of the above techniques for reducing nesting and Alien NEXT between adjacent cables, namely variable or randomized laying techniques and opposite twist, strand and protuberance helicities to name a few, can thus be implemented in this illustrative embodiment.

[066] Referring now to Figure 8 in yet another alternative illustrative embodiment of the present invention, a cable 10 comprised of four (4) twisted pairs of conductors as in 12 is surrounded by a cable jacket 14 and separated by an alternative asymmetric cross web 56 is disclosed. The alternative cross web 56 is of an asymmetric design where the first and second strips 58 and 60 of the cross section of the X-shaped cross web 56 are of different thickness D and D'. Necessarily, variations in cross web thicknesses either in part or as a whole can be applied to the other illustrative embodiments of the present disclosure to improve Alien NEXT effects.

[067] In order to measure the Alien NEXT, and therefore the effects particular cable configurations have on PSANEXT, a test scenario comprised of one victim cable as in 10 surrounded by six (6) other offending cables was used. A test scenario comprising seven (7) cables comprising the asymmetrical cross web 12 as discussed hereinabove with reference to Figures 3, 5 and 6 was found to reduce PSANEXT of both the victim cable and the offending cables. In the embodiment of Figure 7, though the variable cross web thicknesses help reduce unwanted cross talk, the incorporation of the round rod 22 (or filler material) of Figure 6 does not appear to provide the same level of reduction of PSANEXT. Apparently, the incorporation of the round rod 22 (or filler material) improves PSANEXT mitigation by increasing the distance between the victim cable and the six offending cables.

[068] Additionally, improvements in PSANEXT reduction may be obtained by longitudinally randomising the twist lays and the strand lay of the core in a gang mode. Thus the randomisation is performed simultaneously on all the pairs in order to maintain the internal twist lays ratios intact. This latter requirement helps to ensure that adequate internal cable NEXT parameters are maintained. One way to effect the randomisation of the twist lays is by changing the strand lay randomly along the length of the cable. This method affects both the strand lay and the twist lay, albeit to a lesser degree.

[069] The randomisation of twist lays, the strand lay, or both serve to mitigate PSANEXT on a victim cable by eliminating the repetition inherent in the like pairs along the cable length. A similar effect is obtained by randomising the lay of the round filler 22 around the cable core. Such randomisation reduces the nesting between adjacent cables and, consequently, further increases the distance between the victim cable and the six offending cables.

[070] The incorporation of the stranded round rod 22 (or filler) and also the

offset cross web contributes to a lowering of the overall rigidity of the cable due to a reduction in the mechanical rigidity of the assembly, thereby providing for a more pliant or flexible cable. In addition, the introduction of the round filler between the jacket and the core reduces the overall attenuation due to increased air space in the cable. In another preferred enhancement of the above disclosure, the cable jacket is striated in the inner surface in contact with the cable core in order to also reduce the overall attenuation of the cable. This is achieved by the creation of additional air space between the cable core and the jacket.

[071] Although the present invention has been described hereinabove by way of an illustrative embodiment thereof, this embodiment can be modified at will without departing from the spirit and nature of the subject invention.

WHAT IS CLAIMED IS:

1. A telecommunications cable comprising:

a plurality of twisted pairs of conductors arranged around and running generally along a first axis; and

a cable jacket surrounding said twisted pairs, said jacket comprising an outer surface having a second axis;

wherein said second axis is arranged helicoidally around said first axis.

2. A telecommunications cable comprising:

a plurality of twisted pairs of conductors arranged around and running generally along a first axis;

a cable jacket surrounding said twisted pairs; and

a protrusion arranged around and running generally along an outer surface of said jacket;

wherein said protrusion is arranged helicoidally around said first axis.

3. A telecommunications cable comprising:

a first set of two twisted pairs of conductors arranged on opposite sides of and running generally along an axis; and

a second set of two twisted pairs of conductors on opposite sides of and running generally along said axis;

wherein a distance between said first set of twisted pairs is less than a distance between said second set of twisted pairs.

4. A cross web for use in a telecommunications cable, the cross web comprising:

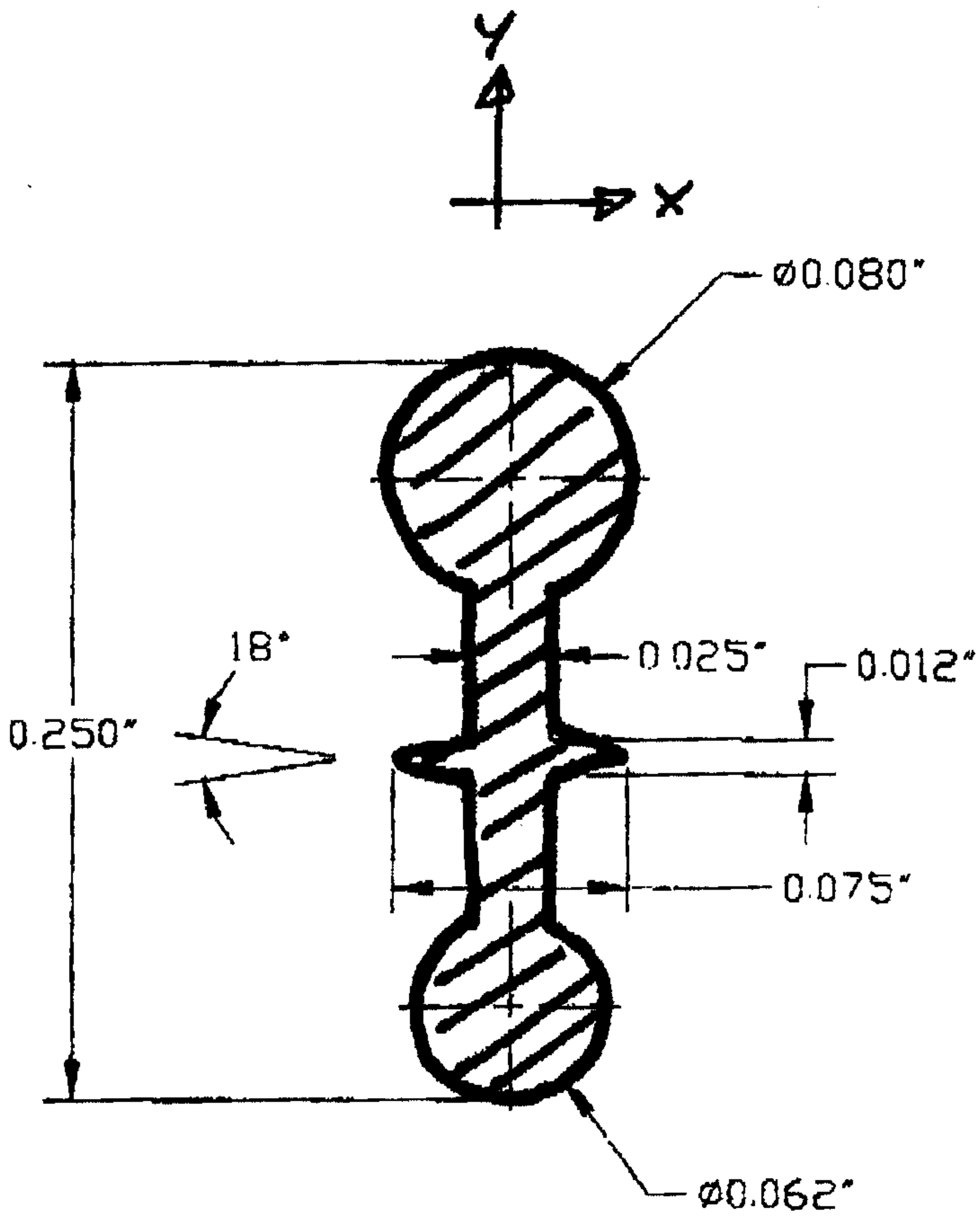
a principal dividing strip comprised of a middle strip and first and second outer strips; and first and second subsidiary dividing strips attached longitudinally along said principal strip and on opposite sides thereof, wherein a point of attachment of said first subsidiary strip is between said middle strip and said first outer strip and a point of attachment of said second subsidiary strip is between said second outer strip and said middle strip.

5. A telecommunications cable comprising:
four twisted pairs of conductors;
a cross web comprised of a principal dividing strip and a first subsidiary dividing strip attached longitudinally along a first side of said principal dividing strip and a second dividing strip attached longitudinally along a second side of said principal dividing strip, said cross web separating said four twisted pairs such that they are arranged asymmetrically; and
a cable jacket covering said cross web and said twisted pairs.

6. A telecommunications cable comprising:
four twisted pairs of conductors;
a cross web separating the twisted pairs, said cross web comprised of a principal dividing strip and first and second subsidiary dividing strips attached longitudinally along said principal dividing strip and on opposite sides thereof,
a longitudinal rod wound around said cross web and said twisted pairs along a length of the cable; and
a cable jacket covering said cross web and said twisted pairs.

7. A telecommunications cable comprising:
four twisted pairs of conductors;
a cross web separating said four twisted pairs; and

a cable jacket covering said cross web and said twisted pairs;
wherein said cable jacket has a thickness which varies along a length of the cable.



(Prior Art)
Fig. 1

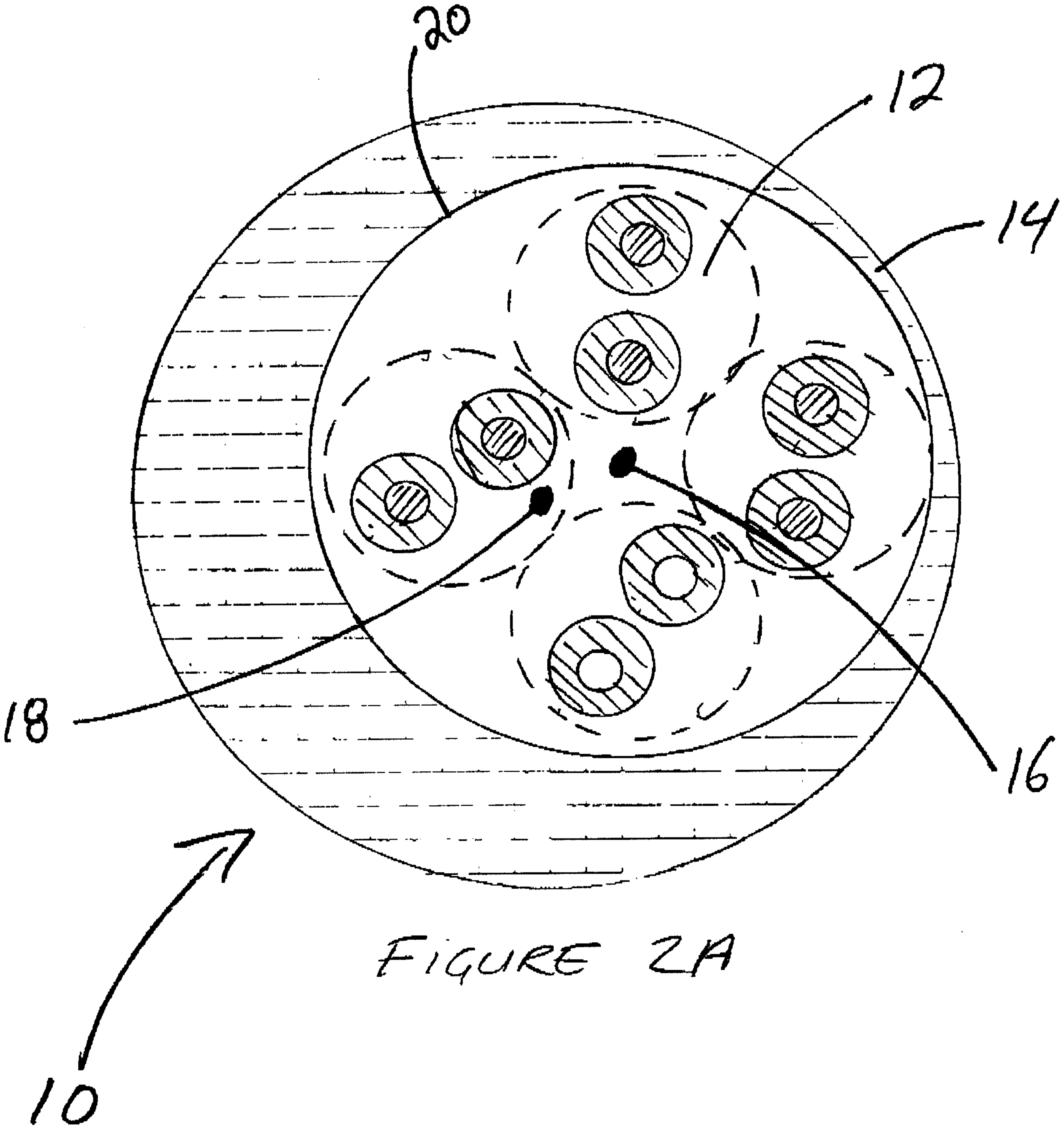


FIGURE 2A

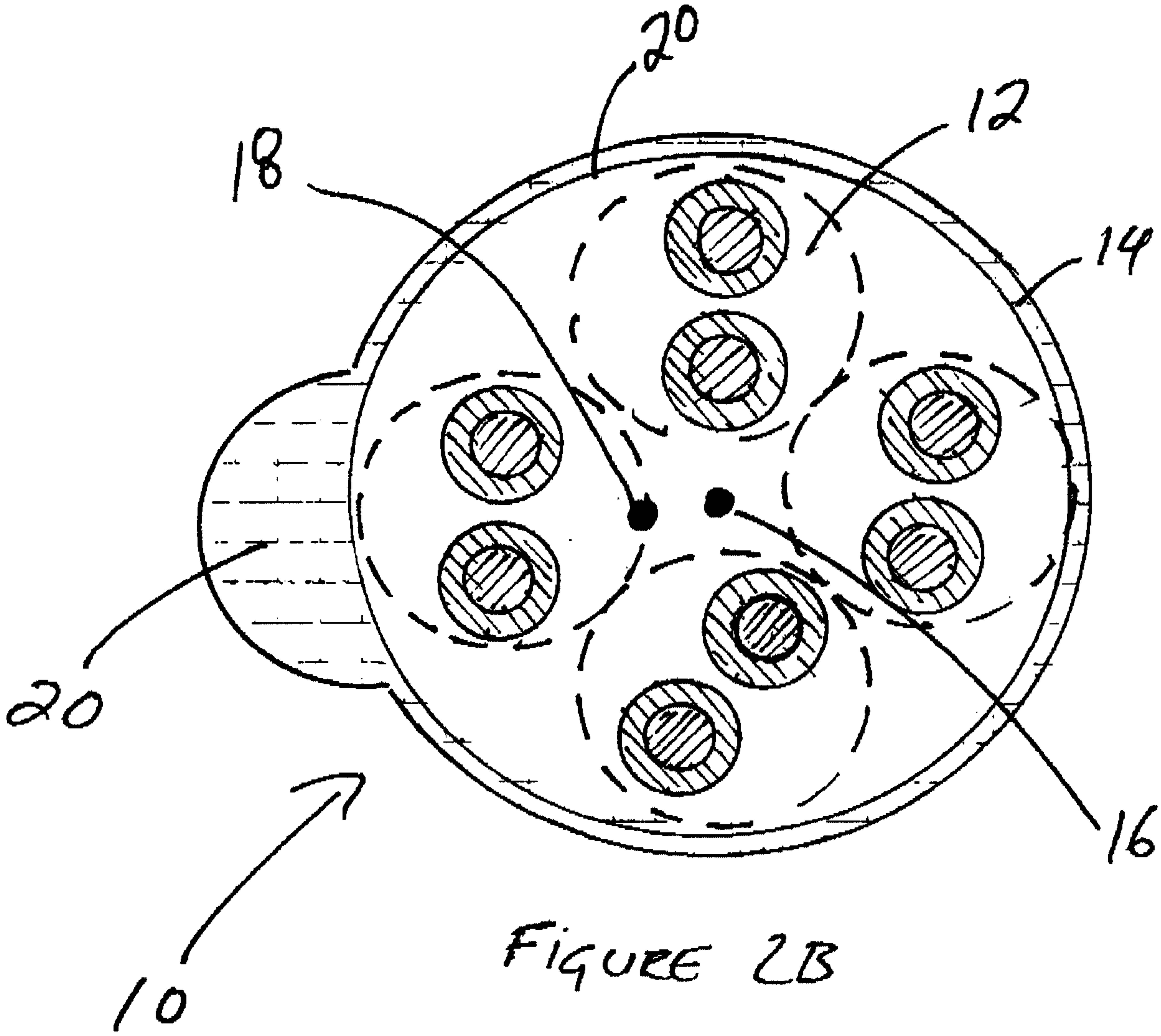


FIGURE 2B

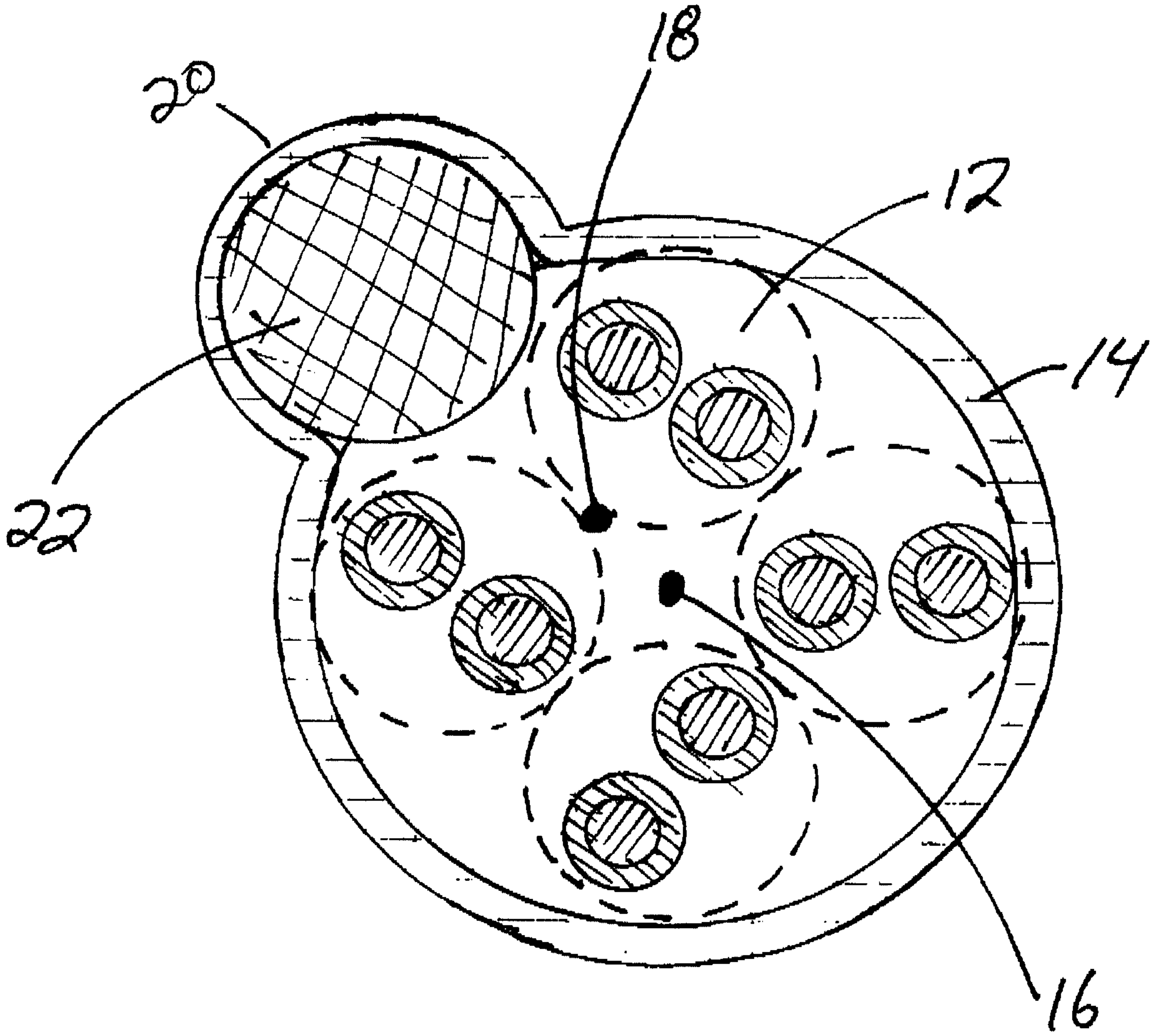


FIGURE 2C

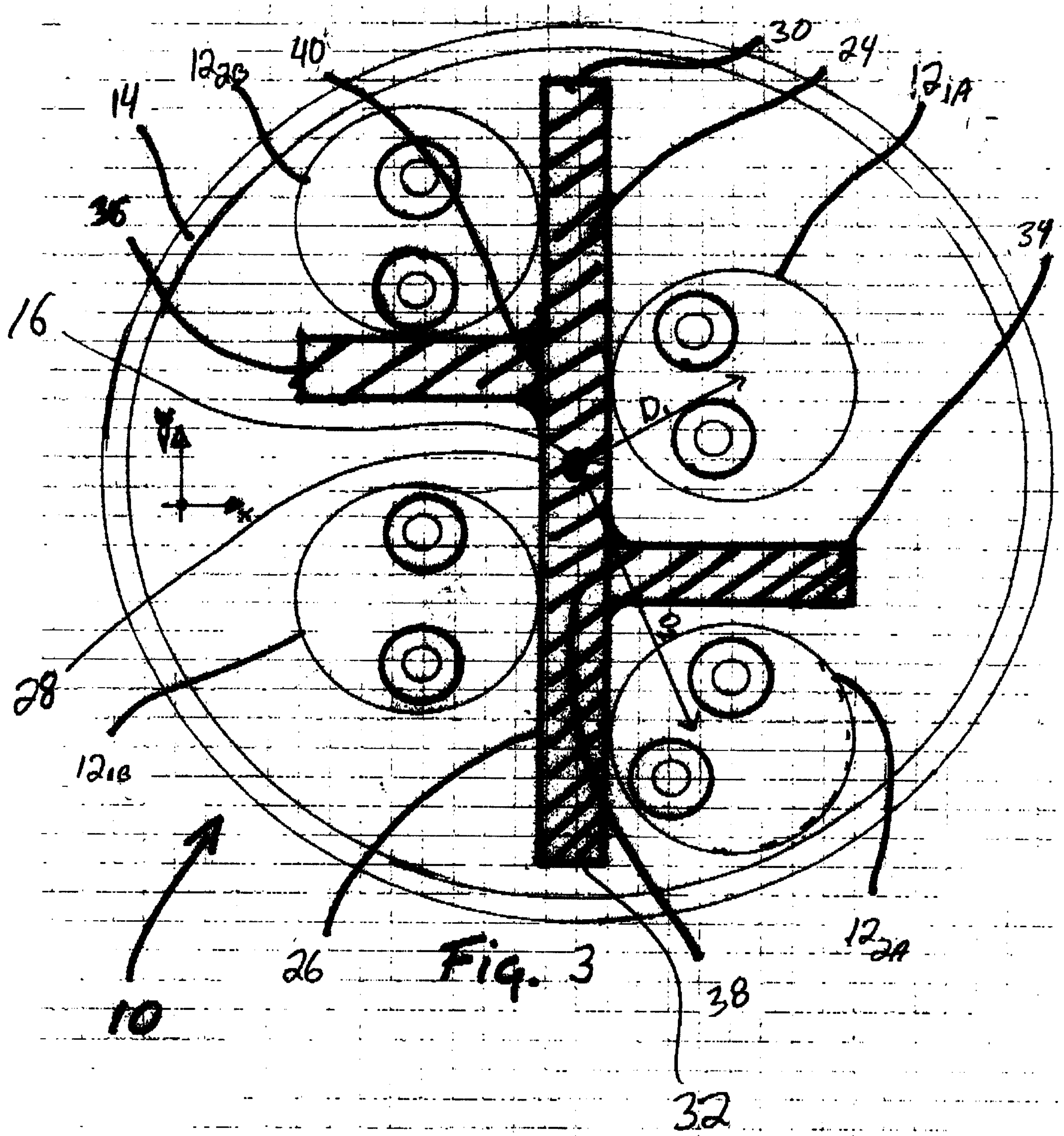


Fig. 3

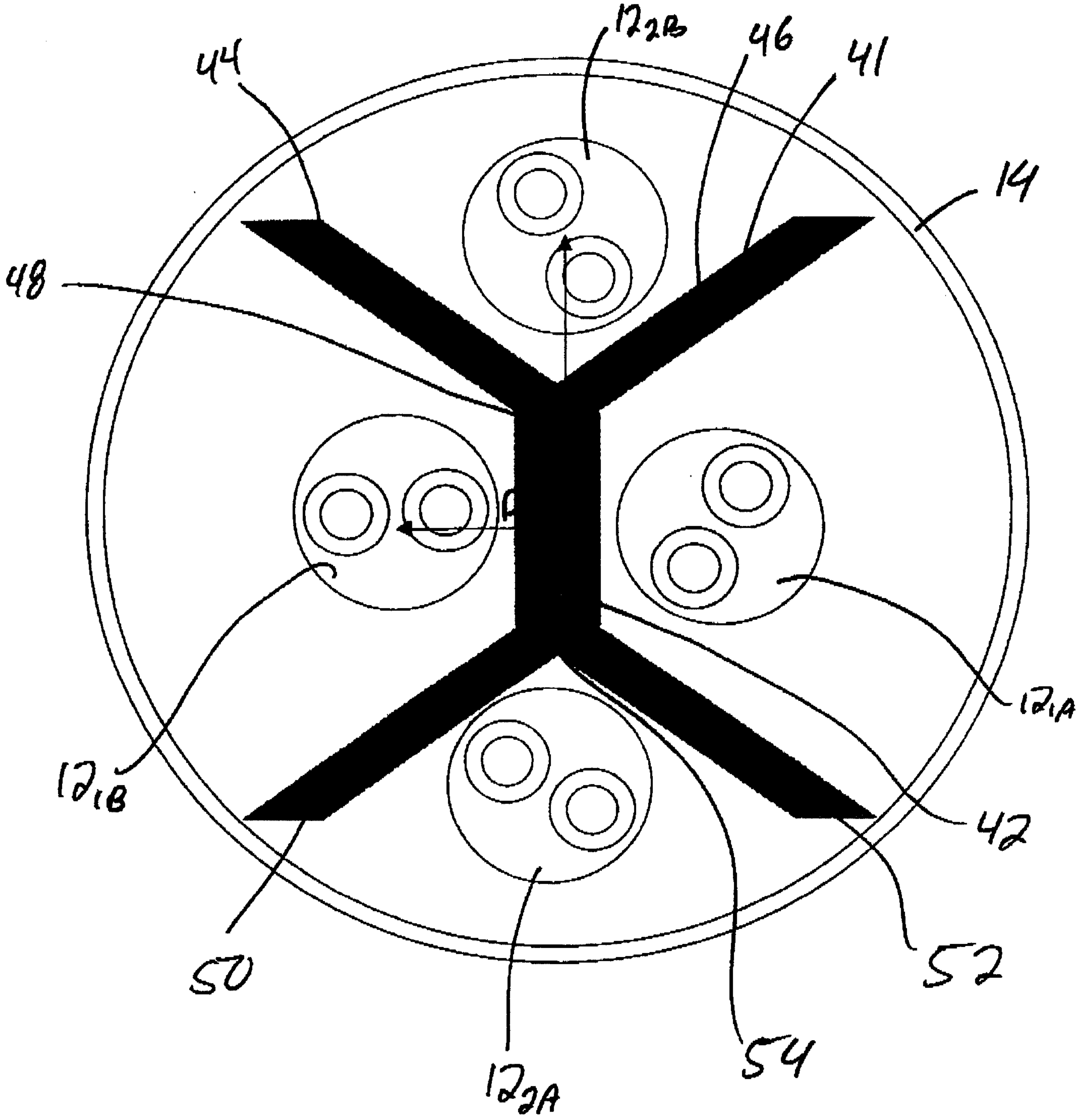


Fig. 4

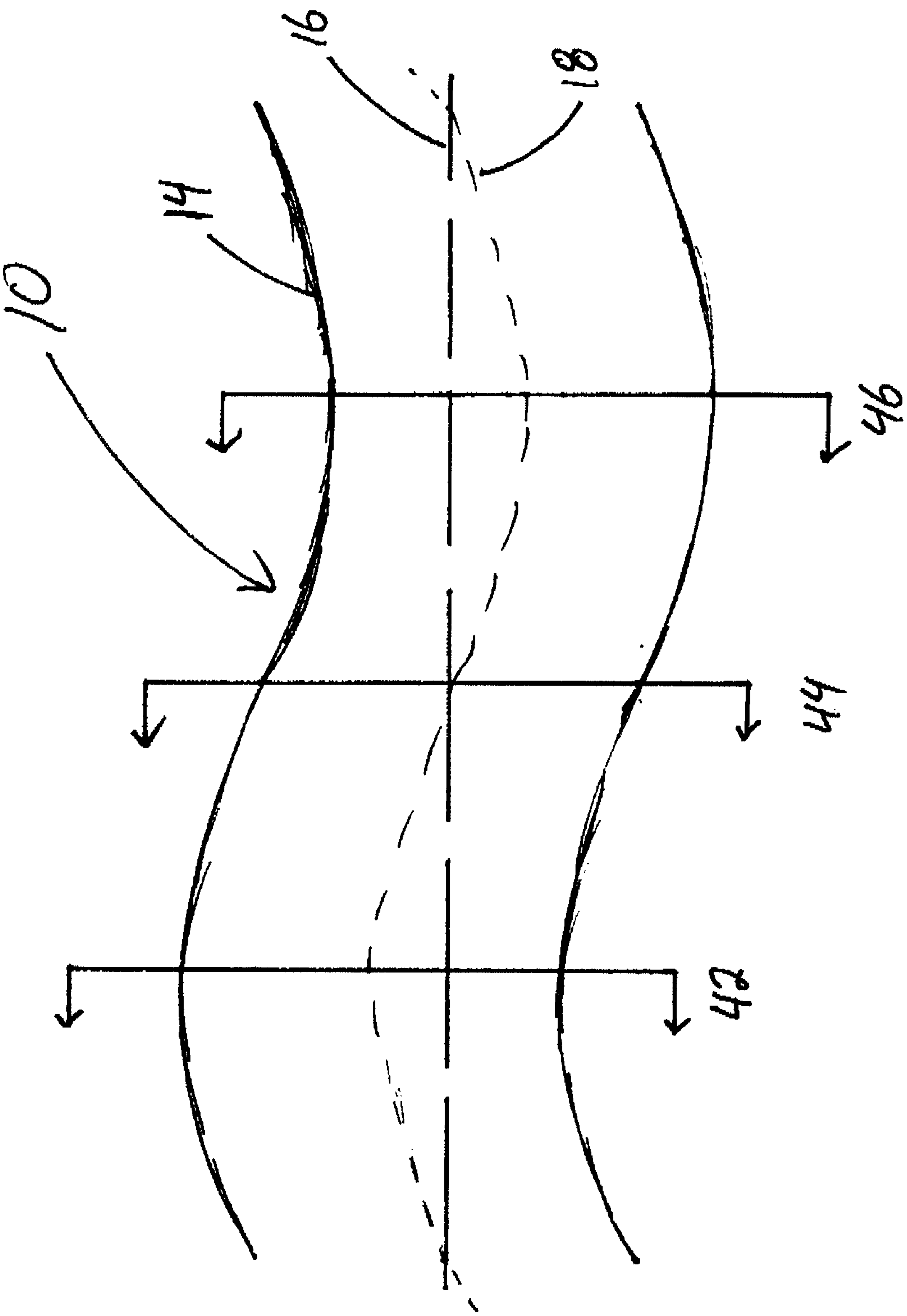


Fig 5A

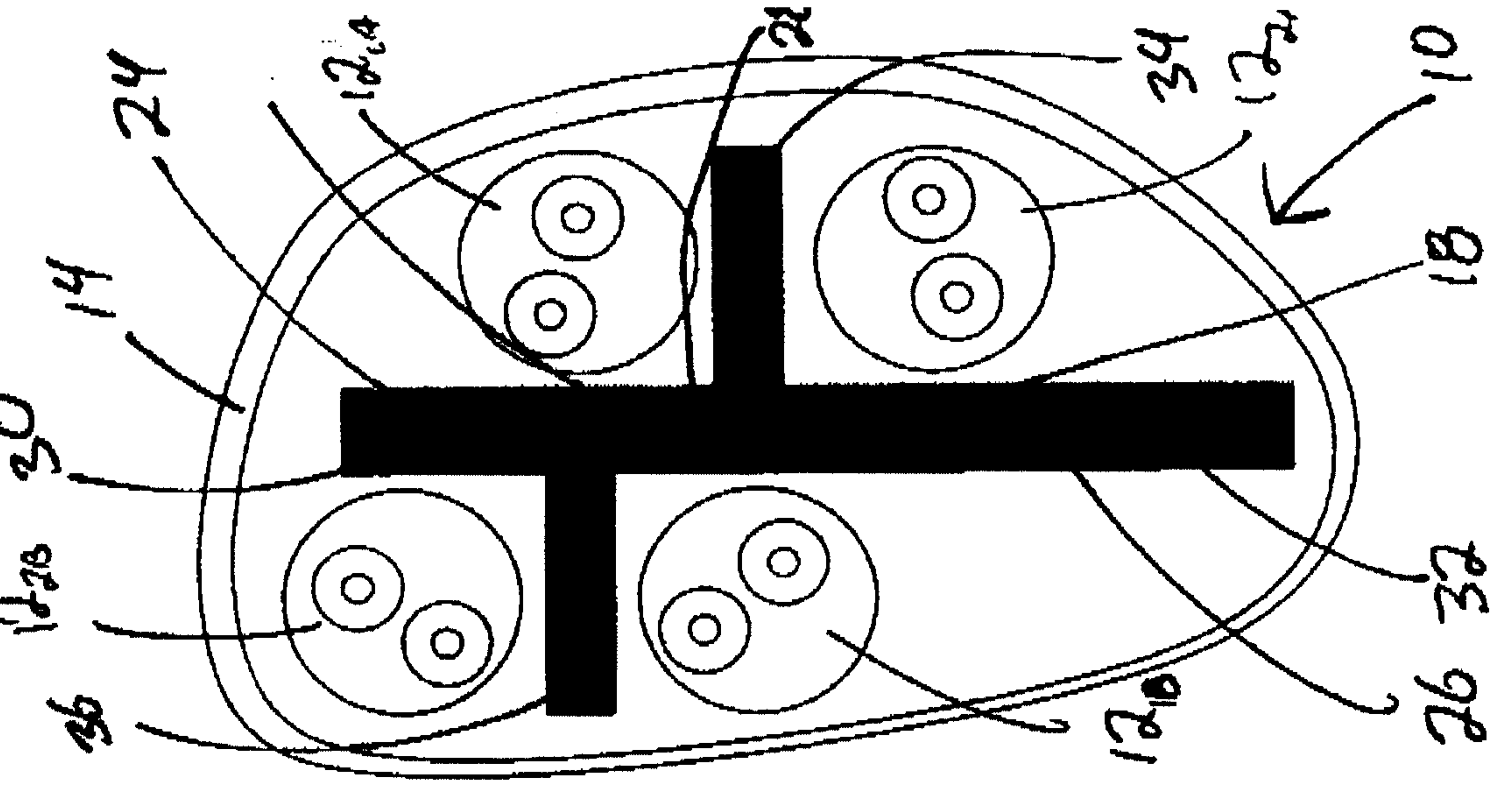


Fig 5D

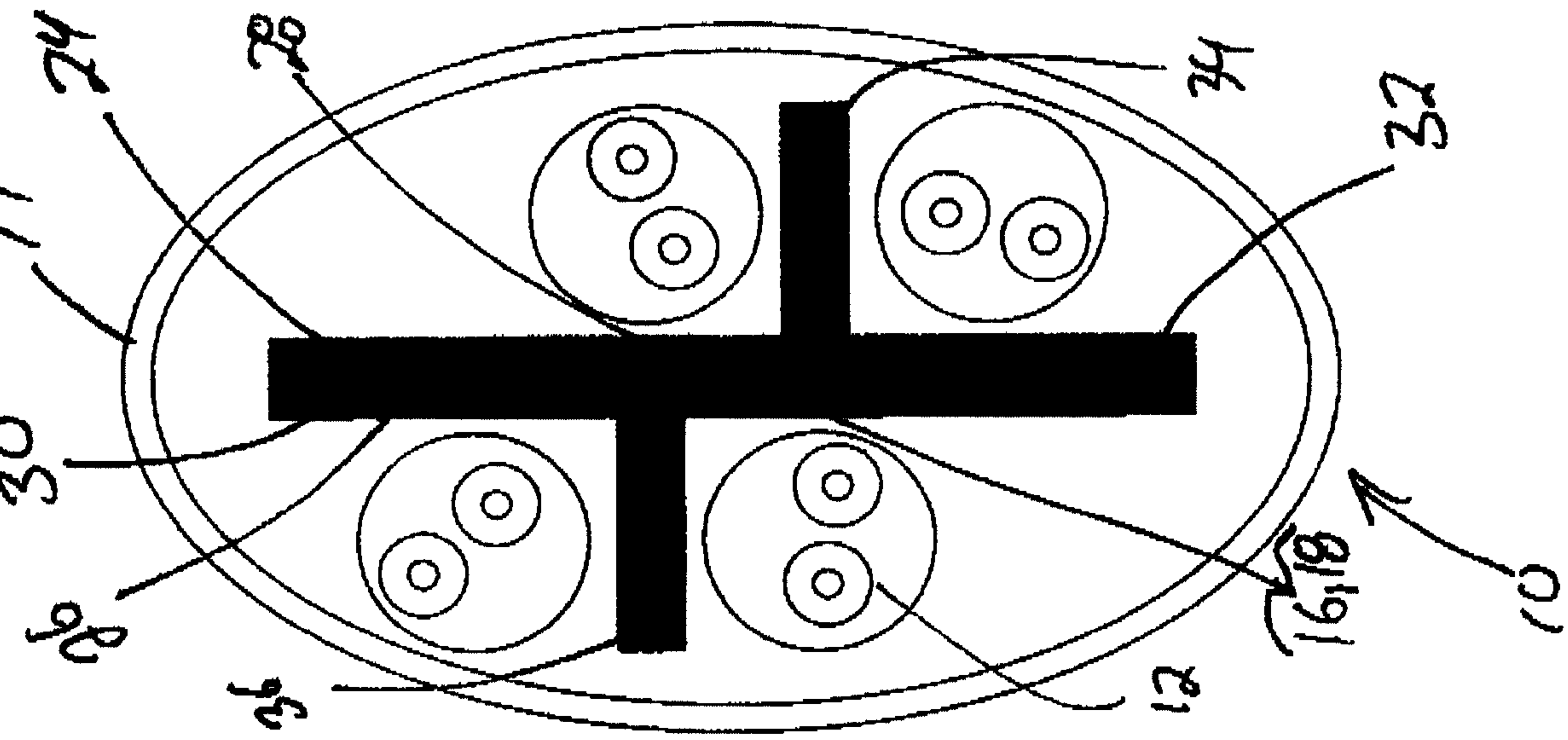


Fig 5C

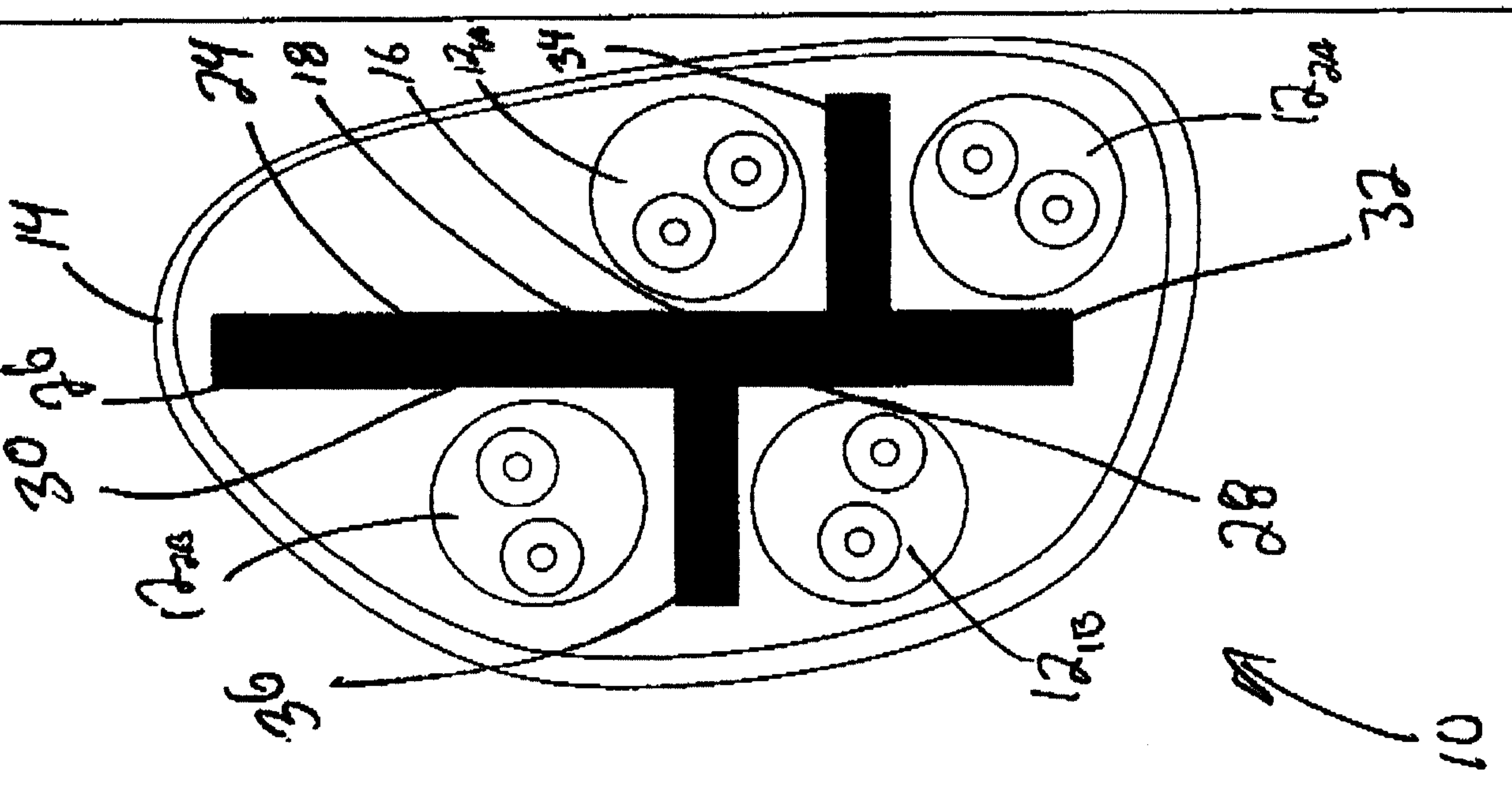


Fig 5B

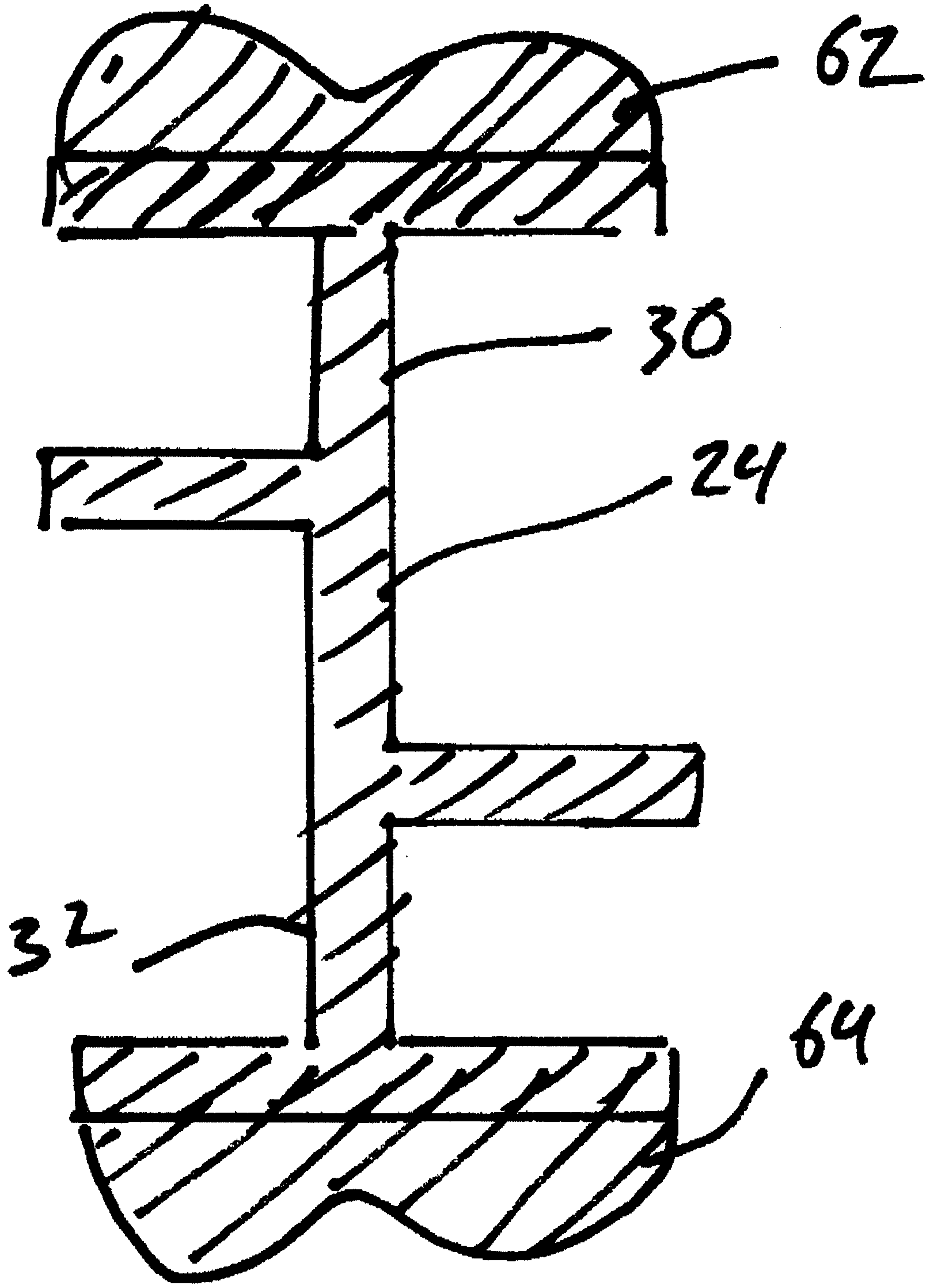


FIGURE 6A

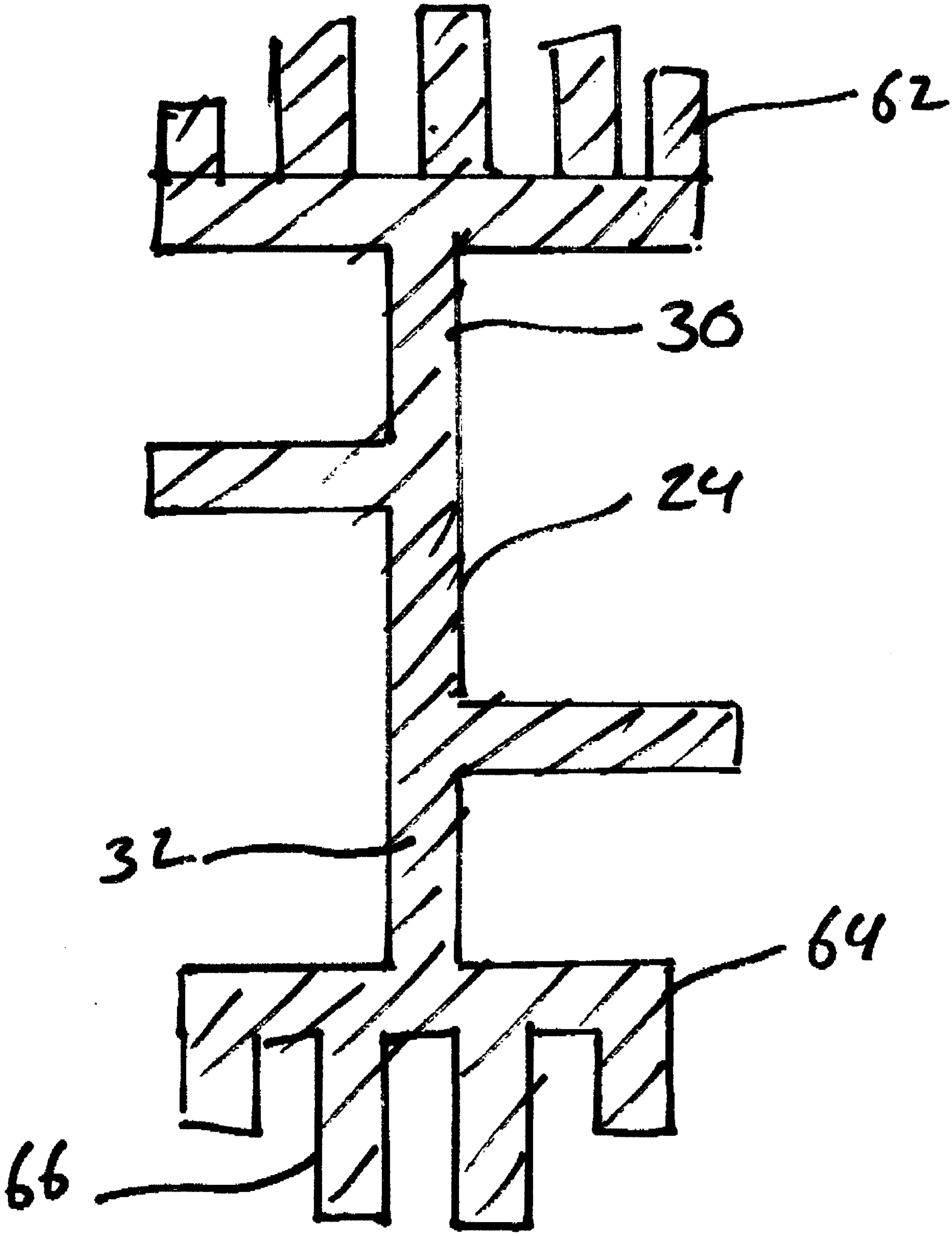


FIGURE 6B

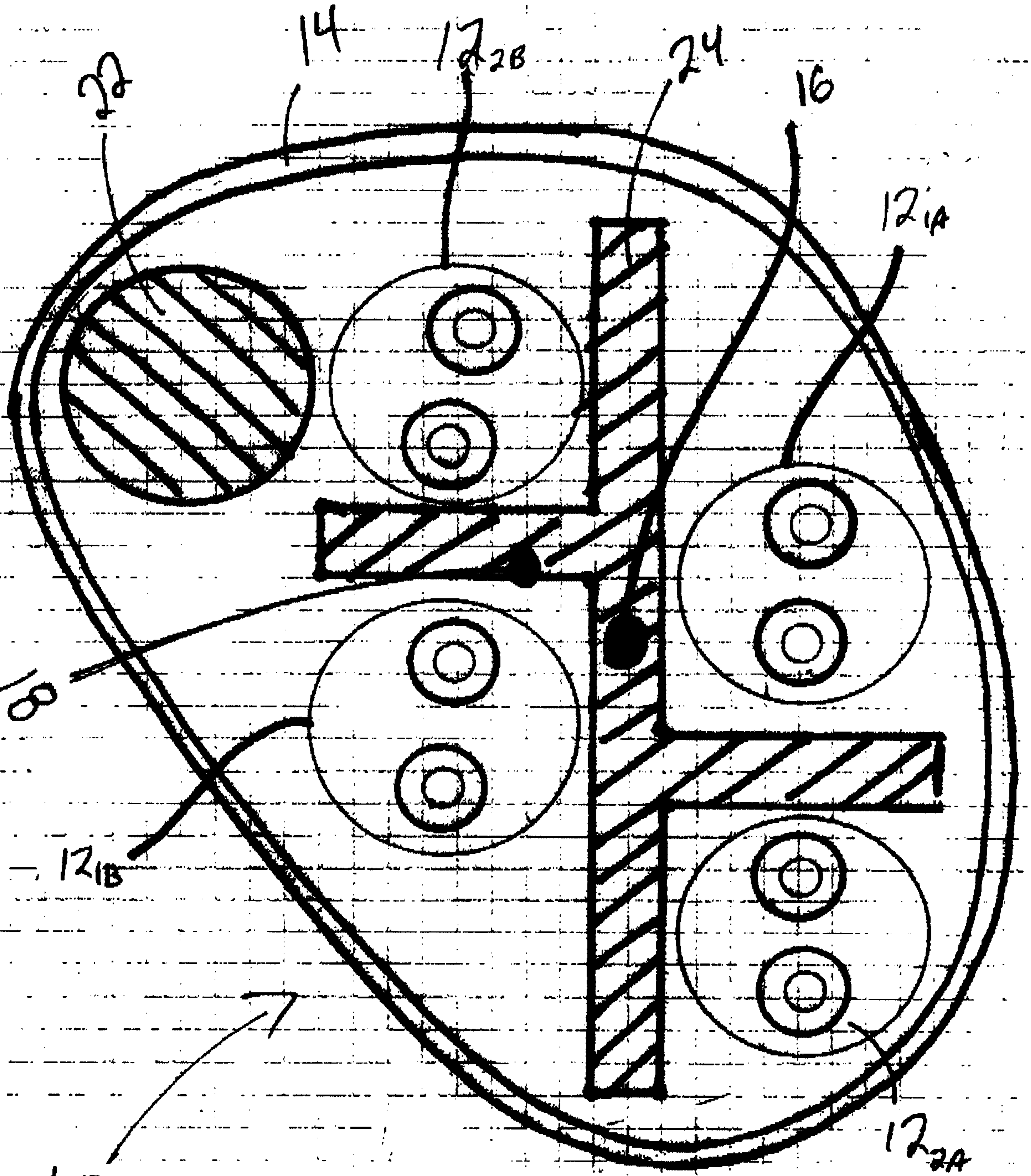


Fig. 7

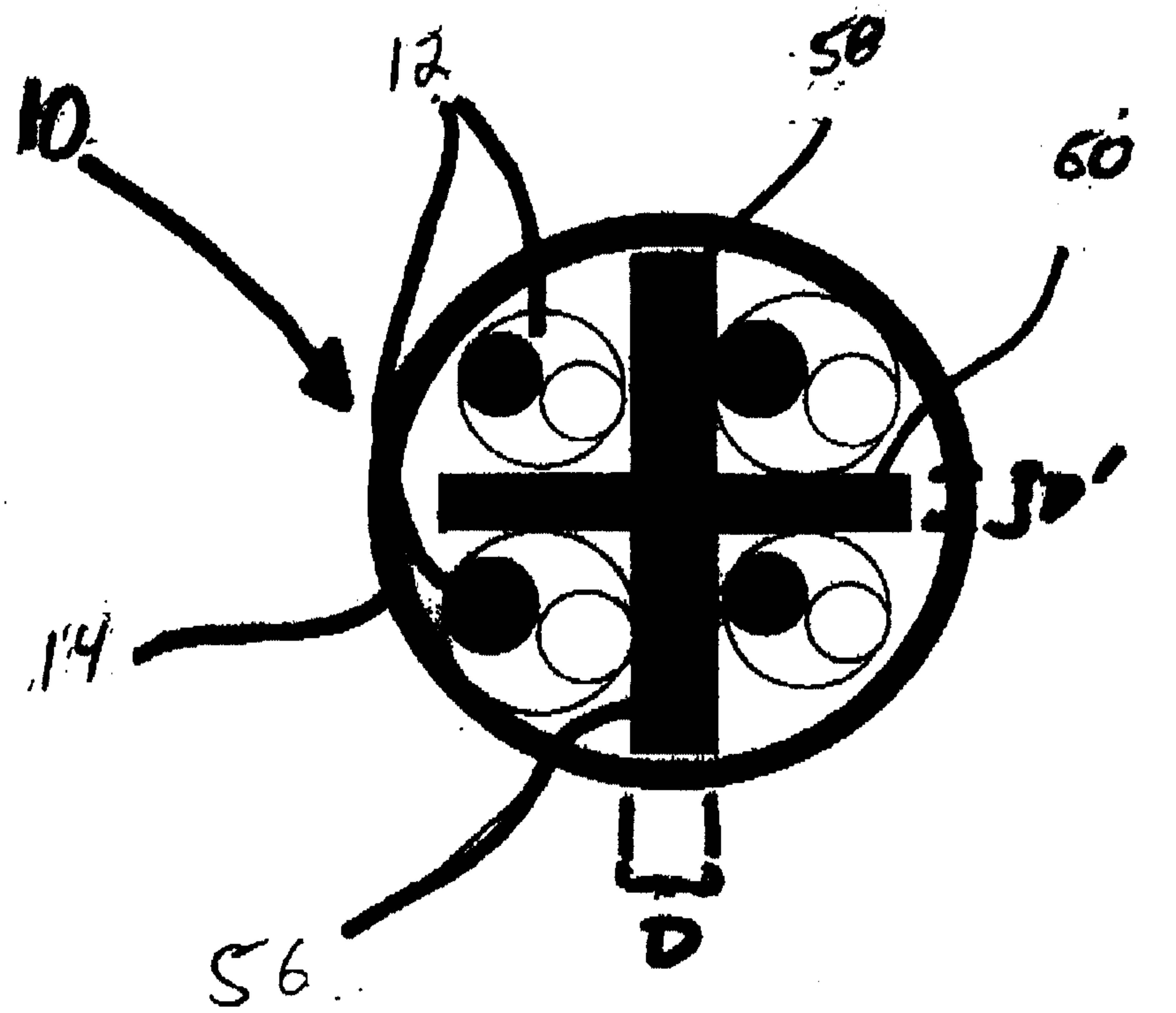
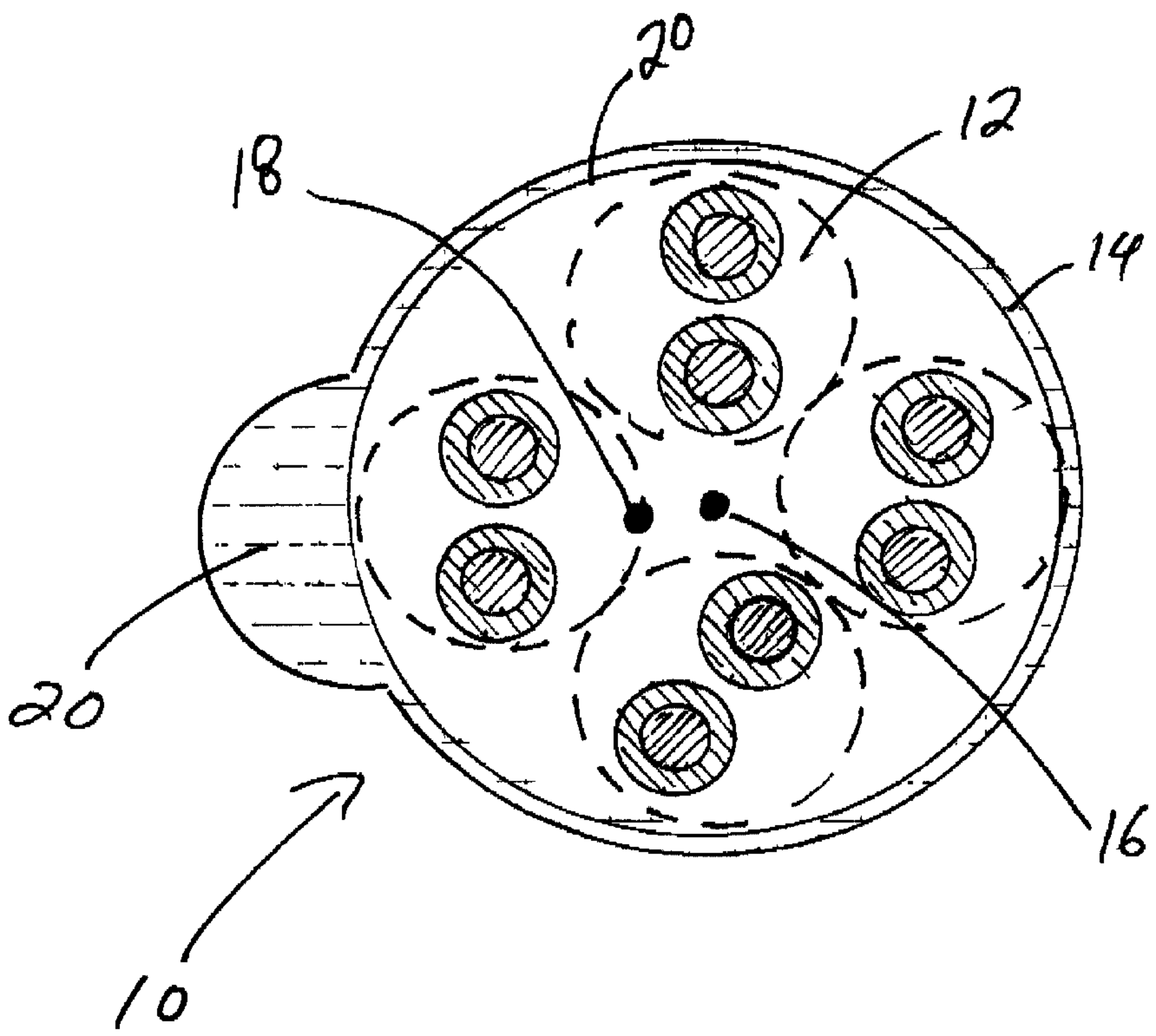


Fig. 8


20
18
12
14
20
16
10