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(54) **SECURITY FENCE ASSEMBLY METHOD FOR BALLISTIC PURPOSES**

(57) A security fence who consists of panels of varying thickness made by a predetermined number of steel meshes. Each individual mesh is made by steel wires, welded or woven, creating quadrangular cells proportionate to the diameter of the steel wire used. Every single panel is made for front assembly in defined distances of the meshes who are separated by positioners, iron made or in polymeric materials, with a slight misalignment between them in order to obstacle the trajectory of the bullets or splinters penetrating the barrier itself. The meshes are fixed to the side supports by means of retention that guarantee their correct positioning and strain resistance. The diameter of the steel wire is determined pursuant to the characteristics of resilience and resistance desired. The barrier so composed intends to offer maximum resistance to penetration while opposing a small resistance to the passage of blast gases.

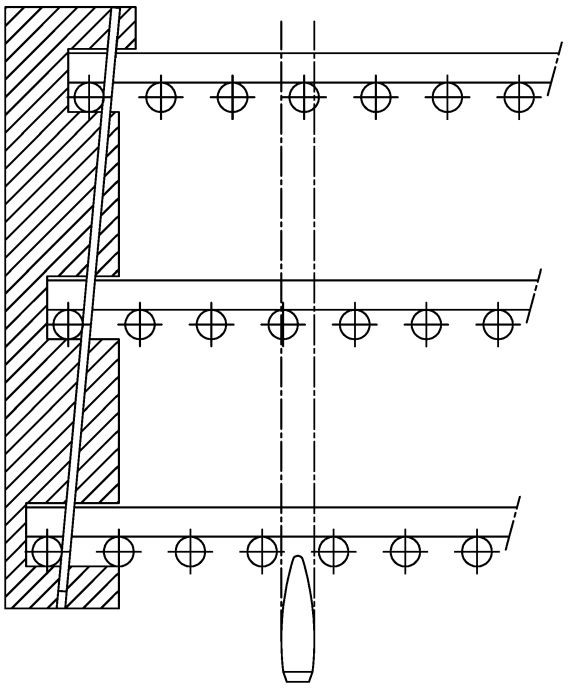

Fig. 1

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Description

Field of the Invention.

[0001] The present invention relates to a relatively light weight and inexpensive barrier, which could be rapidly erected and used as ballistic protection against the threat from weapons and explosives, inside buildings or in external environment.

[0002] The barrier consists of a plurality of meshes assembled frontally and creating a grid structure. Every single mesh is made by steel wires, welded or woven, creating quadrangular cells proportionate to the thickness of the steel wire used.

[0003] The meshes are assembled, with a slight misalignment between them, by positioners made in metallic or polymeric materials.

[0004] The steel wire meshes are so combined together in panels composing the defensive fence.

Description of the Prior Art

[0005] So far, the technique has developed ballistic protections through the arrangement of barriers, solids or in composite materials, suitable to dissipate the energy expressed by impact from objects thrown at high speed.

[0006] US Patent No. 4,526,347 published July 2, 1985 by McLoughlin, is for a fence assembly comprises a plurality of panels of expanded metal mesh having a plurality of closed meshes. The panels are arranged in zig-zag relationship, and each panel is joined to another panel by means of portion of some of the meshes of the panel adjacent an edge thereof, projecting through meshes of the other panel. The interlocking meshes are intertwined to retain the panels interlocked. The fence assembly may be secured to, or buried in, a trench in the ground.

[0007] US Patent No. 20100330341 published December 30,2010 by Percival Jeffrey D. Is for a transparent blast and ballistic projectile resistant barrier is comprised of a two-dimensional array of transparent hardened tiles that are encapsulated in a transparent resin layer. Preferably, the hardened tiles are transparent ceramic tiles, and the resin layer is a transparent polyurethane encapsulating the tiles. Additional transparent polycarbonate layers and glass fiber layers are also employed reinforcing the transparent barrier and providing the transparent barrier with polished exterior surfaces.

[0008] WO/2010/117811 published October 14, 2010 by Braiewa Robert, is for a ballistics shield material comprises an armor structure formed from armor material components. The armor structure is substantially imperforable by armor-piercing fire. The armor structure comprises at least multiple layers of high tensile material layers of para-aramid fabric, and an adhesive material for bonding components together. There is a visco elastic foam bonded with the adhesive. The foam can be acrylic foam is bonded with nitrile phenolic adhesive.

[0009] US No. 20120174748 published July 7, 2012 by Landi Curtis L. is for a ballistic resistant armor material and assembly including a thin, rigid armor component for stopping and capturing ballistic projectiles, backed by a resilient component formed of thermoplastic elastomeric honeycomb material for absorbing projectile strike energy and reducing impact noise and/or blunt trauma injury. The armor component includes multiple layers of high tensile strength aramid fabric or the like sandwiched between front and back plates made of multiple layers of woven carbon cloth impregnated with an epoxy resin or the like. The several layers of the armor component are formed and compressed to provide a rigid outer shell that can advantageously be configured as planar or shaped to suit particular applications. The resilient component is affixed to the inside surface of the armor component and may include one or more layers of flexible honeycomb material having cells that are open, hermetically sealed, or perforated to provide fluid circulation therethrough.

[0010] US No. 20070193221 published Agost 23, 2007 by Davidson Thomas D. Is for a ballistic abatement method and system. A modular ballistic abatement barrier system includes a first corrugated panel having at least one aperture, a second corrugated panel having at least one aperture, and a ballistic cloth placed between the first corrugated panel and the second corrugated panel. The ballistic cloth can also include at least one aperture. The first corrugated panel and the second corrugated panel are coupled using at least one among a mechanical bond and a chemical bond. For example, the ballistic cloth can be laminated between the first corrugated panel and the second corrugated panel to form a multi-layered panel. Alternatively, the first corrugated panel, the ballistic cloth, and the second corrugated panel can be coupled together using a fastener that compresses the ballistic cloth between the first corrugated panel and the second corrugated panel.

[0011] US No. 20060248827 published November 11, 2006 by Meeker James R. Is for a ballistic barrier system and method. The ballistic barrier wall is constructed of a pair of spaced vertical surfaces connected by 2x4 s, 2x8 s or other boards and filled with sand. The outside is spray-coated on both vertical sides with an elastomeric polymer mixture. Panels or walls are connected to other panels and to floor or wall surfaces by straight brackets and angle brackets. The multiple vertical layers of the panel trap bullets, armor piercing shells, bomb shrapnel or other ballistic elements in the wall.

[0012] US No. 6622607 published September 23, 2003 by Miller Withney Wallace is for a mobile bullet barrier. A mobile bullet-resistant barrier that has adjustable and removable bullet-resistant glass panes. The barrier includes a frame supporting a bullet-resistant material, slidable in the frame, the material being substantially transparent. The frame generally having a first frame side, a second frame side, the frame sides being substantially parallel to each other. Also, the frame includes a plurality of cross-tracks, the cross-tracks being perpendicular to the frame sides and connecting the frame sides

together. Further, the frame includes a first base member and a second base member mounted perpendicular to the cross-tracks at an end of each frame side for carrying the frame sides. A plurality of locking rollers are mounted to the base members allowing frame movement.

[0013] US No. 4709659 published December 1, 1987 by Quante Jeffrey B. Is for a ballistic and forced entry resistant barrier. The invention is directed to a forced entry and ballistic resistant barrier comprising a plurality of adjacent segments securely and rigidly affixed to each other. Each segment includes a first pair of longitudinally elongated C-shaped channels whose concave sides are diametrically opposed about a flat bar positioned therebetween. In addition to the first pair of C-shaped channels, each segment preferably comprises a second pair of longitudinally elongated C-shaped channels, larger than the first pair, positioned concentrically about the first pair such that one channel of the second pair overlaps a convex portion of one channel of the first pair; the other channel of the second pair overlaps a complementary convex portion of the other channel of the first pair. The first and second pair of C-shaped channels are positioned so as to preferably obtain a relatively high Free Area percentage while still maintaining strict ballistic resistance and forced entry standards.

[0014] US No. 3930452 published January 6, 1976 by Van Laethem Robert is for a impact resistant panel composed of a group of at least three sheets of vitreous material bonded together via intervening layers of plastic material. According to one form of construction, the group includes a set of consecutive vitreous sheets of at least three different thicknesses which are arranged in order of thickness, and at least the first sheet, taken in the direction from the highest sheet thickness end of the set, is tempered. According to a second form of construction, the group includes a set of consecutive sheets of at least two different thicknesses arranged in order of thickness and at least two of the plastic layers are of different thicknesses and are arranged so that one of the layers having the smallest thickness is nearer the first sheet, taken in the direction from the thickest sheet, than is any other layer.

[0015] EP1828706 published September 5, 2007 by Magnusson Bjoern and Karlstroem Anders is for a light ballistic protection as building elements. The invention concerns a ballistic protection against objects such as projectiles from fire arms, alternatively scatter from for example hand grenades. The protection comprises an enclosure adapted so that the object can penetrate the enclosure in at least one area; at least one intermediate layer comprising granules arranged within the enclosure which intermediate layer and enclosure are arranged to deaccelerate said object. The invention is further characterized in that: the granules are movable arranged with respect to each other; the space in the intermediate layer that is not occupied by granules is filled by a gas medium to enable contact between adjacent granules; the granules have mechanical properties so that a granule is crushed and spread in the intermediate layer when it is hit by an object, at the same time as adjacent granules are subjected to impulses with a subsequent energy dissipation so that the object and fragments thereof remains in the protection with a reduced risk for ricochets.

[0016] WO/2009/045205 published October 1, 2007 by Elliot A. Is for a wall structure for protection from ballistic projectiles. A wall structure and a method for constructing the wall of a building provide protection for inhabitants of the building against ballistic projectiles impacting the wall. The wall structure includes an outer panel and an inner panel. The inner panel is a composite structure that includes a metal sheet having a first face attached to a wallboard panel. Preferably, a sheet of self-healing material is attached to a second face of the metal sheet. A cavity formed between the outer and inner panels is filled with sand or another granular material. A flexible sheet suspended in the cavity provides additional protection. Preferably, a sheet of woven para-aramid fiber such as Kevlar® brand fiber is loosely attached to the flexible sheet to provide further protection.

[0017] US No. 5866839 published February 2, 1999 by Ohayon Shalom is for a high performance armor protection system for tank crews and other combat vehicles includes a high performance armor deflection technique for blocking armor piercing weapons. The armor deflection technique utilizes metal balls which are organized in a specific pattern in which the balls are placed in a predetermined number of vertical rows such that a blocking force is generated against armor piercing weapons. The metal balls may be of a predetermined diameter for the purpose of generating a target density and improving the effect of the deflection technique. The deflection technique prevents armor piercing weapons and chemical piercing jets by causing the metal balls to rotate and thereby deflect the kinetic energy of the weapons and to further form a greater target density to stop the weapons. The armor protection system may be disposed around a tank or fighting vehicle in a belted formation for maximum coverage and protection from attack from any possible angle such that the crews and combat personnel operate within a safe and injury free space.

[0018] The solutions proposed, both by the use of concrete barriers or made intermingling aramid fibers, meet obvious limitations related to their weight or high cost of implementation. In addition, the efficiency of protection offered by such solutions is ballistically limited: while valid against the kinetic energy expressed by the projectile, they are contrasting the passage of gas and sometimes they are maximizing the effects of a burst or deflagration.

[0019] Protection systems made by a metal grid or chains are designed to intercept explosive projectiles and self-propelled grenade counteracting the effects of an explosion from those projectiles, able to create a dart of flame or limited concentration of the explosion, despite their low efficiency against the kinetic energy expressed by the projectile itself.

[0020] So far the solutions proposed do not seem to

be sufficient to meet all the demand for ballistic safety, included the protection from possible launch of objects coming from machinery, in particular splinter stone materials, iron or wood fragments, while ensuring a sufficient guarantee against an accidental or intentional burst.

[0021] It is a well-known fact that a positive containment of a deflagration is achieved by the control of its gas flow, avoiding the rise in pressure due to the gas concentration in a closed environment and the rebound effect due to the collision of gases on the walls.

OBJECTS OF THE INVENTION

[0022] The invention aims to provide a solution to the demand for ballistic protection, safety and security from live beings or material goods, against traumatic events as a result of hitting objects at high speed, especially splinters, fragments or projectiles, thrown by mechanical force or because of gas expansion.

[0023] The invention seeks to provide an optimal and economic solution to both the problems, the launching of projectiles and the explosion of gases, while seeking to dissipate the kinetic energy expressed by the projectile without rebound effects its is also ensured a sufficient flow of the gases.

SUMMARY OF THE INVENTION

[0024] According to the invention there is provided a fence composed of panels of variable thickness made by the assembly of a programmed number of steel wire meshes, galvanized or variously colored, with wires of a predetermined diameter.

[0025] Each individual mesh is composed of a large number of rigid steel wires, placed vertically or horizontally to a distance between them not exceeding ten millimeters, reinforced with a variable number of wires oriented in the opposite direction and welded to the first, so to stiffen the structure and create quadrangular cells size proportionate to the thickness of the steel wire used. Alternatively the steel wires are woven together creating such quadrangular cells size proportionate to the thickness of the steel wire used.

[0026] The vertical and horizontal dimensions of the mesh are determined on the basis of the desired size of the final panel.

[0027] Every single panel is made with the front assembly of a predetermined number of meshes, each separated by positioners, iron or polymeric material made, with a slight misalignment between themselves, so as to create an obstacle and prevent the free crossing of a projectile or a splinter in a straight line, even if launched at high speed without be totally impermeable to gases and minimizing the effects of a blast.

[0028] The mesh panels composing the ballistic fence are positioned in a repetitive series established by virtue of the thickness and characteristics desired for the barrier, fixed to their side supports by means of retention that guarantee the correct positioning and strain resistance.

[0029] So the panels are assembled in modules to be fixed to vertical supports, structures or boxed beams, permanent fixtures on the floor or other rigid structures.

ADVANTAGES OF THE INVENTION

[0030] The modular panel of multiple meshes properly assembled, intends to offer maximum resistance to the penetration of lightweight objects, despite if it launched at high speed, deaccelerating and diverting the flight path of said objects, while opposing the minimum resistance to the passage of gases and minimizing the effects of a blast.

[0031] The characteristics of resilience and resistance of the steel wire used for the mesh predetermines the ability to allow dissipation of the kinetic energy expressed by the projectile, while the use of carbon steel or inox steel is sufficient to contrast the output heat by the process itself. The intentional softness of the mesh barrier is intended to guarantees against rebound side effects, more evident in the case of projectiles of greater weight launched at subsonic speed. It is a well-known fact that the effectiveness of each ballistic protection depends primarily on the physical characteristics of the projectile, by its mass and speed, making it especially insidious the case of small objects launched at supersonic speeds.

[0032] The considerable energy delivered by modern ammunitions requires particular devices to be dissipated by a barrier arranged in order to do it, of course with increased of weight and costs of implementation, therefore by the invention above described it is necessary to provide a module composed of numerous mesh sheets.

[0033] The placement distance between the meshes of the single panel has to be calculated in order to maximize the effects of destabilization of the projectile.

[0034] The mesh barrier so prepared did not create dangerous phenomena of retro-projection of material, while maintaining almost unchanged its mechanical structure, except of course for the wires intercepted by the bullet.

[0035] Finally, it should be noted that the transmission of light through the barrier is limited but not blinded. The predisposition of modular mesh panels also consents their easy replacement and the reintegration of the ballistic fence, who is designed to be assembled with minimum effort and without the use of particular equipment or technologies.

[0036] The fixing of the meshes in the panel is assured by positioners which ensures the alignment and stability of the defensive fence.

[0037] Every single mesh is fastened to the positioner by easy to make means or by a cylindrical pin inserted in a prepared guide.

[0038] The positioners allow to determine the number of mesh in the composition of the panel itself and they also provide a point of attachment to the rigid support, T

beam or box-shaped, which wants to entrust the ground stability of the fence.

[0039] A great number of panels of variable size arranged in such a fence structure allow to ensure a safety perimeter for both indoor and outdoor purposes.

[0040] The invention was primarily conceived in order to contrast a firearm attack, but its use is not limited to this ballistic purpose.

[0041] For example, a processing machine who is crushing stone, splittering, sawing or cutting may be surrounded by a barrier so arranged, in order to ensure the safety of the operators assigned to other processes.

[0042] In the industrial field, it could be used to limit the processing areas that utilize under pressure containers of gas or may develop accidental explosions for chemical reactions, in order to avoid the consequences of a blast.

[0043] External safety barriers on race tracks or roads would guarantee against flying stones or pieces of mechanical involved in accidents.

[0044] Protective barriers so structured can also ensure against the intentional throwed objects for vandalism or terrorism purposes.

[0045] If used in building construction reinforcing walls or perimeter defense it will guarantees against the side effects of a twister or hurricane.

[0046] The structure of such ballistic fence allows spaces between the meshes or between the different panels that can be filled with sensitive detection systems, allowing a possible automatic alert of any impact, thus making it easier both the maintenance and the control of structure.

[0047] The modular ballistic fence thus conceived offers a limited space footprint and a reduced visual impact, which are particularly popular in urban areas, with weight and manufacturing costs lower than alternative solutions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0048] These and other details of my invention will be described in connection with accompanying drawings, wich are furnished only by way of illustration and not limitation of the invention, and in which drawings:

Fig. 1 is a front elevation view of the left portion of the panel composed by three welded steel meshes, positioned according to the invention, showing the mean of retention and positioner who guarantee the designed distance and misalignment between said meshes.

Fig. 2 is a front elevation view of the right portion of the panel composed by three welded steel meshes, positioned according to the invention, showing how a bullet cannot safely cross in straight way the panel itself.

Fig. 3 is a front sectional view showing a different way of fixing two panels by a single positioner to a rigid structure as an iron or steel T beam and the mesh wire grid.

Fig. 4 is a front elevation view of the structure shown in figure No.3.

Fig. 5 is a front elevation view of an iron or steel positioner who connects two panel made by three welded steel meshes.

Fig. 6 is a sectional front view of the positioner shown in Fig. No. 5.

DETAILED DESCRIPTION OF THE INVENTION

[0049] Referring to the drawings the ballistic fence consists of panels of varying thickness made by front assembling of a programmed number of steel wire meshes, galvanized and variously colored, with a predetermined wire diameter.

[0050] Each individual mesh (Fig. 3) is composed of a large number of steel wires, placed vertically or horizontally to a distance between them not exceeding ten millimeters, reinforced with a variable number of wires oriented in the opposite direction and welded to the first, so to stiffen the grid structure and create cells quadrangular size proportionate to the thickness of the steel wire used. The vertical and horizontal dimensions of the mesh are determined on the basis of the desired size of the final ballistic panel.

[0051] Alternatively the steel wires are woven together creating such quadrangular cells with a size proportionate to the thickness of the steel wire used.

[0052] The panel is made of front assembly in defined distances of the meshes (Fig. 4) each separated by thickness and positioners iron made or in polymeric materials, with a slight misalignment between them (Fig. 1 and Fig. 2) so as to create obstacles and prevent the free crossing of objects in a straight line like splinters or projectiles, even if launched at high speed.

[0053] The meshes are positioned in a repetitive series established by virtue of the thickness of the panel and ballistic characteristics desired, fixed to the side supports by means of retention systems (Fig. 5) that guarantee the correct positioning and strain resistance.

[0054] The panels are assembled in modules to be fixed to vertical supports on permanent fixtures on the floor or other rigid structures composing the ballistic fence.

[0055] The diameter of the steel wire is determined pursuant to the characteristics of resilience and resistance desired (Fig. 4) and it may result in changing the other variables of positioning and composition of the mesh.

[0056] The ballistic fence, so composed of panels of multiple meshes properly assembled, intends to offer maximum resistance to the impact of light weight objects, also if launched at high-speed, with maximally absorbing their kinetic energy and diverting their flight path, while opposing the minimum resistance to the passage of gases and minimizing the effects of a blast.

[0057] The placement distance between the meshes of the panel has to be calculated in order to maximize

the effects of destabilization of the projectile, taking into account its probably velocity, mass, shape, lenght and diameter.

[0058] For example, the ammunition in caliber 308 Winchester (ballistically comparable to the 7.62 NATO) who shoots a bullet with a diameter of 7.62 mm and with a mass about 9.3 grams at the respectable speed of 840 meters per second, it is expressing a muzzle energy of about 3,900 Joule, thus applying the solution above described it needs about six steel meshes, positioned at a distance at least of 40 millimeter each other, to achieve the destabilization effect and to deaccelerate said bullet or its fragments.

[0059] As result of the destabilization of the angular momentum of the projectile, we obtain the decrease of the sectional density of the projectile itself, with the abatement of its penetration effectiveness and augmentation in transferring the kinetic energy to the mesh barrier.

[0060] The mesh itself, composed of steel wire having a cylindrical section, in turn provides a curved surface instead of a flat one to the impact which accentuates the mechanical capacity to oppose the kinetic energy received.

[0061] The use of carbon steel wires characterized by a relative softness and ductility allows to increase the absorption capacity of the density of energy released from the projectile to the mesh barrier avoiding rebound effect.

[0062] With its particular combination of materials, shapes and empty spaces, the mesh barrier leverages the laws of kinematics to expand the number and quality of threats that could be faced, while maintaining a sufficient permeability to the gases derived from a blast.

[0063] In the ballistic tests we have not noticed considerable differences in the effectiveness of the barrier resulting from the use of solid projectiles (hard core) rather than the soft point type (mild core) excpet than the soft core type has greater transmission capacity of kinetic energy, while the hard core type has major penetration of the mesh barrier.

[0064] Nevertheless the assembly method described above was effective against all the types of bullet used in the test.

Claims

1. Security fence assembly method for ballistic purposes, who simultaneously is ensuring the safety and protection against the danger from kinetic energy expressed by objects thrown at high speed, as projectiles or splinters, and from expansion of the gases of an explosion or launch.
   characterised in that
   a modular system of panels composed of steel wire meshes of different thickness, specifically set in order to allow the destabilization of the bullet's trajectory and its angular momentum at the impact.

2. Security fence assembly method for ballistic purposes according to claim 1 **characterised in that**
   the use of meshes, made with steel wires of different diameter, positioned axially offset from each other, with a slight misalignment, in order to create a closed perspective to the straight line motion of the projectile.

3. Security fence assembly method for ballistic purposes according to claim 1 **characterised in that**
   the use of steel wires with different diameter and thickness is designed to intercept the rectilinear motion of the projectile and to collapse at the impact, absorbing part of the kinetic energy and avoiding rebound phenomenas.

4. Security fence assembly method for ballistic purposes according to claim 1 **characterised in that**
   the use of steel wires, offering at the impact a curve surface to the rectilinear motion of the projectile, enables to deviate its trajectory and change its angular momentum.

5. Security fence assembly method for ballistic purposes according to claim 1 **characterised in that**
   allows the outflow and partial expansion of an explosion or launch gases.

6. Security fence assembly method for ballistic purposes according to claim 1 **characterised in that**
   the use of steel wires in creating quadrangular cells in the mesh that can be indifferently made welded or woven.

7. Security fence assembly method for ballistic purposes
   characterised in that
   the possibility to utilize the spaces between the meshes or between the individual modules for the insertion of sensitive detection systems with optical or electromagnetic sensor in order to report any impacts while providing good control and maintenance.

8. Security fence assembly method for ballistic purposes
   characterised in that
   an excellent compatibility and a low environmental impact of the modular structure so conceived.

9. Security fence assembly method for ballistic purposes
   characterised in that
   the possibility to assemble the panels without the use of special tools or heavy operating machines.

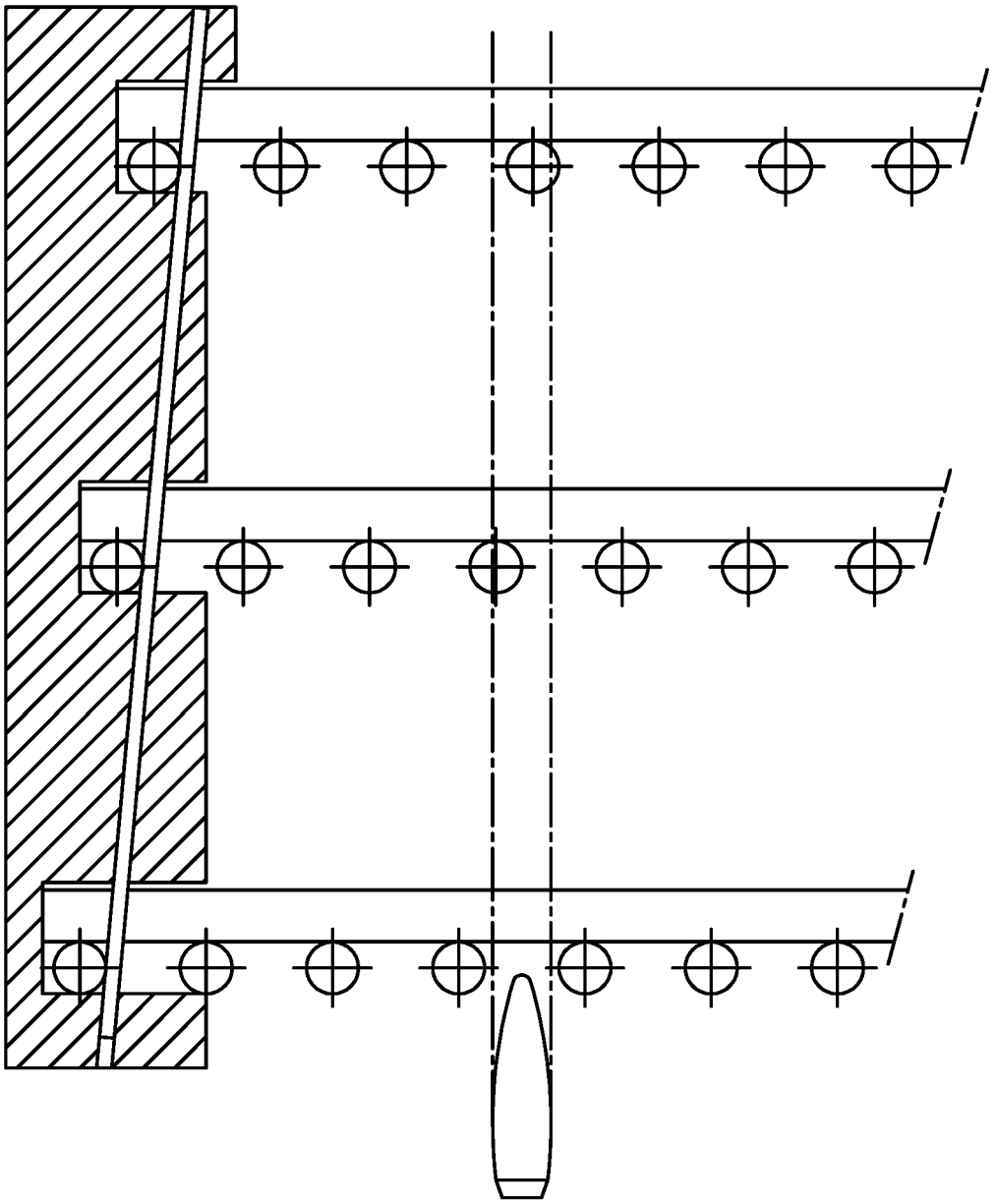

Fig. 1

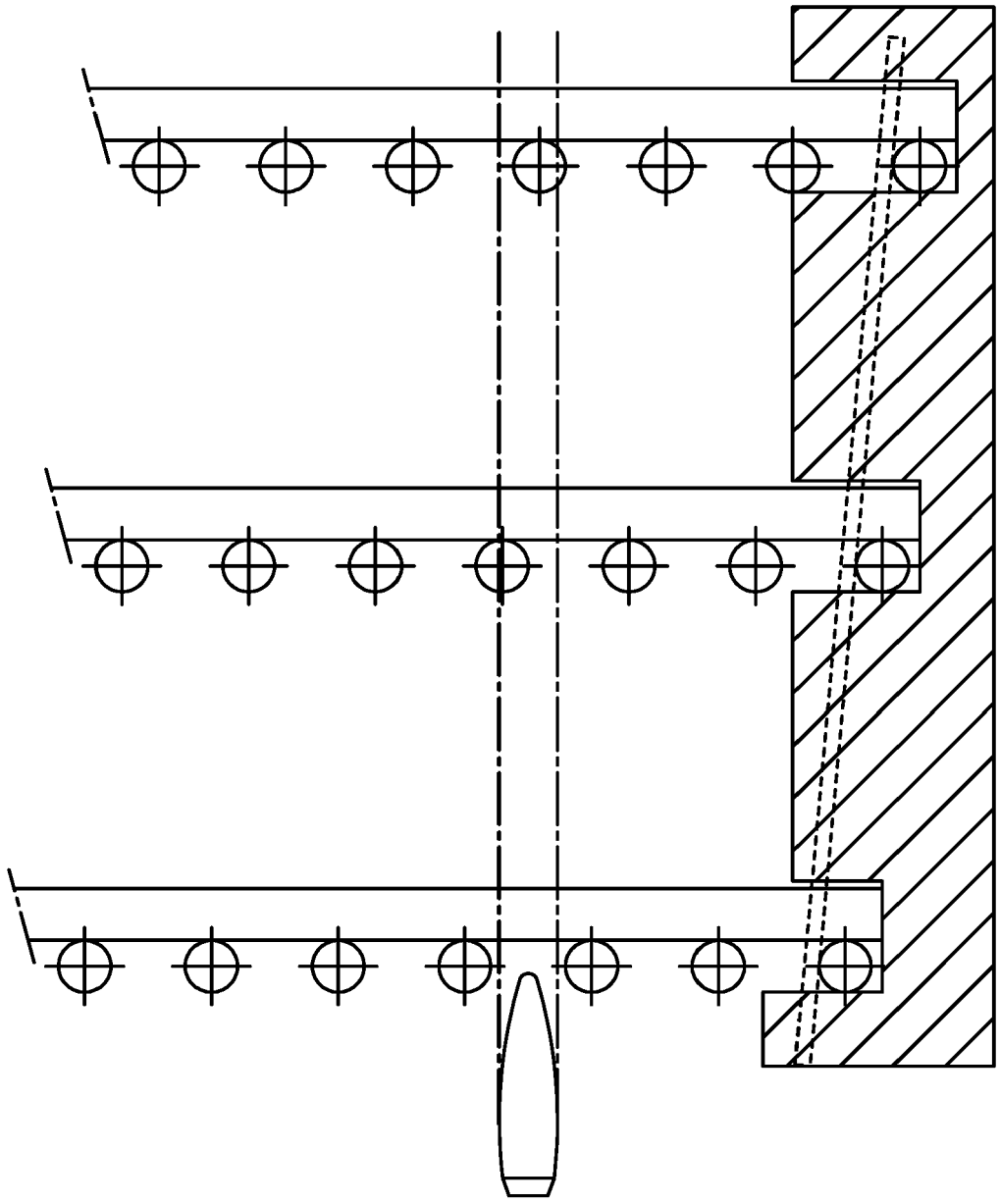

Fig. 2

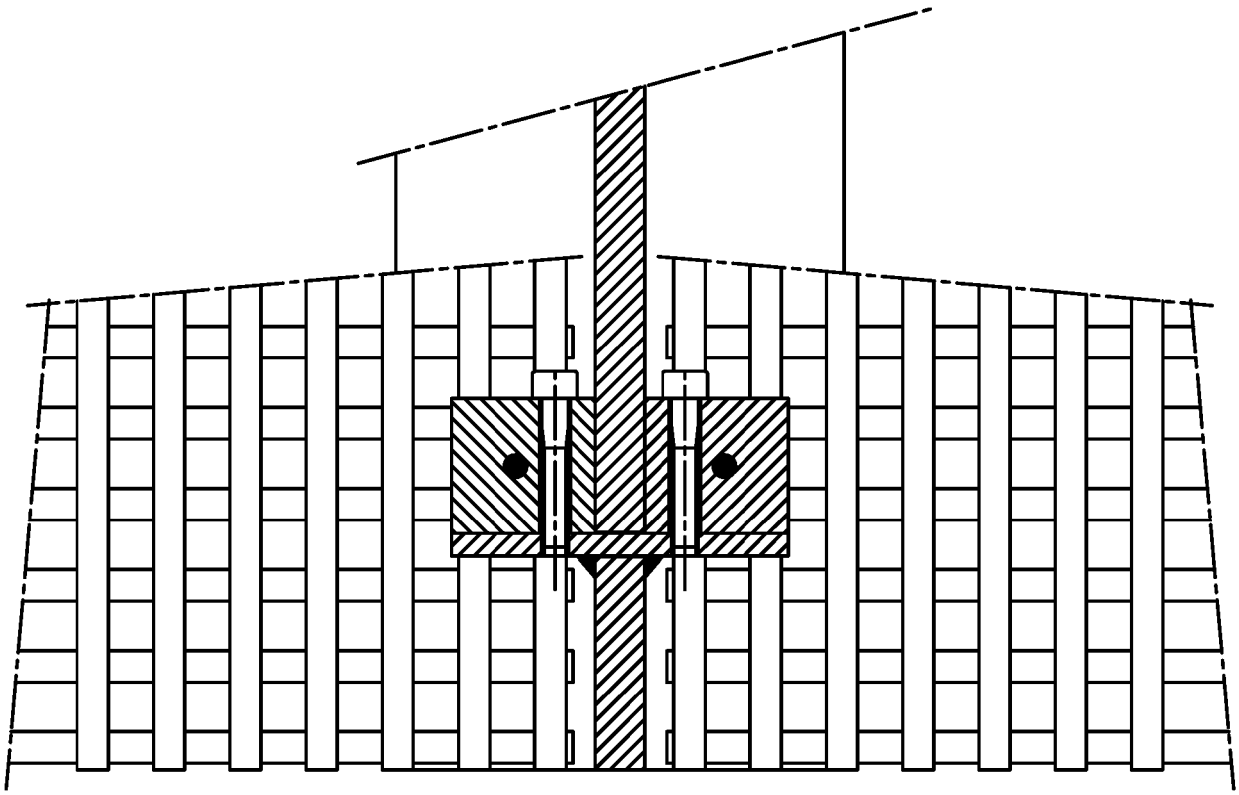

Fig. 3

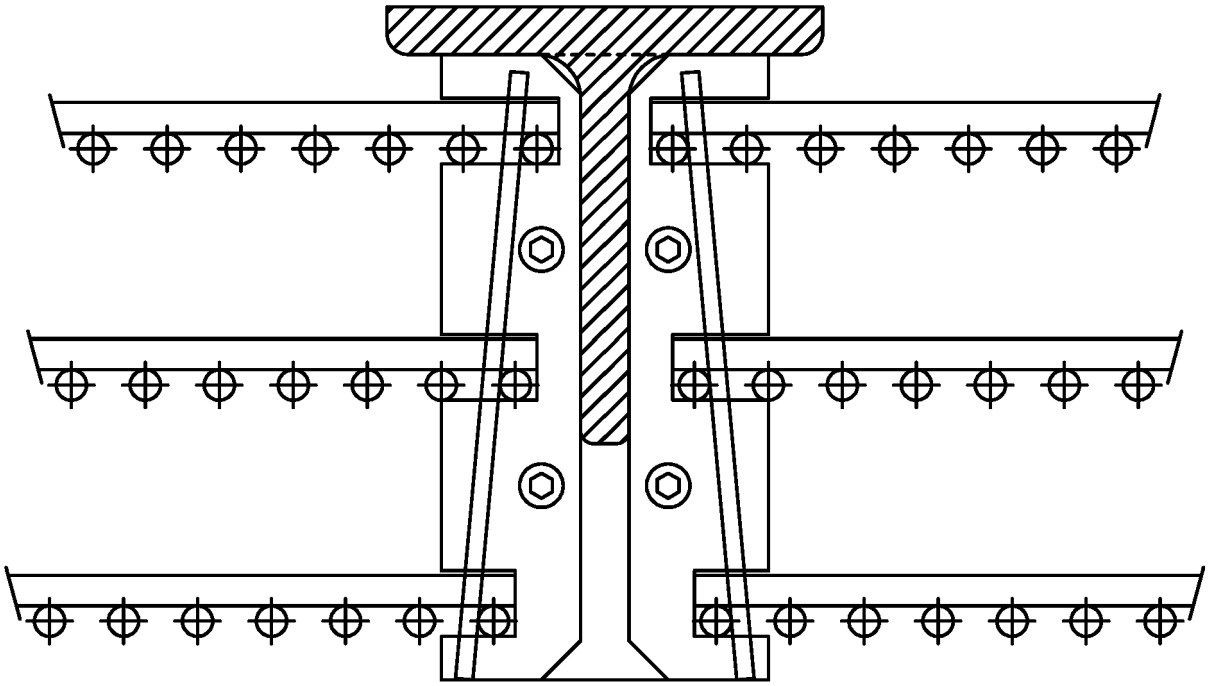

Fig. 4

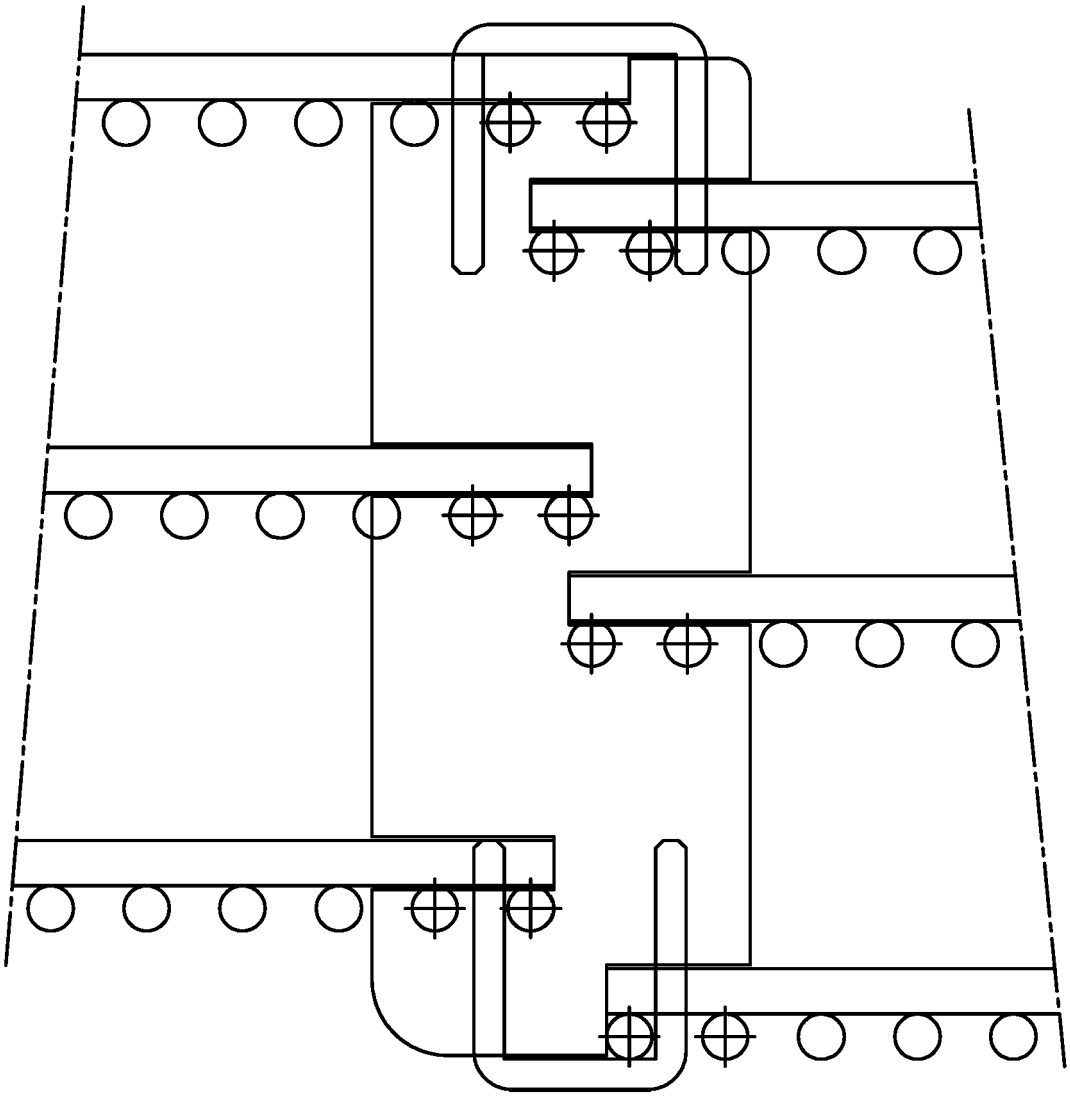

Fig. 5

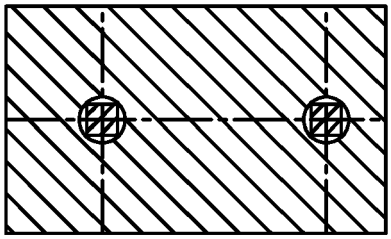

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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