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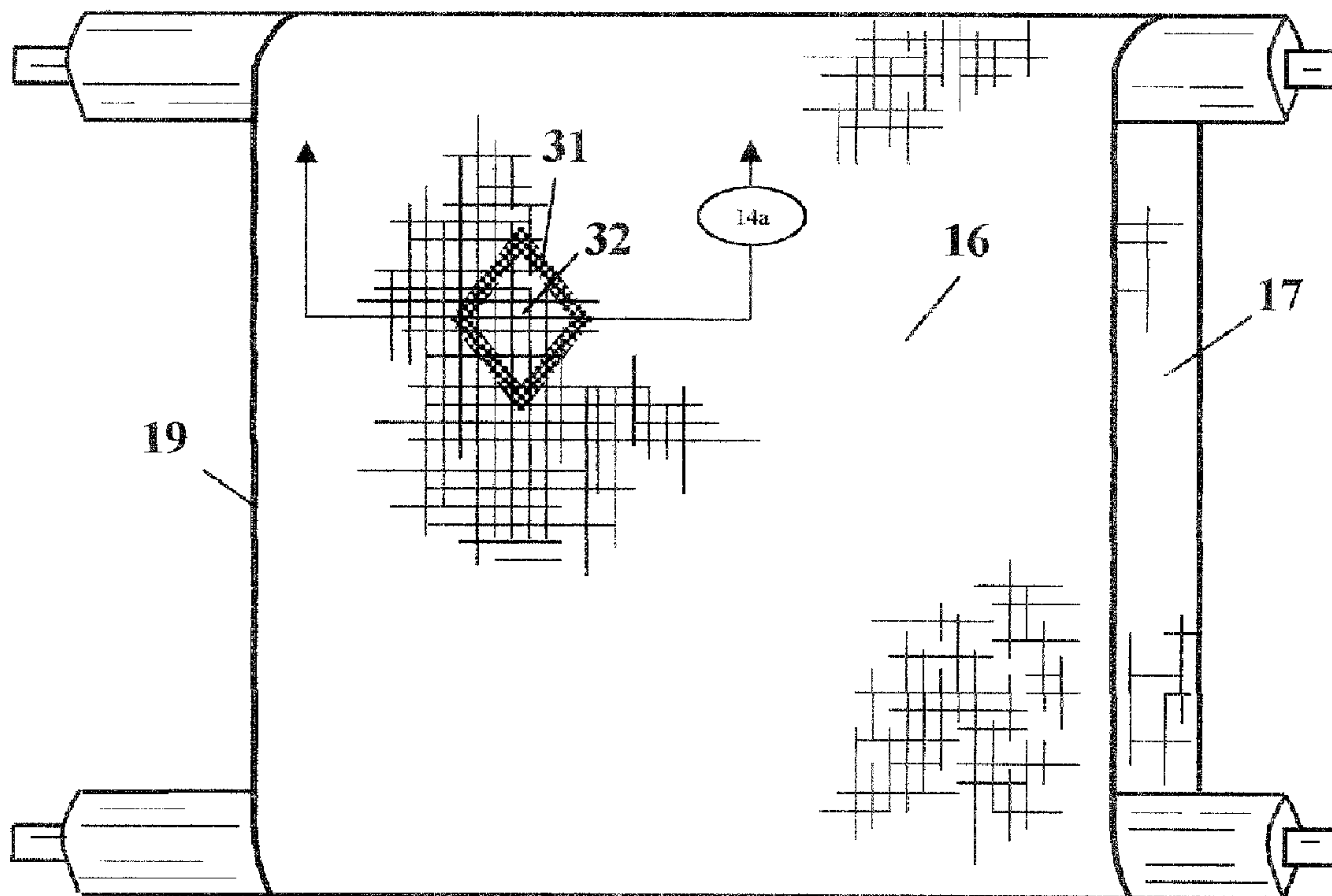
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(54) Titre : METHODE ET APPAREIL DE REPARATION DE TEXTILES SYNTHETIQUES

(54) Title: METHOD AND APPARATUS FOR REPAIRING SYNTHETIC TEXTILES



(57) Abrégé/Abstract:

A process and apparatus are disclosed for repairing damaged synthetic textiles using ultrasonic welding techniques by replacing the damaged area with a like synthetic patch. High frequency vibrations are applied to the patch producing a sealed perimeter, then a flat anvil with a planar surface area adequate to accommodate the apparatus mounted on an electromagnetic press base is placed under the damaged layer and the apparatus is placed thereon. High frequency vibrations are applied to the damaged area forming a sealed perimeter by applying electromagnetic energy to counteract the opposing forces created when the horn makes contact with the anvil. The damaged area is removed leaving a sealed aperture, and the patch is positioned over the aperture forming a lap joint. High frequency vibrations are applied to they lap joint producing a patch having a planar surface bonded flush with the top and bottom-side surfaces of the damaged textile.



Abstract of the Specification

A process and apparatus are disclosed for repairing damaged synthetic textiles using ultrasonic welding techniques by replacing the damaged area with a like synthetic patch. High frequency vibrations are applied to the patch producing a sealed perimeter, then a flat anvil with a planar surface area adequate to accommodate the apparatus mounted on an electromagnetic press base is placed under the damaged layer and the apparatus is placed thereon. High frequency vibrations are applied to the damaged area forming a sealed perimeter by applying electromagnetic energy to counteract the opposing forces created when the horn makes contact with the anvil. The damaged area is removed leaving a sealed aperture, and the patch is positioned over the aperture forming a lap joint. High frequency vibrations are applied to the lap joint producing a patch having a planar surface bonded flush with the top and bottom-side surfaces of the damaged textile.

Field of the Invention

This invention relates in general to synthetic textile repair and more particularly to a process and apparatus that may be used to proficiently repair damaged synthetic paper machine clothing by affixing a patch manufactured from a textile sample woven of like material and concurrently bonding the top and bottom-side surfaces of said textile by means of a lap joint using concentrated high frequency vibrations.

Background Information and Prior Art

A paper machine cloth for the production and support of a paper web includes a fabric made of longitudinal and transverse yarns having a top-side surface provided for the production and support of a paper web and a bottom-side surface facing away there from. Paper machine clothing is fabricated of synthetic polymer resins e.g. Nylon and Polyester and is generally woven to have a flat smooth surface by using one of the following two basic techniques.

In the first of these techniques, fabrics are flat woven by a flat weaving process with their ends being joined to form an endless belt by any one of a well known joining method. The warp yarns extend in the machine direction and the filling yarns extend in the cross machine direction. In the second technique, fabrics are woven directly in the form of a continuous belt with an endless weaving process. In the endless weaving process, the warp yarns extend in the cross machine direction and the filling yarns extend in the machine direction. As used herein, the terms "machine direction" (M.D.) and "cross machine direction" (C.M.D.) refer, respectively, to a direction aligned with the direction of travel of the papermakers' fabric on the papermaking machine, and a direction parallel to the fabric surface and traverse to the direction of travel. Both weaving methods described herein above are well known in the art. The weave selected may consist of a single, double or triple layer weave of synthetic yarns such as monofilament, multifilament or spun yarns.

On papermaking machines, the endless belts are employed in the various sections to form and carry the sheet or web of paper and must possess strength, dimensional stability, resistance to chemical and thermal degradation, resistance to abrasion and have a functional permeability. As these fabrics are easily damaged, especially when placed under a high tensile load, and are very expensive to manufacture, it is advantageous to repair these fabrics rather than replace them.

In the prior art, there have been several attempts to repair these types of fabrics. One such attempt is illustrated in CA 1,293,366, wherein an adhesive backed patch is thermally applied to the top-side surface of the fabric. Another attempt is illustrated in CA 1,050,503 wherein a patch is stapled to the top-side surface of the paper making fabric. While manually replacing each damaged

yarn individually by the method of re-sewing or darning the puncture is also an option, there are several major disadvantages to all of these known processes.

First, re-sewing each individual yarn is limited to the type of fabric weave and is extremely laborious and time consuming as only one side may be repaired at a time. The result is a very inconvenient and costly repair process, therefore making it inappropriate to execute while the fabric remains installed on a paper machine.

Second, as these fabrics are made from synthetic polyamide fibres, they usually have relatively high fixed melting points that must be exceeded to ensure adhesion. Heat activated adhesives are used when the items being adhered are impermeable and able to withstand the temperatures involved but for an adhesive to wet a solid surface the adhesive should have a lower surface tension than the critical surface tension of said solid surface. Because the fibres have smooth exterior surfaces, it is difficult to produce a strong bond because the adhesive does not wet the substrate and a weak-boundary layer may be trapped causing a reduction in joint strength. As the adhesive shrinks when it cures and because of differences between the adhesive and the substrate internal stresses also occur in adhesive joints, as such, the coefficient of thermal expansion of the adhesive and that that is being adhered should be as similar as possible to minimize the stresses due to heat.

Third, when a patch is attached to a damaged area of fabric using staples, only the sections of patch under the staples are fastened directly to the damaged fabric. The remaining overlapping surface area of said patch remains separate in relation to the surface area of said damaged fabric, leaving a possibility for said patch to wear off during the remaining service life of the repaired fabric.

Finally, when a patch is either adhesively heat-activated, or stapled over a damaged area of fabric, said patch is applied to the top-side surface of the damaged fabric only, leaving said damaged area unsupported and weak during the de-watering process providing very little dimensional stability to the repaired area. In both methods, said patch also protrudes from the top-side surface of said damaged fabric and as such, may produce a defect in the formation of the sheet or web of paper.

In response to these needs, the applicant has designed a process and apparatus by which a textile comprising synthetic fibres may be repaired by producing a sealed patch from a textile sample woven of like material and replacing a damaged area of said textile by attaching said sealed patch to said textile using concentrated ultrasonic vibrations. This process provides dimensional stability to the repaired area as the top and bottom-side surfaces of said sealed patch are in planar alignment with the top and bottom-side surfaces of said damaged textile respectively and, as both

surfaces of said damaged textile are concurrently repaired, this process is very efficient making it possible to perform this task while said damaged textile remains installed on a production machine.

The bonding of synthetic materials with ultrasonic frequency is very well known in the prior art. Synthetic textiles may be joined together by overlapping them on an anvil and positioning them under a vibrating welding element. The welding element or horn may comprise any suitable highly thermo conductive material such as aluminium to ensure achievement of higher temperatures at the interface between the overlapping layers of the lap joint. When the vibrating element is applied to the overlapping textiles, the contact with said textiles causes a transfer of vibratory energy from the welding element to the textile material causing surface heat to be generated along the area of contact and causing the thermoplastic elements of said textiles to become molten and flow together. Once the vibratory energy has ceased, the thermoplastic materials cool and harden causing the layers to be joined by producing a solid seal. This process creates a bond that is less sensitive to thermal cycling than adhesives and as resistant to degrading environments as the parent resin. This is true because the final joint consists solely of the parent resin. Bond strengths 85-100% of the strength of the parent resin may be obtained.

Brief Summary of the Invention

One method of the preferred embodiment explained herein consists of repairing a section of paper machine clothing comprising the steps of producing a sealed patch manufactured from a textile sample woven of like material, producing a sealed aperture in the damaged textile and joining said sealed patch to said damaged textile using an ultrasonic welding apparatus. Said ultrasonic welding apparatus comprises a highly thermo conductive vibrating horn and an electromagnetic press base which is supported atop a separate stationary anvil. Said press base consists of two legs that extend out and straddle the application point of said vibrating horn and comprises electromagnet energy to be applied to said anvil to counteract the opposing forces created when said vibrating horn applies compressed high frequency vibrations of 15 – 40 kHz to a 3mm wide rectangular portion of said damaged textile at said application point. Said sealed patch is produced by repeatedly re-aligning the patch outline depicted on the bottom-side surface of said textile sample relative to said vibrating horn and said anvil and applying high frequency vibrations to seal and compress the inner edges of said patch outline to a pre-determined thickness relative to the gauge of said textile sample until said patch outline comprises an enclosed chain of 3mm wide spot welds that have uniform characteristics forming a patch border therein. The removal of said sealed patch from the textile sample comprises making an incision in said patch border and

removing a 2mm portion parallel to said patch outline, thus producing a sealed patch comprising a 2mm wide patch seal having a smaller gauge relative to said sealed patch wherein the top-side surface thereof is in planar alignment with the top-side surface of said sealed patch.

Next, a sealed aperture is produced in said damaged textile by depicting a sealed patch outline of said sealed patch around said damaged area on the top-side surface thereof and supporting said damaged area on said anvil, then continuously re-aligning said apparatus relative to said sealed patch outline and said anvil by applying high frequency vibrations and said electromagnetic energy to seal and compress the inner edge of said sealed patch outline between said vibrating horn and said anvil to a pre-determined gauge relative to said damaged textile until a contiguous series of compacted 3mm wide spot welds that have uniform characteristics form a sealed patch border abutting the inner edge thereof. The damaged area is then removed by making an incision in said sealed patch border and removing a 1mm portion thereof parallel to said sealed patch outline, thus producing a sealed aperture comprising a 2mm wide aperture seal in said damaged textile with a smaller gauge relative to said damaged textile wherein the bottom-side surface thereof is in planar alignment with the bottom-side surface of said damaged textile.

Said sealed patch is then placed over said sealed aperture causing said patch seal to overlap said aperture seal forming a 2mm wide endless lap joint then high frequency vibrations and said electromagnetic energy are employed to join the overlapping layers of textile together by transmitting the vibratory energy in condensed wave form to the common interface between both overlapping layers, wherein the dissipation of energy causes a solid but flexible joint, thus producing a finished patch comprising a 2mm wide finished patch seal having a like gauge as said damaged textile providing dimensional stability and durability to the repaired section of textile.

Objectives of the Invention

It is an objective of this invention to provide a repair process, which overcomes the above-noted disadvantages.

It is also an objective of this invention to provide a new and improved process and apparatus to replace a punctured or damaged area of synthetic woven textile by affixing a patch woven of like material using concentrated high frequency vibrations.

It is an objective of this invention to provide an apparatus for repairing a damaged area of synthetic woven textile that is portable and easy to operate.

It is also an objective of this invention to provide a method for repairing a punctured or damaged area of damaged textile by affixing a patch woven of like material wherein both top and bottom surface layers are repaired collectively.

It is also an objective of this invention to provide a method for repairing a punctured or damaged area of paper machine clothing quickly and efficiently, allowing said method to be performed while said damaged textile remains installed on a paper machine.

It is an objective of this invention to replace a punctured or damaged area of damaged textile by affixing a patch woven of like material wherein the top and bottom-side surfaces of said patch and seal are in planar alignment with the top and bottom-side surfaces of said damaged textile respectively.

It is also an objective of this invention to ensure the crimp of the longitudinal and transverse woven yarns of the patch woven of like material align with the crimp of the longitudinal and transverse woven yarns of the damaged textile.

It is an objective of this invention to providing the damaged area with greater strength and support by giving the textile repair more dimensional stability than is known in the prior art.

It is also an objective of this invention to replace a punctured or damaged area of damaged textile by affixing a patch woven of like material to said textile without the aid of supplementary adhesives or solvents. Said method will produce a change in both physical and chemical properties of the synthetic yarns producing greater adhesive strength than is currently possible with the patch repair processes known in the prior art.

Brief Description of the Drawings

These figures merely illustrate the present invention and are not intended to indicate relative size and dimensions of actual welding systems and components thereof, and for reasons of clarity, neither are said figures illustrated to indicate the textile and repair patch styles, weave patterns and components, or the relative size and dimensions thereof. The invention as set forth in the claims will also become more apparent from the detailed description of a preferred embodiment thereof shown, by way of example only, in the accompanying drawings wherein:

Figure 1 is a schematic block diagram showing the primary components of an apparatus employed to repair a damaged area of synthetic textile using high frequency vibrations in a preferred embodiment of the present invention;

Figure 2 is an elevational view illustrating an embodiment of an apparatus employed to repair a damaged area of synthetic woven textile using high frequency vibrations in accordance with the process described herein;

Figure 3 is an elevational view of Figure 2 turned 90 degrees illustrating an embodiment of an apparatus employed to repair a damaged area of synthetic textile using high frequency vibrations in accordance with the process described herein;

Figure 4 schematically illustrates a top plan view of an embodiment of an electromagnetic press base employed to maintain a secure connection between the apparatus and anvil in accordance with the process described herein;

Figure 5 schematically illustrates an exploded perspective view of a preferred embodiment showing a damaged area of paper machine clothing and the preferred location of the leading patch tip in relation to the damaged area;

Figure 5a schematically illustrates an exploded top plan view of a preferred embodiment showing the dot placement on the bottom-side surface of a textile sample;

Figure 5b schematically illustrates an exploded top plan view of a preferred embodiment showing the alignment and dimensions of a quadrilateral shaped patch outline depicted on the bottom-side surface of a textile sample;

Figure 5c schematically illustrates an exploded top plan view of a preferred embodiment showing the alignment and dimensions of a hexagonal shaped patch outline depicted on the bottom-side surface of a textile sample;

Figure 6 schematically illustrates a partial elevational view of a preferred embodiment showing how the present invention is employed for producing a patch border on the bottom-side surface of a textile sample;

Figure 7 schematically illustrates an exploded top plan view of a preferred embodiment of a series of abutting spot welds applied to the bottom-side surface of a textile sample aligned adjacent to the inner edge of the patch outline. The thick chequered line is used to illustrate the patch border comprising a continuous chain of spot welds skirting the patch surface area;

Figure 7a is an exploded cross sectional view of a preferred embodiment taken from the arrow labelled 7a in Figure 7. It illustrates the gauge difference between the patch border and textile sample. The thick black line is used to illustrate the patch border abutting the inner edge of the patch outline;

Figure 8 is an exploded cross sectional view of a preferred embodiment of the final orientation of a sealed patch removed from a textile sample and illustrates the difference in gauge between the patch seal and sealed patch. The thick black line is used to illustrate the patch seal;

Figure 9 schematically illustrates an exploded perspective view of a preferred embodiment of a sealed patch outline drawn around a damaged area of textile;

Figure 10 schematically illustrates a partial elevational view of a preferred embodiment of the current invention showing how the apparatus is employed for producing a sealed patch border around a damaged area of textile;

Figure 11 schematically illustrates an exploded perspective view of a preferred embodiment of a series of abutting spot welds applied to the top-side surface of a damaged textile aligned adjacent to the inner edge of the sealed patch outline. The thick chequered line is used to illustrate the sealed patch border comprising a continuous chain of spot welds enclosing the damaged area therein;

Figure 11a is an exploded cross-sectional view taken from the arrow labelled 11a in Figure 11 illustrating the gauge difference between the sealed patch border and damaged area. The thick black line is used to illustrate the continuous seal around the inside edge of the sealed patch outline in a preferred embodiment of the current invention;

Figure 12 schematically illustrates an exploded perspective view of a preferred embodiment of a sealed aperture in a damaged textile. The damaged area has been removed and an aperture seal denoted by the thick chequered line remains;

Figure 12a is an exploded cross-sectional view taken from the arrow labelled 12a in Figure 12 illustrating the gauge difference between the aperture seal and damaged textile. The thick black line is used to illustrate the continuous seal around the inside edge of the sealed patch outline depicted on the top-side surface of a damaged textile in a preferred embodiment of the current invention;

Figure 13 is an exploded cross-sectional partial view showing a preferred embodiment of the construction of a finished patch by placing the sealed patch over the sealed aperture in the damaged textile to create a lap joint comprising the patch seal and the aperture seal;

Figure 13a schematically illustrates a partial elevational view showing how the present invention is employed for the process of bonding the overlapping sealed edges together in a preferred embodiment of the current invention;

Figure 14 schematically illustrates an exploded perspective view of a preferred embodiment of a finished patch attached to a repaired textile. The thick chequered line illustrates the finished patch seal comprising a welded lap joint consisting of the patch seal and aperture seal;

Figure 14a is an exploded cross-sectional view of a preferred embodiment of the finished patch taken from the arrow labelled 14a in Figure 14 and illustrates the finished patch comprising a finished patch seal having the same gauge as the damaged textile.

In accordance with the principles and concepts of the current invention, this invention concerns a process and apparatus for repairing synthetic textiles. More specifically, there is rendered a novel process and apparatus for the efficient and economical repair of punctured or damaged synthetic paper machine clothing by using ultra high frequency welding techniques. While the invention will now be described in connection with preferred procedures in conjunction with a preferred apparatus, the invention is not limited in scope to those specific procedures or particular steps set forth. On the contrary, all alternatives, modifications and equivalents included within the spirit and scope of the invention as defined by the appending claims are covered.

Detailed Description of the Preferred Embodiment

Referring to Fig. 1, the operating system of the ultrasonic welding apparatus comprises an amplifier 1 which supplies electrical energy of 50-60 Hz to a transducer 2 that converts said electrical energy into a high frequency mechanical vibration output of 15-40 kHz. A booster 3 is situated between a 30 kHz vibrating ultrasonic spot welding horn 4 and said transducer 2 to accommodate and supply said vibrating horn 4 with the required amplitude necessary to maintain proper working conditions. These vibrating parts 2, 3, 4 are mounted to a press base 5 and placed atop a separate planar anvil 8. Said press base 5 comprises electromagnetic energy employed by a 12V D.C. power supply 6 and provides an attractive force applied to said anvil 8 to counteract the opposing forces created when said vibrating horn 4 makes forced planar contact with said anvil 8 and applies compressed high frequency vibrations.

As illustrated in Fig. 2 and 3, said vibrating parts 2, 3, 4 are mounted vertically and aligned parallel to a post 10 which is mounted perpendicular to said press base 5 causing the surface area 12 of said vibrating horn 4 to be facing the planar surface portion of said anvil 8 exhibited in the aperture 9 located between the legs of said press base 5. A manual pressure lever 13 connected to said post 10 allows said vibrating parts 2, 3, 4 to be manually moved longitudinally up and down said post 10, wherein said vibrating horn 4 may direct compressed high frequency vibrations to a

3mm wide rectangular portion of textile in planar contact with the surface area 12 thereof supported atop said anvil 8 and exhibited in said aperture 9 at the application point 14 located therein.

As further illustrated in Fig. 2, 3 and 4, said anvil 8 composes a separate portable flat metal plate preferably made of low carbon steel, with an adequate surface area to accommodate said ultrasonic welding apparatus and any re-alignment required thereof to repair a damaged area of textile in the preferred embodiment explained herein.

Said press base 5 comprises two legs with planar underside surfaces providing a stable foundation for said apparatus to be mounted in an upright position atop said anvil 8. Each leg extends out and forward in opposite directions from the post mount 11 at a 45 degree angle, then bends forward again at a 90 degree angle relative to said post mount causing both legs to be aligned parallel. Said legs straddle said aperture 9 and said application point 14 is centrally located therein. Each leg houses two 12V D.C. 750 Lb pull, flat-faced rectangular electromagnets 7 electrically connected in parallel to a 12V D.C. power supply 6. Said power supply 6 is required to convert A.C. line current to D.C., provide switching, and incorporate a release function that allows clean release of said ultrasonic welding apparatus from said anvil 8. Said electromagnets 7 are positioned causing the planar electromagnetic top-side surfaces thereof to be in planar alignment with said planar underside surface of said press base 5. The electromagnetic energy is required to maintain a secure connection between said ultrasonic welding apparatus and said anvil 8 by preventing any lifting of said press base 5 from said anvil 8 when said surface area 12 of said vibrating horn 4 is induced at said application point 14 to be in forced planar contact with a portion of textile supported thereon, thus permitting said vibrating horn 4 to deliver compressed high frequency vibrations during an interval of time to said portion causing the longitudinal and transverse yarns to soften and flow along the surface thereof in forced planar contact with said surface area 12 of said vibrating horn 4 forming a compressed planar spot weld at said application point 14 while said ultrasonic welding apparatus remains balanced and upright atop said anvil 8.

It is assumed herein that the textile sample 20 is identical in weave to the damaged textile 19, but such requirements are not necessary to the scope and nature of this invention.

The process of the preferred embodiment described herein comprises three segments, the first segment contains the process of manufacturing a patch 23 from said textile sample 20 and is described herein.

As illustrated in Fig. 5, the first step is to locate the damaged area 15 of said damaged textile 19 and clean and dry the surrounding area to help remove any dirt or impurities. Although cleaning and drying said surrounding area is not necessary to perform this process, it is advisable. The next

step is to view the top-side surface 16 of said damaged textile 19 through an optical device powerful enough to determine the weave pattern and place a dot 18 thereon located ahead of said damaged area 15 in a linear M.D. alignment.

Said dot 18 is used to determine the location of the foremost tip of the finished patch 32. Preferably, the finished patch 32 may be quadrilateral or hexagonal in shape, and is dependent on the shape and physical location of said damaged area 15.

As illustrated in Fig. 5a, the next step is to align the longitudinal and transverse woven yarns of said textile sample 20 and said damaged textile 19 and place a like dot 21 on the bottom-side surface 17 of said textile sample 20 having the same function and weave pattern position as said dot 18 placed on said top-side surface 16 of said damaged textile 19.

As illustrated in Fig. 5b and 5c, the next step is to depict a patch outline 22 large enough to replace said damaged area 15 on said bottom-side surface 17 of said textile sample 20 causing said like dot 21 to be positioned therein in relation to the location of said dot 18 depicted on said damaged textile 19 relative to said damaged area 15.

Referring to Fig. 5b, if said patch outline 22 is quadrilateral in shape, it is preferable to depict said patch outline 22 causing an equal or greater span between two opposite angles to be in linear M.D. alignment and an equal or lesser span between two opposite angles to be in linear C.M.D. alignment.

Referring to Fig. 5c, if said patch outline 22 is hexagonal in shape, it is preferable to depict said patch outline 22 causing the greatest span between two opposite angles to be in linear M.D. alignment, and the smallest span between the parallel sides to be in linear C.M.D. alignment.

As illustrated in Fig. 6, the next step is to position said ultrasonic welding apparatus on top of said anvil 8 causing said press base 5 to make planar contact thereon, then position said textile sample 20 in said aperture 9 causing said top-side surface 16 thereof to be in planar contact with said anvil 8 permitting said surface area 12 of said vibrating horn 4 to make forced planar contact with a portion thereof at said application point 14 located therein.

As illustrated in Fig. 7 and 7a, the next step is to manufacture a sealed patch border 23 adjacent to the inner edge of said patch outline 22 wherein said sealed patch border 23 comprises a contiguous series of compacted spot welds skirting the patch surface area 24 by engaging said electromagnets 7 to maintain a secure connection between said ultrasonic welding apparatus and said anvil 8 and repeatedly re-aligning said patch outline 22 relative to said ultrasonic welding apparatus and said anvil 8 providing adjoining portions adjacent to the inner edge thereof against which said vibrating horn 4 may during an interval of time deliver between 15-40 kHz of high

frequency vibrations to cause said longitudinal and transverse yarns to soften and flow along the surface of said portions in forced planar contact with said surface area 12 while compressing said portions to a pre-determined gauge relative to said textile sample 20 at said application point 14 until said patch outline 22 comprises a contiguous series of compacted 3mm wide spot welds abutting said inner edge thereof.

As illustrated in Fig. 8, the next step is to remove a sealed patch 25 from said textile sample 20 comprising a patch seal 26 having a smaller gauge relative to said sealed patch 25 wherein the top-side surface 16 thereof is in planar alignment with the top-side surface 16 of said sealed patch 25 by making an incision in said sealed patch border 23 preferably with a hot metal straight edge connected to a rheostat aligned parallel to said patch outline 22 and removing a 2mm portion of said sealed patch border 23 skirting said patch surface area 24 defining a patch seal 26.

The rheostat allows for the adjustment of the temperature of the metal straight edge to acquire the desired degree of melt. The actual temperature at which the melt takes place cannot be quantified because it is variable depending upon the heat transfer properties of the surrounding surfaces and the chemical composition of the synthetic fibres in said textile sample 20 and said damaged textile 19. It seems reasonable that a temperature just above the melting point of said specific fibres would be adequate. The temperature of the metal straight edge should be adjusted to apply just enough heat to melt the fibres and create a flow binding all woven plies together to produce a sealed edge.

The second segment contains the process of sealing and removing said damaged area 15 by producing an aperture 30 in said damaged textile 19 comprising an aperture seal 29 and is described herein.

As illustrated in Fig. 9, the next step is to depict a sealed patch outline 27 around said damaged area 15 on said top-side surface 16 of said damaged textile 19 by aligning the longitudinal and transverse woven yarns of said sealed patch 25 and said damaged textile 19 respectively causing the greatest span of said sealed patch 25 to be in linear M.D. alignment and positioning said top-side surface 16 of said sealed patch 25 over said damaged area 15 in planar contact with said top-side surface 16 of said damaged textile 19 placing the leading tip of said patch seal 26 1mm behind said dot 18 placed thereon and drawing around the perimeter thereof.

As illustrated in Fig. 10, the next step is to place said anvil 8 between the layers of said damaged textile 19 causing the damaged layer to be supported on top thereof causing the bottom-side surface 17 of said damaged layer to be in planar contact and said damaged area 15 to be centred thereon, then place said ultrasonic welding apparatus on top of said damaged textile 19 and said

anvil 8 causing said press base 5 to make planar contact with said top-side surface 16 thereof and position said aperture 9 to straddle said damaged area 15 permitting said surface area 12 of said vibrating horn 4 to make forced planar contact with a portion thereof at said application point 14 located therein.

As illustrated in Fig. 11 and 11a, the next step is to manufacture a sealed aperture border 28 adjacent to the inner edge of said sealed patch outline 27 wherein said sealed aperture border 28 comprises a contiguous series of compacted spot welds skirting said damaged area 15 by engaging said electromagnets 7 to maintain a secure connection between said ultrasonic welding apparatus and said anvil 8 during an interval of time and disengaging said electromagnets when said interval of time is terminated, allowing said ultrasonic welding apparatus to be re-aligned relative to said sealed patch outline 27 and said anvil 8 providing adjoining portions adjacent to the inner edge of said sealed patch outline 27 against which said vibrating horn 4 may during said interval of time deliver between 15-40 kHz of high frequency vibrations to cause said longitudinal and transverse yarns to soften and flow along the surface of said portions in forced planar contact with said surface area 12 while compressing said portions to a pre-determined gauge relative to said damaged textile sample 19 at said application point 14 until said sealed patch outline 27 comprises a contiguous series of compacted 3mm wide spot welds abutting said inner edge thereof.

As illustrated in Fig. 12 and 12a, the next step is to create a sealed aperture 30 comprising an aperture seal 29 having a smaller gauge relative to said damaged textile 19 wherein the bottom-side surface 17 thereof is in planar alignment with the bottom-side surface 17 of said damaged textile 19 by making an incision in said sealed aperture border 28 preferably with a hot metal straight edge connected to a rheostat wherein said incision is parallel to said sealed patch outline 27 and removing 1mm of said sealed aperture border 28 enclosing said damaged area 15 therein, producing a 2mm wide parallel portion of said sealed aperture border 28 adjacent to said inner edge of said sealed patch outline 27 defining an aperture seal 29.

The third segment contains the process of repairing said damaged textile 19 by affixing said sealed patch 25 to said sealed aperture 30 and is described herein.

As illustrated in Fig. 13, the next step is to align the longitudinal and transverse yarns of said sealed patch 25 and said damaged textile 19 and place said sealed patch 25 over said sealed aperture 30 causing said patch seal 26 to overlap said aperture seal 29 forming a 2mm wide endless lap joint.

As illustrated in Fig. 13a, the next step is to place said ultrasonic welding apparatus on top of said damaged textile 19 and said anvil 8 causing said press base 5 to make planar contact with said top-side surface 16 thereof and position said aperture 9 to straddle said endless lap joint permitting

said surface area 12 of said vibrating horn 4 to make forced planar contact with a portion thereof at said application point 14 located therein.

As illustrated in Fig. 14 and 14a, the final step is to manufacture a finished patch 32 comprising a finished patch seal 31 having a like gauge as said damaged textile 19 and said finished patch 32 by engaging said electromagnets 7 to maintain a secure connection between said ultrasonic welding apparatus and said anvil 8 during an interval of time and disengaging said electromagnets when said interval of time is terminated, allowing said ultrasonic welding apparatus to be re-aligned relative to said endless lap joint and said anvil 8 providing adjoining portions of said endless lap joint against which said vibrating horn 4 may during said interval of time deliver between 15-40 kHz of high frequency vibrations to cause said longitudinal and transverse yarns to soften and flow along the respective inner surfaces of said portions in forced planar contact with said surface area 12 while compressing said portions to a pre-determined gauge like said damaged textile 19 at said application point 14 until said endless lap joint comprises a contiguous series of compacted 2mm wide spot welds wherein the top and bottom-side surfaces 16, 17 thereof are in planar alignment with said top and bottom-side surfaces 16,17 of said damaged textile respectively defining a finished patch seal 31.

Finally, inspect said finished patch 32 and lightly sand the top and bottom-side surfaces 16, 17 thereof preferably with 220-270 grit sandpaper if necessary.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for repairing a damaged synthetic textile woven of longitudinal and transverse yarns comprising the steps of:
 - a) providing a textile sample woven of like longitudinal and transverse yarns having dimensions adequate to accommodate the required dimensions of a manufactured sealed patch;
 - b) depicting a dot on said damaged textile to be utilized to determine the placement of the leading edge of said manufactured sealed patch;
 - c) depicting a like dot on said textile sample to be utilized to position said manufactured sealed patch;
 - d) depicting a patch outline on said textile sample having a location and surface area adequate to replace the damaged area;
 - e) providing a horn for delivering vibrations to a portion of said damaged textile and said textile sample;
 - f) providing an anvil against which said horn may compress said portion of said damaged textile and said textile sample;
 - g) activating said horn to cause vibrations to be delivered during an interval of time causing said longitudinal and transverse yarns to soften and compress along the surface of said portion then rigidify when said interval of time is terminated;
 - h) aligning said textile sample relative to said vibrating horn and said anvil providing adjoining portions adjacent to the inner edge of said patch outline against which said horn may be activated until said patch outline comprises a contiguous series of compacted spot welds enclosing said surface area and bordering said inner edge thereof defining a sealed patch border;
 - i) removing a sealed patch from said textile sample wherein said sealed patch consists of said surface area enclosed in a portion of said sealed patch border defining a patch seal;
 - j) depicting a sealed patch outline on said damaged textile having like dimensions as said sealed patch enclosing said damaged area therein;
 - k) aligning said horn relative to said damaged textile and said anvil providing adjoining portions adjacent to the inner edge of said sealed patch outline against which said horn may be activated until said sealed patch outline comprises a contiguous series of

compacted spot welds enclosing said damaged area and bordering said inner edge thereof defining a sealed aperture border;

- l) producing a sealed aperture in said damaged textile wherein said sealed aperture is enclosed in a portion of said sealed aperture border defining an aperture seal;
 - m) positioning said sealed patch over said sealed aperture causing said patch seal to overlap said aperture seal producing an endless lap joint; and
 - n) aligning said horn relative to said damaged textile and said anvil providing adjoining portions of said endless lap joint against which said horn may be activated causing the components of said portions to be joined to one another until said endless lap joint comprises a contiguous series of compacted spot welds defining a finished patch seal.
2. The process as claimed in claim 1 wherein said damaged textile and said textile sample are woven of a synthetic polymeric resin.
 3. The process as claimed in claim 1 wherein said damaged textile comprises a top-side surface and a bottom-side surface.
 4. The process as claimed in claim 1 wherein said damaged textile forms an endless belt comprising a machine direction aligned parallel with said longitudinal yarns and the direction of travel, a cross-machine direction aligned parallel with said transverse yarns and traverse to said direction of travel, a top-side surface and a bottom-side surface.
 5. The process as claimed in claim 1 wherein said damaged textile is of a single-layer weave.
 6. The process as claimed in claim 1 wherein said damaged textile is of a multi-layer weave.
 7. The process as claimed in claim 1 wherein said textile sample is of a single-layer weave having a top-side surface and a bottom-side surface.

8. The process as claimed in claim 1 wherein said textile sample is of a multi-layer weave having a top-side surface and a bottom-side surface.
9. The process as claimed in claim 1 wherein said damaged textile and said textile sample are of a like gauge.
10. The process as claimed in claim 1 wherein said damaged textile and said textile sample are of a like woven structure.
11. The process as claimed in claim 1 wherein said horn is comprised of aluminium.
12. The process as claimed in claim 1 or claim 11 wherein said horn is comprised of an alloy of aluminium.
13. The process as claimed in claim 1 wherein said vibrations have a frequency in the ultrasonic frequency range.
14. The process as claimed in claim 1 wherein said anvil is a separate stationary component having a planar surface.
15. The process as claimed in claim 1 wherein said step of depicting a dot on said damaged textile comprises the sub-step of longitudinally aligning said dot relative to the location of said damaged area in said damaged textile on said top-side surface thereof.
16. The process as claimed in claim 1 wherein said step of depicting a like dot on said textile sample comprises the sub-steps of aligning said longitudinal and transverse yarns of said textile sample and said damaged textile and placing said like dot on said bottom-side surface of said textile sample in a location suitable to accommodate said damaged area.
17. The process as claimed in claim 16 wherein said location is further suitable to accommodate a like longitudinal alignment relative to said longitudinal alignment in said damaged textile.

18. The process as claimed in claim 1 wherein said dot and said like dot are positioned in a like woven structural placement.

19. The process as claimed in claim 1 wherein said step of depicting a patch outline comprises the sub-step of positioning said patch outline on said bottom-side surface of said textile sample adjacent to said like dot.

20. The process as claimed in claim 1 or claim 19 wherein the location of said like dot relative to said patch outline is like the location of said dot depicted on said damaged textile relative to said damaged area located therein.

21. The process as claimed in claim 1 or claim 19 wherein said patch outline is depicted having the greater or equal span thereof aligned parallel with said longitudinal yarns of said textile sample.

22. The process as claimed in claim 1 wherein said step of aligning said textile sample relative to said vibrating horn and said anvil further comprises placing said top-side surface of said textile sample in planar contact with said anvil.

23. The process as claimed in claim 1 wherein said step of removing a sealed patch consists of making an incision in said sealed patch border parallel to said patch outline and removing a portion thereof.

24. The process as claimed in claim 1 wherein said patch seal is comprised of a smaller gauge relative to said sealed patch having the top-side surface thereof in planar alignment with the top-side surface of said sealed patch.

25. The process as claimed in claim 1 wherein said step of depicting a sealed patch outline comprises the sub-steps of aligning the longitudinal and transverse woven yarns of said sealed patch and said damaged textile and positioning said top-side surface of said sealed patch over said damaged area in planar contact with said top-side surface of said damaged textile placing the leading edge of said patch seal adjacent to said dot placed thereon and drawing around the perimeter thereof.

26. The process as claimed in claim 1 or claim 25 wherein said sealed patch outline is depicted having the greater or equal span thereof aligned parallel with said longitudinal yarns of said damaged textile.

27. The process as claimed in claim 1 wherein said step of aligning said horn relative to said damaged textile and said anvil further comprises the sub-step of placing said bottom-side surface of said damaged textile in planar contact with said anvil.

28. The process as claimed in claim 1 wherein said step of producing a sealed aperture comprises the sub-steps of removing said damaged area from said damaged textile by making an incision in said sealed aperture border parallel to said sealed patch outline and removing a portion of said sealed aperture border enclosing said damaged area therein producing a parallel portion of said sealed aperture border adjacent to said inner edge of said sealed patch outline.

29. The process as claimed in claim 1 wherein said aperture seal is comprised of a smaller gauge relative to said damaged textile having the bottom-side surface thereof in planar alignment with said bottom-side surface of said damaged textile.

30. The process as claimed in claim 1 wherein said step of positioning said sealed patch over said sealed aperture further comprises the preceding sub-step of aligning the longitudinal and transverse yarns of said sealed patch and said damaged textile.

31. The process as claimed in claim 1 or claim 30 wherein the bottom-side surface of said patch seal overlaps the top-side surface of said aperture seal.

32. The process as claimed in claim 1 wherein said top-side surface of said sealed patch is in planar alignment with said top-side surface of said damaged textile.

33. The process as claimed in claim 1 wherein the bottom-side surface of said sealed patch is in planar alignment with said bottom-side surface of said damaged textile.

34. The process as claimed in claim 1 wherein said finished patch seal and said damaged textile are of a like gauge.

35. An apparatus for affixing a patch comprised of synthetic polymers to a damaged textile comprised of synthetic polymers comprising:

- a) a press base comprising an aperture located therein;
- b) a horn for delivering vibrations to the overlapping portions of said patch and said damaged textile mounted perpendicular to said press base and vertically aligned causing the surface contact area thereof to be facing said aperture;
- c) a separate stationary anvil comprising a planar surface against which said damaged textile and said like patch may be supported and said press base may be placed thereon;
- d) means for activating said horn to cause vibrations to be delivered to said overlapping portions during an interval of time causing said synthetic polymers thereof to soften and flow along the respective inner surfaces in forced abutting contact with said surface contact area then rigidify when said interval of time is terminated; and
- e) means for immobilizing said press base.

36. An apparatus as claimed in claim 35 wherein said vibrations have a frequency in the ultrasonic frequency range.

37. An apparatus as claimed in claim 35 wherein said horn is comprised of aluminium.

38. An apparatus as claimed in claim 35 or claim 37 wherein said horn is comprised of an alloy of aluminium.

39. An apparatus as claimed in claim 35 wherein said anvil is comprised of steel.

40. An apparatus as claimed in claim 35 or claim 39 wherein said anvil is comprised of an alloy of steel.

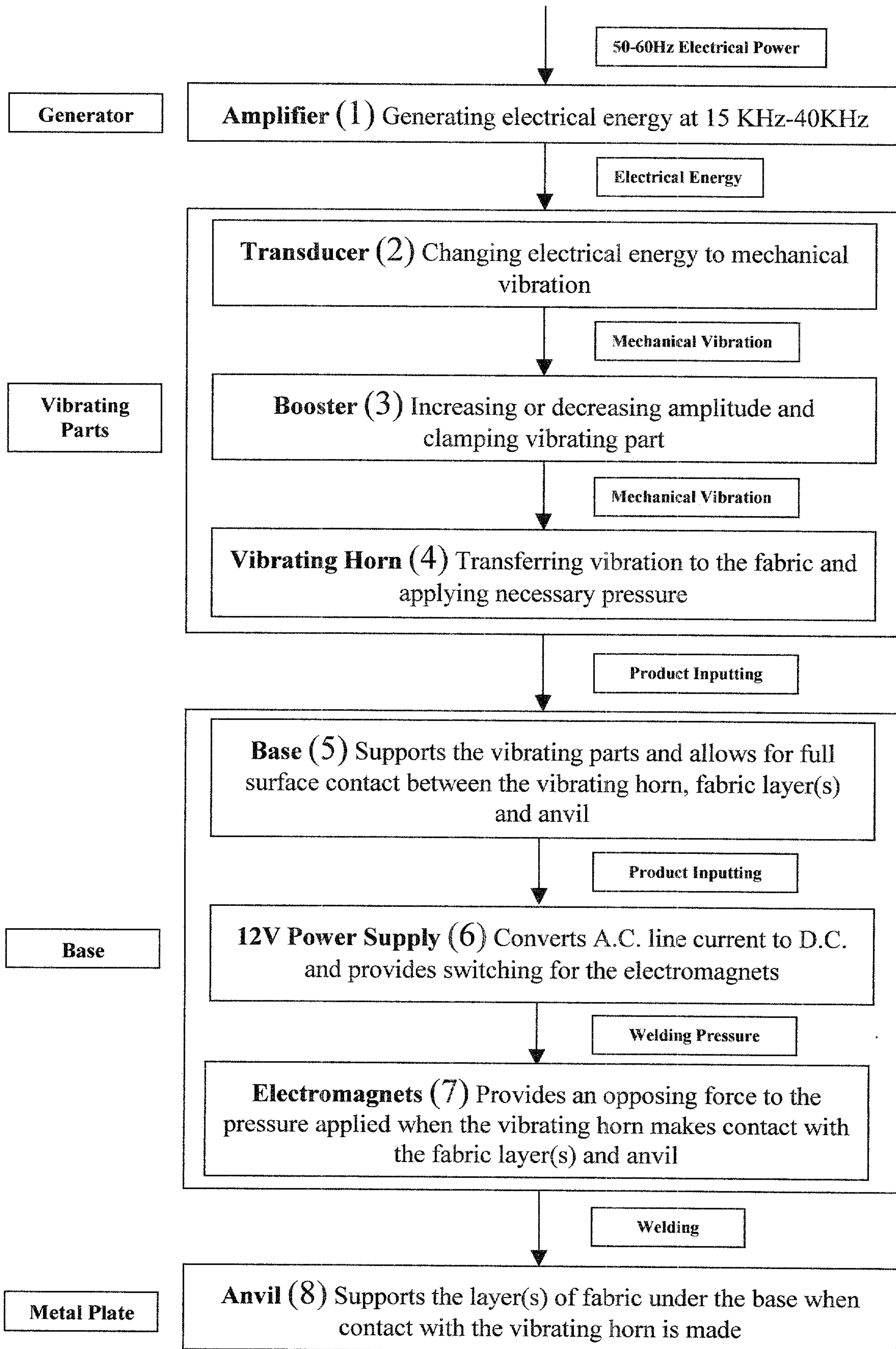
41. An apparatus as claimed in claim 35 wherein said press base further comprises a planar underside surface straddling said aperture providing a stable foundation for said horn to be positioned above said aperture.
42. An apparatus as claimed in claim 35 wherein said horn is further mounted parallel to a post mounted perpendicular to said press base.
43. An apparatus as claimed in claim 42 wherein a pressure lever is connected to said post causing said horn to be moved longitudinally up and down said post wherein said surface contact area may make contact with said overlapping portions supported on said anvil in said aperture.
44. An apparatus as claimed in claim 35 wherein said means for immobilizing said press base provides means to counteract the opposing forces created when pressure is applied to said anvil.
45. An apparatus as claimed in claim 35 or claim 44 wherein said means for immobilizing said press base provides means for said surface contact area of said horn to make forced planar contact with said overlapping portions supported on said anvil in said aperture and deliver vibrations to said overlapping portions forming a compressed seal wherein the top and bottom side surfaces thereof are in planar alignment with the top and bottom side surfaces of said damaged textile respectively when said interval of time is terminated.
46. An apparatus as claimed in claim 35 or claim 44 wherein said means for immobilizing said press base consists of electromagnetic energy employed for maintaining a secure connection between said press base and said anvil.
47. An apparatus as claimed in claim 46 wherein said secure connection comprises means for activating said electromagnetic energy during said interval of time and de-activating said electromagnetic energy when said interval of time is terminated.
48. An apparatus as claimed in claim 46 wherein said electromagnetic energy is derived from electromagnets comprised of planar electromagnetic top-side surfaces.

49. An apparatus as claimed in claim 48 wherein said electromagnets are situated in said press base causing said planar electromagnetic top-side surfaces to be in planar alignment with said planar underside surface thereof.

50. An apparatus as claimed in claim 48 wherein said electromagnets are situated in said press base causing said planar electromagnetic top-side surfaces to be aligned parallel to said planar surface of said anvil.

David Connock

Fig. 1
Operating System of Ultrasonic Welding Apparatus



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Fig. 2

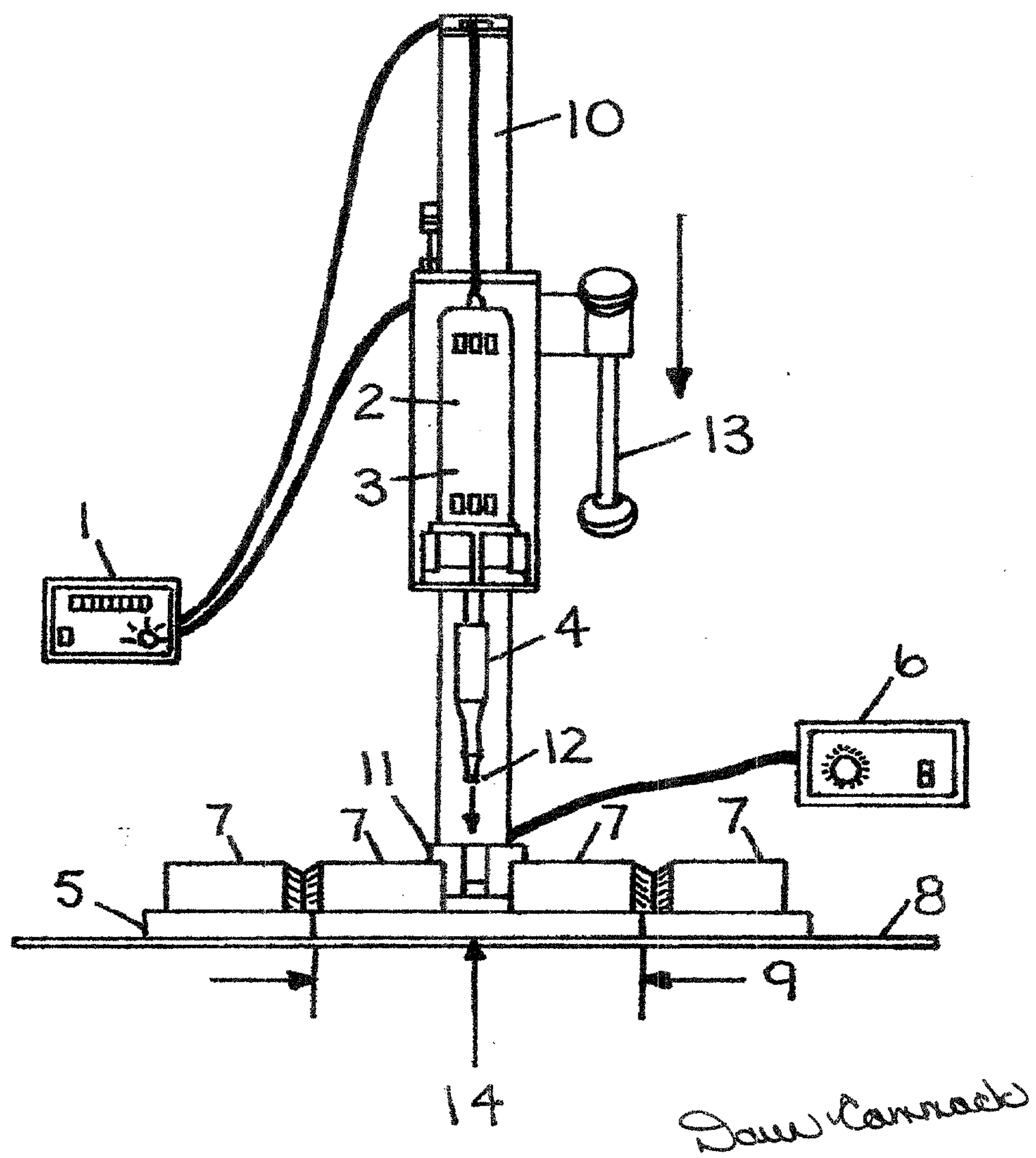


Fig. 3

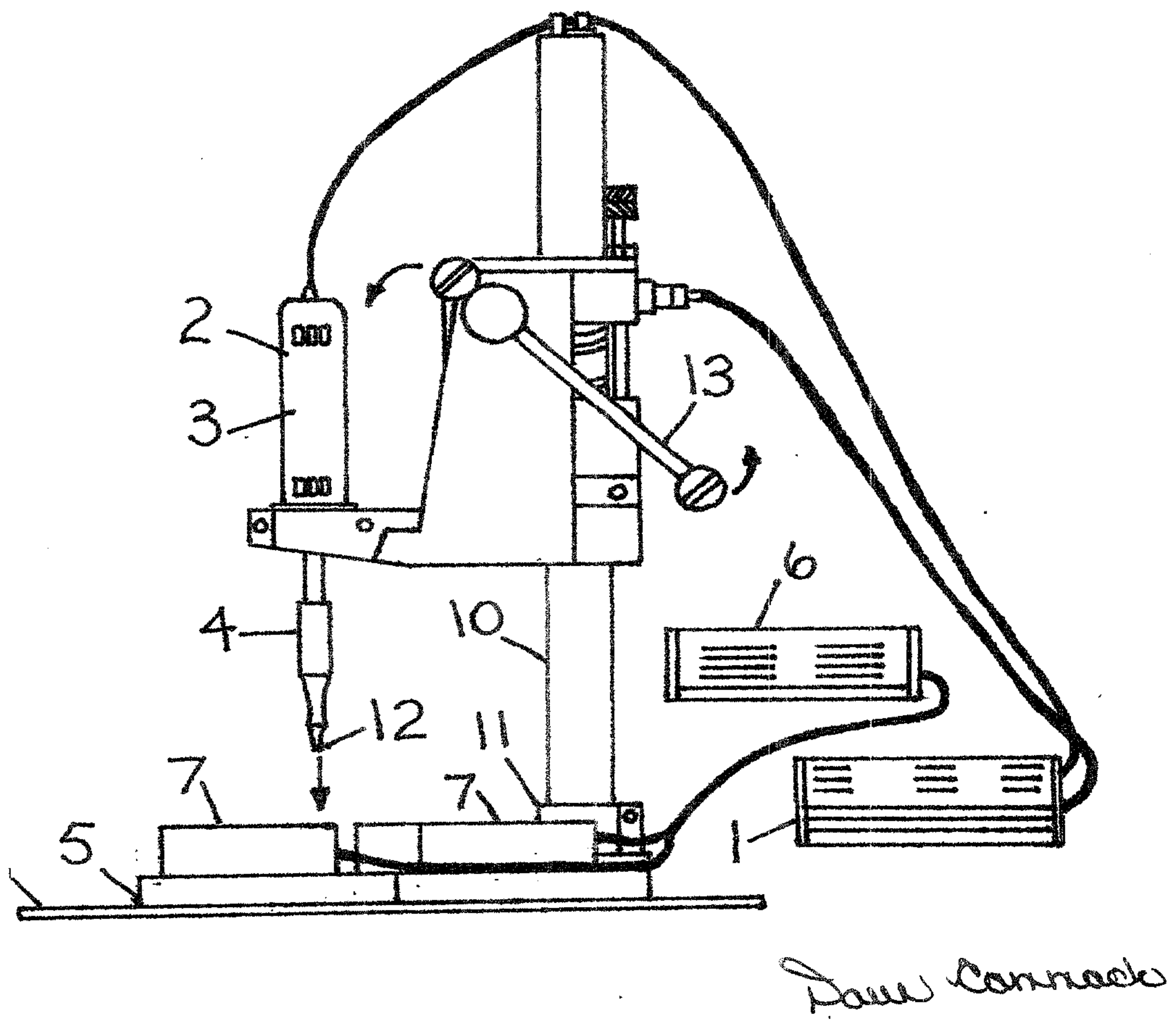
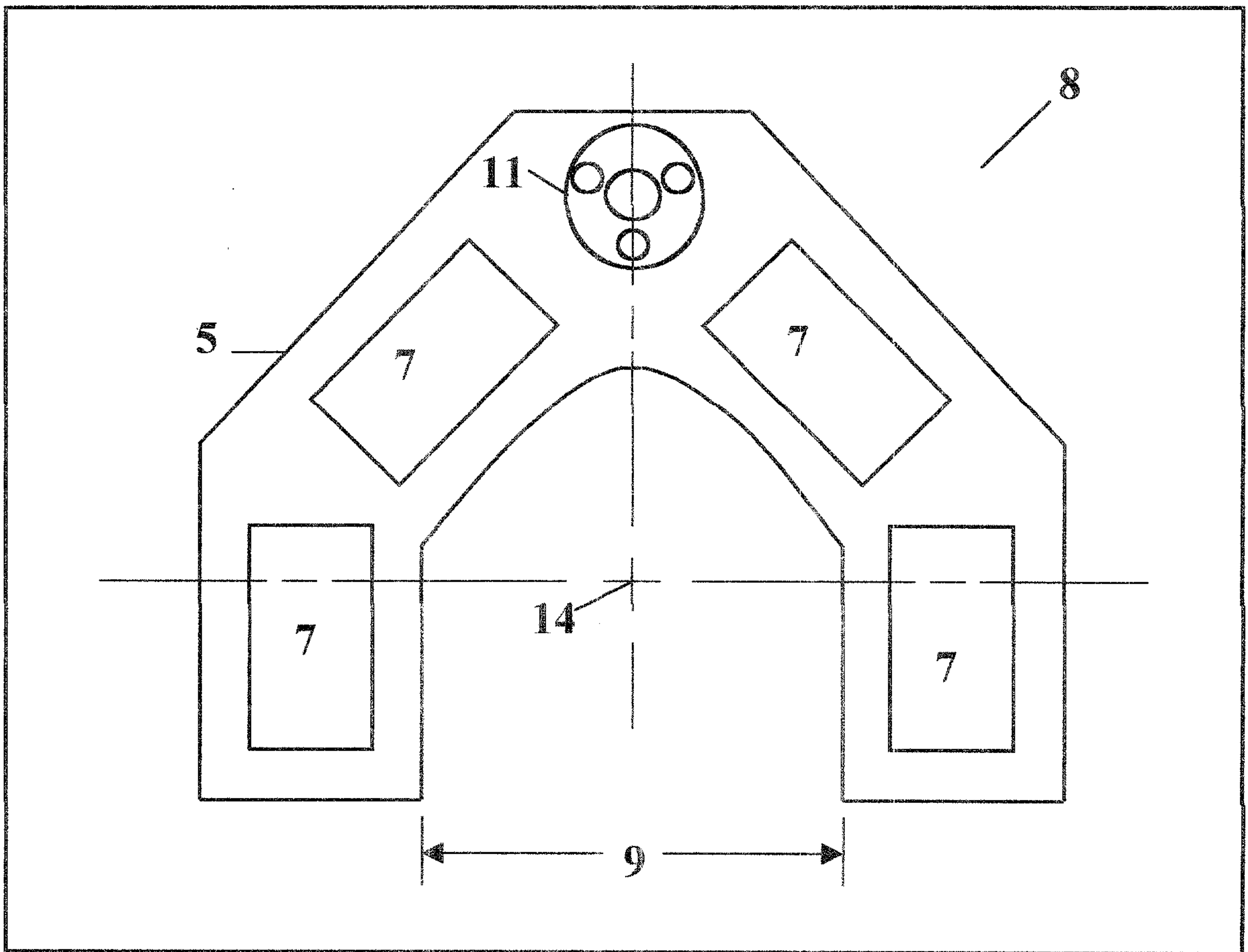


Fig. 4



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Fig. 5

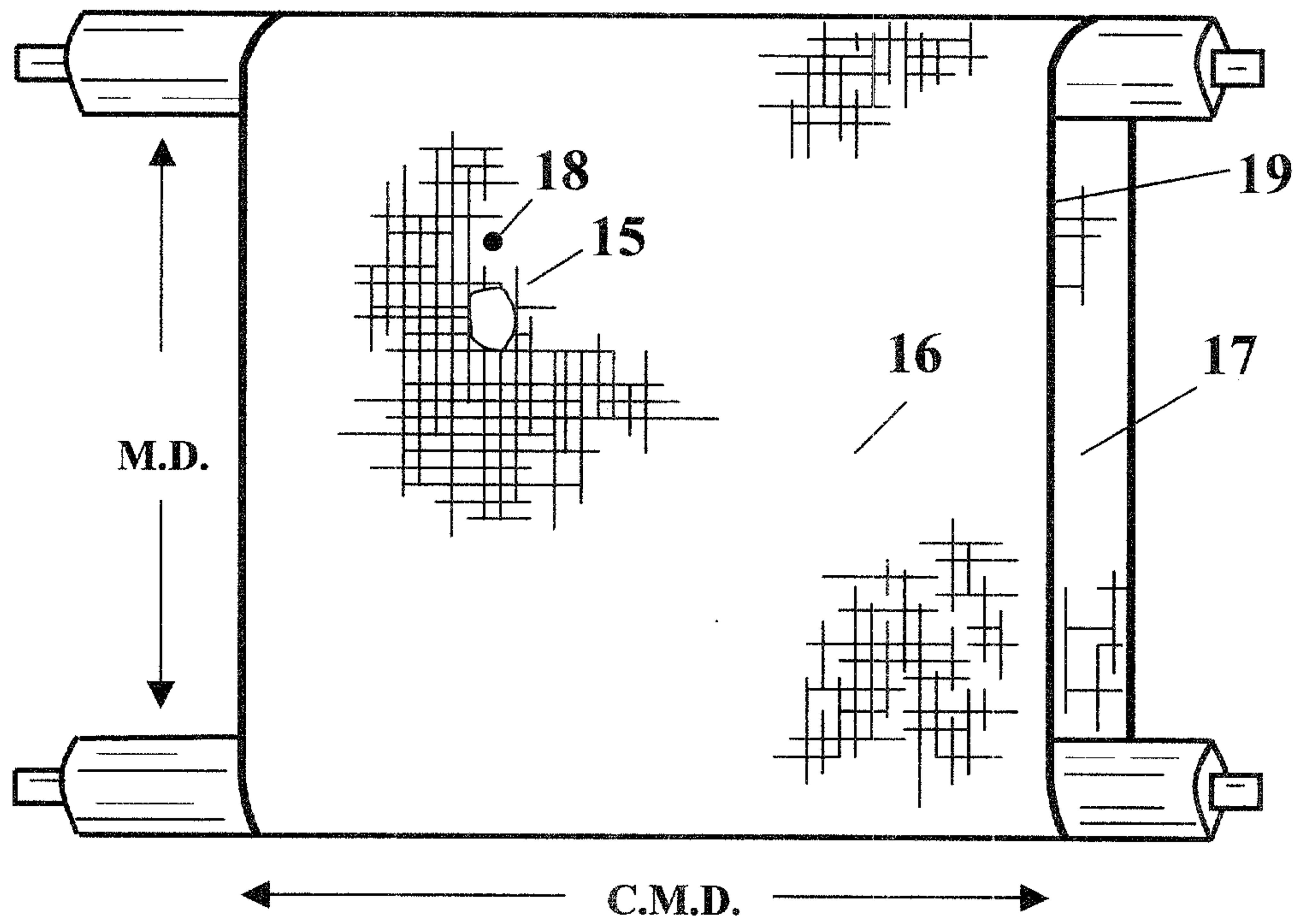


Fig. 5a

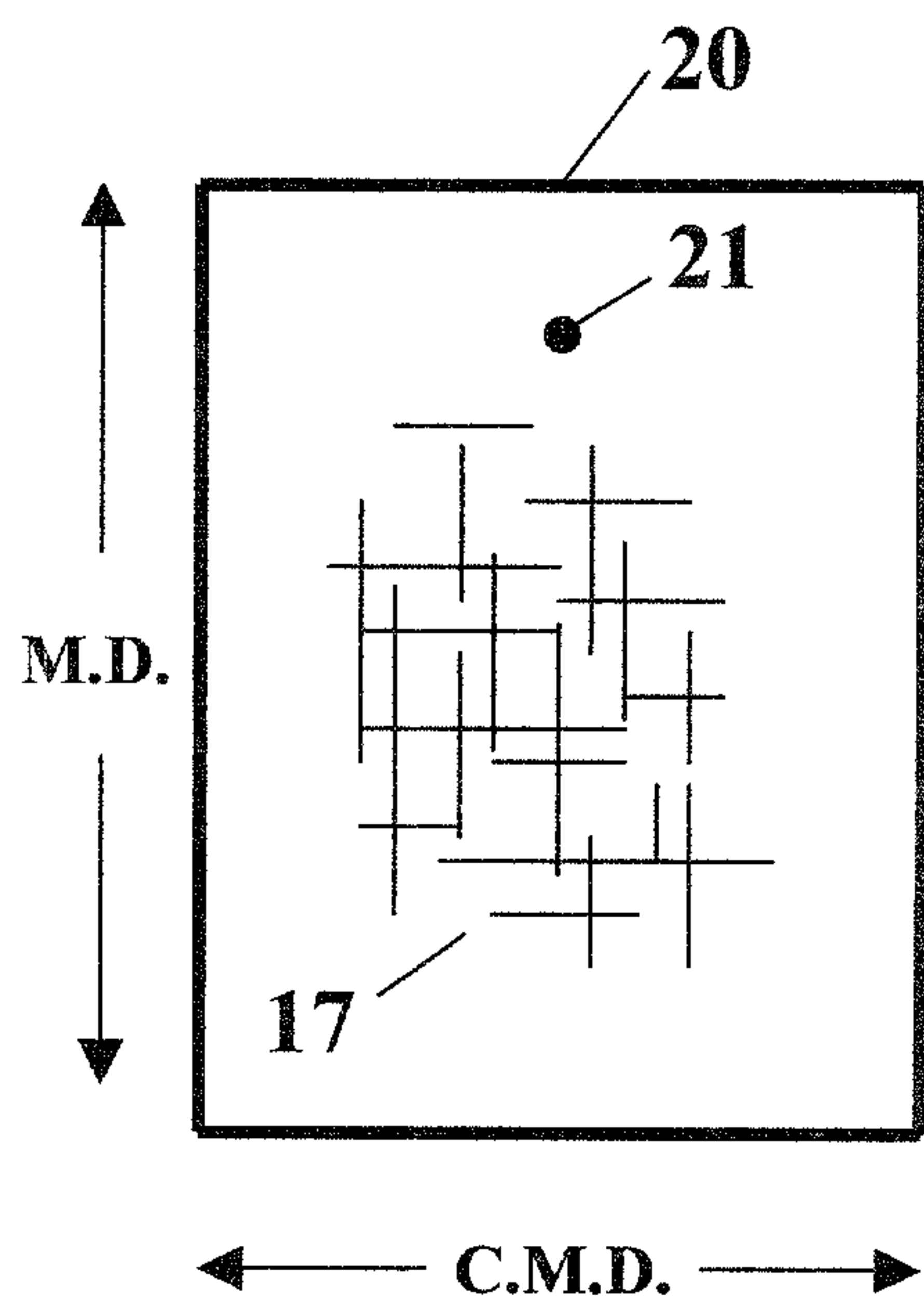


Fig. 5b

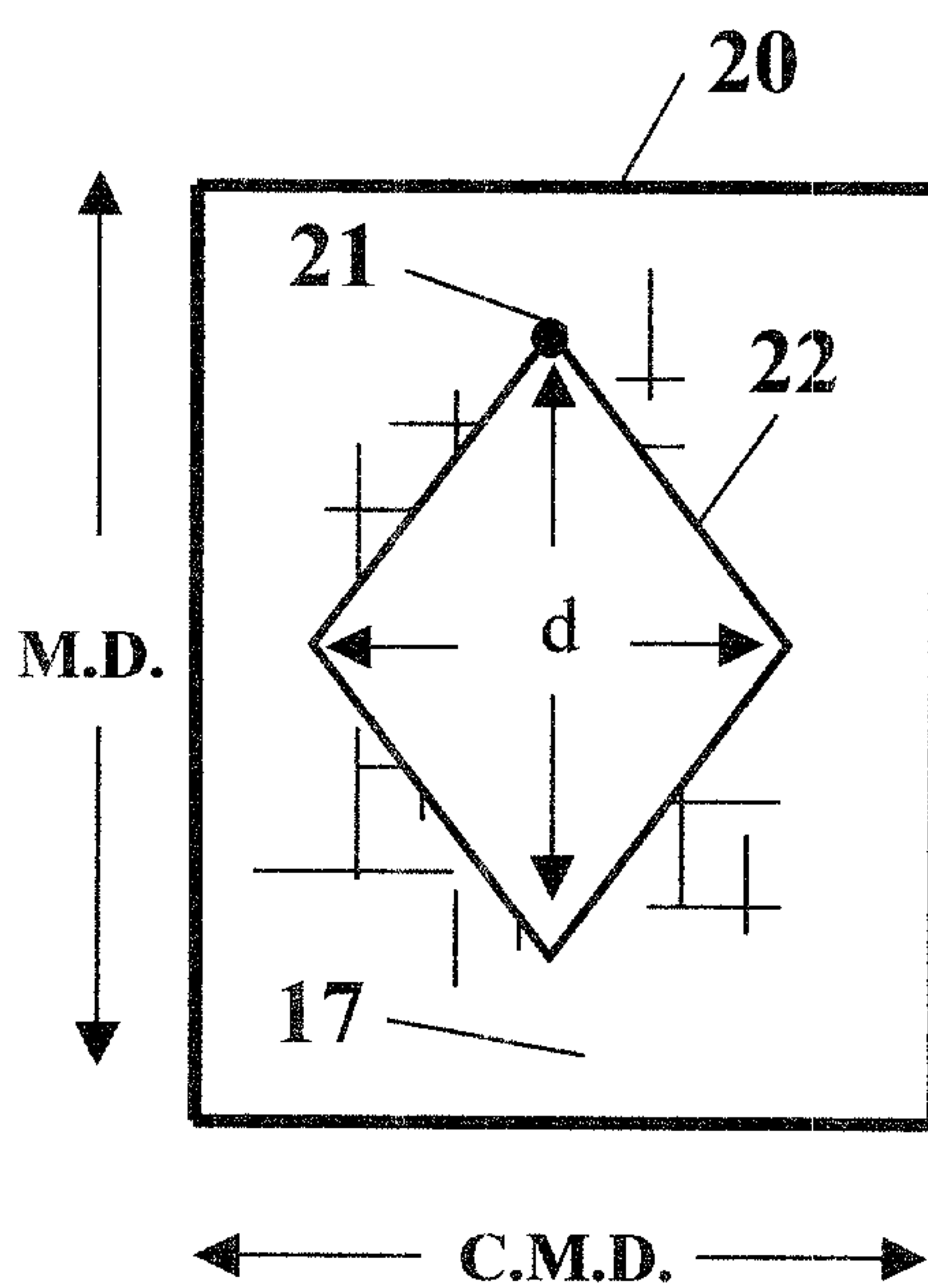
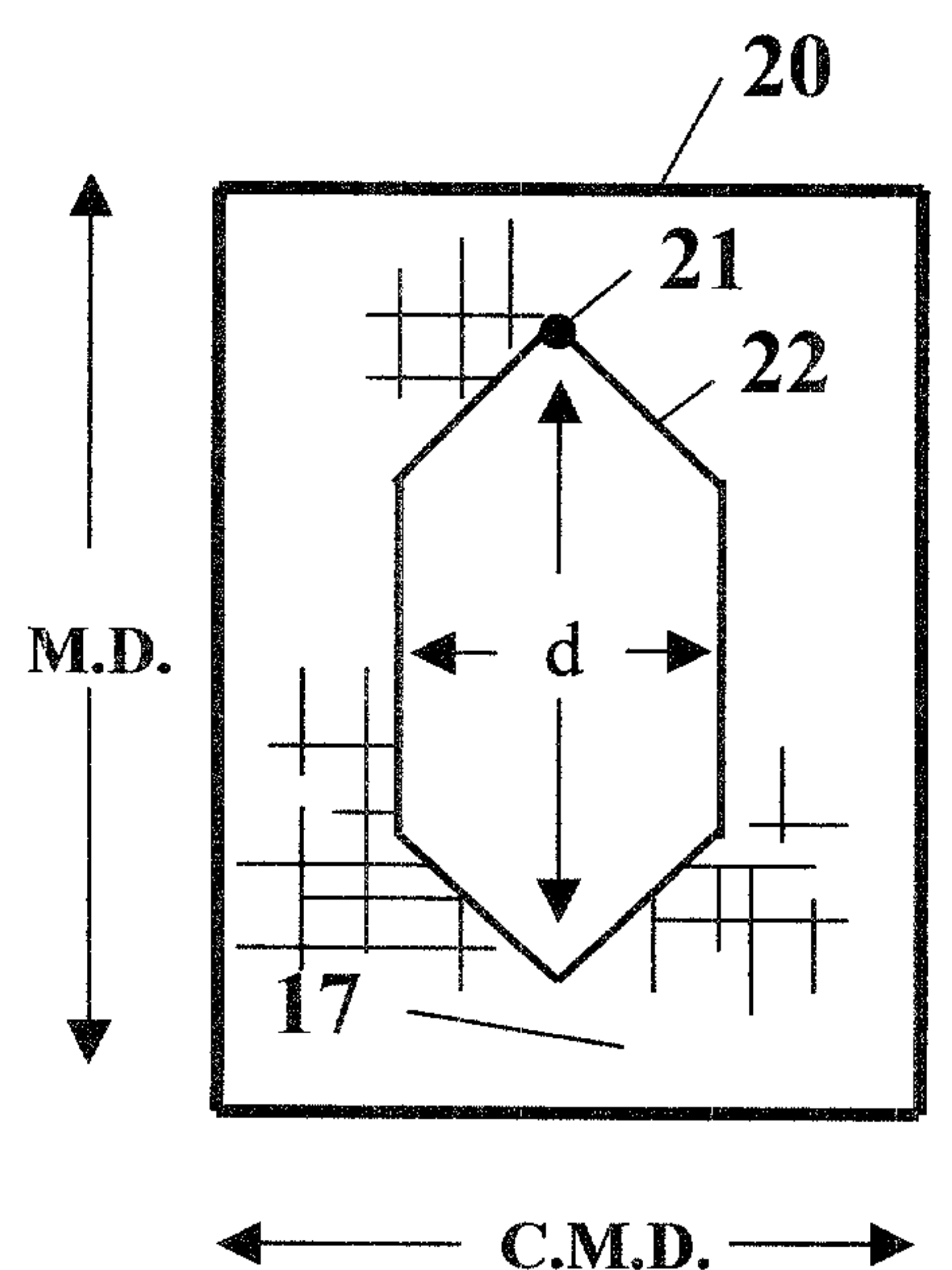


Fig. 5c



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Fig. 6

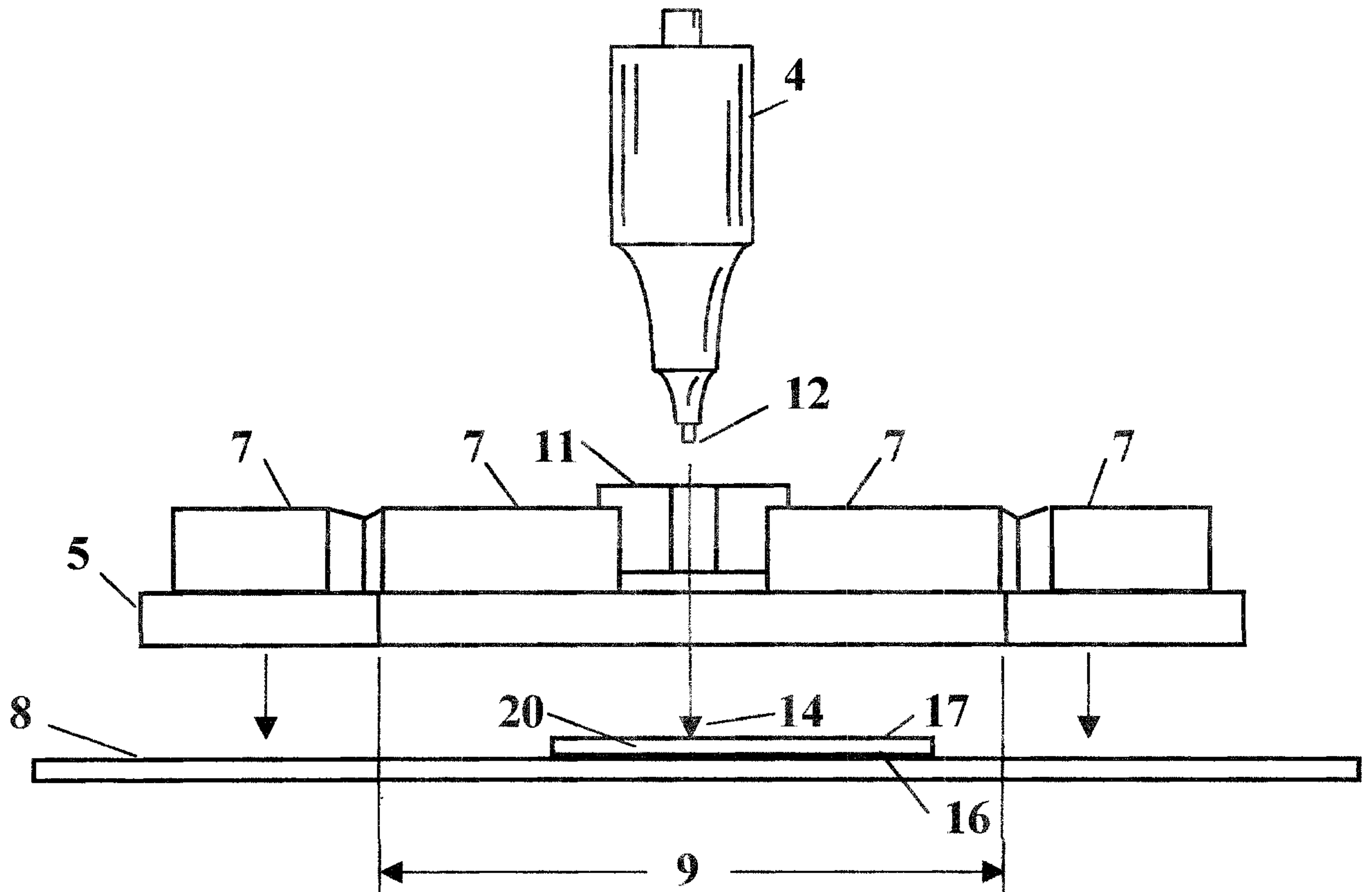


Fig. 7

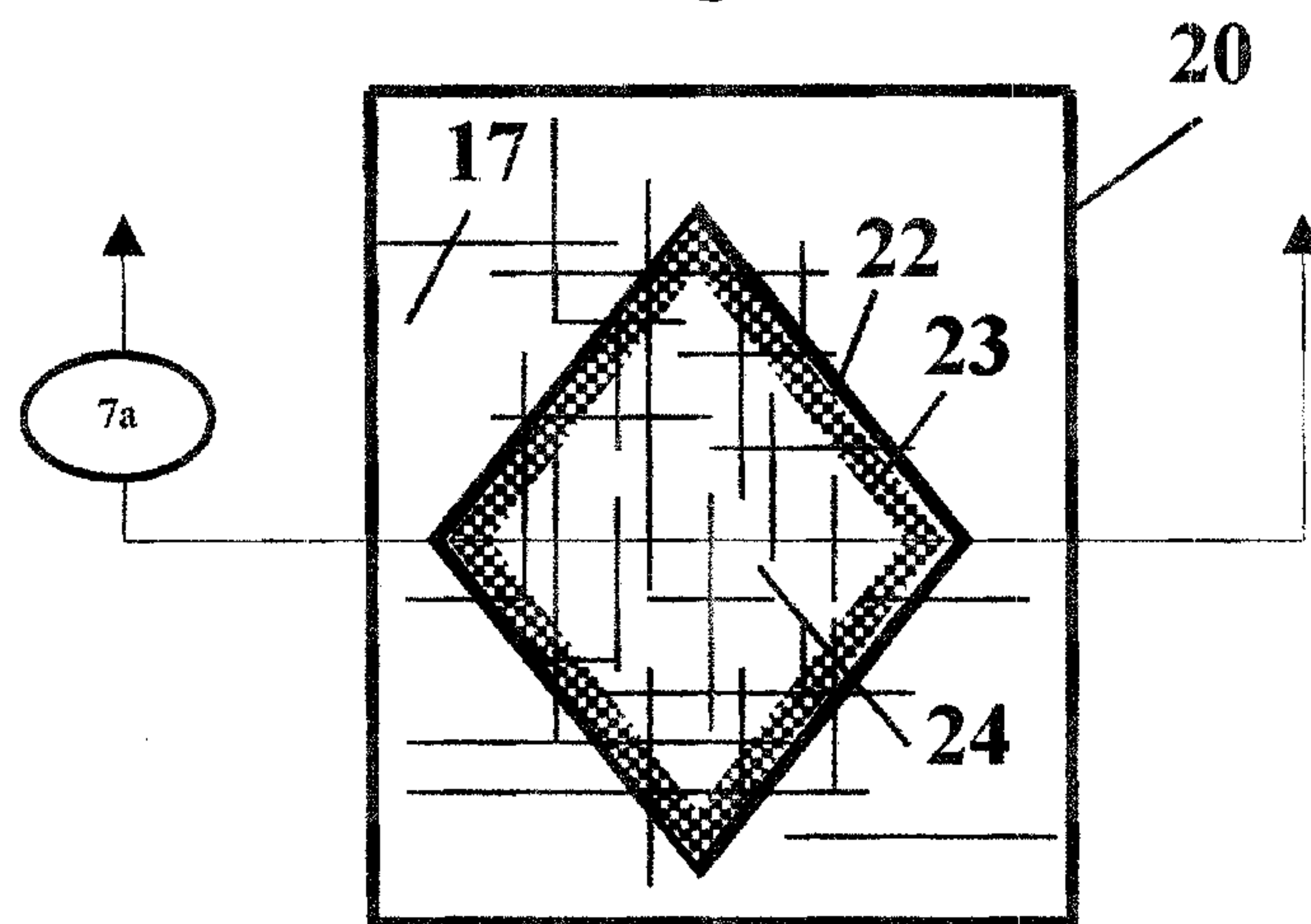
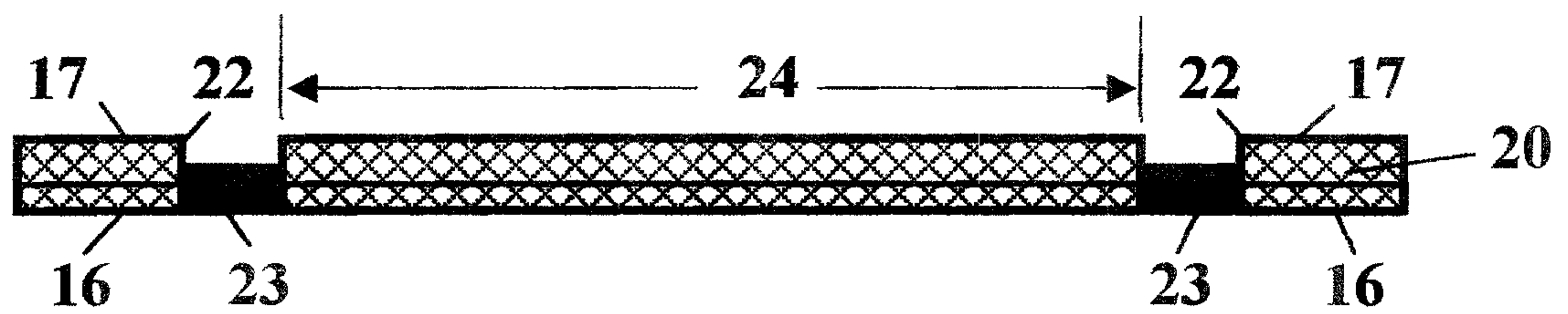


Fig. 7a



Dave Connock

Fig. 8

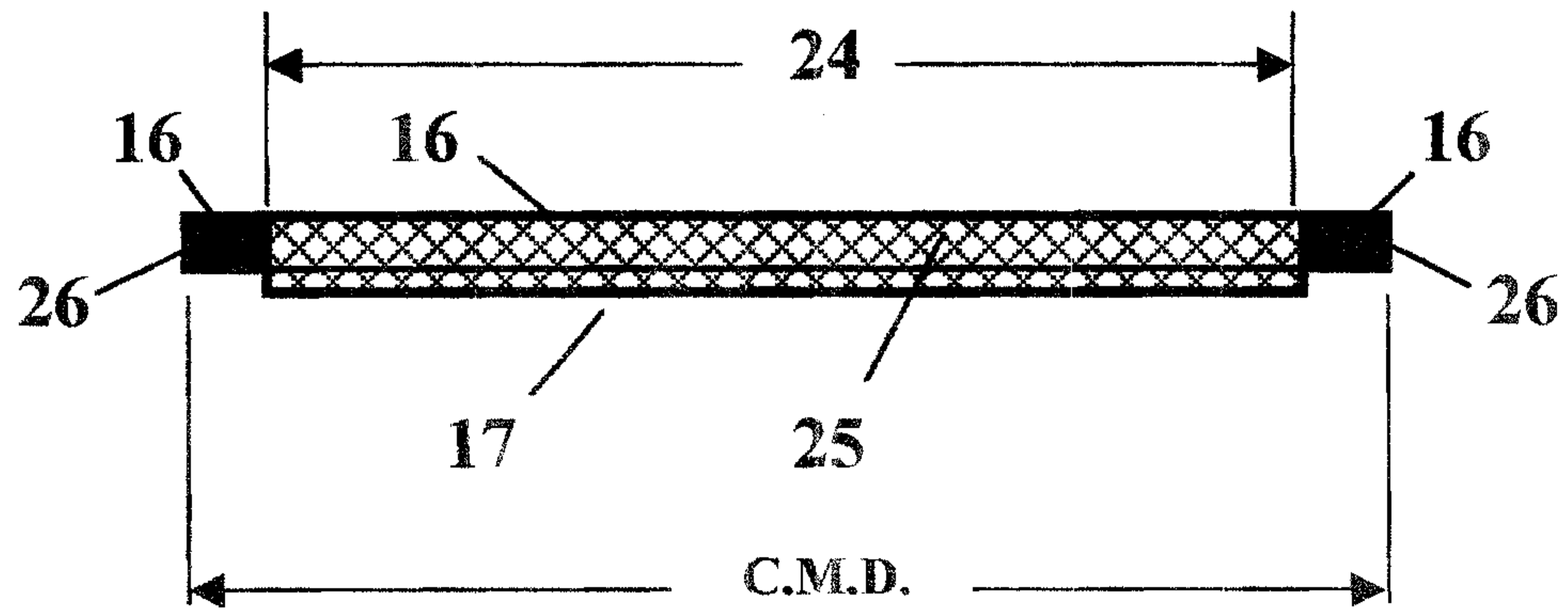


Fig. 9

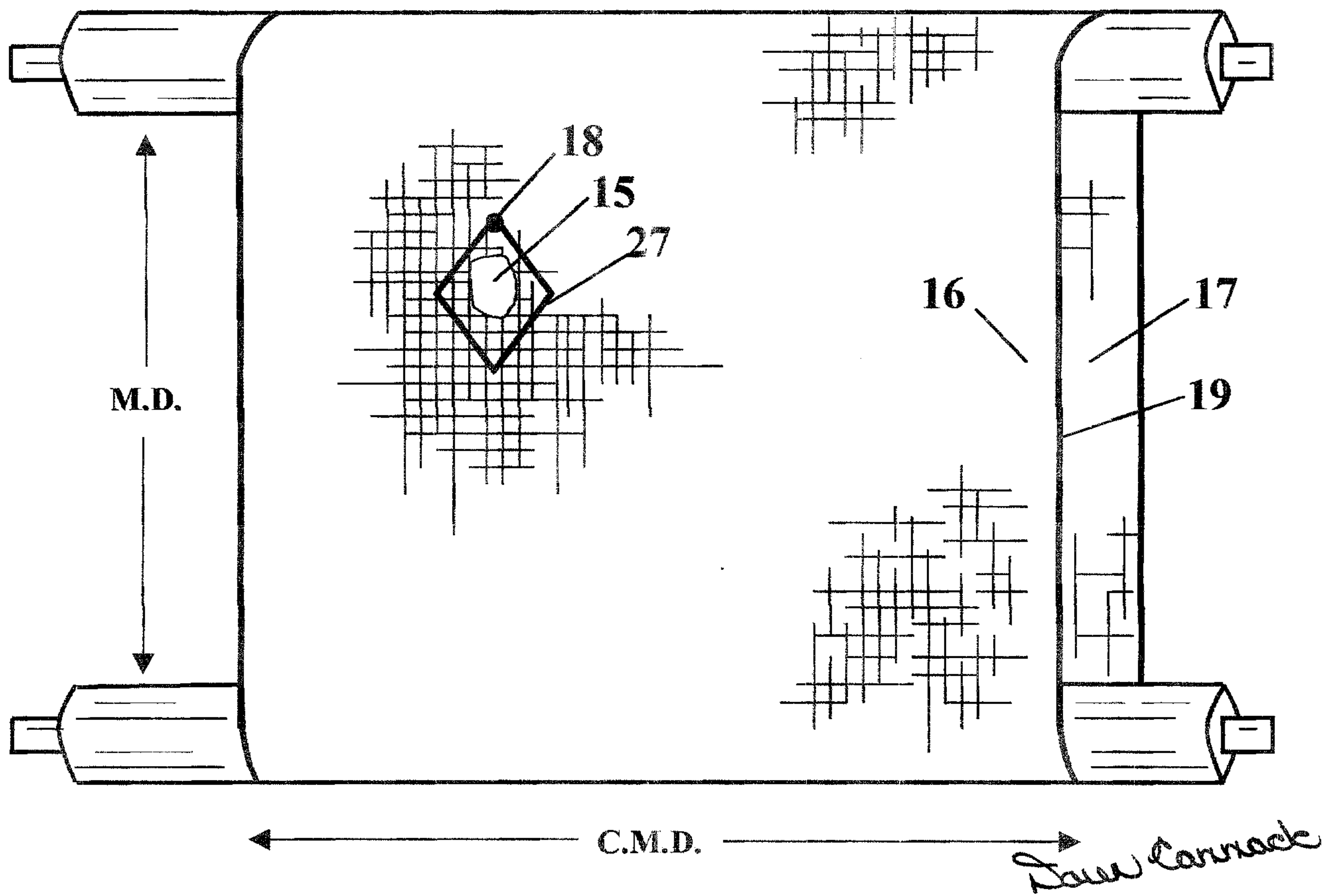


Fig. 10

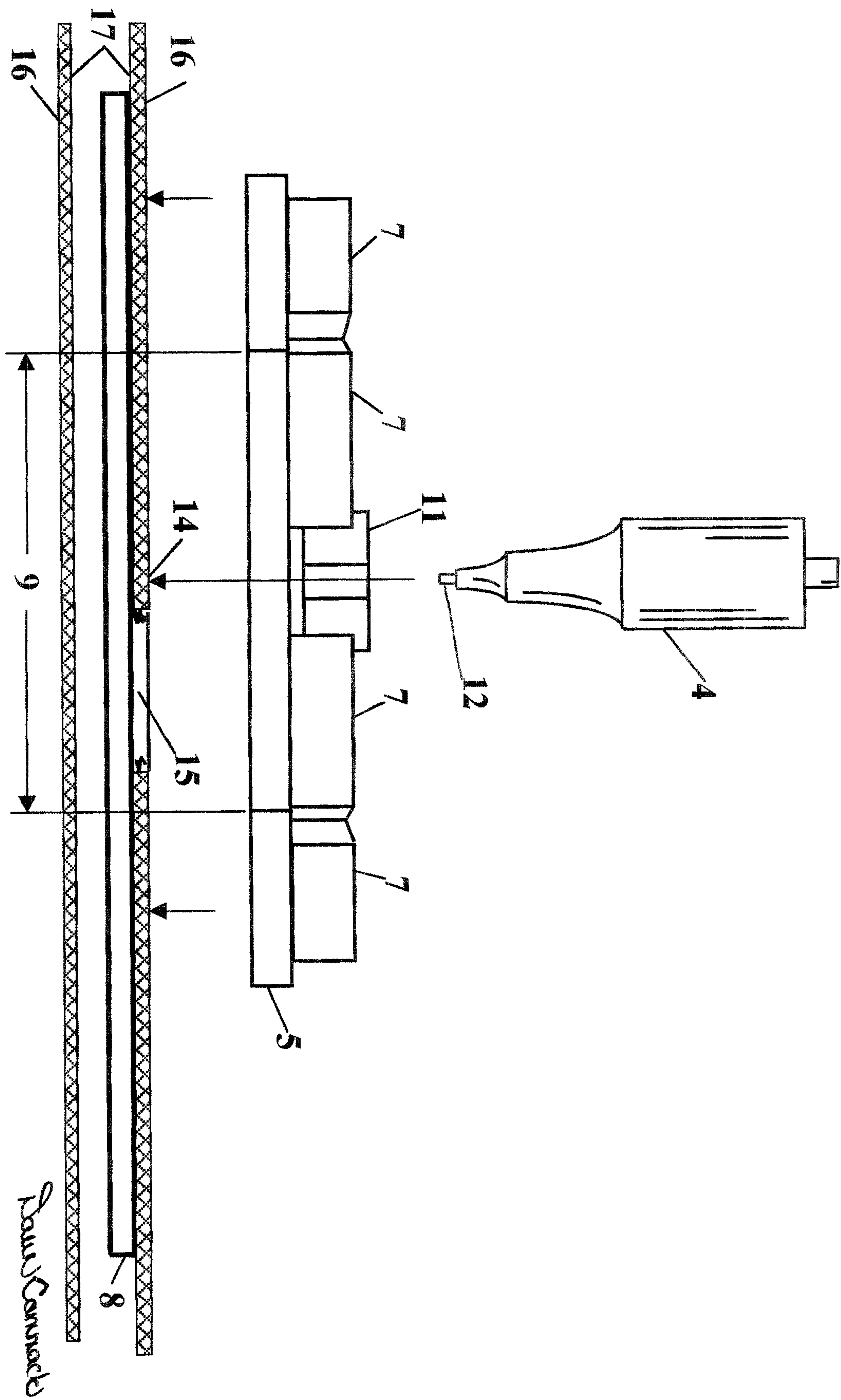


Fig. 11

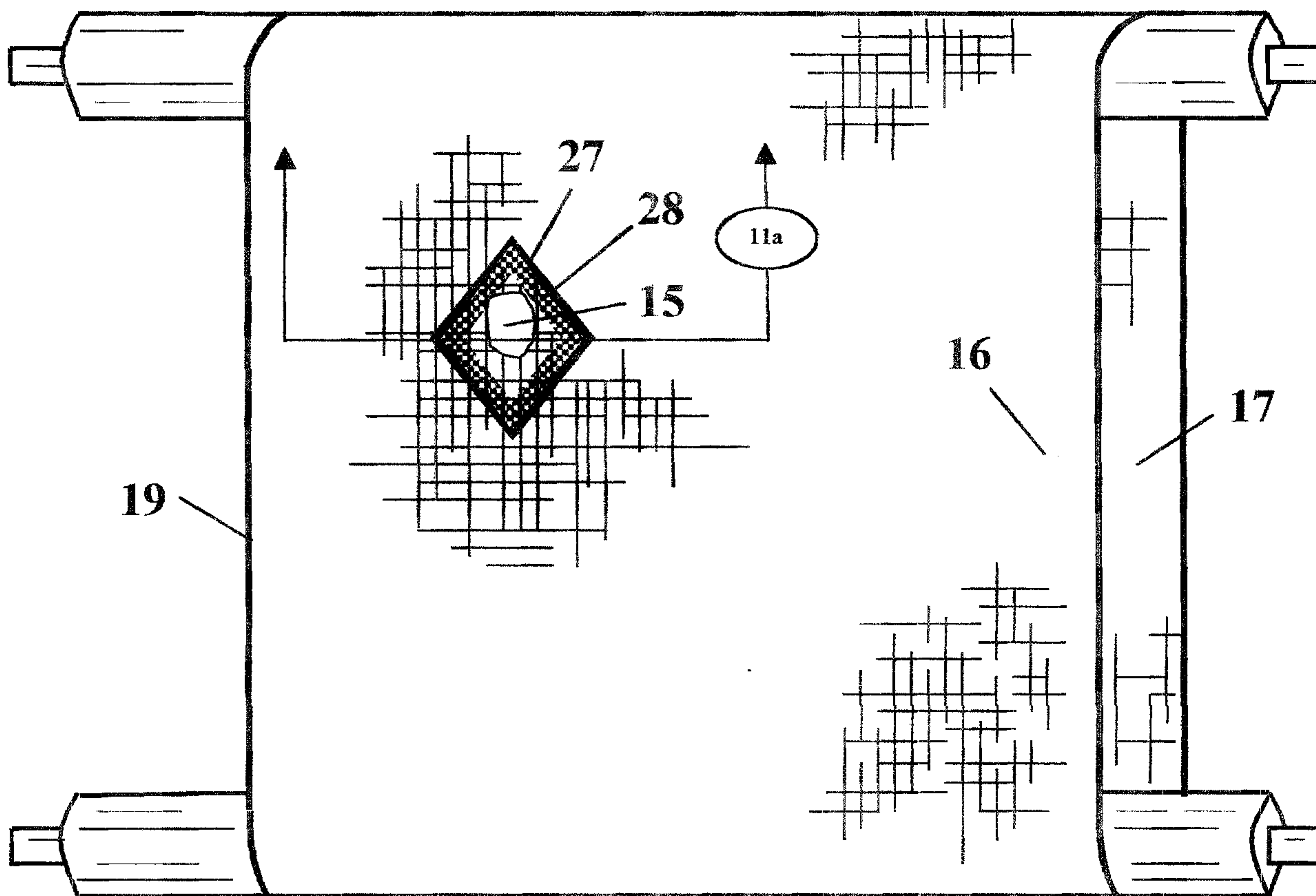
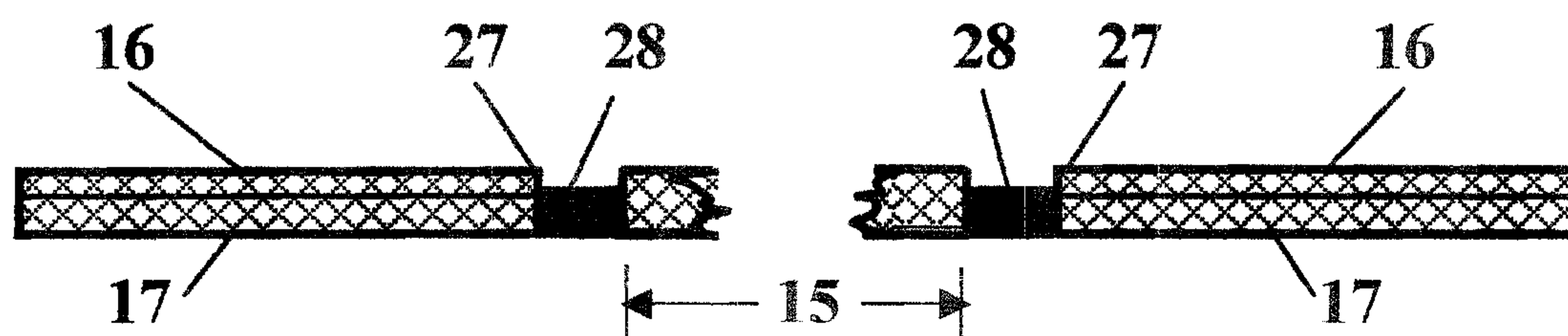


Fig. 11a



Saw Crack

Fig. 12

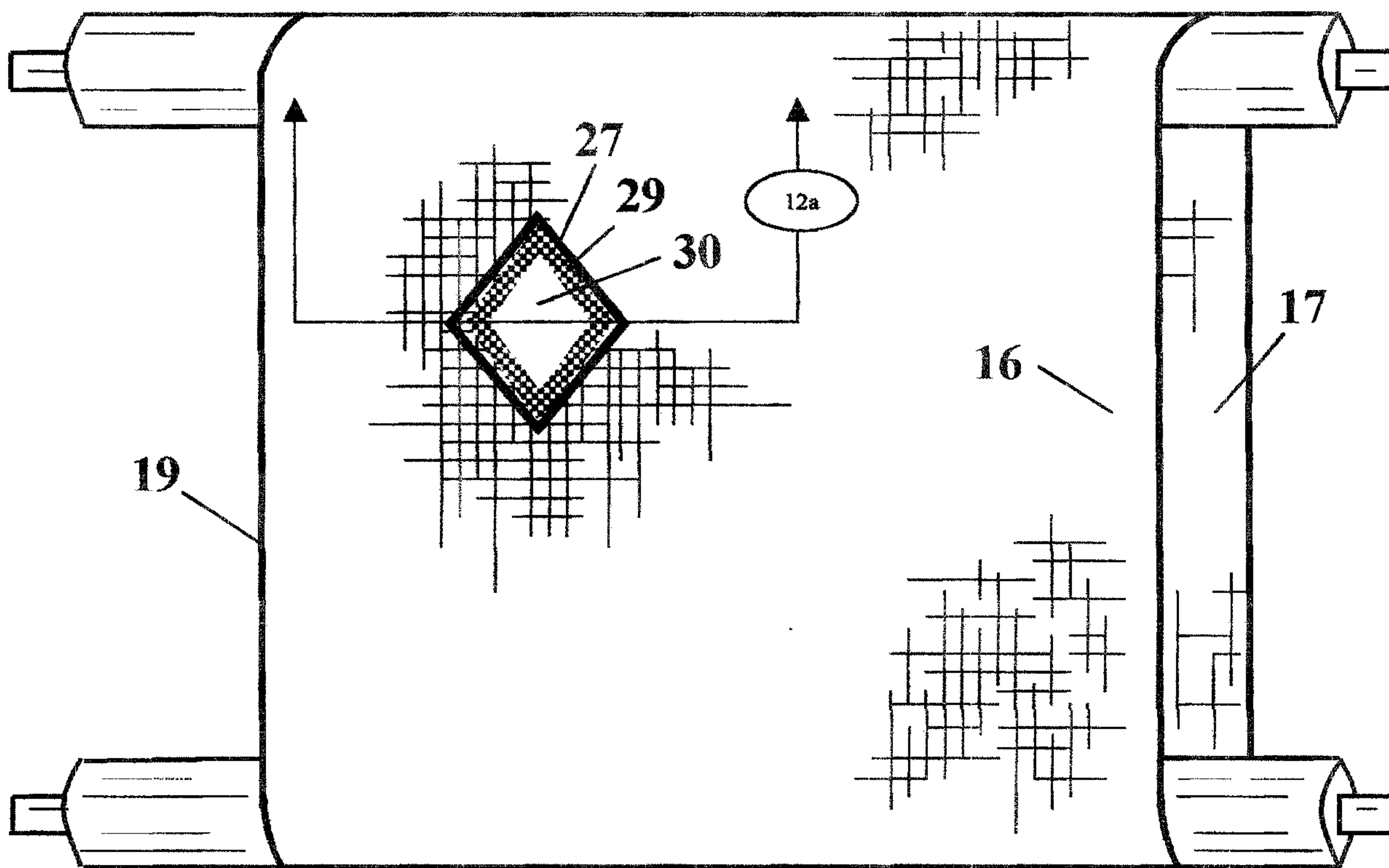
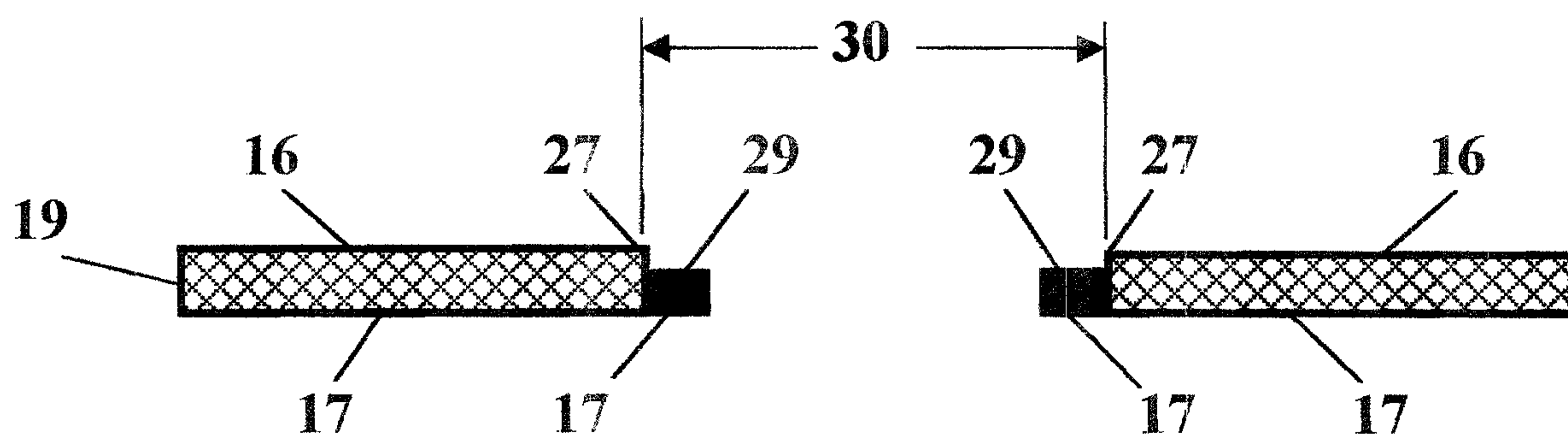


Fig. 12a



Dan Connaek

Fig. 13

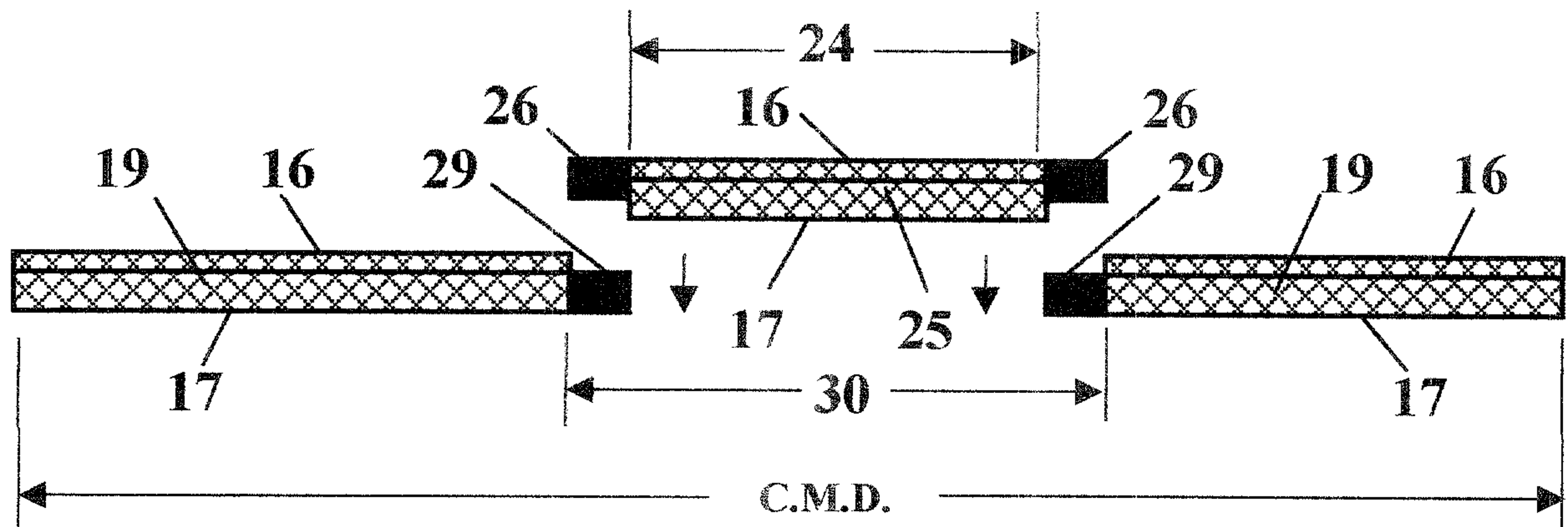


Fig. 13a

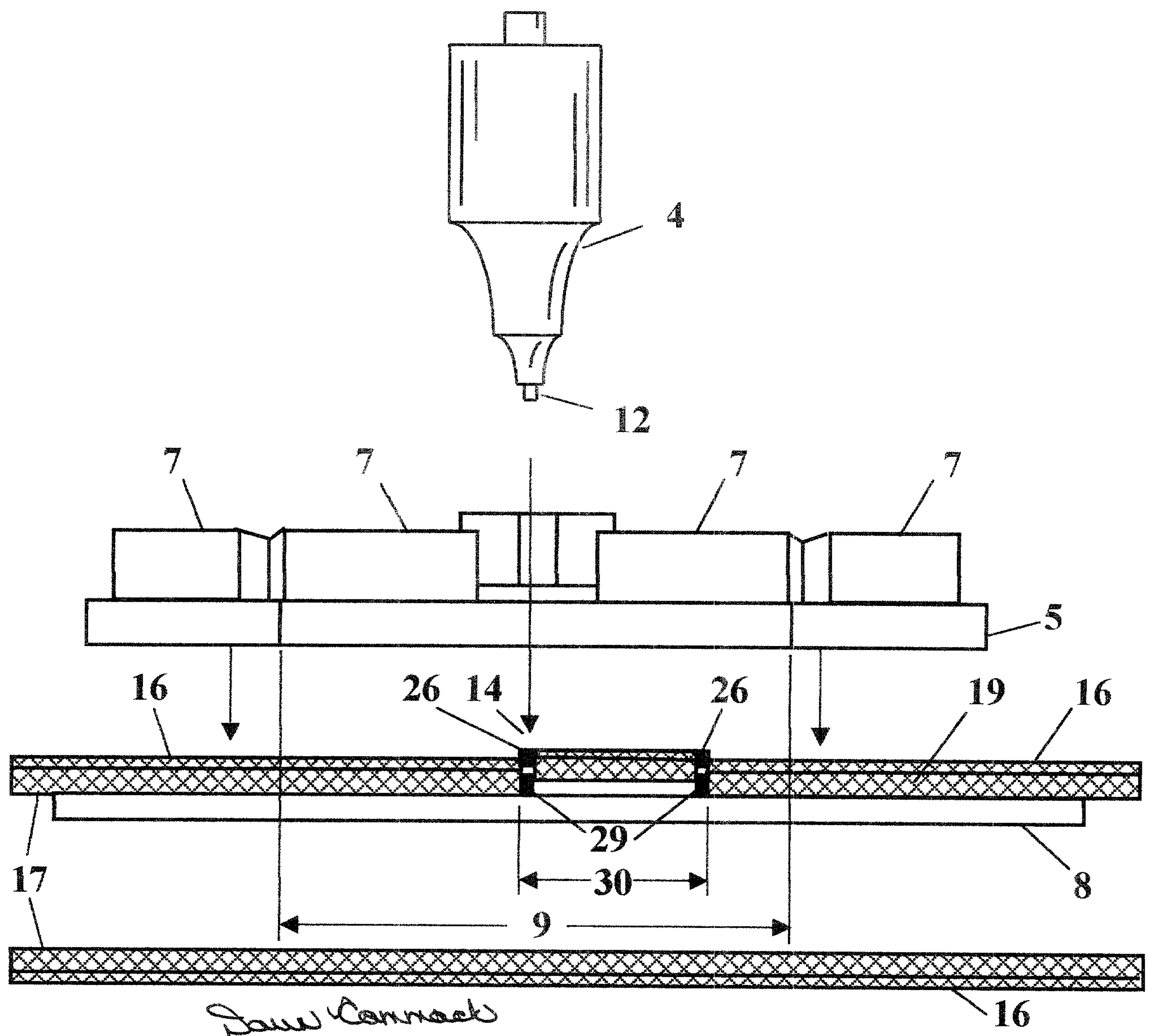


Fig. 14

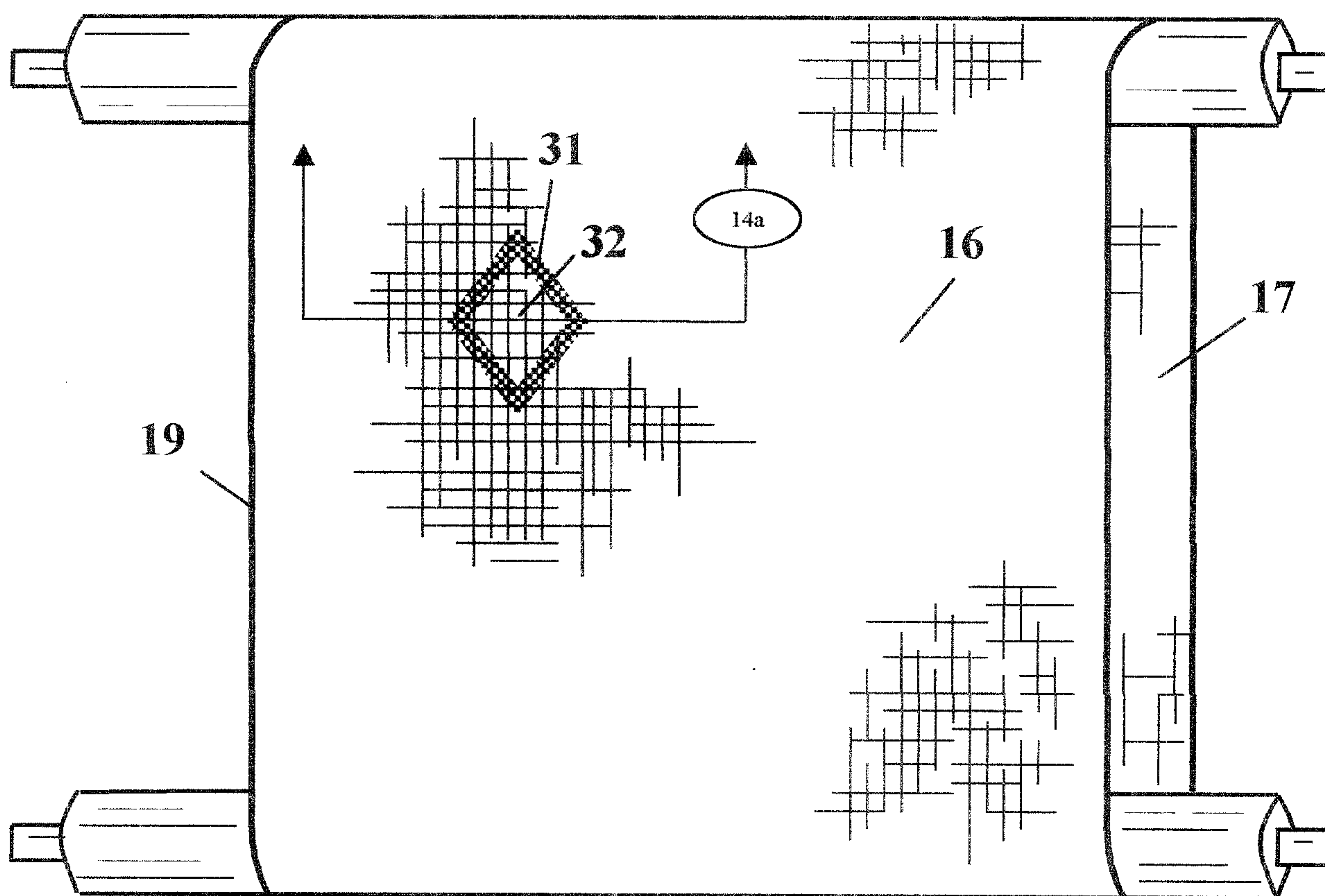
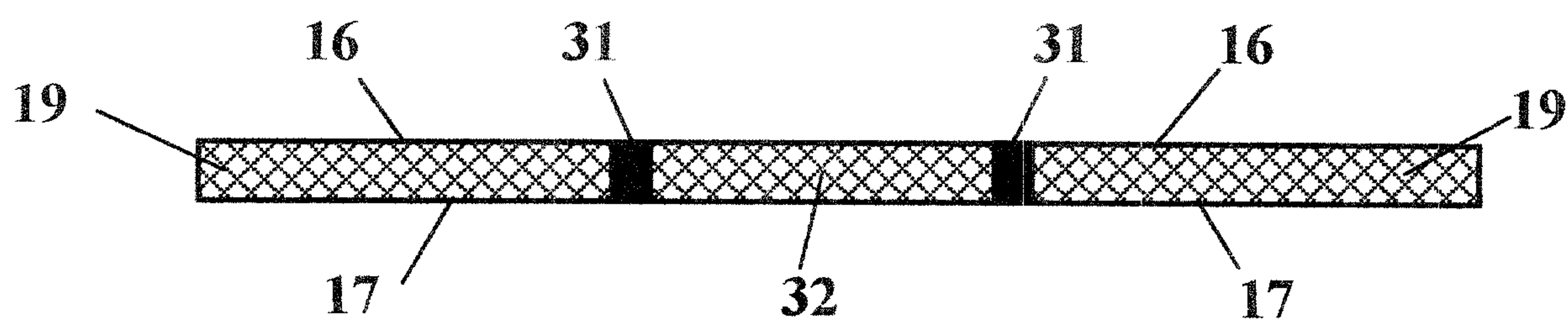


Fig. 14a



Dawn Connors

