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(71) Applicant: **Aarrekorpi, Aapo**
25340 Kanunki (FI)

(72) Inventor: **Aarrekorpi, Aapo**
25340 Kanunki (FI)

(74) Representative: **Nordin, Leif Göran**
Turun Patenttitoimisto Oy,
P.O. Box 99
20521 Turku (FI)

(54) Method for fastening rubber plates, use of the method, blasting mat and uses thereof

(57) The invention relates to a method for fastening rubber plates, use of the method in manufacturing blasting mats, blasting mat and uses thereof. In the method for fastening rubber plates

- at least two rubber plates (41,42) are placed on top of each other,
- a fastening device (71) is arranged through the rubber plates (41,42) so that part of the fastening device (71) is left on both sides (55,56) of the rubber plates (41,42),
- the rubber plates (41,42) are fastened to each other by attaching the fastening device (71) in connection with the rubber plates (41,42),
- a first wire fastening means (81) is arranged in connection with a first end (171) of the fastening device (71) that is left on a first side (55) of the rubber plates (41,42),
- a bonding wire (57) is attached to the first wire fastening means (81).

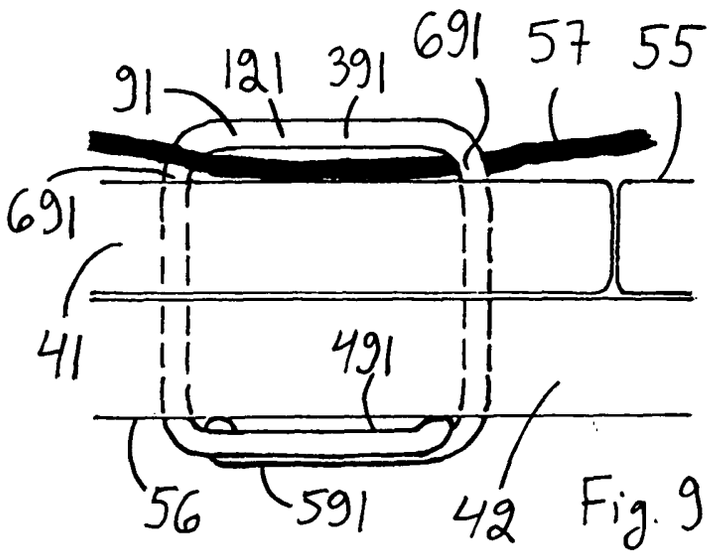

Fig. 9

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a method according to the preamble of the independent claims described further below for attaching rubber plates, use of the method in manufacturing blasting mats, a blasting mat and uses thereof.

PRIOR ART

[0002] Rubber plates are fastened to each other by means of a wire, for example when manufacturing blasting mats. Used tires, for example, are used as raw material for the rubber plates. Holes are made in suitable places in the rubber plates, and they are fastened to each other by manually pulling a wire through the holes alternately from one side of the rubber plate to another. Length of the wire depends on the amount of the rubber plates to be fastened. If it is desired to form a mat that is 5 meters long by fastening together rubber plates made of tires, a wire of about 7 meters is normally on average needed. The wire used for fastening the rubber plates is relatively thick, whereby threading it into the holes in the rubber plates and manually pulling it through them is hard and inconvenient.

[0003] Blasting mats are used to cover a blasting site after a blasting charge has been set. This way the generated blast wave can be dampened and safety of the workers and environment can be secured. The blasting mats that are in use are heavy, typically they weigh around 1000 kg. Moving and placing this kind of mats upon the blasting site is difficult. A mat having rubber plates that are fastened to each other in a conventional manner as described above, stretches easily when lifted up or pulled. The mat is twisted and stretches when it is moved, and thus, the fastening wire easily tears the rubber plates. Therefore, fastening of the blasting mats manufactured in a conventional manner does not sufficiently support the structure of the mat. Furthermore, current blasting mats also stretch when they are pulled, whereby gaps may be formed between the rubber plates causing dangerous situations.

[0004] However, usually a blasting mat is pulled over the blasting site. Blasting charges are placed on the blasting site before the mat is placed over the blasting site. Thus, a problem arises that when pulling the mat over the charged area, the mat easily cuts blasting cables travelling from one charge to another. Therefore, all blasting charges do not explode as planned in advance. Normally connections of the blasting charges can be manually checked with an ohmmeter. In certain types of connections, however, this is not possible, which causes remarkable dangerous situations, in case placing of the blasting mat has cut blasting cables.

THE AIM OF THE INVENTION AND DESCRIPTION OF SOME EMBODIMENTS

[0005] The object of the present invention is to achieve such an arrangement and a method, by means of which the problems and drawbacks occurring in the prior art are minimised or even totally eliminated.

[0006] The invention relates to a method by means of which fastening of rubber plates to each other is easier.

[0007] The invention also relates to the use of the method in manufacturing of the blasting mats, whereby manufacturing of the blasting mats is lighter and simpler.

[0008] The invention further relates to a blasting mat that does not tear up as easily as the existing mats when it is moved and placed in its position, and which is easier to move than the existing mats.

[0009] The invention also relates to using of mats made of rubber plates for new purposes, such as for road construction material and vehicle driving cover.

[0010] In order to realise the above mentioned objects, among others, the invention is characterised by what is presented in the characterising parts of the enclosed independent claims.

[0011] The embodiments and advantages mentioned in this text relate both to the methods, mat as well as to the uses according to the invention, even though it is not always specifically mentioned.

[0012] A typical method according to the invention for fastening rubber plates to each other comprises the following steps:

- at least two rubber plates are placed on top of each other,
- a fastening device is arranged through the rubber plates so that part of the fastening device is left on both sides of the rubber plates,
- the rubber plates are fastened to each other by attaching the fastening device in connection with the rubber plates,
- a first wire fastening means is arranged in connection with a first end of the fastening device that is left on a first side of the rubber plates,
- a bonding wire is attached to the first wire fastening means.

[0013] Typically, the method according to the invention for fastening the rubber plates to each other is used in manufacturing of the blasting mats.

[0014] A typical blasting mat according to the invention comprises

- a first and a second side, as well as outer edges limiting the mat,
- rubber plates,
- fastening devices, which are arranged through the rubber plates and by means of which the rubber plates are fastened to each other,
- wire fastening means that have been arranged on

the first side of the mat, in connection with the fastening devices, and

- a bonding wire that is attached to the wire fastening means.

[0015] In this application, the term rubber plate refers to plates that are made of heavy, elastic and flexible material and that are mainly rectangular or quadrangle in form. Rubber plates that are suitable for the invention are old tires that are cut open or used rubber conveyor belts, for example. Rubber plates that are well suited for the invention can also be made of plastic. The rubber plate that normally is suited for the invention weighs about 80 kg/m^2 or even more. Cross-section of the rubber plates in the lateral direction of the plates may be straight or it may be slightly curved on its edges.

[0016] In an embodiment of the invention a fastening device, which is arranged through the rubber plates, is a pin. In this text, the term pin means a substantially straight and elongated piece. Typically, the pin is made of metal or an alloy, such as steel, iron, aluminium. Length of the pin to be pushed through the rubber plates is typically in pushing direction about 80-200 mm, preferably about 100-150 mm. Thickness of the pin is typically about 8-15 mm, preferably about 10-12 mm. The pin is rigid, but it can be bent so that it keeps the bent form.

[0017] In an embodiment according to the invention the pin comprises at least two arms which are pushed through the rubber plates. According to an embodiment of the invention the two-armed pin is substantially U-shaped so that it comprises a base and two arms, the arms being substantially in parallel in relation to each other. Points of the arms are preferably sharp in order to easier press them through the rubber plate. According to another embodiment of the invention, the two-armed pin is substantially V-shaped in form. According to an embodiment of the invention, the two-armed pin is substantially J-shaped in form so that a first arm is long and a second arm is substantially shorter than the first arm, less than half of the length of the longer arm, for example.

[0018] The wire fastening means is a means in connection with which or through which a bonding wire can be arranged to travel. In an embodiment of the invention, the wire fastening means is formed by bending the end of the pin towards the rubber plate. The wire can be arranged to travel between the bent end of the pin and the rubber plate. If a straight pin is used, the wire fastening means can be arranged on both sides of the rubber plates by bending the first and the second end of the straight pin towards the rubber plates. When using a two-armed pin, for example U-shaped, V-shaped or J-shaped, the first wire fastening means is typically formed automatically in connection with the base of the pin, on the first side of the rubber plates at the same time as the arms of the pin are pressed through the rubber plates. The second wire fastening means can be formed on the second side of the rubber plates by bending the second ends of the arms towards the rubber plates. Of course, it is possible to arrange wire fastening means that are separate from the fastening devices to the mat according to the invention, by bolting metal loops on the rubber mat, for example.

[0019] In an embodiment according to the invention the pin is attached in connection with the rubber plates by bending at least one end of the pin towards the rubber plates. The pins can be attached in connection with the rubber plates also by means of bolts or the like fastening means.

[0020] In an embodiment according to the invention the end of the pin or the arm is bent substantially at least 90 degrees. The pin can be bent even more. Thus, it is possible to have the bent end of the pin to be pushed efficiently inside the rubber plate.

[0021] In an embodiment according to the invention the first end of the pin is bent so that the bent end forms the first wire fastening means on the first side of the rubber plates. In an embodiment according to the invention the second end of the pin is bent so that the bent end forms the second wire fastening means on the second side of the rubber plates. The pin can have a wire fastening means, for example a loop, already prior to the manufacturing according to the method of the invention.

[0022] In an embodiment according to the invention the pin is attached in connection with the rubber plates by bending towards the rubber plates both the first end of the pin that is left on the first side of the rubber plates as well as the second end of the pin that is left on the second side of the rubber plates.

[0023] In an embodiment according to the invention there are at least two fastening devices, such as pins, and wire fastening means, and the bonding wire is arranged in connection with at least two first wire fastening means. Typically, at least two fastening devices have been arranged through one rubber plate. In an embodiment, the arms of one two-armed pin do not penetrate the adjacent rubber plates, but they penetrate two or more superposed rubber plates. When both arms of one pin have been arranged through laterally one and the same rubber plate, the bonding will be highly durable and the seam between the rubber plates remains very tight.

[0024] In an embodiment according to the invention, there are at least two adjacent rubber plates and the superposed rubber plates are arranged at least partly interlocked in relation to each other.

[0025] In an embodiment according to the invention, the second bonding wire is fastened on the second side of the rubber plate to the second wire fastening means. By means of the second bonding wire, the finished mats will be more durable and moving of the mats will be facilitated.

[0026] In an embodiment according to the invention, reinforcement plates are arranged at least on one side of the rubber plates, between the rubber plate surface

and the wire fastening means. The reinforcement plate distributes the load directed at the rubber mat by the wire fastening means or the fastening device, such as a pin or a fastening wire, on a wider area. Thus, by means of the reinforcement plate it is possible to prevent the wire fastening means or the fastening device, such as a pin or a fastening wire, from sticking too much to the rubber plate. The reinforcement plates can be for example plates, shims or the like made of metal or plastic.

[0027] In an embodiment of the invention a fastening device, which is pushed through the rubber plates, is a wire, i.e. a fastening wire. The fastening wire can be thread through the rubber plates so that a loop formed of the wire is always left on one side of the rubber plates, which loop is used as the first wire fastening means.

[0028] An embodiment of the invention comprises a method for fastening rubber plates to each other comprising the following steps:

a) a gripping means is pushed through a first hole in a rubber plate from a first side of the hole to a second side, and a first point of a first wire is gripped by the gripping means,

b) the gripping means and the first wire that is in connection to it are pulled through said first hole from the second side of the hole to its first side, whereby a first wire loop is formed on the first side of the hole.

c) a second wire is thread through the formed first wire loop,

d) the gripping means is pushed through a second hole in a rubber plate from the first side of the hole to the second side, and a second point of the first wire is gripped by said gripping means, and

e) the gripping means and the first wire that is in connection to it are pulled through said second hole from the second side of the hole to the first side, whereby a second wire loop is formed on the first side of the hole, at the same time when the first wire loop tightens around the second wire.

[0029] A blasting mat according to the invention comprises

- a first and a second side, as well as outer edges limiting the mat,
- rubber plates with holes,
- a fastening wire, which is thread through the holes, and by means of which the rubber plates are fastened to each other. According to the invention, the fastening wire is thread through the holes so that loops are formed on the first side of the blasting mat, and that the blasting mat comprises also a bonding wire that is arranged to travel through said loops.

[0030] Surprisingly, it has now been discovered, that the rubber plates can be firmly fastened to each other by pulling the first wire, a so-called fastening wire, with the gripping means through a hole in the rubber plate, whereby a loop can be formed on the first side of the rubber plate, through which the second wire, a so-called bond wire can be threaded. When this stage is repeated at the next hole, pulling of the fastening wire through the hole tightens the first loop around the bond wire. By repeating the work phases as many times as needed, a sufficient amount of rubber plates can be fastened to each other in a remarkably easier and lighter manner compared with what is described in the prior art.

[0031] By using the manner according to the invention for fastening the rubber plates to each other, the rubber plate structure obtained is considerably strong. Using the method according to the invention, by repeating its work phases, a fastening joint i.e. a row of pin fastenings or a fastening stitch, which fastens the rubber plates to each other, is achieved. The fastening joint supports the structure, for example a blasting mat, which is formed when a suitable amount of rubber plates is fastened to each other. In case the rubber plates are thin, a sufficient amount of them is fastened on top of each other.

[0032] Typically, the gripping means used in the method according to the invention may be a hook or the like suitable for the purpose.

[0033] In an embodiment according to the invention, holes are made in the rubber plates by pressing through, for example with an eccentric press. In thin rubber plates, it is also possible to make holes by boring.

[0034] In a preferred embodiment of the present invention, the first and/or the second hole, through which the gripping means is pushed, and through which the first wire is threaded, comprises several holes in different rubber plates. In other words, a second side of the first rubber plate and a first side of the second rubber plate are placed against each other, and the gripping means is pushed through the holes in the first and the second rubber plate at a single push. This way the rubber plates can be fastened into formations that comprise several rubber plate layers, and/or in which the rubber plates are arranged at least partly interlocked in relation to each other.

[0035] Another embodiment of the present invention further comprises a step in which the end or ends of one or several bonding wires and the end or ends of a possible fastening wire are fastened to each other with the fastening means on an outer edge of the mat formed of rubber plates, whereby a loop is formed on the outer edge of the mat. The used fastening means can be, for example, a shackle, a cable head or the like fastening means suitable for the purpose. The fastening means can also be made by pressing an aluminium sleeve onto the wire, thereby forming a loop on an outer edge of the mat. The loop is preferably formed so that all possible first and second wires are fastened to each other on that outer edge of the mat that is located at a right angle in relation to the direction of the fastening joint.

[0036] Fastening of the rubber plates according to

manner of the invention can preferably be used in manufacturing blasting mats. Using the method according to the invention, blasting mats of suitable length can easily be produced by fastening a sufficient amount of rubber plates to each other. Preferably blasting mats comprise two or more layers of adjacent rubber plates placed on top of each other. The rubber plates are arranged interlocked on different layers so that the seams between two adjacent rubber plates do not meet.

[0037] The wire that is used in the method according to the present invention, can be any wire, steel rope or the like that meets the requirements of the final purpose. Using the method according to the invention in manufacturing the blasting mats, the fastening wire is preferably made of steel, and its thickness is about 10-15 mm, preferably 12 mm. The fastening wire can be thinner than the bonding wire and slightly elastic. Respectively, the bonding wire is preferably made of steel, and its thickness is about 14-20 mm. Normally, tensile strength of the bonding wire varies between 12500-25500 kg tension.

[0038] When moving, the blasting mat according to the invention can be displaced by pulling at the bonding wire. Thus, all the pulling force is directed at the bonding wire. As the bonding wire does not stretch, the mat keeps its form when moved. The bonding wire according to the invention also distributes the load directed at it with several wire fastening devices. Preferably, there are wire fastening devices on the entire length of the finished mat. This makes it possible, that the service life of the mats will be significantly prolonged, and that the same mat can be used again and again.

[0039] Preferably, the rubber plates can be made of used tires. Particularly preferably, the rubber plates can be made of used truck tires. The metal weave in the tires increases the strength of the rubber plates. When manufacturing rubber plates of tires, the sides of the tire are cut off, and the tire is cut open. Unless separate cutting procedures are not performed after this, the circumference of the original tire will correspond to approximately one overall dimension of a blasting mat, that is to the length of one edge of the blasting mat.

[0040] In an advantageous embodiment of the invention, bearing means, such as steel loops, are attached to the rubber plates that are fastened to each other and that are used as a blasting mat. With the bearing means, the blasting mat can be moved simply and easily, for example by attaching a separate wire arrangement provided with hooks, or the like to the bearing means. The wire arrangement or the like can thus be lifted and moved with any working machine suitable for the purpose, such as an excavator. The bearing means can be a wire shackle, a chain loop or any other loop suitable for the purpose. Preferably, the fastening means is attached in the mat at a point where two wires form the weave according to the invention. Thus, the fastening means is attached to the mat more firmly and it holds better when moving the mat. Typically, the bearing means are attached to the blasting mat on its first or second side. Typically, at least five bearing means are placed on the mat, preferably one close to each corner and one in the middle area of the mat. This way the blasting mat can be lifted and moved, and further laid down at a desired place mainly straight and precisely. Thereby, such blasting mat does not scrub the ground or the blasting cables or the like placed on the ground.

[0041] Mats made according to the invention, or other mats made of used tires, especially mats made of elongated rubber plates formed of used tires, can also be used for other purposes than as blasting mats. Recycling of tires is advantageous for the environment.

[0042] As a vehicle driving cover, that is for reducing the stress and wearing caused by a vehicle, by means of the rubber plates it is possible to protect grass, pavement, asphalt on the roads, floors in buildings or the like surfaces, for example. A vehicle refers for example to trucks, excavators, working machines, tanks or the like heavy vehicles.

[0043] Mats made according to the invention or other mats made of used tires can be used as road construction material. Rubber mats cushion vibration caused by traffic and support possible soft soil. Rubber mats that are used as road construction material are placed at the road construction stage for example at a depth of 50-100 cm from the road surface.

[0044] Mats made according to the invention or other mats made of used tires can be used in the foundation engineering of buildings, for example in residential buildings, for cushioning the vibration caused by traffic or earthquake.

[0045] Elongated rubber plates can also be used for manufacturing mats without special bonding wires by fastening the rubber plates to each other by simply using the pins according to the invention.

BRIEF DESCRIPTION OF THE FIGURES

[0046] The invention is described in the following exemplary figures, in which

- Fig. 1 shows a manner according to the invention for fastening rubber plates to each other at the first stage, as seen from the side,
- Fig. 2 shows a manner according to the invention for fastening rubber plates to each other at the second stage, as seen from the side,
- Fig. 3 shows a manner according to the invention for fastening rubber plates to each other at the third stage, as seen from the side,
- Fig. 4 shows another manner according to the invention for fastening rubber plates to each other at the first stage, as seen from the side,
- Fig. 5 shows another manner according to the invention for fastening rubber plates to each other at the second stage, as seen from the side,

Fig. 6 shows another manner according to the invention for fastening rubber plates to each other at the third stage, as seen from the side,

Fig. 7 shows a fastening device according to the invention, as seen from the side,

Fig. 8 shows another fastening device according to the invention, as seen from the side,

Fig. 9 shows a manner according to the invention for fastening rubber plates to each other, as seen from the side,

Fig. 10 shows a second manner according to the invention for fastening rubber plates to each other, as seen from the side,

Fig. 11 shows a third manner according to the invention for fastening rubber plates to each other, as seen from the side,

Fig. 12 shows a manner of prior art for fastening rubber plates to each other, as seen from the side,

Fig. 13a shows a manner according to the invention for fastening rubber plates to each other, as seen from the side,

Fig. 13b shows a second manner according to the invention for fastening rubber plates to each other, as seen from the side,

Fig. 13c shows a third manner according to the invention for fastening rubber plates to each other, as seen from the side,

Fig. 14 shows a blasting mat according to the invention as seen from the top, and

Fig. 15 shows a detail in a second blasting mat according to the invention, seen from the side.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE FIGURES

[0047] For the sake of clarity, some of the corresponding parts of different embodiments have the same reference numerals.

[0048] Figure 1 shows the rubber plates 41, 42, 43 that are arranged in two layers 51, 52 interlocked in relation to each other, so that the seams 61, 62 between adjacent rubber plates do not meet on the superposed layers. The figure also shows straight pins 71 for attaching rubber plates to each other.

[0049] In Figure 2, the straight pins 71 are pushed through the rubber plates 41, 42, 43. Each pin 71 is pushed through two superposed rubber plates 41, 42, 43 so that the first ends 171 of the pins are left on the first side 55 of the rubber plates and the second ends 271 of the pins are on the second side 56 of the rubber plates.

[0050] In Figure 3 the pins are attached on the rubber plates so that the first ends 171 and the second ends 271 of the pins are bent towards the rubber plates 41, 42, 43. The first ends 171 of the pins are bent towards the rubber plates 41, 43 so that the bent ends of the pins form the first wire fastening means 81. The first wire 57 is arranged to travel between the first wire fastening means 81 and the rubber plates 41, 43. Also the second ends 271 of the pins are bent towards the rubber plates 42 so that the pins hold the superposed rubber plates 41, 42, 43 tightly together.

[0051] Figure 4 shows U-shaped pins 91, which have two substantially parallel arms 191, 291 attached to a pin base 391.

[0052] In Figure 5, the U-shaped pins 91 are pushed through the rubber plates 41, 42, 43 so that pin bases 391 are left on the first side 55 of the rubber plates and form the first wire fastening means 121. The first wire 57 is arranged to travel between the first wire fastening means 121 and the rubber plates 41, 43. The ends 491, 591 of the pin arms are on the second side 56 of the rubber plates.

[0053] In the situation of the Figure 6, the originally U-shaped pins 91 have been formed into loops by bending. The U-shaped pins 91 are attached to the rubber plates so that ends 491, 591 of the pin arms that are located on the second side 56 of the rubber plates are bent towards the rubber plates 42. The first wire 57 is arranged to travel on the first side 55 of the rubber plates between the rubber plates 41, 43 and the first wire fastening means 121 formed by the bases 391 of the U-shaped pins.

[0054] Figure 7 shows a U-shaped pin 91, which is typically used for fastening two or more superposed rubber plates to each other. The U-shaped pin comprises a base 391 and two arms 191, 291 which arms are substantially parallel in relation to each other. The ends 491, 591 of the arms are typically sharp on their points, so that they will be easier pushed through a rubber plate.

[0055] Figure 8 shows a J-formed pin 93 for fastening rubber plates to each other. The J-shaped pin comprises a base 393 and two arms 193, 293 substantially in parallel to each other, the first arm 193 of which is long and the second arm 293 is substantially shorter than the first arm. Typically, the length of the shorter arm 293 is 10-50% or 20-40 % of the length of the longer arm 193. Two or more superposed rubber plates are fastened to each other by means of the J-shaped pin so that the first, i.e. the longer arm 193, is pushed through the rubber plates so that the end 493 of the arm extends to the second side of the rubber plates. The second, i.e. the shorter arm 293 is pushed inside the rubber plates only partly, but it is so short that it does not extend to the second side of the rubber plates. The first 193 and the second 293 arm as well as the base 393 of the pin form the wire fastening means on the first side of the rubber plates, when the J-shaped pin is used for fastening two or more superposed rubber plates to each other.

[0056] In Figure 9 two superposed rubber plates 41, 42 are fastened to each other by means of the pin 91 that was U-shaped prior to the bending of the arms. The base 391 of the pin and the bases 691 of the arms form the wire fastening means 121 on the first side 55 of the

rubber plates. The first wire 57 is arranged on the first side 55 of the rubber plates, between the wire fastening means 121 and the rubber plate 41. On the second side 56 of the rubber plates, the ends of the arms 491, 591 of the originally U-shaped pin 91 are attached to the rubber plate 42 by bending them towards the rubber plate.

[0057] In Figure 10, two wires 57, 58 are arranged in connection with the originally U-shaped pin 91, which is fastened to the rubber plates 41, 42. The first wire 57 is arranged on the first side 55 of the rubber plates and the second wire 58 is arranged on the second side 56 of the rubber plates. On the second side of the rubber plates, the ends of the arms 491, 591 of the U-shaped pin are bent towards the rubber plate 42 so that they form the second wire fastening means 122, in connection with which the second wire 58 is arranged.

[0058] Figure 11 shows in more detail the fastening of the rubber plates to each other by means of pins according to Figure 3 described above, which pin has been substantially straight when pushed through the rubber plates 41, 42. In the situation shown in the Figure, the ends of the pin 171, 271 on the both sides 55, 56 of the rubber plates are bent towards the rubber plates 41, 42. The first wire 57 is arranged in connection with the first wire fastening means 81 that is formed when bending the first end 171 of the pin.

[0059] The wire fastening means formed by the pin shown in Figures 3, 6, 9, 10 and 11 are shown in a non-tightened state, for the sake of clarity. In practise, the shown wire fastening means could be tightened tightly towards the rubber plate and an eventual bonding wire.

[0060] Figure 12 shows a manner of prior art for fastening rubber plates to each other as seen from the side. Rubber plates 1, 2, 3, 4 have holes 1', 2', 3', 4' through which the wire 101 is alternately thread from the first side 5 of the rubber plates to the second side 6.

[0061] Figure 13a shows a manner according to the invention for fastening rubber plates to each other as seen from the side. Rubber plates 1, 2, 3, 4 have holes 1', 2', 3', 4' through which the first wire 7 is pulled from the first side 5 of the plates to the second side 6 of the plate. Thus, the first wire 7 forms a group of loops 11, 12, 13, 14 on the second side 6 of the rubber plates. The second wire 8 is led through these loops 11, 12, 13, 14. In practise, every bond, that is the second wire that is led through the loop formed by the first wire, is preferably formed one at a time. In this case, the first wire 7 is first pulled through the hole 1' in the rubber plate 1, whereby on the second side 6 of the rubber plate 1, at the hole1', a loop 11 is formed through which the second wire 8 is led. After this, the first wire 7 is pulled through the hole 2' in the next rubber plate 2, whereby on the second side 6 of the rubber plate 2, at the hole 2', a loop 12 is formed. At the same time that the loop 12 is formed of the first wire 7, the previous loop 11 tightens around the second wire 8, and thus a firm bond is formed. The loops 11, 12, 13, 14 formed by the first wire 7 are shown in a non-tightened state in Figure 13a, for the sake of clarity. In practise, all bonds shown in the figure, however, would be firm and tightened.

[0062] Figure 13b shows another manner according to the invention for fastening rubber plates to each other as seen from the side. The rubber plates 1, 2, 3, 4 are placed partly on top of each other, whereby the plates 1, 2, 3, 4 can be fastened to each other so that open seams are not created between the adjacent plates 1, 2, 3, 4. Otherwise the plates of the figure 13b are fastened in the same manner as described in figure 13a. The bonds are shown in a non-tightened state also in Figure 13b, for the sake of clarity.

[0063] Figure 13c shows a third manner according to the invention for fastening rubber plates to each other as seen from the side. The rubber plates 1, 2, 3, 4 are placed on top of each other in two layers 21, 22. The plates 1, 2, 3, 4 are arranged interlocked on top of each other, so that the seams between adjacent rubber plates do not meet on the superposed layers. The first wire 7 is first pulled through the holes 1', 2' in the first and second rubber plates 1, 2, from the second side 6 of the first plate 1 to the first side 5 of the second plate 2, whereby on the first side 5 of the second rubber plate 2, a loop 11 is formed through which the second wire 8 is led. After this, the first wire 7 is pulled through the hole 3' of the third rubber plate 3 that is arranged after the first rubber plate 1 and through the second 2" hole of the second plate 2, thereby forming a loop 11 on the first side 5 of the rubber plate 2. At the same time as the loop 11' is formed of the first wire 7, the previous loop 11 tightens around the second wire 8, and a firm bond is formed. The loops 11, 11' formed by the first wire 7 are shown in a non-tightened state in Figure 13c, for the sake of clarity. In practise, all bonds shown in the figure, however, would be firm, i.e. tightened.

[0064] In figure 13c, the holes through which the first wire is pulled are formed of two superposed holes located in different rubber plates. This way rubber plates can be fastened to each other so that they are arranged on top of each other in two layers so that the seams of the plates do not get superposed. The hole, through which the wire is pulled, can also be formed of more than two superposed holes. This way rubber plates can be connected on top of each other in more than two layers.

[0065] Figure 14 shows a blasting mat according to the invention as seen from the top. The blasting mat 31 comprises a group of rubber plates 32, 34 that are fastened to each other by means of the bonds made with the method according to the invention. Preferably the rubber plates 32, 34 are fastened to each other in two layers in a manner shown in figure 13c. The bonds are shown in the figure as dots 301, 302, 303, 304. In the mat shown in figure 14, a continuous row of stitches 311, 312 is made of separate bonds according to the invention. Continuous second wire is used in adjacent rows of stitches 311, 312 but it is also possible to form the adjacent rows of stitches 311, 312 by using separate second wires on each row and by connecting these sec-

ond wires to each other on the outer edge of the mat. This way it is possible to make loops 315, 316 on the edges of the mat in order to facilitate moving of the mat. Normally, the mat has preferably at least six fastening joints, i.e. rows of bond stitches or rows of pin fastenings. Also bearing means 35, 36, 37, 38, 39 are attached to the blasting mat to facilitate moving of the mat. The bearing means 35, 36, 37, 38, 39 can be, for example, steel loops that are attached to the blasting mat by bolting through the mat.

[0066] The blasting mat is easy to lay down precisely to the desired place and desired position when lifting it by the bearing means 35, 36, 37, 38, 39 according to the invention. In a prior art solution, when blasting a 2,5 meters wide canal, for example, typical mats that are manufactured with prior art methods, that are movable by pulling from the shorter end and are 3 x 5 meters in size, are placed transversely across the canal. This way, about 2,5 meters can be proceeded with one mat. The mats according to the invention are easy to place lengthwise on the canal, whereby 4,5 meters can be proceeded with one mat. Bearing means according to the invention can also be used in another manner than that according to the invention in the blasting mats bound together.

[0067] Figure 15 shows a detail in another blasting mat 31 according to the invention, as seen from the side. The blasting mat 31 is formed by the rubber plates 1, 2, 3, 4 that are arranged on top of each other in two layers 21, 22 and fastened to each other in the manner described in figure 13c. On the outer edge of the rubber plates 2, 4, in this case on the long side of the rubber plates, a loop 41 is formed by connecting the first 7 and the second wire 8 with a fastening means 42. The loop 41 facilitates moving of the mat, and makes it possible to better place it upon the blasting site.

[0068] It is apparent to the man skilled in the art that the invention is not limited exclusively to the examples described above, but that the invention can vary within the frames of the claims presented below.

Claims

1. Method for fastening rubber plates to each other, which method comprises the following steps:

   - at least two rubber plates are placed on top of each other,
   - a fastening device is arranged through the rubber plates so that part of the fastening device is left on both sides of the rubber plates,
   - the rubber plates are fastened to each other by attaching the fastening device in connection with the rubber plates,

   characterized in that

   - a first wire fastening means is arranged in connection with a first end of the fastening device that is left on a first side of the rubber plates,
   - a bonding wire is attached to the first wire fastening means.

2. Method according to claim 1, **characterized in that** the fastening device is a pin.

3. Method according to claim 2, **characterized in that** the pin comprises at least two arms which are arranged through the rubber plates.

4. Method according to claim 2, **characterized in that** the pin is attached in connection with the rubber plates by bending at least one end of the pin towards the rubber plates.

5. Method according to claim 4, **characterized in that** the end of the pin is bent substantially at least 90 degrees.

6. Method according to claim 2, **characterized in that** the first end of the pin is bent so that the bent end forms the first wire fastening means on the first side of the rubber plates.

7. Method according to claim 4, **characterized in that** the pin is attached in connection with the rubber plates by bending towards the rubber plates both the first end of the pin that is left on the first side of the rubber plates as well as the second end of the pin that is left on the second side of the rubber plates.

8. Method according to claim 2, **characterized in that** the second end of the pin is bent so that the bent end forms the second wire fastening means on the second side of the rubber plates.

9. Method according to claim 1, **characterized in that** there are at least two fastening devices and wire fastening means, and that the bonding wire is arranged in connection with at least two first wire fastening means.

10. Method according to claim 1, **characterized in that** there are at least two adjacent rubber plates and the superposed rubber plates are arranged at least partly interlocked in relation to each other.

11. Method according to claim 8, **characterized in that** the second bonding wire is attached on the second side of the rubber plate to the second wire fastening means.

12. Method according to claim 1, **characterized in that** reinforcement plates are arranged at least on one

side of the rubber plates, between the rubber plate surface and the wire fastening means.

13. Method according to claim 1, **characterized in that** additionally in the method bearing means are attached to the rubber plates that are fastened to each other.

14. Method according to claim 1, **characterized in that** the rubber plates are made of used tires or used conveyor belts.

15. Method according to claim 1, **characterized in that** the fastening device is a wire and that a first wire fastening means is formed on the first side of the rubber plates by threading a wire into a loop from the second side of the rubber plates to the first side.

16. Use of the method according to claim 1 in manufacturing blasting mats.

17. A blasting mat comprising

- a first and a second side, as well as outer edges limiting the mat,
- rubber plates,
- fastening devices, which are arranged through the rubber plates and by means of which the rubber plates are fastened to each other,

characterized in that

- on the first side of the mat, in connection with the fastening devices wire fastening means have been arranged, and
- a bonding wire is attached to the wire fastening means.

18. Blasting mat according to claim 17, **characterized in that** the ends of the bonding wire are connected to each other on an outer edge of the rubber plate with the fastening means for forming a loop into an edge of the rubber plate.

19. Blasting mat according to claim 17, **characterized in that** at least five bearing means are attached to the mat on its one side.

20. Blasting mat according to claim 17, **characterized in that** the rubber plates are made of used tires or used conveyor belts.

21. Blasting mat according to claim 17, **characterized in that** the fastening device is a pin, at least one end of which is bent towards the rubber plates and thus fastened to the rubber plates.

22. Blasting mat according to claim 21, **characterized in that** the pin has at least two arms which are arranged at least partly through the rubber plates.

23. Blasting mat according to claim 17, **characterized in that** the fastening device is a wire and that a first wire fastening means is arranged on the first side of the rubber plates by threading a wire into a loop from the second side of the rubber plates to the first side.

24. Use of a blasting mat according to claim 17 as a vehicle driving cover.

25. Use of a blasting mat according to claim 17 as road construction material.

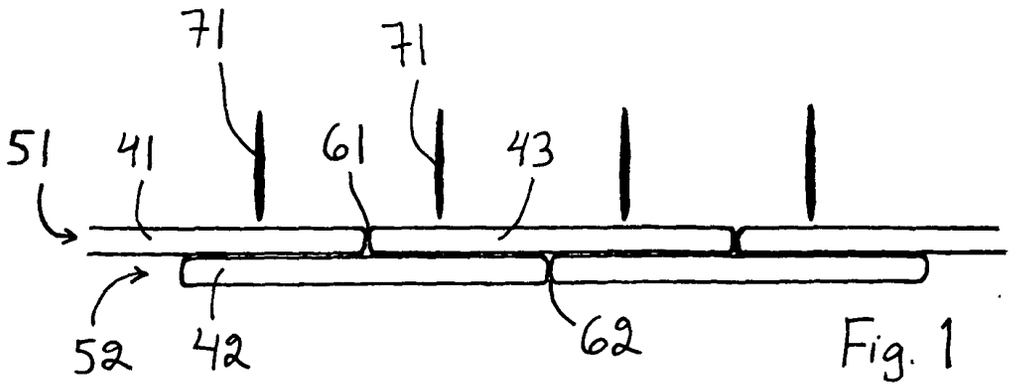


Fig. 1

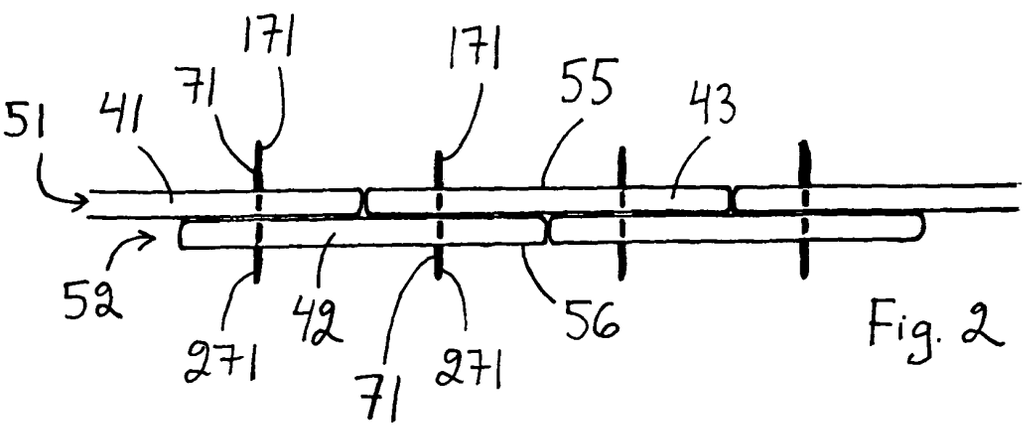


Fig. 2

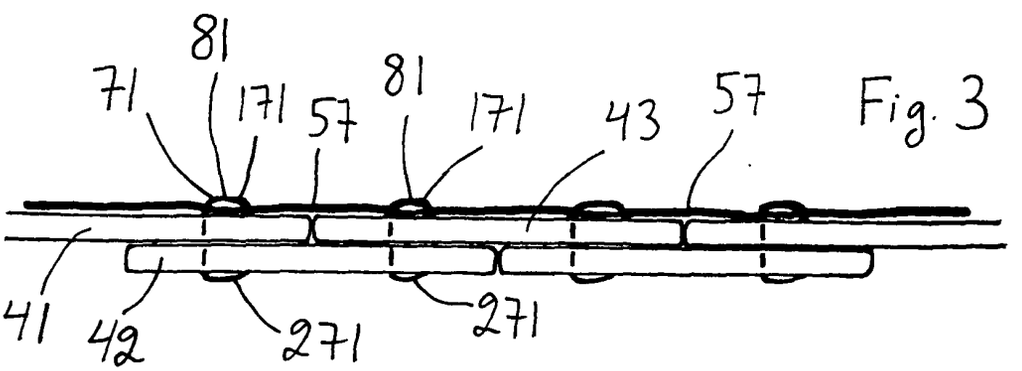


Fig. 3

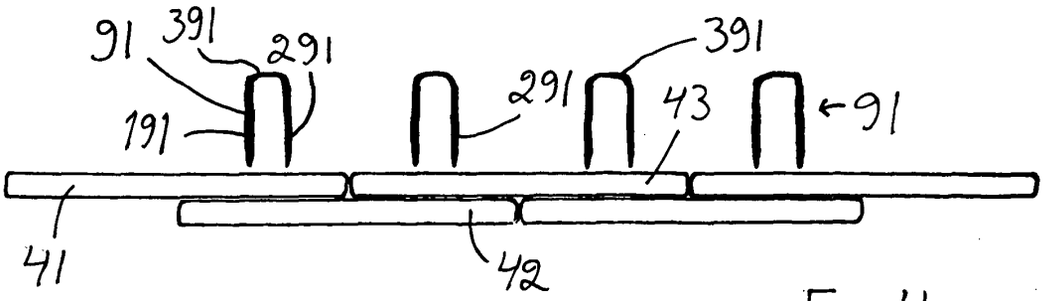


Fig. 4

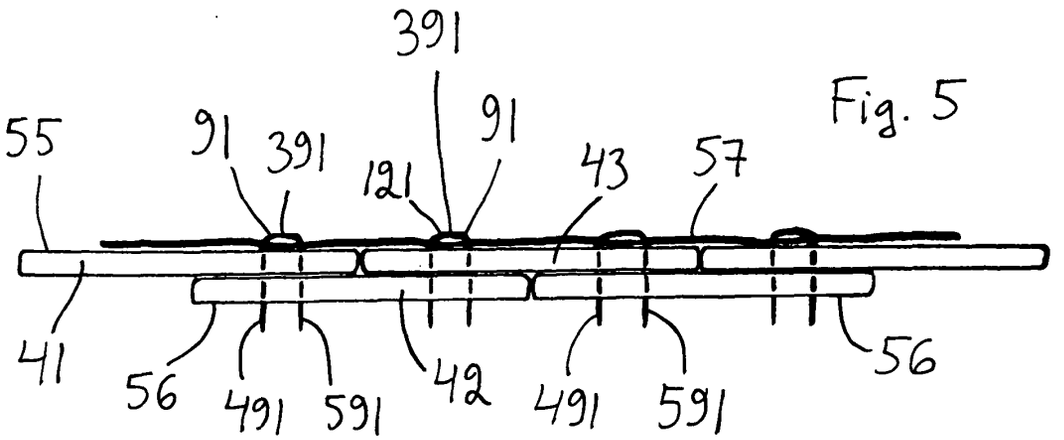
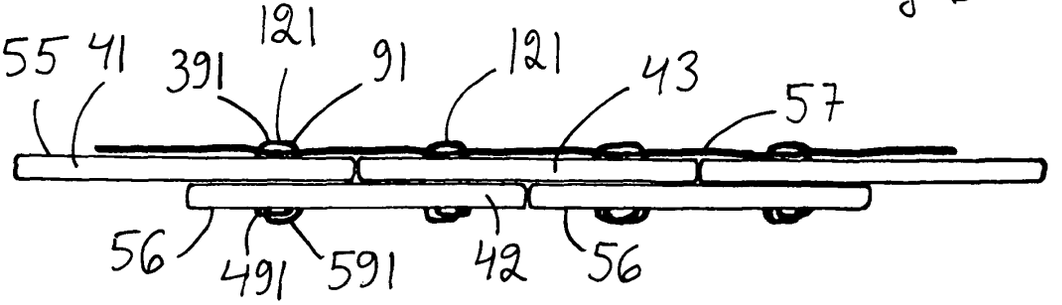


Fig. 5

Fig. 6



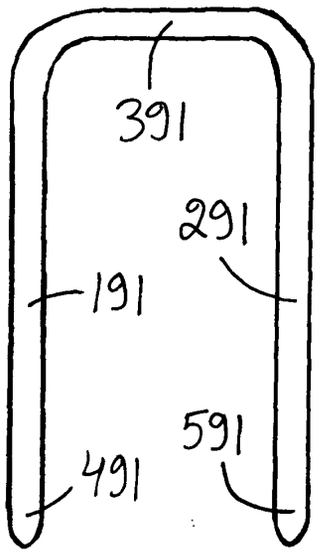


Fig. 7

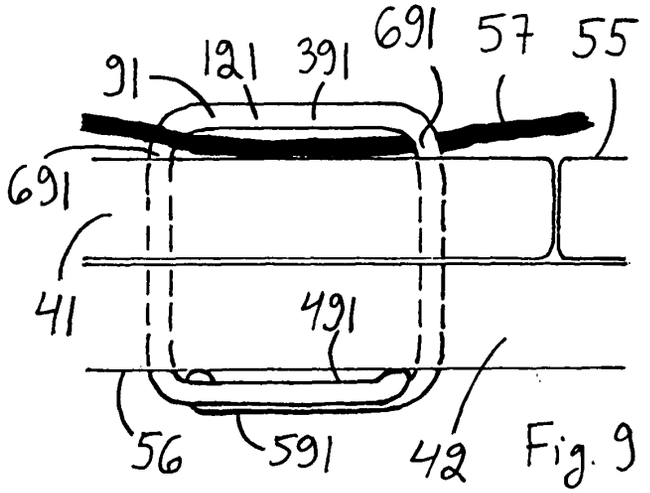


Fig. 9

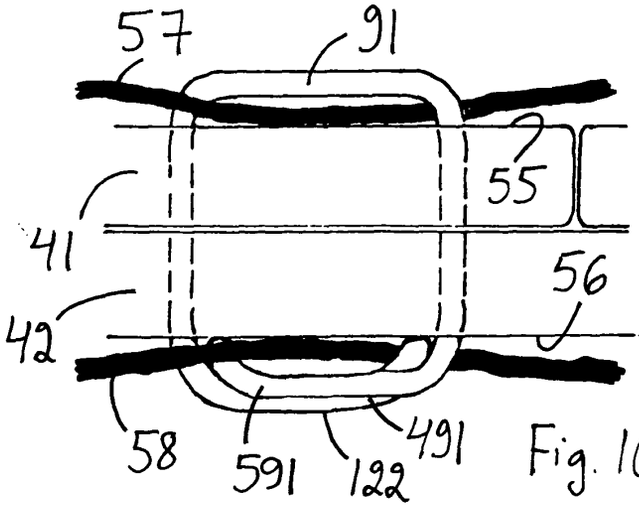
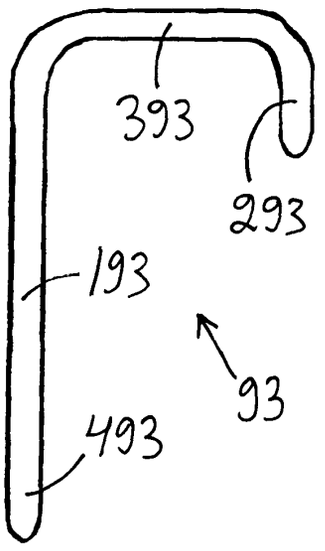


Fig. 10

Fig. 8



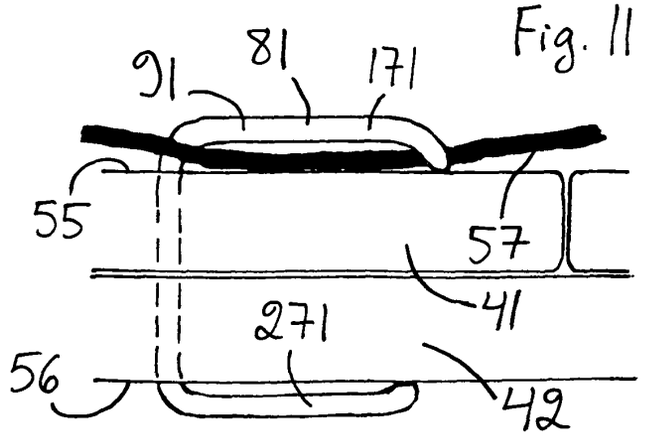


Fig. 11

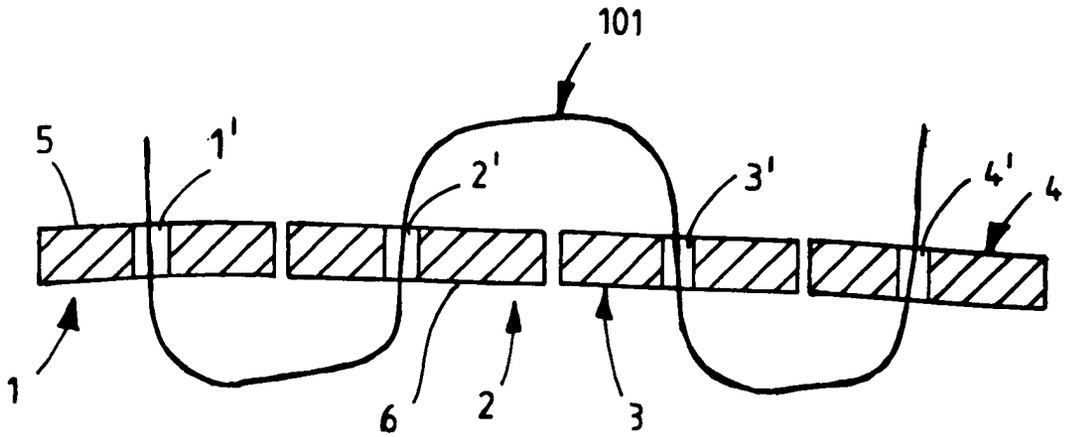


FIG. 12

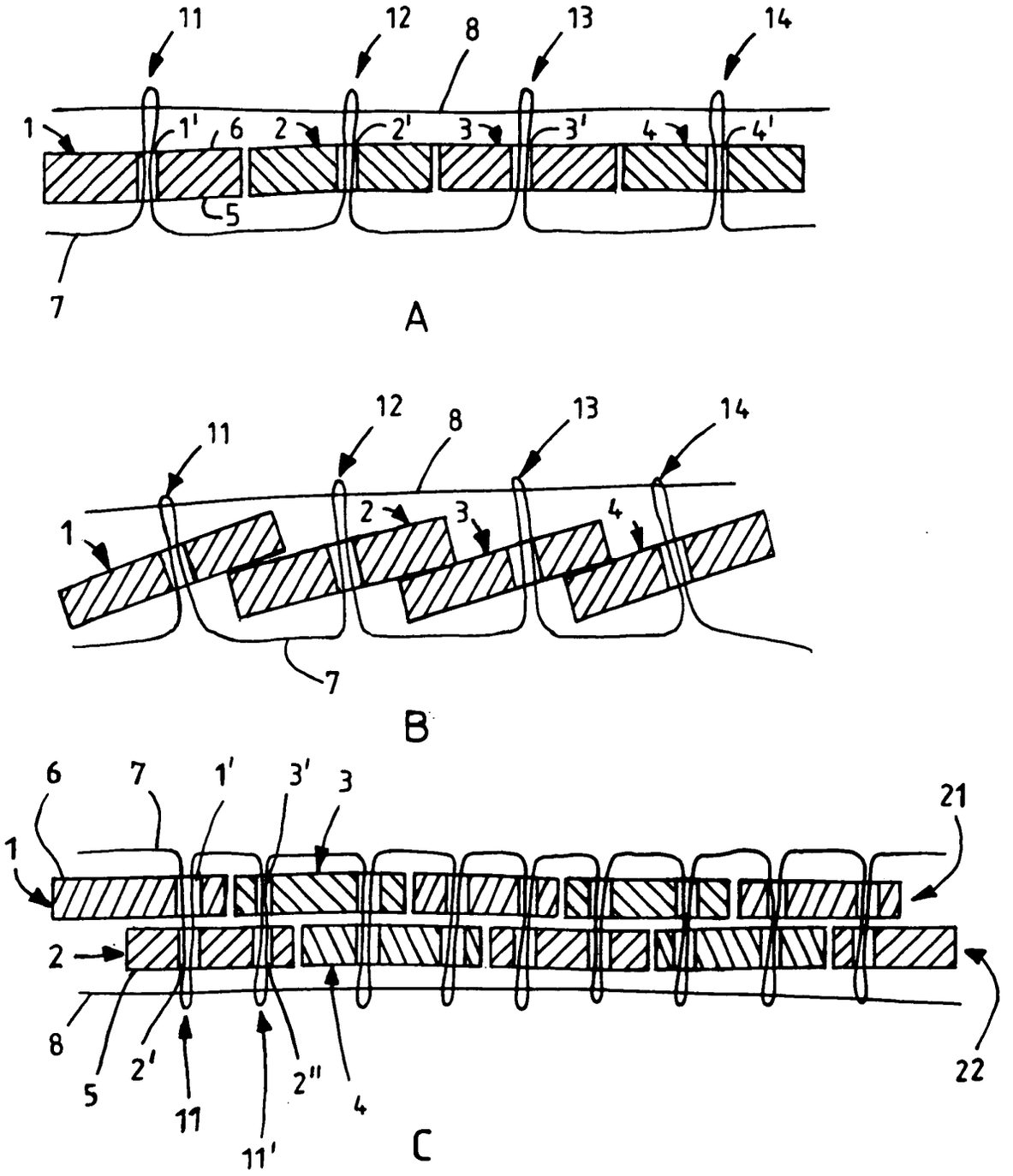

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FIG. 13

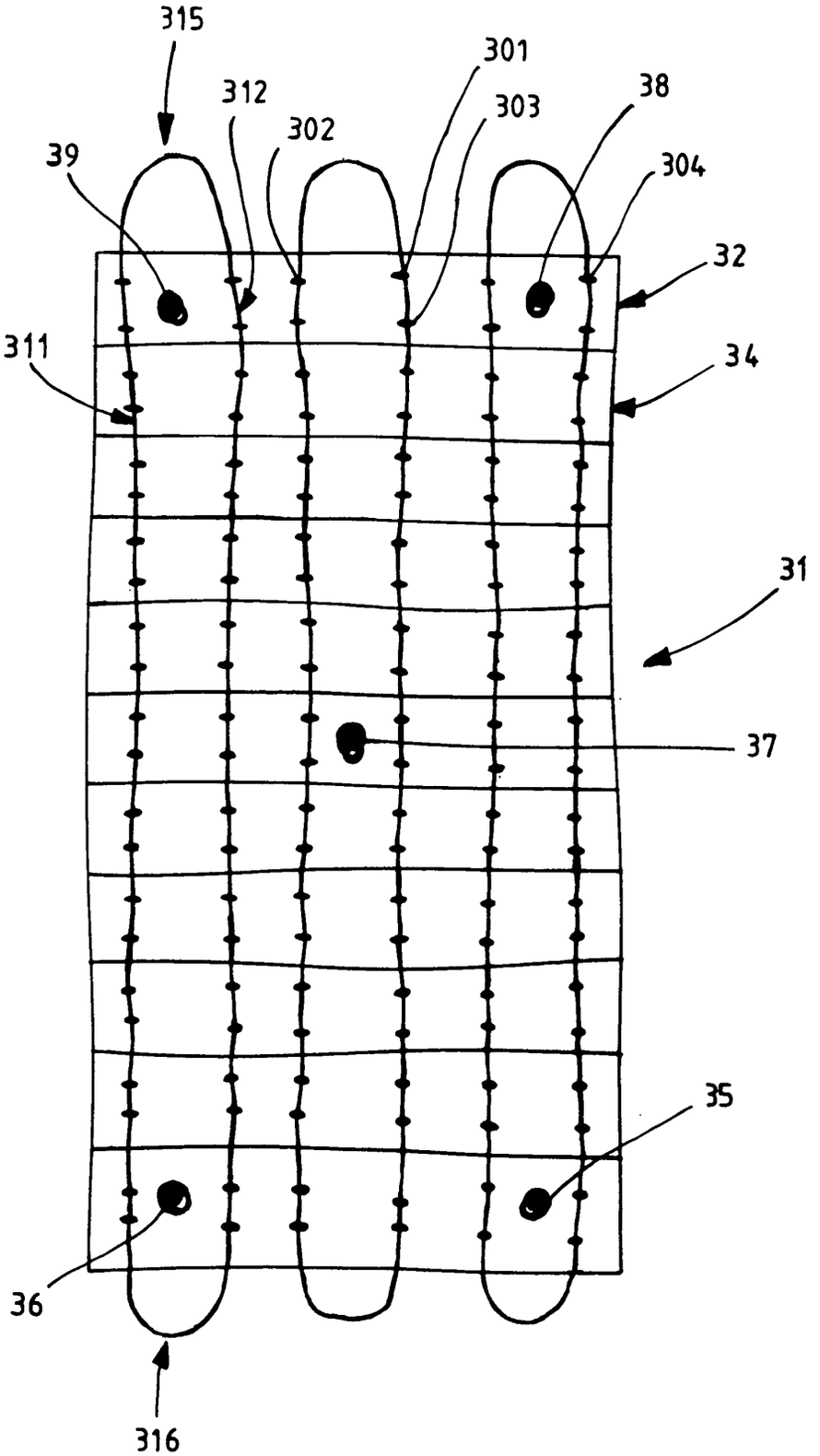

FIG. 14

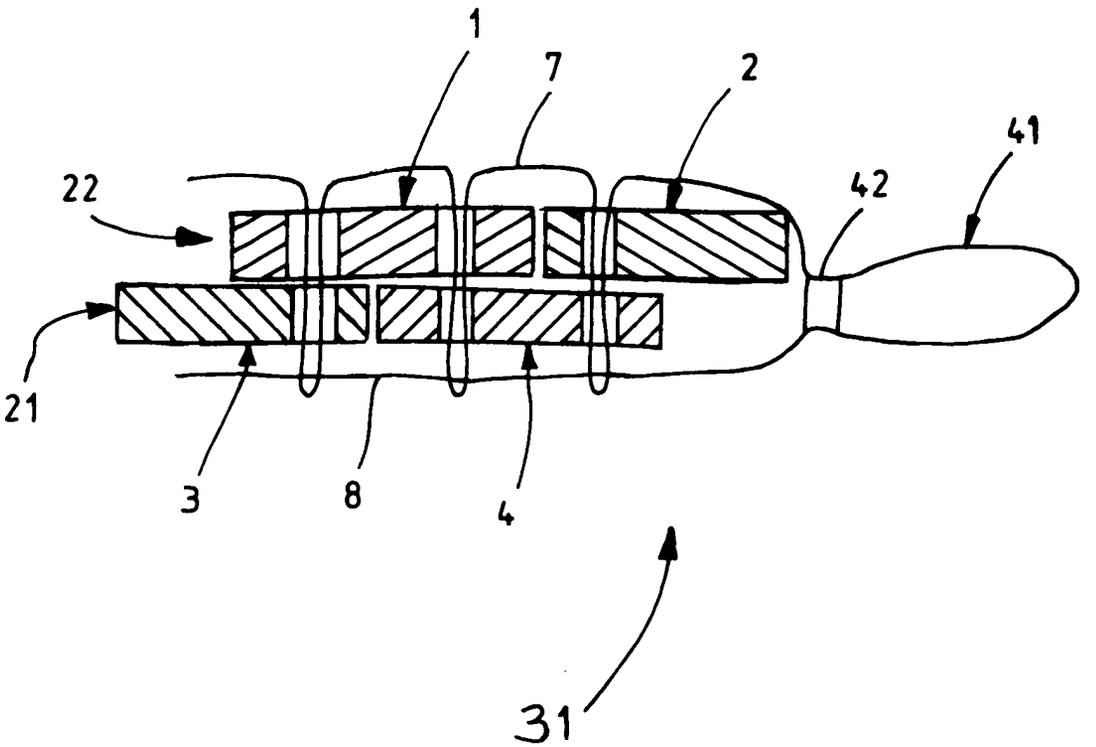

FIG. 15