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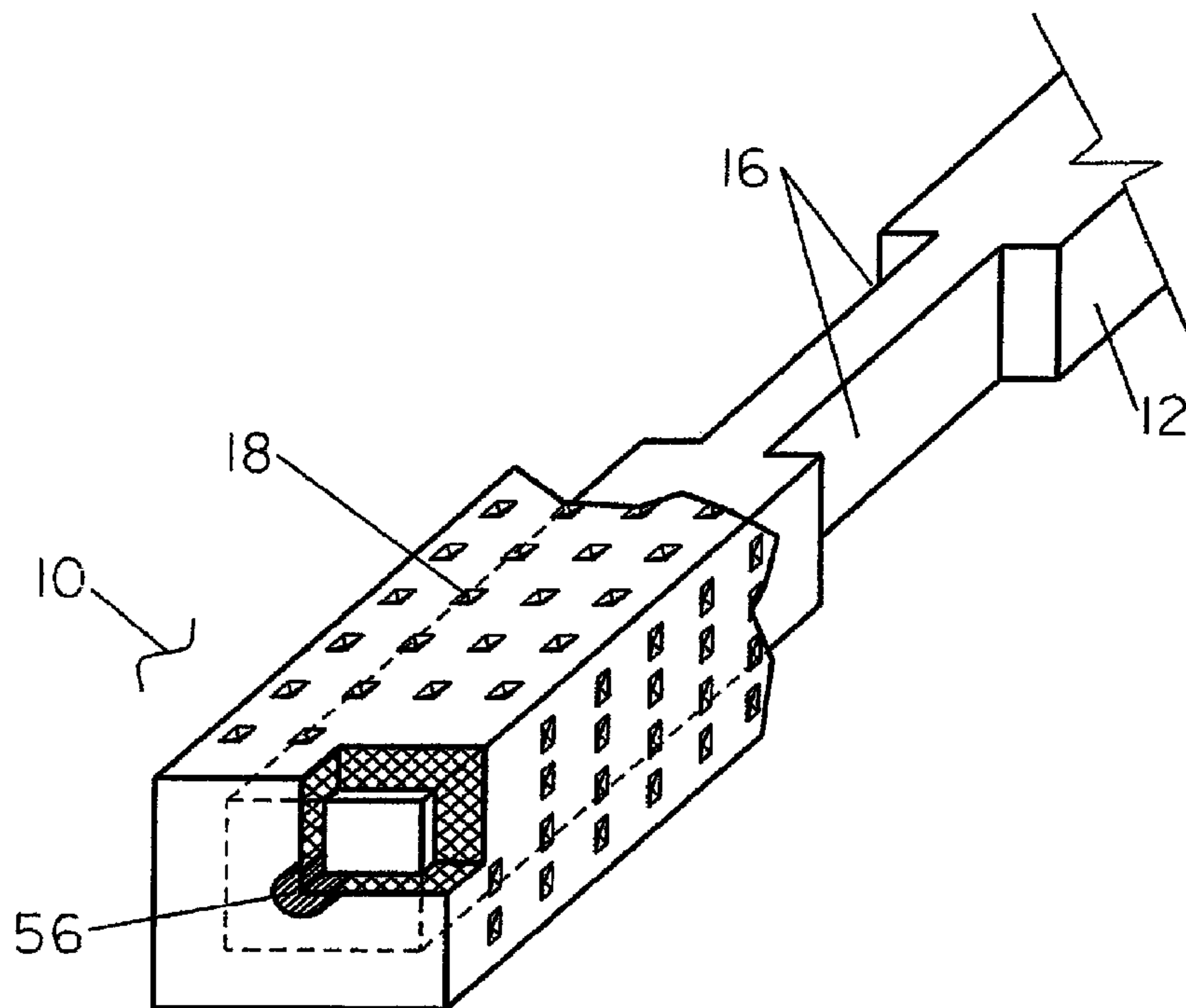


FIGURE 2a

(57) Abrégé/Abstract:

A composite load bearing member is provided comprising an elongated inner structural member and a thick polymeric composite outer member. An apparatus for producing the composite load bearing member is provided including devices for suspending the inner structural member within a mold cavity prior to and during injection of the polymeric composite outer member. A method of using the apparatus to produce the composite load bearing member is provided.

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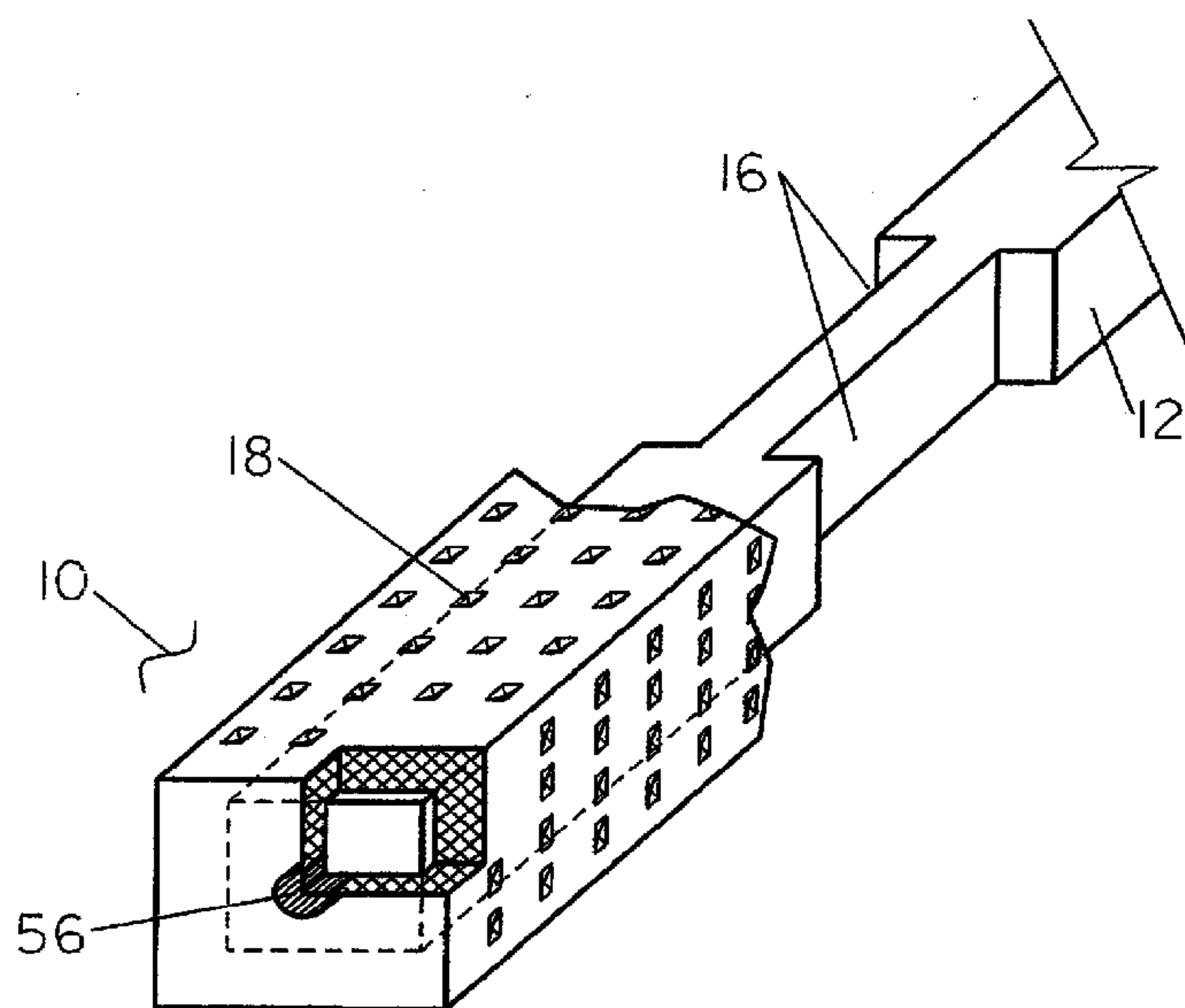


FIGURE 2a

(57) Abstract: A composite load bearing member is provided comprising an elongated inner structural member and a thick polymeric composite outer member. An apparatus for producing the composite load bearing member is provided including devices for suspending the inner structural member within a mold cavity prior to and during injection of the polymeric composite outer member. A method of using the apparatus to produce the composite load bearing member is provided.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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TITLE:

COMPOSITE LOAD BEARING

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STRUCTURE

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1 technological advancement, railroad ties are still typically made of wood. In fact, in 2006
2 approximately 18.4 million railroad ties were replaced in the United States alone. Of
3 these, 91.1% were wood, 7.7% were concrete, 0.8% were composite, and 0.4% were
4 steel. This current trend of maintaining railroad ties made of wood is predominantly due
5 to the traditional advantages of the use of wood railroad ties over other types of available
6 railroad ties.

7 The advantages of continuing to use conventional railroad ties in the United States
8 railroad industry mainly revolve around their consistent and well-known performance
9 characteristics as well as the fact that they are relatively inexpensive to purchase and
10 initially install. Clearly the performance characteristics of modern, wood railroad ties are
11 well-known due to their extensive use throughout the industry dating back to the early
12 years of the railroad industry itself. That is, not only is the life of the wood tie relatively
13 straight-forward to predict, but the strength and stiffness of replacement ties roughly
14 correspond to those of existing wood ties that may be closely situated but not yet needing
15 replacement. This, in turn, allows replacement of only those ties that need to be replaced
16 rather than having to replace an entire section of track ties merely because the
17 performance characteristics of replacement ties is substantially different than those of
18 existing ties. Moreover, the initial purchase and installation of wood ties are relatively
19 inexpensive, not only because of the cost of the wood itself, but also because of the ready
20 availability of the ties and the existing means for their installation.

21 However, the use of conventional wood railroad ties have a number of
22 disadvantages associated therewith as well. First and foremost, despite their
23 predictability, wood ties must be replaced every few years making such use somewhat

1 expensive over a long period of time. Furthermore, wood's natural susceptibility to
2 certain environmental conditions results in a much greater replacement frequency in
3 some areas compared to others. For example, in a mild, relatively dry climate, a wood
4 railroad tie typically needs replacement every fifteen years; however, in warm, wet areas
5 (particularly those native to wood destroying pests, such as termites) a wood railroad tie
6 might need replacement as frequently as every five years. Thus, one can easily see the
7 long-term economic need for a railroad tie comprised of longer lasting more durable
8 materials.

9 In an attempt to combat the harsh effects of the environment and, in particular,
10 wood destroying insects, wood ties are typically treated with preservatives. However, the
11 typical preservatives currently used to treat wood ties are either prone to leaching and
12 dissipating from the wood into the surrounding environment and/or are hazardous in
13 nature. For instance, borate products are known for their ability to preserve wood when
14 used as a fungicide and pesticide; however, it is also well known that the borate
15 treatments tend to leach out of treated wood very quickly, particularly along crevices or
16 checks in the surface of the wood itself. In addition, creosote is currently used as a
17 surface treatment to wood railroad ties and utility poles to preserve the wood and prevent
18 deterioration due to insects; however, creosote is a known carcinogen, harmful to humans
19 and animals. In fact, the Environmental Protection Agency considered banning creosote
20 in 1987, but the agency allowed its continued use because of the lack of suitable
21 alternatives. Additionally, a number of lawsuits have been filed in recent years relating
22 to the detrimental effects of creosote usage. Therefore, it is clearly undesirable not only

1 to manufacture such railroad ties, but also to have such railroad ties in use and finally, to
2 dispose of such ties as well.

3 In an effort to provide a railroad tie with increased longevity, railroad ties of
4 varying material composition have developed over the years; however, none of them
5 have had great success in replacing wood ties because of the various drawbacks
6 associated with their respective use. Steel ties, for instance, have realized only limited
7 use due to a number of factors. First, although steel is a strong, stiff material (with
8 similar properties to wood), steel's susceptibility to rusting makes it an unattractive
9 alternative. Additionally, the use of steel ties is also associated with a high noise level
10 during use. Moreover, since the current method of locating the positions of trains
11 throughout a particular railway system is by utilizing the steel rails for transmitting an
12 electrical signal, the steel rails must be electrically isolated from one another, clearly
13 precluding the use of steel ties between the rails. Finally, the use of steel ties also does
14 not facilitate the typical system of attaching rails to ties through the use of railroad tie
15 spikes. Therefore, steel railroad ties have emerged as an unattractive option to traditional
16 wood ties.

17 Another option to wood railroad ties that has emerged over the years is railroad
18 ties comprised substantially of concrete. Again, although concrete potentially extends the
19 duration of ties, it also has a number of disadvantages associated therewith. Concrete ties
20 are significantly more expensive than wood ties. This is true, not only in the original
21 purchasing phase, but also in the installation phase. That is, since concrete is
22 significantly heavier than wood, such ties are not able to be handled, transported, or
23 installed using existing processes and equipment. Furthermore, the use of concrete ties

1 requires much more complex rail fastening systems, again increasing the cost of
2 installation. In addition, because of the nature of the repeated compressive and tensile
3 loading a railroad tie experiences, steel reinforcement bars are typically needed. The use
4 of such reinforcement potentially short-circuiting the aforementioned train locating
5 system as well. Finally, the performance characteristics of concrete (particularly
6 hardness and stiffness) are significantly different than those of wood. Because of this
7 difference, when concrete ties are mixed into sections with existing wood ties, uneven
8 loading occurs, resulting in significantly shorter lifespan of the surrounding wood ties.
9 For this reason, entire sections of railroad ties must be replaced when replacing with
10 concrete ties, again resulting in much higher installation costs. Thus, concrete ties are
11 also considered an unattractive alternative to wood railroad ties.

12 From this background a number of composite railroad ties have emerged in an
13 effort to obtain a longer lasting alternative to a wood tie that maintains the beneficial
14 performance characteristics of a wood tie. Two competing challenges exist in the
15 development and production of composite railroad ties: product performance and
16 economics. That is, virgin resin material could be used to provide the desired
17 performance characteristics; however, the final product would be many times the cost of
18 a wood tie. In contrast, pure recycled polymers could be used to reduce the cost of the
19 tie, but the material properties of such a railroad tie would not be acceptable. Therefore,
20 the typical composite tie composition that has developed to best achieve both parameters
21 is through the use of a material combination of recycled plastic and a mineral additive.
22 However, although the desired properties with such a composition may be obtained, it is
23 difficult to maintain such requirements throughout extensive production runs. High

1 quality, durable recycled plastics are necessary to achieve sufficient strength. Moreover,
2 manufacturing such composite ties consumes tremendous volumes of recycled plastic
3 requiring the maintenance of multiple sources. However, even slight variation in the
4 quality of the recycled plastics not only has an impact on the properties of the polymer,
5 but it also impacts the interaction between the polymers and the mineral additives. All of
6 this leading to railroad ties that may last five times longer than wood railroad ties but that
7 are still unacceptable because of they lack the consistent strength and stiffness properties
8 of wood ties.

9 Other approaches have been taken for providing composite load bearing members
10 as well including those disclosed in United States Patent Numbers 6,766,963, 6,659,362,
11 6,336,265, 6,247,651, 6,179,215, 5,886,078, 5,722,589, 5,609,295, 4,286,753, While all
12 disclose a novel approach in solving the problem, each has its own respective
13 disadvantages as well. For instance, U.S. Patent No. 6,336,265 issued to Niedermair
14 discloses a railroad tie comprised of a slightly undersized wood railroad tie with an end
15 cap attached to each end and coated in a thin plastic film in an effort to retain the
16 performance characteristics of the wood tie, while extending its life through surface
17 protection. However, Neidermair has disadvantages in at least three areas. First, the
18 method of producing the composite tie in Neidermair is a complicated and potentially
19 expensive one, involving the removal of all treated surfaces from an existing wood
20 railroad tie, machining the ends to fit the end caps, and feeding the complete assembly
21 through an extrusion process. Additionally, the plastic coating applied to Neidermair is
22 relatively thin and potentially easily penetrated through typical use and environmental
23 conditions allowing a path for moisture or insects to the untreated wood inside. Finally,

1 the use of a traditional railroad spike is either precluded, or if used, provides an additional
2 path for moisture or insects to the untreated wood tie inside.

3 Additionally, an attempt at a reinforced composite load bearing structure is
4 disclosed in U.S. Patent No. 5,609,295 and 5,722,589 issued to Richards. The Richards
5 patents disclose a composite member comprising a binding constituent and an aggregate
6 material potentially including an inner strengthening member. However, the Richards
7 patents also have a number of drawbacks associated therewith, particularly when used as
8 a railroad tie. First, the fact that the member is composed mainly of aggregate material
9 leads to both weight and performance characteristics more similar to those associated
10 with existing concrete ties as opposed to existing wood ties. That is, the weight of such a
11 tie precludes traditional transportation and installation methods as used on wood ties, and
12 the increased density of such a tie precludes its use alongside existing wood ties because
13 it would lead an uneven loading condition, as previously described. Finally, existing rail
14 connecting methods could not be used with such a tie either; rather, a more complex
15 system of inserts and/or bolting methods must be used, as described in the Richards
16 patents.

17 In addition to the foregoing, another significant example of the long felt need for
18 an economical solution to traditional load bearing members is in the marine timber or
19 marine pile industry. Marine timbers are load bearing members that provide columnar
20 support for marine piers and other marine structures. As in the railroad industry,
21 traditional chemically treated wooden marine timbers are still the norm in the industry
22 despite the technological advancements made in composite and other materials.
23 Similarly to traditional railroad ties, wooden marine timbers suffer from a number of

1 drawbacks, in particular the frequent need for replacement due to the wear and tear of
2 harsh environmental conditions. Attempts have been made in the industry to produce
3 longer lasting composite marine timbers through the use of recycled plastics reinforced
4 by fiberglass rebar; however, although these timbers may provide longer life than
5 traditional chemically treated wooden timber, they are significantly more expensive to
6 produce and further dependent on a consistent flow of high quality virgin or recycled
7 polymers. Hence the long-term, economic feasibility of such members is far from sound.

8 In view of the limitations associated with the prior art, a substantial need exists
9 for a composite load bearing member that has similar properties to that of a traditional
10 wood load bearing member, has a much longer life than that of a traditional wood load
11 bearing member, and is relatively inexpensive to manufacture. Applicant's invention,
12 through a novel combination of component materials and configurations, provides such a
13 load bearing structure.

14

15 SUMMARY OF THE INVENTION

16 The general purpose of the present invention, which will be described
17 subsequently in greater detail, is to provide a composite load bearing member, which
18 contains many of the advantages of the prior art along with significant novel features that
19 result in a composite load bearing member that is not anticipated, rendered obvious,
20 suggested, or even implied by any of the known devices, either alone or in combination.

21 In view of the foregoing, it is an object of the present invention to provide a
22 composite load bearing member that is less expensive than traditional composite
23 members.

1 It is another object of the present invention to provide a composite load bearing
2 member with similar performance characteristics to that of traditional wood members.

3 It is another object of the present invention to provide a composite load bearing
4 member similar in weight to traditional wood members.

5 It is another object of the present invention to provide a composite load bearing
6 member that is extremely resistant to harsh environmental conditions.

7 It is another object of the present invention to provide a composite load bearing
8 member that is not harmful to the environment.

9 It is another object of the present invention to provide a composite load bearing
10 member that is durable and long-lasting.

11 It is another object of the present invention to provide a composite load bearing
12 member that may be used with existing transportation and installation methods.

13 It is another object of the present invention to provide a method of manufacturing
14 a composite load bearing member that is efficient and inexpensive.

15 In satisfaction of these and other related objectives, the present invention provides
16 a composite load bearing member with an internal reinforcement member. As will be
17 discussed in the specification to follow, practice of the present invention provides an
18 inexpensive, durable, long-lasting structural member allowing side by side replacement
19 along traditional wood members.

20 The preferred embodiment of the present invention incorporates an internal
21 structure into a composite load bearing member both to provide stiffness and to displace
22 composite material. The internal structures are preferably comprised of chemically
23 treated wood structural members selected from a variety of structural shapes including

1 the traditional rectangular shape. This internal structural member is completely
2 embedded within and bonded to a substantial amount of composite material, most
3 preferably comprised of post consumer or post industrial recycled polymers, preferably
4 having a small amount of mineral additive. In production, the internal structural member
5 is placed within a mold in suspended fashion. That is, the internal structure should be
6 spaced apart from all sides of the mold. The present invention, preferably, provides for a
7 plurality of spacing mechanisms attached to the internal member along all sides of the
8 internal member, except for the side facing a gate wherein the polymer is introduced.
9 Most preferably, the spacing mechanisms are composed of a material similar to that of
10 the polymeric composite that is to be used. Next, the polymeric composite is prepared
11 accordingly and forced through a gate into the mold completely encapsulating and
12 bonding with the internal member. The gate is closed, and the composite member is
13 allowed to cool and is ejected from the mold. Thus, in the case of a railroad tie or marine
14 timber, the present invention provides a composite railroad tie having the strength and
15 stiffness of a traditional wood member in a package that is much more durable and
16 environmentally resistant than a traditional wood member.

17 The present invention provides many advantages over traditional support
18 members, particularly railroad ties and marine timbers, as well as prior art composite load
19 bearing members. Importantly, the present invention can be engineered to provide
20 performance characteristics on par with those of traditional wood members. That is, the
21 strength and stiffness characteristics of wood railroad ties or marine timbers may be
22 easily replicated through the joint action of the internal structural member and the
23 polymeric composite outer member. Thus, the present invention provides a structural

1 member that may be placed in close proximity to traditional wood members, while
2 maintaining substantially equivalent loading on each, a requirement of which concrete,
3 steel, and aggregate members are incapable. At the same time, the overall density of the
4 member of the present invention can be engineered to be much more similar to that of a
5 solid wood member than that of the prior art. Therefore, the present invention provides a
6 structural member similar in weight and performance characteristics to traditional wood
7 members so as to be handled, transported, and installed using existing or traditional
8 methods, including providing the capability of being lifted and maneuvered manually by
9 two people, another requirement that steel, concrete, and aggregate members are not
10 capable of fulfilling.

11 Moreover, the present invention provides a composite member for use as a
12 railroad tie allowing the traditional method of attaching a rail thereto. Rails have long
13 been attached to traditional wood railroad ties by embedding spikes into the railroad tie
14 itself. The head of the spike has an elongated edge that overlaps a lower portion of a rail,
15 entrapping the rail against the tie as the spike is driven into the tie. Embodiments of the
16 present invention allow for such a railroad spike to be driven deeply into the composite
17 member, potentially embedding into the inner structural member itself. Optionally, voids
18 may be intentionally placed in the inner member where railroad spikes are intended to be
19 driven such that a railroad spike does not penetrate the internal structure but remains
20 embedded into the polymeric composite portion of the load bearing member. Thus, in
21 contrast to steel, concrete, or aggregate based members, the present invention allows use
22 of traditional methods of rail attachment.

1 In addition to incorporating the advantages of traditional wood structural
2 members, the present invention also provides advantages over wood members as well.
3 First, the thick polymeric composite fully encapsulates the inner member leaving no path
4 for moisture or other environmental effects, providing protection from harsh
5 environmental conditions, normally destructive to wood. Secondly, although some wood
6 boring pests have been known to bore through thin sheets of polymer, the thickness of the
7 polymeric composite used in the present invention provides excellent protection from
8 such pests as well. Finally, as a back up to the protection provided by the polymeric
9 composite, the internal structural member of the present invention is treated with a
10 chemical agent as well, preferably one not damaging to the environment such as borate.
11 Furthermore, although borate based products are difficult to use in traditional wood
12 members that are not externally protected due to its tendency to dissipate its surrounding
13 environment, such a treatment is possible with the present invention because the treated
14 member is sealed from the environment by the thick layer of polymeric composite.
15 Therefore, even if a small leak path to the inner member is introduced, such as through
16 spiking into the inner member in attaching the rail, in the case of a railroad tie, the
17 present invention provides an additional layer of environmental protection, resulting in a
18 more durable, long-lasting product than that of the traditional wood tie.

19 Finally, embodiments of the present invention provide significant improvements
20 over the prior art composite load bearing members, such as composite railroad ties,
21 marine timbers, or the like. In contrast to any of the prior art composite structural
22 members, the present invention provides an inner member that not only provides
23 structural integrity and stiffness to the structure, but also displaces a significant amount of

1 polymeric material. This has the dual effect of balancing the aforementioned competing
2 challenges of product performance and economic efficiency by taking advantage of the
3 attributes of both the inexpensive wooden core and the durable polymeric composite
4 providing protection. Thus, embodiments of the present invention provide a structural
5 load bearing member, such as a railroad tie, marine timber or the like, having the
6 performance advantages of solid wood combined with the durability advantages of prior
7 art composite structures, with significantly less expense than that associated with prior art
8 composite structures.

9

10 BRIEF DESCRIPTION OF THE DRAWINGS

11 Applicant's invention may be further understood from a description of the
12 accompanying drawings, wherein unless otherwise specified, like referenced numerals
13 are intended to depict like components in the various views.

14 Figure 1a is a cross-sectional view of an embodiment of the present invention.

15 Figure 1b is a cross-sectional view of an another embodiment of the present
16 invention.

17 Figure 1c is a cross-sectional view of an another embodiment of the present
18 invention.

19 Figure 1d is a cross-sectional view of another embodiment of the present
20 invention.

21 Figure 1e is a cross-sectional view of another embodiment of the present
22 invention.

1 Figure 1f is a cross-sectional view of another embodiment of the present
2 invention.

3 Figure 2a is a perspective view of an embodiment of the present invention.

4 Figure 2b is a partial side cross-sectional view of an embodiment of the present
5 invention.

6 Figure 3 is a depiction of an apparatus for producing composite structural
7 members of the present invention.

8 Figure 4 is a depiction of another embodiment of an apparatus for producing
9 composite structural members of the present invention.

10

11 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

12 Referring to figures 1a-1f, a composite structural member is shown and generally
13 designated by numeral 10. Composite member (10) contains inner structural member
14 (12). In the preferred embodiment, inner member (12) is comprised of solid wood
15 sections. Inner member (12) may be comprised of other materials such as steel, fiber-
16 glass composites, laminated or engineered wood sections, foamed, honey-combed or
17 reinforced polymeric structures, or other structural materials as known in the art as well;
18 however, it is contemplated that inner structural member (12) should have structural and
19 economic characteristics similar to wood for maximum efficiency of the present
20 invention. Additionally, inner member (12) may be chemically treated with pesticides
21 and/or preservatives for maximum protection from environmental hazards and wood
22 destroying pests. Preferably, inner member (12) is to be pretreated with an

1 environmentally friendly chemical such as a borate based product as currently known in
2 the art of pesticide treatment of wooden articles of construction.

3 Furthermore, inner member (12) may take the form of any of a number of known
4 structural cross-sectional shapes, a few of which are depicted in figures 1a-1f. Each of
5 these figures, although not intended to be drawn to scale, is intended to depict the
6 representative shape and size of a standard railroad tie, in which the outer dimensions are
7 typically seven inches high by nine inches wide. In the preferred embodiment, inner
8 structural member (12), regardless of the exact configuration, should be of the
9 approximate, respective dimensions of four inches high and six inches wide. For
10 example, figure 1a depicts a cross-section of the present invention wherein the outer
11 envelope is seven inches high and nine inches wide and inner structural member (12) is a
12 solid rectangular cross-section that is four inches high and six inches wide. Additionally,
13 figure 1f depicts a cylindrical member as typically used in the marine pile industry.
14 Figures 1a-1f are only a sampling of the potential structural shapes that inner member
15 (12) and composite member (10) may generally take in the present invention, and such
16 figures are meant as exemplary and not limiting.

17 Still referring to figures 1a-1f, the remainder of member (10) is comprised of
18 composite (14). Composite (14) is preferably a polymeric composite comprised of post
19 consumer and/or post industrial recycled polymer mixed with or without a non-polymeric
20 additive, such as mica, gypsum, talc, and/or various rubber materials. Composite (14)
21 encapsulates and adheres to inner member (12) providing a thick layer of leak and insect
22 proof protection of inner member (12). In the present invention, composite (14)
23 comprises 20-95% by volume of member (10), preferably 60% by volume. This amount

1 of composite (14) is considered optimum because it provides a significant thickness of
2 composite material on each side of inner member (12) for the dual purpose of maximum
3 protection of inner member (12) and maximum durability and longevity of structural
4 member (10). This, in turn, provides a member (10) with the beneficial characteristics of
5 a polymeric composite load bearing member along with the performance characteristics
6 of a wood member in a package that is much more economical to produce than prior art
7 composite members.

8 Referring to figure 2a, an embodiment of member (10) is shown with a cut-away
9 section allowing a partial perspective view of inner member (12). In this embodiment, as
10 previously referenced, inner member (12) is shown with strategically placed voids (16).
11 Voids (16) are configured such that when railroad spikes are used to attach a rail to
12 member (10), the spikes will embed into composite (14) and not penetrate into inner
13 member (12). Thus, since inner member (12) is never penetrated in this embodiment of
14 the present invention, inner member (12) remains completely sealed by composite (14),
15 leaving no potential for penetration by moisture or wood destroying pests.

16 Still referring to figure 2a, a perspective view of a partial embodiment of
17 composite load bearing member (10) is shown with texture (18) applied to the exterior
18 surfaces of member (10). In the railroad industry, railroad ties are placed into gravel for
19 stability and support. When member (10) is used as a railroad tie, texture (18) provides a
20 surface that will grip and settle into the gravel bed more securely than that of a smooth
21 surface. Texture (18) can be arranged in any number of patterns; however, a pattern of
22 tightly spaced small pyramidal indentions has been found to be extremely beneficial.

1 Referring to figure 2b, a partial side cross-sectional view of the composite load
2 bearing member is depicted. The embodiment of the present invention depicted in figure
3 2b includes an embodiment of suspension members (54) and block member (56), which
4 are subsequently described in greater detail.

5 Now referring to figure 3, a novel apparatus and process for manufacturing the
6 above described load bearing structure is depicted and generally referred to by the
7 numeral 50. Mold member (52) is depicted with a cut-away section allowing a partial
8 perspective view of inner member (12). Mold member (52) is shown in the general
9 dimensions of a rectangular structural member, such as that of a traditional railroad tie;
10 however, a number of variations and shapes may be accomplished and are contemplated
11 by the present invention, including, but not limited to a cylindrical member such as that
12 of a marine timber or fence post. Additionally, an embodiment of inner member (12) is
13 depicted suspended in mold member (52) by a plurality of suspension members (54). A
14 variety of suspension members (54) are contemplated by the present invention; however,
15 three embodiments are seen to be most beneficial. The first embodiment of suspension
16 member (54) is in the form of any of a number of shapes, such as an angle or "T"
17 member, which is attached to inner member (12) extending therefrom to contact the inner
18 surface of mold member (52). Furthermore, this embodiment of suspension members
19 (54) is comprised of a material similar to that used in composite (14). Thus, in this
20 embodiment of suspension members (54), the surface of members (54) may soften and
21 bond with composite (14) during molding. Regardless of whether a chemical bonding
22 takes place, a physical engagement between suspension members (54) and composite
23 (14) takes place as the materials cool and composite (14) shrinks about suspension

1 members (54). Additionally, when texture (18) is hot stamped onto the surface of
2 member (10), composite (14) and suspension members (54) are again partially melted
3 and their respective materials are displaced at the surface of member (10), resulting in
4 composite (14) filling in any gaps on the surface of member (10) that may have resulted
5 from the lack of complete chemical and/or physical bonding of composite (14) and
6 suspension members (54). As seen in figure 4, another embodiment of suspension
7 members (54) comprise metal pin members extending from the inner surface of mold
8 member (52) in a plurality of locations throughout mold member (52). In this
9 embodiment, after composite (14) is injected into mold member (52) and has begun to
10 solidify, suspension members (54) are retracted allowing the partially fluid composite
11 (14) to fill in the voids left where suspension members (54) were located. This
12 embodiment is most preferably automated by electrically or hydraulically controlled
13 suspension members (54). Alternatively, suspension members (54) may be screws, bolts,
14 or the like that are attached to inner member (12). In this embodiment, once member (10)
15 has sufficiently cooled, suspension members (54) may then be removed, and the
16 remaining voids may be filled with an epoxy or other sealant to achieve complete sealing
17 of inner member (12).

18 Finally, an embodiment of the present invention includes block member (56)
19 located between inner member (12) and mold member (52) at the end opposite gate end
20 (58). Block member (56) may also be comprised of the same or similar material as that
21 of composite (14). Block member (56) supports inner member (12), resisting the forces
22 exerted onto inner member (12) by composite (14) during the injecting process. Block
23 member (56) may also be configured in a grooved or stepped fashion such that when

1 molten composite (14) flows completely around inner member (12), composite (14) will
2 surround and form a physical and/or chemical bond with block member (56), resulting in
3 near complete sealing of inner member (12) in composite (14). Again, in the instance
4 that complete bond and sealing do not take place between composite (14) and block (56),
5 the heat stamping process of placing texture (18) onto the surface of member (10) results
6 in displacement of both composite (14) and block member (56) resulting in complete
7 sealing of inner member (12) from the external environment.

8 Furthermore, alternative embodiments of block member (56) exist as well and are
9 contemplated by the current invention. That is, block member (56) may be a significantly
10 thinner member than previously described and made of any of a number of materials,
11 including metallic or composite materials. This embodiment may be used in conjunction
12 with suspension members (54) of the second or third type as previously described,
13 wherein suspension members (54) are configured to engage with block member (56),
14 which resists the forces generated during the process of injecting composite (14), and
15 provides for the prevention of suspension members (54) from embedding into inner
16 member (12). Suspension members (54) may then either be retracted (if of the second
17 embodiment type previously described) while composite (14) is cooling to allow
18 composite (14) to fill in the voids left by suspension members (54). Alternatively,
19 suspension member (54) may be removed after cooling of member (10), wherein a
20 sealant may be used to fill the remaining voids, sealing inner member (12) from the
21 external environment.

22 In practice, the process of manufacturing the present invention is generally as
23 follows. First, inner member (12) is suspended in mold member (52) in one of the

1 methods as previously described. Next, composite (14) is prepared for injection in any
2 number of methods as generally known in the art. Composite (14) is then injected
3 through gate end (58) of mold member (52) flowing along inner member (12) until mold
4 member (52) is completely filled and inner member (12) is completely surrounded with
5 composite (14). Following this, gate member (60) is closed and member (10) is allowed
6 to cool. As previously described, at some point in the cooling process, if the second
7 embodiment of suspension members (54) is utilized, suspension members (54) must be
8 retracted to allow closure of the voids. Otherwise, if the first embodiment of suspension
9 members (54) is utilized, composite (14) shrinks as it cools and mechanically engages
10 with suspension member (54) to substantially seal off inner member (12) from the
11 external environment. Additionally, as previously described, block member (56) also
12 bonds with composite (14) and seals inner member (12) from the external environment as
13 well. Once member (10) has cooled, member (10) is removed from mold member (52),
14 and texture (18) is hot stamped onto the surface of member (10). As previously
15 mentioned, this step displaces material on the surface of member (10), resulting in the
16 surface of composite (14) being displaced filling any gaps that may exist between
17 suspension members (54) and composite (14). Alternatively, texture (18) may be applied
18 during the molding process itself by texturing the surface of the mold. The result being a
19 composite load bearing structure (10) having the strength and stiffness similar to that of a
20 traditional wood member with the durability, longevity, environment resistance and pest
21 resistance of a composite member produced at a much lower cost than that of traditional
22 composite structures.

1 Although the invention has been described with reference to specific
2 embodiments, this description is not meant to be construed in a limited sense. Various
3 modifications of the disclosed embodiments, as well as alternative embodiments of the
4 inventions will become apparent to persons skilled in the art upon reference to the
5 description of the invention. It is, therefore, contemplated that the appended claims will
6 cover such modifications that fall within the scope of the invention.

1 We claim:

2 1. A composite load bearing member, comprising:

3 an inner structural member, said inner structural member having a

4 proximal end and a distal end, said inner structural member having

5 a structural cross-section longitudinally elongated along a side

6 surface from said proximal end to said distal end; and

7 an outer composite member, said outer composite member completely

8 encapsulating said inner structural member, said outer composite

9 member comprising between 20% and 95% of said load bearing

10 member by volume, said outer composite member being comprised

11 of between 35% and 100% polymeric material.

12

13 2. The composite load bearing member of claim 1 further comprising a plurality

14 of suspension members, said suspension members being located radially about

15 said inner member and extending from the surface of said inner structural member

16 to the outer surface of said composite load bearing member member.

17

18 3. The composite load bearing member of claim 2 further comprising a block

19 member, said block member being located at said distal end of said inner

20 structural member.

21

22 4. The composite load bearing member of claim 3 wherein said inner structural

23 member is comprised of wood.

1

2 5. The composite load bearing member of claim 4 wherein the surface of said
3 composite load bearing member is deformed to fill in any gaps between said
4 suspension members and said outer composite member.

5

6 6. The composite load bearing member of claim 5 wherein said outer composite
7 member is comprised of material selected from the group consisting of post-
8 consumer polymers, post-industrial polymers, and non-polymeric additives.

9

10 7. The composite load bearing member of claim 5 wherein said outer composite
11 member is comprised of material selected from the group consisting of recycled
12 thermoplastic materials, waste thermoset materials, and non-polymeric additives.

13

14 8. The composite load bearing member of claim 7 wherein said outer composite
15 member comprises between 45% and 70% of said composite load bearing
16 member by volume.

17

18 9. A composite load bearing member, comprising:

19 an inner structural member, said inner structural member having a
20 proximal end and a distal end, said inner structural member being
21 comprised of wood, said inner structural extending longitudinally
22 from said proximal end to said distal end;

1 an outer composite member, said outer composite member completely
2 encapsulating said inner structural member, said outer composite
3 member comprising between 20% and 95% of said load bearing
4 member by volume, said outer composite member being comprised
5 of between 35% and 100% polymeric material;
6 a suspension member, said suspension member being located about said
7 inner structural member and extending radially from the surface of
8 said inner structural member to the outer surface of said composite
9 load bearing member; and
10 a block member, said block member being located at said distal end of said
11 inner structural member.

12
13 10. The composite load bearing member of claim 9 wherein the cross section of
14 inner structural member is of a general shape selected from the group consisting
15 of rectangular and circular.

16
17 11. The composite load bearing member of claim 10 wherein said composite load
18 bearing member has a proximal end and a distal end, said composite load bearing
19 member being of general cross-sectional shape selected from the group consisting
20 of rectangular and circular, said cross-sectional shape extending longitudinally
21 from said proximal end to said distal end of said composite load bearing member.

22

1 12. The composite load bearing member of claim 11 wherein the thickness of
2 said outer composite member is between 0.5 inches and 2.5 inches.

3
4 13. The composite load bearing member of claim 12 wherein the surface of said
5 composite load bearing member is deformed to fill in any gaps between said
6 suspension member and said outer composite member.

7
8 14. The composite load bearing member of claim 13 wherein said outer
9 composite member is comprised of material selected from the group consisting of
10 post-consumer polymers, post-industrial polymers, and non-polymeric additives.

11
12 15. The composite load bearing member of claim 13 wherein said outer
13 composite member is comprised of material selected from the group consisting of
14 recycled thermoplastic materials, waste thermoset materials, and non-polymeric
15 additives.

16
17 16. An apparatus for manufacturing a composite load bearing member,
18 comprising:
19 a mold member having a longitudinal cavity with a proximal end and a
20 distal end, wherein an elongate inner structural member is located
21 internally to said mold member via a plurality of suspension
22 members;

1 a block member, said block member juxtaposed said proximal end of said
2 elongate inner structure; and
3 a reversibly actuating gate member attached to said proximal end of said
4 longitudinal cavity through which a polymeric material may be
5 forced to completely encapsulate said elongate inner structural
6 member.

7
8 17. The apparatus of claim 16 wherein said elongate inner structural member is
9 located a specified distance from said distal end of said longitudinal cavity via
10 said block member.

11
12 18. The apparatus of claim 17 wherein said plurality of suspension members is
13 comprised of a polymeric material, said plurality of suspension members being
14 attached to said inner structural member.

15
16 19. The apparatus of claim 17 wherein said plurality of suspension members is a
17 plurality of retractable pin members extending from said cavity of said mold
18 member wherein said plurality of retractable pin members may be retracted.

19
20 20. The apparatus of claim 17 wherein said plurality of suspension members are
21 reversibly attached to said inner structural member and removable after
22 solidification of said polymeric material.

23

1 21. A method of producing a composite load bearing member, comprising:
2 selecting an elongate inner structural member having a proximal and distal
3 end;
4 attaching suspension members to said elongate inner structural member,
5 said suspension members being comprised of a material capable of
6 bonding with a polymeric mixture;
7 attaching a block member to the distal end of said elongate inner structural
8 member, said block member being comprised of a material capable
9 of bonding with a polymeric mixture;
10 placing said elongate inner structural member into a mold member having
11 a cavity with a proximal and distal end, said elongate structural
12 member being internally located within said cavity via said
13 suspension members and spaced a specified distance from said
14 distal end of said cavity via said block member;
15 preparing said polymeric mixture;
16 forcing said polymeric mixture through a closable gate member attached to
17 said proximal end of said cavity;
18 closing said gate member;
19 allowing said polymeric mixture to solidify;
20 ejecting said composite load bearing member from said cavity of said
21 mold member; and
22 hot stamping a textured pattern onto at least a portion of the surface of said
23 composite load member.

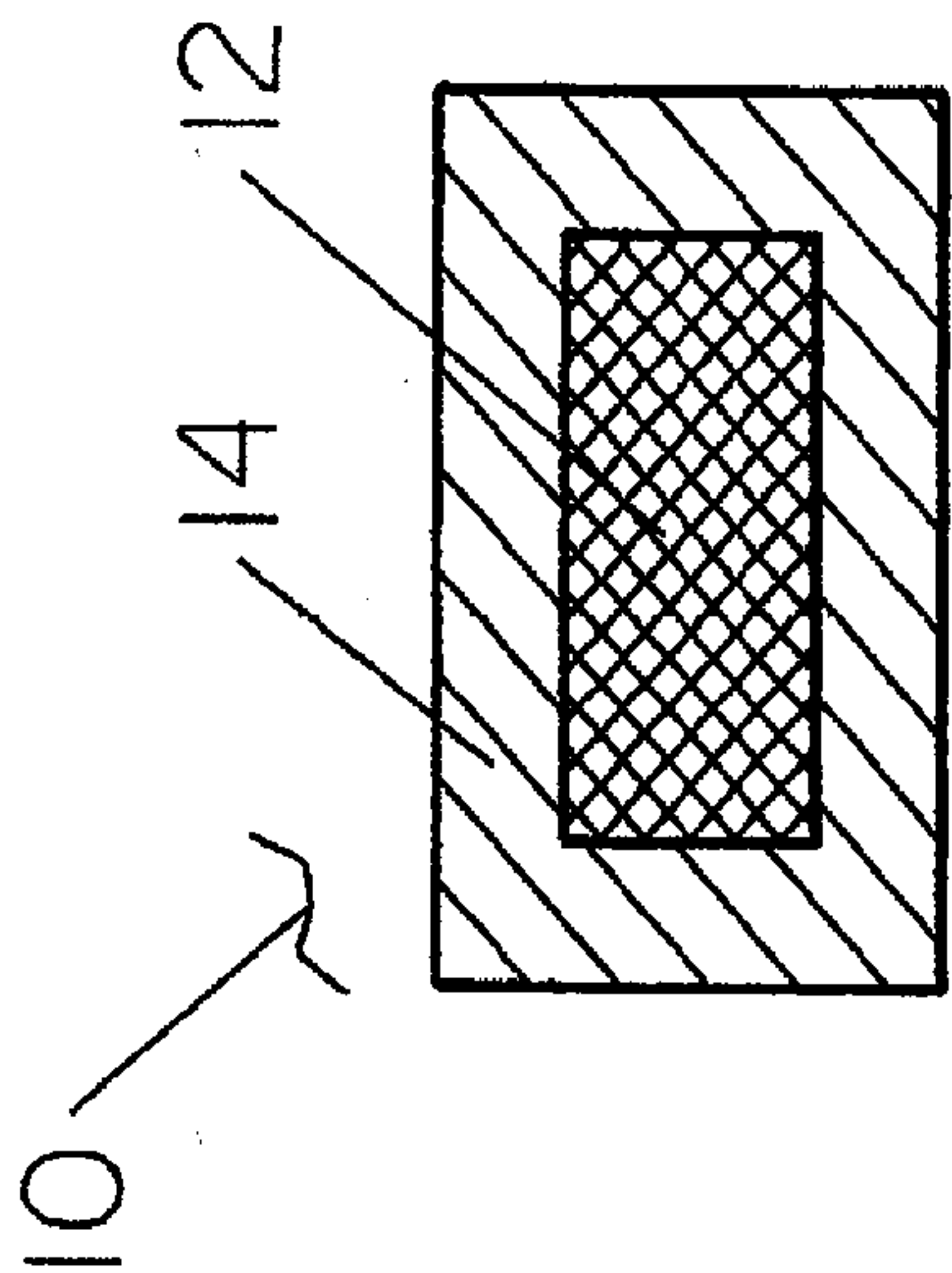


FIGURE 1a

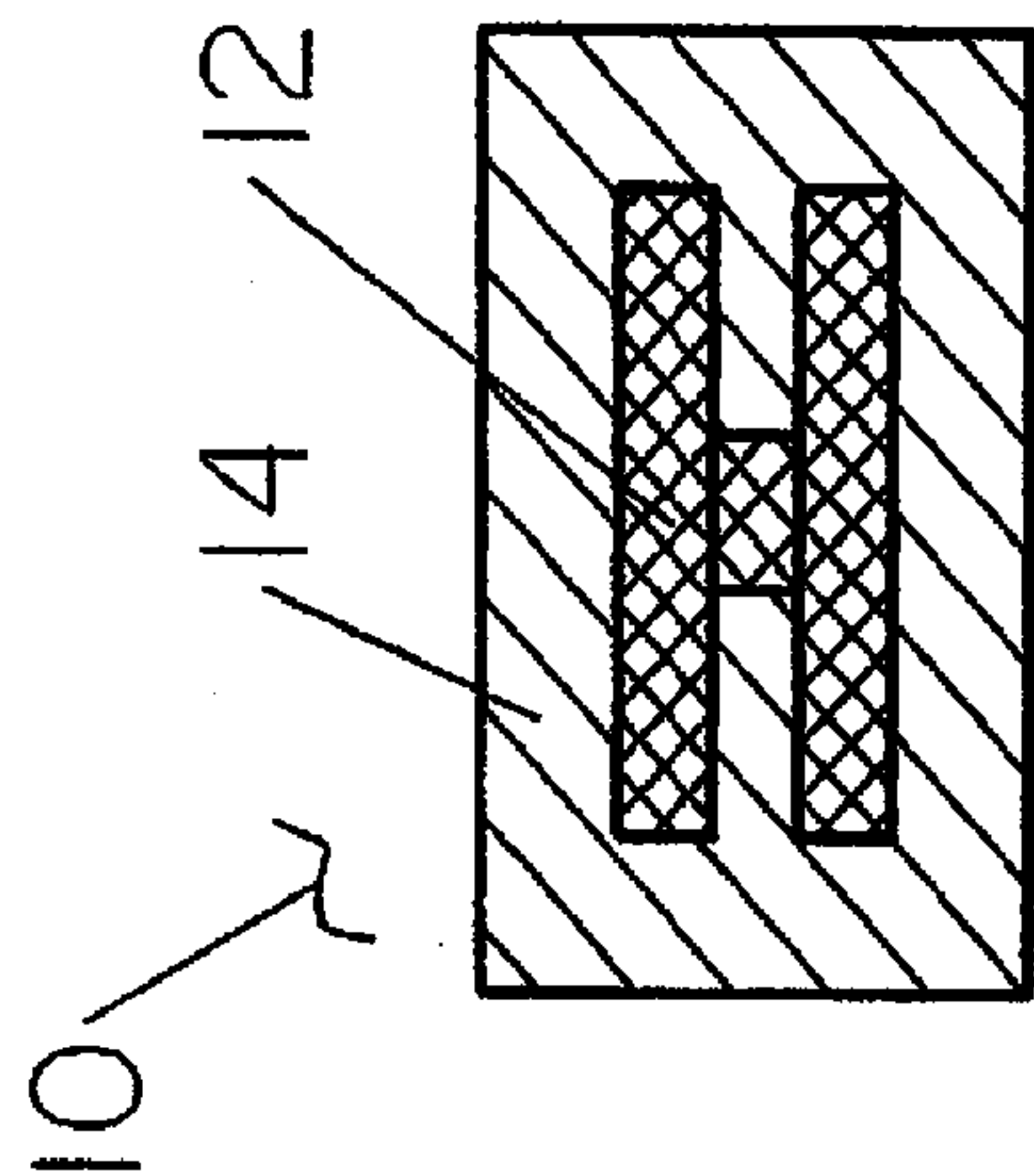


FIGURE 1b

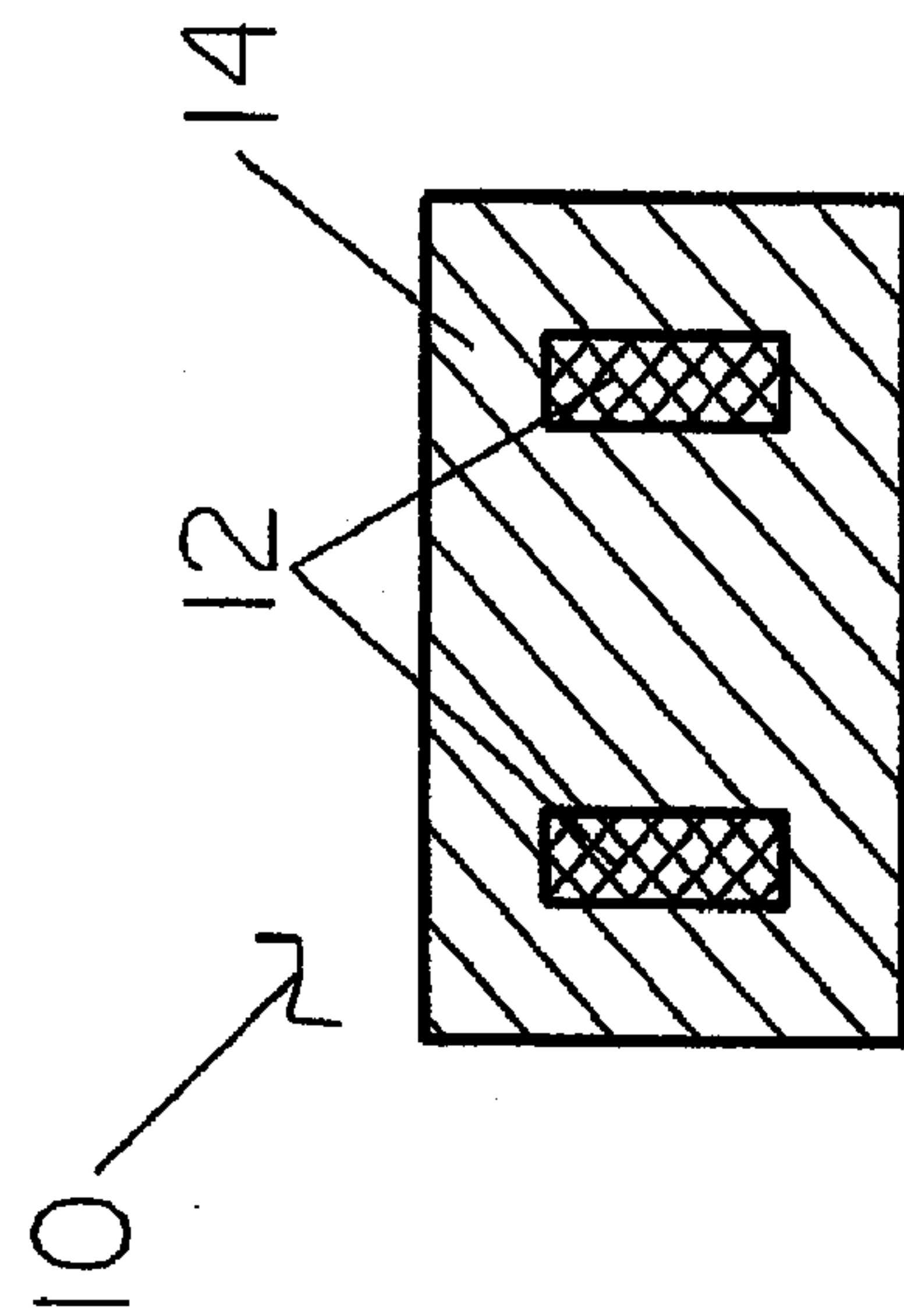


FIGURE 1c

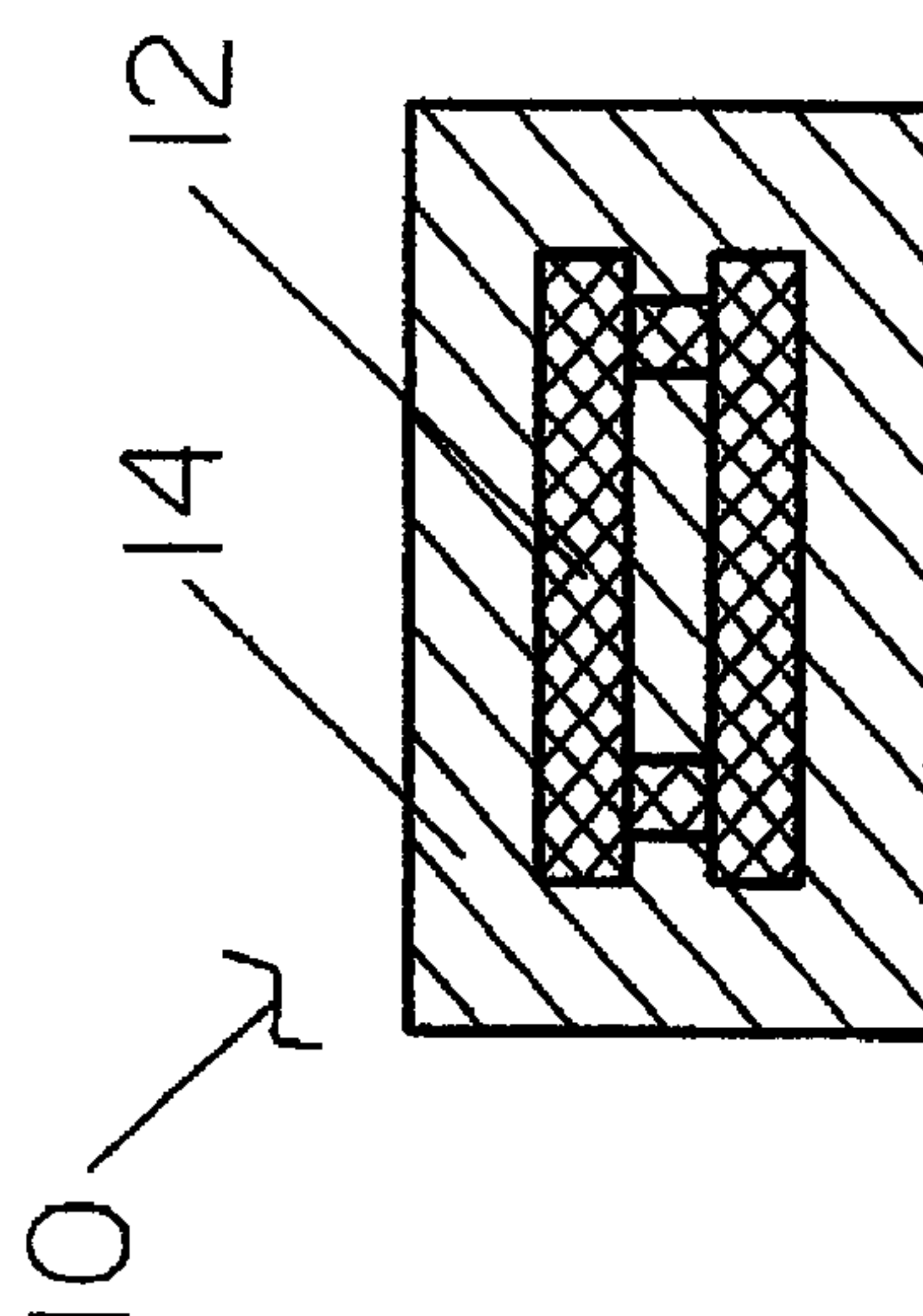


FIGURE 1d

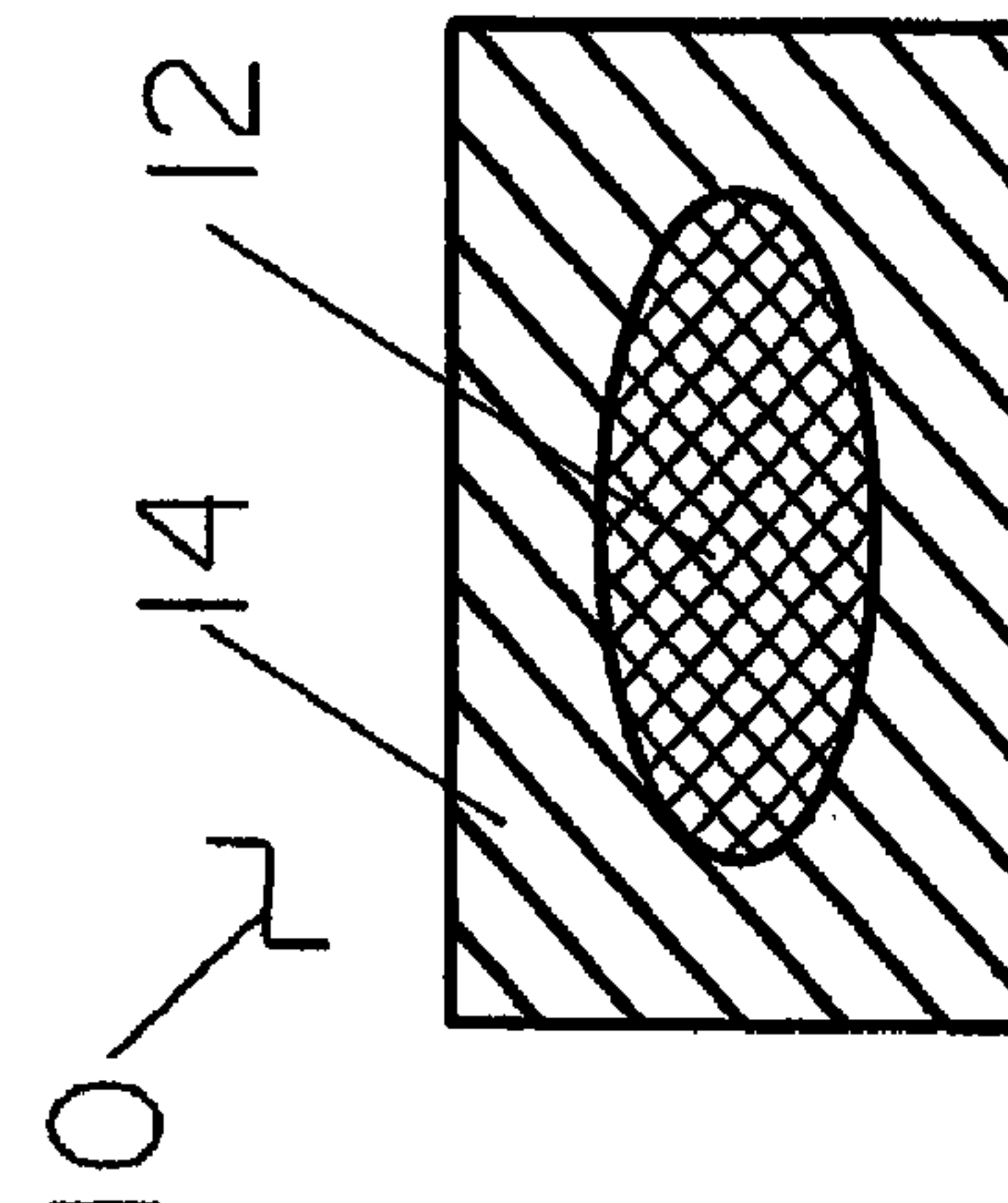


FIGURE 1e

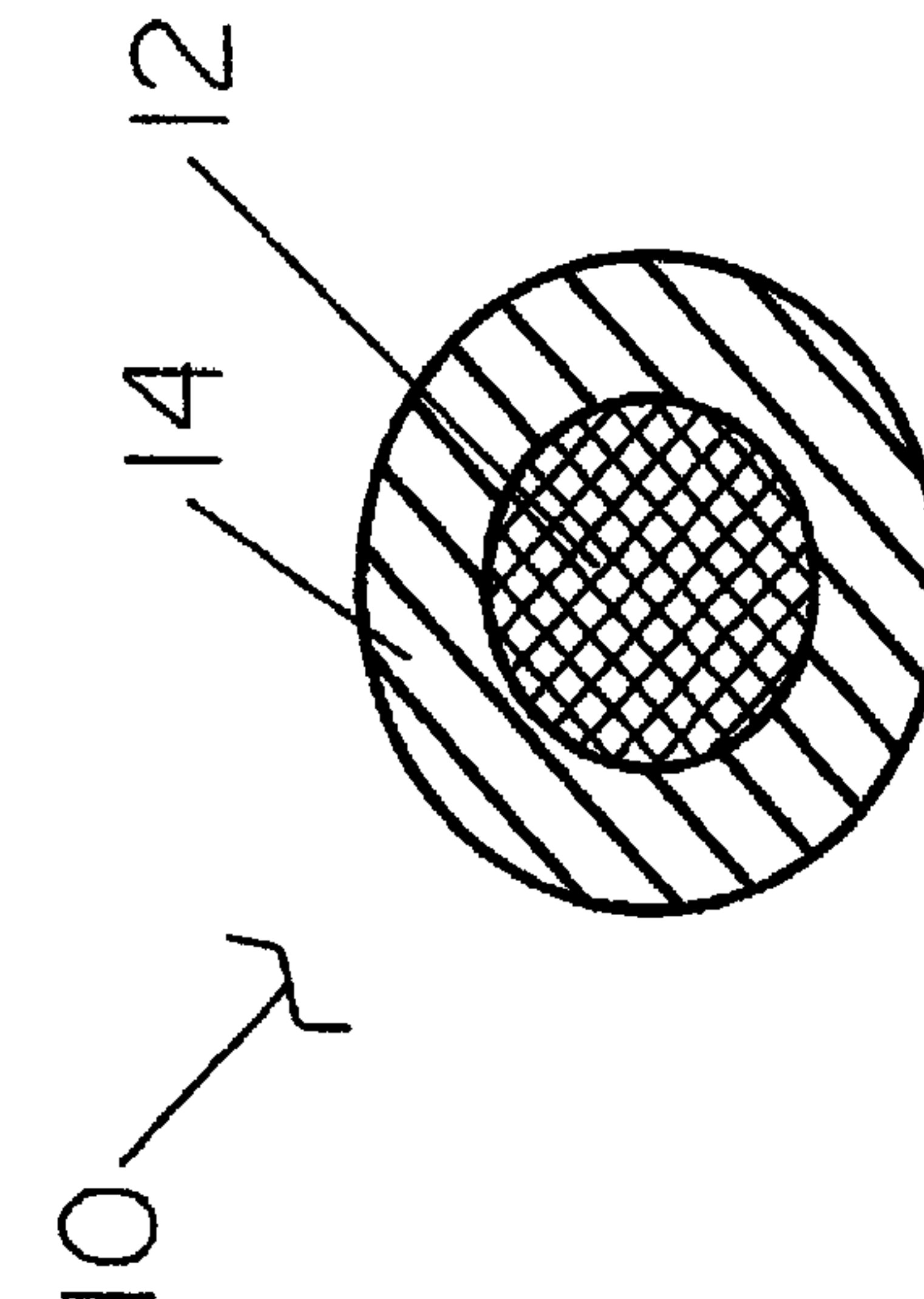


FIGURE 1f

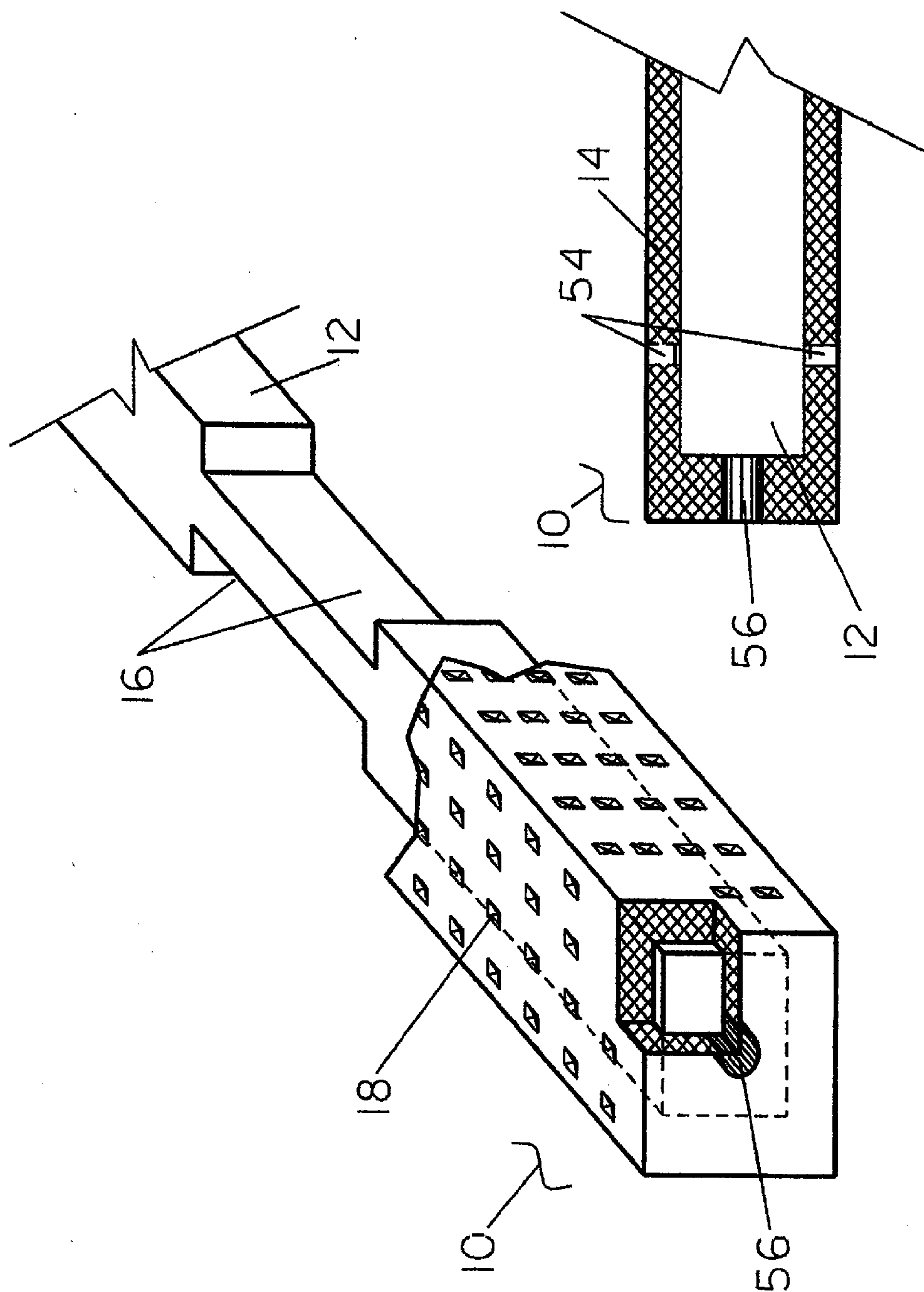


FIGURE 2b

FIGURE 2a

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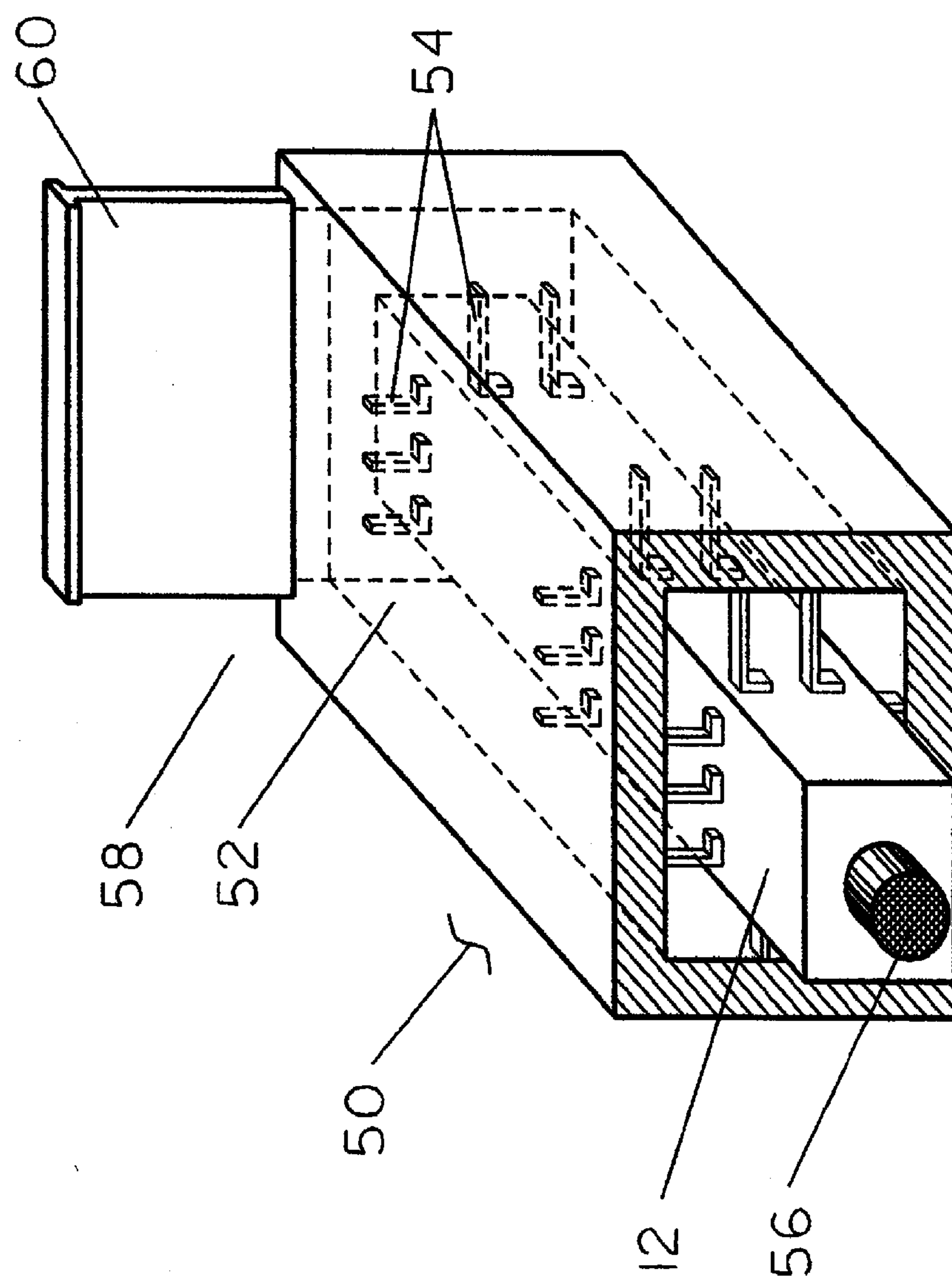


FIGURE 3

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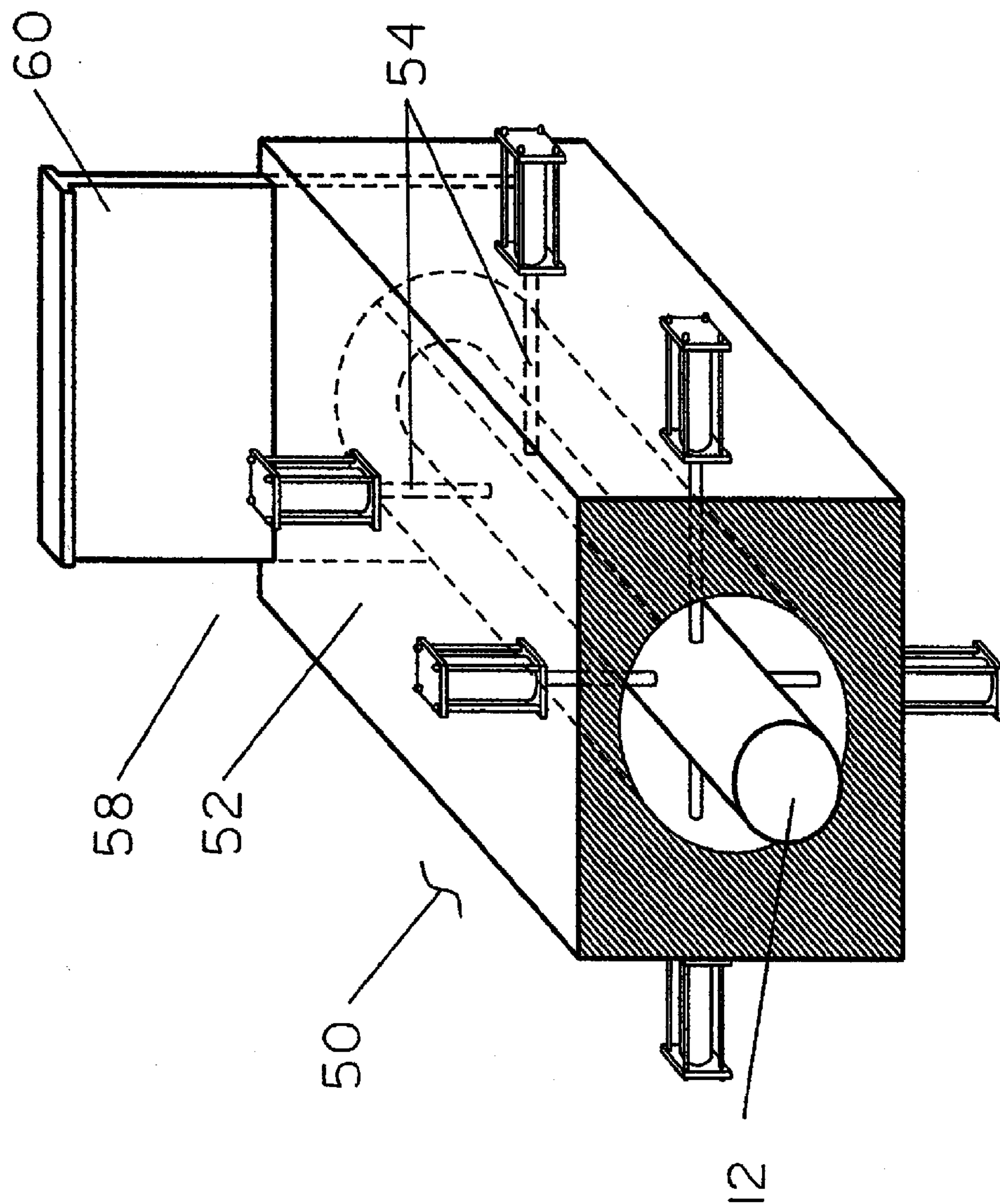


FIGURE 4

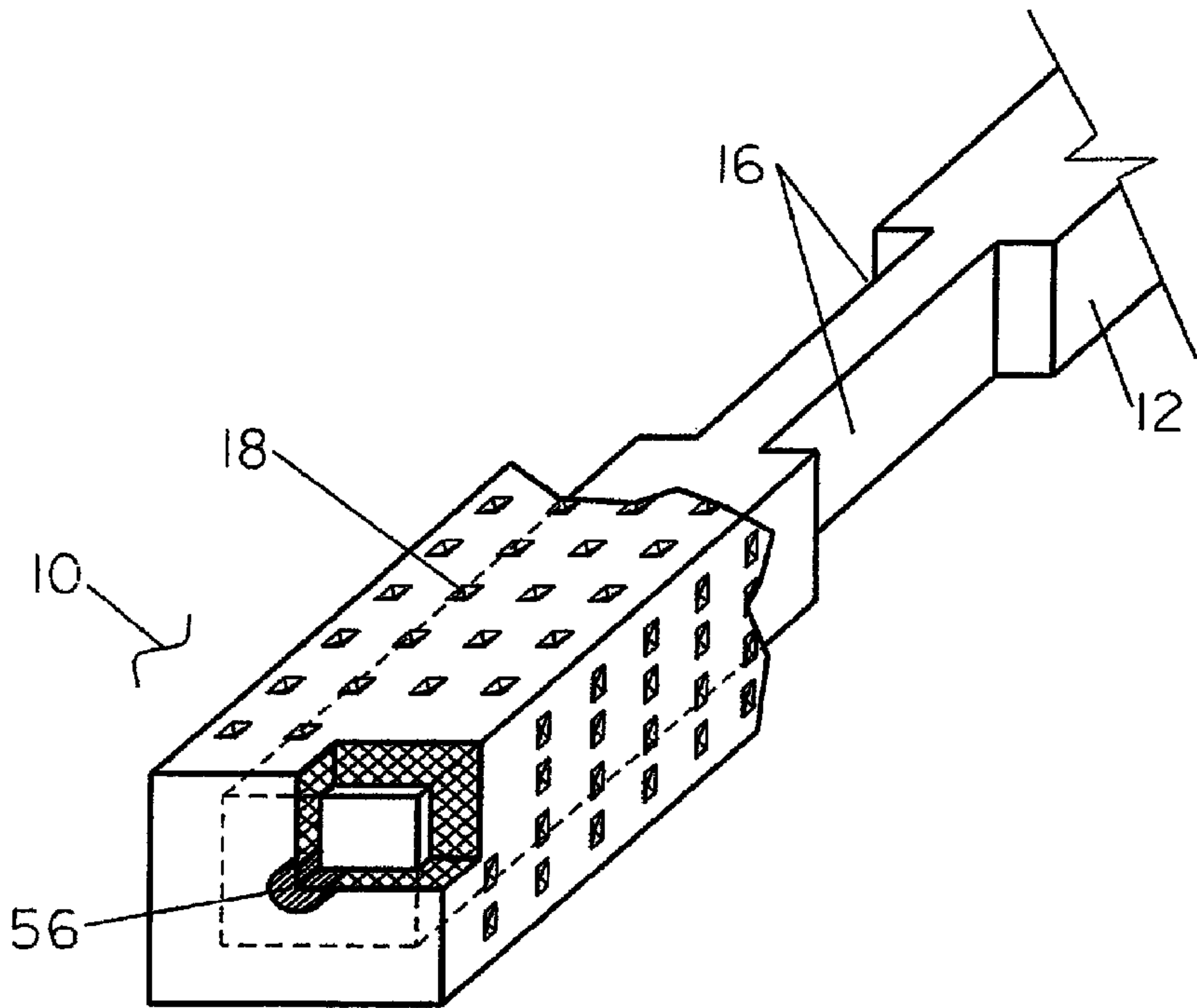


FIGURE 2a