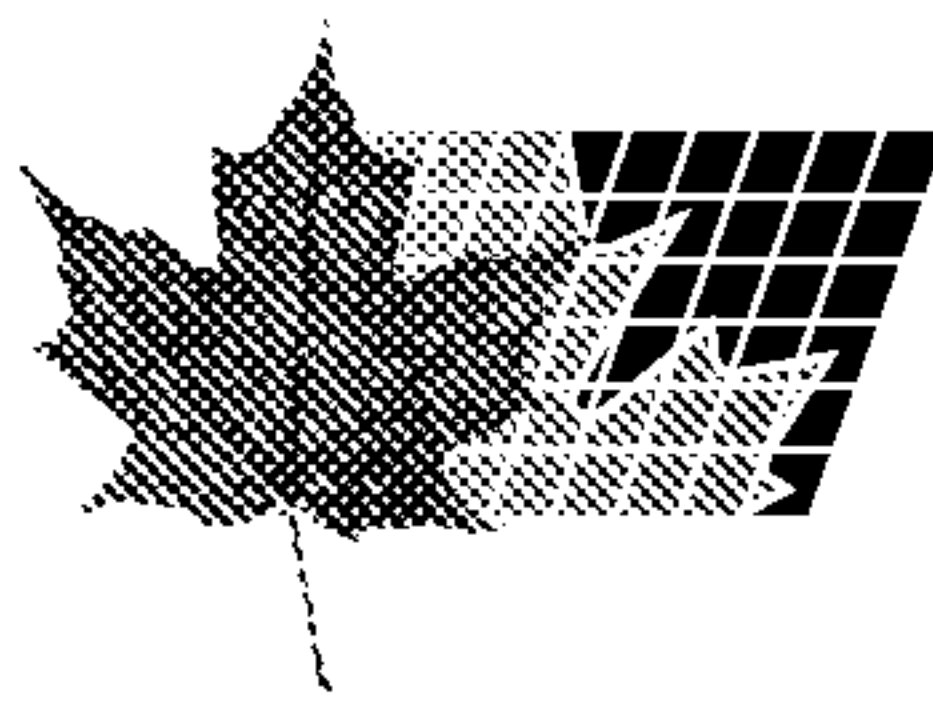




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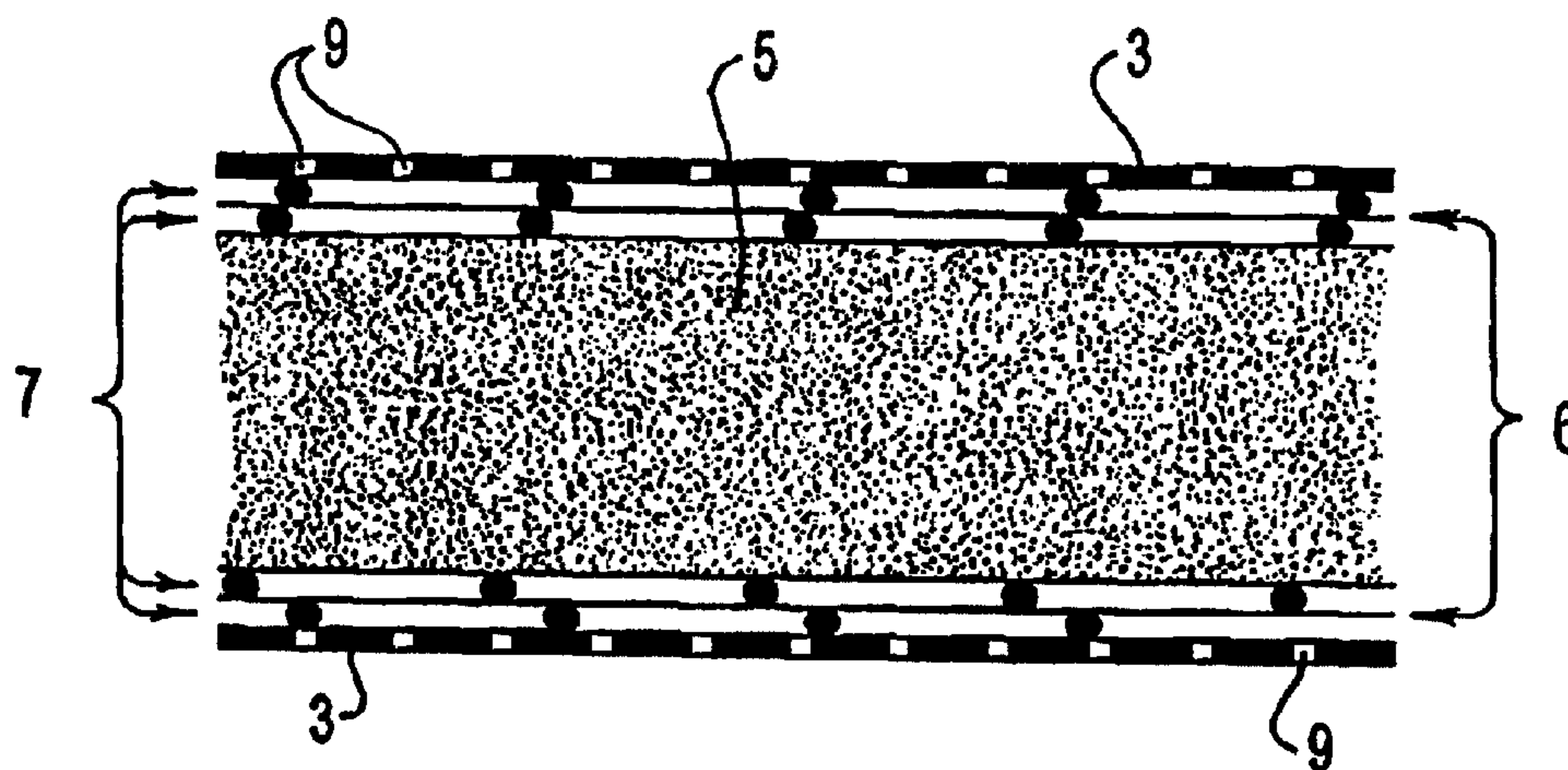
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(54) **DISPOSITIF AMELIORE POUR ATTENUER LE SON**

(54) **AN IMPROVED SOUND ATTENUATING DEVICE**



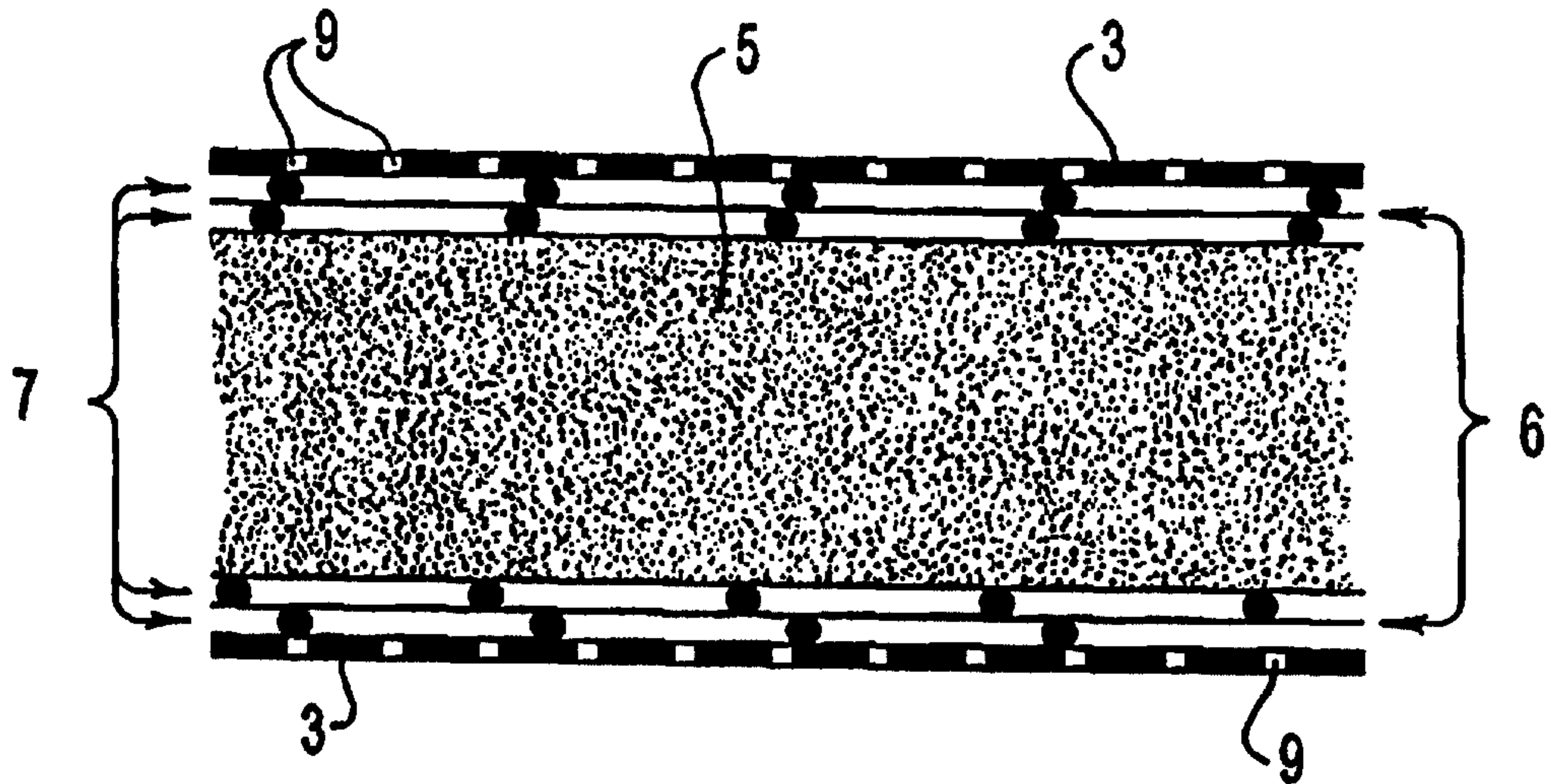
(57) L'invention concerne un procédé pour atténuer le son et un dispositif pour atténuer le son dans une conduite de transport de gaz. Ledit dispositif comprend un noyau de matériau (5) à absorption acoustique compris sensiblement dans une pellicule imperméable (6) pour éviter tout contact direct entre le matériau à absorption acoustique et le flux de gaz traversant ladite conduite de gaz, où le matériau absorbant est maintenu en position entre au moins deux plaques de protection perforées (3). Entre lesdites plaques de protection et la pellicule imperméable, il est prévu des écarteurs (7) pour éviter tout contact entre la pellicule et les éléments de protection et de blocage pour entraver le flux interne d'air entre la pellicule et le parement perforé.

(57) An improved method for attenuating sound and a sound attenuating device for use in a gas transportation duct, said device comprising a core of acoustically absorptive material (5) substantially enclosed within an impervious film (6) to prevent direct contact between the acoustically absorptive material and gas flowing through said gas transportation duct, wherein said enclosed absorptive material is maintained in position between at least two perforated facing plates (3) and further wherein there is provided between the perforated facing and the impervious film spacing means (7) to prevent contact between the film and the perforated facing and blocking means to impede the internal flow of air between the film and the perforated facing.

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>(51) International Patent Classification <sup>6</sup>:</b><br><b>F24F 13/24, F16L 55/033, F01N 1/24, B60K 13/04</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>A1</b> | <b>(11) International Publication Number:</b> <b>WO 99/13274</b><br><b>(43) International Publication Date:</b> 18 March 1999 (18.03.99)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>(21) International Application Number:</b> PCT/AU98/00742<br><b>(22) International Filing Date:</b> 11 September 1998 (11.09.98)<br><b>(30) Priority Data:</b><br>PO 9106 11 September 1997 (11.09.97) AU<br><b>(71) Applicant (for all designated States except US):</b> HRL TECHNOLOGY PTY. LTD. [AU/AU]; 677 Springvale Road, Mulgrave, VIC 3170 (AU).<br><b>(72) Inventor; and</b><br><b>(75) Inventor/Applicant (for US only):</b> JENVEY, Peter, Lee [AU/AU]; 7 Meribah Court, Parkdale, VIC 3195 (AU).<br><b>(74) Agent:</b> PHILLIPS ORMONDE & FITZPATRICK; 367 Collins Street, Melbourne, VIC 3000 (AU).                                                                                                                                                                                                                                                    |           | <b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).<br><br><b>Published</b><br><i>With international search report.</i> |
| <b>(54) Title:</b> AN IMPROVED SOUND ATTENUATING DEVICE<br><br><b>(57) Abstract</b><br><p>An improved method for attenuating sound and a sound attenuating device for use in a gas transportation duct, said device comprising a core of acoustically absorptive material (5) substantially enclosed within an impervious film (6) to prevent direct contact between the acoustically absorptive material and gas flowing through said gas transportation duct, wherein said enclosed absorptive material is maintained in position between at least two perforated facing plates (3) and further wherein there is provided between the perforated facing and the impervious film spacing means (7) to prevent contact between the film and the perforated facing and blocking means to impede the internal flow of air between the film and the perforated facing.</p> |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |



AN IMPROVED SOUND ATTENUATING DEVICE

The present invention relates to an improved sound attenuating device. More particularly, but not exclusively, the invention relates to an improved sound attenuating device suitable for use in ventilation, air conditioning, exhaust, flue gas and other air or gas transportation ducts.

Sound dampening of such gas transportation ducts can be achieved by use of acoustically absorptive material within the duct to absorb acoustic energy. One of the problems associated with the use of acoustically absorptive material in gas transportation ducts is that such material is susceptible to erosion or teasing out by the flow of gas through the duct. Accordingly, in known sound attenuating devices for use in gas transportation ducts, the acoustically absorptive material is typically protected by the combination of an outer perforated facing (usually of metal) and a thin inner protective layer. The inner protective layer can be a pervious fibrous material such as fibreglass cloth. In dusty environments, or where hygiene requires encapsulation of all fibres, the inner protective layer may comprise an impervious film to either prevent contamination of the absorptive material by gas borne dust or to prevent tearing out of the acoustically absorptive material.

For effective performance of the sound attenuating device where impervious film is used, the outer perforated facing should not be in direct contact with the inner protective film but rather there should be an air gap between them. This air gap allows the film to move more freely in response to acoustic forces generated by pressure waves in the gas allowing the sound to be transmitted more effectively into the acoustically absorptive material for attenuation. If the impervious layer is restricted from moving in response to acoustic pressure waves, sound is not transferred as efficiently into the absorptive material and the performance of the sound attenuating device is adversely affected. A further problem which may arise in known sound attenuating devices, occurs where a continuous internal air gap is provided between the outer perforated plate and the

film. In these circumstances, the flow of gas through the gas transportation duct can result in the impervious film fluttering and generating its own noise. This fluttering is due to flow between the impervious film and the outer perforated facing.

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According to known prior art sound attenuating devices, a spacing layer may be provided between the impervious film and the perforated facing. The spacing is included to prevent contact between the impervious film and the outer perforated facing so as to improve performance of the sound attenuating device.

10 However, the known prior art suffers the disadvantage that the movement of the impervious film in response to acoustic forces is restricted, and so the transfer of sound into the absorptive material is diminished.

In other applications, the prior art includes the use of concrete reinforcing  
15 weld mesh as a spacing layer between the impervious film and the outer perforated facing. With this method, the overlapping transverse bars of the mesh allow a continuous gas path between the impervious film and the outer perforated material thereby permitting internal flow along the length of the sound attenuating device and the consequent generation of noise by the flow passing the  
20 impervious film, and the transverse bars between the impervious film and the perforated facing.

It is accordingly an object of the present invention to provide in one embodiment a sound attenuating device for use in carrying air or gas laden with  
25 dust or other particulate matter and thereby provide a more efficient transmission of acoustic energy into an acoustically absorptive material for attenuation.

It is a further object of the present invention to provide in one embodiment a sound attenuating device which alleviates or at least minimises the risk of  
30 release of fibrous materials used for acoustic absorption which could pose a health risk or be a source of contamination during food preparation or processing.

It is a yet further object of the present invention to provide in one embodiment a sound attenuating device for use in gas transportation ducts which prevents or at least minimises the continuous internal air flow within the sound attenuating device thereby reducing noise generated by means of the flow  
5 interacting with the impervious film, the spacer(s) and/or the outer perforated facing.

Through experimental testing, the applicant has found that the inclusion of regularly spaced transverse spacers between the perforated facing and the  
10 impervious film, positioned at right angles to the flow of gas within a gas transportation duct, serve to substantially block internal longitudinal flow between the film and the perforated facing thereby reducing the generation of acoustic energy caused by the flow of gas between the impervious film and the perforated facing.

15

The applicant has further found that increased sound attenuation is achieved if air gaps are provided adjacent both sides of the impervious film to allow unrestricted movement of the film in response to acoustic forces.

20

The present invention accordingly provides, in one embodiment, a sound attenuating device for use in a gas transportation duct, said device comprising a core of acoustically absorptive material substantially enclosed within an impervious film to prevent direct contact between the acoustically absorptive material and gas flowing through said gas transportation duct, wherein said  
25 enclosed absorptive material is maintained in position between at least two perforated facing plates and further wherein there is provided between the perforated facing and the impervious film, spacing means to prevent contact between the film and the perforated facing and blocking means to impede the internal flow of air between the film and the perforated facing.

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In a second embodiment of the present invention there is provided a sound attenuating device integrally formed with an internal surface of a gas

transportation duct, said device comprising a core of acoustically absorptive material positioned between at least one internal surface of the duct and one or more perforated facing plates and said acoustically absorptive material being covered by an impervious film to prevent direct contact between the acoustically  
5 absorptive material and gas flowing through said gas transportation duct, and wherein there is provided between the perforated facing and the impervious film, spacing means to prevent contact between the film and the perforated facing and blocking means to impede the internal flow of air between the film and the perforated facing.

10

In one preferred aspect of the present invention the acoustically absorptive material comprises fibrous material which is totally encapsulated within an impervious layer to ensure there is no release of fibrous material which could pose a health risk or be a source of contamination during food preparation or  
15 processing.

The present invention provides, in a further embodiment, a sound attenuating device wherein a plurality of transverse spacers between the impervious film and the acoustically absorptive material are also provided to  
20 space the film away from the absorptive material.

To further assist in the understanding of the present invention, a particularly preferred embodiment of the invention will now be described in relation to the drawings and photographs.

25

Figure 1 is a longitudinal view of the sound attenuating devices of the present invention located within a gas transportation duct;

Figure 2 is a cross-sectional view of the sound attenuating devices within  
30 the gas transportation duct taken across section A-A;

Figure 3 is a longitudinal view of a single sound attenuating device according to the present invention;

Figure 4 is a cross-sectional view of a single sound attenuating device of Figure 3 taken across section B-B;

Figure 5 is a photographic representation of the acoustic insert assembly;

Figure 6 is a photographic representation of the perforated facing plate; and

Figure 7 is a photographic representation showing an expanded view of the acoustic insert assembly and the perforated facing.

As shown in the figures, the present invention provides a sound attenuating device (1) suitable for use in gas transportation ducting. In the illustrated embodiment, three sound attenuating devices are positioned within a gas transportation duct (8) orientated substantially parallel to the airflow as shown in Figure 1.

20

According to the embodiment illustrated in the figures, the sound attenuating device (1) includes an acoustic insert assembly (2) located between two parallel perforated plates (3) and having contoured capping shells (4) positioned at either end of the acoustic insert assembly, said capping shells (4) being contoured to minimise pressure loss and noise generated as a result of aerodynamic resistance against the flow of air.

As shown in Figure 4, the acoustic insert assembly (2) includes a block of acoustically absorptive material (5) enclosed within a layer of impervious film (6) and there is also provided a series of transverse spacers (7). These spacers (7) are located between both the perforated plate (3) and the impervious film (6) and between the acoustically absorptive material (5) and the impervious film (6). In

30

the preferred embodiment, mineral wool, ceramic fibre and/or fibreglass insulation material has been found to be particularly suitable for use as the acoustically absorptive material (5). Further, in the preferred embodiment, film formed from polyethylene terephthalate has been found to be particularly suitable for enclosing the acoustically absorptive material. However, it is to be appreciated that there are other commercially available durable impervious films that may be equally suitable.

The applicant has found a suitable spacer construction to be in the form of a soft, pliable plastic mesh as shown in Figures 5 to 7. The mesh shown in Figures 5 to 7 has a cross-sectional depth of approximately 4mm and openings of 50mm. However, it is to be appreciated that other configurations and dimensions may be used.

One advantage of using such mesh material is that the mesh is pliable to conform easily with the external shape of the absorptive material thus easing fabrication and providing a barrier between the impervious film (6) and the perforated plate (3) to reduce internal gas flow. Furthermore, in using such soft pliable plastic mesh the applicant has found the cut ends of the mesh are less likely to damage the impervious film than is the case if metal or hard plastic meshes are used.

In the preferred embodiment illustrated by the figures, the perforated plate is made of stainless steel having a thickness of 0.9mm. The perforated plate (3) has a plurality of regularly spaced holes (9) which in the preferred embodiment are 6.35mm in diameter. It is been found by the applicant that in dusty environments, these large diameter holes minimise bridging and blockage of the holes by gas borne particles carried by the gas flow in the gas transportation duct (8). Also by spacing the impervious layer away from the perforated plate, the tendency of the perforations to block is further reduced.

Throughout the description and claims of the specification the word "comprise" and variations of the word, such as "comprising" and "comprises" is not intended to exclude other additives, components, integers or steps.

- 5           While it has been convenient to describe the invention herein in relation to a particularly preferred embodiment, it is to be appreciated that other constructions and arrangements are considered as falling within the scope of the invention. Various modifications, alterations, variations and/or additions to the constructions and arrangements described herein are also considered as falling
- 10   within the scope and ambit of the present invention.

## CLAIMS:

1. A sound attenuating device for use in a gas transportation duct, said device comprising a core of acoustically absorptive material substantially  
5 enclosed within an impervious film to prevent direct contact between the acoustically absorptive material and gas flowing through said gas transportation duct, wherein said enclosed absorptive material is maintained in position between at least two perforated facing plates and further wherein there is provided between the perforated facing and the impervious film, spacing means to prevent  
10 contact between the film and the perforated facing and blocking means to impede the internal flow of air between the film and the perforated facing.
2. A sound attenuating device according to claim 1 wherein there is further provided between the impervious film and the acoustically absorptive material,  
15 spacing means to prevent contact between the film and the acoustically absorptive material and blocking means to impede the internal flow of gas between the film and the acoustically absorptive material.
3. A sound attenuating device integrally formed with an internal surface of a  
20 gas transportation duct, said device comprising a core of acoustically absorptive material positioned between at least one internal surface of the duct and one or more perforated facing plates and said acoustically absorptive material being covered by an impervious film to prevent direct contact between the acoustically absorptive material and gas flowing through said gas transportation duct, and  
25 wherein there is provided between the perforated facing and the impervious film, spacing means to prevent contact between the film and the perforated facing and blocking means to impede the internal flow of air between the film and the perforated facing.
- 30 4. A sound attenuating device according to claim 3 wherein there is further provided between the impervious film and the acoustically absorptive material, spacing means to prevent contact between the film and the acoustically

absorptive material and blocking means to impede the internal flow of gas between the film and the acoustically absorptive material.

5. A sound attenuating device according to claim 3 or claim 4 integrally  
5 formed with an internal surface of a gas transportation duct wherein there is further provided one or more sound attenuating device(s) according to claim 1 or claim 2.

6. A sound attenuating device according to any one of the preceding claims  
10 wherein the acoustically absorptive material comprises a fibrous material.

7. A sound attenuating device according to any one of the preceding claims wherein the fibrous material is selected from the group comprising:

- i) mineral wool;
- 15 ii) fibreglass; and
- iii) ceramic fibres

8. A sound attenuating device according to any one of the preceding claims wherein said blocking means comprises a plurality of transverse spacers.  
20

9. A sound attenuating device according to any one of the preceding claims wherein the plurality of transverse spacers serve as both the spacing means and blocking means.

25 10. A sound attenuating device according to any one of the preceding claims wherein the transverse spacers are orientated substantially at right angles to the flow of gas within the transportation duct.

11. A sound attenuating device according to any one of the preceding claims  
30 wherein the plurality of transverse spacers are provided in the form of a mesh for wrapping around said acoustically absorptive material.

12. A sound attenuating device according to any one of the preceding claims wherein the mesh is a pliable plastic mesh having a cross-sectional depth about 4mm and openings of about 50mm.

5 13. A sound attenuating device according to any one of the preceding claims wherein the impervious film is formed from polyethylene terephthalate.

10 14. A sound attenuating device according to any one of the preceding claims wherein the perforated facing plate comprises a perforated stainless steel plate having a plurality of regularly spaced holes.

15. A sound attenuating device according to claim 14 wherein said perforated facing plate is from 1mm to 3mm thick.

15 16. A sound attenuating device according to claim 14 or 15 wherein said holes are from 3mm to 10mm in diameter.

17. A sound attenuating device according to claim 16 wherein said holes are about 6.5mm in diameter.

20

18. A method of attenuating sound comprising positioning one or more sound attenuating devices according to any one of the preceding claims in a gas transportation duct so that the longitudinal axis of said sound attenuating device is substantially parallel to the direction of air flow through said gas transportation duct.

25

19. A sound attenuating device according to any one of claims 1 to 16 substantially as hereinbefore described with reference to any of the figures.

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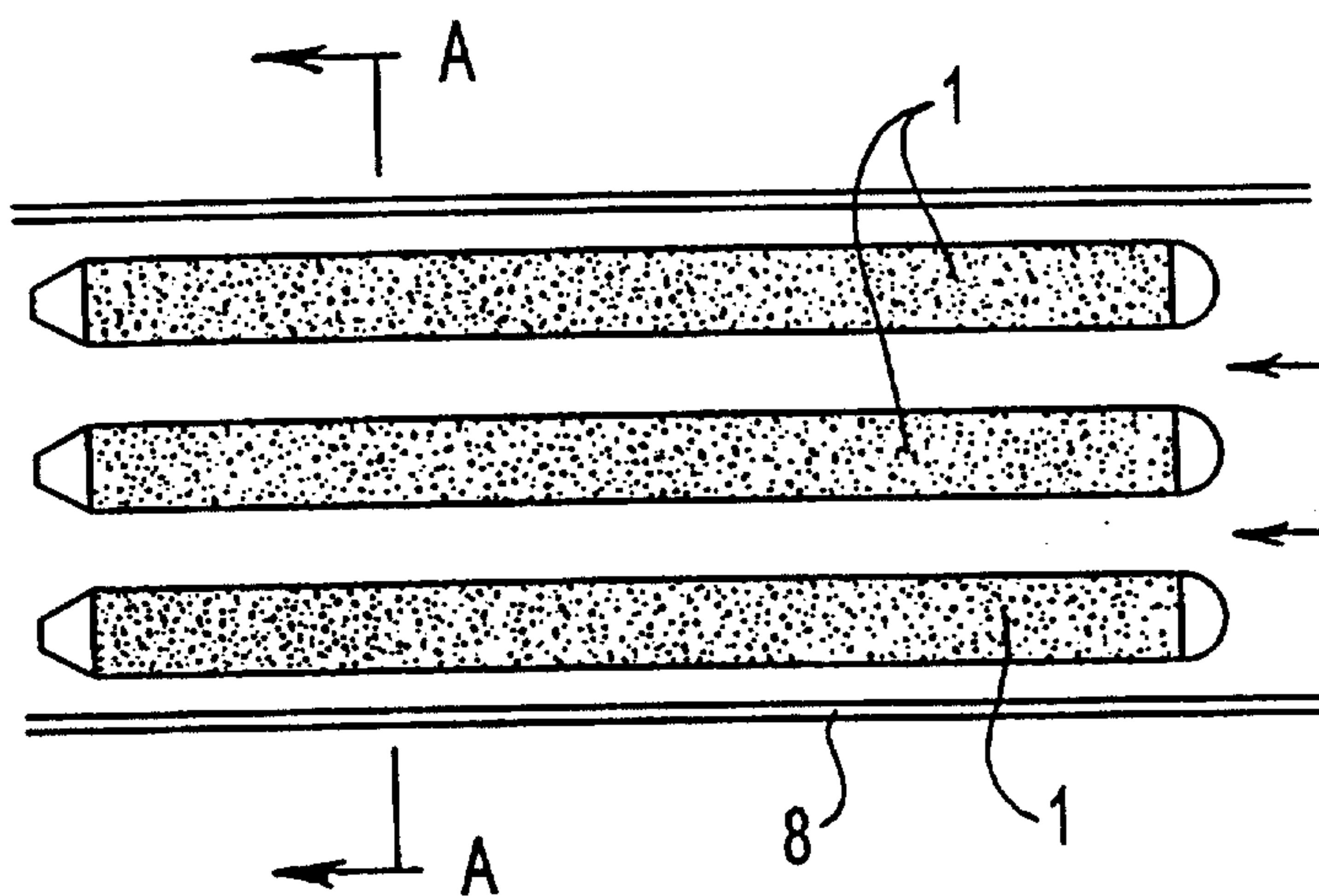


FIG 1

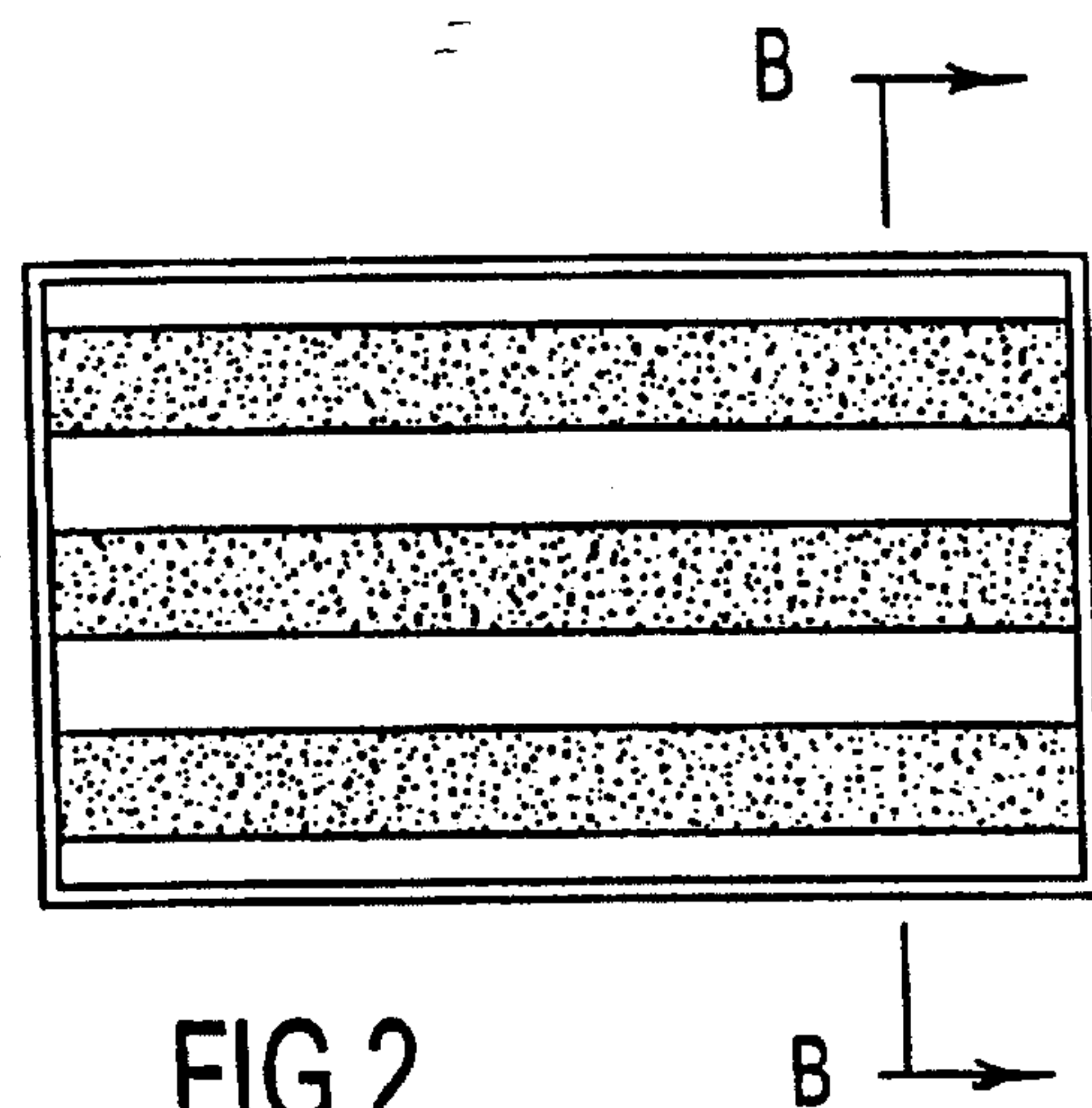


FIG 2

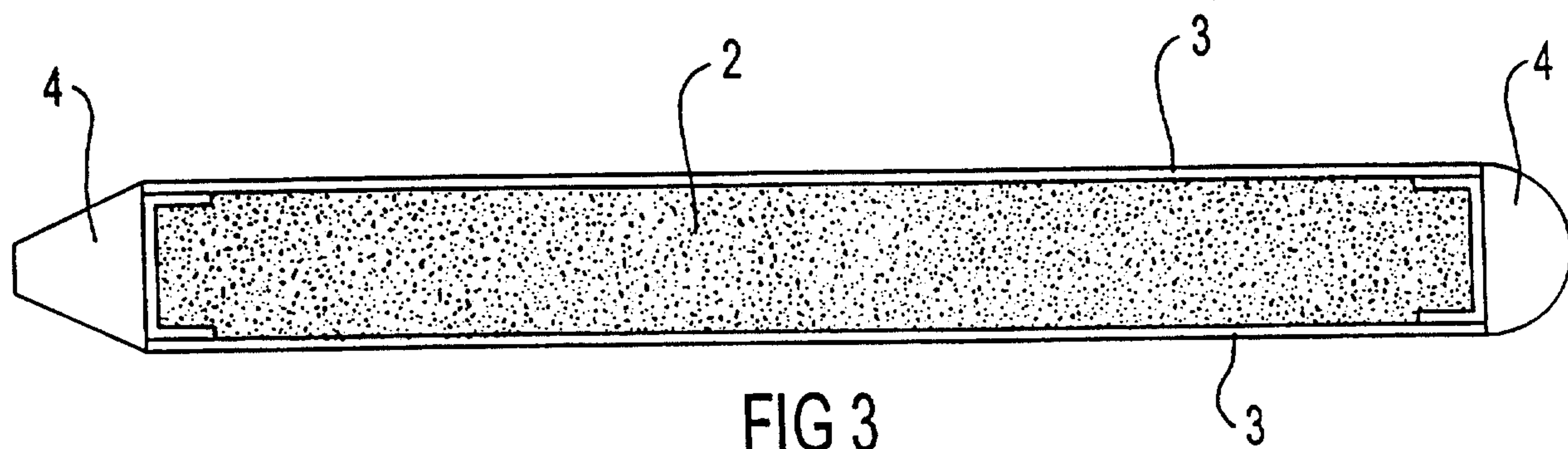
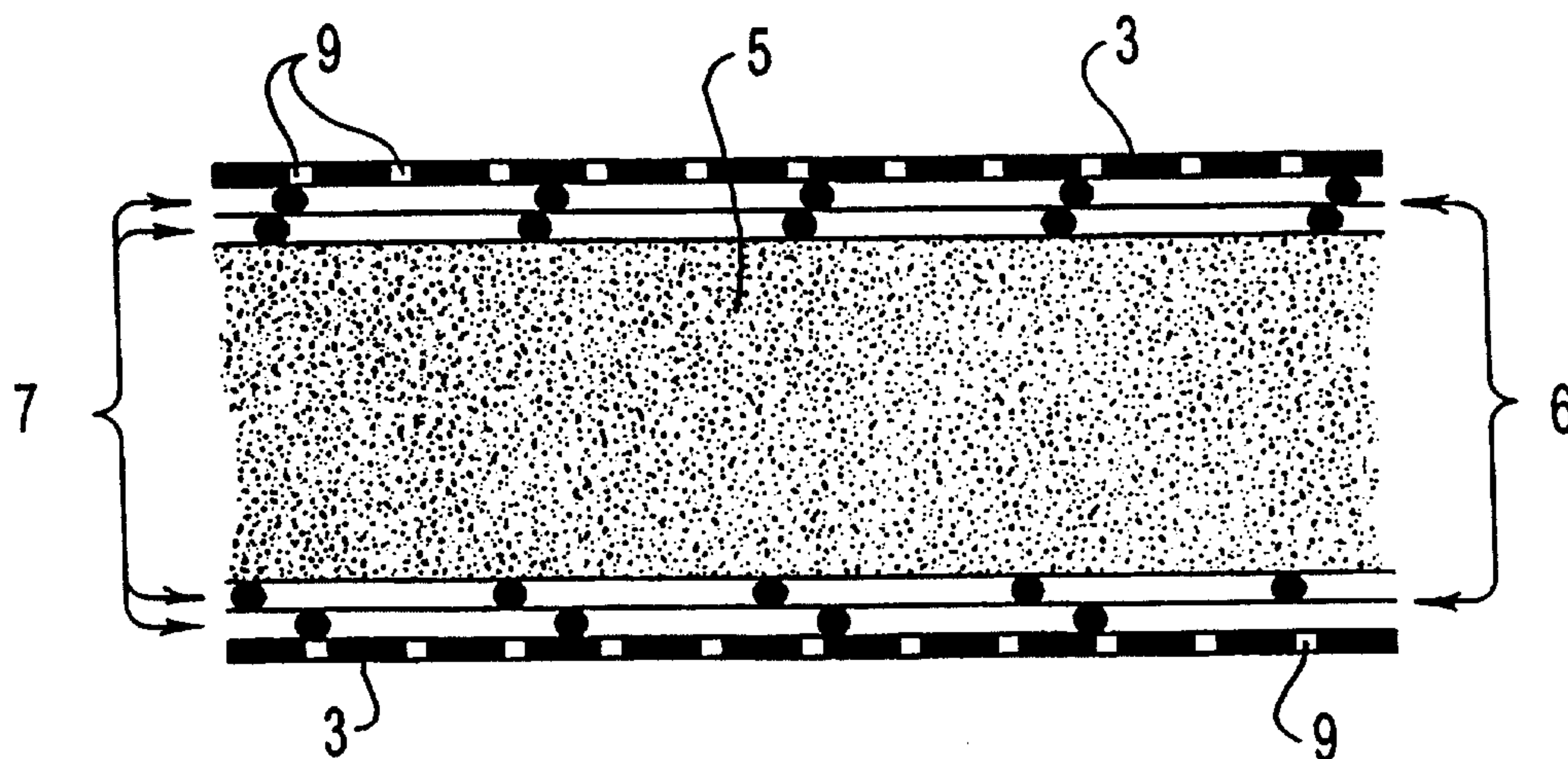


FIG 3



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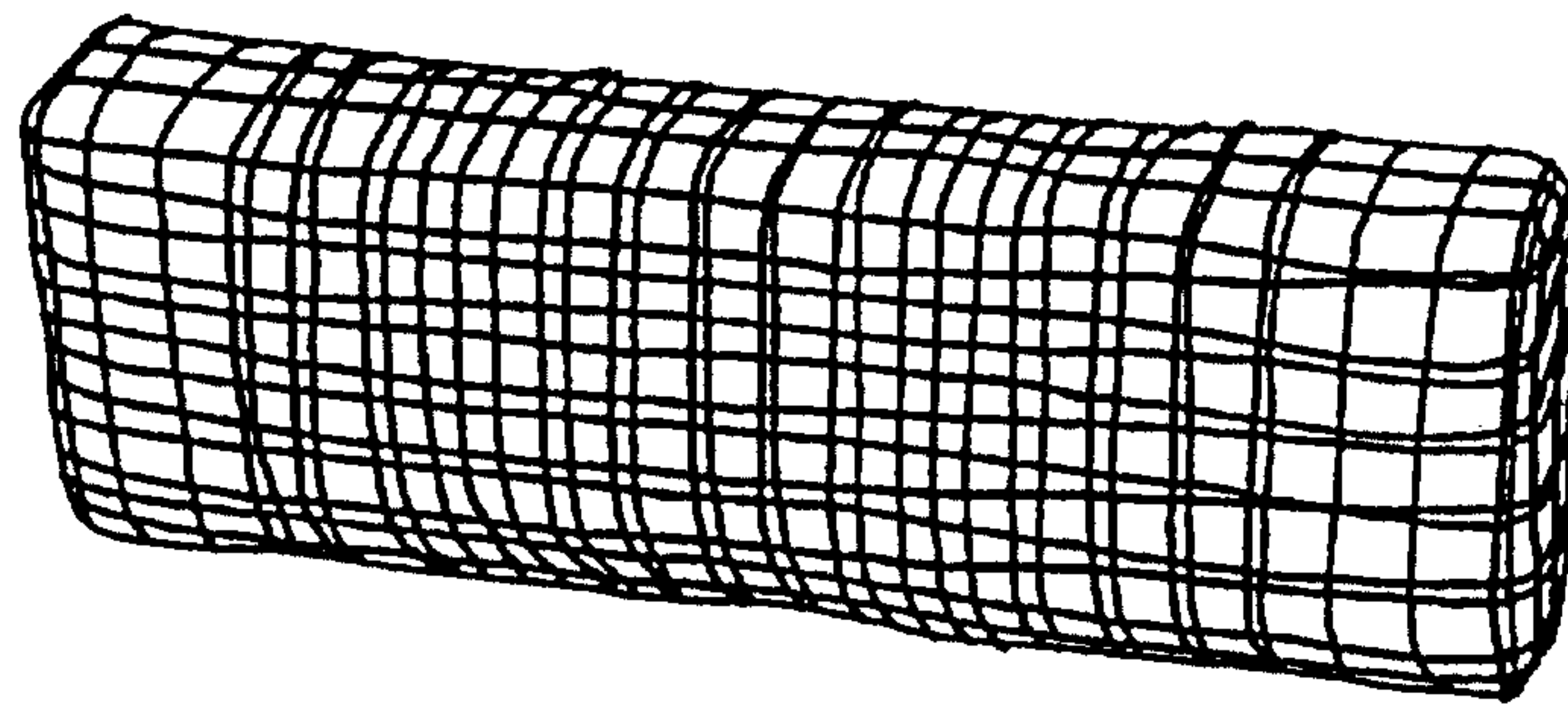


FIG 5

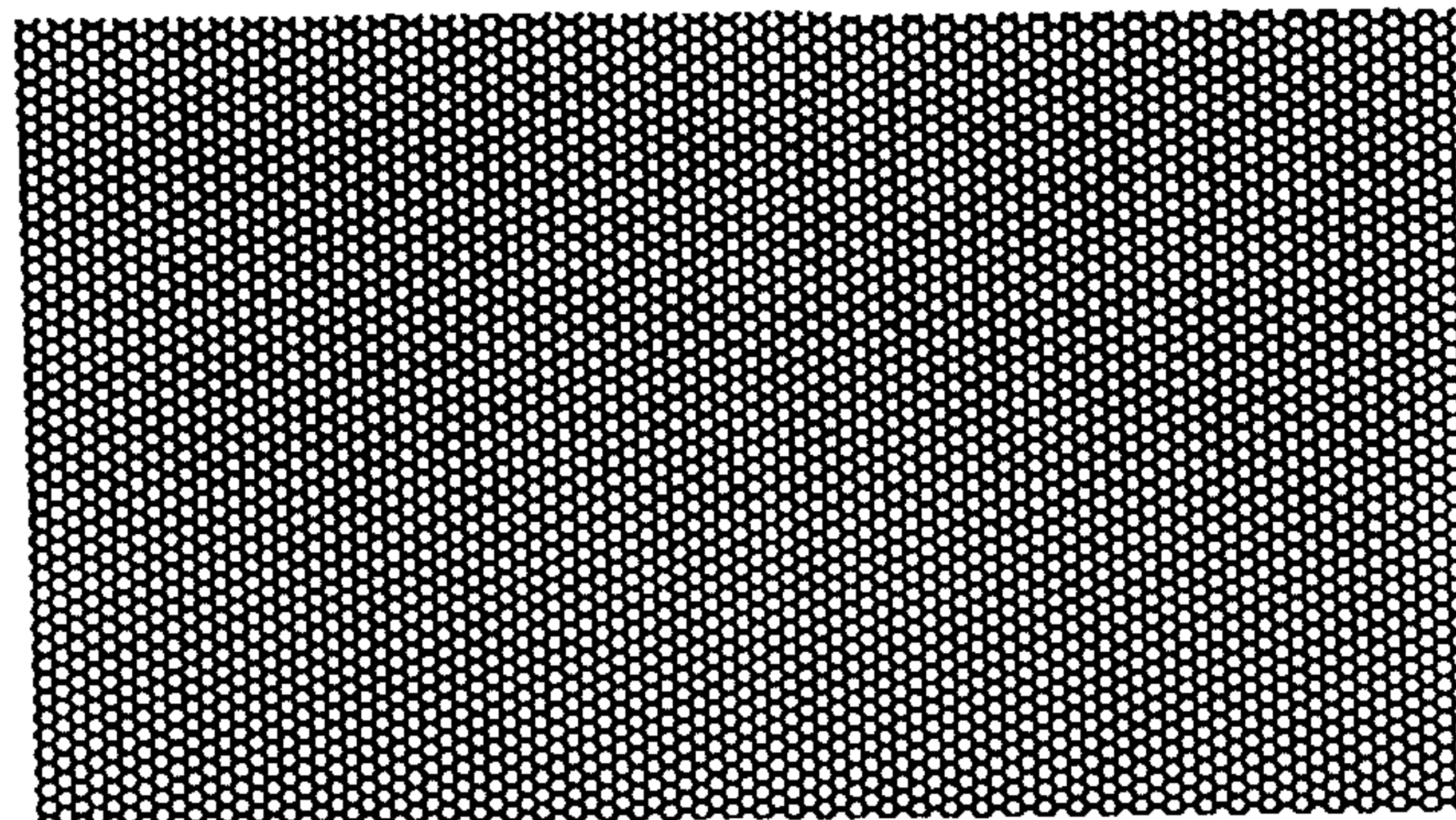


FIG 6

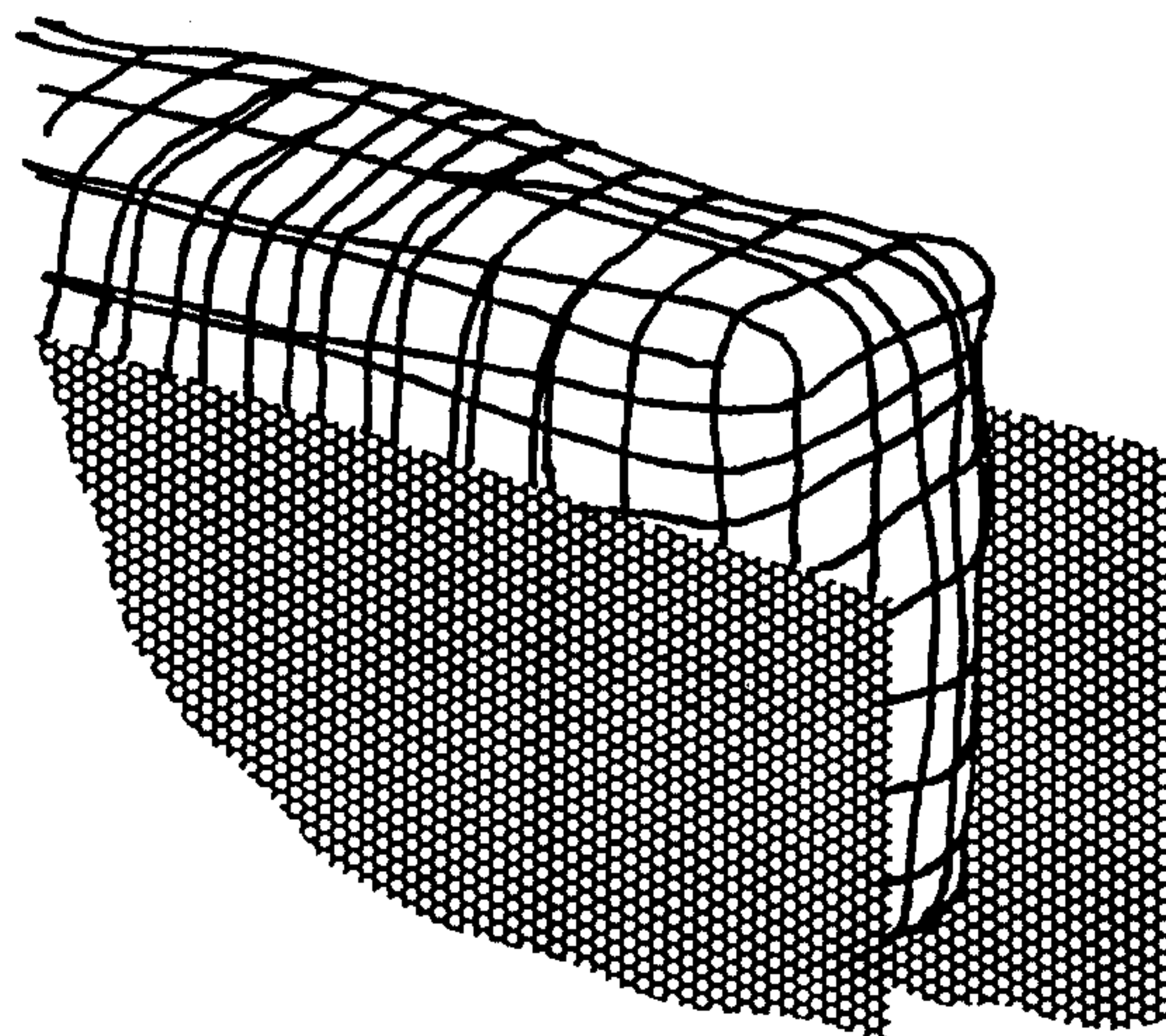


FIG 7