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(54) **GRANULE-FILLED ABSORBING SOUND BARRIER**

MIT GRANULATGEFÜLLTE SCHALLDÄMMENDE SCHUTZWAND

BARRIÈRE ACOUSTIQUE À ABSORPTION DU SON REMPLIE DE GRANULÉS

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- **Printout from meeting agenda/ protocol of a meeting held on 01-12-2015 in 'Teknik- and Miljoudvalget' Vallensbæk municipality, see website** (<https://vallensbaek.dk/dagsorden/teknik-og-miljoudvalget-01-12-2015>), including annexes 1-6 listed under item 10 in the agenda/ protocol
- **Report of recycling of glass fiber materials 'Miljotest nt. 1455, 2012' from the Danish Environmental Protection Agency**
- **Translation into English of the passages emphasized in grey marking in P-E2**
- **Report of recycling of glass fiber materials 'Miljotest nr. 1455, 2012' from the Danish Environmental Protection Agency**
- **ISO Standard 10534-2:2001 published on 8 October 2001**
- **ISO standard 534:2003 published on 12 September 2003, including description of test arrangement and test measurements**
- **ISO standard 1793-1:1997 published on 7 April 1998**
- **"Video of disassembly of a cassette of the sound barrier installed at Vallensbæk"**, , Retrieved from the Internet: URL: <https://www.youtube.com/watch?v=ePPUco7esYA&feature=youtu.be>

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- Invoice of Milijoskcerm ApS to installation firm NCC Danmark A/S for Vallensbcek project
- Report drafted for Danish Environmental Agency with the title 'Pilot production of noise screen made of recycled glass fiber'

Description

Field of the invention

[0001] The present invention involves a design of a sound barrier of the type comprising upright supports or pillars configured for anchoring in the ground, while between said supports or pillars are fastened elongated and primarily horizontally extending shield elements consisting of one or more layers of sheets and one or more layers of sound-absorbing granule material. The sound-absorbing granules are based on recycled glass fiber.

[0002] The invention likewise concerns a method of producing a sound barrier.

Prior art

[0003] In the creating of sound barriers along railroad tracks, for example, which are served by high-speed trains, it can often be difficult to achieve the desired and required soundproofing and absorption.

[0004] From DK 177352 B1, corresponding to WO 2013/076601 A, there is known a sound barrier, where the sound barrier makes use of granules of fiberglass, for example, where the granules are bound together with the aid of an adhesive to form a continuous mat, which is covered with a water impenetrable membrane. Thus, this sound barrier is not resistant to water, since water nullifies the cohesive adhesive effect, and furthermore the entry of water can cause frost cracks and thus the sound barrier will either be destroyed or the sound barrier effect diminished.

Background of the invention

[0005] Against this background, the purpose of the invention is to indicate a new type of soundproofing material and a design for an improved sound barrier, primarily intended for mounting along railroad tracks or highways with high traffic density etc., served by high-speed trains - such as electrically powered high-speed trains or motor vehicles in the case of highways.

[0006] A further purpose of the invention is to utilize granules based on recycled glass fiber, where the glass fiber has previously been used in wind turbine blades, sailboats, and other non-polluting components.

[0007] The fiberglass granules which are used are mechanically crushed into pieces varying in length and thickness, and therefore the granules which are used are not homogeneous in size.

[0008] Utilization of the indicated granules can help alleviate the major environmental storage problems affecting the wind turbine industry, among others, in connection with the stockpiling of used wind turbine blades, as well as waste products and scraps from new production of wind turbine blades, for example.

[0009] A further purpose of the invention is to make a sound barrier which is not destroyed by either wind, wa-

ter, or temperature changes, including frost, such that the elements of the sound barrier are resistant to the climate in which the sound barrier is installed.

[0010] Finally, a purpose of the invention is to utilize the raw granules in loose form, where the granules are not further processed in any way or processed for any purpose other than pure granules.

Description of the invention

[0011] Design of sound barriers of the type comprising upright supports or pillars configured for anchoring in the ground, while between said supports or pillars are fastened elongated and primarily horizontally extending shield elements consisting of one or more layers of sheets and one or more layers of sound-absorbing granule material. The sound-absorbing granules are based on recycled glass fiber. The sound barrier is special in that the shield elements are designed as assembled cassette structures and outfitted with means for blowing in of granules or the granules are packed in sack means that are directly placed in the shielding elements, wherein the granules are hygroscopic and packed in a sack material made of a water-soluble film.

[0012] The granules are preferably used loose. The high density thus allows one to produce "slender sound barrier cassettes" due to the high weight per unit area.

[0013] The fiberglass granules by virtue of their loose form can thus be directly shoveled, poured, blown, inflated, guided, led, or otherwise introduced directly into the soundproofing cassette, e.g., by conveyor belt, with the help of screw conveyors, or otherwise. According to one aspect of the invention, the granules is blown into the cassettes.

[0014] Alternatively, the fiberglass granules can be introduced for example in sack means, where the sack means are made of a water-soluble film material.

[0015] The sack can furthermore be directly positioned in the shielding element or the shielding element can be afterwards placed in a sack filled in this way. There are further possibilities for lining the sack.

[0016] In practical manner, the granules will be supplied to a type of tube, such as a round tube or a rectangular tube, and preferably connected to funnel for supply of granules at one end of the tube, and where the other end of the tube has a connection to sacks for filling with said granules.

[0017] The sack or membrane can be endless for example in the form of tubes or hoses, making it possible for one end to be closed, gathered, or in some other way halt the passage of granules, which are possibilities, not necessities, as desired and required for the handling, packing and filling of granules in cassettes. Depending on the surroundings, one possibility can thus be to place a filled sack or membrane with granule material at the application site for the sound barrier.

[0018] Because the granules are loose and can be subjected to water also means that the granules are broken

up by frost and thus become even more pieces, which simply means a fine dividing of the material, not having as such any functional importance to the soundproofing effect of the granules.

[0019] The sack material is soluble in water, so that the granules can be placed in the cassette as a whole, after which the sack is dissolved and the granules then obtain a surface which enables a larger contact surface in regard to uptake of water and thus an increasing of what the skilled person understands as being weight per unit area.

[0020] Examples of water-soluble films are known from PVOH, PVA, and PVAL.

[0021] The application of water-soluble films is used in many compounds - including as a "form releaser" - since epoxy does not adhere to polyvinyl alcohol. The combination of the granules being hygroscopic and thus taking up water and the sack likewise dissolving on account of the permeable fiber membrane means that the fibers will remain in the sack under dry conditions. When the sound barrier is set up, the sound barrier cassette will be subjected to the weather conditions and the sack will be dissolved. The binder in the crushed fiberglass granules is typically epoxy, so that the water-soluble film thus will not bind to it. Films which are not water-soluble will be perforated to allow for absorption. Absorption in a granule-filled water-soluble film occurs when the film comes in contact with moisture and water. Thus, there is no reason to use perforated film when one is using water-soluble films. The use of water-soluble films is known in connection with other elements, but is never used in connection with hygroscopic fiberglass granules in connection with a sound barrier.

[0022] The use of the water-soluble film only finds exclusive application as a filler packaging during the production process of the cassette, so that noise pollution etc. is avoided. The packaging will be intact during transport and thus also act as a sound barrier during transport. Thus, it will not be possible for any noise pollution to occur during the production process or in a logistical connection, when the sound barrier cassettes are being handled in closed premises or rooms.

[0023] One or more sheets are reflective and/or one or more sheets are corrugated.

[0024] There can be perforations in one or more sheets, which perforations are not larger than those which are able to hold back the granules.

[0025] In a special embodiment, the design of the sound barrier is of the type comprising upright supports or pillars, which can be anchored in the ground, wherein there are secured between said supports or pillars elongated primarily horizontally extending shield elements, consisting for example of thin-wall profiled metal sheets and a core of a sound-absorbing granule material, characterized in that granules are used which are based on recycled glass fiber. Furthermore, the sound barrier is distinguished in being designed such that granules can be blown into an assembled cassette structure.

[0026] In this way, the granules do not have to be glued or otherwise processed before the blowing in.

[0027] In one embodiment, the cassette which is designed to be filled with granules is characterized in being able to be provided with an internal stiffening. Alternatively, it can be an internal stiffening. In this way, one achieves further shape stability and strength. In another alternative embodiment, there can be an external stiffening instead of an internal one, or as a supplement to an internal stiffening.

[0028] In one embodiment, the sound barrier is characterized in that the absorption is different and varies as a consequence of the fiber size blown in.

[0029] In one embodiment, the sound barrier is characterized in that the granules have no further processing or crushing. Preferably, the glass fibers have thus been used previously for another purpose, but can now be used for an entirely different purpose instead of being taken to a dump site. The glass fiber can thus typically be a waste material or a waste product made into granules with no further processing. That is, the granules as the starting product do not have to be supplied with liquids, undergo heat treatment or the like, in order to be used for the mentioned purpose.

[0030] In one embodiment, the sound barrier is characterized in that the granules are hygroscopic and thus take up water. The hygroscopic property will contribute to an increased density and thus an increased soundproofing.

[0031] In one embodiment, the sound barrier is characterized in being designed so that it can be mounted in a way such that the granules are blown in after the mounting. In one special configuration, the cassettes are configured such that they can be connected and have one or more channels, so that the granules can be blown in after mounting. The blowing or other filling method can occur after the cassette has been mounted in pillars on-site.

[0032] The cassette can furthermore be designed with a removable sheet or an opening, so that the granules can be filled into the cassettes. Such a sheet or such an opening is placed so that the removal and the refilling of the granules can be done with the cassette mounted in pillars on-site.

[0033] The sound barrier design according to the invention is characterized in that the sound barrier is designed such that granule fill can be blown into the wall of the shield. The sound barrier thus becomes absorbing from both sides facing the noise source - such as a railway or highway. The sound barrier cassette is based on a self-supporting structure with internal stiffening - such that the granules etc. only act as absorbing and soundproofing material - characterized by its high density and good absorbing properties.

[0034] In this way, noise can be absorbed by means of the fill which is blown into the shield, thereby achieving an extremely effective absorption of the sound pressure waves from, e.g., passing high-speed trains or a motor

vehicle or some other noise source, in that the sound pressure waves are effectively absorbed in the granules. The absorption in the sound barrier as a whole is thereby increased very significantly.

[0035] Preferably, the sound barrier design according to the invention is such that the cassette can be produced in various self-supporting configurations.

[0036] A cassette consists of a top and a bottom, as well as side pieces, all of which are connected to form an assembled frame.

[0037] The frame is provided with a net or a perforated sheet. Behind the net or the perforated sheet is mounted a fiber membrane, which allows for the passage of air. If the granules are already filled into a sack or a net of corresponding material and/or with corresponding function, the providing of a net or a perforated sheet for the frame can be omitted.

[0038] In the end pieces there are produced a blow-in hole, so that the granules can be blown in from either end, optionally for filling later on.

[0039] A good filling is achieved in this way. The permeable fiber membrane allows for passage of the blowing air and at the same time acts as a filter, so that the granules are held back by the fiber membranes.

[0040] Depending on the length of the shield, the internal configuration of the shield will have many different designs in order to achieve sufficient stability.

Description of figures

[0041] The invention shall be explained more closely below with regard to the drawing, which shows:

Fig. 1 shows a perspective image of one embodiment of a sound barrier design according to the invention, filled with granules.

Fig. 2 shows a perspective image of one embodiment of a sound barrier design according to the invention configured for filling of granules; optionally after installation and assembly on-site.

Fig. 3 shows the blowing in of granules in the sound barrier design according to the invention in Fig. 1, seen from the side. The blowing in occurs with the cassette standing horizontally on the floor.

Fig. 4 shows the blowing in of granules in the sound barrier design according to the invention in Fig. 1, seen from the side. The blowing in occurs with the cassette standing vertically on the floor.

Fig. 5 shows an elevation view of a cassette with a configuration for a sound barrier design according to the invention.

Detailed description of the invention

[0042] The sound barrier shown in Fig. 1-4 is built as a self-supporting structure. The cassette is mounted in or on pillars, such as those with an H-profile, which are anchored in the ground, and between which the cassettes are mounted primarily horizontally as running shielding elements. The cassette for example consists of thin-wall profiled metal sheets 4 and a filled core 9 of a sound-absorbing granule material. The sound barrier 10 as shown can also comprise various profile sheets and corrugated trapezoidal sheets, which form a mechanical barrier and front side of the shield 10. What is common to all the sheets which are mounted on the front is that they are perforated to one degree and extent or another. It will be extremely easy to provide a potential equalization of all metal parts in a sound barrier of the described type, so that it also becomes suitable for use along railroad tracks with electrically operated trains. The shield consists of a top profile 1, a bottom profile 2 and side pieces 6, which are joined into a shape-stable and self-supporting frame. The internal stiffening 8 ensures that the cassette remains stable. In order to hold back the granules 9, a mechanical net 4 is mounted. Behind this net is mounted a permeable fiber membrane 3. The fiber membrane allows the passage of the blowing-in air, but at the same time holds back the blown-in granules.

[0043] Figure 2 shows an empty cassette with a sheet, here a side piece 6 and top profile with a hole 7 for blowing in of granules. The cassette is designed for serial connection to identical cassettes.

[0044] Figures 3 and 4 show a cassette or a shield element 10 which is placed on a base 12 such as the ground and with connection means for a hose 11 for blowing in of granules in the form of recycled glass fiber.

[0045] Figure 5 shows a cassette 10 which is designed to receive granules. The cassette 10 shown can receive one or more sound-reflecting sheets and at the same time receive granules, see the previous figures.

Claims

1. Sound barrier design of the type comprising upright supports or pillars, configured for anchoring in the ground, and wherein there are secured between said supports or pillars elongated primarily horizontally extending shield elements (10), consisting of one or more sheets (4) and one or more layers of sound-absorbing granules (9), wherein the granules used are based on recycled glass fiber, **characterized in that** the shield elements (10) are designed as assembled cassette structures (10) and outfitted with means (7) for blowing in of granules or the granules are packed in sack means that are directly placed in the shielding elements (10). wherein the granules are hygroscopic and packed in a sack material made of a water-soluble film.

2. Sound barrier design according to claim 1, **characterized in that** the cassette (10) is designed with an internal stiffening (8) and configured with holes or an access for granules for distribution during the blowing in.

3. Sound barrier design according to any one of claims 1 to 2, **characterized in that** the granules are hygroscopic.

4. Sound barrier design according to any one of claims 1 to 3, **characterized in** further comprising a water collector or an irrigation system for ongoing or periodic moistening of the granules.

5. Sound barrier design according to any one of claims 1 to 4, **characterized in that** it comprises a plurality of cassettes, where the cassettes (10) are configured with channel connections which are designed so that the granules can be blown into one cassette (10) and distributed to another cassette via at least one channel connection and after the cassettes (10) have been mounted.

6. Sound barrier design according to claim 1, **characterized in that** the cassettes are designed with a hatch, a gate, or corresponding releasing means for emptying of the cassette for the granules.

7. Sound barrier design according to claim 1, **characterized in that** the cassettes are designed with a hatch, a gate, or corresponding releasing means for filling of the cassette with the granules.

8. Method for making a sound barrier, consisting of:

- providing supports or pillars anchored in a base such as the ground;
- providing shield elements (10), preferably box-shaped, between the supports or pillars;

characterized in that it further comprises the step of

- blowing granules into the preferably box-shaped shield elements (10), the granules being recycled glass fiber, or

packing the granules in sack means and placing said filled sack means directly in the shielding elements (10), wherein the granules are hygroscopic and packed in a sack material made of a water-soluble film.

Patentansprüche

1. Design einer schalldämmenden Schutzwand des Typs, der aufrechte Stützen oder Pfeiler, konfiguriert

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zur Verankerung im Erdboden, umfasst, und wobei zwischen den Stützen oder Pfeilern längliche vorwiegend horizontal ausgedehnte Abschirmelemente (10) fest montiert sind, die aus einer oder mehreren Platten (4) und einer oder mehreren Lagen von schallabsorbierendem Granulat (9) bestehen, wobei das verwendete Granulat auf wiederverwerteten Glasfasern basiert, **dadurch gekennzeichnet, dass** die Abschirmelemente (10) als vorgefertigte Kassettenstrukturen (10) ausgelegt und mit Vorrichtungen (7) zum Einblasen von Granulat versehen sind oder dass das Granulat in sackartige Vorrichtungen gepackt ist, die direkt in die Abschirmelemente (10) eingesetzt sind, wobei das Granulat hygroskopisch und in einen wasserlöslichen Film verpackt ist.

2. Design einer schalldämmenden Schutzwand nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kasette (10) mit einer internen Versteifung (8) entworfen und mit Löchern oder einem Einlass für Granulat zu dessen Verteilung beim Einblasen konfiguriert ist.

3. Design einer schalldämmenden Schutzwand nach einem der Ansprüche 1 bis 2, **dadurch gekennzeichnet, dass** das Granulat hygroskopisch ist.

4. Design einer schalldämmenden Schutzwand nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** es weiterhin einen Wassersammler oder ein Bewässerungssystem für fortlaufende oder periodische Befeuchtung des Granulats umfasst.

5. Design einer schalldämmenden Schutzwand nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** es eine Mehrzahl von Kassetten umfasst, wobei die Kassetten (10) mit Kanalanschlüssen konfiguriert sind, die so ausgelegt sind, dass das Granulat in eine Kasette (10) eingeblasen und über mindestens einen Kanalanschluss in eine andere Kasette weiterverteilt werden kann, nachdem die Kassetten (10) eingebaut worden sind.

6. Design einer schalldämmenden Schutzwand nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kassetten mit einer Luke, einem Auslass oder einer entsprechenden Öffnungsvorrichtung zum Entleeren des Granulats aus der Kasette entworfen sind.

7. Design einer schalldämmenden Schutzwand nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kassetten mit einer Luke, einem Einlass oder einer entsprechenden Öffnungsvorrichtung zum Füllen des Granulats in die Kasette entworfen sind.

8. Verfahren zur Herstellung einer schalldämmenden Wand, bestehend aus:

- Bereitstellung von Stützen oder Pfeilern, die in einer Basis wie etwa dem Erdboden verankert sind;
- Bereitstellung von Abschirmelementen (10), vorzugsweise kastenförmig, zwischen den Stützen oder Pfeilern;

dadurch gekennzeichnet, dass es weiterhin den folgenden Schritt umfasst:

- Einblasen von Granulat in die vorzugsweise kastenförmigen Abschirmelemente (10), wobei das Granulat aus wiederverwerteten Glasfasern besteht, oder

Packen des Granulats in Sackvorrichtungen und Einsetzen der gefüllten Sackvorrichtungen direkt in die Abschirmelemente (10), wobei das Granulat hygroskopisch und in einem Sackmaterial verpackt ist, das aus einem wasserlöslichen Film gefertigt ist.

Revendications

1. Conception de barrière acoustique du type comprenant des supports ou piliers verticaux, conçus pour s'ancrer dans le sol, et dans laquelle, fixés entre lesdits supports ou piliers, on trouve des éléments de blindage (10) allongés s'étendant principalement horizontalement, consistant en une ou plusieurs plaques (4) et une ou plusieurs couches de granules absorbant le son (9), dans laquelle les granules utilisées sont basées sur de la fibre de verre recyclée, **caractérisée en ce que** les éléments de blindage (10) sont conçus comme des structures en cassette assemblées (10) et équipés d'un moyen (7) de soufflage de granules ou **en ce que** les granules sont conditionnées dans un sac qui est directement placé dans les éléments de blindage (10), dans lequel les granules sont hygroskopiques et conditionnées dans un matériau de sac constitué d'un film soluble dans l'eau.
2. Conception de barrière acoustique selon la revendication 1, **caractérisée en ce que** la cassette (10) est conçue avec un raidisseur interne (8) et conçue avec des orifices ou un accès pour la distribution des granules au cours du soufflage.
3. Conception de barrière acoustique selon l'une quelconque des revendications 1 à 2, **caractérisée en ce que** les granules sont hygroskopiques.
4. Conception de barrière acoustique selon l'une quelconque des revendications 1 à 3, **caractérisée en ce qu'elle** comprend en outre un collecteur d'eau ou un système d'irrigation pour l'humidification continue ou périodique des granules.

5. Conception de barrière acoustique selon l'une quelconque des revendications 1 à 4, **caractérisée en ce qu'elle** comprend une pluralité de cassettes, où les cassettes (10) sont conçues avec des branchements de canal qui sont conçus de sorte que les granules peuvent être soufflées dans une cassette (10) et distribuées dans une autre cassette via au moins un branchement de canal et après que les cassettes (10) ont été montées.

6. Conception de barrière acoustique selon la revendication 1, **caractérisée en ce que** les cassettes sont conçues avec une trappe, une porte, ou un moyen de sortie correspondant pour vider les granules de la cassette.

7. Conception de barrière acoustique selon la revendication 1, **caractérisée en ce que** les cassettes sont conçues avec une trappe, une porte, ou un moyen de sortie correspondant pour remplir la cassette avec les granules.

8. Procédé de réalisation d'une barrière acoustique, consistant à :

- prévoir des supports ou piliers ancrés dans une base telle que le sol ;
- prévoir des éléments de blindage (10), de préférence en forme de boîte, entre les supports ou piliers ;

caractérisé en ce qu'il comprend en outre l'étape de

- soufflage des granules dans les éléments de blindage (10) de préférence en forme de boîte, les granules étant de la fibre de verre recyclée, ou

le conditionnement des granules dans un sac et placement dudit sac rempli directement dans les éléments de blindage (10), dans lequel les granules sont hygroskopiques et conditionnées dans un matériau de sac constitué d'un film soluble dans l'eau.

Fig 4

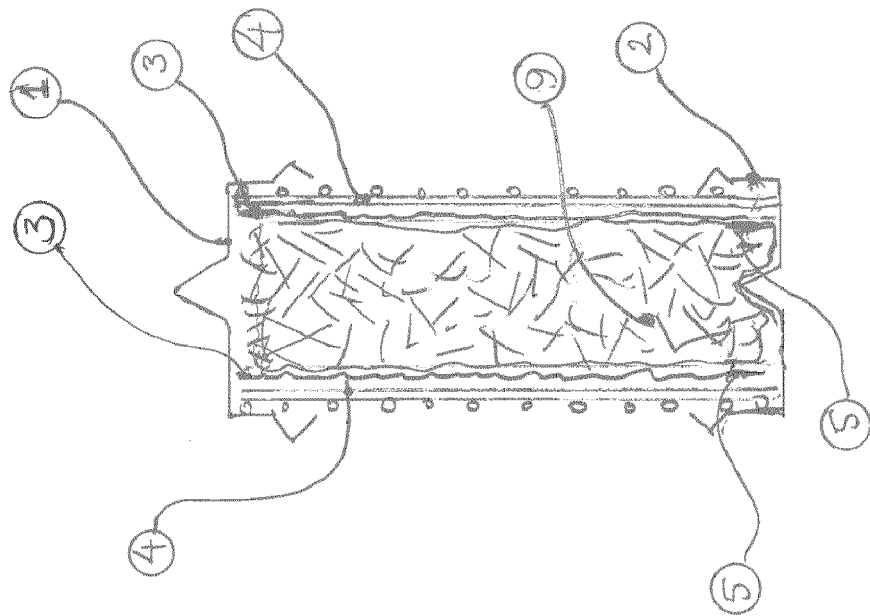


Fig 2

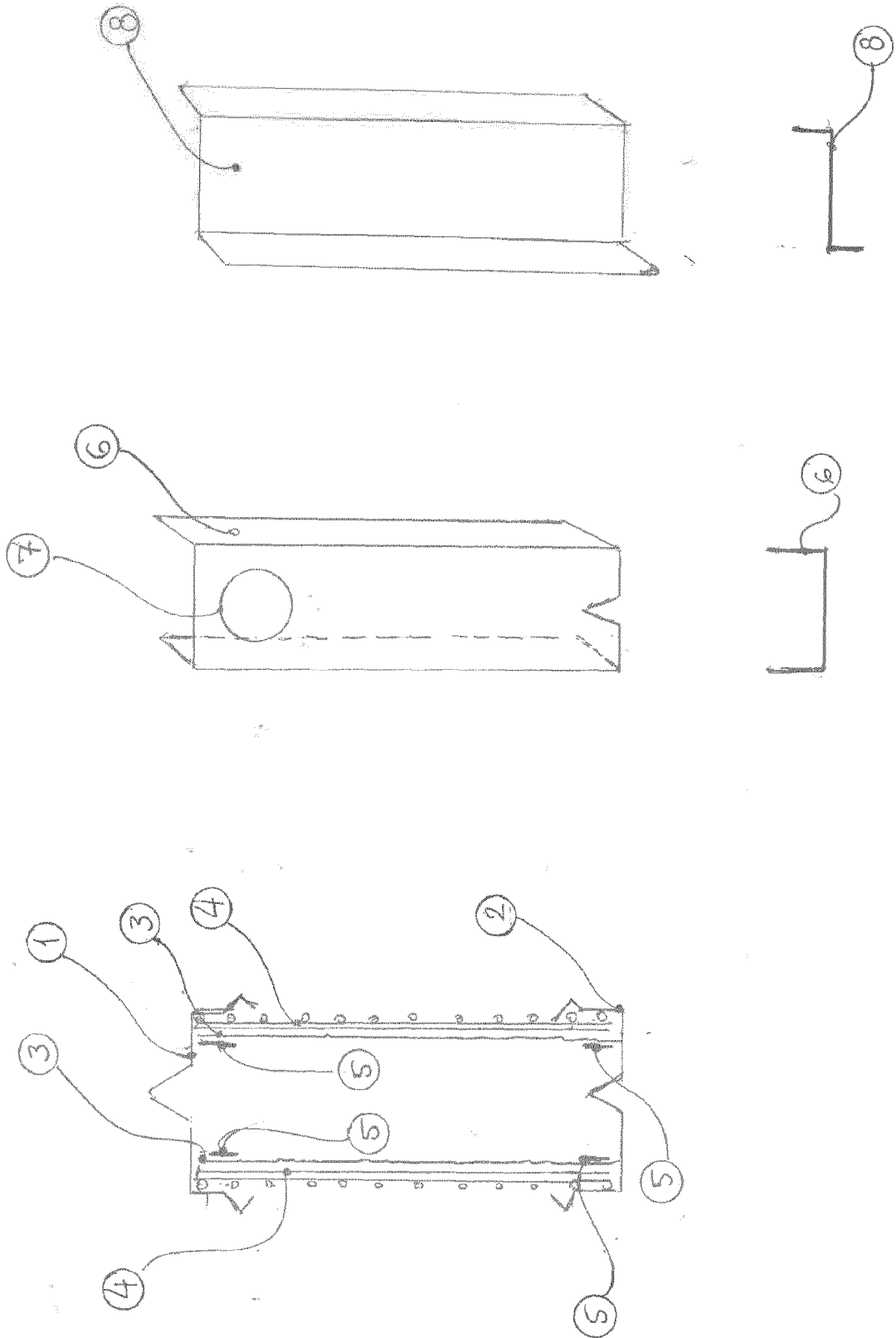


Fig 3

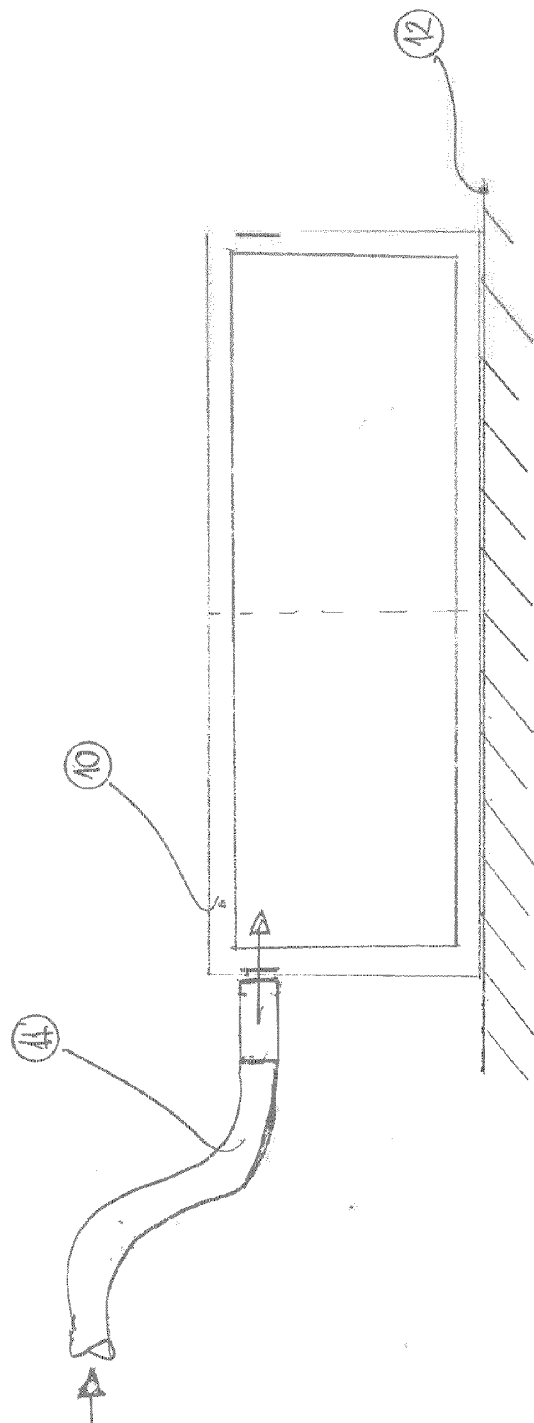


Fig 4

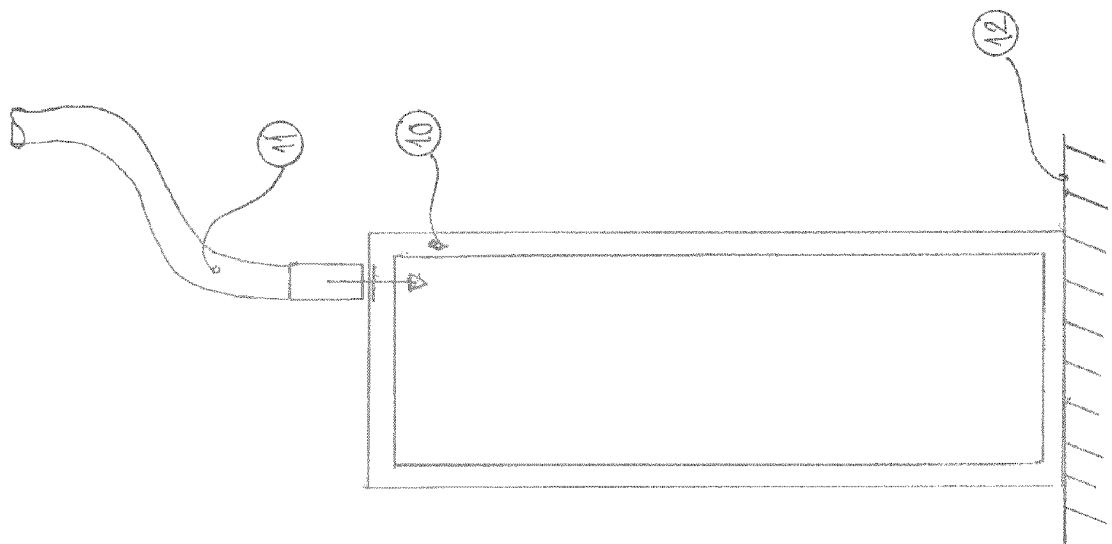
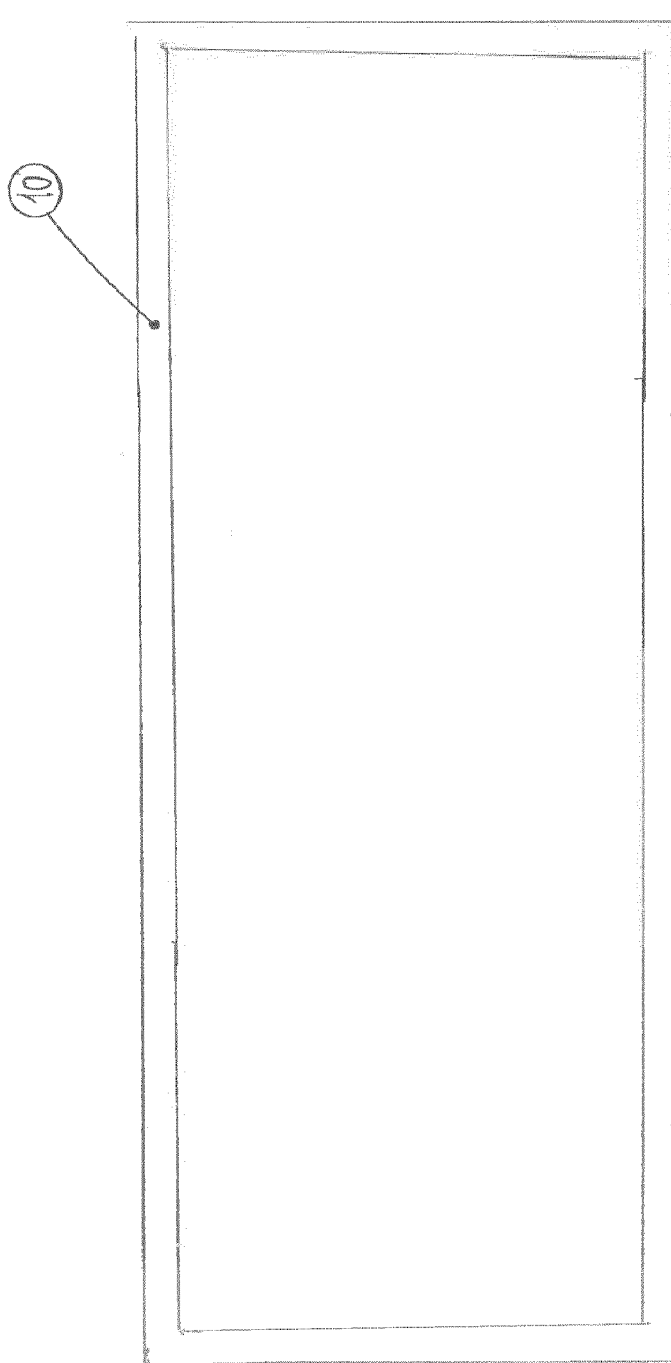


Fig 5



REFERENCES CITED IN THE DESCRIPTION

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