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(54) **NON-DETONABLE EXPLOSIVE SCENT TRAINING TOOL**

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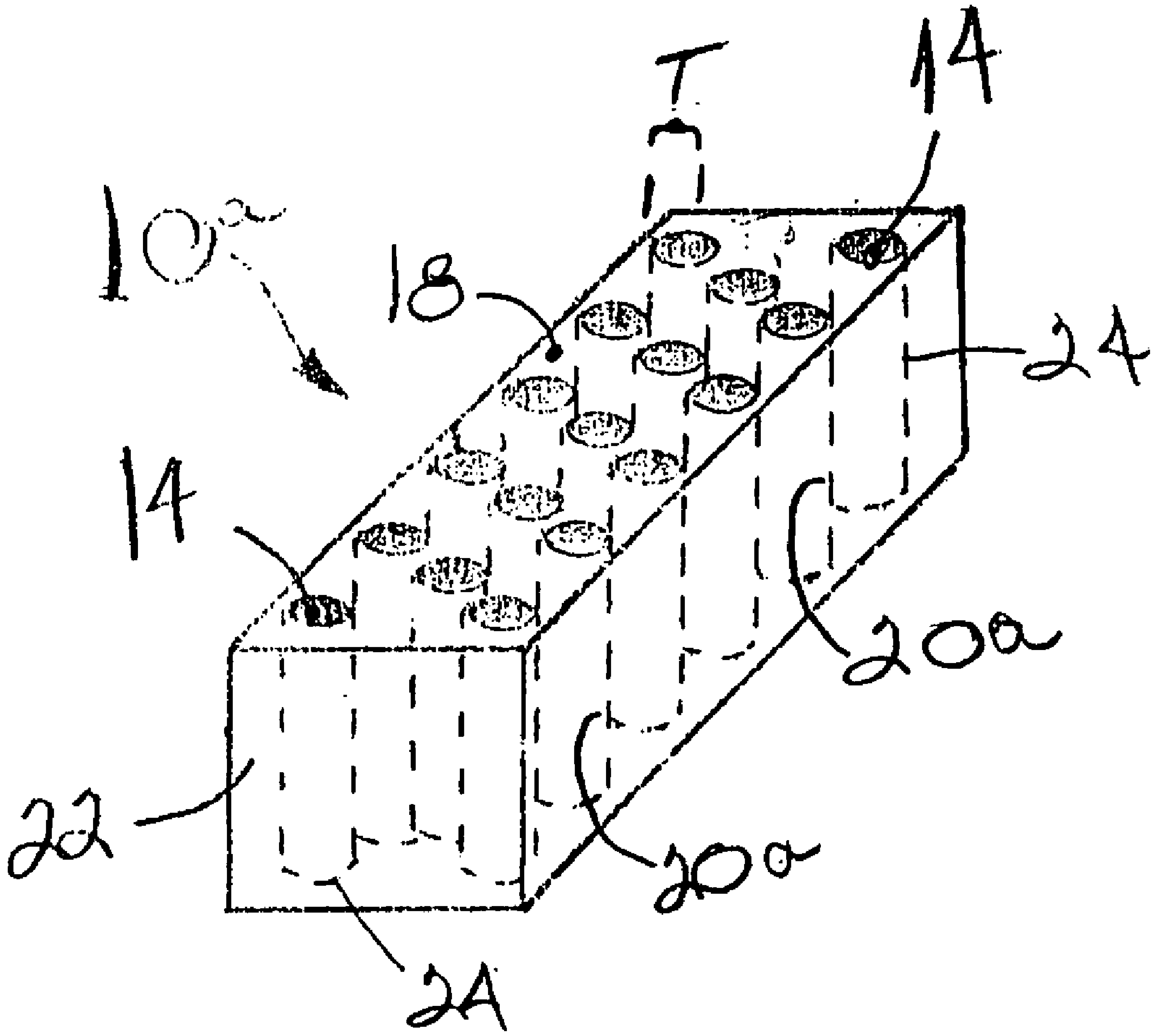
(57) **ABSTRACT**

A non-detonable explosive scent source for use as a tool in training dogs to detect explosive is disclosed. The tool utilizes actual explosive materials as the scent source, and not diluted or synthetic explosive materials. The explosive is contained in a carrier made from a non-volatile material such as metal, ceramic or the like. The explosive is contained in sub-critical dimension receiver spaces formed within the carrier and exposed to atmosphere. The receiver spaces have at least one dimensional parameter less than the "critical thickness" of the explosive material. "Critical thickness" relates to a property of explosive materials that requires every dimension of the explosive material in a charge must exceed the critical thickness property of the explosive used or the charge will not detonate. When any imension of a charge's explosive material is smaller than the explosive's critical thickness, the charge in effect ceases to be an explosive charge.



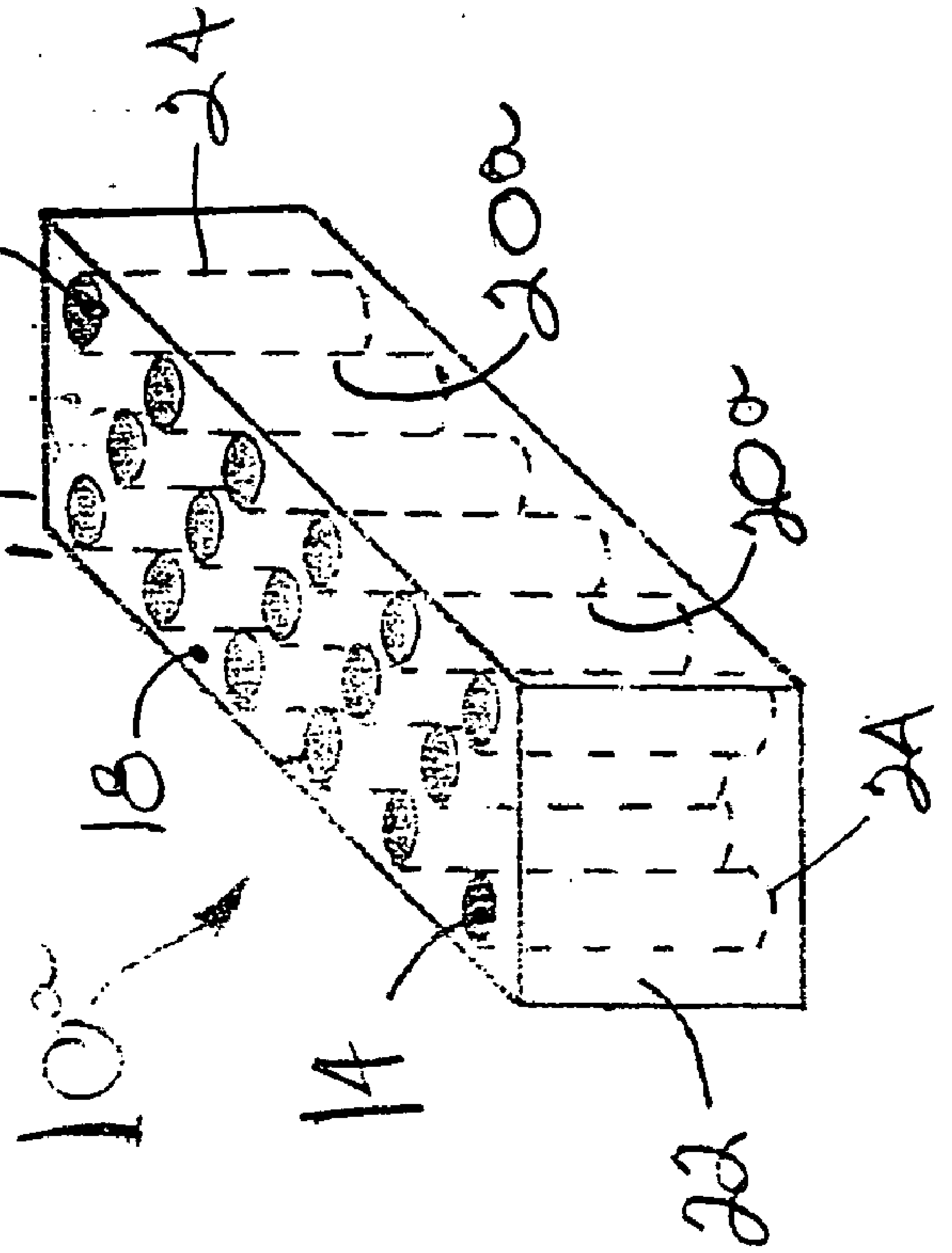


Fig. 2

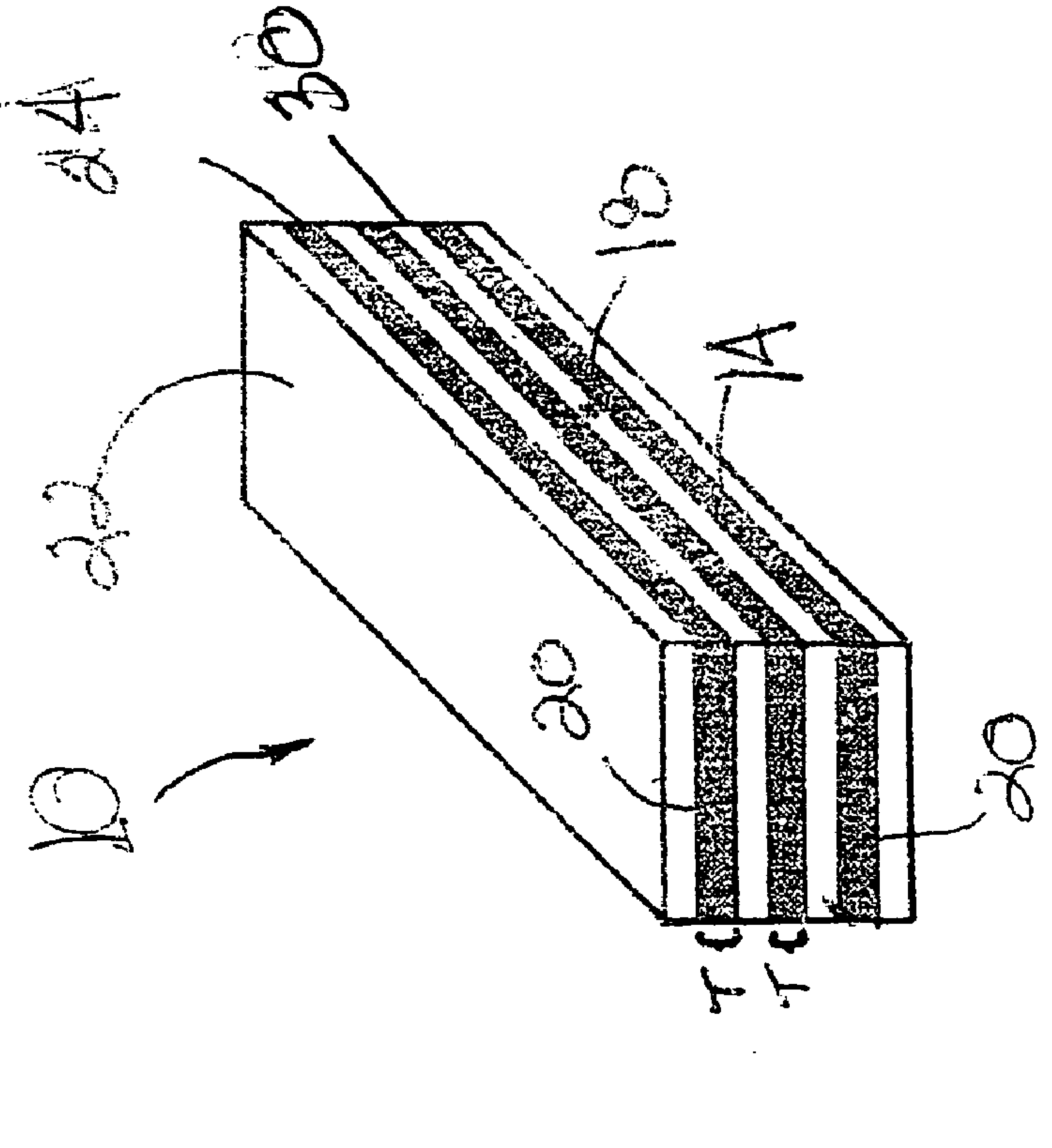


Fig 1

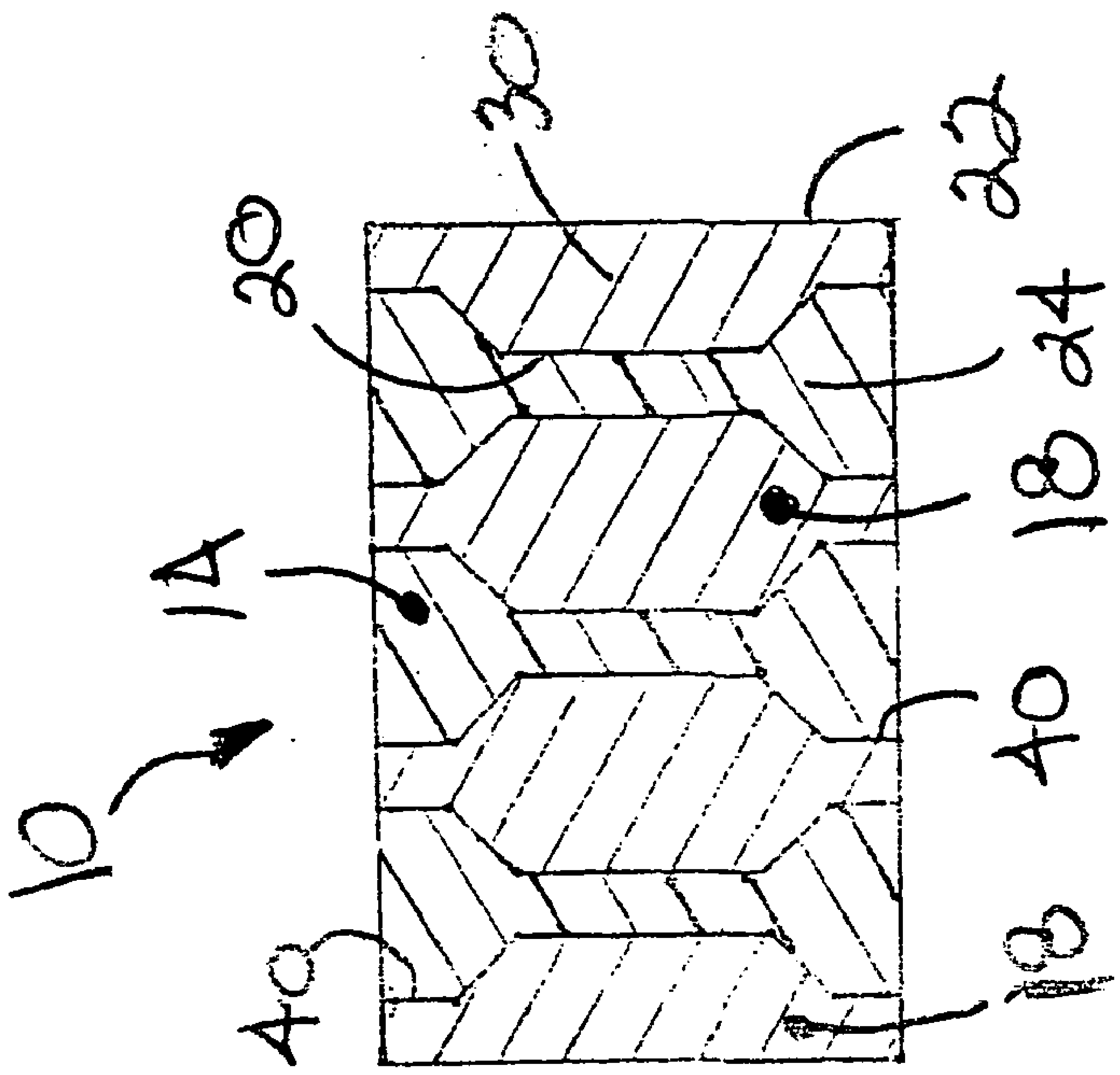


Fig. 4

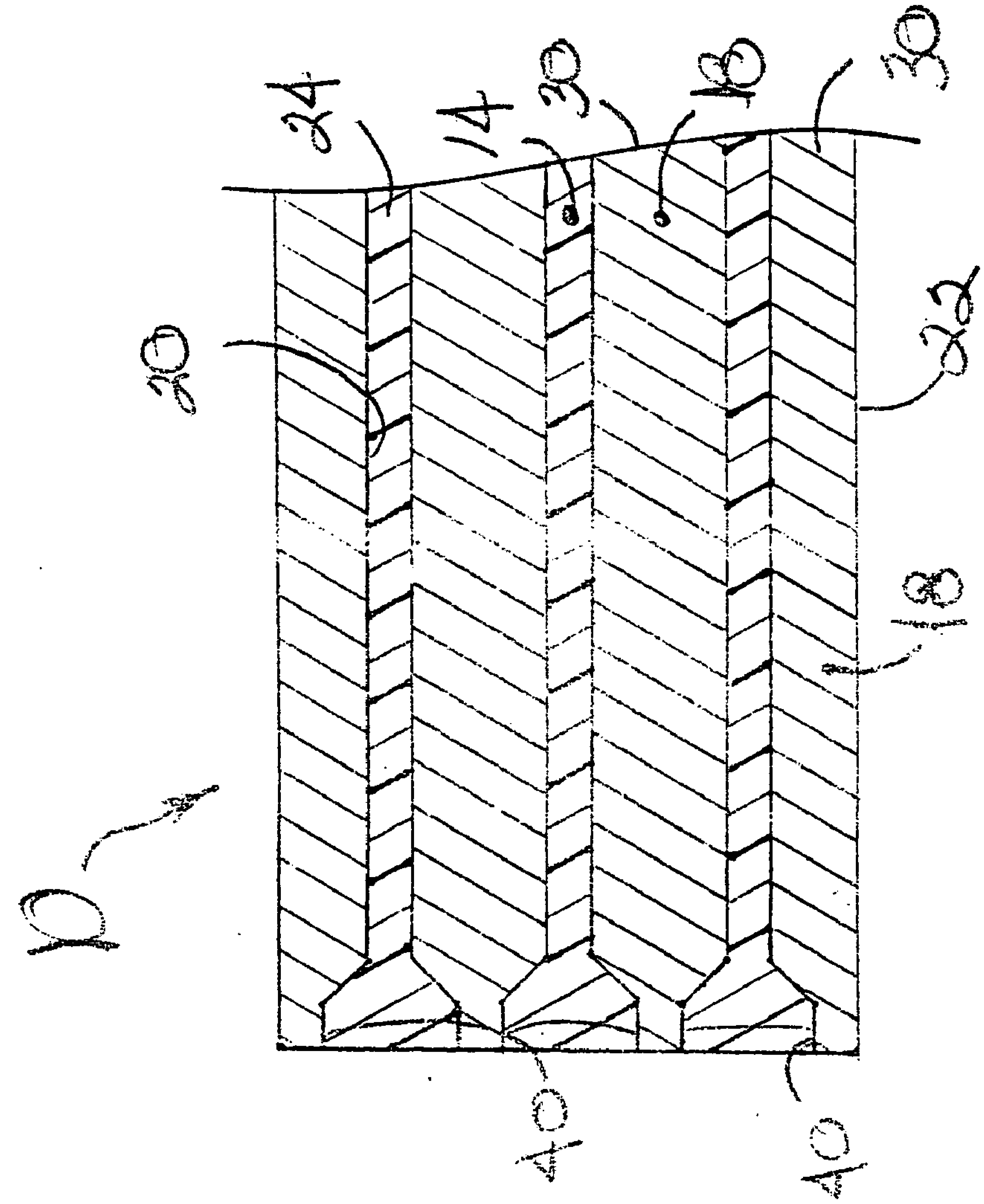
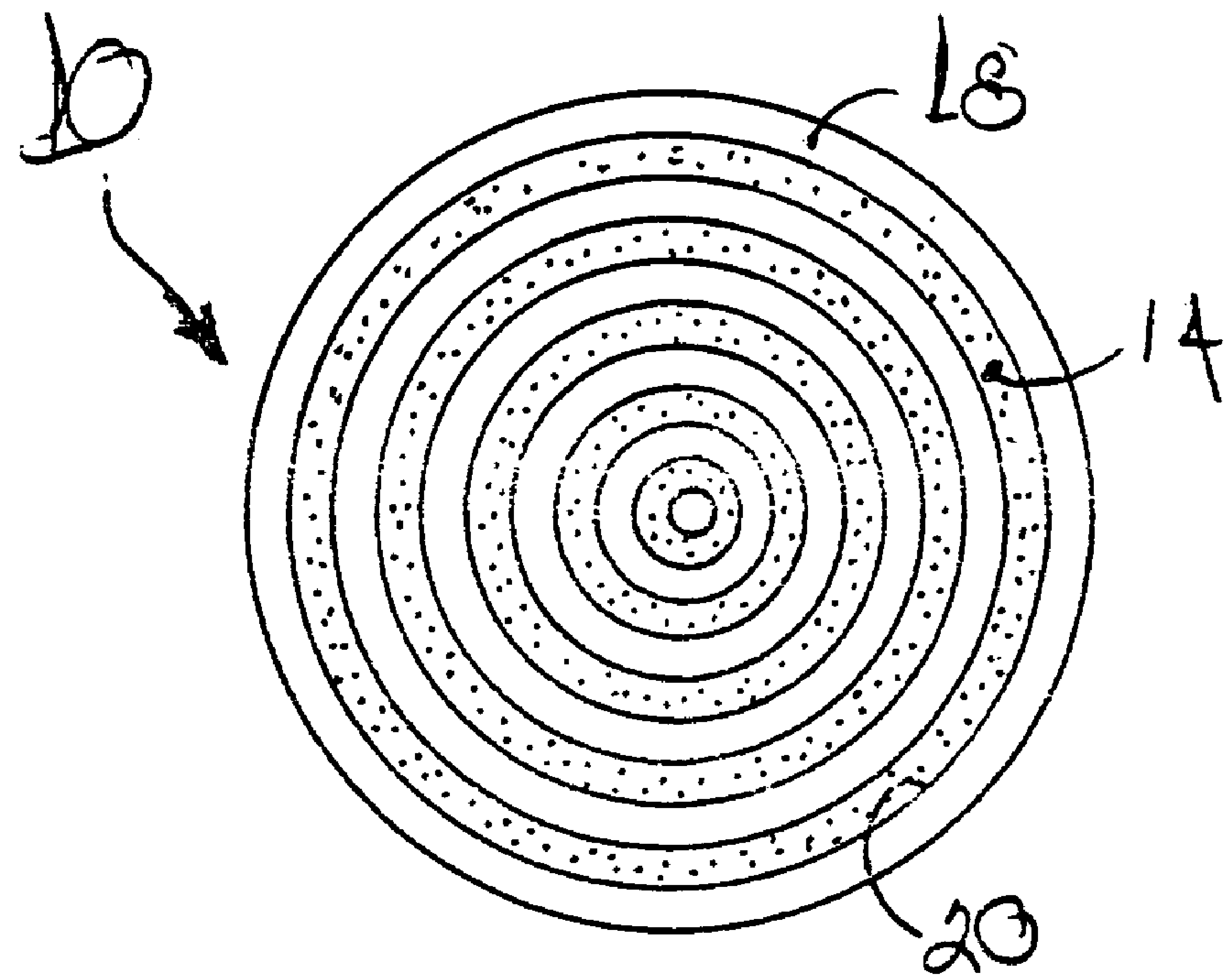


Fig. 3

Fig. 5A



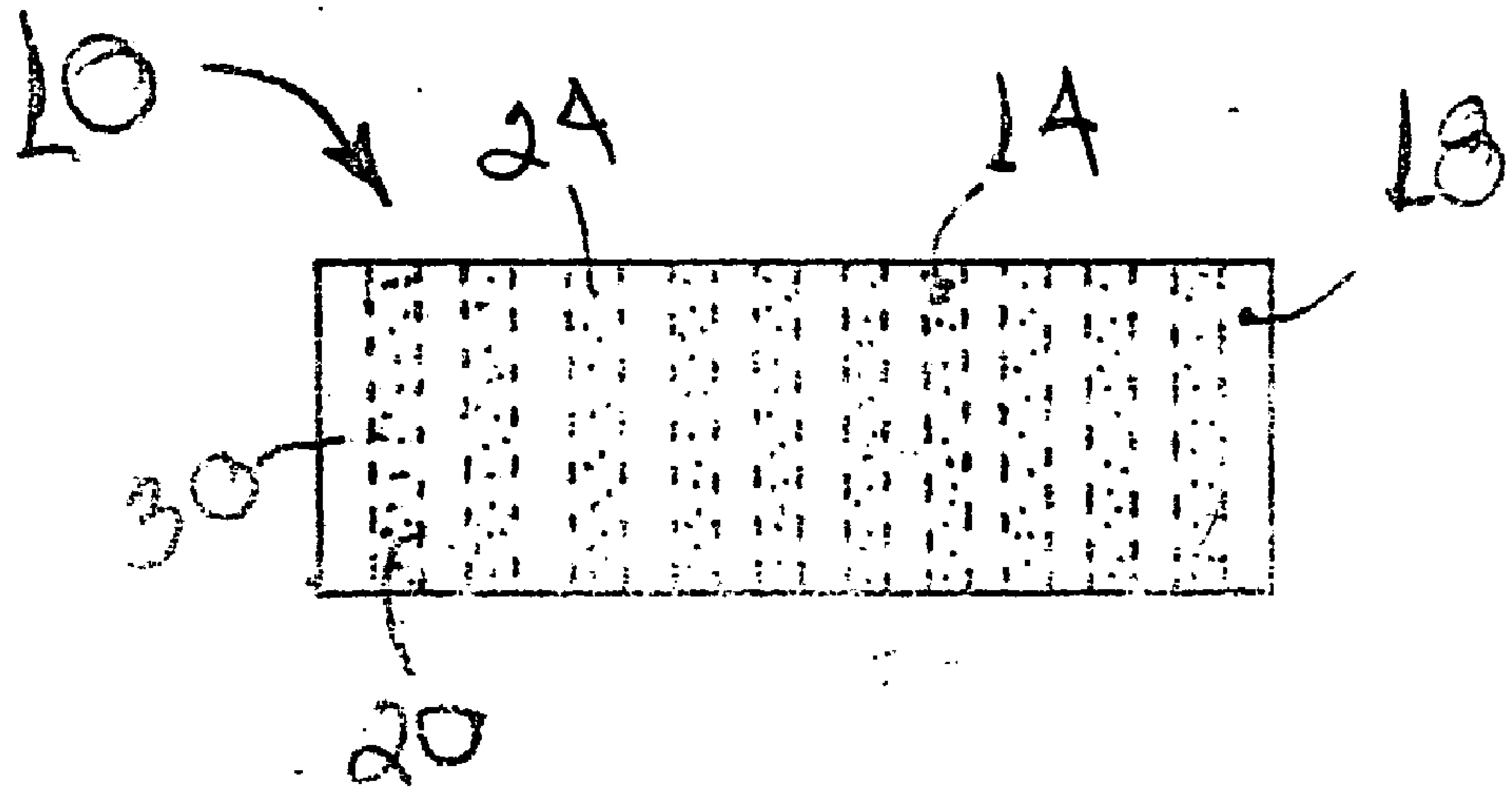


Fig. 5B

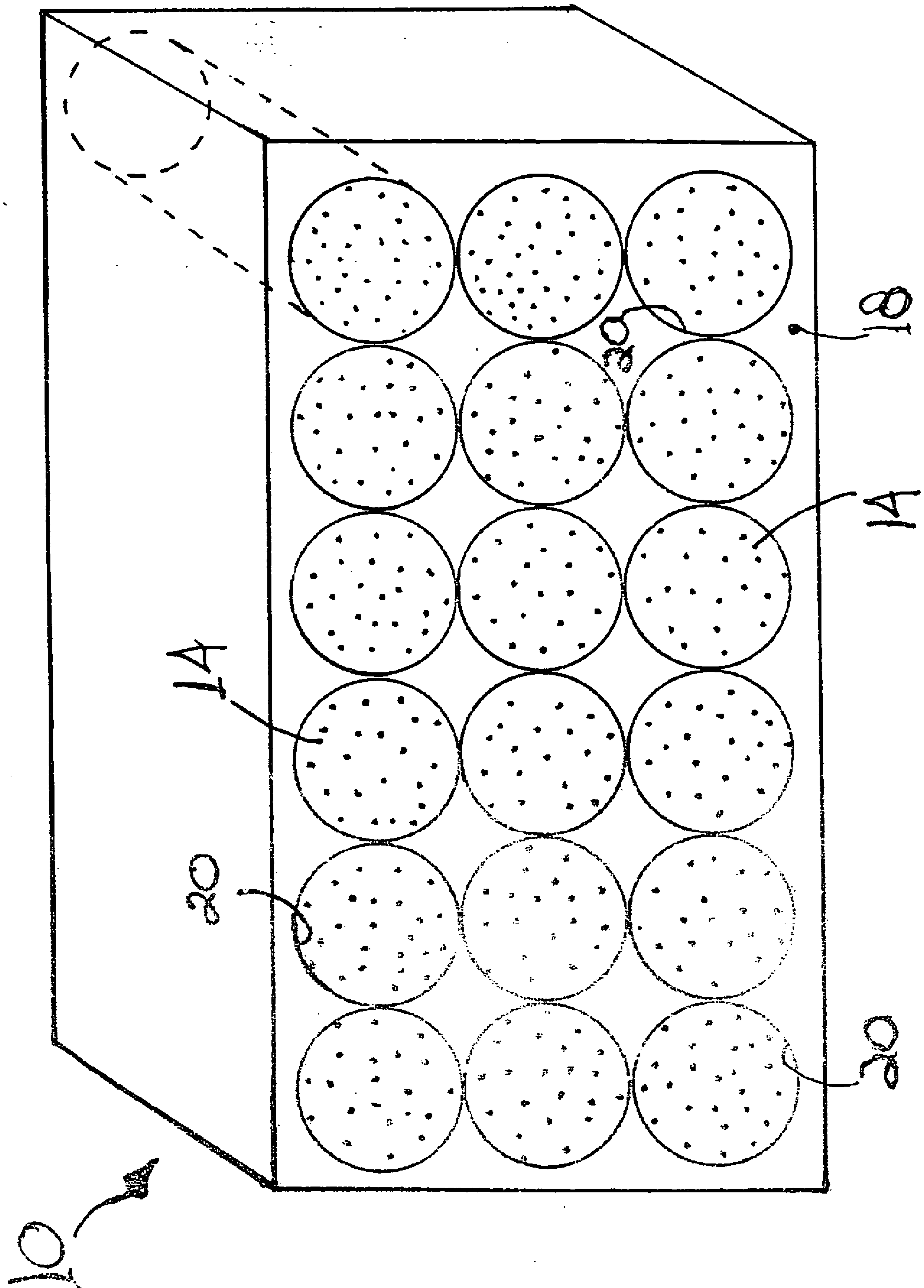


Fig. 6

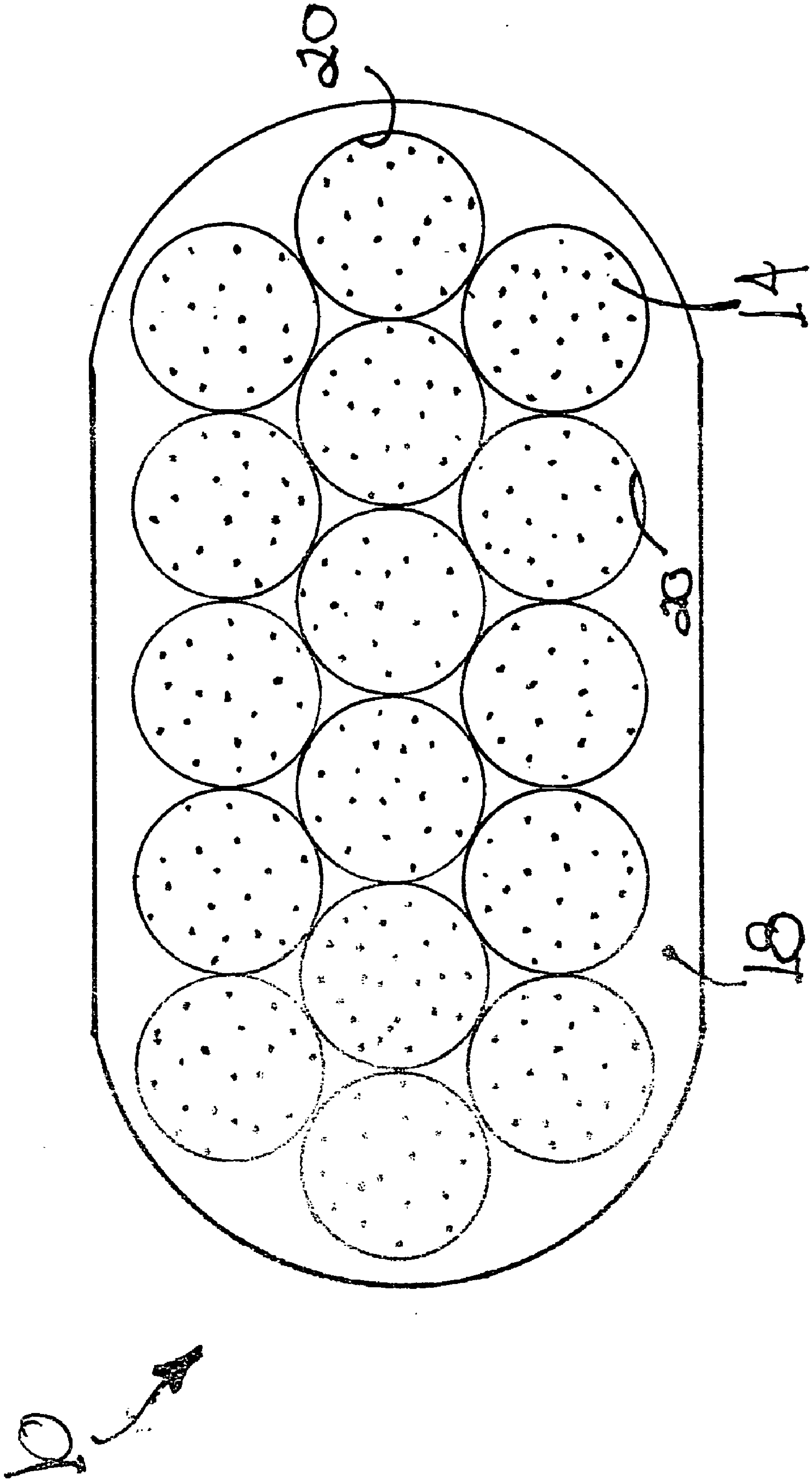


Fig. 7

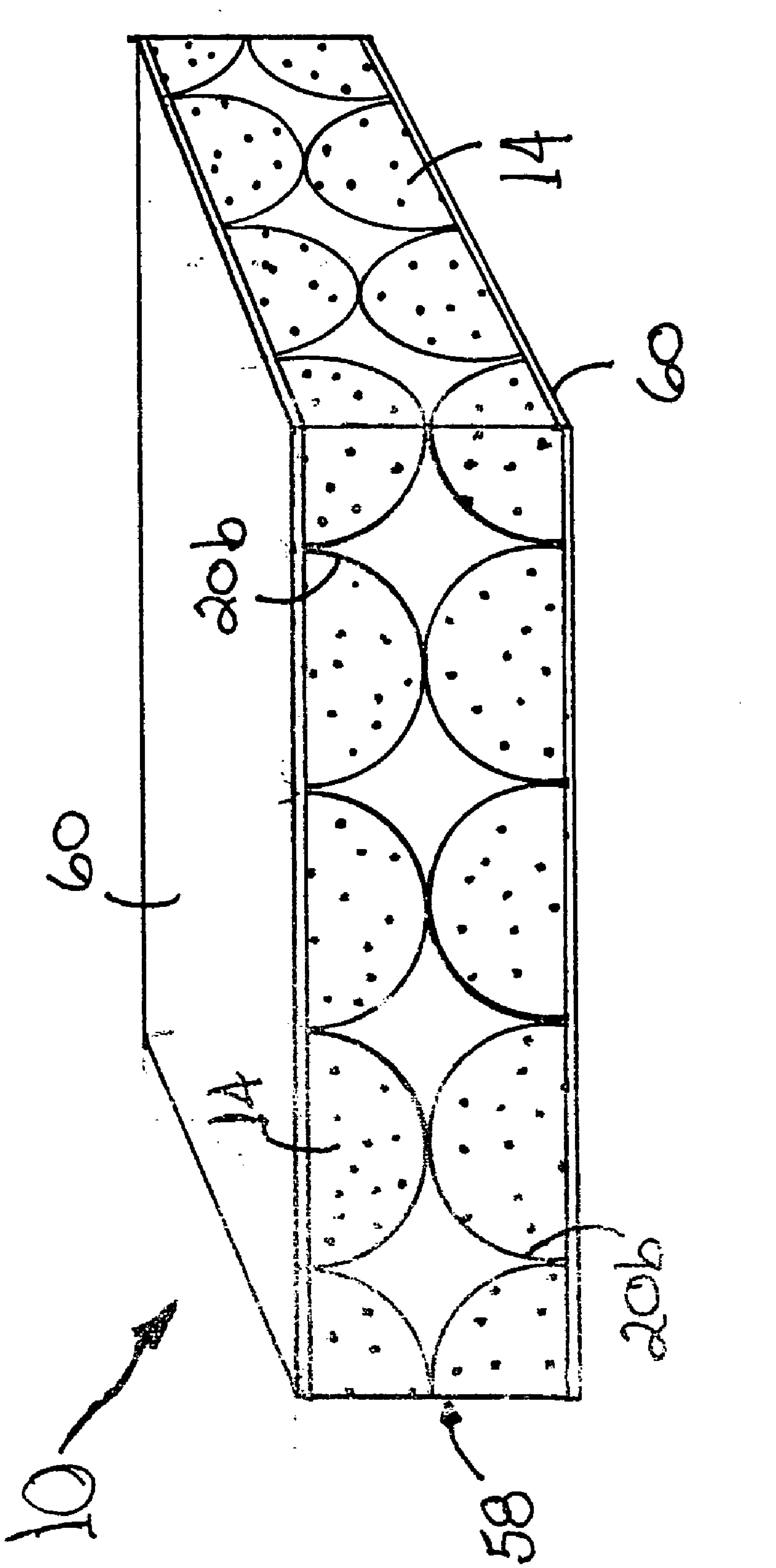


FIG. 8

NON-DETONABLE EXPLOSIVE SCENT TRAINING TOOL

FIELD OF THE INVENTION

[0001] The present invention is in the field of compositions specialized and designed for use in training dogs. More specifically, the present invention relates to an explosive scent source for training dogs to detect explosives.

BACKGROUND OF THE INVENTION

[0002] Due to the increased terrorist threat following the 9/11 terrorist attack in New York City, an increasing number of airports and many small cities in the US and internationally are using dogs trained to detect explosives to provide enhanced security. To maintain their effectiveness dogs require frequent training, which involves the dog's smelling and detecting various explosives. Military explosive security dogs are currently trained with ½ to 1 pound samples of various actual explosives. Typically an explosive scent kit contains dynamite, black powder, TNT, ammonium nitrate dynamite, a water-gel explosive (e.g. Tovex®), Composition C4, DetaSheet®, Det Cord, and PBXN-106. The total explosive weight of such a kit can be 10 pounds. If actual explosive materials are used as training tools, certain regulations must be followed for the transport, storage, handling, and disposal of these explosives. This greatly increases the cost of fielding and maintaining the effectiveness of an explosive security dog team. Therefore, the field has been motivated to provide non-explodeable explosive scent simulants for training dogs to detect explosives.

[0003] Some forms of non-detonable explosive scent simulant are available in the field. These are explosive scents are made by dramatically diluting the subject explosive with an inert material such as glass beads or diatomaceous earth. The concentration of explosive in such simulants is typically less than one percent. A concern in the field is that in view of such a high dilution percent, other, non-explosive odors may be introduced into the simulant by the manufacturing process or in the handling of the training tool. It is not possible to remove all traces of such contaminates at levels undetectable by dogs. This leads to the problem of the trainee dog triggering on the contaminant and not the explosive. This is very dangerous because the dog may detect the simulant scents in training, but fail to detect real explosives in the field. Also, the active ingredient of many explosives, e.g. nitroglycerin in dynamite, have high vapor pressures. Compounding them in low concentrations results in the possibility that significant quantities of the explosive may evaporate or sublimate from the explosive scent tool during its lifetime, rendering it useless.

[0004] Simpson et al., U.S. Pat. Nos. 5,648,636, 5,413,812 and 5,359,936, discloses a simulator which is chemically equivalent to an explosive, but cannot be detonated or exploded. The simulator comprises explosive and non-explosive material combined in proportions equivalent to an explosive, having a similar scent, chemical element, chemical bonding pattern, x-ray absorption and isotope ratio equivalent to explosive material. Kury et al., U.S. Pat. No. 5,958,299, discloses an explosive simulant for testing explosive detection systems, however, this simulant contains no actual explosive material.

[0005] It would be beneficial to have an explosive scent comprised totally from a pure explosive which has been rendered unable to detonate, preventing confusion of the dog triggering on the contaminant and not the explosive. Costs are dramatically reduced for the transportation, and storage of such training materials. Additionally, other advantages include reduced hazards during handling and the elimination of the possibility of theft of explosive materials while in storage.

SUMMARY OF THE INVENTION

[0006] The present invention is a safe, non-detonable explosive scent training tool for training dogs to detect explosive materials such as dynamite, black powder, TNT, ammonium nitrate dynamite, a water-gel explosive (e.g. Tovex®), Composition C4, DetaSheet®), Det Cord, and PBXN-106. Many other explosive materials are practicable in the present explosive scent training tool, including: RDX (cyclotrimethylenetrinitramine), HMX (cyclotetramethylenetetranitramine), PETN (Pentaerythritol Tetranitrate), and certain perchlorates and nitrates. See *Picatinney Arsenal Encyclopedia of Explosives and Related Items*, NITS, US GPO for a general listing of high explosives. The present non-detonable explosive scent training tool uses actual explosive materials as a scent source packaged in a manner to render the explosive materials non-detonable. The term "non-detonable" as used herein means that the item or charge containing an explosive material cannot be detonated if exposed to fire or to an otherwise appropriate detonating shock. The present scent training tool exploits a physical property typical of all explosive materials to construct a scent training tool that while it utilizes an actual explosive material as the scent source, the explosive in the tool cannot be detonated. This renders the scent training tool safer and less difficult to handle and store, and also provides a better scent training aid than such tools utilizing diluted or synthetic explosive scent sources.

[0007] The critical thickness of an explosive relates to a fundamental property of explosive materials that requires that every dimension of an explosive charge must exceed the critical diameter or thickness property of the explosive material used in the charge. The critical thickness property of an explosive material is dependent on the charge into which it is incorporated, i.e., the type of the explosive material used in the charge, and the configuration of the charge itself. Charge configuration features include the density of the explosive material, the shape of the overall charge, the shape of the explosive material in the charge, the strength with which the explosive material is constricted in the charge (the inertial confinement) and the strength, mass and configuration of the non-explosive structure of the charge. When any dimension of the explosive material in a charge is reduced in size so that it is smaller than its critical thickness, then the charge will fail to detonate and, in effect, will cease to be an explosive charge. The present scent training tool exploits the "critical thickness" or "critical diameter" property typical of all explosive materials to construct non-detonable training tools having an actual explosive scent source, but which cannot be used as an explosive charge.

[0008] The present non-detonable explosive scent training tools are such that in no part of a tool does the thickness of the explosive material component exceed its critical thickness. This is accomplished in a variety of ways. For example, the scent tool can be configured as a laminate with the explosive material in layers thinner than its critical thickness separated by alternating layers of an inert material. The scent tool can comprise explosive material packed into holes or pits in an inert material, with the holes or pits being smaller in diameter than the critical diameter of the explosive material used. Other configurations are selectable by one of ordinary skill in the art in view of the figures and teachings herein. As an example, a present scent training tool can be configured as a ribbon comprising a layer of explosive material and an inert material rolled in a spiral, in jelly-roll fashion, to form a disk shaped tool. Appropriate inert materials include materials that are substantially non-volatile and preferably non-flammable, and do not have scents that substantially compete with or mask the explosive scent for a dog. Appropriate inert materials may include: metals, ceramics, composites and high molecular weight plastics.

[0009] The present explosive scent training tools do not comprise an explosive charge in the sense that the tools cannot be detonated in the usual manners. Even though the present scent tools contain an explosive material, under the UN Transportation Regulations for Hazardous Materials, the present scent tools likely will be classified as 1.4 explosives. This likely classification for the present scent tools, class 1.4, relates to items that represents only a moderate fire hazard. A class 1.3 item may burn, but it will not detonate. Furthermore, an item classified as a 1.4S explosive may be shipped in an essentially unregulated manner including shipment by cargo aircraft. The storage regulations for such items are also greatly relaxed in comparison to items classified as 1.1, 1.2, or 1.3 explosives. This greatly reduces shipping and storage costs.

[0010] Optionally, the present explosive-scent tools can be constructed so that no explosive material is exposed where it can be touched. This reduces the risk of contaminating the scent source during handling and cleaning. The item can also be made virtually tamper-proof by welding or bolting it closed (with high security bolts) so that the explosive contained therein cannot be removed easily for illegal purposes. In view of the above, the safe handling of an explosive based scent tool is increased, while the utility of stealing the tool in order to convert it for illegal purposes is diminished. It is an object of the present invention to provide a scent training tool that without more cannot be used as an explosive charge.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is a diagram of a laminated block shaped scent training tool of the present invention showing alternating layers of explosive material and an inert carrier medium.

[0012] **FIG. 2** is a diagram of an alternative block shaped scent training tool showing explosive material filled channels through the inert carrier medium.

[0013] **FIG. 3** is a cross-sectional diagram of a laminated block shaped scent training tool having an increased exposed explosive surface area.

[0014] **FIG. 4** is a diagram of the alternative block shaped scent training tool of **FIG. 2** showing an increased exposed explosive surface area.

[0015] **FIG. 5** is a diagram of a disk-shaped scent training tool configured with concentric alternating layers of carrier medium and explosive material around a core.

[0016] **FIG. 6** is a perspective view of a block shaped explosive scent tool of the present invention, with the explosive material shaped as rods and packed in the block in a body centered cubic packing arrangement.

[0017] **FIG. 7** is an end elevation view of a block shaped explosive scent tool of the present invention, with the explosive material shaped as rods and packed in the block in a hexagonal closest packing arrangement.

[0018] **FIG. 8** is a perspective view of a block shaped explosive scent tool of the present invention, wherein the explosive materials are partial spheres exposed at the surfaces of the block. Additionally, shown is a vapor permeable film or layer covering two of the surfaces.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Referring now to the drawings, the details of preferred embodiments of the present invention are graphically and schematically illustrated. Like elements in the drawings are represented by like numbers, and any similar elements are represented by like numbers with a different lower case letter suffix.

[0020] As exemplified in the figures, the present invention is a non-detonable explosive scent training tool **10** for use as a scent source in the training of explosives detecting dogs. Generally, the present scent training tool **10** comprises an explosive material **14**, an inert carrier medium **18** made from a relatively non-volatile material, and a plurality of sub-critical dimension receiver spaces **20** formed by or in the inert carrier medium **18**. The sub-critical dimension receiver spaces **20** are "sub-critical" in that each defines a volume having at least one physical dimension T that is less than the critical thickness of the explosive material to be contained within the receiver space **20**. The receiver spaces **20** are exposed to the outer surface **22** of the inert carrier medium **18**. The receiver spaces **18** contain the explosive material **14**, and allow volatile emanations from the explosive material **14** to pass out of the scent training tool **10** to atmosphere. In a preferred embodiment as illustrated in **FIGS. 1 and 2**, the present non-detonable explosive scent training tool **10** has an overall shape configured as an oblong block. However, other shape configurations are selectable by one of ordinary skill in the art for practice in the present invention. For example, see the disk shaped configuration of the scent training tool **10** illustrated in **FIGS. 5A and 5B**.

[0021] In the preferred embodiment of **FIG. 1**, the explosive material scent training tool **10** is configured as a planar laminate block. The laminate comprises a plurality of alternating explosive material layers **24** sandwiched between inert carrier medium layers **30**. In this embodiment, the explosive material layers **24** define the sub-critical receiver spaces **20** of the scent tool **10**. The explosive material layers **24** all have a thickness dimension T that is less than the "critical thickness" dimension for the explosive material **14** used in the layer **24**. Because the thickness T of the explosive layers **24** is less than the explosive material's critical thickness, the explosive material cannot be detonated and the scent tool **10** cannot be used as an explosive charge.

[0022] **FIG. 2** illustrates the explosive material scent training tool **10** configured as a porous or perforate block. In this embodiment, the inert carrier material **18** has a plurality of receiver spaces formed as through bores **24** extending completely through a thickness of the inert carrier medium **18**. In this embodiment, the diameter of the through bores **24** define the sub-critical dimension T for the receiver spaces **20***a* of the scent tool **10**. The explosive material **14** is packed into bore holes **24**. Because the bore holes **24** are smaller in diameter T than the explosive material's critical thickness, the explosive material **14** cannot be detonated and the scent tool **10** cannot be used as an explosive charge.

[**0023**] **FIGS. 3 and 4** are cross-sectional diagrams respectively of a laminate block scent tool **10** (see **FIG. 1**) and a bore hole block scent tool **10** (see **FIG. 2**) and illustrate how the atmospheric interface can be increased to enhance volatilization of the explosive material **14** without exceeding the critical thickness dimension T of the intended explosive material **14**. Specifically, each receiver space **20**, proximate the outer surface **22** of the carrier medium **18**, is enlarged to define a terminus volume **40** that still does not have a dimensional parameter greater than the critical thickness of the intended explosive material **14**. The terminus volume **40** has an interface with the atmosphere that is larger than the receiver space **20** otherwise would have.

[**0024**] **FIGS. 3 and 4** also illustrate the optional feature of the present scent training tool **10** having the explosive material **14** contained in the receiver spaces **20** recessed from the outer surface **22** of the inert carrier medium **18**. This feature allows the tool to be handled or cleaned without contaminating the explosive material **14**. Optionally, the explosive scent tool **10** can be fitted with covers (not shown) to prevent contamination or can be contained in a well ventilated housing (not shown).

[**0025**] Other shapes for the present non-detonable explosive scent tool **10** are practicable by the ordinary skilled artisan. For example, as shown in **FIGS. 5A and 5B**, the present explosive scent training tool **10** can have an overall shape configured as a disk. In the embodiment illustrated, the disk can comprise a plurality of concentric alternating rings of carrier medium **18** and explosive material **14** around a core. Alternatively, a disk shaped explosive scent training tool **10** can be accomplished in the present invention as a laminate similar to the manner of **FIG. 1**, or as a perforate disk similar to the manner of **FIG. 2**. Further, a disk shaped scent training tool **10** can comprise a spiral of a ribbon made of a layer of explosive material **14** over a layer of an inert material **18** rolled up in jelly-roll fashion (not shown).

[**0026**] Other configurations for defining the receiver space **20** of the present invention **10** are also known to and selectable by the ordinary skilled artisan for practice in the present invention. For example, packed preformed-rod configurations can be utilized, as exemplified in **FIGS. 6 and 7**. **FIG. 6** illustrates a body centered cubic packing arrangement for a plurality of parallel rods **50** shaped from an explosive material **14**. **FIG. 7** illustrates a hexagonal closest packing arrangement for a plurality of parallel rods **50** shaped from an explosive material. Although random packing is also possible, this is not the most efficient use of space and it introduces at least some degree of uncertainty in the configuration. For the purpose of illustration, in **FIGS. 6 and 7**, the speckles indicate explosive material **14** (e.g. RDX, HMX, PETN) and the carrier material **18** is not speckled. However, in practice the reverse configuration can also be used, i.e., the speckled elements are the carrier material, and the non-speckled elements indicate the explosive material. The point being that practice the present explosive scent tool **10** is not limited to the inert material being of a larger dimensional configuration than the explosive material **14**.

[**0027**] **FIG. 8** illustrates another alternative configuration for the receiver space **20** of the present scent tool **10**. In this configuration, a block shaped explosive scent tool **10** incorporates receiver spaces **20***b* which are portions of sphere shapes. In this configuration, the explosive materials **14** are partial spheres exposed at the surfaces of the block **58**. Additionally, shown is an optional film **60** or layer covering two of the surfaces of the block **58**. Alternatively, the film **60** could cover the entire surface of the scent tool **10**. If utilized, the file **60** must be vapor permeable to allow the scent of the explosive material **14** to pass through it to atmosphere. Optionally, the film **60**, though vapor permeable, can be liquid impermeable, to prevent loss of a relatively fluent explosive material **14** from the receiver spaces **20***b*.

[**0028**] It should be noted that there is no "critical thickness" T dimension parameter for the carrier material **18** in the same sense as there is for the explosive material **14**. The shape or design of the holder/carrier material **18** in not limited by the parameter T, and can be very much greater or smaller. It should be emphasized that a surface coating of explosive onto a separate inert support is not an object of the present invention, as the resulting inert volume of such current scent tools is a substantial portion of the total volume of the tool, and the effective shelf/useful life of the tool is reduced.

[**0029**] Explosive materials **14** anticipated for use in the present non-detonable explosive scent training tool include: dynamite, black powder, TNT, ammonium nitrate dynamite, a water-gel explosive (e.g. Tovex), Composition C4, DetaSheet, Det Cord, and PBXN-106. Other explosive materials may be selectable by the ordinary skilled artisan for practice in the present invention. The inert carrier medium **18** is constructed of a relatively non-volatile and preferably non-flammable material. Materials suitable for practicing the carrier medium **18** of the present scent tool **10** include metals (especially sheet metals), ceramics, high molecular weight plastics, and composites. Materials selection criteria include consideration of the finished scent tool's item classification under the UN Transportation Regulations for Hazardous Materials. The carrier medium **18** is specifically configured with the specific explosive material **14** with which it is to be used. A carrier medium **18** of the present invention is intended only for use with an explosive material **14** which has a critical thickness property appropriate for the dimensions of the carrier medium's sub-critical receiver spaces **20**.

[**0030**] The present non-detonable explosive scent tool is not limited to practice with relatively solid or with particulated explosive materials. For example, the present explosives scent tool **10** can also be practiced with liquid explosives (e.g. nitroglycerin) and solid, non-particulated explosives (e.g. TNT). Additionally, the present scent tool **10** can be practiced with non-homogenious explosives materials such as fuel-oxidizer blends (e.g. ammonium perchlorate-aluminum, potassium perchlorate-titanium dihydride, and black powder).

[**0031**] While the above description contains many specifics, these should not be construed as limitations on the scope of the invention, but rather as exemplifications of one or another preferred embodiment thereof. Many other variations are possible, which would be obvious to one skilled in the art. Accordingly, the scope of the invention should be determined by the scope of the appended claims and their equivalents, and not just by the embodiments.

What is claimed is:

1. A non-detonable explosive scent training tool comprising:

an explosive material;

an inert carrier medium made from a relatively non-volatile material and having an outer surface; and

a plurality of sub-critical dimension receiver spaces formed by the carrier medium, the receiver spaces exposed to the outer surface of the inert carrier medium and containing the explosive material.

2. The non-detonable explosive scent training tool of claim 1, wherein the explosive material is formulated with at least one compound selected from the group consisting of: nitrocellulose, ammonium nitrate, TNT, RDX (cyclotrimethylene trinitramine), HMX (cyclo-1,3,5,7-tetramethylene 2,4,6,8-tetranitramine), perclorates, nitrates and PETN (pentaerythritoltetranitrate).

3. The non-detonable explosive scent training tool of claim 1, wherein the sub-critical dimension receiver space has dimensional features that are less than a critical thickness parameter for the explosive material.

4. The non-detonable explosive scent training tool of claim 1, wherein the inert carrier medium is constructed of relatively non-volatile material selected from the group consisting of a metal, a ceramic, a high molecular weight plastic or a composite.

5. The non-detonable explosive scent training tool of claim 1, wherein the receiver spaces formed by the carrier medium are layer spaces between layers of inert carrier medium.

6. The non-detonable explosive scent training tool of claim 1, wherein the receiver spaces formed by the carrier medium are through bores extending completely through the carrier medium.

7. The non-detonable explosive scent training tool of claim 1, wherein the carrier medium has an overall shape configured as a block.

8. The non-detonable explosive scent training tool of claim 1, wherein the carrier medium has an overall shape configured as a disk with concentric alternating layers of carrier medium and explosive around a core.

9. The non-detonable explosive scent training tool of claim 1, wherein the carrier medium has an overall shape of a disk comprising a spiraled ribbon of the explosive material layered on the inert carrier medium.

10. The non-detonable explosive scent training tool of claim 1, wherein the explosive material contained in the receiver spaces is recessed from the outer surface of the inert carrier medium.

11. The non-detonable explosive scent training tool of claim 1, wherein a surface of the tool is covered with a vapor permeable film, the film allowing the scent of the explosive material to pass through it to atmosphere.

12. The non-detonable explosive scent training tool of claim 1, wherein a surface of the tool is covered with a film, the film being vapor permeable to allow a scent of the explosive material to pass through it to atmosphere and being impermeable, to a fluent explosive material.

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