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(54) **PERMANENT PLASTIC FORMWORK SYSTEM**

(57) The invention relates to a permanent plastic formwork system formed by two parallel surfaces, namely an outer surface (1) and an inner surface (2), consisting of a plurality of flat or longitudinally curved, hollow plastic slats (4) obtained by means of extrusion, provided internally with metal sections (13) providing them with rigidity and joined longitudinally by means of tongued-and-grooved ends (4a and 4b), separators (5) existing between the two surfaces. Said separators are provided with a threaded area (6) and an inclined appendage (8) for securing the rebar mesh (3) located between the surfaces. The slats (4) are secured to the ground using U-shaped parts (9) containing a threaded rod (10) that can be used to clamp and fix same. In addition, in closed structures reinforced internal elements can be incorporated diametrically, such as metal bars (11) with flat surfaces (12) at their ends enabling same to be secured to the above-mentioned inner surface (2).

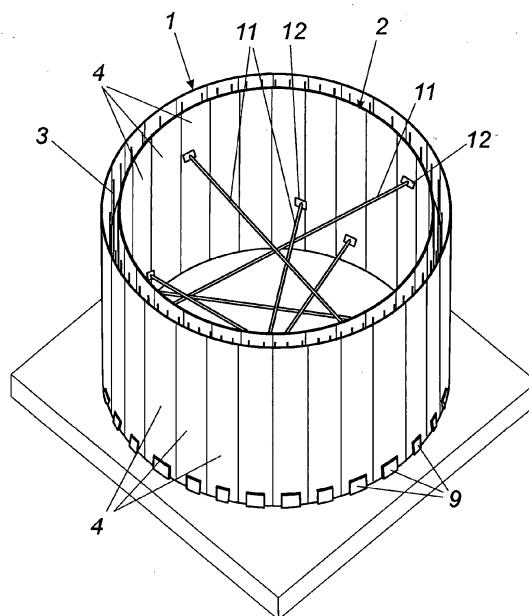


Fig. 1

Description

Object of the Invention

[0001] As expressed in the title of the present specification, the invention relates to a permanent plastic formwork system, which provides the function for which it is intended with a series of novel features and advantages, in addition to other features and advantages inherent to its organization and formation, which will be described in detail below, involving an innovative and/or alternative improvement to the systems already known in this field for the same purpose.

[0002] More specifically, the object of the invention consists of a permanent formwork system, i.e., not reusable, designed to be manufactured mainly from plastics, intended for building structures of any shape and essentially formed from two parallel surfaces, advantageously formed by the longitudinal coupling of a plurality of hollow slats obtained by means of extrusion, which prevents the restriction or limitation of the length or width thereof, the rebar being installed between the mentioned parallel surfaces, which rebar is duly secured by means of placing special separating elements which in turn fix and assure the distance between both surfaces, leaving the gap between them prepared to pour therein the fresh concrete.

Field of Application

[0003] The field of application of the present invention is the field of construction.

Background of the Invention

[0004] As is known, formworks are generally formed of a frame formed by a set of metal or wood plates suitably arranged to receive the concrete which, when hardened, forms the walls or construction elements built with this material which, depending on the type of construction, will have one shape or another.

[0005] Today, and as a reference to the state of the art, it must be mentioned that different formwork systems are known for building different types of constructive elements, which, however, in most cases form elements which must be sized for each type of construction, being, according to what the sizes are, elements that are complex and heavy to handle, and even though they can be reused, they are expensive to manufacture.

[0006] It is therefore necessary to create a formwork system which, by means of standard elements that are easy and inexpensive to manufacture, and therefore low cost, allow building any type of structure regardless of the size or shape it must have, this being the main objective of the present invention, relating to which it should be mentioned on the other hand that the applicant does not know of the existence of any other permanent formwork system having technical, structural and constitutional or configuration features similar to those herein

considered.

Description of the Invention

[0007] Therefore the formwork system proposed by the invention is by itself a novelty within its field, since due to its application a means is specifically achieved which provides considerable advantages for building any type of concrete structure because it is considerably more practical, effective and inexpensive, furthermore being quick and easy to install.

[0008] Specifically and to that end, the novel formwork system, which as previously mentioned is especially designed to be manufactured mainly from plastics, is essentially formed from two parallel surfaces, between which the rebar is installed, leaving the gap between them prepared for pouring the fresh concrete therein.

[0009] Each of said surfaces consists of a plurality of hollow and identical slats which, according to the type of construction for which they are intended, can be slightly longitudinally curved, for example for making curved surfaces, or they can be flat and suitable in number so as to form the appropriate structure, being joined longitudinally to one another, which slats, preferably made of plastic, are obtained by means of extrusion; therefore the length or width thereof will not be restricted, being able to be cut according to if one size or another is required, depending on the width of the structure to be built.

[0010] Said slats are joined to one another by means of tonguing and grooving the respective ends thereof, which slats have a specially studied configuration so as to allow them to be distanced with respect to one another and, if needed, so that they can rotate with respect to one another up to a certain point as a result of the configuration of their ends and of the relative flexibility of the plastic from which they are made, thus exactly adjusting the length of the parallel surfaces to the length required to be able to form the different structures in each case.

[0011] Also, and in order to prevent the plastic with which the slats are made from yielding albeit a millimeter, it has been provided to include inside said slat, which is hollow and provided with a series of longitudinal reinforcing partition walls internally dividing it into cells, metal sections which, adjusted to some of said cells, will provide the slats, and accordingly the structure of the formwork, with complete rigidity.

[0012] The special geometry of the described slats furthermore and advantageously allows transporting them individually or as a group by winding the surface, formed by longitudinally joining the appropriate number of slats, in the form of a spiral.

[0013] On the other hand, in order to assure that the distance between both parallel surfaces is maintained, the invention provides placing between each of them and at different levels a series of separating elements which furthermore act increasing the rigidity of the assembly.

[0014] Said separating elements, made up of a tubular body, the length of which will determine the thickness of

the wall to be built, have at each of their ends a threaded area suitable for inserting a nut in order to fix them to the corresponding slats, having the particularity of having in their central part one or two appendages generated therefrom in an inclined manner that are especially intended to serve as a support and secure the inner mesh or rebar which is located between the described parallel surfaces.

[0015] In parallel, each of the slats forming the parallel surfaces of the formwork is secured to the ground by means of special U-shaped parts which will be fixed to said ground by means of conventional systems, inside which there is a threaded rod which allows adjusting the distance existing between said rod and one of the walls of the corresponding slat, clamping it and leaving it completely in register.

[0016] Also, and to assure the rigidity of the assembly, in the event of building closed structures, such as tanks or the like, the invention additionally provides for the use of inner elements arranged diametrically, specifically metal bars the length of which will be defined by the size of the tank in each case, having flat surfaces at their ends which allow them to be secured to the inner surface of the formwork, which will aid in preventing the inner surface from collapsing towards the center and the outer surface from collapsing outwardly through the mentioned separating elements, which situation will be especially critical during the process of pouring the concrete and less important during the concrete setting phase. In the event of building flat walls, said bars will be secured to the ground in an inclined manner on both sides thereof.

[0017] In an alternate embodiment of the invention, to build circular structures the slats can be fixed by means of an inner metal structure formed by rings fixed to vertical posts, the lower ring being fixed to the ground by means of a crosspiece, and externally incorporating outer bands which prevent the slats forming the outer surface of the formwork from collapsing outwardly.

[0018] Finally, to build the upper covering or dome in the case of building closed circular structures such as tanks or the like, the invention provides for the use of other slats with a trapezoidal configuration and special design suitable for being fixed laterally to one another until forming a conical covering in order to subsequently deposit the concrete.

[0019] The novel permanent plastic formwork system accordingly represents an innovative structure with structural and constitutional features that have been unknown up until now for such purpose, which reasons, combined with its practical use, provide it with sufficient basis to be granted the exclusive privilege that is sought.

Description of the Drawings

[0020] To complement the description which is being made and for the purpose of aiding to better understand the features of the invention a set of drawings is attached to the present specification as an integral part thereof, in

which the following has been depicted in an illustrative and non-limiting manner:

Figure 1 shows a perspective view of an embodiment of the novel permanent plastic formwork system according to the invention, using as an example the embodiment of a cylindrical tank, in which the main parts and elements it comprises as well as the configuration and arrangement thereof are observed.

Figure 2-A shows a plan view of the slats forming the parallel inner and outer surfaces.

Figures 2-B and 2-C show respective details of the reinforcing metal section introduced inside the slats and of the configuration of the tongued-and-grooved ends of the latter.

Figure 3 shows a side elevational view of the slat.

Figures 4-A and 4-B show in detail the two possible positions for joining the slats.

Figure 5 shows a perspective view of the configuration of the separators.

Figure 6 shows a detail view of the manner of joining the parallel surfaces with the separators by means of nuts as well as the support of the rebar mesh therein.

Figures 7 and 8 respectively show a perspective view of the configuration of the U-shaped parts and the manner of securing the slats to them.

Figure 9 shows a perspective view of the configuration of the bars for additional inner support for the case of closed structures, such as the cylindrical structure used as an example.

Figures 10-A and 10-B respectively show respective upper and lower perspective views of an embodiment of the slat intended for construction of conical coverings.

Figure 11 shows a perspective view of the alternative variant of the separating element with two appendages.

Figure 12 shows a perspective view of the alternative embodiment of the inner metal structure for building circular structures.

Figure 13 shows a detail of the T-shaped configuration of the end of the crosspiece of the structure depicted in Figure 12.

Figure 14 shows a detail of the configuration of the pins fixing the rings to the posts in the metal structure shown in Figure 12.

[0021] Lastly, Figure 15 shows a perspective view of the formwork built by means of the metal structure and external coupling of reinforcing bands option.

Preferred Embodiment of the Invention

[0022] In view of the mentioned figures and in accordance with the reference numbers used, a preferred embodiment of the permanent plastic formwork system comprising the parts indicated and described below can be

seen therein.

[0023] Therefore, as observed in Figure 1, the formwork system in question is essentially formed from two parallel surfaces (cylindrical and concentric surfaces in the case of the depicted example as it is a circular tank), an outer surface (1) and an inner surface (2), between which there is installed a rebar mesh (3), leaving the gap between them prepared for pouring the fresh concrete therein.

[0024] Each of said surfaces (1) and (2) consists of a plurality of hollow slats (4) (Figures 2-A, 2-B, 2-C and 3) preferably made of plastic and obtained by means of extrusion, provided with inner reinforcing partition walls, between which metal sections (13) are incorporated, as is observed in the detail of Figure 2-B.

[0025] The slats (4) are all identical, flat or slightly longitudinally curved according to the type of structure to be built, the number of which will be suitable to form, in this case, the appropriate circumference, and are joined longitudinally to one another by means of the respective tongued-and-grooved ends (4a) and (4b) they have, allowing engagement in the contiguous slat.

[0026] As observed in Figure 2-C, said ends have the male end (4a), an inner arrow shape (14) arranged between respective longer walls (15) bent at their ends (16), a design which is especially studied to engage with certain flexibility, in two different positions, a more open position and a more closed position, whichever is suitable, as observed in Figures 4-A and 4-B, in the female end (4b) of the contiguous slat, as a result of which said female end (4b) has an arrow-shaped channel (17) suitable for receiving the aforesaid arrow (14) and two pairs of grooves (18) intended for the bent ends (16) of the male end (4a) some of which are arranged closer to the end of the slat (4) and others of which are arranged more towards the inside, being able to move them apart or bring them closer to one another and, where appropriate, make them rotate slightly with respect to one another up to a certain limit angle, thus exactly adjusting the length and the diameter of the concentric or parallel surfaces (1) and (2) to the required length in order to be able to form the different diameters or structures needed in each case.

[0027] On the other hand, in order to assure that the distance between the parallel surfaces (1) and (2) is maintained, the invention provides placing between each of the mentioned slats (4) forming it and at different levels a series of separating elements or separators (5), depicted in Figure 5, which further collaborate in increasing the rigidity of the assembly, made up of a tubular body, the length of which will determine the thickness of the wall, having at each of their ends a threaded area (6) suitable for inserting a nut (7) in order to fix them to the corresponding slats (4), with the particularity of having in their central part at least one appendage (8) generated therefrom in an inclined manner that is especially intended to serve as a support for securing the rebar mesh (3) which, as previously mentioned, is located between the de-

scribed parallel surfaces (1) and (2), as can be observed in Figure 6.

[0028] In an embodiment variant, the described separating element (5), as it is observed in Figure 11, has in its central area two appendages (8) arranged perpendicularly, such that one is secured to the horizontal rods of the mesh (3) and the other one to the vertical rods, and their threaded ends are hollow to receive screws (26), instead of nuts (7), for fixing them, furthermore having a flat configuration in the lower part of the tubular body forming it provided with a notch (27) suitable for resting in the lower gasket (28) which will be described below.

[0029] In parallel, each of the slats (4) forming the surfaces (1) and (2) of the formwork is fixed to the ground by means of U-shaped parts (9), shown in Figure 7, which will be fixed to said ground by means of conventional systems, inside which there is a threaded rod (10) which allows adjusting the distance existing between said rod and one of the walls of the corresponding slat, clamping it and leaving it completely in register, as shown in Figure 8.

[0030] Also, and to assure the rigidity of the assembly, depending on the type of structure to be built, such as closed structures as is the case of the example used, the invention additionally provides for the use of inner elements arranged diametrically, such as metal bars (11) the length of which will be defined by the inner diameter of the inner surface (2), having flat surfaces (12) at their ends which allow them to be secured thereto (Figures 1 and 9), which optionally for longitudinal structures are suitable for being secured in an inclined manner on both surfaces (1) and (2) and against the ground.

[0031] The process for assembling the assembly on which the concrete will be poured thus first consists of placing the U-shaped parts (9), following the necessary line or circumference depending on the size and shape of the structure to be built, being placed and fixed by means of conventional systems directly on the slab of the floor, having a fixed position therein, both those parts serving for securing to the outer surface (1) and those serving for securing to the inner surface (2) being placed at the same time.

[0032] Once the position of the parts (9) is fixed, the slats (4) forming the outer surface (1) are placed, successively engaging them with the contiguous slat by means of the respective insertion of the male ends (4a) and female ends (4b) in the most suitable position out of the two possible positions.

[0033] With the outer surface (1) completely formed, the rebar mesh (3) is placed thereon, securing it on the appendages (8) of each of the separators (5) which will also be inserted in each of the slats (4) forming the outer surface (1) while advancing in the placement of the mesh (3), said separators furthermore being fixed by means of nuts (7) from the outer side of the slats (4).

[0034] A similar process will be followed to place the slats (4) forming the inner surface (2), assuring their fixing to the ground by means of the U-shaped parts (9) and

introducing the opposite end of the separators (5) through them and equally fixed by means of nuts (7) at the inner face thereof, such that as a result of said separators both surfaces (1) and (2) are maintained parallel or coaxial (according to the type of structure) and fix the centered position of the rebar mesh (3) inside the thickness of the wall.

[0035] Once the assembly is assembled, the metal bars (11) can be placed diametrically, where appropriate, inside the formed cylinder to increase resistance during the process of pouring and the setting of the concrete, which will have a length defined for each tank size, being fixed to the inner cylindrical surface (2) by means of flat surfaces (12) such that the load they support is compression.

[0036] It should be indicated that the position of said bars (11) must be as uniform as possible so as to not cause overloads in any of the areas when others are reinforced, it not being necessary for them to all be placed at the same height since the force the concrete will exert will be greater in the lower part of the cylinder.

[0037] Finally, the concreting process will be carried out, pouring the concrete in the gap or space remaining between the parallel surfaces (1) and (2), which will preferably be done from different points, allowing it to settle and vibrating it when considered appropriate.

[0038] After the setting time of the concrete has elapsed, the formwork can be removed, following the described steps in the reverse order and finally eliminating the threaded area (6) of the separators (5) which, after extracting the nuts (7), will project inside and outside the walls of the structure, the surface thus being smooth and the body thereof prepared for placing the dome, where appropriate.

[0039] It must finally be pointed out that for building concrete domes intended to cover cylindrical tanks, as observed in Figures 10-A and 10-B, the slats (4) have a circular trapezium configuration, being able to longitudinally be slightly curved, like those used for building circular structures, being provided at the lower parts with reinforcing ribs (19), such that the consecutive joining of a certain number of them by means of engaging the open sections (20) they have on one of their sides in the recesses (21) they have on the opposite side, forms a cone frustum.

[0040] Said slats (4) are coupled at the upper part by means of the flanges (24) which they have on their smaller sides, which overlap and are fixed by means of screwing to a ring (25), and at the lower part by means of the flanges (22) provided on their larger sides, provided with gaps (23) in the parallel surfaces (1) and (2) forming the tank or structure to be covered, fixed thereto by means of U-shaped joining parts (9), and to one another by means of separators (5) with the incorporation of the corresponding rebar mesh (3), then pouring the concrete so that it can set in the same way as that previously described, forming a perfect frustoconical covering once the formwork is removed.

[0041] In an alternative embodiment variant of the invention especially intended for making circular structures, such as tanks or the like, the invention provides in order to assure the resistance of the formwork during the process of pouring the concrete for replacing the bars (11) with an inner metal structure (Figure 12), i.e. it will be located on the inner part of the inner surface (2), consisting of a plurality of circular rings (29), formed by sections of L-shaped flat surfaces fixed horizontally every certain space to vertical posts (31) by means of pins (30), the lower ring (29) being fixed to the ground by means of a crosspiece (32), at the T-shaped ends (33) of which, shown in Figure 13, there are coupled four of the aforesaid posts (31), diametrically opposite two by two, since these posts consist of quadrangular tubes engaging on said T-shaped ends (33).

[0042] For their part, as can be seen in the detail of Figure 14 the mentioned pins (30) fixing each ring (29) to the posts (31) consist of L-shaped flat surfaces, or angle irons, provided with a bracket (34) incorporating a hole (35) suitable for a bolt (36) or the pin itself, one being located on each side of the post (31) to join the ends of the sections of ring (29) thereto.

[0043] Said rings (29), are provided with holes (37) suitable for receiving the screws (26) which will fix the separators (5), or alternatively the threaded ends (6) of said separators which will be fixed by means of the corresponding nut (7), according to the type of separator that is used.

[0044] Finally, the invention provides for the coupling on external reinforcing bands (38) on the outer part of the slats (4) forming the outer surface (1), which prevent the outward collapse of said surface during the process of pouring the concrete (Figure 15).

[0045] Therefore, with this variant of embodiment, the process for assembling the formwork system consists of fixing the crosspiece (32) and the four posts (31) on its T-shaped ends (33), then placing the first of the rings (29) or lower ring flush with the ground and equally fixed thereto.

[0046] Then the remaining posts (31) are placed, the other rings (29) being fixed therein by means of the corresponding pins (30).

[0047] Once said structure is assembled, the first slat (4) forming the inner surface (2) of the formwork is placed, placing therein the separators (5), optionally resting on a lower gasket (28) by means of the notch (27) provided in the alternative shape of said separators (5), as observed in Figure 11, and placing the mesh (3) secured to them by the appendages (8), after which the first of the slats (4) forming the outer surface (1) of the formwork will be placed, externally fixing the separators (5) whether with nuts (7) or screws (26), according to the type of separator.

[0048] After this point the remaining elements will be placed following the same order until covering the entire structure up to the last slat (4) of the outer surface (1), at which time the outer reinforcing bands (38) will be

placed to finally place said slat (4).

[0049] Having sufficiently described the nature of the invention as well as a way of putting it into practice, it is not considered necessary to extend the explanation so that any person skilled in the art can understand its scope and the advantages derived therefrom, stating for all intents that within its essential nature, other embodiments can be carried out which differ in detail from the embodiment indicated by way of example which will also be granted the protection that is sought provided that its essential principle is not altered, changed or modified.

Claims

1. Permanent plastic formwork system, of the type made up of a frame consisting of two parallel surfaces, an outer surface (1) and an inner surface (2), between which there is installed a rebar mesh (3), leaving the gap between them prepared for pouring the fresh concrete therein which, when hardened, will form the walls of the structure to be built, said frame subsequently being suitably removed, **characterized in that** each of said parallel surfaces (1) and (2) consists of a plurality of slats (4) suitable in number so as to form the appropriate structure in each case, preferably made of plastic and obtained by means of extrusion, which slats are hollow and identical and are joined longitudinally to one another by means of the tongued-and-grooved ends (4a) and (4b) that they have.
2. Permanent plastic formwork system according to claim 1, **characterized in that** the male end (4a) of the slats (4) have a inner arrow shape (14) arranged between respective longer walls (15) bent at their ends (16), and the female end (4b) has an arrow-shaped channel (17), suitable for receiving the afore-said arrow (14), and two pairs of grooves (18), some more outer grooves and some more inner grooves, intended to receive the bent ends (16) of the male end (4a), to engage in two different positions, a more open position and a more closed position.
3. Permanent plastic formwork system according to claims 1 and 2, **characterized in that** it is provided that there are arranged between the parallel surfaces (1) and (2), between each of the mentioned slats (4) forming them and at different levels, a series of separating elements or separators (5); **in that** said separators (5) are made up of a tubular body, the length of which will determine the thickness of the wall, having at each of their ends a threaded area (6) suitable for inserting a nut (7) in order to fix them to the corresponding slats (4).
4. Permanent plastic formwork system according to claims 1 to 3, **characterized in that** the separating elements or separators (5) in the central part of the tubular body forming them have an appendage (8) generated therefrom in an inclined manner that is especially intended to serve as a support for securing the rebar mesh (3) which is located between the surfaces (1) and (2).
5. Permanent plastic formwork system according to claims 1 to 4, **characterized in that** the separators (5) alternately have in their central area two appendages (8) arranged perpendicularly; **in that** their threaded ends are hollow to receive screws (26); and **in that** they have a flat T-shaped configuration in the lower part of the tubular body forming them provided with a notch (27) suitable for resting on a lower gasket (28).
6. Permanent plastic formwork system according to claims 1 to 5, **characterized in that** each of the slats (4) forming the surfaces (1) and (2) of the formwork is secured to the ground by means of U-shaped parts (9) which are fixed to said ground by means of conventional systems, and inside which there is a threaded rod (10) which allows adjusting the distance existing between said rod (10) and one of the walls of the corresponding slat (4), clamping it and leaving it completely in register.
7. Permanent plastic formwork system according to claims 1 to 6, **characterized in that** depending on the type of structure to be built, the slats (4) can have a longitudinally flat configuration for making flat surfaces, or a slightly curved configuration for making curved or cylindrical surfaces.
8. Permanent plastic formwork system according to claims 1 to 7, **characterized in that** the slats (4) incorporate, inserted therein between their longitudinal reinforcing partition walls, metal sections (13) providing rigidity to the slat.
9. Permanent plastic formwork system according to claim 1, **characterized in that** to build conical coverings, in addition to being able to have a longitudinally flat or curved configuration, the slats (4) forming the surfaces (1) and (2) have an elevated T-shaped configuration in the form of a circular trapezium, having at their lower part reinforcing ribs (19) and having on one of their sides for their mutual coupling, open sections (20) engaging in recesses (21) provided on their opposite side, as well as flanges (22) in their larger sides, provided with gaps (23) allowing their coupling on the parallel surfaces (1) and (2) forming the tank or structure to be covered, and flanges (24) overlapping one another fixed to a ring (25) joining them together.
10. Permanent plastic formwork system according to

claims 1 to 5 and 8, **characterized in that** in an alternative embodiment variant there is provided an inner metal structure, located in the inner part of the inner surface (2), consisting of a plurality of circular rings (29), formed by sections of L-shaped flat surfaces, fixed horizontally to vertical posts (31) every certain space by means of pins (30), the lower ring (29) being fixed to the ground by means of a cross-piece (32), at the T-shaped ends (33) of which there are coupled four of the aforesaid posts (31), diametrically opposite two by two, since the latter consist of quadrangular tubes engaging on said T-shaped ends (33).

11. Permanent plastic formwork system according to claim 10, **characterized in that** the pins (30) fixing each ring (29) to the posts (31) consist of L-shaped flat surfaces, or angle irons, provided with a bracket (34) incorporating a hole (35) suitable for a bolt (36) or the pin itself, one being located on each side of the post (31) to join the ends of the sections of ring (29) thereto.
12. Permanent plastic formwork system according to claims 10 and 11, **characterized in that** the rings (29) are provided with holes (37) suitable for receiving the screws (26) which will fix the separators (5), or alternatively the threaded ends (6) of said separators which will be fixed by means of the corresponding nut (7), according to the type of separator that is used.
13. Permanent plastic formwork system according to claims 1 to 12, **characterized in that** the coupling of external reinforcing bands (38) at the outer part of the slats (4) forming the outer surface (1) is provided.

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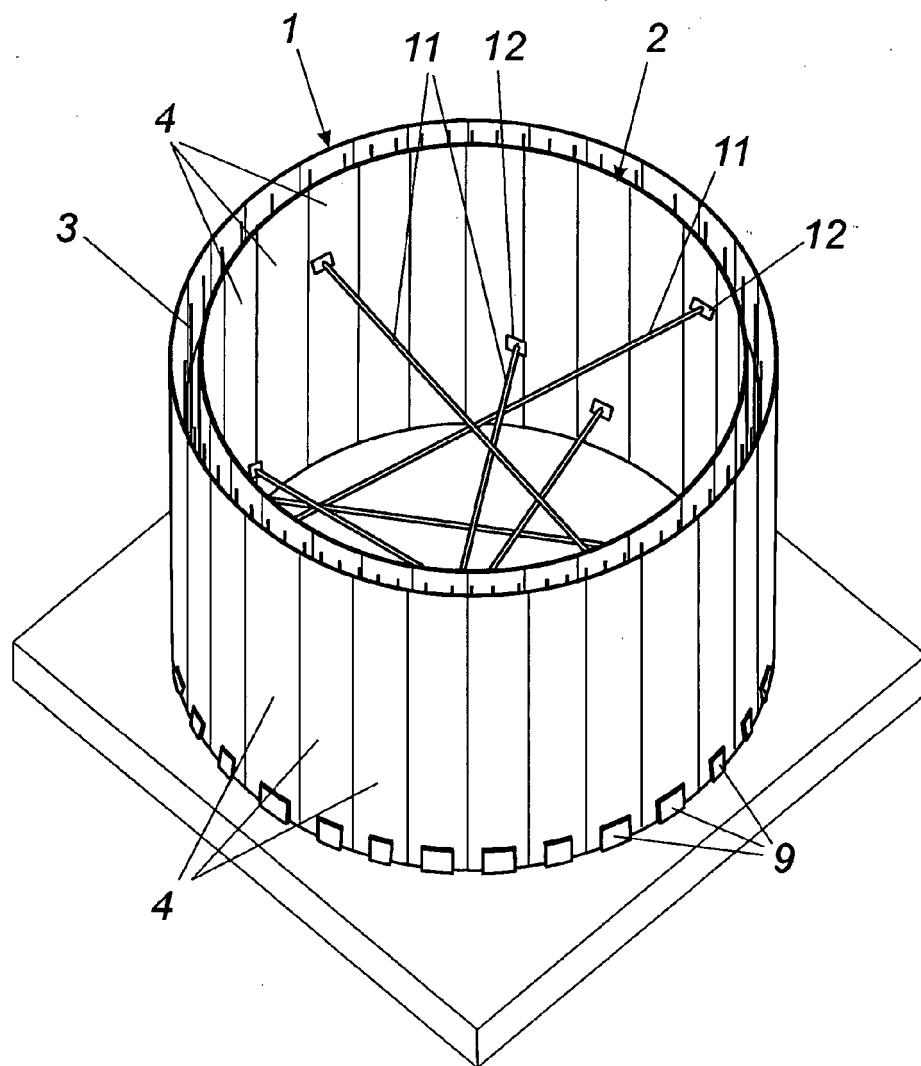


Fig. 1

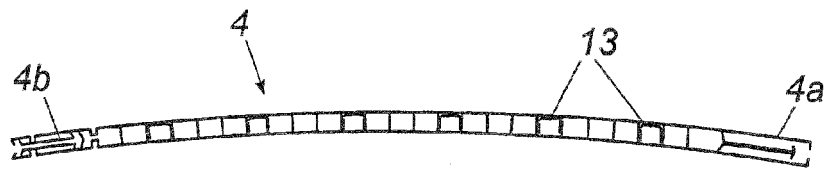


Fig. 2-A

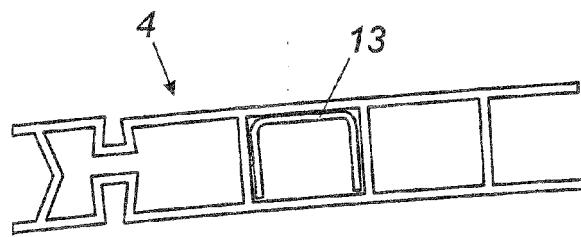


Fig. 2-B

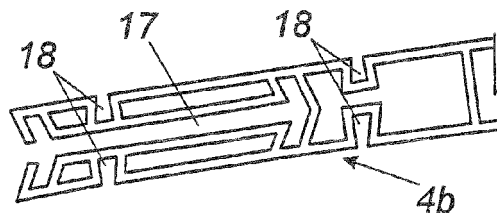
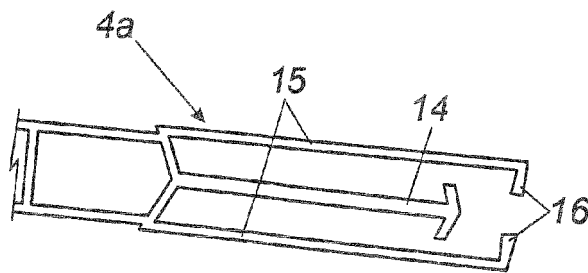


Fig. 2-c

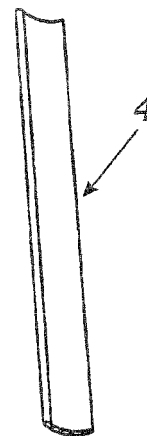


Fig. 3

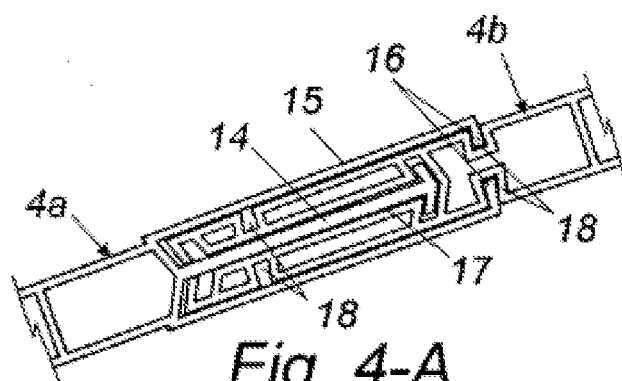


Fig. 4-A

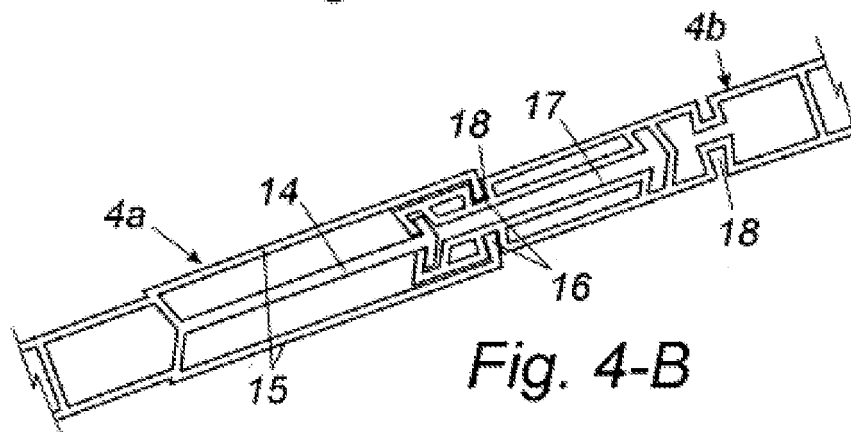


Fig. 4-B

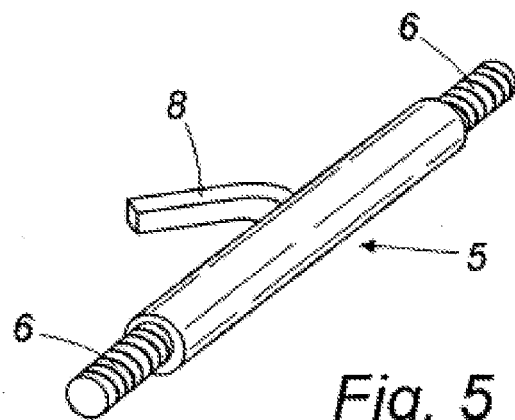


Fig. 5

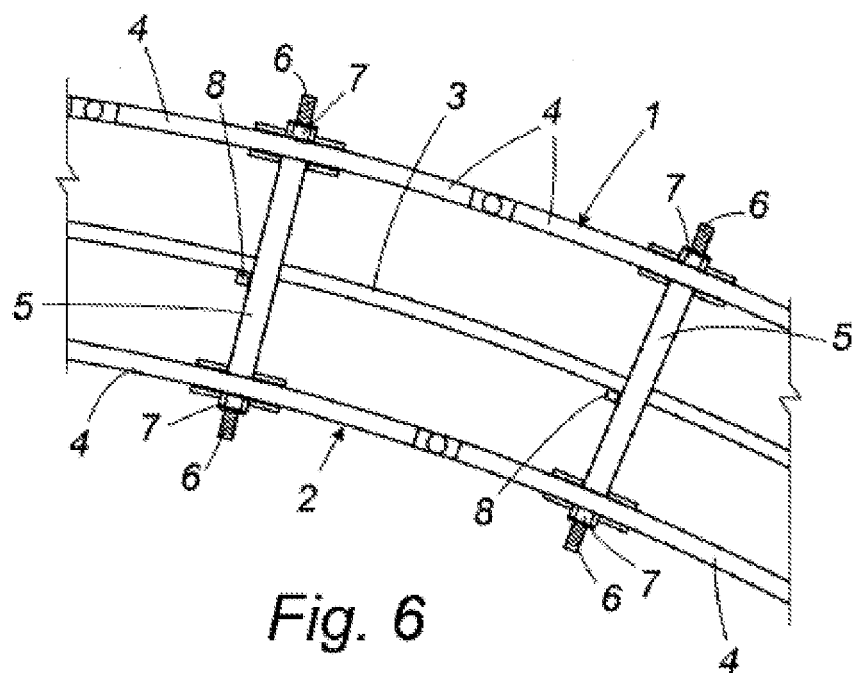


Fig. 6

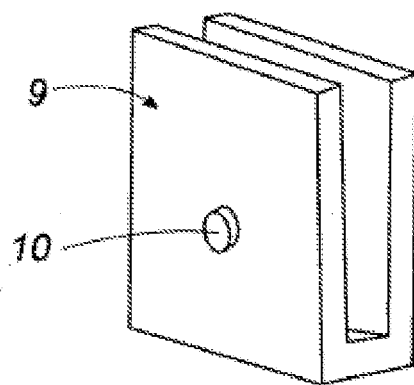


Fig. 7

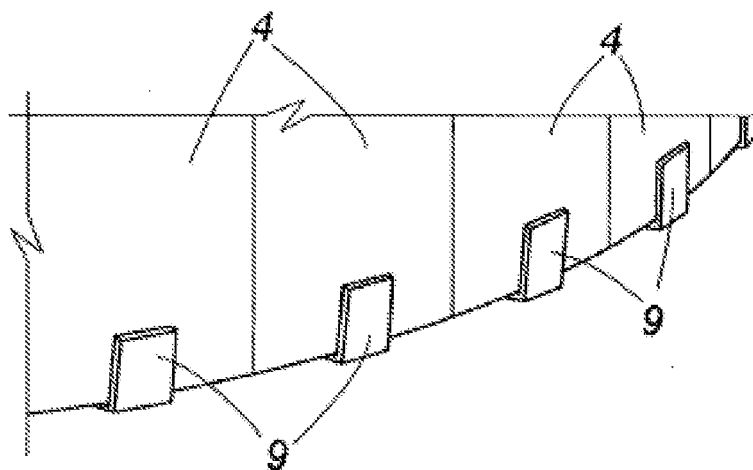


Fig. 8

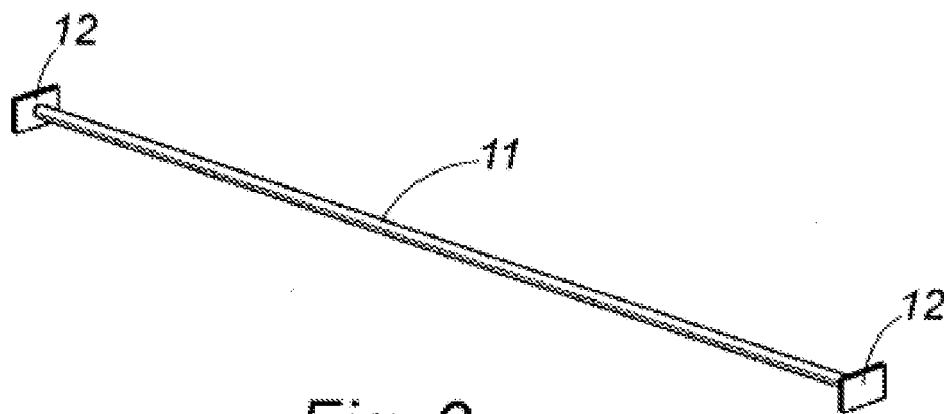


Fig. 9

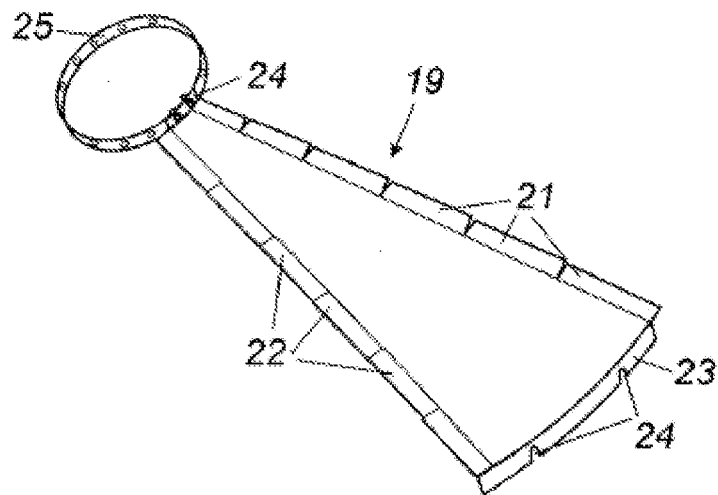


Fig. 10-A

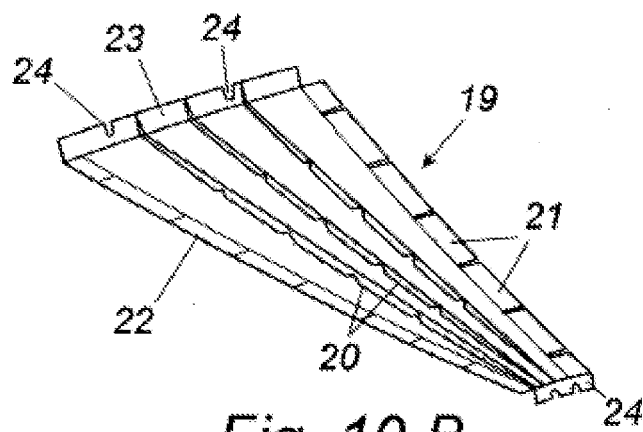
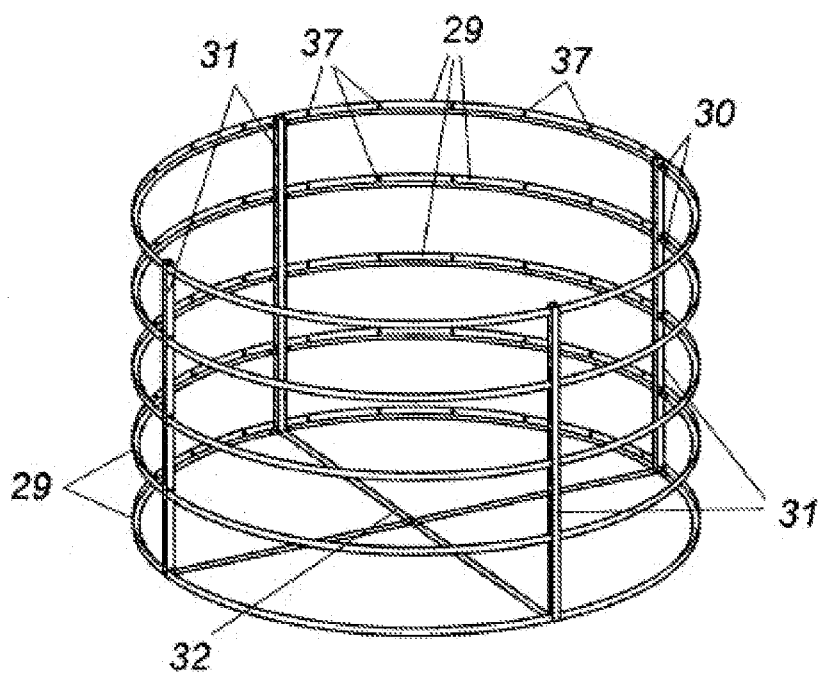
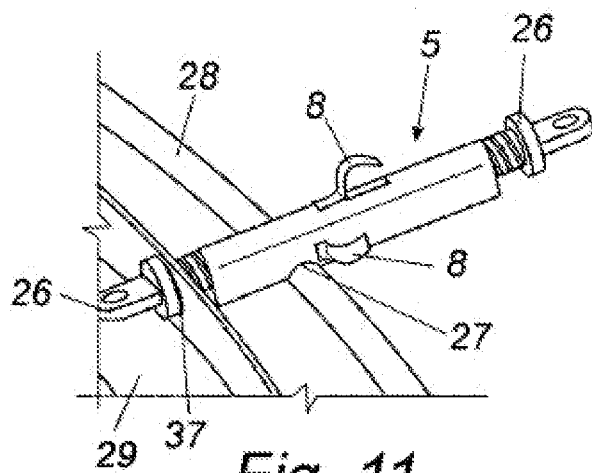


Fig. 10-B



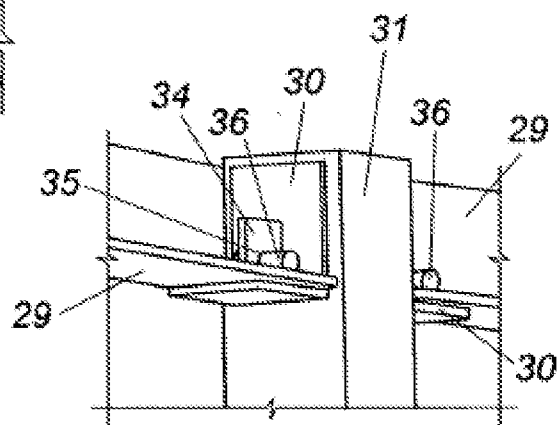
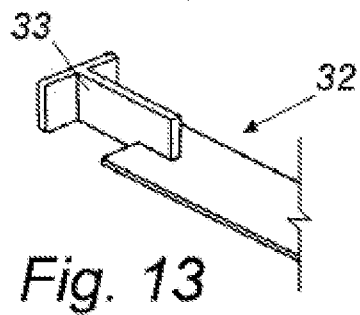


Fig. 14

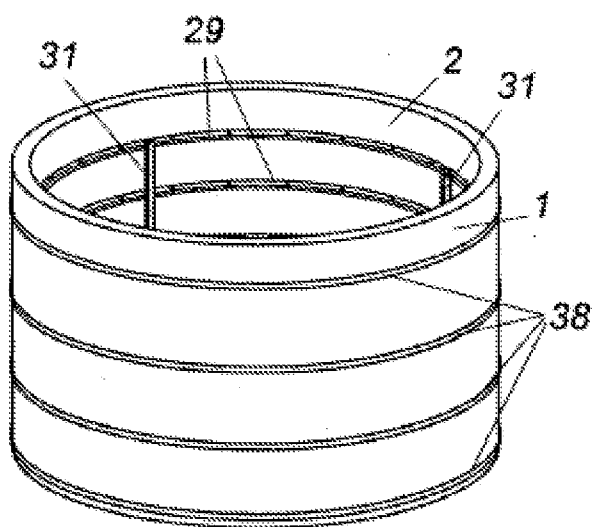


Fig. 15